CHAPTER 51

STRUCTURES - GENERAL

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BS BODY STATION. DISTANCE MEASURED PARALLEL TO BODY ℄ TO A PLANE PERPENDICULAR TO BODY ℄ FROM A POINT 130 INCHES FORWARD OF THE NOSE.

BL BODY BUTTOCK LINE. DISTANCE IN A HORIZONTAL PLANE MEASURED FROM BODY VERTICAL ℄.

WL WATER LINE. DISTANCE MEASURED PERPENDICULAR FROM A HORIZONTAL PLANE LOCATED 136 INCHES BELOW BOTTOM OF BODY.

FSS FRONT SPAR STATION

RSS REAR SPAR STATION

WS WING STATION. A PLANE PERPENDICULAR TO WING CHORD PLANE MEASURED FROM INTERSECTION OF LEADING EDGE AND WBL 0.

WBL WING BUTTOCK LINE. A PLANE NORMAL TO WING CHORD PLANE AND PARALLEL TO BODY ℄. IT IS MEASURED FROM INTERSECTION OF WING CHORD PLANE AND BL 76.45

NAC WL NACELLE WATERLINE. A PLANE PARALLEL TO WING CHORD PLANE MEASURED FROM NACELLE ℄ WHICH IS NAC WL 100.

TYP TYPICAL

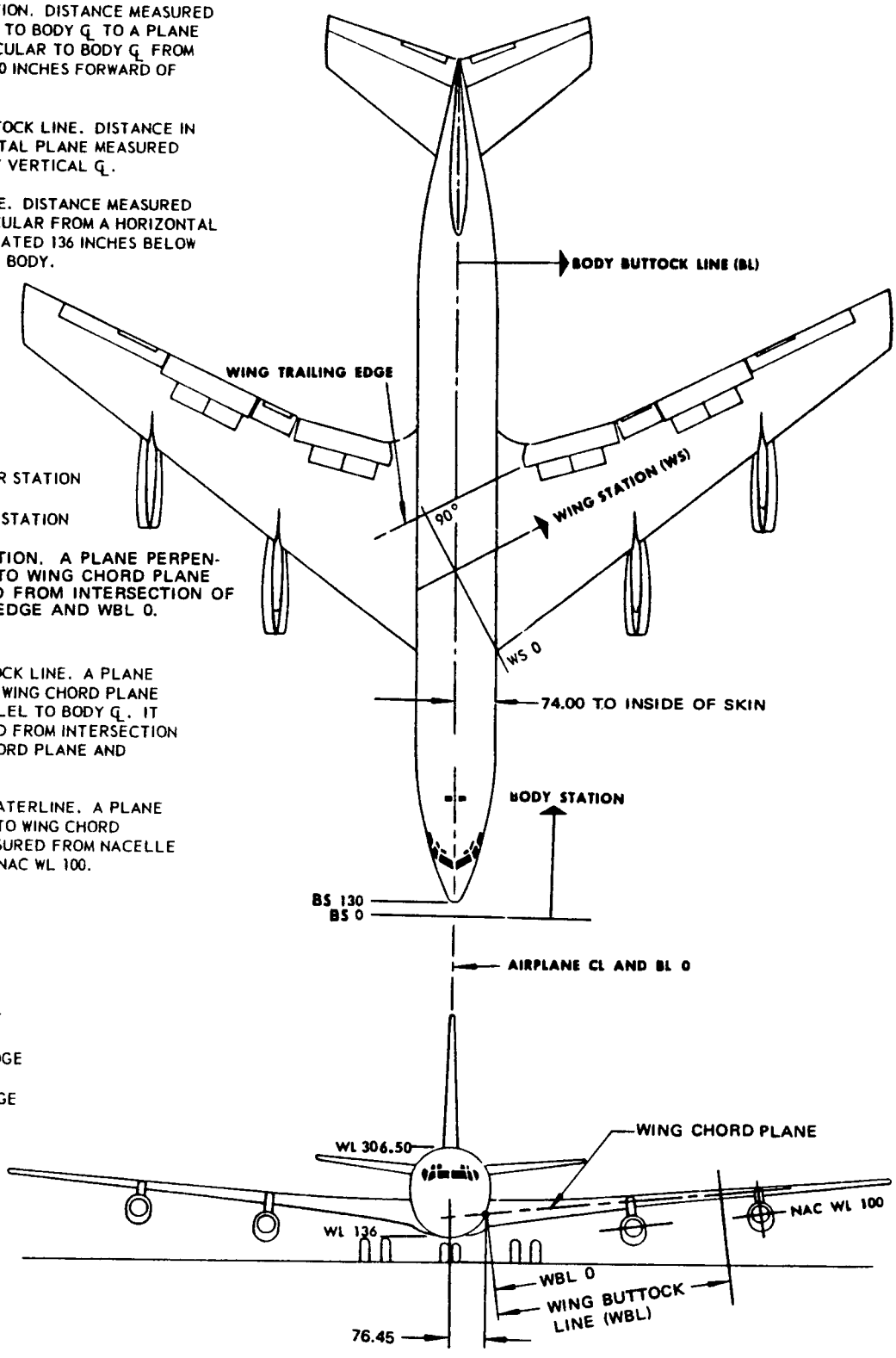
MAX MAXIMUM

MIN MINIMUM

HT HEAT TREAT

TE TRAILING EDGE

LE LEADING EDGE



NOTE

[A] FOR AIRPLANES WITH WING TIP PROBE

[B] FOR AIRPLANES WITHOUT WING TIP PROBE

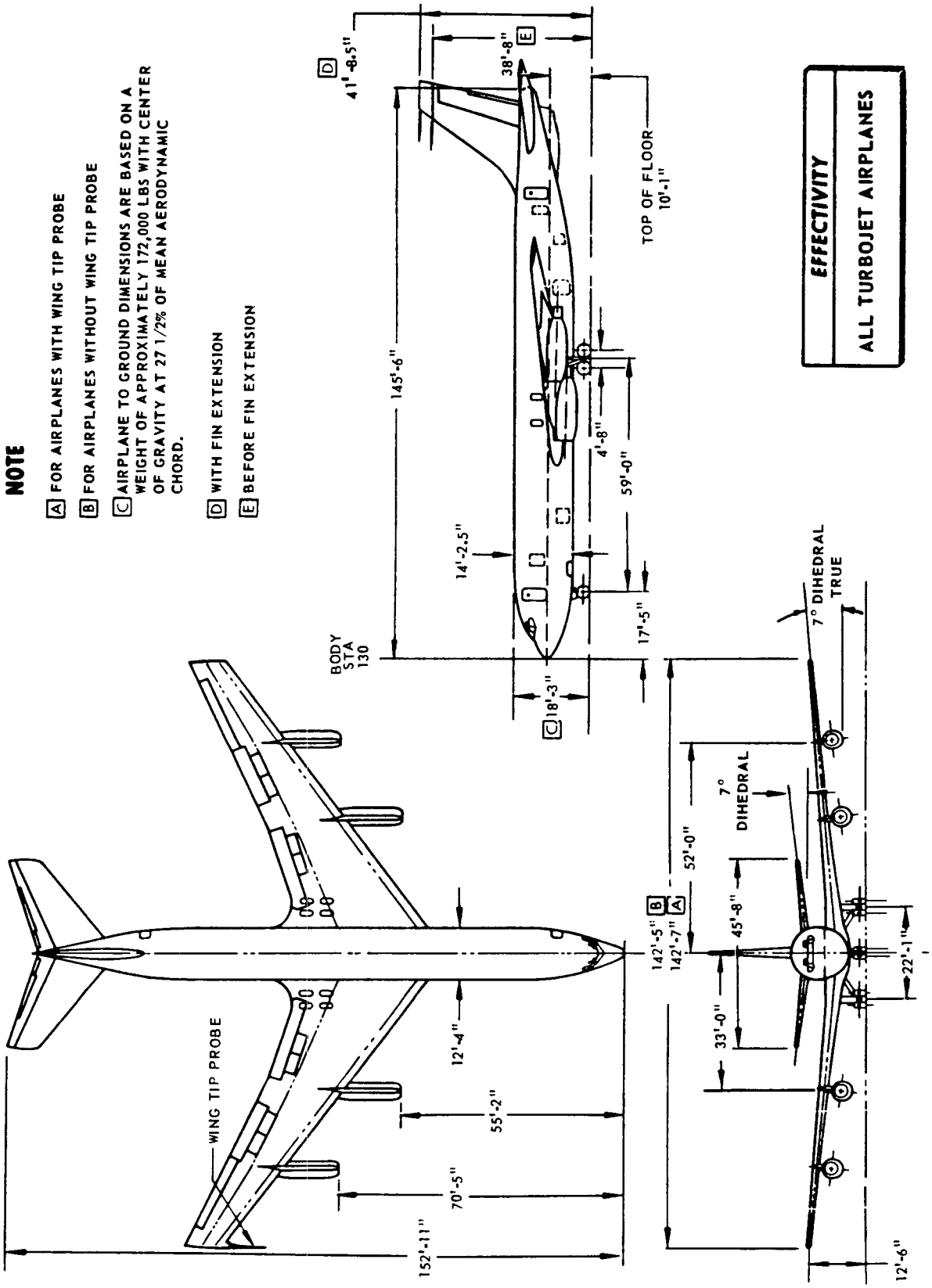
[C] AIRPLANE TO GROUND DIMENSIONS ARE BASED ON A WEIGHT OF APPROXIMATELY 172,000 LBS WITH CENTER OF GRAVITY AT 27 1/2% OF MEAN AERODYNAMIC CHORD.

[D] WITH FIN EXTENSION

[E] BEFORE FIN EXTENSION

EFFECTIVITY

ALL TURBOJET AIRPLANES



Principal Dimensions
Figure 2 (Sheet 1 of 2)

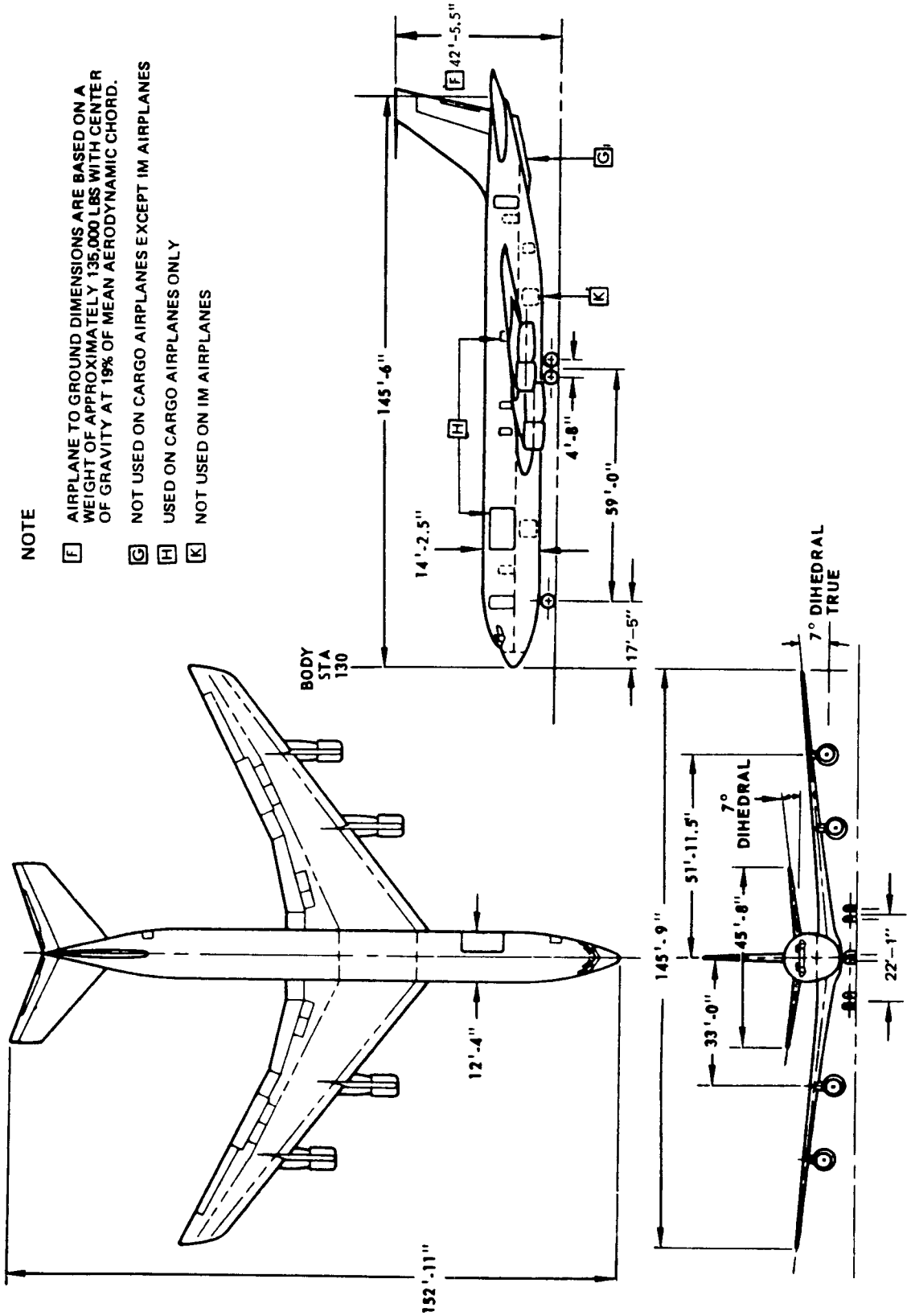
NOTE

[F] AIRPLANE TO GROUND DIMENSIONS ARE BASED ON A WEIGHT OF APPROXIMATELY 135,000 LBS WITH CENTER OF GRAVITY AT 19% OF MEAN AERODYNAMIC CHORD.

[G] NOT USED ON CARGO AIRPLANES EXCEPT IM AIRPLANES

[H] USED ON CARGO AIRPLANES ONLY

[K] NOT USED ON IM AIRPLANES



Principal Dimensions
Figure 2 (Sheet 2)

Airplane Section No.	Drawing Title	Boeing Dwg. No.
11	WING CENTER SECTION	65-1001
12	INBOARD WING ASSY	65-1003
13	OUTBOARD WING ASSY	50-5305
14	INBOARD WING LE INSTL	65-1071
15	OUTBOARD WING LE INSTL	50-8260 A B
		65-18460 C
16	INBOARD WING TE INSTL	65-1100
17	OUTBOARD WING TE INSTL	5-73117
19	WING TIP INSTL	5-73119 A B
		65-18282 C
30	WING SPOILER INSTL	65-1066
31	INBOARD FLAP INSTL	65-1061 A B
		65-19635 C
32	OUTBOARD FLAP INSTL	5-73132
33	INBOARD AILERON INSTL	65-1096
34	OUTBOARD AILERON INSTL	5-73134
41	BODY INSTL SECTION 41	50-2541
43	BODY INSTL SECTION 43	50-2543
46	BODY INSTL SECTION 46	50-2546
48	BODY INSTL SECTION 48	50-2548
49	VENTRAL FIN INSTL	65-12752 A B
		65-13752 C
61	MAIN LANDING GEAR INSTL	65-1325
62	NOSE LANDING GEAR INSTL	65-1326
72	INBOARD STRUT INSTL	65-2504 A
		50-8229 B
		65-10616 C
74	OUTBOARD STRUT INSTL	65-2482 A
		50-8230 B
		65-10617 C
76	POWER PLANT INSTL	65-2447 A
		65-19045 B
		65-10600 C
81	STABILIZER CENTER SECTION INSTL	50-9781
82	STABILIZER STRUCTURE INST	50-9782
83	STABILIZER LE INSTL	50-9783
84	ELEVATOR & BALANCE ASSY	50-9784
85	FIN INSTL DORSAL	50-8288
86	FIN INTERSPAR AND TE ASSY	65-8367
86	FIN EXTENSION INSTL (KIT) FIN EXTENSION ASSY	65-14291
	(REWORK)	65-13131
	VERTICAL TAIL ASSY	65-13328
87	FIN LE INSTL	5-71787
88	RUDDER & BALANCE ASSY	50-9788
89	FIN TIP INSTL	50-11379

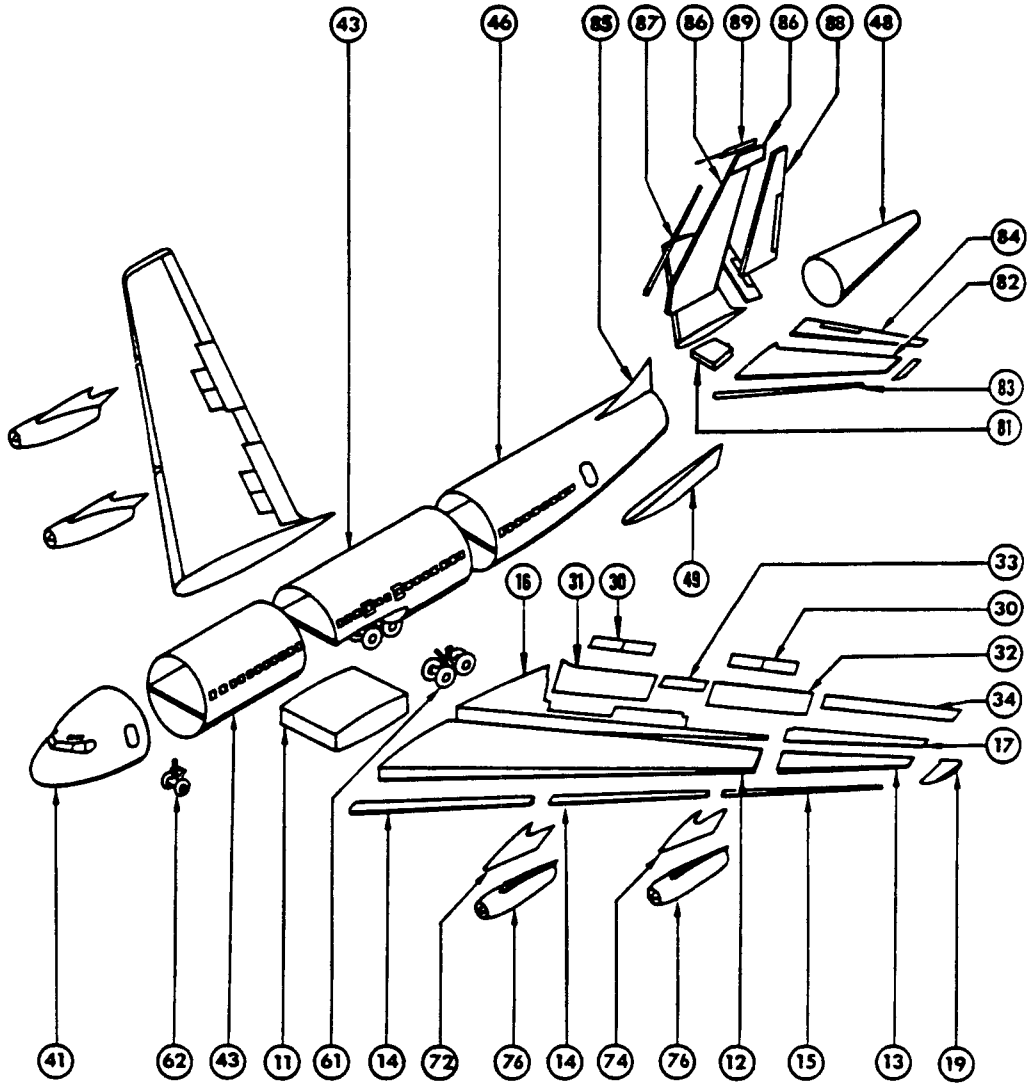
NOTE

A FOR AIRPLANES WITH JT4 ENGINES

B FOR AIRPLANES WITH ROLLS-ROYCE CONWAY ENGINES

} (TURBOJET)

C FOR AIRPLANES WITH JT3D ENGINES (TURBOFAN)



Major Assembly Breakdown
Figure 3 (Sheet 2 of 2)

NOTE

- AREAS AS INDICATED ARE CLASSED AS SECONDARY STRUCTURE.
- THESE COMPONENTS, THOUGH NOT PRIMARY LOAD CARRYING UNITS, ARE SUBJECTED TO AERODYNAMIC LOADS AND SUBJECT TO COMPLETE FAILURE. SUCH FAILURES, WHICH MAY CAUSE POSSIBLE DAMAGE TO PRIMARY STRUCTURE AND ENGINES OR ADVERSELY AFFECT AERODYNAMIC CHARACTERISTICS AND/OR SURFACE STIFFNESS, MUST BE CONSIDERED.
- SEE NOTES [A] AND [B] .
- OTHER AREAS ARE CONSIDERED AS PRIMARY STRUCTURE. WITHIN PRIMARY STRUCTURE ARE PRINCIPAL STRUCTURAL ELEMENTS (SEE FIGURE 5). PRINCIPAL STRUCTURAL ELEMENTS (PSE'S) ARE THOSE WHICH CONTRIBUTE SIGNIFICANTLY TO CARRYING FLIGHT, GROUND AND PRESSURIZATION LOADS.

[A] TRAILING EDGE

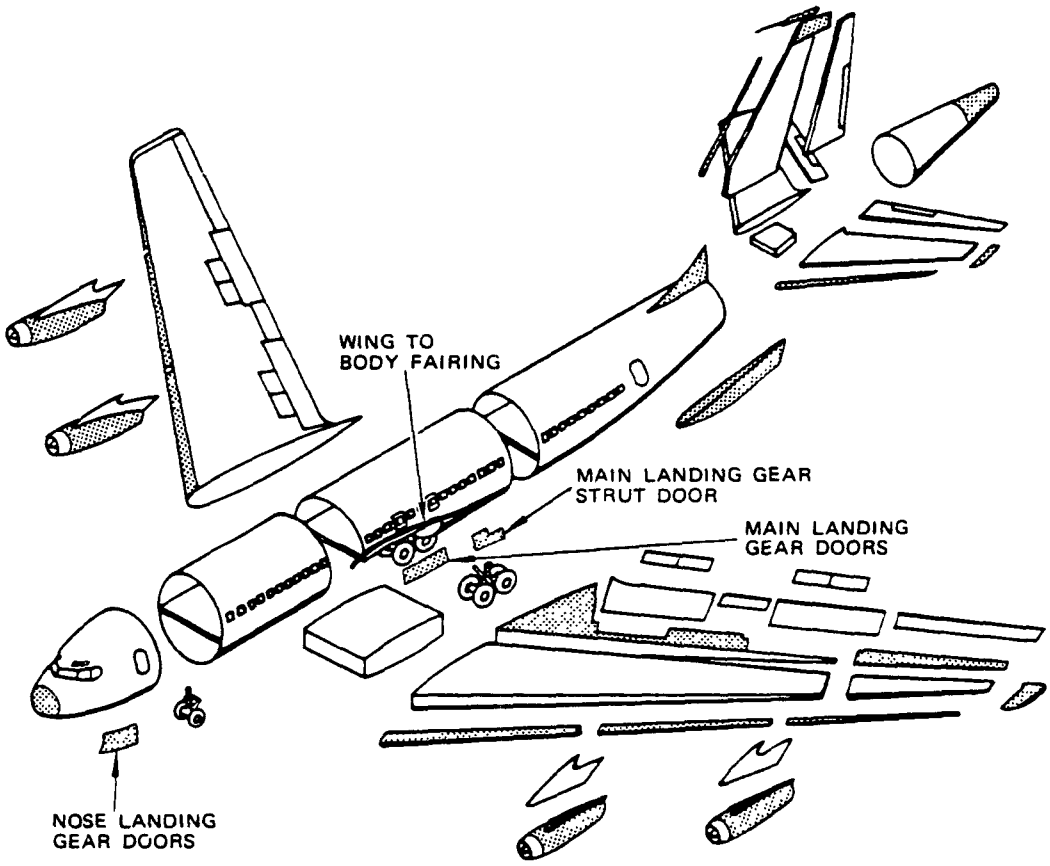
1. PRIMARY STRUCTURE IN THIS AREA IS DEFINED AS THAT STRUCTURE WHICH GIVES SUPPORT TO THE FLAPS, AILERONS, SPOILERS AND COVE LIP DOORS.
2. SECONDARY STRUCTURE IN THIS AREA IS LIMITED TO THE UPPER AND LOWER PANELS.

[B] LEADING EDGE

1. PRIMARY STRUCTURE IN THIS AREA IS LIMITED TO THE LEADING EDGE FLAPS AND SLATS AND TO THE FIXED LEADING EDGE RIBS WHICH SUPPORT THEIR HINGES.
2. SECONDARY STRUCTURE IN THIS AREA IS LIMITED TO THE FIXED LEADING EDGE STRUCTURE.

Structural Classification Diagram
Figure 4 (Sheet 1)

SECONDARY STRUCTURE



FUSELAGE UPPER LOBE SKIN AND STRINGERS
FUSELAGE LOWER LOBE SKIN AND STRINGERS
FUSELAGE CIRCUMFERENTIAL SPLICES
FUSELAGE LAP SPLICES
TYPICAL FRAMES
SKIN AT CORNERS OF MISC. ACCESS DOOR CUTOUTS
STRINGER / FRAME ATTACHMENTS
BULKHEAD BS 178 (FORWARD PRESSURE)
FUSELAGE BS 227.8 BULKHEAD
FUSELAGE BS 259.5 BULKHEAD
FUSELAGE BS 294.5 BULKHEAD
LOWER LOBE FRAMES BS 360 TO BS 600J
FUSELAGE BS 600K / 620 BULKHEAD
FUSELAGE BS 820 BULKHEAD
FUSELAGE BS 960 BULKHEAD
LOWER LOBE FRAMES BS 960M TO BS 1420
FUSELAGE BS 1440 BULKHEAD (AFT PRESSURE)
FUSELAGE BS 1505.87 BULKHEAD
FUSELAGE BS 1592 BULKHEAD
SECTION 48 SKIN AND STRINGERS

FLOOR BEAM STRUCTURE
HORIZONTAL PRESSURE DECK
OVERWING STUB FRAMES
STRINGER 18A
SKIN BS 820 AT STRINGER 18A
DELTA BEAM - UNDER WING
FUSELAGE FLOOR BEAMS OVER MAIN LANDING GEAR WHEEL WELL
FUSELAGE KEEL BEAM (BS 820 TO BS 960)

CREW WINDOW CABIN STRUCTURE
WINDOW FORGINGS (PASSENGER CABIN)
SKIN AT CORNERS OF WINDOW FORGINGS
FORWARD ENTRY DOOR
AFT ENTRY DOOR
EMERGENCY EXIT DOORS
FORWARD GALLEY DOOR
AFT GALLEY DOOR
ELECTRONIC BAY ACCESS DOOR
FUSELAGE UPPER DECK CARGO DOOR
FUSELAGE LOWER LOBE CARGO COMPARTMENT DOORS

FUSELAGE STRUCTURE
TABLE I

Principal Structural Elements
Figure 5 (Sheet 1)

ELECTRONICS ACCESS DOOR CUTOUT
FUSELAGE LOWER LOBE CARGO COMPARTMENT DOOR CUTOUTS
FUSELAGE UPPER DECK CARGO DOOR CUTOUT
FORWARD ENTRY DOOR CUTOUT
FORWARD GALLEY DOOR CUTOUT
AFT ENTRY DOOR CUTOUT
AFT GALLEY DOOR CUTOUT
EMERGENCY EXIT DOOR CUTOUT

NOSE LANDING GEAR WHEEL WELL

FORWARD ACCESS DOOR AND CUTOUT / DOPPLER ANTENNA WELL

FUSELAGE STRUCTURE
TABLE I (CONT)

FORWARD ENGINE MOUNT FITTING, LINKS AND SUPPORT STRUCTURE
AFT ENGINE MOUNT FITTING, LINKS AND SUPPORT STRUCTURE
THRUST LINK
FRONT SPAR FITTING
MIDSPAR FITTINGS
DIAGONAL BRACE AND LOWER SPAR ATTACH FITTING

POWER PLANT STRUCTURE
TABLE II

CENTER SECTION FRONT SPAR CHORDS, WEB, AND STIFFENERS
CENTER SECTION REAR SPAR CHORDS, WEB, AND STIFFENERS
CENTER SECTION LOWER PANEL STRINGERS AND SKIN
CENTER SECTION UPPER PANEL STRINGERS AND SKIN
CENTER SECTION UPPER AND LOWER SKIN SPLICE STRINGERS
CENTER SECTION SPANWISE BEAMS
OVERWING FLOOR BEAMS
LEFT AND RIGHT LOWER BEAM - BL 13.0 AND 42.0
WING - TO - BODY BREATHER WEB ATTACHMENT
FRONT SPAR TERMINAL FITTINGS AND BOTTLE PINS
REAR SPAR TERMINAL FITTINGS AND BOTTLE PINS
LOWER SURFACE BBL 70.5 SPLICE
UPPER SURFACE BBL 70.5 SPLICE
LOWER SURFACE WS 360 SPLICE
UPPER SURFACE WS 360 SPLICE
WS 733 PRODUCTION BREAK JOINT
REAR SPAR CHORDS, WEB, AND STIFFENERS
FRONT SPAR CHORDS, WEB, AND STIFFENERS
LOWER PANEL STRINGERS AND SKIN
UPPER PANEL STRINGERS AND SKIN
UPPER AND LOWER SKIN SPLICE STRINGERS
LOWER PANEL CUTOUTS
TYPICAL RIBS
SHEAR TIED RIBS
BBL 70.5 RIB
TRAILING EDGE FLAPS - MAIN BOX
TRAILING EDGE FLAP TRACKS AND SUPPORT STRUCTURE
TRAILING EDGE FLAP MAIN CARRIAGES AND SEQUENCE CARRIAGES
FLOOR BEAMS AND INTERCOSTALS
ENGINE SUPPORT STRUCTURE
MAIN LANDING GEAR SUPPORT STRUCTURE (INCLUDING BEAVERTAIL)

WING STRUCTURE
TABLE III

Principal Structural Elements
Figure 5 (Sheet 3)

FIN

- FRONT SPAR CHORDS, STIFFENERS, AND WEB
- REAR SPAR CHORDS, STIFFENERS, AND WEB
- TERMINAL FITTING
- TORSION RIB (FIN STA. 50.53)
- SKIN
- TYPICAL RIBS
- CLOSURE RIB

STABILIZER

- FRONT SPAR CHORDS, STIFFENERS, AND WEB
- REAR SPAR CHORDS, STIFFENERS, AND WEB
- SKIN (EXPOSED PANELS)
- FRONT SPAR TERMINAL FITTING
- REAR SPAR TERMINAL FITTING
- REAR SPAR TERMINAL SHEAR FITTING
- CLOSURE RIB
- TYPICAL INSPAR RIB
- INSPAR ELEVATOR SUPPORT RIB
- CENTER SECTION FRONT SPAR
- CENTER SECTION REAR SPAR
- CENTER SECTION REAR SPAR AUX. FAILSAFE FITTING
- CENTER SECTION TRANSVERSE RIB (- 100 / - 200)
- CENTER SECTION BL 0 RIB
- CENTER SECTION TORQUE BOX
- CENTER SECTION CLOSURE RIB
- STABILIER ACTUATOR FITTING
- STABILIER ACTUATOR SUPPORT FITTINGS (- 100 / - 200)
- STABILIER ACTUATOR ARMS (- 100 / - 200)
- HINGE HOUSING AND HINGE BEARING
- CENTER SECTION JACKSCREW SUPPORT FITTING
- CENTER SECTION DIAGONAL BRACE

ATTACH POINTS

- FIN TO BODY TERMINAL PINS
- STABILIZER CENTER SECTION TO BODY HINGE PINS
- STABILIZER SPAR TO BODY HINGE PINS
- STABILIZER CENTER SECTION HINGE HOUSING BEARING
- JACKSCREW SUPPORT FITTING TO JACKSCREW GIMBLE

EMPENNAGE STRUCTURE
TABLE IV

Principal Structural Elements
Figure 5 (Sheet 4)

MAIN LANDING GEAR
- OUTER CYLINDER
- INNER CYLINDER
- TRUNNION
- TRUNNION / OLEO PIN
- DRAG BRACE
- DRAG BRACE FUSE PIN
- DRAG BRACE / OLEO PIN
- TORSION LINKS
- PINS, TORSION LINK
- SIDE STRUT ASSY.
- PINS, SIDE STRUT
- PISTON ROD (ORIFICE SUPPORT TUBE)
- ORIFICE PLATE
- METERING PIN
- GLAND NUT
- TRUCK ASSY.
- PINS, TRUCK ASSY.

NOSE LANDING GEAR
- OUTER CYLINDER
- INNER CYLINDER
- TORSION LINKS
- PINS, TORSION LINKS
- TRUNNION PINS
- TOW COLLAR ASSY.
- PINS, TOW COLLAR ASSY.
- STEER KNUCKLE ASSY.
- PINS, STEER KNUCKLE ASSY.
- STEERING SUPPORT PLATES
- PIN, SUPPORT PLATES
- TOW AND STEERING LINK ASSY.
- DRAG BRACE ASSY.
- PINS, DRAG BRACE
- TUBE, PISTON
- ORIFICE, PISTON TUBE
- ORIFICE ROD (METERING PIN)
- ORIFICE ROD BULKHEAD
- GLAND NUT

LANDING GEAR STRUCTURE
TABLE V

Principal Structural Elements
Figure 5 (Sheet 5)

SHEET METAL MATERIALS

1. General

A. Most of the sheet metal used in the structure of the Boeing 707 Intercontinental airplane is aluminum alloy; some magnesium alloys are also used, as well as steel and titanium. The most frequently used sheet metals are tabulated in Figure 1 and are indicated by domestic designations. Figure 2 lists standard sheet metal gages and corresponding minimum stop drill hole sizes. Deburr or otherwise smooth out all stop holes. Figure 10 tabulates various equivalent materials.

B. When repairing the airplane structure, all bare metal parts, including surfaces exposed by cutting or drilling, shall be coated using protective treatments described in 51-8-0.

2. Aluminum Alloys

A. Aluminum alloys are designated by symbols of the Aluminum Association new standard four-digit index system. Figure 3 identifies equivalent materials as designated by the old and the new systems.

B. The heat treat condition of the material is indicated by a "T" number that follows the alloy designation. "0" following the alloy designation indicates that the material is in the annealed condition. Although the sheet metal may be received and formed in the annealed condition, no heat-treatable alloy shall be used in the annealed condition, but shall be heat treated before installation in the airplane.

C. The word "clad" preceding the material designation indicates that a protective coating of pure aluminum has been applied prior to completion of the final rolling process of the material.

D. Figure 4 lists aluminum alloy materials with instructions for permissible substitutions if the original material is not available when making structural repairs.

E. The most commonly used aluminum alloy sheet materials, are 2024-T3 and 7075-T6. 7075-T6 is stronger than 2024-T3. The two materials differ also in forming characteristics. 7075-T6 has a larger minimum bend radius than 2024-T3, and the sheet is most often formed in the annealed condition 7075-0 and heat treated to 7075-T6 after forming. 2024-T3 is generally formed in the heat treated condition. Minimum bend radii of sheet metals are given in figure 5.

F. When 7075-T6 sheet metal is dimpled, heated dimpling tools must be used to prevent cracking of the sheet, whereas, softer aluminum alloys may be dimpled at room temperature. Dimpling procedures are described in 51-2-7.

G. The 7075-T6 material must be handled very carefully, because even slight damage, such as scratches, burrs and nicks, has a detrimental effect upon its fatigue strength.

ALLOY	GAGE																		
	.010	.016	.032	.040	.045	.050	.056	.063	.071	.080	.090	.100	.112	.125	.140	.160	.18	.375	.450
ALUMINUM CLAD 2024 QQ-A-362	X	X	X	X	X	X	X	X	X	X	X	X							
ALUMINUM BARE 2024 QQ-A-355						X			X					X					
ALUMINUM CLAD 7075 QQ-A-287		X	X	X		X		X	X										
ALUMINUM BARE 7075 QQ-A-283								X		X									
ALUMINUM BARE 7178 MIL-A-9180																X	X	X	X
4130 STEEL ANQQ-S-685																			
CORROSION RESISTANT STEEL TYPE 301 MIL-S-5059																			
CORROSION RESISTANT STEEL TYPE 302 MIL-S-5059						X													
MAGNESIUM QQ-M-44				X		X													

Most Commonly Used Sheet Metal
Figure 1

FIGURES 2 AND 3 DELETED

FORM	ORIGINAL MATERIAL	SUBSTITUTES
.016 TO .125 SHEET	CLAD 2024-T4	CLAD 2024-T3 2024-T3 CLAD 7075-T6 [A] 7075-T6 [A]
	CLAD 2024-T3	2024-T3 CLAD 7075-T6 [A] 7075-T6 [A]
	CLAD 7075-T6	7075-T6
FORMED OR EXTRUDED SECTION	2024-T4	7075-T6 [A] [B]
ALL GAGES	CLAD 7178-T6 7178-T6	NONE

SHEET MATERIAL TO BE REPLACED	MATERIAL SUBSTITUTION FACTOR									
	[A] 7075-T6	[A] CLAD 7075-T6	2024-T3		CLAD 2024-T3		2024-T4		CLAD 2024-T4	
	[C]	[C]	[D]	[E]	[D]	[E]	[D]	[E]	[D]	[E]
7075-T6	1.00	1.10	1.20	1.78	1.30	1.83	1.20	1.78	1.24	1.84
CLAD 7075-T6	1.00	1.00	1.13	1.70	1.22	1.76	1.13	1.71	1.16	1.76
2024-T3	1.00	1.00	1.00	1.00	1.09	1.10	1.00	1.10	1.03	1.14
CLAD 2024-T3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.10
2024-T4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.03	1.14
CLAD 2024-T4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

NOTE

[A] THESE MATERIALS MAY NOT BE USED AS SUBSTITUTES IN PRESSURIZED AREA NOR FOR WING INTERSPAR SKIN OR SKIN SPLICE PLATES.

EXAMPLE:

TO REPLACE .040 7075-T6 MATERIAL WITH CLAD 7075-T6, MULTIPLY GAGE BY MATERIAL SUBSTITUTION FACTOR TO GET SUBSTITUTE GAGE.
(.040 x 1.10 = .045 GAGE)

[B] USE NEXT HIGHER GAGE WHEN USING A FORMED SECTION AS A SUBSTITUTE FOR AN EXTRUSION.

[C] FOR FLAT SHEET AND FORMED SECTIONS - ALL GAGES.

[D] FOR FLAT SHEET UP TO AND INCLUDING .063 GAGE.

[E] FOR FLAT SHEET .071 GAGE AND GREATER AND FOR FORMED SECTIONS.

Material Substitution
Figure 4

GAGE	ALUMINUM				MAGNESIUM				STEEL						
					QQ-M-44 (FS-1)				18-8 CRES			17-7 PH		1020 1025 4130 8630 ANLD	4130 8630 NORM
	2024-0	2024-T3	7178-0 7075-0	7178-T6 7075-T6	ANNEALED		HARD		ANLD	QTR HARD	HALF HARD	COND A	COND TMD		
					550°F	ROOM	325°F	ROOM							
[A]	.03	.06	.03	.09	.06	.09	.09	.19	.06	.06	.06	.03	.16	.06	.06
.016	.03	.06	.03	.09	.06	.09	.09	.19	.06	.06	.06	.03	.16	.06	.06
.018	.03	.06	.03	.12	.06	.09	.09	.19	.06	.06	.06	.03	.16	.06	.06
.020	.03	.06	.03	.12	.06	.09	.09	.19	.06	.06	.06	.03	.16	.06	.06
.022	.06	.09	.06	.12	.06	.16	.12	.25	.06	.06	.06	.03	.16	.06	.06
.025	.06	.09	.06	.12	.06	.16	.12	.25	.06	.06	.06	.03	.16	.06	.06
.028	.06	.09	.06	.16	.06	.16	.16	.28	.06	.06	.09	.03	.19	.06	.09
.032	.06	.12	.06	.16	.06	.19	.16	.31	.06	.06	.09	.03	.25	.06	.09
.036	.06	.16	.06	.19	.09	.22	.19	.38	.06	.09	.12	.03	.31	.09	.12
.040	.06	.16	.06	.19	.09	.22	.19	.44	.06	.09	.12	.03	.31	.09	.12
.045	.09	.19	.09	.25	.09	.25	.25	.50	.06	.09	.12	.06	.38	.09	.16
.050	.09	.19	.09	.25	.09	.25	.25	.50	.06	.09	.12	.06	.38	.09	.16
.056	.12	.22	.12	.28	.12	.28	.28	.56	.06	.12	.16	.06	.44	.09	.19
.063	.12	.22	.12	.31	.16	.31	.31	.62	.06	.12	.19	.06	.50	.09	.19
.071	.12	.28	.12	.38	.16	.38	.38	.81	.09	.16	.22	.09	.62	.09	.22
.080	.16	.34	.19	.44	.19	.44	.44	.81	.09	.16	.22	.09	.62	.12	.25
.090	.19	.38	.19	.50	.19	.44	.44	1.00	.09	.19	.25	.16	.75	.12	.28
.100	.22	.44	.22	.62	.25	.50	.50	1.00	.12	.22	.28	.22	.88	.16	.31
.112	.25	.50	.28	.75	.25	.56	.56	1.12	.12	.22	.31	.22		.16	.34
.125	.25	.56	.28	.88	.25	.62	.62	1.25				.25		.16	.38
.140	.34	.62	.38	1.00	.34	.69	.69	1.50				.28		.19	.38
.160	.38	.75	.44	1.12	.38	.75	.75	1.62				.31		.22	.44
.180	.44	.88	.50	1.25	.38	1.00	1.00	1.88				.34		.28	.50
.190	.50	.88	.56	1.25	.38	1.00	1.00	1.88				.34		.34	.50

NOTE

[A] ALL GAGES BELOW .016

Minimum Bend Radii
Figure 5

H. When making structural repairs, it may be necessary to perform an identification test to distinguish between the different aluminum alloys, if the material designations on the sheet metal are obliterated. The hardness test described in 51-5-1 is one of the tests that can be used to identify materials.

3. Magnesium Alloys

A. Magnesium alloys are similar in appearance to aluminum alloys. Magnesium weighs two thirds as much as aluminum; for this reason magnesium alloys are used in the structure in certain low stress applications with resultant saving in weight of the airplane.

B. Forming of magnesium alloy sheets usually must be done at elevated temperatures. Parts that are formed at temperatures below 325°F must be strain relieved.

C. Magnesium alloys can be machined with tools designed for use on steel or brass, provided cutting edges are sharp.

D. Magnesium alloys must not be used where contact with methyl alcohol is possible, such as in liquid deicing and water injection systems. Do not use magnesium parts in integral fuel tank areas.

E. Use Type B rivets (5056-F aluminum alloy) in magnesium alloy parts and use clad 2024-T3 aluminum alloy for repair parts.

WARNING: SMALL PARTICLES AND FINE SHAVINGS OF MAGNESIUM IGNITE EASILY AND PRESENT AN EXTREME FIRE HAZARD. MAGNESIUM DUST IS HIGHLY FLAMMABLE AND, IN THE PROPER CONCENTRATION, MAY CAUSE AN EXPLOSION. WATER IN CONTACT WITH MOLTEN MAGNESIUM PRESENTS A STEAM EXPLOSION HAZARD. EXTINGUISH FIRES OF MAGNESIUM WITH ABSOLUTELY DRY TALC, CALCIUM CARBONATE, SAND OR GRAPHITE BY APPLYING THE POWDER TO A DEPTH OF ONE-HALF INCH, OR MORE, OVER THE BURNING METAL. DO NOT USE FOAM, WATER, CARBONTETRACHLORIDE, OR CARBON DIOXIDE.

4. Titanium Alloy

A. Titanium alloy resembles corrosion resistant steel and is comparable to it in strength. Titanium alloy weighs about half as much as steel.

B. Titanium alloy does not require a protective coating because its corrosion resistance is very good; however, it is cathodic to magnesium and aluminum and shall be insulated from them similarly to corrosion resistant steel.

C. High speed steel drills can be used to drill titanium alloy, however, drill speeds must be sharply reduced to prevent overheating of titanium and to increase the life of the drill. Nevertheless, when drilling titanium alloy, the life of the drill is several times shorter than its corresponding cutting life when drilling steel. Drills shall be examined and changed frequently because the maintenance of a sharp cutting edge is important.

D. Use corrosion resistant steel, Type 302 rivets annealed, and monel rivets to repair titanium.

E. Use hot dimpling tools and procedures for obtaining dimples in titanium.

WARNING: FIRE HAZARDS, WHEN WORKING WITH TITANIUM, ARE SIMILAR TO THOSE DESCRIBED FOR MAGNESIUM, AND THE SAME FIRE EXTINGUISHING METHODS SHALL BE USED.

5. Corrosion Resistant Steel

A. Corrosion resistant steel plating is used in some areas of the airplane structure where high strength is required.

B. Steel is cathodic to magnesium and aluminum and must be insulated from them when making repairs. Apply at least three coats of zinc chromate primer to surfaces of magnesium alloy or aluminum alloy which may contact corrosion resistant steel.

6. Flat Patterns

A. A flat pattern is the outline of the flat blank sheet required to make a bent up or formed part. To make a flat pattern take the dimensions and contours from the damaged or opposite hand part. This may be accomplished accomplished by the following methods: shaping a piece of soldering wire around the part, or cutting a cardboard template to fit the part, or scaling the part and making a sketch as illustrated in the following paragraph. The later method is the most accurate. Derive the developed length and lay out the flat pattern.

(1) Make a sketch of the section to be formed (figure 6) showing the following dimensions:

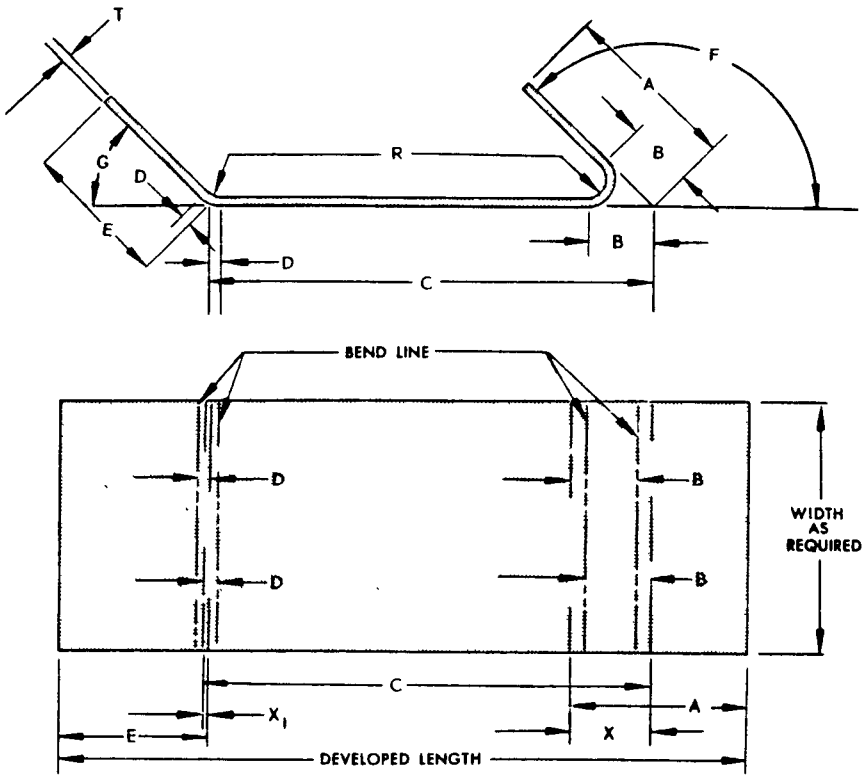
A = Flange Length
B = Set-back (figure 7)
C = Web Length
D = Set-back (figure 7)
E = Flange Length
B.R. = Bend Radius (figure 5)
F = Flange Angle
G = Flange Angle
T = Gage

(2) Derive the developed length by the following formula:

Developed Length = $A-X+C-X_1+E$
X (See figure 8)
X_1 (See figure 8)

(3) Lay out flat pattern on the flat blank sheet of repair material (figure 6) with a pencil or sharp crayon.

CAUTION: DO NOT USE A METAL SCRIBER. THE SCRATCHES ON THE METAL MAY CAUSE CRACKS.



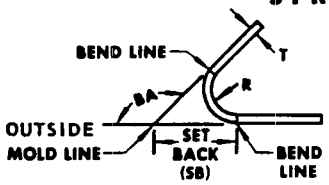
FLAT PATTERN

EXAMPLE:

A = 1.20	F = 135°
B = .453 (SEE FIGURE 7)	G = 45°
C = 3.00	T = .063
D = .078 (SEE FIGURE 7)	R = .12 (SEE FIGURE 5)
E = 1.00	X = .55 (SEE FIGURE 8)
	X_1 = .035 (SEE FIGURE 8)

DEVELOPED LENGTH = 1.20 − .55 + 3.00 − .035 + 1.00 = 4.615 USE 4.62

Flat Pattern Layout
Figure 6



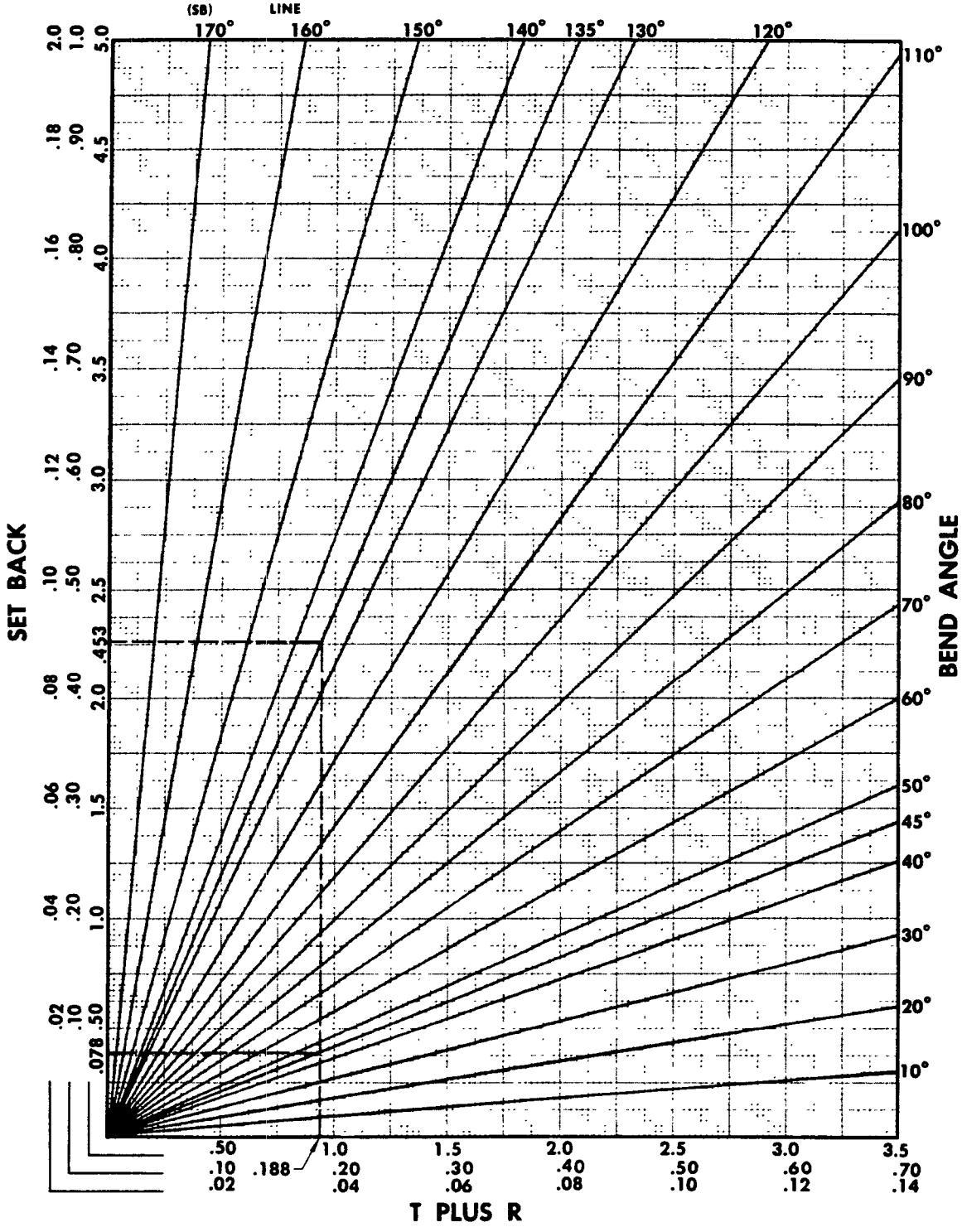
SB = DISTANCE FROM MOLD LINE TO BEND LINE

BA = BEND ANGLE

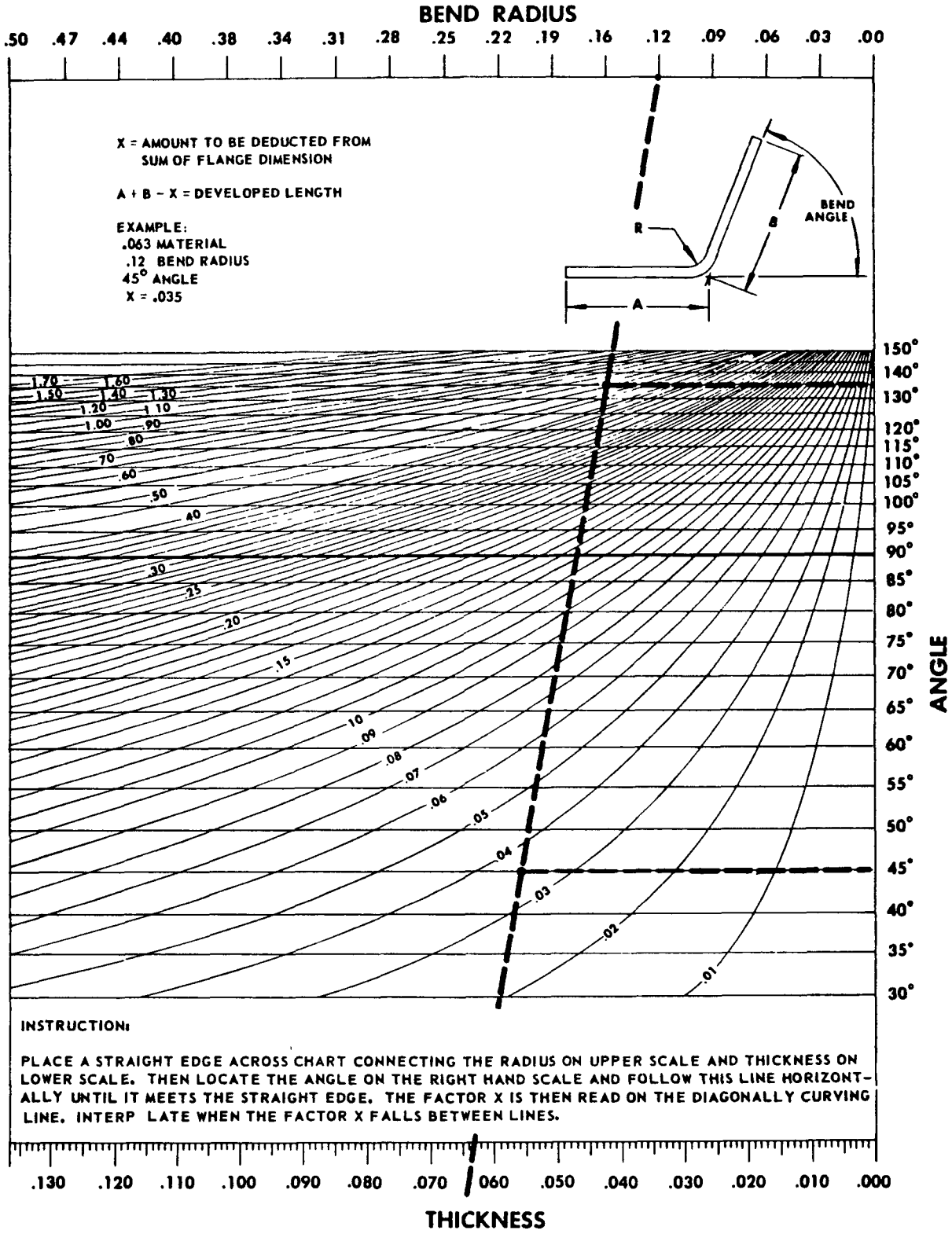
R = BEND RADIUS

T = THICKNESS

1. ENTER CHART AT BOTTOM ON APPROPRIATE SCALE USING SUM OF T + R
2. READ UP TO BEND ANGLE
3. DETERMINE SET BACK FROM CORRESPONDING SCALE ON LEFT



Flat Pattern Set-Back Graph
Figure 7



Developed Length Graph
Figure 8

7. Shim Rules

A. The tabulation shown in figure 9 below designates the requirements for shims when used in repair applications except in sections 11, 12 and 13.

RATIO SHIM GAGE FASTENER DIA. (%)	FASTENER TYPE AND MATERIAL	[B] FREE SHIM	[A] INTEGRAL SHIM REQ'D TO PREVENT SLIPPAGE AND POSSIBLE SUBSEQUENT BENDING OF FASTENER.
TO 20%	RIVETS (ETC.) (AL ALLOY)	X	
21% AND GREATER			X
TO 25%	HI-SHEAR RIVETS (STEEL)	X	
26% AND GREATER			X
TO 33%	SHEAR LOCK BOLTS (STEEL)	X	
34% AND GREATER			X
TO 40%	LOCKBOLTS, BOLTS (STEEL)	X	
41% AND GREATER			X

NOTE

[A] SHIM MUST BE RIVETED (OR SPOTWELDED) IN ORDER THAT IT BE MADE INTEGRAL WITH REPAIR PART.

[B] SHIM MAY BE TACKWELDED OR TACK-RIVETED TO A REPAIR PART FOR CONVENIENCE OF INSTALLATION.

EXAMPLE – FOR SHIM

EXAMPLE – FOR SHIM GAGE OF .040 AND 5/32 ALUMINUM ALLOY RIVET

$$\frac{\text{SHIM GAGE}}{\text{FASTENER DIAMETER}} = \frac{.040}{5/32} = 25.6\%$$

THEREFORE INTEGRAL SHIM REQUIRED

END

MATERIAL		DOMESTIC DESIGNATION (USA)			UK DESIGNATION
		MATERIAL	SPEC	TENSILE STRENGTH	SPEC
ALUMINUM ALLOY	SHEET	3003-H14	QQ-A-250/2 1/2 HARD		L 16 OR L 59
		3003-0	QQ-A-250/2		L 17 OR L 61
		7075-T6	QQ-A- 250/12		NONE
		CLAD 2024-T3	QQ-A-250/5		L72 OR L 89
		BARE 2024-T3	QQ-A-250/4		L70
		CLAD 7075-T6	QQ-A- 250/13		L88
	BAR AND ROD	2024-T4	QQ-A-225/6		L64
		2024-T6	QQ-A-225/6		L65
ALLOY STEEL	SHEET	4130 (ANNEAL)	MIL-S-18729		S514 SOFT
		4130 (QUENCH AND TEMP)	MIL-S-18729	125-150 KSI	S514 HARD
		4130 (ANNEAL)	MIL-S-18729		S516 SOFT
		4130 (QUENCH AND TEMP)	MIL-S-18729	125-150 KSI	S516 HARD
		1020 OR 1025 USE 4130 (ANNEAL) IF SPOT WELDING REQUIRED	MIL-S-7952 MIL-S-18729		S511
	BAR AND ROD	4340 (NORM)	MIL-S-5000		S1 AND S93
		4340 (QUENCH AND TEMP)	MIL-S- 5000	125-150 KSI	S95 AND 96
		4340	MIL-S- 5000	150-180 KSI	S97 AND S119
CORROSION RESISTANT STEEL	SHEET	AISI 304	QQ-S-766		S521
		AISI 321 OR 347	MIL-S-6721		
		AISI 301 COND 1/4 HARD	MIL-S-5059		S520
	BAR AND ROD				
		AISI 302, 321 AND 347	QQ-S-763		S125, 126, 127, 128

Approximately Equivalent Strength Materials
Figure 10

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
ACID BRIGHTENERS FOR ALUMINUM	MIL-C-25378 (REF)	KELITE L-20 Richardson Chemical Co. Allied-Kelite Products Div. 1250 N. Main St. Los Angeles, California 90051
		TURCO 3002A Turco Products, Inc., Div. of Purex Corp. Ltd. 24600 S. Main St. Carson, California 90749
ACIDITY TEST PAPER		#60781 pHydrion Papers VWR Scientific 600 So. Spokane Seattle, Washington 98101
NONSTRUCTURAL ADHESIVE	BMS 5-14E Grade 1	Pro-Seal 590M Teledyne Coast Pro-Seal & Manufacturing Co. 19451 Susana Rd. Compton, California 90221
		M6249 U.S. Rubber Company Consumer and Industrial Products Div. Passaic, New Jersey
	BMS 5-25 Grade 1	Hysol Div., Dexter Corp. 2850 Willow Pass Road P.O. Box 831 Pittsburg, California 94565
	BMS 5-29J TYPE 2 Class 1	Component AB Hysol 4405 Component CD Hysol 3538 Hysol Div., Dexter Corp. 2850 Willow Pass Road P.O. Box 831 Pittsburg, California 94565
		Component AB; 183-C-417 Component CD; 183-C-418 Fuller - O'Brien Corporation 450 Grand Ave. So. San Francisco, California 94080

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
NONSTRUCTURAL ADHESIVE (Cont)	BMS 5-29J TYPE 2 Class 1 (Cont)	Component AB: 522 Component CD: 542 Technical Research Company 13535 Monster Road So. Seattle, Washington 98178
		Component AB: J1170-1 Component CD: E-18-1 Tra-Con 55 North Street Medford, Massachusetts 02155
	BMS 5-29J TYPE 1	Component A Epon 828 Component B Epon 812 Shell Chemical Corporation 50 W. 50th St. New York, N.Y. 10020
		Component C Versamid 115 Component D Versamid 125 General Mills, Inc. P.O. Box 191 Kankakee, Illinois 60901
	BMS 5-34	Churchill 3C-90A Churchill 3C-90B Churchill Chemical Corp. 3137 E. 26th St. Los Angeles, California 90023
	BMS 5-42C Type 1	EC 1593 (Nominal: 10% solids) Minnesota Mining and Manufacturing Co. 3M Center St. St. Paul, Minnesota 55101
	Type 2	AF-30 Minnesota Mining and Manufacturing Co. 3M Center St. St. Paul, Minnesota 55101
ADHESIVE IN TWO-COMPARTMENT BAG	BMS 5-29J Grade II	3147-N2X Whittaker Corp. Research and Dev. Narmco Materials Div. 600 Victoria St. Costa Mesa, California 92627

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
ADHESIVE IN TWO-COMPARIMENT BAG (Cont)	BMS 5-29J Grade II (Cont)	80055-30 or 80055-31 80055-44 or 80055-45 Fenwal Incorporated 400 Main St. Ashland, Massachusetts 01721
ADHESIVE COMPONENTS		
RESINS	BMS 5-29	EPON 812 EPON 828 EPON 815 Shell Chemical Corporation 50 W. 50th St. New York, New York 10020 VERSAMID 115, VERSAMID 125 General Mills Corporation 9200 Wayzata Minneapolis, Minnesota 55440
CATALYSTS	BAC5432 Compound 7	Curing Agent "T" Curing Agent "U" Shell Chemical Corporation 50 W. 50th St. New York, New York 10020
FILLER	BAC5432	MICROBALLOON PHENOLIC SPHERES BJO -0930 Bakelite Company Division Union Carbide Corp. New York, New York
AERODYNAMIC SMOOTHER	BMS 5-79A	3C-414 B-1/2, B-2, B-4 Churchill Chemical Corporation 3137 E. 26th St. Los Angeles, California 90023 Pro-Seal 898 B-1/2, B-2, B-4, B-8, C-24, C-48, D-2 Teledyne Coast Pro-Seal and Manufacturing Co. 19451 Susana Rd. Compton, California 90221
ALODINE 1200 POWDER		American Products Inc. Spring Garden St. Ambler, Pennsylvania 19002

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
ALUMINUM FOIL TAPE		Johnson and Johnson, Inc. Permacel Div. U.S. Highway No. 1 New Brunswick, New Jersey 08903
COATING, CONDUCTIVE		No. 3202009, Coating No. 6108101, Catalyst (Black) DeSoto Inc. Pacific Plant 4th and Cedar Sts. Berkeley, California 94710
FIBERGLASS		
HONEYCOMB CORE		General Purpose, Class 1: NP 3/16 - 112 - 4.5 NP 3/16 - 112 - 6.0 NP 3/16 - 112 - 9.0 Hexcel Corporation 11711 Dublin Blvd. Dublin, California 94566
CLOTH	BMS 9-3D Type D, H or H-2 Class VII (wet layup)	Clark-Schwebel International S.A. Battice, Belgium Bay Mills, Ltd. 365 Evans Avenue Toronto, Ontario, Canada MBZ TK2 Hexcel Corporation 11711 Dublin Blvd. Dublin, California 94566 Burlington Industrial Fabrics Co. Div. of Burlington Industries 1345 Avenue of the Americas New York, New York 10019 J. P. Stevens and Company, Inc. 1460 Broadway New York, New York 10036 United Merchants and Manufacturers, Inc. 1407 Broadway New York, N.Y. 10018

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
	BMS 8-79, Class II (Epoxy Prepreg)	E-715-120-CS272 E-715-181-CS272 E-715-182-CS272 E-715-184-CS272 E-715-7581-CS272 U.S. Polymeric, A. Hitco Co. P.O. Box 2187 Santa Ana, California 92707

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
FIBERGLASS (Cont)		
CLOTH (Cont)	BMS 8-79, Class II (Epoxy Prepreg) (Cont)	Narmco 551-182-Volan A Narmco 551-184-Volan A Narmco 551-7581-Volan A Whittaker Corporation Research & Development Narmco Mtls Division 600 Victoria St. Costa Mesa, California 92627
KELITE POLYCOTE		Richardson Chemical Co. Allied-Kelite Products Div. 1250 N. Main St. Los Angeles, California 90051
NYLON		Nylon Coated Nylon N/N1 The Connecticut Hard Rubber Co. 407 East St. New Haven, Connecticut 06509
PARTING FILMS		
PREFERRED - PVA (POLYVINYL ALCOHOL)		Reynolon 4201 or 4301 Reynolds Metal Company 2819 First Ave. Seattle, Washington 98121
ALTERNATE - POLYETHYLENE		0.004 Inch Thick Any available source
- PVC (POLYVINYL CHLORIDE)		0.010 to 0.020 Bakelite Company Division Union Carbide Co. New York, New York
POTTING COMPOUND		
ALUMINUM FILLER	BMS 5-28A Type III	Epocast 15-11 with 9614 Hardener Furane Plastics Co. 5121 San Fernando Rd. W. Los Angeles, California 90039
ALUMINUM FILLER		Atomized Aluminum Filler, Grade 123 Aluminum Company of America 1501 Alcoa Bldg. Pittsburgh, Pennsylvania 15219

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
PLASTIC PHENOLIC LAMINATE COTTON BASE	MIL-P-15035 TYPE FBG TYPE FBM	Micorta 286 (FBG) Micorta 262 (FBM) Westinghouse Electric Corp. Micorta Division Insulating Materials Div. Manor, Pennsylvania 15665 Synthane Grade CE (FBG) Synthane Grade C (FBM) Synthane-Taylor Corp. Valley Forge Road Valley Forge, Pennsylvania 19481
PRIMER, AEROSOL		Fuller-O'Brien Corp. 6323 Maywood Ave. Huntington Park, California 90255
PRIMER	MIL-S-4383 (REF)	EC776SR (EC1309) & EC1290 Minnesota Mining and Manufacturing Co. 3M Center St. St. Paul, Minnesota 55101
PRIMER		PRC No. 1 Products Research and Chemical Corp. 410 Jersey Ave. Glouster City, New Jersey 08030
PRIMER, SPECIAL	BMS 10-11F TYPE 1	Finch System Finch Paint and Chemical Co. 20846 So. Normandie Ave. Torrance, California 90502 Desoto Systems #1, #2, #3 Desoto Inc. Pacific Plant 4th and Cedar Sts. Berkeley, California 94710
PRIMER, ZINC CHROMATE	MIL-P-6889 or MIL-P-8585	Any approved source of supply

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
SEALANT, HIGH TEMPERATURE	BMS 5-18 TYPE II	Pro-Seal 714 Teledyne Coast Pro-Seal & Manufacturing Co. 19451 Susana Rd. Compton, California 90221
		PR 810 Products Research and Chemical Corp 2919 Empire Ave Burbank, California 91504
SEALANT, INTEGRAL FUEL TANK	BMS 5-26 Class A	PR 1422A, PR 1422B Products Research and Chemical Corp 2919 Empire Ave Burbank, California 91504
		Pro-Seal 890A, Pro-Seal 890B Teledyne Coast Pro-Seal & Manufacturing Co. 19451 Susana Rd. Compton, California 90221
SEALANT, PRESSURE AND ENVIRONMENTAL	BMS 5-79	Pro Seal 898 B-1/2, B-2, B-4, C-24, C-48, B-8, D-2 Teledyne Coast Pro-Seal & Manufacturing Co. 19451 Susana Rd. Compton, California 90221
		3C-414, B-1/2 Churchill Chemical Corp. 3137 E. 26th St. Los Angeles, California 90023
SEALANT, PRESSURE AND ENVIRONMENTAL	BMS 5-95 CLASS B	PR 1436G B2 Products Research and Chemical Corp. 2919 Empire Ave. Burbank, California 91504
		Pro-Seal 870 B-2 Teledyne Coast Pro-Seal & Manufacturing Co. 19451 Susana Road Compton, California 90221

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
SOLVENT, ALKALINE CLEANER		Oakite 204 Oakite Products, Inc. 558 First Ave. So. Seattle, Washington 98104 PENNSALT 2271R Pennwalt Corp. Chemical Specialties 2700 So. Eastern Ave. Los Angeles, California 90022 Pacific Chemical B82 Pacific Chemical Mfg. Co. 4501 Shilshole NW Seattle, Washington 98107
SOLVENT, CLEANING (PRESEALING)	BMS 11-7	PFL-307-56 AMS Div. of Union Oil 2100 E. 37th St. Wichita, Kansas 67219 TL-4119 Fuller-O'Brien Corp. 450 E. Grand So. San Francisco, California 94080 T-2279A Enmar Incorporated 630 E. 13th Andover, Kansas 67002 Turco 4460 Turco Products, Inc., Div. of Purex Corp. Ltd. 24600 S. Main St. Carson, California 90749 Formula No. C-32 Commercial Chemical Co. Inc. 20 Province St. Boston, Massachusetts 02116
SOLVENT, CLEANERS	TT-M-261	Methyl-Ethyl-Ketone Toluol

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
SOLVENT, NEUTRALIZER	BMS 3-2B TYPE 1	Shell-Sol 345 Shell Petrochemical Suite 26, Two Plaza S.W. 6700 S.W. Haines Rd. Tigard, Oregon 97223
STRIPPERS, PAINT		Del Chem E-Z Strip 19AC Penrwalt Corp. Chemical Specialties Div. 2700 So. Eastern Ave. Los Angeles, California 90022
		Turco 4669 (thick) Turco Products, Inc. Div. of Purex Corp. Ltd. 24600 So. Main St. Carson, California 90749
		Nuvite 631-3A Nuvite Chem Compounds Corp. 213 Freeman Street Brooklyn, New York 11222
		DuBois R2134 DuBois Chemicals Div. Chemed Corp. 3623 6th Ave. So. Seattle, Washington 98104
		DuBow 1800 Sure-Strip DuBow Chemical Corp. 39 Hanse Avenue Freeport, L.I., New York
		Cee Bee A290 Chemtron Corp. Inorganic Chemical Div. 9520 E. Cee Bee Drive Downey, California 90241
		Androx 204 Brent Chemical Products, Ltd. Brentford, Middlesex, England

NOMENCLATURE	SPECIFICATION	RECOMMENDED MATERIALS
TAPE, ALUMINUM FOIL		Permacel P112 Johnson and Johnson, Inc. Permacel Div. U.S. Highway No. 1 New Brunswick, New Jersey 08903
TAPE, WEATHER PROOFING ADHESIVE	BMS 10-3	Scotchcal SSE-133, 630 & 850 Minnesota Mining and Manufacturing Co. 3M Center St. St. Paul, Minnesota 55101
TEMPILSTIK OR TEMPILA (TEMPERATURE INDICATORS)		Tempilstik Corp. 132 West 22nd Street New York, New York 10011
TOP COAT		EC776SR Type I Minnesota Mining and Manufacturing Co. 3M Center St. St. Paul, Minnesota 55101
CORROSION RESISTANT FINISH (FOR INTEGRAL FUEL TANK ONLY)	BMS 10-20D TYPE I	PR 1560 Base, Accelerator Products Research and Chemical Corporation 2919 Empire Ave. Burbank, California 91504 DeSoto 823-010 Base, 910-099 Activator, 010-005 Thinner DeSoto Inc. Pacific Plant 4th and Cedar Sts. Berkeley, California 94710
	BMS 10-20D TYPE I & TYPE II	Finch 454-4-1 Base, CA 109, TL 52 Thinner Finch Paint and Chemical Co. 20846 So. Normandie Ave. Torrance, California 90502
TURCO PRE-PAINT		Turco Products, Inc. Div. of Purex Corp. Ltd. 24600 S. Main St. Carson, California 90749

SEALANTS

1. General

A. Throughout this manual many of the repairs require the use of sealants. These sealants have been chosen for the particular properties which they possess, but in many instances alternate sealants with similar or superior qualities could be substituted. The purpose of the data in this subject is to provide the operator with alternate materials for use where the specified material is not available.

B. Sealants are designated by a Boeing Material Specification (BMS) number. This is followed by a classification letter which denotes the method of application for which it is suited. Following the classification is a number which represents the maximum time available (in hours) for application at 75 ±5°F. For example:

BMS 5-95	Class B-1/2
Spec. No.	Application Class: Application time (hrs)

C. When choosing substitute sealants, match the application class of the specified sealant. The repair work should be completed within the sealant's application time. The use of a sealant with a greater application time is permissible, however, a longer cure time will be required.

2. Application Classes

A. The application class designation for sealants to Boeing Material Specifications are as follows.
All classes are not necessarily available for any particular sealant.

- Class A - Brush application
- Class B - Injection, fillet or fay
- Class C - Fay, when long squeeze out life is required
- Class D - Extra heavy for hole filling
- Class E - Sprayable as a coating
- Class F - Sprayable as a primer

3. Common Sealants

A. A list of common sealants to Boeing Material Specificiations with a description of their properties and the available application classes are shown in Table I.

4. Substitution Data

A. Refer to Table II to find suitable substitutes for sealants called out in this manual.

BMS	CLASS	BASE	COLOR	DESCRIPTION
5-19	A, B	Thiokol	Brown	Pressure, Weather and Fuel Cavity Sealant
5-26	A,B,C	Thiokol	Dark Gray	Integral Fuel Tank Sealant
5-32	B(not for Fay)	Thiokol	Brown	Pressure, Weather, Fuel Cavity, Low Density Sealant
5-63	B	Silicone	White	Firewall Sealant - Hydraulic Fluid Resistant (Phosphate Ester Base)
5-79	A,B,C,D	Thiokol	Gray	Pressure, Environmental and Fuel Cavity Sealant
5-95	B,C,E,F	Thiokol	Gray	Chromate Type Pressure, Environmental and Fuel Cavity Sealant

Common Sealants
Table I

ORIGINAL SPECIFIED SEALANT	PERMISSIBLE SUBSTITUTES					
	BMS 5-19	BMS 5-26	BMS 5-32	BMS 5-63	BMS 5-79	BMS 5-95
BMS 5-19	-	YES	YES	NO	YES	YES
BMS 5-26	NO	-	NO	NO	NO	NO
BMS 5-32	YES	YES	-	NO	YES	YES
BMS 5-63	NO	NO	NO	-	NO	NO
BMS 5-79	YES	YES	YES	NO	-	YES
BMS 5-95	YES	YES	YES	NO	YES	-

Substitute Sealants
Table II

FASTENERS

1. General

A. The fasteners commonly used in this Boeing airplane are AN426D and AN470D rivets. If the AN426D and AN470D rivets are to be replaced with the softer AN426AD or AN470AD rivets, substitution tables in 51-2-3 can be used to determine the number of rivets required.

B. Rivets that are in contact with magnesium shall be Type B rivets which are made of 5056-F alloy, e.g. AN426B and AN470B rivets.

C. Shear head rivets (BAC-R15CE) have smaller heads than ordinary 100° head rivets. They are intended for use in coutersunk holes in thin sheets. Fig. 3 of 51-2-9 gives strength values of countersunk shear head rivets for material thicknesses in which they should be used in preference to standard AN426 rivets in countersunk holes. Hole sizes for shear head rivets shall conform to 51-2-5, Fig. 1, table IX. Do not shave shear head rivets. For substitution of shaved AN426 rivets for shear head rivets, see 51-2-3.

D. Rivets used in integral fuel tanks shall be fluid tight. Fluid tight quality is attained by using 2117 (or 2024 "as quenched") aluminum alloy rivets having a close shank tolerance in close tolerance holes. Hole sizes for close tolerance shank rivets BAC-R15BA and BAC-R15BB are given in 51-2-5, Fig. 1, table X. It is important on which side the driven head of the rivet is upset because the sealing takes place around the shank just under the upset head and this determines the location of the seal plane. When sealing is required on the flush side of a countersunk rivet, the shank is upset into a 82° countersink, forming an NACA type rivet head. To obtain a fuel-tight rivet, the upsetting should be done evenly so that the rivet head fills the entire countersink. Grip ranges for fluid tight rivets of various lengths are given in 51-2-2 Fig. 7. The countersunk head should be formed above flushness and shaved per the requirements of aerodynamic smoothness 51-4-1. For replacement procedure of fluid tight rivets see 57-2-2.

E. Hi-shear rivets and lockbolts are made of alloy steel with aluminum collars. In permanent installation hi-shear rivets and lockbolts are preferred to NAS bolts because they are lighter, and smaller. Hi-shear rivets should not be used when tensile loads are critical. Pull-type lockbolts have greater residual tension than stump-type lockbolts and hi-shear rivets and therefore will maintain tighter joints.

F. Blind rivets are used in applications where access is not available to form the driven head of a conventional rivet. Blind rivets shall not be used in applications involving tension in the rivet or head prying. Do not use blind rivets in locations subject to severe vibration such as the sonic areas of the wings. Blind rivets are also not suitable for use in fluid tight joints.

NOTE: Blind rivets used in repairs in this manual are time limited and should be inspected at frequent intervals for looseness. The repairs shown using blind rivets have FAA (DER) approval contingent on accomplishment of the inspections at the intervals stated.

CAUTION: DO NOT USE BLIND RIVETS ON CONTROL SURFACE HINGE BRACKETS, WING ATTACHMENT FITTINGS, LANDING GEAR FITTINGS, FIXED TAIL SURFACE ATTACHMENT FITTINGS, OR IN OTHER SIMILAR HIGHLY STRESSED LOCATIONS.

G. Blind bolts have higher shear strength than blind rivets. Blind bolts should be used only where loads are primarily in shear. Do not use blind bolts where their parts could get into engine air intakes if they should fail by becoming loose.

NOTE: Blind bolts used in repairs in this manual are time limited and should be inspected at frequent intervals for looseness. The repairs shown using blind bolts have FAA (DER) approval contingent on accomplishment of the inspections at the intervals stated.

H. Threaded fasteners 1/4 inch or larger in diameter, except special sizes, are of Unified Thread System, per National Bureau of Standards Handbook H28. Use of special threads is to be avoided wherever possible.

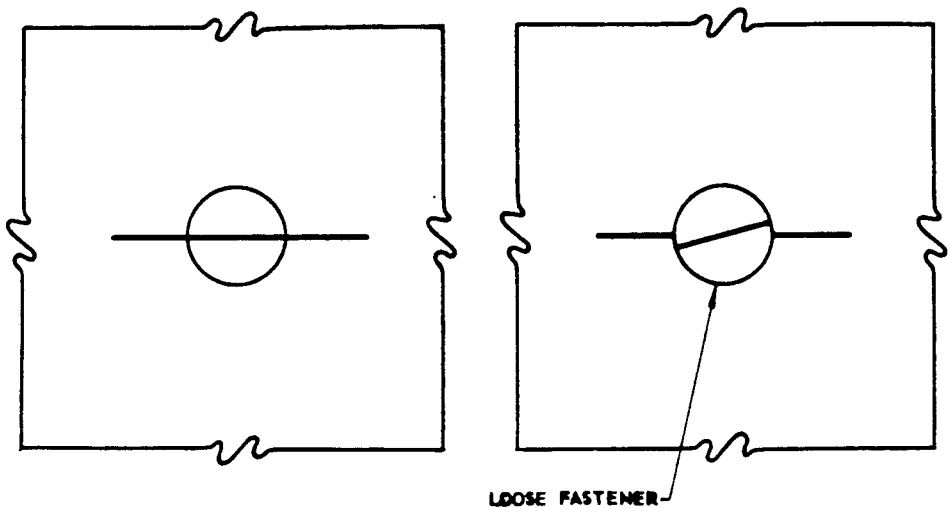
J. Loose fasteners must be replaced. They may be shown by the following situations:

(1) The fastened material moves relative to the fastener. Skin deflection is evident.

(2) Tipping of the fastener head may indicate its loosening or slippage. Rivet head periphery rolled upward also indicates looseness.

(3) A black or dark grey stain is found adjacent to or around the fastener head. Generally, it takes the form of a dirt streak aft of the loose rivet.

(4) Mark a red line across the fastener head and the adjacent material. Check the line at the next inspection. Any loosening of the fastener will break the line as indicated in Fig. 1.


LOOSE FASTENER

FASTENER IDENTIFICATION

1. General

A. The symbol system shown in Detail I of Fig. 1 is based on NAS 523 standard. This symbol system is used on most Boeing drawings and in this manual. The basic rivet code used to identify the fastener contains (x) codes assigned by Boeing to identify fasteners not covered by the NAS 523 code.

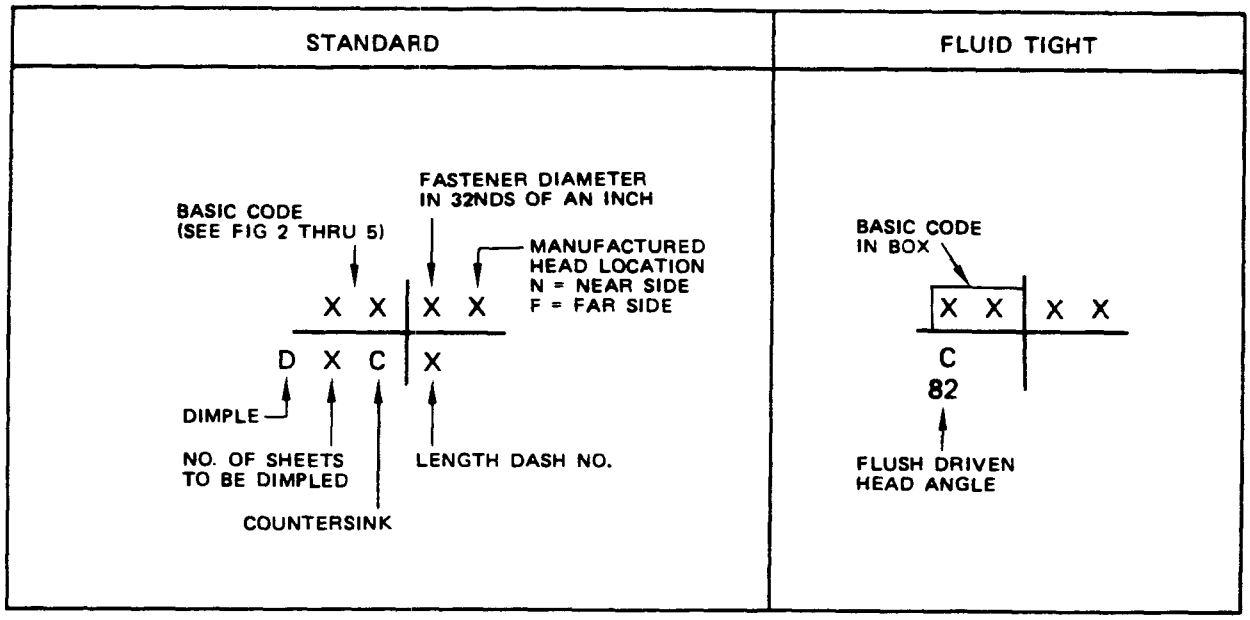
B. The coding for oversize fasteners and the original fasteners they replace is covered in Fig. 2 thru 5.

C. Some older Boeing drawings use the obsolete fastener symbols explained in Detail II of Fig. 1.

D. A listing of fastener vendors is shown in Fig. 6.

E. A listing of obsolete and replacement fasteners is shown in Fig. 7.

NOTE: Continued use of obsolete fasteners, if available, is permitted for repairs contained in this manual which show obsolete fastener symbols or callouts.



DETAIL I – CURRENT FASTENER SYMBOLS

BF / 6N / C — MS20427M6 RIVET
3/16 DIAMETER
MONEL
COUNTERSINK NEAR SIDE

RL / 5 — NAS1398D BLIND RIVET
5/32 DIAMETER
2117-T4

XFV / 8 / DC — BACB30GY LOCKBOLT
1/4 DIAMETER
STEEL, WITH BACC30K COLLAR
DIMPLED SKIN
COUNTERSINK STRUCTURE

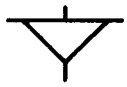
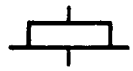
XCZ / 8 — BACB30FM HEX-DRIVE BOLT
1/4 DIAMETER
STEEL

[XC] / 6F / C / 82 — BAC-R15BB-6AD
3/16 DIAMETER
UNIVERSAL HEAD RIVET,
MANUFACTURED
HEAD FAR SIDE
COUNTERSINK 82°
NEAR SIDE FOR
FLUID TIGHT DRIVEN HEAD

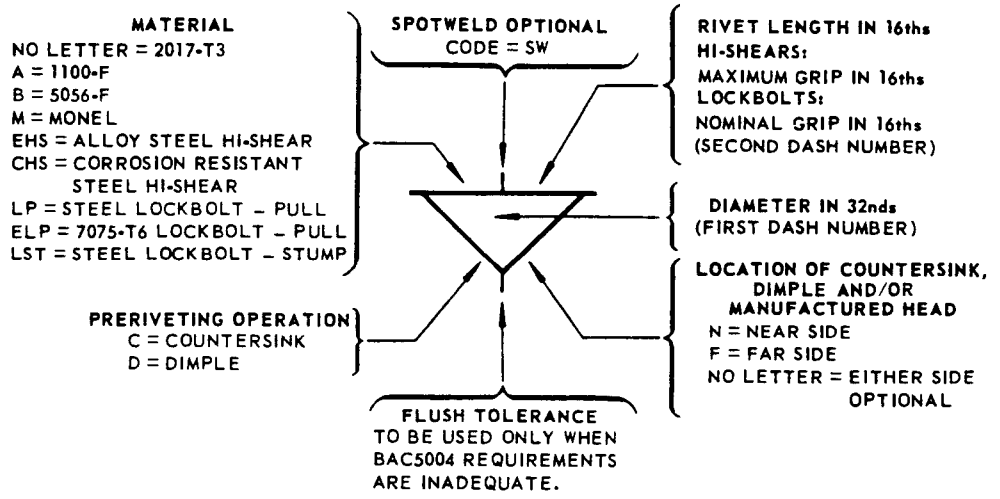
EXAMPLES

Fastener Symbols
Figure 1 (Sheet 1)

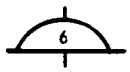
SYMBOLS FOR RIVETS, HI-SHEARS & LOCKBOLTS

100° CSK HEAD BASIC SYMBOL		PROTRUDING HEAD BASIC SYMBOL	
RIVETS	LOCKBOLTS, HI-SHEARS	RIVETS	LOCKBOLTS, HI-SHEARS
			
AN426 (AL ALLOY) AN427 (MONEL)	BAC-B30AW (ELP) BAC-B30AP (LST) BAC-B30AM (LP) BAC-R15AZ (EHS) BAC-R15AU (CHS)	AN470 (AL ALLOY) NAS508 (MONEL)	BAC-R15AY (EHS) BAC-B30AN (LST) BAC-B30AL (LP, ELP)

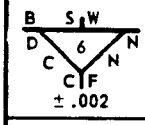
COMPOSITION OF SYMBOLS & CODE



EXAMPLES OF SYMBOL & CODE COMPOSITION



= 3/16 DIAMETER UNIVERSAL HEAD RIVET 2017-T3 AN470D6



= 3/16 DIAMETER 100° COUNTERSUNK HEAD RIVET 5056-F, AN426B, DIMPLE NEAR SIDE, COUNTERSINK INSTRUCTURE NEAR SIDE, COUNTERSINK FAR SIDE, FLUSHNESS TOLERANCE ± .002, SPOTWELD OPTIONAL

HOLE LOCATION SYMBOL



HOLE LOCATION FOR 5/32 RIVET. THE NUMBER SIGNIFIES RIVET DIAMETER IN 32nds

DETAIL II – OBSOLETE FASTENER SYMBOLS

Fastener Symbols
Figure 1 (Sheet 2)

TYPE	CODE	PART NUMBER		MATERIAL ALLOY AND TEMPER AS SUPPLIED	DESCRIPTION
		STANDARD	VENDOR		
SOLID SHANK UNIVERSAL HEAD	BM	MS20470D		2017-T4	
	BL	MS20470DD		2024-T4	
	BJ	MS20470AD		2117-T4	
	BK	MS20470B		5056-H32	
	XC	BACR15BB-AD		2117-T4	CLOSE TOLERANCE
	XD	BACR15BB-DD		2024-T4	CLOSE TOLERANCE
	LN	MS20615M		MONEL	
SOLID SHANK FLUSH HEAD	BE	MS20426D		2017-T4	100° HEAD
	CY	MS20426DD		2024-T4	100° HEAD
	BB	MS20426AD		2117-T4	100° HEAD
	BC	MS20426B		5056-H32	100° HEAD
	XA	BACR15BA-AD		2117-T4	100° PRECISION HEAD, CLOSE TOL SHANK
	XB	BACR15BA-DD		2024-T4	100° PRECISION HEAD, CLOSE TOL SHANK
	XF	BACR15CE-D		2017-T4	100° SHEAR HEAD
	XE	BACR15CE-B		5056-H32	100° SHEAR HEAD
	XGL	BACR15CE-M		MONEL	100° SHEAR HEAD
	BF	MS20427M		MONEL	100° HEAD, CLOSE TOL SHANK
	XEO	BACR15DG-AD		2117-T4	MODIFIED 82° HEAD
	XEM	BACR15DG DD		2024-T4	MODIFIED 82° HEAD
RIVET SLUG	XPZ	BACR15BD-DD		2024-T4	MACHINE DRIVEN
	XRA	BACR15BD AD		2117-T4	MACHINE DRIVEN
BLIND PROTRUDING HEAD	RK	NAS1398B	CR2263 (K P Q)	5056-F	LOCKED STEM
	RL	NAS1398D	CR2163 (K P Q)	2017-T4	LOCKED STEM
	RM	NAS1398M	CR2563M (K P Q)	MONEL	LOCKED STEM
	TK	NAS1398MW	CR2563 (K P Q)	MONEL (CAD.PL)	LOCKED STEM
	XPU	BACR15EB-P	CR2239 (K Q)	5056-H32	NON HOLE FILLING
	XLR	BACB30LB	BP-T (O)	STEEL (CAD. PL)	BOLT, HIGH STRENGTH
BLIND 100° HEAD	RO	NAS1399B	CR2262 (K P Q)	5056-F	LOCKED STEM
	RP	NAS1399D	CR2162 (K P Q)	2017-T4	LOCKED STEM
	RR	NAS1399M	CR2562M (K P Q)	MONEL	LOCKED STEM
	TO	NAS1399MW	CR2562 (K P Q)	MONEL (CAD.PL)	LOCKED STEM
	XPT	BACR15EB	CR2238 (K Q)	5056-H32	NON HOLE FILLING
	XLP	BACB30LA	B100-T (O)	STEEL (CAD. PL)	BOLT, HIGH STRENGTH

STANDARD RIVETS

TABLE I

NOTES
- SEE FIG. 6 FOR VENDORS

Fastener Identification - Rivets
Figure 2 (Sheet 1)

TYPE	ORIGINAL FASTENER		OVERSIZE FASTENER		
	CODE	PART NO.	CODE	PART NO.	NOMINAL OVERSIZE
SOLID SHANK UNIVERSAL HEAD	BM	MS20470D	XYM	BACR15ET-D	1/32
	BL XD	MS20470DD BACR15BB-DD	XYO	BACR15ET-DD	1/32
	BJ XC	MS20470AD BACR15BB-AD	XYN	BACR15ET-AD	1/32
	BK	MS20470B	XYL	BACR15ET-B	1/32
SOLID SHANK FLUSH HEAD	BE	MS20426D	XAD	BACR15AD-D	1/32
	CY XB	MS20426DD BACR15BA-DD	XBL	BACR15AD-DD	1/32
	BC	MS20426B	XAC	BACR15AD-B	1/32
	XF	BACR15CE-D	XKC XPK	BACR15DS-D BACR15EA-D	1/32 3/64
	XEO	BACR15DG-AD	XPR	BACR15DL-AD	1/32
	XEM	BACR15DG-DD	XPS	BACR15DL DD	1/32

NOTES
- SEE FIG. 6 FOR VENDORS

OVERSIZE RIVETS

TABLE II

Fastener Identification - Rivets
Figure 2 (Sheet 2)

TYPE	CODE	PART NUMBER		MATERIAL	DESCRIPTION	COLLAR		[A] 1/64 OVERSIZE FASTENER
		STANDARD	VENDOR			PART NO.	MATL	
PROTRUDING HEAD	XEP XER XES	BACB30DX	2LPYT	STEEL, 95 KSI	TENSION, PULL TYPE	NAS1080 NAS1080P NAS1080R	2024-T4 2024-T4 STEEL	BACB30DX-X
	XOH XOJ XOK	BACB30DX-A	2LPYEU-C	CRES, 95 KSI	TENSION, PULL TYPE	NAS1080 NAS1080P NAS1080R	2024-T4 2024-T4 STEEL	BACB30DX-A-X
	XFE XFF	BACB30HC	2LSPT	STEEL, 95 KSI	TENSION, STUMP TYPE, HAMMER DRIVEN	NAS1080 NAS1080R	2024-T4 STEEL	BACB30DX-X [B]
	XFO XFR XFP	BACB30GW	SALPYT	STEEL, 95 KSI	SHEAR, PULL TYPE	NAS1080C BACC30K NAS1080E	2024-T4 2024-T4 STEEL	BACB30CU
	XLW	BACB30GW-A	SALPYEU-C	CRES, 95 KSI	SHEAR, PULL TYPE	BACC30K	2024-T4	BACB30GW-A-X
100° FLUSH HEAD	XEW XEX XEY	BACB30DY	2L426YT	STEEL, 95 KSI	TENSION, PULL TYPE	NAS1080 NAS1080P NAS1080R	2024-T4 2024-T4 STEEL	BACB30DY-X
	XMK XML XMM	BACB30DY-A	2L426YEU-C	CRES, 95 KSI	TENSION, PULL TYPE	NAS1080 NAS1080P NAS1080R	2024-T4 2024-T4 STEEL	BACB30DY-A-X
	XFH XFJ	BACB30HD	2LS426T	STEEL, 95 KSI	TENSION, STUMP TYPE HAMMER DRIVEN	NAS1080 NAS1080R	2024-T4 STEEL	BACB30DY-X [B]
	XFV XFT	BACB30GY	SAL100YT	STEEL, 95 KSI	SHEAR, PULL TYPE	BACC30K NAS1080E	2024-T4 STEEL	BACB30CT
	XLU	BACB30GY-A	SAL100YEU-C	CRES, 95 KSI	SHEAR, PULL TYPE	BACC30K	2024-T4	BACB30GY-A-X

NOTES

- SEE FIG. 6 FOR VENDORS

[A] OVERSIZE FASTENERS USE SAME COLLARS AS STANDARD FASTENERS.

[B] WHEN AN OVERSIZE REPLACEMENT IS NEEDED FOR A STUMP TYPE LOCKBOLT, USE PULL TYPE AS LISTED WITH PINTAIL REMOVED.

Fastener Identification - Lockbolts
Figure 3

PROTRUDING HEAD

PART NUMBER			MATERIAL	DESCRIPTION	COLLAR	1/64 OVERSIZE FASTENER PART NUMBER			1/32 OVERSIZE FASTENER PART NUMBER		
CODE	STANDARD	VENDOR				CODE	STANDARD	VENDOR	CODE	STANDARD	VENDOR
XMX	BACB30MB	HL 20 [K] [N]	STEEL 95 KSI	TENSION HEAD HEX-DRIVE	BACC30X	XMY	BACB30MC	HL 64 [K] [N]	XMS	BACB30MD [P]	HL 220 [K] [N]
XPB	BACB30MB-A	HL 448 [K] [N]	CRES 95 KSI		BACC30X	XTZ	BACB30MC-A	HL 452 [K] [N]	XUD	BACB30MD-A [P]	HL 454 [K] [N]
XUN	BACB30NX-C	HL 512 [K] [N]	TITANIUM 95 KSI		BACC30X-M	XMY	BACB30MC	HL 64 [K] [N]	XMS	BACB30MD [P]	HL 220 [K] [N]
XCZ	BACB30FM	HL 118 [K] [N] 62550 [G]	STEEL 95 KSI	SHEAR HEAD HEX-DRIVE	BACC30M	XDD	BACB30FP	HL 62 [K] [N] 62549 [G]	XKJ	BACB30KK [P]	HL 218 [K] [N] 65960 [G]
XNJ	BACB30FM-A	HL 440 [K] [N] 67067 [G]	CRES 95 KSI		BACC30M	XNN	BACB30FP-A	HL 442 [K] [N] 67069 [G]	XSJ	BACB30KK-A [P]	HL 240 [K] [N] 67072 [G]
XTJ	BACB30MY-C	HL 510 [K] [N] 68833 [G]	TITANIUM 95 KSI		BACC30M	XDD	BACB30FP	HL 62 [K] [N] 62549 [G]	XKJ	BACB30KK [P]	HL 218 [K] [N] 65960 [G]

100° FLUSH HEAD

PART NUMBER			MATERIAL	DESCRIPTION	COLLAR	1/64 OVERSIZE FASTENER PART NUMBER			1/32 OVERSIZE FASTENER PART NUMBER		
CODE	STANDARD	VENDOR				CODE	STANDARD	VENDOR	CODE	STANDARD	VENDOR
XNB	BACB30JC	HL 21 [K] [N]	STEEL 95 KSI	TENSION HEAD HEX-DRIVE	BACC30X	XMS	BACB30LX	HL 65 [K] [N]	XSL	BACB30LY [P]	HL 221 [K] [N]
XRT	BACB30JC-A	HL 449 [K] [N]	CRES 95 KSI		BACC30Z	XUD	BACB30LX-A	HL 453 [K] [N]	XTX	BACB30LY-A [P]	HL 455 [K] [N]
XUO	BACB30NY-C	HL 513 [K] [N] 69226 [G]	TITANIUM 95 KSI		BACC30X-M	XMS	BACB30LX	HL 65 [K] [N]	XSL	BACB30LY [P]	HL 221 [K] [N]
XSS	BACB30ND	HL 525 [K] [N]	STEEL 95 KSI	SHEAR HEAD HEX-DRIVE (MS20426 TYPE HEAD)	BACC30M		BACB30ND-X	HL 527 [K] [N]		BACB30ND-Y	HL 255 [K] [N]
XYA	BACB30ND-A	HL 445 [K] [N]	CRES 95 KSI		BACC30X		BACB30ND-A X	HL 447 [K] [N]		BACB30ND-A-Y	HL 257 [K] [N]
XUP	BACB30NZ-C	HL 323 [K] [N] 69227 [G]	TITANIUM 95 KSI		BACC30X-M		BACB30ND-X	HL 527 [K] [N]		BACB30ND-Y	HL 255 [K] [N]
XDA	BACB30FN	HL 19 [K] [N] [G] 62547	STEEL 95 KSI	SHEAR HEAD HEX-DRIVE	BACC30M	XDE	BACB30FQ	HL 63 [K] [N] [G] 62544	XKA	BACB30KF [P]	HL 219 [K] [N] [G] 64788
XNL	BACB30FN-A	HL 441 [K] [N] [G] 67068	CRES 95 KSI		BACC30M	XNP	BACB30FQ-A	HL 443 [K] [N] [G] 67070	XSG	BACB30KF-A [P]	HL 241 [K] [N] [G] 67071
XTO	BACB30NW-C	HL 511 [K] [N] [G] 69228	TITANIUM 95 KSI		BACC30M	XDE	BACB30FQ	HL 63 [K] [N] [G] 62544	XKA	BACB30KF [P]	HL 219 [K] [N] [G] 64788

STANDARD AND OVERSIZE HEX-DRIVE BOLTS

TABLE I

NOTES

- SEE FIG. 6 FOR VENDORS
- [P] USE BACC30AC COLLAR

Fastener Identification - Threaded Fasteners
Figure 4 (Sheet 1)

CODE	TYPE	STANDARD BOLT		DESCRIPTION	1/64 OVERSIZE BOLT		1/32 OVERSIZE BOLT	
		PART NUMBER	VENDOR		PART NUMBER	VENDOR	PART NUMBER	VENDOR
	PROTRUDING HEAD	BACB30NE	A B C D E F G H J K	HEXAGON HEAD, CLOSE TOL., STEEL, 160 KSI TENSION	BACB30NE-X	A B C D E F G H J K	BACB30NE-Y	A B C D E F G H J K
		BACB30NF	A B C D E F G H J K	HEXAGON HEAD, CLOSE TOL., STEEL 95 KSI SHEAR	BACB30NE-X	A B C D E F G H J K	BACB30NE-Y	A B C D E F G H J K
		BACB30NJ	A B C D E G J K	12 POINT HEAD, CLOSE TOL., STEEL, 125 KSI SHEAR	BACB30NJ-X	A B C D E G J K	BACB30NJ-Y	A B C D E G J K
		BACB30MT	A B C D E G J K	12 POINT HEAD, STEEL, 220 KSI TENSION	BACB30MT-X	A B C D E G J K	BACB30MT-Y	A B C D E G J K
		BACB30NK	J	12 POINT HEAD, CLOSE TOL., MARAGING STEEL, 156 KSI SHEAR	BACB30NK-X	J	BACB30NK-Y	J
		BACB30NG	J	12 POINT HEAD, MARAGING STEEL, 260 KSI TENSION	BACB30NG-X	J	BACB30NG-Y	J
		BACB30FD	B F G K	12 POINT HEAD, STEEL, 180 KSI TENSION	BACB30FD-X	B F G K	BACB30FD-Y	B F G K
		BACB30NM-C	A B C E G H J K L M N	HEXAGON HEAD, CLOSE TOL., TITANIUM 160 KSI TENSION	BACB30NE-X	A B C D E F G H J K	BACB30NE-Y	A B C D E F G H J K
		BACB30NR-C	A	HEXAGON HEAD, CLOSE TOL., TITANIUM 160 KSI TENSION				
		BACB30MR-C	A B C E G H J K L M	12 POINT HEAD TITANIUM, 160 KSI TENSION	BACB30FD-X	B F G K	BACB30FD-Y	B F G K
	100° FLUSH HEAD	BACB30LU	A B C D E F G H J K	PHILLIPS RECESS CLOSE TOL., STEEL 160 KSI TENSION	BACB30LU-X	A B C D E F G H J K	BACB30LU-Y	A B C D E F G H J K
		BACB30EL	B G H K N	HI-TORQUE RECESS, REDUCED HEAD, STEEL, 95 KSI SHEAR	BACB30KP	B G H K N	BACB30KR	B G H K N
		BACB30MS-C		HI-TORQUE RECESS, CLOSE TOL., TITANIUM, 95 KSI SHEAR				
		BACB30NU-C		HI-TORQUE RECESS, REDUCED HEAD, TITANIUM, 95 KSI SHEAR				

NOTES
● SEE FIG. 6 FOR VENDORS

STANDARD AND OVERSIZE BOLTS

TABLE II

Fastener Identification - Threaded Fasteners
Figure 4 (Sheet 2)

TYPE	PART NUMBER			DESCRIPTION	NUT	WASHER
	CODE	STANDARD	VENDOR			
100° FLUSH HEAD	XWD XWE XJV XJW	BACB30KD	TL 100 [B] [E] [K]	STEEL	BACN10HY BACN10RE BACN10GM BACN10MT	BACW10BZ BACW10AU
	XUL XUW XWB	BACB30MU	TLV 100 [B] [E] [G] [H]	TITANIUM 95 KSI	BACN10HY M BACN10HY-M BACN10RE	BACW10CA-CVS BACW10CA-CCS BACW10BZ
PROTRUDING HEAD	XUH	BACB30PB	TL 200 [B] [E] [K]	STEEL	BACN10HY	
	XUM XUX XWC	BACB30MW	TLV 200 [B] [E] [G] [H]	TITANIUM 95 KSI	BACN10HY-M BACN10HY-M BACN10RE	BACW10CA-CVS BACW10CA-CCS BACW10BZ
	XWH XWJ	BACB30PE	[B] [E] [K]	STEEL	BACN10RD	

STANDARD TAPER SHANK BOLTS
TABLE I

TYPE	OVERSIZE		DOUBLE OVERSIZE		TRIPLE OVERSIZE	
	STANDARD	VENDOR	STANDARD	VENDOR	STANDARD	VENDOR
100° FLUSH HEAD	BACB30KD-X	TL 100-X	BACB30KD-Y	TL 100-Y	BACB30KD-Z	TL 100-Z
PROTRUDING HEAD	BACB30PB-X	TL 200-X	BACB30PB-Y	TL 200-Y	BACB30PB-Z	TL 200-Z
	BACB30PE-X		BACB30PE-Y		BACB30PE-Z	

OVERSIZE TAPER SHANK BOLTS
TABLE II

NOTES
- SEE FIG. 6 FOR VENDORS

Fastener Identification - Tapered Shank Bolts
Figure 5

[A] AIR INDUSTRIES CORP.
12570 KNOTT STREET
GARDEN GROVE, CALIFORNIA 92641

[B] OMARK INDUSTRIES
1415 EAST GRAND AVE.
EL SEGUNDO, CALIFORNIA 90245

[C] DUMONT AVIATION ASSOCIATES
3969 PARAMOUNT BLVD.
LAKEWOOD, CALIFORNIA 90712

[D] FEDERAL MANUFACTURING CORP.
6910 FARMDALE AVENUE
NORTH HOLLYWOOD, CALIFORNIA
91605

[E] P.B. FASTENERS
1700 WEST 132ND ST.
GARDENA, CALIFORNIA 90249

[F] SCREWCORP
13001 EAST TEMPLE AVENUE
CITY OF INDUSTRY, CALIFORNIA
91746

[G] STANDARD PRESSED STEEL CO.
JENKINSTOWN, PENNSYLVANIA 19046

[H] STANDARD PRESSED STEEL CO.
WESTERN PLANT
2701 SO. HARBOR BLVD.
SANTA ANA, CALIFORNIA 92702

[J] VALLEY-TODECO INC.
12975 BRADLEY AVENUE
SYLMAR, CALIFORNIA 91342

[K] VOI-SHAN MANUFACTURING CO.
8463 HIGUERA STREET
CULVER CITY, CALIFORNIA 90230

[L] BLAKE RIVET COMPANY
5030 FIRESTONE BLVD.
SOUTH GATE, CALIFORNIA 90280

[M] CAMCAR SCREW & MANUFACTURING
CORP.
600 118TH AVENUE
ROCKFORD, ILLINOIS 61101

[N] HI-SHEAR CORPORATION
2600 SKYPARK DRIVE
TORRANCE, CALIFORNIA 90509

[O] HUCK MANUFACTURING CO.
2650 BELLEVUE AVENUE
DETROIT, MICHIGAN 48207

[P] OLYMPIC FASTENING SYSTEMS INC.
11445 DOLAN STREET
DOWNEY, CALIFORNIA 90241

[Q] TOWNSEND COMPANY
CHERRY RIVET DIVISION
1224 EAST WARNER AVENUE
SANTA ANA, CALIFORNIA 92707

Fastener Vendors
Figure 6

OBSOLETE FASTENERS			REPLACEMENT FASTENERS		
CODE	PART NO.	DESCRIPTION	CODE	PART NO.	DESCRIPTION
CR	ACT509-T	LOCKBOLT- 100° CSK HEAD	XFA	BACB30GX ( )-( )	LOCKBOLT-PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH NAS1080 COLLAR
DM	ACT509-T	LOCKBOLT- 100° CSK HEAD	XFC	BACB30GX ( )-( )	LOCKBOLT-PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED, WITH NAS 1080 COLLAR
CT	ALPP( )-T	LOCKBOLT- PROTRUDING HEAD	XEP	BACB30DX ( )-( )	LOCKBOLT-PULL, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080 COLLAR
EB	ALPP( )-T	LOCKBOLT- PROTRUDING HEAD	XES	BACB30DX ( ) - ( )	LOCKBOLT-PULL, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED, WITH NAS 1080R COLLAR
	AN3	BOLT- PROTRUDING HEAD		BACB30NE	BOLT-PROTRUDING HEAD, ALLOY STEEL, CAD PLATED
B	AN426B	RIVET- 100° CSK HEAD, ALUMINUM	XZF BC	BACR15BA-B MS20426B	RIVET-100° CSK HEAD, 5056F AL, ANODIZED
	AN426D	RIVET- 100° CSK HEAD, ALUMINUM	XZG BE	BACR15BA-D MS20426D	RIVET-100° CSK HEAD, 2017-T4 AL, ANODIZED
	AN426AD	RIVET- 100° CSK HEAD ALUMINUM	XA BB	BACR15BA-AD MS20426AD	RIVET-100° CSK HEAD, 2117-T4 AL, ANODIZED
M	AN427M	RIVET- 100° CSK HEAD, MONEL	BF	MS20427M	RIVET-100° CSK HEAD, MONEL
	AN470B	RIVET- PROTRUDING HEAD, ALUMINUM	XZJ BK	BACR15BB-B MS20470B	RIVET-PROTRUDING HEAD, 5056-H32 AL, ANODIZED
	AN470D	RIVET- PROTRUDING HEAD, ALUMINUM	XZK BM	BACR15BB-D MS20470D	RIVET-PROTRUDING HEAD, 2017-T4 AL, ANODIZED
BJ	AN470AD	RIVET– PROTRUDING HEAD, ALUMINUM	XC BJ	BACR15BB-AD MS20470AD	RIVET–PROTRUDING HEAD, 2117-T4 AL, ANODIZED
	BACB30AB ( )-( )	BOLT– 100° CSK HEAD		BACB30LU ( )-( )	BOLT – 100° CSK HEAD, ALLOY STEEL, CAD PLATED
CT FM	BACB30AL ( )-( )	LOCKBOLT– PROTRUDING HEAD	XEP	BACB30DX ( )-( )	LOCKBOLT – PULL, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH NAS1080 COLLAR
EB	BACB30AL ( )-( )	LOCKBOLT– PROTRUDING HEAD	XES	BACB30DX ( )-( )	LOCKBOLT – PULL, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080R COLLAR
DM	BACB30AM ( )-( )	LOCKBOLT– 100° CSK HEAD	XFC	BACB30GX ( )-( )	LOCKBOLT – PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080R COLLAR
CR FP LP	BACB30AM ( )-( )	LOCKBOLT– 100° CSK HEAD	XFA	BACB30GX ( )-( )	LOCKBOLT – PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080 COLLAR
DA EC LST	BACB30AN ( )-( )	LOCKBOLT– PROTRUDING HEAD	XFE	BACB30HC ( )-( )	LOCKBOLT – STUMP, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080 COLLAR

OBSOLETE FASTENERS			REPLACEMENT FASTENERS		
CODE	PART NO.	DESCRIPTION	CODE	PART NO.	DESCRIPTION
DB	BACB30AP ( )–( )	LOCKBOLT– 100° CSK HEAD	XFL	BACB30HG ( )–( )	LOCKBOLT – STUMP, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080 COLLAR
EE	BACB30AP ( )–( )	LOCKBOLT– 100° CSK HEAD	XFM	BACB30HG ( )–( )	LOCKBOLT – STUMP, 100° CSK HEAD, ALLOY STEEL, CAD PLATED
DY	BACB30AR ( )–( )	LOCKBOLT– PROTRUDING HEAD	XFO	BACB30GW ( )–( )	LOCKBOLT – PULL, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080C COLLAR
			XCZ	BACB30FM ( )–( )	HEX-DRIVE BOLT, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30M COLLAR
EA	BACB30AT ( )–( )	LOCKBOLT– 100° CSK HEAD	XFV	BACB30GY ( )–( )	LOCKBOLT – PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30K COLLAR
			XDA	BACB30FN ( )–( )	HEX-DRIVE BOLT, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30M COLLAR
CC	BACB30AU	BOLT–BLIND PROTRUDING HEAD	XLR	BACB30LB ( )–( )	HUCK-BOLT, BLIND, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED
DJ ELP	BACB30AW ( )E( )	LOCKBOLT– 100° CSK HEAD	XFX	BACB30GQ ( )–( )	LOCKBOLT – PULL, 100° CSK HEAD, ALUMINUM. WITH NAS 1080D COLLAR
DK	BACB30AY ( )–( )	JO-BOLT, BLIND 100° CSK HEAD	XLP	BACB30LA ( )–( )	HUCK-BOLT, BLIND, 100° CSK HEAD, ALLOY STEEL, CAD PLATED
	BACB30BF	BOLT– 100° CSK HEAD		BACB30LR ( )–( )	BOLT – 100° CSK HEAD, A286 CRES, CAD PLATED
DR	BACB30CC ( )–( ) BACB30CC ( )W( )	JO-BOLT, BLIND PROTRUDING HEAD	XLP	BACB30LB ( )–( )	HUCK-BOLT, BLIND, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED
HD	BACB30CP ( )–( )	BOLT, BLIND PROTRUDING HEAD	XLT	BACB30LB ( )C( )	HUCK-BOLT, BLIND, PROTRUDING HEAD, A286 CRES
HE	BACB30CQ ( )–( )	BOLT – BLIND 100° CSK HEAD	XLS	BACB30LA ( )C( )	HUCK-BOLT, BLIND, 100° CSK HEAD, A286 CRES
XCX	BACB30EA ( )–( )	LOCKBOLT– 100° CSK HEAD	XCY	BACB30HD ( )–( )	LOCKBOLT – STUMP, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080 COLLAR
XCY	BACB30EA ( )–( )	LOCKBOLT– 100° CSK HEAD	XFJ	BACB30HD ( )–( )	LOCKBOLT – STUMP, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080R COLLAR
DX	BACB30N ( )–( )	LOCKBOLT– PROTRUDING HEAD	XFO	BACB30GW ( )–( )	LOCKBOLT – PULL, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080C COLLAR
DZ	BACB30P ( )–( )	LOCKBOLT– 100° CSK HEAD	XFS	BACB30GY ( )–( )	LOCKBOLT – PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080C COLLAR
	BB351	BOLT – BLIND, 100° CSK HEAD	XLS	BACB30LA ( )C( )	BOLT – BLIND, 100° CSK HEAD, CRES
	BB352	BOLT – BLIND PROTRUDING HEAD	XLT	BACB30LB ( )C( )	BOLT – BLIND, PROTRUDING HEAD, CRES

OBSOLETE FASTENERS			REPLACEMENT FASTENERS		
CODE	PART NO.	DESCRIPTION	CODE	PART NO.	DESCRIPTION
AV	BACR15AN	RIVET DEUTSCH–BLIND, 100° CSK HEAD	XLP	BACB30LA ( )–( )	HUCK-BOLT, BLIND, 100° CSK HEAD, ALLOY STEEL, CAD PLATED NOTE: HEAD DIMS NOT SAME AS BACR15AN
CE	BACR15AP 4-49 4-74 4-99 5-61 5-61 5-92 5-123 5-123 5-124 5-185 6-147	RIVET–BLIND PROTRUDING HEAD	AAP	NAS1738E 4-1 4-2 4-2 5-1 5-2 5-2 5-2 5-3 5-3 5-3 6-3	RIVET–BLIND, PROTRUDING HEAD, AL SLEEVE. INCONEL SPINDLE
	5-185 5-216 6-221 6-258 6-258		RL	NAS1398D 5-4 5-4 6-4 6-4 6-5	RIVET–BLIND, PROTRUDING HEAD, 2017 AL SLEEVE
CD	BACR15AQ 4-70 5-178 6-143	RIVET–BLIND 100° CSK HEAD	AAV	NAS1739E 4-2 5-3 6-3	RIVET–BLIND, 100° CSK HEAD, AL SLEEVE, INCONEL SPINDLE
	4-216 5-178 5-204 5-395 6-254 6-254 6-291 6-587		RP	NAS1399D 4-4 5-4 5-4 5-7 6-4 6-5 6-5 6-10	RIVET–BLIND, 100° CSK HEAD, 2017 AL SLEEVE
EF CHS	BACR15AU ( ) – ( )	RIVET – HI–SHEAR 100° CSK HEAD	XNM	BACB30FN ( ) A ( ) U	HEX–DRIVE BOLT, 100° CSK HEAD, A286 CRES, PASSIVATED. WITH BACC30M COLLAR
XJ XK	BACR15AY	RIVET–HI–SHEAR PROTRUDING HEAD	XFR	BACB30GW ( ) – ( )	LOCKBOLT–PULL, PROTRUDING HEAD, ALLOY STEEL. CAD PLATED. WITH BACC30K COLLAR
			XCZ	BACB30FM ( ) – ( )	HEX–DRIVE BOLT, PROTRUDING HEAD, ALLOY STEEL. CAD PLATED, WITH BACC30M COLLAR
XL XM	BACR15AZ	RIVET–HI–SHEAR, 100° CSK HEAD	XFV	BACB30GY ( ) – ( )	LOCKBOLT–PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30K COLLAR
			XDA	BACB30FN ( ) – ( )	HEX–DRIVE BOLT, 100° CSK HEAD, ALLOY STEEL, CAD PLATED, WITH BACC30M COLLAR
EW	BACR15BQ	RIVET–BLIND PROTRUDING HEAD 2117-T4 AL SLEEVE	RL	NAS1398D	RIVET–BLIND, PROTRUDING HEAD, 2017 AL SLEEVE
EV	BACR15BQ –B	RIVET–BLIND PROTRUDING HEAD 5056F AL SLEEVE	RK	NAS1398B	RIVET–BLIND, PROTRUDING HEAD, 5056 AL SLEEVE

OBSOLETE FASTENERS			REPLACEMENT FASTENERS		
CODE	PART NO.	DESCRIPTION	CODE	PART NO.	DESCRIPTION
HL	BACR15BQ–M	RIVET–BLIND PROTRUDING HEAD MONEL SLEEVE	RM	NAS1398M	RIVET–BLIND, PROTRUDING HEAD, MONEL SLEEVE
ES	BACR15BR	RIVET–BLIND 100° CSK HEAD 2117-T4 AL SLEEVE	RP	NAS1399D	RIVET–BLIND, 100° CSK HEAD, 2017 AL SLEEVE
ET	BACR15BR–B	RIVET–BLIND 100° CSK HEAD 5056F AL SLEEVE	RO	NAS1399B	RIVET–BLIND, 100° CSK HEAD, 5056 AL SLEEVE
HM	BACR15BR–M	RIVET–BLIND 100° CSK HEAD MONEL SLEEVE	RM	NAS1399M	RIVET–BLIND, 100° CSK HEAD, MONEL SLEEVE
PV	BACR15DJ–P	RIVET–BLIND PROTRUDING HEAD	AAP	NAS1738E	RIVET–BLIND, PROTRUDING HEAD, AL SLEEVE, INCONEL SPINDLE
			XPU	BACR15EB–P	RIVET–BLIND, PROTRUDING HEAD, AL SLEEVE
EO	BACR15E–157C	RIVET–BLIND PROTRUDING HEAD 5056F AL SLEEVE	RK	NAS1398B	RIVET–BLIND, PROTRUDING HEAD, 5056 AL SLEEVE
EN	BACR15E–163C	RIVET–BLIND PROTRUDING HEAD 2117-T4 AL SLEEVE	RL	NAS1398D	RIVET–BLIND, PROTRUDING HEAD, 2017 AL SLEEVE
AL	BACR15E–563C	RIVET–BLIND PROTRUDING HEAD MONEL SLEEVE	RM	NAS1398M	RIVET–BLIND, PROTRUDING HEAD, MONEL SLEEVE
EP	BACR15F–162C	RIVET BLIND 100° CSK HEAD 2117-T4	RP	NAS1399D	RIVET–BLIND, 100° CSK HEAD, 2017 AL SLEEVE
BR	BACR15F–562C	RIVET BLIND 100° CSK HEAD MONEL SLEEVE	RR	NAS1399M	RIVET–BLIND, 100° CSK HEAD, MONEL SLEEVE
CE	CKL–P	RIVET–BLIND PROTRUDING HEAD	AAP	NAS1738E	RIVET–BLIND, PROTRUDING HEAD
			RL	NAS1398D	
	CR163C	RIVET–BLIND PROTRUDING HEAD 2117-T4 AL SLEEVE	RL	NAS1398D	RIVET–BLIND, PROTRUDING HEAD, 2017 AL SLEEVE
	CR2249	RIVET–BLIND PROTRUDING HEAD	AAP	NAS1738E	RIVET–BLIND, PROTRUDING HEAD, AL SLEEVE. INCONEL SPINDLE
	CR2262	RIVET–BLIND 100° CSK HEAD	RO	NAS1399B	RIVET–BLIND, 100° CSK HEAD, 5056 AL SLEEVE
XHH	F164	JO–BOLT–BLIND 100° CSK HEAD	XLS	BACB30LA ( ) C ( )	HUCK BOLT–BLIND 100° CSK HEAD, CRES
	HL-18	HEX–DRIVE BOLT PROTRUDING HEAD	XCZ	BACB30FM ( ) – ( )	HEX–DRIVE BOLT, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30M COLLAR
	HL-19	HEX–DRIVE BOLT 100° CSK HEAD	XDA	BACB30FN ( ) – ( )	HEX–DRIVE BOLT, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30M COLLAR
	HL-1970				

OBSOLETE FASTENERS			REPLACEMENT FASTENERS		
CODE	PART NO.	DESCRIPTION	CODE	PART NO.	DESCRIPTION
	HL-63	HEX-DRIVE BOLT 100° CSK HEAD		BACB30FQ ( ) A ( ) BACB30FQ ( ) K ( )	HEX-DRIVE BOLT, 100° CSK HEAD, 1/64 OVERSIZE, ALLOY STEEL, CAD PLATED OR AL COATED. WITH BACC30M COLLAR
	HS-42P	RIVET-HI-SHEAR PROTRUDING HEAD OVERSIZE	XDD	BACB30FP ( ) - ( )	HEX-DRIVE BOLT, PROTRUDING HEAD, OVERSIZE, ALLOY STEEL, CAD PLATED. WITH BACC30M COLLAR
			XAY	BACB30CU ( ) - ( )	LOCK-BOLT-PULL, PROTRUDING HEAD, OVERSIZE, ALLOY STEEL, CAD PLATED. WITH BACC30K COLLAR
	HS-51P	RIVET-HI-SHEAR 100° CSK HEAD	XNM	BACB30FN ( ) A ( ) U	HEX-DRIVE BOLT, 100° CSK HEAD, A286 CRES, PASSIVATED. WITH BACC30M COLLAR
	NAS333 NAS333CPA NAS334	BOLT- 100° CSK HEAD		BACB30LU ( ) - ( )	BOLT-100° CSK HEAD, PHILLIPS RECESS, ALLOY STEEL, CAD PLATED
	NAS464P( ) A( )	BOLT- PROTRUDING HEAD		BACB30NE ( ) - ( )	BOLT-HEX HEAD, LONG THREAD, ALLOY STEEL, CAD PLATED
BO	NAS508M	RIVET- PROTRUDING HEAD MONEL	LN	MS20615M	RIVET-PROTRUDING HEAD, MONEL
	NAS517	BOLT- 100° CSK HEAD		BACB30LU ( ) - ( )	BOLT - 100° CSK HEAD, PHILLIPS RECESS, ALLOY STEEL, CAD PLATED
	NAS1103-( ) NAS1103-( ) W	BOLT- HEX HEAD		BACB30NE ( ) - ( )	BOLT-HEX HEAD, LONG THREAD, ALLOY STEEL, CAD PLATED
	NAS1104 NAS1105	BOLT- HEX HEAD		BACB30NF ( ) - ( )	BOLT-HEX HEAD, SHORT THREAD, ALLOY STEEL, CAD PLATED
	NAS1217	BOLT- PAN HEAD		NAS1217( )T	BOLT-PAN HEAD, HI-TORQUE RECESS, SHORT THREAD, ALLOY STEEL, CAD PLATED
	NAS1218	BOLT- PAN HEAD		NAS1218( )T	BOLT-PAN HEAD, HI-TORQUE RECESS, LONG THREAD, ALLOY STEEL, CAD PLATED
	NAS1303 THRU NAS1320	BOLT- HEX HEAD		BACB30NE	BOLT-HEX HEAD, LONG THREAD, ALLOY STEEL, CAD PLATED
DZ	NAS 1436 THRU NAS1442	LOCKBOLT- 100° CSK HEAD	XFV	BACB30GY ( ) - ( )	LOCKBOLT-PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30K COLLAR
			XDA	BACB30FN ( ) - ( )	HEX-DRIVE BOLT, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30M COLLAR

OBSOLETE FASTENERS			REPLACEMENT FASTENERS		
CODE	PART NO.	DESCRIPTION	CODE	PART NO.	DESCRIPTION
DX	NAS 1446 THRU NAS 1452	LOCKBOLT–PROTRUDING HEAD	XFR	BACB30GW ( ) – ( )	LOCKBOLT–PULL, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30K COLLAR
			XCZ	BACB30FM ( ) – ( )	HEX–DRIVE BOLT, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30M COLLAR
DS	NAS 1465 THRU NAS 1472	LOCKBOLT–PROTRUDING HEAD		BACB30DX ( ) – ( )	LOCKBOLT–PULL, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH NAS1080 OR NAS1080P COLLAR
			XMX	BACB30MB ( ) – ( )	HEX–DRIVE BOLT, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30X COLLAR
	NAS 1475 THRU NAS 1482	LOCKBOLT–100° CSK HEAD		BACB30DY ( ) – ( )	LOCKBOLT–PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH NAS1080 OR NAS1080P COLLAR
			XYA	BACB30ND	HEX–DRIVE BOLT, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30X COLLAR
FM FN	R1028–T	LOCKBOLT–PROTRUDING HEAD	XEP	BACB30DX ( ) – ( )	LOCKBOLT–PULL, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH NAS1080 COLLAR
FP	R1029–T	LOCKBOLT–100° CSK HEAD	XFA	BACB30GX ( ) – ( )	LOCKBOLT–PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH NAS1080 COLLAR
XAV	R3008–T	LOCKBOLT–100° CSK HEAD	XAV	BACB30CH ( ) – ( )	LOCKBOLT–PULL, 100° CSK HEAD, 1/64 OVERSIZE, ALLOY STEEL, CAD PLATED. WITH NAS1080R COLLAR
EW	RV200C	RIVET–BLIND PROTRUDING HEAD 2117–T4 AL SLEEVE	RL	NAS1398D	RIVET–BLIND, PROTRUDING HEAD, 2017 AL SLEEVE
DX	SALP–T	LOCKBOLT–PROTRUDING HEAD	XFE	BACB30HC ( ) – ( )	LOCKBOLT–STUMP, PROTRUDING HEAD, ALLOY STEEL, CAD PLATED. WITH NAS 1080 COLLAR
DZ	SAL100–T	LOCKBOLT–100° CSK HEAD	XFV	BACB30GY ( ) – ( )	LOCKBOLT – PULL, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30K COLLAR
EA	SLS100C–T		XDA	BACB30FN ( ) – ( )	HEX–DRIVE BOLT, 100° CSK HEAD, ALLOY STEEL, CAD PLATED. WITH BACC30M COLLAR
CD	100V	RIVET–BLIND 100° CSK HEAD	RP	NAS1399D	RIVET–BLIND, 100° CSK HEAD, 2017 AL SLEEVE

Obsolete and Replacement Fasteners
Figure 7 (Sheet 6)

FASTENER INSTALLATION AND REMOVAL

1. Fastener Installation

A. Solid shank aluminum rivets, hi-shear rivets, bolts, HI-LOK fasteners, Jo-bolts and blind hi-shear bolts may be installed with hand tools or power tools. Lockbolts must be installed with power tools. See paragraph 1.B. for hi-shear rivet installation, paragraph 1.C. for blind hi-shear bolt installation, paragraph 1.E. for Jo-bolt installation. See paragraph 1.F. for HI-LOK fastener installation.

NOTE: Blind bolts used in repairs in this manual are time limited and should be inspected at frequent intervals for looseness. The repairs shown using blind bolts have FAA (DER) approval contingent on accomplishment of the inspections at the intervals stated.

B. With the exception of slipping the collar over the stud and using a special rivet set, the driving procedure for hi-shear rivets is similar to that for solid shank rivets.

NOTE: When installing a hi-shear rivet in a standard rivet hole, check that the hole size is within the limits prescribed in 51-2-5.

Hi-shear rivets may be driven from either end. To drive a hi-shear rivet from the collar end, use a hi-shear rivet set in the rivet gun and a flush-type bucking bar. To drive a hi-shear rivet from the head end, use a flush rivet set in the rivet gun and a hi-shear rivet set in a special bucking bar. See paragraph 3 for special tools used for installing hi-shear rivets.

NOTE: The maximum grip (measured in 1/16 inch) of the hi-shear rivet shall not exceed the material thickness by more than 1/16 inch.

C. Blind hi-shear bolts are installed by the use of blind bolt hand tools or with a B1750 power unit and gun. (See paragraph 3.) With a power unit the procedure is as follows:

(1) Install correct mandrel in gun and slide rivet sleeve on mandrel.

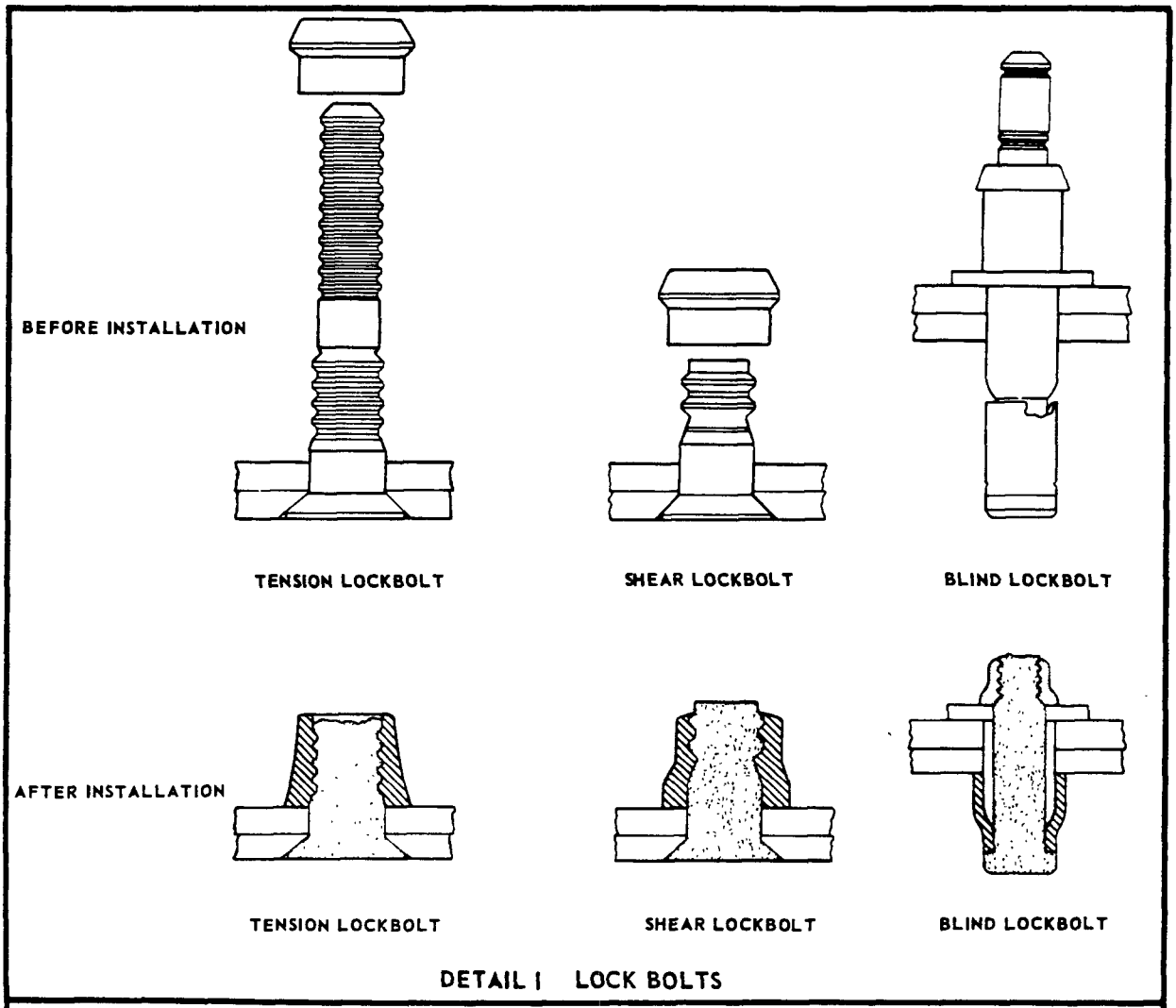
(2) Screw rivet expander on mandrel and insert mandrel, with rivet sleeve and rivet expander, into rivet hole.

(3) Operate power unit and gun to retract the mandrel forcing the expander into the rivet sleeve.

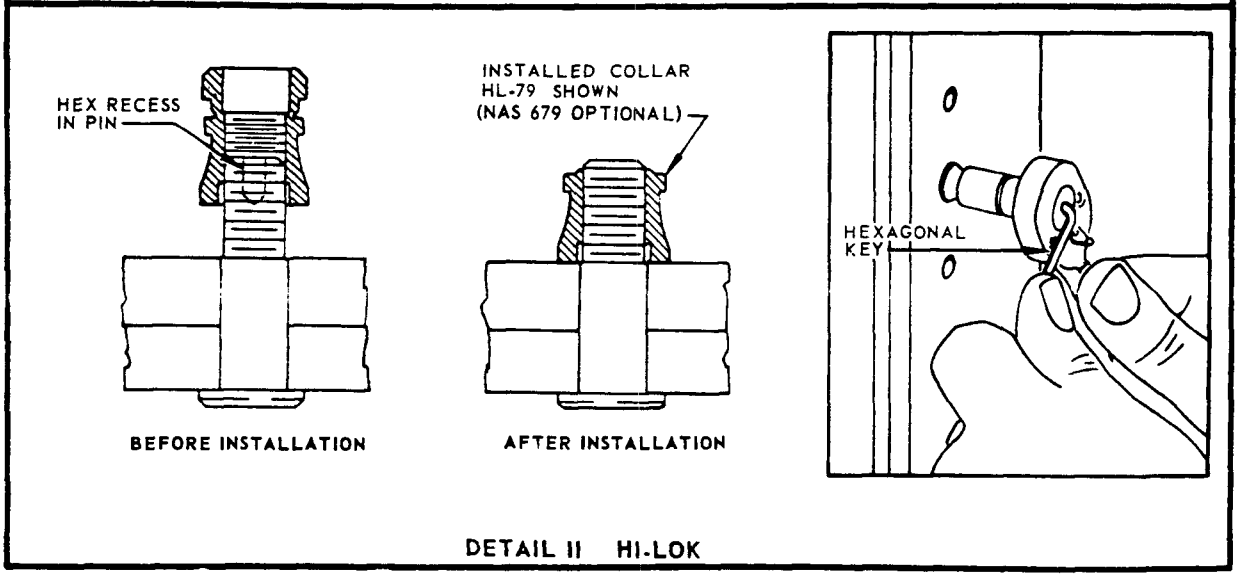
(4) Retract mandrel from rivet by reversing motion of the gun.

(5) Install core bolt and torque with a core bolt driver.

D. There are three types of lockbolts; the tension type, the shear type, and the blind type (Fig. 1). The tension type lockbolt is installed with a special pneumatic pulling gun that swages the collar to the bolt and snaps off the excess bolt. The shear type lockbolt is driven with a special lockbolt set fitted to standard riveting equipment. A heavy bucking bar is held against the rivet head, while the set swages the collar into the locking grooves of the lockbolt. Blind lockbolts are installed using a special pull gun that swages the collar into the locking grooves and pulls off the excess bolt. See paragraph 3.B. for special tools used for installing lockbolts.



DETAIL I LOCK BOLTS



DETAIL II HI-LOK

Lockbolt and Hi-Lok Installation
Figure 1

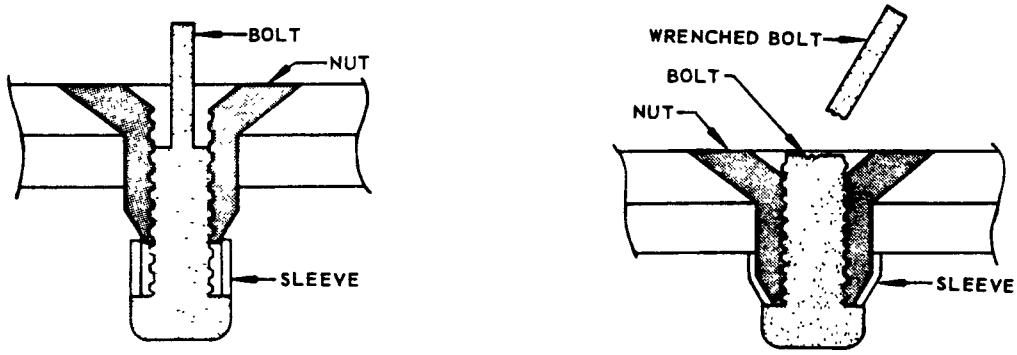
NOTE: The maximum grip (measured in 1/16 inch) of the Lockbolt shall not exceed the material thickness by more than 1/16 inch.

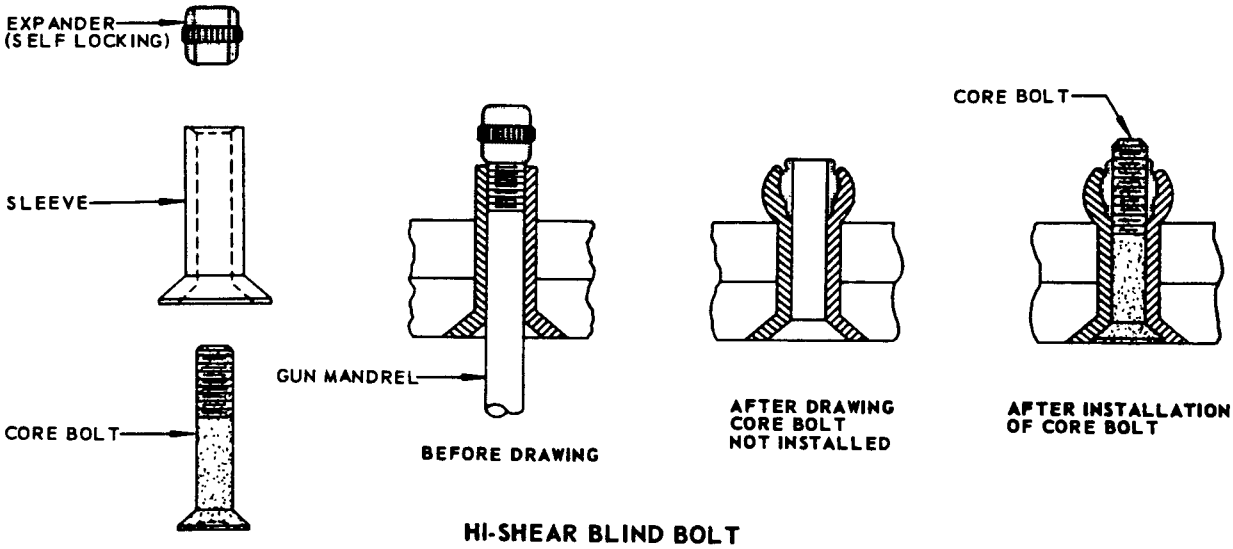
E. The Jo-bolt is driven with a special wrench adapter that expands the bolt end. (See figure 2.) See paragraph 3-F for special tools used for installing Jo-bolts.

NOTE: The maximum grip (measured in 1/16 inch) of the Jo-bolt shall not exceed the material thickness by more than 1/16 inch.

F. The HI-LOK fastener is installed in a manner similar to that of a bolt and nut installation. A hexagonal key with an open end (or ratchet) wrench are used. The collar (HL79) is considered properly installed when the hexagonal upper portion is "torqued-off" during the fastener installation. Torque per 51-2-4 is not required. See figure 1. As an alternate method use NAS679 tension nuts, torqued per 51-2-4, in place of HL79 collars.

NOTE: The maximum grip (measured in 1/16 inch) of the fastener shall not exceed the material thickness by more than 1/16 inch.





Blind Bolt Installation
Figure 2

2. Fastener Removal

A. The general procedure for removing solid shank aluminum rivets may be applied to all fasteners. See paragraph 2.B. for special hi-shear rivet removal procedure, paragraph 2.C. for blind hi-shear rivet removal procedure, paragraph 2.D. for Jo-bolt removal procedure, and paragraph 2.E. for lockbolt removal. A HI-LOK fastener may be removed by loosening the collar with a pair of pliers while holding the pin with a hexagonal key. An undamaged pin, after having been driven out may be used again. The general procedure for removal of solid shank aluminum rivets (figure 4) is as follows:

(1) File a flat area on the manufactured head of non-flush rivets.

(2) Back up the flush or nonflush rivet with a block of wood or a bucking bar, and center punch the center of the manufactured head.

(3) Using a drill 1/32 of an inch smaller than the rivet shank, drill through the head of the rivet so that the drill does not damage the skin or cut the sides of the rivet hole.

NOTE: Hold the drill at a 90° angle to the skin and start the drill by hand.

(4) Insert a drift punch into the hole drilled in the rivet and tilt the punch to break off the rivet head.

(5) Using a drift punch and hammer, drive out the rivet shank while supporting the opposite side of the structure.

CAUTION: TO PREVENT CRACKED DIMPLES OR DAMAGED UNDERSTRUCTURE, WHEN REMOVING RIVETS FROM DIMPLED HOLES, DRILL A HOLE INTO THE RIVET SHANK BEFORE DRIVING IT OUT.

B. The general method of removing solid shank aluminum rivets (paragraph 2) may be utilized on either end of hi-shear rivets or lockbolts. If special hi-shear removal tools are available it is advisable to use one of the following removal methods: The drill-out method employs the use of a drill-out bushing to guide the high-speed drill onto the end of the rivet pin. Remove enough of the rivet end to release its grip on the collar and tap the rivet pin out with a hammer. The collar cutter method employs the use of a hollow-mill collar cutter to cut away enough of the rivet collar to permit the rivet to be driven out with a sharp tap from a hammer. The chisel method employs the use of a chisel with a blade edge less than collar height of a hi-shear rivet or lockbolt. Crack opposite sides of the collar with the chisel, pry off the collar pieces and drive the shank out with a hammer and punch. The punch-out method employs the combined usage of three tools, a punch to be inserted into a rivet gun, a guide bushing to guide the punch onto the rivet end, and a hollow bucking tool to back up the structure. The punch-out method and the collar cutter method are generally considered as preferable to the drill-out method because the drill-out method requires drilling of the steel hi-shear rivet shank. See figure 5 for hi-shear rivet removal.

C. Blind hi-shear bolts are removed by first removing the core bolt with a core bolt driver. Using a high-speed drill 1/32 of an inch smaller than the sleeve shank, drill the head of the sleeve. Drill through the head only, so that the skin will not be damaged by the drill. Drive the sleeve shank from the rivet hole with a drift punch.

D. Jo-bolts are removed by drilling through the head of the nut, using a high-speed drill the same diameter as the shank of the nut. The head is snapped off, and a hammer and punch are used to drive out the bolt and sleeve.

NOTE: The Jo-bolt removal procedure is essentially the same as the removal procedure for removing solid shank rivets (paragraph 2.A.).

E. Lockbolt collars of all types, except blind, are removed by the hollow mill collar cutter method or by the chisel method. Use a hammer and punch to drive the lockbolt shank through the hole.

3. Special Tools

A. Installation of certain types of high strength fasteners requires the use of special driving tools or special rivet dies. Special installation and removal tools for special fasteners are listed in paragraphs 3.A. through 3.H. inclusive.

B. Installation of Huck blind lockbolts and pull type shear lockbolts is accomplished using pull guns such as the Model 126 hydraulic pull gun or the Model 352 or Model 353 pneumatic pull guns. These pull guns are available from the Huck Manufacturing Co., Detroit 7, Michigan. Short or long nose assemblies in various sizes for installing different diameter fasteners are available from the above manufacturer. Installation of Huck blind rivets is accomplished using a Model 350 pneumatic pull gun, also available from the above manufacturer.

C. Hi-shear rivets are installed using special rivets sets such as the straight gun set, offset gun set and full notched gun sets for use with conventional rivet guns, as well as insert sets and squeezer sets for use with portable and stationary squeezers, are available from the Hi-Shear Rivet Tool Co., Los Angeles 45, California.

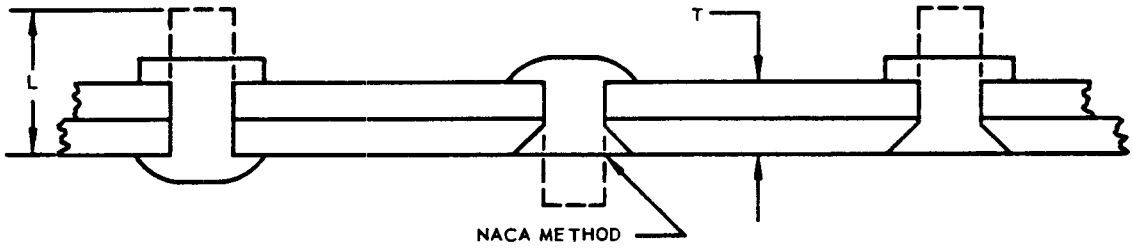
D. Huck stump type shear lockbolts, like hi-shear rivets are driven with conventional riveting guns using special swaging dies. Swaging dies are available from Huck Manufacturing Co., Detroit 7, Michigan; Martin Aircraft Tool JC. Co., 10630 South Santa Fe Avenue, South Gate, California or equivalent.

E. Blind hi-shear bolts are installed by the use of simple hand tools as shown by blind bolt FIX KIT, FK-110 or by a hydraulically powered gun which is supplied pressure from an electrically powered hydraulic cart. Cart Model B-1750 is for installing bolts from 5/32 to 1/2 inch in diameter. Information relative to hand tools and power tools is available from Hi-Shear Rivet Tool Co., 2600 West 247th Street, Torrance, California.

F. Jo-bolts are installed using either a Model 742 pneumatic right angle offset, a Model 302 pneumatic pistol, or a HW200 or HW300 ratchet hand tool. These driving tools, as well as various nose adapters and wrench adapters for installing the different size Jo-bolts, are available from Lok-Fast Inc., 2313 West Olive, Burbank, California.

G. Special tools such as drill out bushings, hollow-mill collar cutters and punch-out tools for removing hi-shear rivets are available from Hi-Shear Rivet Tool Company, Martin Aircraft Tool Company, or equivalent source.

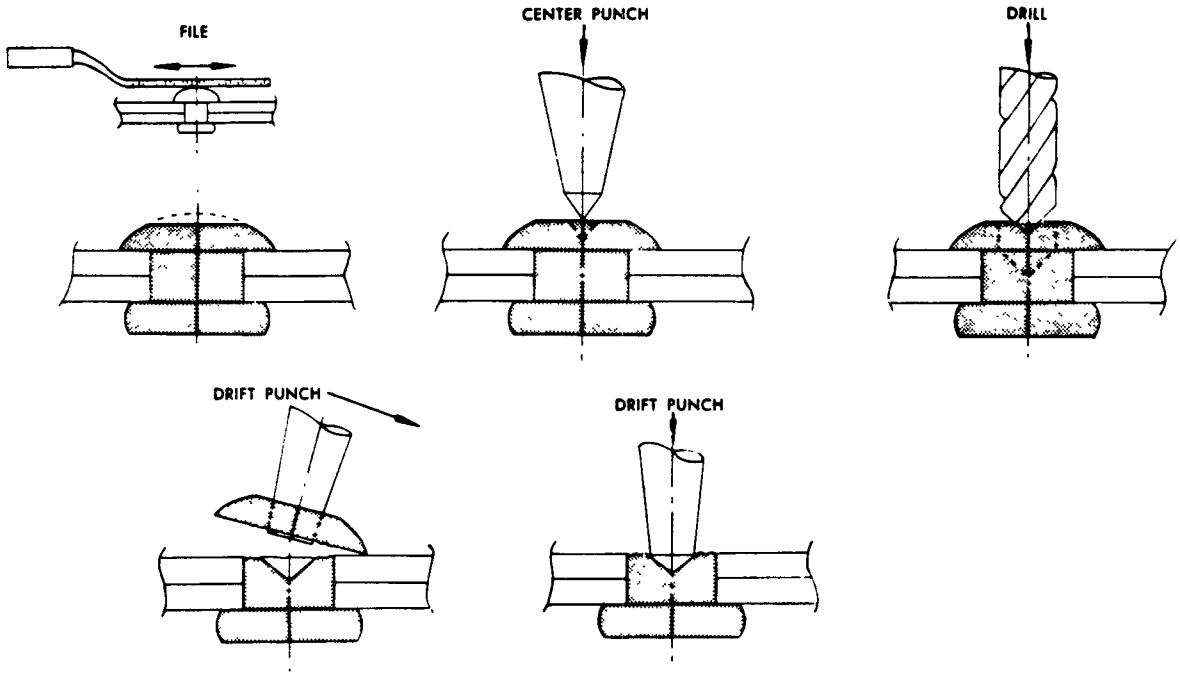
H. When nesting coin dimples in countersunk instructure the depth of the countersink must be accurately controlled to insure that dimples nest tightly within the limits specified in 51-2-7. A stop countersink tool available from Zephyr Manufacturing Co., Inc., Inglewood, California; Martin Aircraft Tool Company, or equivalent source is recommended for this purpose.



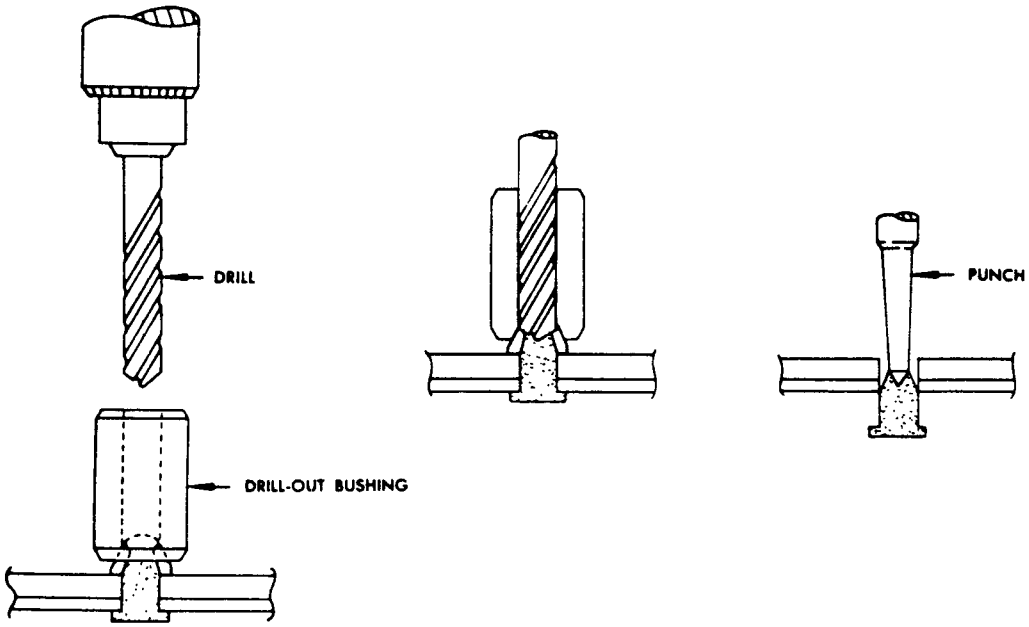
GRIP RANGES FOR UNIVERSAL AND COUNTERSUNK HEAD RIVETS

RIVET LENGTH L		5/32 DIA. GRIP T		3/16 DIA. GRIP T		1/4 DIA. GRIP T		5/16 DIA. GRIP T	
FRACTION	DASH NO.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
1/4	- 4	.031	.093						
5/16	- 5	.094	.156	.062	.124				
3/8	- 6	.157	.218	.125	.187				
7/16	- 7	.219	.250	.188	.218	.109	.172	.078	.140
1/2	- 8	.251	.312	.219	.281	.173	.234	.141	.203
9/16	- 9	.313	.375	.282	.343	.235	.296	.204	.265
5/8	-10	.376	.437	.344	.406	.297	.359	.266	.328
11/16	-11	.438	.468	.407	.468	.360	.421	.329	.390
3/4	-12	.469	.531	.469	.500	.422	.484	.391	.453

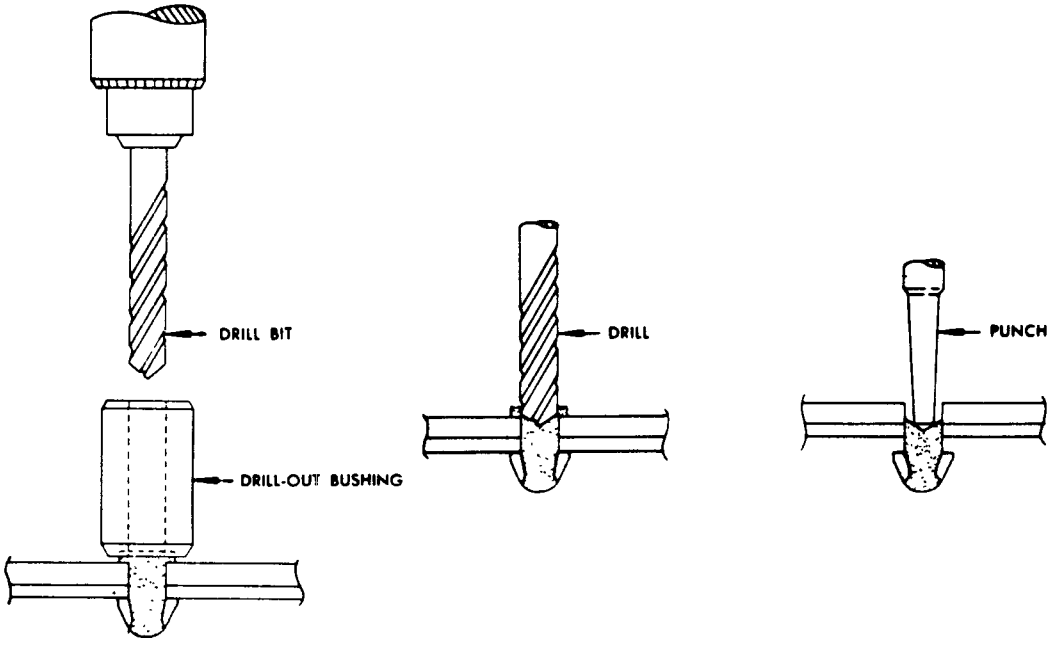
Grip Range for Fluid Tight Rivets
Figure 3



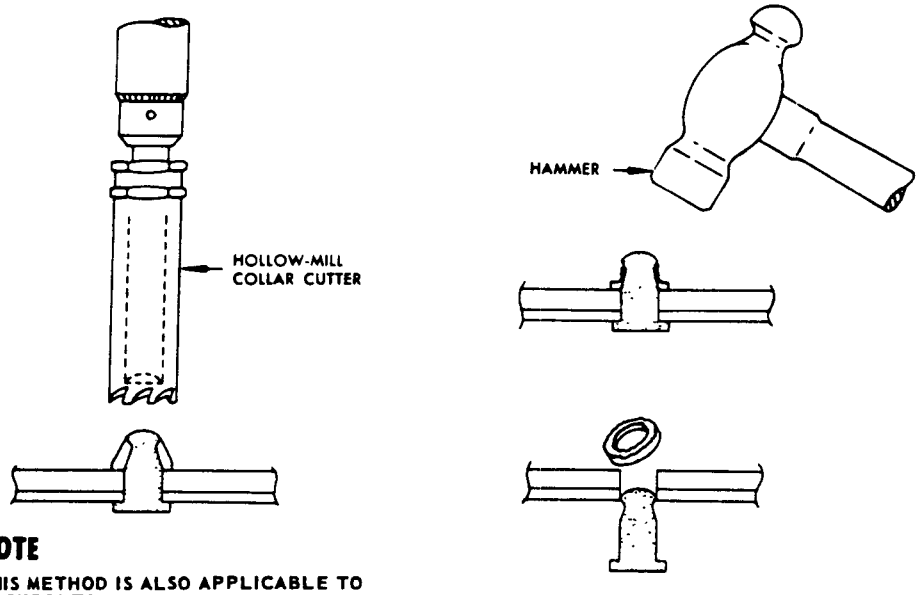
Solid Shank Rivet Removal
Figure 4.



DRILL-OUT BUSHING METHOD



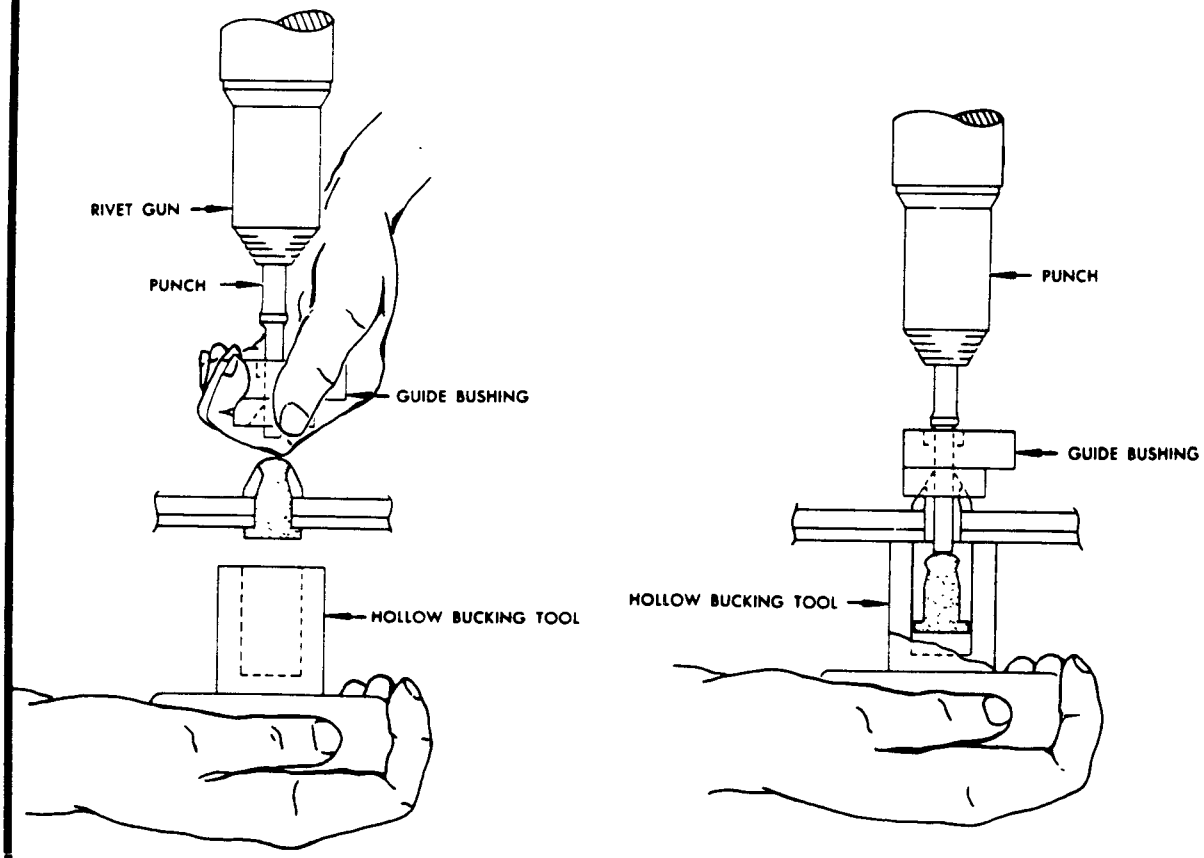
Hi-shear Rivet Removal
Figure 5 (Sheet 1 of 3)



NOTE

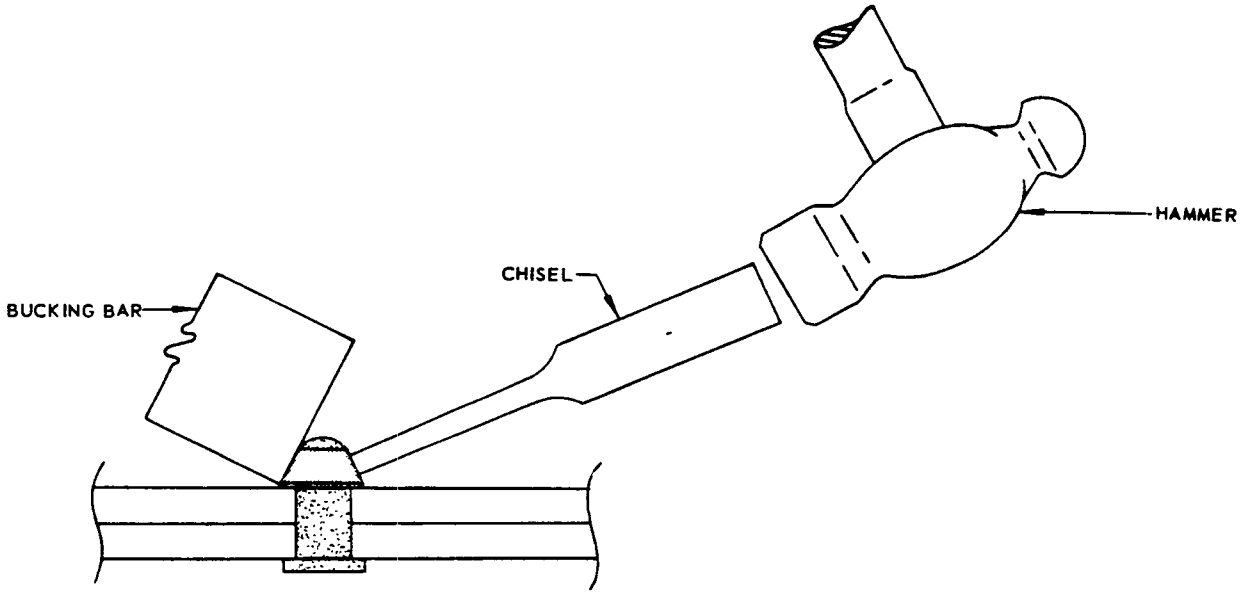
THIS METHOD IS ALSO APPLICABLE TO LOCKBOLTS.

HOLLOW-MILL COLLAR CUTTER METHOD

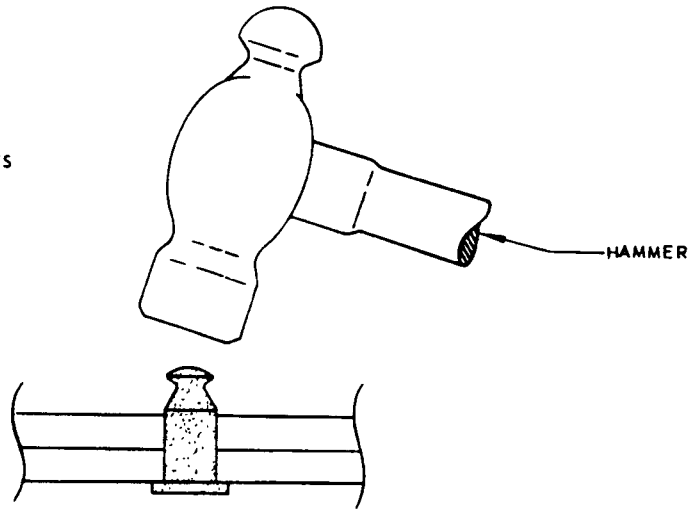


PUNCH-OUT METHOD

Hi-shear Rivet Removal
Figure 5 (Sheet 2 of 3)



NOTE
THIS METHOD IS ALSO APPLICABLE TO LOCKBOLTS

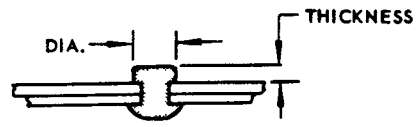


CHISEL METHOD

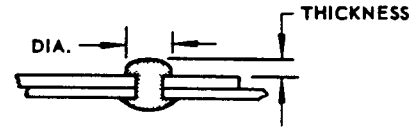
TABLE I

STANDARD DRIVEN HEAD DIMENSIONS FOR "D" RIVETS

Rivet Diameter	Minimum Head Diameter	Head Thickness	
		Min.	Max.
1/16	.081	.025	.040
3/32	.122	.038	.050
1/8	.163	.050	.070
5/32	.203	.062	.092
3/16	.244	.075	.105
7/32 A	.285	.087	.110
1/4	.325	.100	.130
9/32 A	.365	.113	.140
5/16	.406	.125	.158
11/32 A	.450	.137	.170
3/8	.488	.150	.190
13/32 A	.530	.165	.200



STANDARD FLAT DRIVEN HEAD



UNIVERSAL DRIVEN HEAD

A Oversize Replacements

TABLE II

GRIP RANGES FOR "D" RIVET LENGTHS AND DIAMETERS

RIVET LENGTH L		1/8 DIA. GRIP T		5/32 DIA. GRIP T		3/16 DIA. GRIP T		1/4 DIA. GRIP T		5/16 DIA. GRIP T		3/8 DIA. GRIP T	
FRACTION	DASH NO.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
5/32	2.5	.015	.057										
3/16	-3	.058	.094	.020	.071								
1/4	-4	.095	.130	.072	.124	.064	.120						
5/16	-5	.131	.178	.125	.187	.121	.175	.091	.103				
3/8	-6	.179	.230	.188	.249	.176	.219	.104	.175				
7/16	-7	.231	.295	.250	.314	.220	.276	.176	.216				
1/2	-8	.296	.350	.315	.375	.277	.335	.217	.265	.242	.298		
9/16	-9	.351	.410	.376	.428	.336	.394	.266	.339	.299	.355		
5/8	-10	.411	.468	.429	.481	.395	.453	.340	.385	.356	.410	.188	.250
11/16	-11	.469	.525	.482	.530	.454	.513	.386	.445	.411	.467	.251	.313
3/4	-12	.526	.597	.531	.587	.514	.569	.446	.491	.468	.524	.314	.375
13/16	-13	.598	.648	.588	.638	.570	.625	.492	.548	.525	.581	.376	.437
7/8	-14	.649	.715	.639	.702	.626	.680	.549	.602	.582	.630	.438	.500
15/16	-15	.716	.772	.703	.758	.681	.736	.603	.675	.631	.687	.501	.563
1	-16	.773	.840	.759	.810	.737	.791	.676	.728	.688	.744	.564	.625

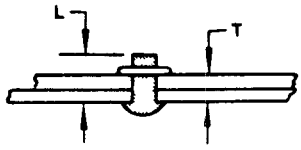
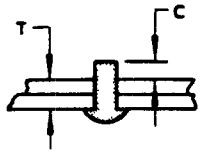


TABLE III

AVERAGE NOMINAL PROJECTION BEFORE DRIVING FOR "D" RIVETS UP TO 1/2 INCH LONG

RIVET DIA.	C
1/16	.093
3/32	.120
1/8	.156
5/32	.156
3/16	.180
1/4	.250
5/16	.256
3/8	.406



Dimensions for Driving of "D" Rivets
Figure 6

4. "D" Rivet Installation

A. Identification.

(1) Most conventional rivets used in the Boeing 707 airplanes are of 2017-T3 aluminum alloy material, indicated by a letter "D" in the rivet designation: ordinary protruding head rivet AN470D, ordinary flush head rivet AN426D (MS20426D), and shear head rivet BAC-R15CE-D.

(2) The "D" rivets are harder and stronger than the 2117-T3 "AD" rivets. "D" rivets are identified by a raised dot in the center of the manufactured head; "AD" rivets are identified by a dimple in the manufactured head.

B. Tools.

(1) "D" rivets can be installed with the same tools used for "AD" rivet installation. Due to the hardness of the "D" rivets, only very smooth bucking bars should be used.

(2) Rivet guns and bucking bars should be large enough to drive rivets in a reasonable length of time. Three to four seconds duration is desirable; seven seconds should be maximum.

C. Installation.

(1) "D" rivets are stored and driven at room temperature. Dimensional limits of the driven head must be more rigidly controlled for "D" rivets than for the softer "AD" rivets.

NOTE: Drive "D" rivets to a head diameter of 1.3 times the shank diameter, not to 1.5 diameter. Overdriving causes diagonal cracks.

(2) Figure 6, table I lists the standard driven head dimensions for "D" rivets. If too long a rivet has been selected, it is more desirable to leave the head thickness over the maximum in table I than to increase the driven diameter.

(3) Proper rivet length before driving can be selected from figure 6: table II gives rivet length based on riveted material thickness; table III gives the dimension for the required shank projection.

D. Cracked Driven Heads.

(1) Cracks in driven heads are undesirable from a quality standpoint and must be kept to a minimum.

(2) Cracks on the sides of driven heads which run at a 45° angle to the flat surface of the head are caused by upsetting the rivet material beyond the limit of its ductility. Diagonal cracks shall be evaluated as follows:

(a) Hairline or superficial cracks are negligible in all cases regardless of their numbers. Intersecting superficial cracks are also acceptable.

(b) Rivets having diagonal cracks which do not intersect are acceptable. The maximum number shall be three.

(c) Rivets with severe cracks are not acceptable and should be replaced.

(3) There are two types of vertical cracks: one caused by a lap in rivet wire, and the other caused by overheat treating of the rivets. It is very important to distinguish between these two types.

(a) Cracks due to lap in rivet wire appear infrequently. The surface exposed by the cracks will be smooth and dull in appearance and will be only a few thousandths deep (0.005 to 0.015). These cracks are acceptable.

(b) When cracks from overheating appear, they are usually found in a large percentage of the rivets being driven. This cracking is due to excessive temperatures being reached during the heat treatment of the rivet.

These cracks are not acceptable, and rivets having these vertical cracks on either head shall be rejected. The batch which was overheated should be segregated and scrapped because the ductility cannot be restored by reheat treatment.

5. Tapered Shank Bolts

A. General

(1) Steel tapered shank fasteners are used in this airplane for their good fatigue properties. Where a new part or repair part is being installed with tapered shank fasteners in existing holes, it will be necessary to use an oversize fastener to ensure correct hole alignment. There are three oversizes provided for each basic size of fastener. Great care must be taken to drill and ream new parts concentrically with the existing holes to remain within the hole limits for the oversize fasteners.

B. Installation

(1) Tapered shank fasteners can be installed with hand tools, in the specially reamed holes described in 51-2-3, as follows:

(a) Push the fastener into the hole by finger pressure (approximately 10 pounds).

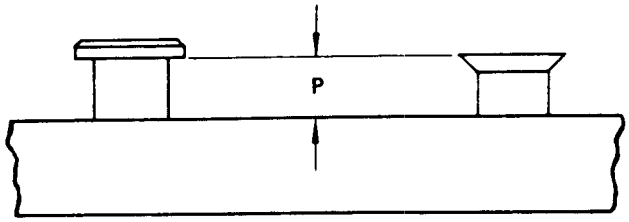
(b) Check the head protrusion with a gage to ensure that it is within the limits shown in Fig. 7.

(c) Tighten the nut with a torque wrench to the loads shown in 51-2-4. It is permissible to drive the fasteners into the tapered holes before tightening the nuts, but as extreme care has to be taken to avoid separation of the plates, it is not recommended for repair purposes.

(2) Examine installed fasteners for head dishing. Smooth uniform dishing is acceptable but bolts showing head dishing with a distinct ring are to be rejected (Fig. 8).

C. Removal

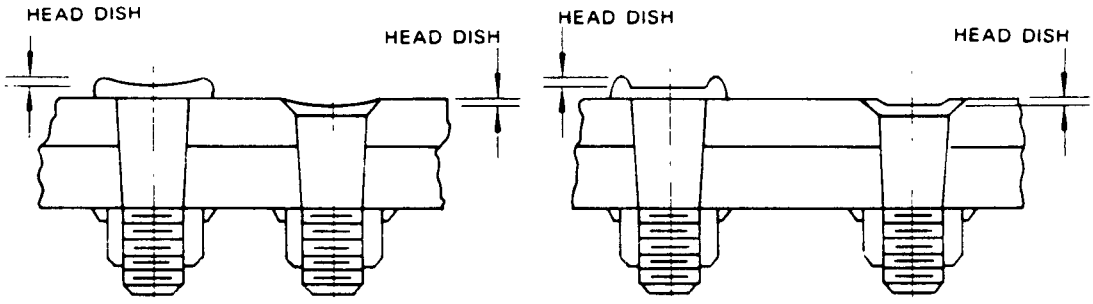
(1) Fastener removal is achieved by removing the nut and driving out the fastener. Due to the interference taper fit of the bolt, this may require some sharp blows initially, therefore the structure must be supported by a bucking bar recessed to accept the bolt during removal. Undamaged bolts may be used again, but must be relubricated with a cetyl acid before use.



DIMENSION P MUST BE CHECKED WITH CLEAN HOLES E.G. NO SEALANT OR PRIMER, AFTER INSERTION BY FINGER PRESSURE (APPROX 10 LBS)

FASTENER DIAMETER	DIMENSION P	
	MIN	MAX
3/16	0.072	0.173
1/4	0.086	0.232
5/16	0.101	0.260
3/8	0.115	0.289
7/16	0.130	0.288

Head Protrusion before Driving for Taper Shank Bolts
Figure 7



Head Dishing Limits for Installed Taper Shank Bolts
Figure 8

FASTENER SUBSTITUTION

1. General

A. Fasteners specified by repairs contained in this manual or by drawings, have been selected with consideration for strength, corrosion, weight, temperature, fatigue properties, and method of installation.

B. When adapting the typical repairs shown in this manual to suit actual conditions, it may be found necessary to use fasteners of a different type to those originally specified. This may be due to nonavailability of a particular fastener, restricted access, or other difficulties not envisaged in the original repair.

C. For the purposes of the substitution tables in this subject "equivalent fastener" means a fastener which is directly interchangeable with the original fastener. Usually equivalent fasteners are supplied under a vendor part number and may not meet all of the more stringent requirements for fasteners supplied to the Boeing standard.

D. "Alternative fasteners" are those with similar or superior properties to the original fastener, which can be used for substitution provided that consideration is given to pressure or fuel sealing, designated non-magnetic areas of the airplane, thread and grip lengths, hole sizes (Ref 51-2-5), accessibility and installation tools.

NOTE: The tables must not be used for finding substitutes for fasteners listed in the "alternative fastener" column.

E. Substitution may be made between different fastener groupings, provided fasteners with equivalent or greater strength are used. Tension type fasteners are designed for use in tension and shear applications, but it is not acceptable to use shear fasteners in tension.

NOTE: Fasteners that have been substituted between the fastener groupings, may not have adequate corrosion protection, or proper temperature range. These fasteners must be replaced by original specified fasteners, equivalent fasteners or by alternative fasteners within the specified group, when they become available.

F. Substitution factors for MS20470D/BACR15BB-D and MS20426D/BACR15BA-D rivets are given in Fig. 2 and 3. The quantity of substitute rivets required is calculated by multiplying the original fastener requirement by the factor shown in the appropriate table. Where factors are given for substitute rivets of a larger size, they may be used as an alternative provided that adequate edge margins are available. For minimum edge margins refer to 51-2-6. When using the tables shown in Fig. 2 and 3, the factor opposite the

thinnest gage to be riveted is to be used for protruding head fasteners. For flush rivet substitutions use the gage of the material to be countersunk or use the substitution figures for the minimum gage in Fig. 2 if more critical.

NOTE: The substitution tables shown in Fig. 2 and 3, apply only to the following:

Skin and structure in unpressurized areas of the fuselage, leading edge slats and flaps, control surfaces, nacelles, pylons and all secondary structure shown in 51-0, Fig. 4 except the wing leading edge skin.

G. When using substitute fasteners the spacing shown on the applicable repair figure must be maintained.

H. Do not use a substitute flush head fastener which requires enlargement of a countersink beyond that specified for the original fastener.

I. Straight shank bolts must not be substituted for taper shank bolts.

J. When substituting a bolt with a bolt, the same locking feature of the original fastener must be retained, i.e. drilled head, drilled shank, or self-locking nut. When substituting a hex-drive bolt or a lockbolt with a bolt, the bolt must be installed with an appropriate self-locking nut.

2. Taper Shank and 70-Degree Radiused Lead-In Fastener Replacement

A. Oversize taper shank fasteners BACB30KD-X, BACB30KD-Y or BACB30KD-Z may be used to replace 70-degree head radiused lead-in bolts BACB30PT in structural repairs. However, the oversize 70-degree lead radiused lead-in bolts may not be used to replace taper shank bolts, because the difference in head diameter may result in an unacceptable edge margin condition if further rework is attempted.

NOTES

- REFER TO SHEET 2 FOR INDEX-FASTENER SUBSTITUTION
- REFER TO 51-2-2 FOR REMOVAL AND INSTALLATION OF FASTENERS

[A] NOT ALLOWED IN FLUID TIGHT APPLICATIONS

[B] THE COUNTERSINK DEPTH FOR BACR15CE RIVETS MUST BE MAINTAINED AND THE EXCESS PORTION OF THE HEADS OF SUBSTITUTE RIVETS SHAVED OFF AFTER INSTALLATION

[C] THE NOMINAL DIAMETER OF NAS1738 AND NAS1739 BLIND RIVETS IS APPROX 1/64 INCH GREATER THAN THE NOMINAL DIAMETER OF NAS1398 AND NAS1399 BLIND RIVETS. REFER TO 51-2-5

[D] NAS1398 AND NAS1399 BLIND RIVETS ARE SUPPLIED WITH DIFFERENT SPINDLE CONFIGURATIONS, FULL SERRATIONS, AND PARTIAL SERRATIONS. RIVETS HAVING DIFFERENT SPINDLE CONFIGURATIONS CANNOT BE INSTALLED WITH THE SAME PULLING HEAD OF THE TOOL.
NAS1398-()-() AND
NAS1399-()-() = PARTIAL SERRATIONS
NAS1398-()A() AND
NAS1399-()A() = FULL SERRATIONS

[E] FOR NUTPLATE ATTACHMENT ONLY

[F] SUBSTITUTE ONLY WHEN BLIND SIDE SHEET THICKNESS IS LESS THAN 1/4 HOLE DIAMETER. TOOL ACCESSIBILITY MUST BE ADEQUATE

[G] MUST NOT BE SUBSTITUTED IN MAGNESIUM STRUCTURE

[H] REFER TO 51-8-0 FOR REQUIRED PROTECTIVE TREATMENT FOR FASTENER INSTALLATION

[J] THESE BOLTS REQUIRE A LARGER FILLET RELIEF UNDER THE BOLT HEAD REFER TO 51-2-5

[K] DO NOT SUBSTITUTE CADMIUM PLATED FASTENERS FOR BARE OR ALUMINUM COATED FASTENERS WHEN INSTALLED THRU TITANIUM STRUCTURE.

[L] DO NOT SUBSTITUTE IN SOFT MATERIALS SUCH AS PLASTIC, FIBERGLASS, ETC.

[M] USE ONLY IF THERE IS NO HEAD HEIGHT RESTRICTION

INDEX - FASTENER SUBSTITUTION	SHEET NO.
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rivet - Blind - Protruding Head	7
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Bolt - Recess Drive - Flush Head	30
Bolt - Recess Drive - Protruding Head	33
Bolt - Taper Shank - Protruding Head	35
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FASTENER SUBSTITUTION
Figure 1 (Sheet 2)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
XC	BACR15BB-AD	2117-T31 AL, ANODIZED, CLOSE TOLERANCE SHANK		MS20470AD BACR15BB-DD MS20470DD BACR15BB-D MS20470D } [A]	
XD	BACR15BB-DD	2024-T4 AL, ANODIZED, CLOSE TOLERANCE SHANK		MS20470DD	
XZH	BACR15BB-A	1100F AL, ANODIZED, CLOSE TOLERANCE SHANK		MS20470A MS20470B BACR15BB-B MS2047UAD BACR15BB-AD } [L]	
XZJ	BACR15BB-B	5056-H32 AL, ANODIZED, CLOSE TOLERANCE SHANK		MS20470B BACR15BB-AD MS20470D BACR15BB-D MS20470AD } [G]	
XZK	BACR15BB-D	2017-T4 AL, ANODIZED, CLOSE TOLERANCE SHANK		MS20470D BACR15BB-DD MS20470DD	
XPM	BACR15DX-M	MONEL, CLOSE TOLERANCE SHANK		MS20615-M	
BM	MS20470D	2017 AL		MS20470DD BACR15BB-DD	
				ALSO SEE FIG. 2	
XJ XK XN XO	BACR15AY()-()	ALLOY STEEL HI SHEAR FLAT HEAD INTERFERENCE F17 160 KSI		NAS529()-()	

RIVET-SOLID SHANK-PROTRUDING HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 3)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
XYN	BACR15ET()AD()	2117-T3 AL UNIVERSAL HEAD CLOSE TOLERANCE 0.031 OVERSIZE SHANK		NAS1242AD()-()	
XYL	BACR15ET()B()	5056-H32 AL UNIVERSAL HEAD CLOSE TOLERANCE 0.031 OVERSIZE SHANK		NAS1242B()-()	
XYM	BACR15ET()D()	2017-T3 AL UNIVERSAL HEAD CLOSE TOLERANCE 0.031 OVERSIZE SHANK		NAS1242D()-()	
XYO	BACR15ET()DD()	2024-T31 AL UNIVERSAL HEAD CLOSE TOLERANCE 0.031 OVERSIZE SHANK		NAS1242DD()-()	

RIVET-SOLID SHANK-PROTRUDING HEAD

Fastener Substitution
Figure 1 (Sheet 4)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
XA	BACR15BA-AD	2117-T4 AL, ANODIZED, 100° HEAD CLOSE TOLERANCE SHANK		MS20426D BACR15BA-D [A] MS20426DD BACR15BA-DD MS20426AD	
XZF	BACR15BA-B	5056F AL, ANODIZED, 100° HEAD, CLOSE TOLERANCE SHANK		MS20426B BACR15BA-AD MS20426D BACR15BA-D [G] MS20426AD	
XZE	BACR15BA-A	1100F AL, ANODIZED, 100° HEAD, CLOSE TOLERANCE SHANK		MS20426A BACR15BA-B MS20426AD BACR15BA-AD [L] MS20426B	
XZG	BACR15BA-D	2017-T4 AL, ANODIZED, 100° HEAD, CLOSE TOLERANCE SHANK		MS20426D BACR15BA-DD MS20426DD	
XB	BACR15BA-DD	2024-T4 AL, ANODIZED, 100° HEAD, CLOSE TOLERANCE SHANK		MS20426DD	
XE	BACR15CE-B	5056-H32 AL, ANODIZED, 100° SHEAR HEAD		NAS1097B MS20426B BACR15BA-B [G] MS20426AD [B] BACR15BA-AD	
XF	BACR15CE-D	2017-T4 AL, ANODIZED, 100° SHEAR HEAD		NAS1097D MS20426D BACR15BA-D [B] MS20426DD BACR15BA-DD	
XGL	BACR15CE-M	MONEL, 100° SHEAR HEAD		NAS1200M MS20427M [B]	
BE	MS20426D	2017-T4 AL, 100° HEAD		MS20426DD BACR15BA-DD	
				ALSO SEE FIG. 3	

RIVET-SOLID SHANK-FLUSH HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 5)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
XL XM XP	BACR15AZ()-()	ALLOY STEEL HI SHEAR 100° HEAD INTERFERENCE FIT 160 KSI		NAS525()-()	
	BACR15AD()AD()	2117-T3, AL 100° HEAD 0.031 OVERSIZE SHANK		NAS1241AD()-()	
XAC	BACR15AD()B()	5056-H32, AL 100° HEAD 0.031 OVERSIZE SHANK		NAS1241B()-()	
XBL YBT XAD	BACR15AD()D()	2017-T3, AL 100° HEAD 0.031 OVERSIZE SHANK		NAS1241D()-()	
	BACR15AD()DD()	2024-T31 100° HEAD 0.031 OVERSIZE SHANK		NAS1241DD()-()	
	BACR15DX()-()	A286 CRES UNI- VERSAL HEAD CLOSE TOLERANCE SHANK		NAS1198()-()	
XOR	BACR15DY()-()	A286 CRES 100° SHEAR HEAD CLOSE TOLERANCE SHANK		NAS1200()-()	
XPN	BACR15DY()M()	MONEL 100° SHEAR HEAD CLOSE TOLERANCE SHANK		NAS1200M()-()	

RIVET-SOLID SHANK-FLUSH HEAD

Fastener Substitution
Figure 1 (Sheet 6)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
XPU	BACR15EB-P	BULBED CHERRYLOCK, SELF-PLUGGING, 5056 AL SLEEVE. MAX TEMP 250°F		NAS1738E NAS1738MW NAS1738B	
XPJ	BACR15DR-P	NON-STRUCTURAL (PULL THRU TYPE), C1018 STEEL SLEEVE, CAD PLATED. MAX TEMP 450°F	CHERRY CCR27455 OLYMPIC RV570A	BACR15BB-B MS20470B MS20604MP } [E]	
RK	NAS1398B()-() [D] NAS1398B()A() [D]	5056 AL SLEEVE, SPINDLE. MAX TEMP 250°F	CHERRY CR2263()-() OLYMPIC RV1250()-() VOI-SHAN CR9263()A()	NAS1398D()-() NAS1398D()A() } [G] NAS1398MW()-() NAS1398MW()A() NAS1738B NAS1738E } [C] [F] NAS1738MW NAS1398CW()-() NAS1398CW()A()	
RL	NAS1398D()-() [D] NAS1398D()A() [D]	201, AL SLEEVE, LOCKED SPINDLE. MAX TEMP 250°F	CHERRY CR2163()-() VOI-SHAN CR2163()-() OLYMPIC RV1200()-() VOI-SHAN CR9163()A()	NAS1398MW()-() NAS1398MW()A() NAS1398CW()-() NAS1398CW()A() NAS1738B NAS1738E } [C] [F] NAS1738MW	
RM	NAS1398M()-() [D] NAS1398M()A() [D]	MONEL SLEEVE, LOCKED SPINDLE. MAX TEMP 900°F	CHERRY CR2563M()-() OLYMPIC RV1290M()-()	NAS1398MS()-() NAS1398MS()A() NAS1738M [C] [F]	
TK	NAS1398MW()-() [D] NAS1398MW()A() [D]	MONEL SLEEVE, CAD PLATED. LOCKED SPINDLE. MAX TEMP 450°F	CHERRY CR2563()-() VOI-SHAN CR2563()-() OLYMPIC RV1210()-()	NAS1738MW [C] [F]	

RIVET-BLIND-PROTRUDING HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 7)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
RN	NAS1398C()-() [D] NAS1398C()A() [D]	A-286 CRES SLEEVE, LOCKED SPINDLE	CHERRY CR2663W()-() VOI-SHAN CR2663W()-() OLYMPIC RV1240-()-()	NAS1398CS()-() NAS1398CS()A()	
XGA	BACR15DA()-()	5056-F AL BLIND SELF PLUGGING		NAS1399B()-() NAS1739B()-() NAS1739E()-()	
XGB	BACR15DA()H()	5056-F AL BLIND-PULL THRU		MS20604B()T() MS20604B()W()	

RIVET-BLIND-PROTRUDING HEAD

Fastener Substitution
Figure 1 (Sheet 8)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
XPT	BACR15EB	BULBED CHERRYLOCK, SELF-PLUGGING, 5056 AL SLEEVE. MAX TEMP 250°F		NAS1739E NAS1739MW NAS1739B	
XPH	BACR15DR	NON-STRUCTURAL (PULL THRU TYPE), C1018 STEEL SLEEVE, CAD PLATED. MAX TEMP 450°F	CHERRY CCR264SS OLYMPIC RV571A	BACR15BA-B MS20426B MS20605MP } [E]	
RO	NAS1399B()-() [D] NAS1399B()A() [D]	5056 AL SLEEVE, SPINDLE. MAX TEMP 250°F	CHERRY CR2262()-() OLYMPIC RV1251()-() VOI-SHAN CR9262()A()	NAS1399D()-() NAS1399D()A() } [G] NAS1399MW()-() NAS1399MW()A() NAS1399CW()-() NAS1399CW()A() NAS1739B NAS1739E NAS1739MW } [C] [F]	
RP	NAS1399D()-() [D] NAS1399D()A() [D]	2017 AL SLEEVE, LOCKED SPINDLE. MAX TEMP 250°F	CHERRY CR2162()-() OLYMPIC RV1201()-() VOI-SHAN CR9162()A()	NAS1399MW()-() NAS1399MW()A() NAS1399CW()-() NAS1399CW()A() NAS1739B NAS1739E NAS1739MW } [C] [F]	
RR	NAS1399M()-() [D] NAS1399M()A() [D]	MONEL SLEEVE, LOCKED SPINDLE. MAX TEMP 900°F	CHERRY CR2562M()-() OLYMPIC RV1291M()-()	NAS1399MS()-() NAS1399MS()A() NAS1739M [C] [F]	
TK	NAS1399MW()-() [D]	MONEL SLEEVE, CAD PLATED. LOCKED SPINDLE. MAX TEMP 450°F	CHERRY CR2562()-() OLYMPIC RV1291()-()	NAS1739MW [C] [F]	
TO	NAS1399MW()A() [D]				

RIVET-BLIND-FLUSH HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 9)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
RS	NAS1399C()-() [D] NAS1399C()A() [D]	A-286 CRES SLEEVE, LOCKED SPINDLE	CHERRY CR2662()-() OLYMPIC RV1241-()-()	NAS1399CS()-() NAS1399CS()A()	
TR	NAS1399CW()-() [D] NAS1399CW()A() [D]	A-286 CRES SLEEVE, CAD PLATED. LOCKED SPINDLE.	CHERRY CR2662W()-() OLYMPIC RV1241W()-()		
	BACR15DA()C()	5056-F BLIND 100° HEAD SELF PLUGGING		NAS1399B()-() NAS1739B()-() NAS1739E()-()	
	BACR15DA()CH()	5056-F BLIND 100° HEAD PULL THRU		MS20605B()T() MS20605B()W()	

RIVET-BLIND-FLUSH HEAD

Fastener Substitution
Figure 1 (Sheet 10)

REPAIR FASTENER				
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]
CODE	PART NUMBER	DESCRIPTION		
XCZ YEF	BACB30FM()-()	ALLOY STEEL, CAD PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 250°F	HI-SHEAR HL18 SPS HL18 VOI-SHAN HL18	BACB30FM()-() BACB30FM()K() BACB30FM()A() BACB30FM()AK() BACB30MB()-() BACB30MB()A() BACB30GW()-() BACB30GW()A() BACB30DX()-() BACB30DX()A() BACB30HC()-() BACB30HC()A() BACB30NX()K() BACB30MY()K() BACB30NE()-() BACB30LM()-() BACB30NM()K() BACB30NR()K() BACB30LJ()-() BACB30NF()-() BACB30FD [J] BACB30FD-P [J] BACB30MY()C() BACB30NH-S [J] BACB30NL()S() BACB30NM()C() BACB30NR()C() BACB30NX()C()
	BACB30FM()K()	ALLOY STEEL, AL COATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 250°F		
XEK XNJ	BACB30FM()A()	A286 CRES, CAD PLATED 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 250°F	HI-SHEAR HL440 SPS HL440	
	BACB30FM()AK()	A286 CRES, AL COATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 250°F		
XTC XTJ YAX	BACB30MY()C()	6AL-4V TITANIUM, CAD PLATED 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 250°F	HI-SHEAR HL510 SPS HL510 VOI-SHAN HL510 DUMONT BACMY()C	
YHZ YHY YJJ YLC YLD	BACB30MY()K()	6AL-4V TITANIUM, AL COATED 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 250°F	HI-SHEAR HL10V SPS HL10V VOI-SHAN HL10V LITTON B30MY()C AIC L-800()K()	

BOLT - HEX DRIVE, PROTRUDING HEAD (SHEAR) (CONT)

Fastener Substitution
Figure 1 (Sheet 11)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
XNK XYC	BACB30FM()A()U	A286 CRES, PASSIVATE, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 800°F	HI-SHEAR HL40 SPS HL40 VOI-SHAN HL40	BACB30FM()A()U BACB30FM()A()SU BACB30MB()A()U BACB30GW()A()U BACB30DX()A()U BACB30HC()A()U BACB30LM()SU() BACB30LJ()SU() BACB30NL()SU() BACB30NH()SU() [J] BACB30LE-U [J]	
	BACB30FM()A()SU	A286 CRES, PASSIVATE, 96 KSI SHEAR, DRY FILM LUBRICATED			

BOLT-HEX-DRIVE,-PROTRUDING HEAD (SHEAR)

Fastener Substitution
Figure 1 (Sheet 12)

REPAIR FASTENER				
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]
CODE	PART NUMBER	DESCRIPTION		
XMX XTG	BACB30MB()-()	ALLOY STEEL, CAD PLATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	HI-SHEAR HL20 SPS HL20 VOI-SHAN HL20	BACB30FD BACB30FD-P BACB30LE BACB30LE-K BACB30NH-S } [J] BACB30MB()-() BACB30MB()A() BACB30MB()AK() BACB30MB()K()
XPB XRU	BACB30MB()A()	A286 CRES, CAD PLATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	HI-SHEAR HL448 SPS HL448 VOI-SHAN HL448	
YJQ YHW	BACB30MB()AK()	A286 CRES, AL COATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F		
YHX	BACB30MB()K()	ALLOY STEEL, AL COATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	HI-SHEAR HL20 SPS HL20 VOI-SHAN HL20	
YPC YBC YJR YKA	BACB30MB()A()U	A286 CRES, PASSIVATE, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR. MAX TEMP 900°F	HI-SHEAR HL48 SPS HL48 VOI-SHAN HL48	BACB30LE-U BACB30NH-S-U } [J]
XUN XZB YAW	BACB30NX()C()	6AL-4V TITANIUM, CAD PLATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	HI-SHEAR HL512 SPS HL512 VOI-SHAN HL512 DUMONT B30NX()C	BACB30NX()C() BACB30NX()K() BACB30MB()-() BACB30MB()A() BACB30MB()AK() BACB30MB()K()
YJC YJH YLK YMA YLG YLH	BACB30NX()K()	6AL-4V TITANIUM, AL COATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR. MAX TEMP 450°F	HI-SHEAR HL12V SPS HL12V VOI-SHAN HL12V LITTON B30NX()K AIC L-802()K()	BACB30FD BACB30FD-P BACB30LE BACB30LE-K BACB30NH-S } [J]

BOLT-HEX DRIVE-PROTRUDING HEAD (TENSION)

Fastener Substitution
Figure 1 (Sheet 13)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
XDA YEG	BACB30FN()-()	ALLOY STEEL, CAD PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 250°F	HI-SHEAR HL19PB- SPS HL19PB- VOI-SHAN HL19PB-	BACB30FN-()-() BACB30FN()A() BACB30FN()K() BACB30FN()AK() BACB30NW()C() BACB30NW()K() BACB30EL()-() BACB30LL()-() BACB30RF()P() BACB30NU()C() BACB30NU()K() BACB30GY()-() BACB30GY()A() BACB30FN()A()N	
XNL	BACB30FN()A()	A286 CRES, CAD PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 250°F	HI-SHEAR HL441UC- SPS HL441UC- VOI-SHAN HL441UC-		
	BACB30FN()K()	ALLOY STEEL, AL COATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED MAX TEMP 250°F	HI-SHEAR HL19WZ- SPS HL19WZ- VOI-SHAN HL19WZ-		
	BACB30FN()AK()	A286 CRES, AL COATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 250°F	HI-SHEAR HL41AZ- SPS HL41AZ- VOI-SHAN HL41AZ-		
XTO YAY	BACB30NW()C()	6AL-4V TITANIUM, CAD PLATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 250°F	HI-SHEAR HL-511 SPS HL-511 VOI-SHAN HL-511 DUMONT B30NW()C		
YJB YJA YJK YLE YLF	BACB30NW()K()	6AL-4V TITANIUM, CAD PLATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 250°F	HI-SHEAR HL11V SPS HL11V VOI-SHAN HL11V LITTON B30NW()K AIC L-803()K()		
XZD	BACB30NZ()C()	6AL-4V TITANIUM, CAD PLATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	HL323	BACB30DY()-() BACB30DY()A() BACB30DY()D()	
YMK	BACB30NZ-K	6AL-4V TITANIUM, CAD PLATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	HI SHEAR HL523 SPS HL523 VOI-SHAN HL523 LITTON B30NZ()K AID L-804()K()	BACB30JC()-() BACB30JC()A() BACB30JC()A()U	

BOLT-HEX DRIVE-FLUSH HEAD (SHEAR)(CONT)

Fastener Substitution
Figure 1 (Sheet 14)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
XNM XYD	BACB30FN()A()U	A286, CRES, PASSIVATED. 95 KSI SHEAR. MAX TEMP 900°F	HI-SHEAR HL441N SPS HL441N VOI-SHAN HL441N	BACB30LL()U() BACB30GY()A()U	

BOLT-HEX DRIVE-FLUSH HEAD(SHEAR)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30JC()A()U	A286, CRES, PASSIVATED. 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 900°F	HI-SHEAR HL49 SPS HL49 VOI-SHAN HL49	BACB30LR()U() BACB30LP()U()	
XNB XRT XTE	BACB30JC()-()	ALLOY STEEL, CAD PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 450°F	HI-SHEAR HL21PB SPS HL21PB VOI-SHAN HL21PB	BACB30JC()-() BACB30JC()A() BACB30NY()C() BACB30NY()K() BACB30EM()L() BACB30LU()-() BACB30LH()-() BACB30LP()-() BACB30LR()-() BACB30MS()C() BACB30MS()K() BACB30NN()C() BACB30NN()K() NAS583 THRU NAS590	
XXZ	BACB30JC()A()	A286 CRES, CAD PLATED, 95 KSI SHEAR, CETYL ALCOHOL LUBRICATED. MAX TEMP 450°F	HI-SHEAR HL449UC SPS HL449UC VOI-SHAN HL449UC		
XUO XZC	BACB30NY()C()	6AL-4V TITANIUM, CAD PLATED, CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	HI-SHEAR HL513 SPS HL513 VOI-SHAN HL513 DUMONT B30NY()C		
XLJ YLR YJD	BACB30NY()K()	6AL-4V TITANIUM, AL COATED CETYL ALCOHOL LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	HI-SHEAR HL13V SPS HL13V VOI-SHAN HL13V LITTON B30NY()R() AIC L-801()K()		

BOLT-HEX DRIVE-FLUSH HEAD (TENSION)

Fastener Substitution
Figure 1 (Sheet 15)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
XFO XFP XFR	BACB30GW()-()	ALLOY STEEL, CAD PLATED, LUBRICATED. 95 KSI SHEAR 450°F MAX TEMP		NAS1446 THRU 1452 NAS7016 THRU 7022 NAS7036 THRU 7042	BACB30GW()-() BACB30GW()A() BACB30GW()D() NAS1446 THRU NAS1452 BACB30FM()-() BACB30FM()K() BACB30FM()A() BACB30FM()AK() BACB30MB()-() BACB30MB()A() BACB30DX()-() BACB30DX()A() BACB30HC()-() BACB30HC()A() BACB30NX()K() BACB30MY()K() BACB30NE()-() BACB30LM()-() BACB30NM()K() BACB30NR()K() BACB30LJ()-() BACB30NF()-() BACB30FD } [J] BACB30FD-P } BACB30MY()C() BACB30NH-S [J] BACB30NL()S() BACB30MY()C() BACB30NM()C() BACB30NR()C()
XLW XNY	BACB30GW()A()	A286 CRES CAD PLATED LUBRICATED 95 KSI SHEAR 450°F MAX TEMP		NAS7016 THRU 7022	
	BACB30GW()D()	ALLOY STEEL CAD PLATED LUBRICATED 95 KSI SHEAR 450°F MAX TEMP			
XNK	BACB30GW()D()N	ALLOY STEEL DIFFUSED NICKEL CAD PLATED 95 KSI SHEAR		NAS1446 THRU 1452 NAS7016 THRU 7022 NAS7036 THRU 7042	BACB30HC()D()N BACB30DX()D()N

LOCKBOLT - PROTRUDING HEAD (SHEAR) (CONT)

Fastener Substitution
Figure 1 (Sheet 16)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
XOC XON	BACB30GW()A()U	A286 CRES PASSIVATED 95 KSI SHEAR 900°F MAX TEMP		NAS7016 THRU 7022 BACB30HC()A()U BACB30DX()A()U BACB30FM()A()U BACB30FM()A()SU BACB30MB()A()U BACB30LM()U() BACB30LU()U() BACB30NL()U() BACB30NH()U() [J]	
	BACB30AR()-()	STEEL-CAD PLATED LOCK SHEAR FLAT HEAD STUMPTYPE HAMMER DRIVEN		NAS1426 THRU 1432 NAS1446 THRU 1452 NAS7016 THRU 7022 NAS7036 THRU 7042	
XAX XWG	BACB30CU()-()	ALLOY STEEL CAD PLATED 0.0156 OVERSIZE PULL TYPE GUN DRIVEN		NAS1446 THRU 1452	

LOCKBOLT-PROTRUDING HEAD (SHEAR)

Fastener Substitution
Figure 1 (Sheet 17)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
XEP XER XES	BACB30DX()-()	ALLOY STEEL CAD PLATED LUBRICATED 95 KSI SHEAR MIN TEMP 450°F	2LPY-T()-()	NAS1465 THRU 1472 NAS6965 THRU 6972	BACB30DX()-() BACB30DX()A() BACB30MB()-() BACB30MB()A() BACB30MB()AK() BACB30MB()K() BACB30HC()D()N BACB30HC()-() BACB30HC()A() BACB30LE()-() [J] BACB30LE-K [J] BACB30NH [J] NAS1465 THRU NAS1472 NAS1496 THRU NAS1502
XEV XOH XOJ XOK	BACB30DX()-()	A286 CRES CAD PLATED LUBRICATED 95 KSI SHEAR MAX TEMP 450°F	2LPY-EU()-()C	NAS695 THRU 6972	
XFE XFF	BACB30HC()-()	ALLOY STEEL CAD PLATED LUBRICATED 95 KSI SHEAR MAX TEMP 450°F	2LSP-T()-()	NAS1466 THRU 1472 NAS1496 THRU 1502 NAS6966 THRU 6972	
XRH XRJ	BACB30HC()A()	A286 CRES CAD PLATED LUBRICATED 95 KSI SHEAR MAX TEMP450°F	2LSP-EU()-()	NAS6966 THRU 6972	
YRC YRD YFG	BACB30HC()D()N	ALLOY STEEL NICKEL-CAD PLATED 95 KSI SHEAR MAX TEMP 600F	2LSP-DT()-()N	NAS1466 THRU 1472 NAS1496 THRU 1502 NAS6966 THRU 6972	BACB30DX()D()N
YRL YRK	BACB30HC()A()U	A286 CRES PASSIVATED 95 KSI SHEAR MAX 900°F	2LSP-EU()-()	NAS6966 THRU 6972	BACB30DX()A()U BACB30MB()A()U BACB30LT()U() BACB30LE()U() [J] BACB30PN() [J]
YEZ	BACB30DX()D()N	ALLOY STEEL DIFFUSED NICKEL CAD PLATED LUBRICATED 95 KSI SHEAR MAX. TEMP 600°F	2LPY-DT()-()N	NAS1465 THRU 1472 NAS6965 THRU 6972	BACB30HC()D()N

LOCKBOLT - PROTRUDING HEAD (TENSION) (CONT)

Fastener Substitution
Figure 1 (Sheet 18)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
XOB XOF XOG	BACB30DX()A()U	A286 CRES PASSIVATED 95 KSI SHEAR 600°F MAX TEMP	2LPY-EU-()-()	NAS695-() THRU 6972-() BACB30HC()A()U BACB30MB()A()U BACB30LT()N() BACB30LE()U() BACB30PN } [J]	
XFW	BACB30GP()-()	7075-T6 AL		NAS1525 THRU 1532	
XFY	BACB30GR()-()	7075-T6 AL		NAS1556 THRU 1562	

LOCKBOLT-PROTRUDING HEAD-TENSION

Fastener Substitution
Figure 1 (Sheet 19)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
XFT XFV XFS	BACB30GY()-()	ALLOY STEEL CAD PLATED, LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	SAL100Y-T()-()	NAS1436 THRU 1442	BACB30FN()A()N BACB30FN()-() BACB30FN()A() BACB30FN()K() BACB30FN()AK() BACB30NW()C() BACB30NW()K() BACB30FB()-() BACB30EL()-() BACB30LL()-() BACB30RF()P() BACB30NU()C() BACB30NU()K() BACB30AT()-() BACB30AT()A() NAS1436 THRU NAS1442 BACB30GY()-() BACB30GY()A()
XLU XOO	BACB30GY()A()	A286 CRES CAD PLATED, LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	SAL100Y-EU()-()C		
YNZ	BACB30GY()D()N	ALLOY STEEL, NICKEL-CAD PLATED, LUBRICATED. 95 KSI SHEAR MAX TEMP 600°F	AL100Y-DT()-()N	NAS1436 THRU 1442 BACB30EL()CN()	
XOD XOA	BACB30GY()A()U	A286 CRES, PASSIVATED, LUBRICATED. 95 KSI SHEAR MAX TEMP 900°F	SAL100Y-EU()-()	BACB30FN()A()U BACB30LL()U()	
XEW XES XEY	BACB30DY()-()	ALLOY STEEL, CAD PLATED, LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	2L426Y-T()-()	NAS1475 THRU 1482 NAS6955 THRU 6962	BACB30ND()-() BACB3GND()A() BACB30DY()-() BACB30DY()A() BACB30NZ()C() BACB30NZ()K()
XMK XML XMM XOL	BACB30DY()A()	A286 CRES, CAD PLATED. LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	2L426Y-EU()-()C	NAS6955 THRU 6962	

LOCKBOLT-FLUSH HEAD (SHEAR)(CONT)

Fastener Substitution
Figure 1 (Sheet 20)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30DT()-()	A286 STEEL CAD PLATE STUMP TYPE HAMMER DRIVEN		NAS1416 THRU 1422 NAS1436 THRU 1442 NAS6976 THRU 6982	
XFX	BACB30GQ()-()	7075-T6 AL PULL TYPE 100° HEAD GUN DRIVEN		NAS1535 THRU 1542	
XAX	BACB30CT()-()	ALLOY STEEL 0.0156 OVERSIZE PULL TYPE GUN DRIVEN		NAS1436 THRU 1422	
XFZ	BACB30GS()-()	7075-T6 AL STUMP TYPE 100° HEAD HAMMER DRIVEN		NAS6915 THRU 6922	

LOCKBOLT-FLUSH HEAD (SHEAR)

Fastener Substitution
Figure 1 (Sheet 21)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
XFA XFB XFC	BACB30GX()-()	ALLOY STEEL, CAD PLATED, LUBRICATED. 95 KSI SHEAR MAX TEMP 450°F	2L509YT()-()	NAS1456 THRU 1462 NAS6946 THRU 6952	BACB30LP BACB30LU()-() BACB30LR()-() BACB30GX()--()X BACB30JC()-() BACB30JC()A() BACB30GX()-()
XZW XZX XZY	BACB30GX()-()X	ALLOY STEEL, CAD PLATED, UNLUBRICATED 95 KSI SHEAR MAX TEMP 450°F			
XFD	BACB30GX()D()N	ALLOY STEEL, DIF-FUSED NICKEL-CAD PLATED. 95 KSI SHEAR MAX TEMP 600°F	2L509YDT()-()ND	NAS1456 THRU 1462 NAS6946 THRU 6952 BACB30EM()L()	
XFL XFM	BACB30HG()-()	STEEL CAD PLATE 100° HEAD STUMP TYPE		NAS1456 THRU 1462 NAS1486 THRU 1492 NAS6946 THRU 6952	
XFH XFJ	BACB30HD()-()	STEEL CAD PLATE 100° HEAD STUMP TYPE		NAS1476 THRU 1482 NAS6926 THRU 6932 NAS6956 THRU 6962	

LOCKBOLT-FLUSH HEAD (TENSION)

Fastener Substitution
Figure 1 (Sheet 22)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30NE()-()	ALLOY STEEL, CAD PLATED, HEX HEAD, LONG THREAD. 95 KSI SHEAR MAX TEMP 450°F		NAS6603 THRU 6620 NAS6703 THRU 6720 BACB30LM()-() BASB30NM()C() BACB30NM()K() BACB30MR()C() BACB30MR()K() BACB30LE BACB30LE()K() BACB30NH()-()	[J]
	BACB30NF()-()	ALLOY STEEL, CAD PLATED, HEX HEAD, SHORT THREAD. 95 KSI SHEAR MAX TEMP 450°F		NAS6203 THRU 6620 NAS6303 THRU 6320 NAS6403 THRU 6420 BACB30LJ()-() BACB30NR()C() BACB30NR()K() BACB30NL()-() BACB30LT()-() BACB30LM()-() BACB30NM()C() BACB30NM()K() BACB30MR()C() BACB30MR()K() BACB30LE()-() BACB30LE()K() BACB30NH()-() BACB30NE BACB30FM BACB30MY BACB30MB BACB30NX BACB30GW BACB30DX BACB30HC	[J]

BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 23)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30LJ()-()	A286 CRES, CAD PLATED, HEX HEAD, SHORT THREAD. 95 KSI SHEAR MAX TEMP 450°F		NAS6303 THRU 6320 NAS6403 THRU 6420 BACB30NR()C() BACB30NR()K() BACB30NF()-() BACB30NL()-() BACB30LT()-() BACB30LM()-() BACB30NM()C() BACB30NM()K() BACB30MR()C() [J] BACB30MR()K() [J] BACB30LE [J] BACB30LE()K() [J] BACB30NH()-() [J] BACB30NE()-()	
	BACB30LM()-()	A286 CRES, CAD PLATED, HEX HEAD, LONG THREAD. 95 KSI SHEAR MAX TEMP 450°F		NAS6703 THRU 6720 NAS6803 THRU 6820 BACB30NM()C() BACB30NM()K() BACB30MR()C() BACB30MR()K() BACB30LE BACB30LE()K() BACB30NH()-()	
	BACB30LM()U()	A286 CRES, PASSIVATED, HEX HEAD, LONG THREAD 95 KSI SHEAR MAX TEMP 800°F		NAS6703 THRU 6720 BACB30LE()U() BACB30PN	

BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 24)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30NM()C()	6AL-4V TITANIUM, CAD PLATED, HEX HEAD LONG THREAD. 95 KSI SHEAR MAX TEMP 450°F		NAS6703 THRU 6720 NAS6803 THRU 6820	BACB30NM()K() BACB30MR()C() BACB30MR()K() BACB30LE BACB30LE()K() BACB30NH()-() [J] BACB30NM()C() BACB30NE()-() BACB30LM()-()
	BACB30NM()K()	6AL-4V TITANIUM, AL COATED, HEX HEAD, LONG THREAD. 95 KSI SHEAR MAX TEMP 450°F			
	BACB30NR()K()	6AL-4V TITANIUM, AL COATED, HEX HEAD, SHORT THREAD. 95 KSI SHEAR MAX TEMP 450°F		NAS6803 THRU 6820 NAS6403 THRU 6420	BACB30NR()K() BACB30NR()C() BACB30NE BACB30NF BACB30NM()C() BACB30NM()K() BACB30NL()-() BACB30LT()-() BACB30MR()C() BACB30MR()K() BACB30LE()K() BACB30LE BACB30NH()-() [J] BACB30FM BACB30MY BACB30MB BACB30NX BACB30DX BACB30HC BACB30LJ()-() BACB30LM()-()
	BACB30NR()C()	6AL-4V TITANIUM, CAD PLATED, HEX HEAD, SHORT THREAD. 95 KSI SHEAR MAX TEMP 450°F		NAS6303 THRU 6320 NAS6403 THRU 6420	

BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 25)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30LJ()U()	A286 CRES, PASSIVATED, HEX HEAD, SHORT THREAD 95 KSI SHEAR MAX TEMP 800°F		BACB30LT()U() NAS6303U THRU 6320U	
	BACB30NJ	H-11 STEEL, DIFFUSED NICKEL CAD PLATED, 12 POINT HEAD. SHORT THREAD. 125 KSI SHEAR MAX TEMP 600°F	BACB30UU		
	BACB30NJ()L()	H-11 STEEL, AL COATED, 12 POINT HEAD, SHORT THREAD. 125 KSI SHEAR MAX TEMP 600°F	BACB30UU		
	BACB30NJ()K()	H-11 STEEL, AL COATED, 12 POINT HEAD, SHORT THREAD. 125 KSI SHEAR MAX TEMP 350°F	BACB30UU()K()		BACB30NL BACB30NH [J]
	BACB30NL	PH13-8Mo CRES, CAD PLATED, 12 POINT HEAD, SHORT THREAD 125 KSI SHEAR MAX TEMP 450°F			BACB30NH BACB30UU BACB30US [J]
	BACB30NL()U()	PH13-8Mo CRES, PASSIVATED, 12 POINT HEAD, SHORT THREAD. 125 KSI SHEAR. MAX TEMP 600°F			BACB30UU()-() BACB30US()-() [J]

BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 26)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30LT()-()	A286 CRES, CAD PLATED, 12 POINT HEAD, SHORT THREAD. 110 KSI SHEAR MAX TEMP 450°F		BACB30NL BACB30NH	
	BACB30MR()C()	6AL-4V TITANIUM, CAD PLATED, 12 POINT HEAD, LONG THREAD. 95 KSI SHEAR MAX TEMP 450°F		BACB30MR()C() BACB30MR()K() BACB30LE BACB30LE()K() BACB30NH()-()	
	BACB30MR()K()	6AL-4V TITANIUM, AL COATED, 12 POINT HEAD, LONG THREAD. 95 KSI SHEAR MAX TEMP 450°F			
	BACB30LE	A286 CRES, CAD PLATED, 12 POINT HEAD, LONG THREAD. 110 KSI SHEAR MAX TEMP 450°F		BACB30LE BACB30LE()K() BACB30NH()-()	
	BACB30LE()K()	A286 CRES, AL COATED, 12 POINT HEAD, LONG THREAD. 110 KSI SHEAR MAX TEMP 450°F			
	BACB30PN	INCONEL 718, 12 POINT HEAD, LONG THREAD. MAX TEMP 1200°F		BACB30LE()U()	
	BACB30NH	PH13-8Mo CRES, CAD PLATED, 12 POINT HEAD, LONG THREAD. 125 KSI SHEAR MAX TEMP 450°F		BACB30US	

BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 27)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30NH()U()	PH13-8Mo CRES, PASSIVATED, 12 POINT HEAD, LONG THREAD. 125 KSI SHEAR. MAX TEMP 600°F		BACB30US()-()	
	BACB30MT()T()	H-11 STEEL, DIFFUSED NICKEL CAD PLATED, 12 POINT HEAD. LONG THREAD. 125 KSI SHEAR MAX TEMP 600°F	BACB30US	NAS1785()-() BACB30TR()T()	
	BACB30MT()K()	H-11 STEEL, AL COATED, 12 POINT HEAD, LONG THREAD. 125 KSI SHEAR MAX TEMP 350°F	BACB30US()K()	BACB30NH()-()	
	BACB30MT()L()	H-11 STEEL, AL COATED, 12 POINT HEAD, LONG THREAD. 125 KSI SHEAR MAX TEMP 600°F	BACB30US		
	BACB30LJ()SU()	A286 CRES, PASSIVATED, HEX HEAD, SHORT THREAD DRY FILM LUBRICATED. 95 KSI SHEAR. MAX TEMP 450°F		BACB30NL()SU() BACB30LM()SU() BACB30NH()SU() [J] BACB30LJ()U() BACB30LM()U() BACB30NH()U() [J]	
	BACB30LM()SU()	A286 CRES, PASSIVATED, HEX HEAD, LONG THREAD, DRY FILM LUBRICATED. 95 KSI SHEAR. MAX TEMP 450°F		BACB30NH()SU() [J] BACB30NH()U() BACB30LM()U() BACB30LE()U() BACB30PN BACB30LE BACB30LE()K() } [J]	

BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 28)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30NH()SU()	PH13-8Mo, PASSIVATED, 12 POINT HEAD, LONG THREAD, DRY FILM LUBRICATED. 125 KSI SHEAR. MAX TEMP 450°F		BACB30NH()U() BACB30US	
	BACB30NL()SU()	PH13-8Mo, PASSIVATED, 12 POINT HEAD, SHORT THREAD, DRY FILM LUBRICATED. 125 KSI SHEAR MAX TEMP 450°F		BACB30NL()U() BACB30UU BACB30US [J]	
	BACB30FD()-()	4340 OR 8740 STEEL 180 KSI MIN TENSILE 102 KSI MIN SHEAR 450°F		NAS624() THRU 644() NAS1785()-()	
	BACB30GE()-()	HEX CLOSE TOL 160,000 PSI SHORT THREAD		NAS6306C() THRU 6320C()	
	BACB30TR()HT()	H-11 STEEL 220 KSI MIN TENSILE 125 KSI MIN SHEAR 12 POINT LOW PROFILE HEAD 350°F AND 600°F	BACB30US	NAS1785	

BOLT - EXTERNAL WRENCHING - PROTRUDING HEAD

Fastener Substitution
Figure 1 (Sheet 29)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30EL()-()	ALLOY STEEL, CAD PLATED, REDUCED HEAD, HI-TORQUE, SHORT THREAD. 95 KSI SHEAR MAX TEMP 450°F		NAS4703 THRU 4712 NAS4803 THRU 4812 NAS4903 THRU 4912 BACB30EL()-() BACB30EL()CN() BACB30LL BACB30NU()C() BACB30NU()K() BACB30RF()P() BACB30FN()-() BACB30FN()A() BACB30FN()K() BACB30FN()AK() BACB30NW()C() BACB30NW()K() BACB30GY()-() BACB30GY()A() BACB30FN()A()N	
	BACB30LL	A286, CAD PLATED, REDUCED HEAD, HI-TORQUE, SHORT THREAD. 95 KSI SHEAR, MAX TEMP 450°F			
	BACB30NU()C()	6AL-4V TITANIUM, CAD PLATED, REDUCED HEAD, HI-TORQUE, SHORT THREAD. 95 KSI SHEAR, MAX TEMP 450°F			
	BACB30NU()K()	6AL-4V TITANIUM, AL COATED, REDUCED HEAD, HI-TORQUE, SHORT THREAD. 95 KSI SHEAR, MAX TEMP 450°F			
	BACB30LU	ALLOY STEEL, CAD PLATED, PHILLIPS RECESS, LONG THREAD. 95 KSI SHEAR, MAX TEMP 450°F		NAS4104 THRU 4116 NAS4204 THRU 4216 NAS4304 THRU 4316 NAS7103 THRU 7116 NAS7203 THRU 7216 NAS7303A THRU 7316	BACB30LU BACB30LR BACB30NN()C() BACB30NN()K() BACB30LP BACB30MS()C() BACB30MS()K() NAS583 THRU 590
	BACB30LR	A286 CRES, CAD PLATED, PHILLIPS RECESS, LONG THREAD. 95 KSI SHEAR, MAX TEMP 450°F		NAS4204 THRU 4216 NAS4304 THRU 4316 NAS7203 THRU 7216 NAS7303 THRU 7316	
	BACB30NN()C()	6AL-4V TITANIUM, CAD PLATED, PHILLIPS RECESS, LONG THREAD. 95 KSI SHEAR, MAX TEMP 450°F			

BOLT-RECESS DRIVE-FLUSH HEAD(CONT)

Fastener Substitution
Figure 1 (Sheet 30)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30NN()K()	6AL-4V TITANIUM, AL COATED, PHILLIPS RECESS, LONG THREAD. 95 KSI SHEAR, MAX TEMP 450°F		NAS4204 THRU 4216 NAS4304 THRU 4316 NAS7203 THRU 7216 NAS7303 THRU 7316	BACB30LU BACB30LR BACB30NN()C() BACB30LP BACB30MS()C() BACB30MS()K() NAS583 THRU 590
	BACB30LP	A286 CRES, CAD PLATED, HI-TORQUE, LONG THREAD. 95 KSI SHEAR, MAX TEMP 450°F		NAS4204 THRU 4216 NAS4304 THRU 4316 NAS7203 THRU 7216 NAS7303 THRU 7316 BACB30EM()L() BACB30MS()C() BACB30MS()K() BACB30LP NAS583 THRU 590	
	BACB30MS()C()	6AL-4V TITANIUM, CAD PLATED, HI-TORQUE, LONG THREAD. 95 KSI SHEAR, MAX TEMP 450°F			
	BACB30MS()K()	6AL-4V TITANIUM, AL COATED, HI-TORQUE, LONG THREAD. 95 KSI SHEAR, MAX TEMP 450°F			
	BACB30EL()CN()	ALLOY STEEL, DIFFUSED-NICKEL CAD PLATED, HI-TORQUE, SHORT THREAD, REDUCED HEAD. 95 KSI SHEAR, MAX TEMP 600°F		BACB30LL()U() BACB30FN()A()U BACB30GY()A()U BACB30GY()D()N	
	BACB30LR()U()	A286 CRES, PASSIVATED, PHILLIPS RECESS, LONG THREAD. 95 KSI SHEAR, MAX TEMP 800°F		NAS4204 THRU 4216 NAS7203 THRU 7216 NAS4304 THRU 4316 NAS7303 THRU 7316 BACB30LP()U() BACB30LR()U()	

BOLT-RECESS DRIVE-FLUSH HEAD(CONT)

Fastener Substitution
Figure 1 (Sheet 31)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30LL()U()	A286 CRES PASSIVATED HI-TORQUE REDUCED HEAD 95 KSI SHEAR MAX TEMP 800°F		NAS4803 THRU 4816 BACB30FN()A()U	
	BACB30AB-P()-()	100° HEAD CLOSE TOL 160 KSI		NAS4403 THRU 4414 NAS4503 THRU 4514 NAS7403 THRU 7414 NAS7503 THRU 7514 NAS7603 THRU 7614	
	BACB30FA()-() -P	100° HEAD HI-TORQUE SELF-LOCKING 160 KSI		NAS4104 THRU 4110 NAS4204 THRU 4210 NAS4304 THRU 4310 NAS7103 THRU 7110 NAS7203 THRU 7210 NAS7303 THRU 7310	
	BACB30FB	ALLOY STEEL REDUCED HEAD HI-TORQUE LONG THREAD CLOSE TOL		NAS1993 THRU 1996	
	BACB30LH()-()	A286 STEEL 100° HEAD CROSS RECESS SHORT THREAD 95 KSI SHEAR		NAS4502 THRU 4516 NAS7502 THRU 7516 NAS7602 THRU 7616	
	BACB30TP	ALLOY STEEL 100° HEAD CROSS RECESS CLOSE TOL		NAS1973	

BOLT-RECESS DRIVE-FLUSH HEAD

Fastener Substitution
Figure 1 (Sheet 32)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30LK	A286 CRES, CAD PLATED, PHILLIPS RECESS, SHORT THREAD. 95 KSI SHEAR, MAX TEMP 450°F		NAS1578 NAS5100 THRU 5106 NAS7800 THRU 7806 NAS7900 THRU 7906	BACB30LE()-() [J] BACB30LK()-() BACB30NT()C BACB30NT()K BACB30NF()-() BACB30NE()-() BACB30LJ()-() BACB30LM()-() BACB30MB()-() BACB30NM()C() BACB30NM()K() BACB30NR()K() BACB30NR()C() BACB30LT()-()
	BACB30NT()C()	6AL-4V TITANIUM, CAD PLATED, PHILLIPS RECESS, SHORT THREAD. 95 KSI SHEAR, MAX TEMP 450°F			
	BACB30NT()K()	6AL-4V TITANIUM, AL COATED, PHILLIPS RECESS, SHORT THREAD. 95 KSI SHEAR, MAX TEMP 450°F		NAS5100 THRU 5106 NAS5200 THRU 5206 NAS7800 THRU 7806 NAS7900 THRU 7906	BACB30MR()C() BACB30MR()K() BACB30LE()K() } [J]
	NAS623-()-()W	ALLOY STEL, CAD PLATED, PHILLIPS RECESS, SHORT THREAD. 95 KSI SHEAR, MAX TEMP 450°F			NAS623()-() NAS623()-()W NAS1217-()-() NAS1217-()-()B NAS1217-()-()P NAS1217-()-()T NAS1217-()E-()P NAS1218-()-() NAS1218-()-()B NAS1218-()-()P NAS1218-()-()T NAS1218-()E()P
	NAS623()-()	ALLOY STEEL, CAD PLATED, PHILLIPS RECESS, SHORT THREAD. 95 KSI SHEAR, MAX TEMP 450°F			
	BACB30LK()U()	A286 CRES, PASSIVATED, PHILLIPS RECESS, SHORT THREAD. 95 KSI SHEAR, MAX TEMP 800°F		NAS1578 NAS5100 THRU 5106 NAS7800 THRU 7806	BACB30LM()U() BACB30LJ()U() BACB30LT()U() NAS1217-()E-() NAS1218-()E-()

BOLT - RECESS DRIVE - PROTRUDING HEAD (CONT)

Fastener Substitution
Figure 1 (Sheet 33)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
	BACB30EM-P()-()	ALLOY STEEL ,DIFFUSED, NICKEL-CAD PLATED, SHORT THREAD. 95 KSI SHEAR, MAX TEMP 900°F		BACB30-P()L-() BACB30NH()U()	
	BACB30EM-P()L-()	ALLOY STEEL, DIFFUSED NICKEL-CAD PLATED, LONG THREAD. 95 KSI SHEAR, MAX TEMP 900°F		BACB30LM()U()	

BOLT - RECESS DRIVE - PROTRUDING HEAD

Fastener Substitution
Figure 1 (Sheet 34)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
YJW	BACB30MW()C()	6AL-4V TITANIUM, CAD PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD. 95 KSI SHEAR, MAX TEMP 450°F		BACB30MW()C() BACB30MW()K() BACB30PB()-() BACB30PB()A() BACB30PE()-() BACB30PE()A() BACB30PE()K() BACB30PE()AK() NAS1728()-() NAS1729()-()	
YKG	BACB30MW()K()	6AL-4V TITANIUM, AL COATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD. 95 KSI SHEAR, MAX TEMP 450°F			
YFX XUH	BACB30PB()-()	ALLOY STEEL, CAD PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD. 108 KSI SHEAR, MAX TEMP 450°F	TL200	BACB30PB()A() BACB30PE()-() BACB30PE()A() BACB30PE()K() BACB30PE()AK() NAS1728()-() NAS1729()-()	
	BACB30PB()A()	A286 CRES, CAD PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD. 110 KSI SHEAR, MAX TEMP 450°F	TLCB200	BACB30PE()A() BACB30PE()AK() NAS1728()-() NAS1729()-()	
XWH	BACB30PE()-()	ALLOY STEEL, CAD PLATED, CETYL ALCOHOL LUBRICATED, TENSION HEAD. 108 KSI SHEAR, MAX TEMP 450°F		BACB30PE()-() BACB30PE()K() BACB30PE()A() BACB30PE()AK()	
YHQ	BACB30PE()K()	ALLOY STEEL, AL COATED, CETYL ALCOHOL LUBRICATED, TENSION HEAD. 108 KSI SHEAR, MAX TEMP 450°F			

BOLT-TAPER SHANK-PROTRUDING HEAD(CONT)

Fastener Substitution
Figure 1 (Sheet 35)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
XWJ	BACB30PE()A()	A286 CRES, CAD PLATED, CETYL ALCOHOL LUBRICATED, TENSION HEAD. 110 KSI SHEAR, MAX TEMP 450°F		BACB30PE()A() BACB30PE()AK()	
YHR	BACB30PE()AK()	A286 CRES, AL COATED, CETYL ALCOHOL LUBRICATED, TENSION HEAD. 110 KSI SHEAR, MAX TEMP 450°F			

BOLT-TAPER SHANK-PROTRUDING HEAD

Fastener Substitution
Figure 1 (Sheet 36)

REPAIR FASTENER					
ORIGINAL OR SPECIFIED			EQUIVALENT	ALTERNATIVE [H] [K]	
CODE	PART NUMBER	DESCRIPTION			
XJV XJW XWD	BACB30KD()-()	ALLOY STEEL, CAD PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD. 108 KSI SHEAR, MAX TEMP 450°F	TLD100-()-()	BACB30KD()A() NAS1724()- NAS1725()-()	
XFB YMS	BACB30KD()A()	A286 CRES, CAD PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD. 110 KSI SHEAR, MAX TEMP 800°F	TLCB100-()W()	NAS1724 NAS1725	
XUW XUL XYU YAZ YAC	BACB30MU()C()	6AL-4V TITANIUM, CAD PLATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD. 95 KSI SHEAR, MAX TEMP 450°F	TLV100-()W()	BACB30MU()C() BACB30MU()K() BACB30KD()A() BACB30KD()-() NAS1724	
YKH YKG	BACB30MU()K()	6AL-4V TITANIUM, AL COATED, CETYL ALCOHOL LUBRICATED, SHEAR HEAD. 95 KSI SHEAR, MAX TEMP 450°F			
	BACB30PD()A()	A286 CRES, CAD PLATED, LUBRICATED, TENSION HEAD. 110 KSI SHEAR, MAX TEMP 450°F	TLCB300-()W()		
	BACB30PD()-()	ALLOY STEEL, CAD PLATED, LUBRICATED, TENSION HEAD. 108 KSI SHEAR, MAX TEMP 450°F	TL300-()-()	BACB30PD()A()	

BOLT-TAPER SHANK-FLUSH HEAD

Fastener Substitution
Figure 1 (Sheet 37)

SUBSTITUTE RIVET	RIVETED MATERIAL	RIVET DIA		RIVETED MATERIAL GAGE															
		ORIGINAL MS20470D OR BACR15BB-D	SUBSTITUTE RIVET	.025	.028	.032	.036	.040	.045	.050	.056	.063	.071	.080	.090	.100	.112	.125
				QUANTITY FACTOR [C]														
NAS1398D BLIND PROTRUDING HEAD RIVET [A] [B] [D]	CLAD OR BARE 2024-T3 2024-T4 ALUMINUM ALLOY	1/8	1/8	1.5	1.5	1.5	1.5	1.5	1.4	1.3	1.2	1.1	1.1	1.0				
			5/32	1.3	1.3	1.2	1.2	1.2	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7		
		5/32	5/32	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.4	1.3	1.2	1.2				
			3/16	1.5	1.5	1.4	1.4	1.3	1.2	1.2	1.1	1.0	1.0	0.9	0.8	0.8		
		3/16	3/16	1.8	1.8	1.6	1.6	1.5	1.5	1.5	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0
			1/4			1.4	1.4	1.3	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.7
		1/4	1/4			1.8	1.8	1.7	1.7	1.5	1.5	1.5	1.6	1.5	1.4	1.3	1.3	1.2
	CLAD OR BARE 7075-T6 ALUMINUM ALLOY	1/8	1/8	1.8	1.8	1.7	1.5	1.5	1.4	1.3	1.2	1.1	1.1	1.0				
			5/32	1.6	1.6	1.4	1.4	1.4	1.1	1.1	0.9	0.9	0.8	0.8	0.7	0.7		
		5/32	5/32	2.0	2.0	1.8	1.8	1.7	1.5	1.5	1.4	1.3	1.2	1.2				
			3/16	1.9	1.9	1.7	1.6	1.4	1.4	1.2	1.1	1.0	1.0	0.9	0.8	0.8		
		3/16	3/16	2.2	2.2	2.0	2.0	1.8	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0
			1/4			1.7	1.7	1.5	1.4	1.3	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7
		1/4	1/4			2.2	2.2	2.0	2.0	1.8	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2
BACR15BB-AD OR MS20470AD PROTRUDING HEAD RIVETS	CLAD OR BARE 2024-T3 2024-T4 ALUMINUM ALLOY	1/8	1/8	1.0	1.0	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3				
			5/32	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9				
		5/32	5/32	1.0	1.0	1.0	1.0	1.2	1.2	1.3	1.3	1.3	1.3	1.3				
			3/16	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9				
		3/16	3/16	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.3	1.3	1.3	1.3				
			1/4							0.8	0.8	0.8	0.8	0.8				
		1/4	1/4							1.0	1.1	1.2	1.3	1.3	1.3			
			5/16									0.8	0.9	0.9	0.9			
	CLAD OR BARE 7075-T6 ALUMINUM ALLOY	1/8	1/8	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3				
			5/32	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9				
		5/32	5/32	1.0	1.0	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3				
			3/16	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9				
		3/16	3/16	1.0	1.0	1.0	1.0	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3		
			1/4							0.8	0.8	0.8	0.8	0.8	0.8	0.8		
		1/4	1/4							1.1	1.2	1.3	1.3	1.3	1.3	1.3		
			5/16									0.9	0.9	0.9	0.9	0.9		

Fastener Substitution for MS20470D and BACR15BB-D
Universal Head Rivets
Figure 2 (Sheet 1)

SUBSTITUTE RIVET	RIVETED MATERIAL	RIVET DIA		RIVETED MATERIAL GAGE															
		ORIGINAL MS20470D OR BACR15BB-D	SUBSTITUTE RIVET	.025	.028	.032	.036	.040	.045	.050	.056	.063	.071	.080	.090	.100	.112	.125
				QUANTITY FACTOR [C]														
NAS1738E BLIND PROTRUDING HEAD RIVET [A] [B] [D] [E]	CLAD OR BARE 2024-T3 2024-T4 ALUMINUM ALLOY	1/8	1/8			1.7 1.3	1.7 1.4	1.5 1.2	1.4 1.1	1.2 1.0	1.1 0.9	1.0 0.8	0.9 0.7	0.8 0.6	0.6	0.5		
			5/32			1.7 1.5	1.7 1.4	1.7 1.4	1.7 1.5	1.5 1.3	1.4 1.2	1.2 1.1	1.1 1.0	1.0 0.8	0.9 0.8	0.9 0.7	0.8 0.7	0.6
		5/32	5/32															
			3/16															
		3/16	3/16				1.7	1.7	1.7	1.7	1.7	1.5	1.3	1.2	1.1	1.0	0.9	0.9
	CLAD OR BARE 7075-T6 ALUMINUM ALLOY	1/8	1/8			1.4 1.0	1.3 1.0	1.3 1.0	1.2 0.9	1.1 0.9	1.1 0.8	1.0 0.8	0.9 0.7	0.8 0.7	0.8 0.6	0.6	0.5	
			5/32			1.2 1.0	1.3 1.0	1.4 1.1	1.4 1.1	1.3 1.1	1.2 1.0	1.1 0.9	1.1 0.9	1.0 0.8	0.9 0.8	0.9 0.7	0.8 0.7	0.6
		5/32	3/16															
		3/16	3/16				1.2	1.3	1.4	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.9	0.9

NOTES

- THIS SUBSTITUTION TABLE IS NOT APPLICABLE TO THE STRUCTURAL AREAS NOTED IN PAR. 1.F.
- REFER TO 51-30-05 FOR FASTENER HOLE SIZES

[A] ALL PRIMARY STRUCTURE JOINTS AND JOINTS SUBJECT TO ALTERNATING LOADS REQUIRE THE QUANTITY FACTORS FOR SUBSTITUTE BLIND RIVETS TO BE MULTIPLIED BY 1.5

[B] KEEP THE QUANTITY OF BLIND RIVETS USED FOR REPLACEMENT OF A PORTION OF THE SOLID RIVETS IN A GIVEN JOINT TO A MINIMUM IN ORDER THAT OVERSTRESSING OF THE REMAINING SOLID RIVETS SHALL NOT OCCUR.

[C] USE THESE QUANTITY FACTORS FOR RIVETS IN SINGLE SHEAR APPLICATIONS ONLY

[D] SUBSTITUTE NAS1738E FOR NAS1398D ONLY WHEN BLIND SIDE SHEET THICKNESS IS LESS THAN 1/4 HOLE DIAMETER, TOOL ACCESSIBILITY MUST BE ADEQUATE.

[E] NAS1738 RIVETS ARE INSTALLED IN A LARGER HOLE SIZE THAN THE ORIGINAL FASTENER. USE THE FOLLOWING HOLE SIZES FOR INSTALLATION.

RIVET NOMINAL DIAMETER	MIN HOLE DIAMETER	MAX HOLE DIAMETER
1/8	0.143	0.146
5/32	0.176	0.180
3/16	0.205	0.209

Fastener Substitution for MS20470D and BACR15BB-D
Universal Head Rivets
Figure 2 (Sheet 2)

SUBSTITUTE RIVET	RIVETED MATERIAL	RIVET DIA		RIVETED MATERIAL GAGE													
		ORIGINAL MS20426D OR BACR15BA-D	SUBSTITUTE RIVET	.040	.045	.050	.056	.063	.071	.080	.090	.100	.112	.125	.140	.160	.180
				QUANTITY FACTOR [C]													
NAS 1399D BLIND RIVET IN COUNTER-SUNK HOLES [A] [B] [D]	CLAD OR BARE 2024-T3	5/32	5/32		3.5	3.3	2.8	2.6	2.4	2.0	1.6	1.4	1.2	1.0			
			3/16				2.4	2.0	1.8	1.5	1.3	1.1	0.9	0.8	0.7		
	2024-T4 7075-T6 ALUMINUM ALLOY	3/16	3/16				2.9	2.5	2.2	2.0	1.8	1.6	1.3	1.1	1.0		
			1/4						2.1	1.9	1.7	1.4	1.2	1.0	0.8	0.7	
		1/4	1/4						2.7	2.4	2.1	2.1	1.9	1.7	1.4	1.2	1.2
BACR15BA-AD OR MS20426AD RIVETS IN COUNTER-SUNK HOLES	CLAD OR BARE 2024T3 2024T4 7075-T6 ALUMINUM ALLOY	5/32	5/32	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.3						
			3/16	1.0	0.9	0.9	0.9	0.9	1.0	1.0	1.0	0.9	0.9				
		3/16	3/16			1.1	1.1	1.1	1.2	1.3	1.3	1.3	1.3				
NAS1739E BLIND RIVETS IN COUNTER-SUNK HOLES [A] [B] [D] [E]	CLAD OR BARE 2024T3 2024T4 7075-T6 ALUMINUM ALLOY	5/32	5/32	1.4	1.3	1.4	1.3	1.2	1.3	1.2	1.1	1.0	0.9	0.8	0.8		
			3/16	1.2	1.2	1.2	1.1	1.1	1.1	1.0	0.9	0.8	0.8	0.7	0.7	0.6	
		3/16	3/16			1.4	1.4	1.4	1.3	1.3	1.3	1.2	1.1	1.0	0.9	0.9	

NOTES

- THIS SUBSTITUTION TABLE IS NOT APPLICABLE TO THE STRUCTURAL AREAS NOTED IN PAR. 1.F.
- REFER TO 51-30-05 FOR FASTENER HOLE SIZES

[A] ALL PRIMARY STRUCTURE JOINTS AND JOINTS SUBJECT TO ALTERNATING LOADS REQUIRE THE QUANTITY FACTORS FOR SUBSTITUTE BLIND RIVETS TO BE MULTIPLIED BY 1.5

[B] KEEP THE QUANTITY OF BLIND RIVETS USED FOR REPLACEMENT OF A PORTION OF THE SOLID RIVETS IN A GIVEN JOINT TO A MINIMUM IN ORDER THAT OVERSTRESSING OF THE REMAINING SOLID RIVETS SHALL NOT OCCUR.

[C] USE THESE QUANTITY FACTORS FOR RIVETS IN SINGLE SHEAR APPLICATIONS ONLY

[D] SUBSTITUTE NAS1739E FOR NAS1399D ONLY WHEN BLIND SIDE SHEET THICKNESS IS LESS THAN 1/4 HOLE DIAMETER, TOOL ACCESSIBILITY MUST BE ADEQUATE.

[E] NAS1739 RIVETS ARE INSTALLED IN A LARGER HOLE SIZE THAN THE ORIGINAL FASTENER. USE THE FOLLOWING HOLE SIZES FOR INSTALLATION.

RIVET NOMINAL DIAMETER	MIN HOLE DIAMETER	MAX HOLE DIAMETER
1/8	0.143	0.146
5/32	0.176	0.180
3/16	0.205	0.209

Fastener Substitution for MS20426D and BACR15BA-D
Rivets in Countersunk Holes
Figure 3

TORQUE VALUES

1. General

   A. The torque values quoted may be used only where they do not conflict with specific information contained within the Maintenance Manual, Overhaul Manual, Service Bulletins or drawings of the Boeing Company.

   B. The torque values listed in Table 1, Fig. 1 apply to nut tightening only; however, when tightening must be accomplished by bolt rotation, use the high limit of the tabulated values ±10%.

   C. Torque values for taper shank bolts, reduced head bolts, and 70-degree head radius lead-in bolts are listed in Fig. 1.

   D. Where access is not available for the installation of hex-drive bolt collars it is permissible to use locknuts. Table IV, Fig. 1, lists torque values for locknuts on hex-drive bolts. Refer to 51-2-2 for installation procedure.

   E. Refer to 51-2-2 for procedures when applying torque to fasteners in fay seal areas.

2. Torque Wrench Adapters and Extensions

   A. The use of torque wrench adapters and/or extensions is limited to those applications where it is impossible to apply the torque wrench directly.

   B. When using adapters and/or extensions a corrected torque wrench reading is required. Follow the example in Fig. 2 to determine the corrected torque wrench reading.

   C. Adapters must not be used on other than rigid frame torque wrenches.

   D. Apply force to the torque wrench handle or handle extension, perpendicular to the handle and in its plane of rotation.

NUT PART NO.	BACN10JC (SHEET METAL HEX-SIZES 4 THRU 7/16 ONLY), ALL PLATE-NUTS EXCEPT BACN10JA, BACN10JB AND BACN10RM, ALL CLIP-NUTS, INSERTS AND TAPPED HOLES: MS21042, BACN10JD (3/16 THRU 1-1/4 ONLY).		BACN10JC(1/2 THRU 1-1/2), BACN10JD THIN STYLE ALL SIZES -103 THRU -120.
BOLT PART NO.	BACB30LT, BACB30NL, BACB30NJ, BACB30NK, BACB30LJ, BACB30NR, BACB30NF, BACB30PF, BACB30PU, BACB30PW, BACB30LK, BACB30NT, BACB30BE, BACB30BG, BACB30PC, BACB30LH, BACB30RF, BACB30SW, BACS12CB, NAS 563 THRU NAS572, NAS1801, NAS1802, NAS600 THRU NAS606, NAS623, NAS1351, NAS1352, MS21262, MS24678, NAS1217, NAS1218		ALL
FASTENER DIAMETER AND THREAD SIZE	NUT TIGHTENING TORQUE RANGE (POUND-INCH) [A]		
	DRY BOLT	LUBRICATED BOLT [C]	DRY OR LUBRICATED BOLT
10-32 1/4-28 5/16-24 3/8-24	20-30 50-80 100-150 160-240	20-25 50-75 90-125 150-200	18-25 30-50 60-95 95-160
7/16-20 1/2-20 9/16-18 5/8-18	450-550 480-790 800-1150 1100-1500	260-425 440-650 700-920 1000-1200	270-350 290-510 480-850 660-980
3/4-16 7/8-14 1-12 OR 1-14 1-1/8-12	2300-3000 2500-4500 3700-7500 5000-9000	1700-2150 2600-3400 3600-5500 4900-6700	1300-2000 1500-3300 2200-5300 3000-6200
1-1/4-12 1-3/8-12 1-1/2-12	9000-13,000 --- ---	7500-9700 --- ---	5400-8600 7000-9000 10,000-12,000

NUT TIGHTENING TORQUE VALUES
TABLE 1 (SHEET 1)

NUT PART NO.	BACN10HR, BACN10JG, BACN10HC	BACN10GW, BACN10JA, BACN10B, BACN10JB, BACN10RM, NAS577, BACN10JD (7/16 THRU 1-1/4 ONLY)
BOLT PART NO.	BACB30NG, BACB30NH, BACB30MT	BACB30FD, BACB30MR, BACB30LE [B], BACB30PN [B], BACB30NE, BACB30LM, BACB30NM, BACB30LN, BACB30NS, BACB30EM, BACB30LP, BACB30LU, BACB30LR, BACB30MS, BACB30NN, NAS6603 THRU NAS6620, NAS6703 THRU NAS6720

FASTENER DIAMETER AND THREAD SIZE	NUT TIGHTENING TORQUE RANGE (POUND-INCH) [A]			
	DRY BOLT	LUBRICATED BOLT [C]	DRY BOLT	LUBRICATED BOLT [C]
10-32	---	---	30-35	20-25
1/4-28	90-125	70-80	65-100	50-75
5/16-24	180-250	145-180	130-200	90-125
3/8-24	300-500	275-330	220-410	150-250
7/16-20	510-840	370-440	370-690	260-425
1/2-20	870-1300	500-575	630-1070	440-650
9/16-18	1300-1800	800-1000	1000-1470	700-920
5/8-18	1900-2300	1350-1650	1400-1900	1000-1200
3/4-16	3300-4300	2800-3300	2400-3500	1700-2150
7/8-14	5100-6700	3900-4500	3700-5500	2600-3400
1-12 or 1-14	7000-10,900	6200-7000	5100-8900	3600-5500
1-1/8-12	9500-13,000	8300-9400	6900-10,700	4900-6700
1-1/4-12	15,800-19,200	11,000-12,000	11,500-15,700	7500-9700
1-3/8-12	20,000-24,000	16,000-17,000	---	---
1-1/2-12	---	---	---	---

NUT TIGHTENING TORQUE VALUES
TABLE 1 (SHEET 2)

NOTES

[A] WHEN ANY BOLT IS TO BE INSTALLED BY WRENCHING THE HEAD, SUCH AS WHEN INSTALLING BOLTS INTO PLATE-NUTS, CLIP-NUTS, BARREL-NUTS, INSERTS, OR TAPPED HOLES, THE INSTALLATION TORQUE SHALL BE THE MAXIMUM TORQUE INDICATED IN THE TABLE FOR THE NUT ±10 PERCENT.

[B] WHEN BACB30LE OR BACB30PN BOLTS ARE INSTALLED WITH BACN10HR NUTS, USE THE INSTALLATION TORQUE INDICATED FOR BACN10GW NUTS.

[C] LUBRICATED BOLTS INCLUDE DRY-FILM LUBRICATED (MIL-L-8937) BOLTS AND BOLTS WITH ANTI-FRICTION COMPOUNDS SUCH AS EASE-OFF 990, MIL-C-11796 AND MIL-G-23827 APPLIED TO THE THREADS.

FASTENER DIAMETER	TORQUE RANGE (POUNDS INCH) [D]			
	FASTENER PULLED IN BY NUT		SEAL APPLICATIONS OR DRIVEN-IN FASTENERS	
	MIN.	MAX.	MIN.	MAX.
3/16	55	75	30	50
1/4	80	105	60	80
5/16	190	225	140	160
3/8	380	420	225	255
7/16	630	710	420	460
1/2	780	1150	625	880
9/16	1100	1750	920	1350
5/8	1600	2300	1250	1850
3/4	3400	5000	2600	3900
7/8	5500	7500	4400	6000
1	7700	10600	6100	8400

TORQUE VALUES FOR TAPER SHANK BOLTS

TABLE II

BACB30EL BACB30DP		
FASTENER DIAMETER AND THREAD SIZE	TORQUE RANGE (POUNDS INCH)	
	MIN.	MAX.
3/16-32	15	18
1/4-28	26	30
5/16-24	60	65
3/8-24	95	105

TORQUE VALUES FOR REDUCED HEAD BOLTS

TABLE III

FASTENER DIAMETER AND THREAD SIZE	TORQUE RANGE (POUNDS INCH)	
	MIN.	MAX
1/4	60	80
5/16	125	145
3/8	200	230

TORQUE VALUES FOR 70° HEAD RADIUS LEAD-IN BOLTS

TABLE V

FASTENER DIAMETER AND THREAD SIZE	TORQUE RANGE (POUNDS INCH)			
	SHEAR TYPE HEX-DRIVE BOLTS BACB30FM BACB30FN BACB30MY BACB30NW		TENSION TYPE HEX-DRIVE BOLTS BACB30JC BACB30MB BACB30NX BACB30NY	
	LOCKNUTS BACN10GW BACN10JC		LOCKNUT BACN10GW	
	MIN.	MAX	MIN.	MAX.
3/16 - 32	25	35	40	50
1/4 - 28	60	80	115	130
5/16 - 24	130	160	200	250
3 /8 - 24	200	240	360	420
7/16 - 20	270	330	525	675
1/2 - 20	370	430	725	1000

TORQUE VALUES FOR LOCKNUTS ON HEX-DRIVE BOLTS

TABLE IV

NOTES

[D] TORQUE CONTROLLED NUT RUNNERS SHOULD BE SET AT NOMINAL VALUE OR LESS TO ALLOW FOR OVERRIDE CAUSED BY INERTIA

$$T1 = \frac{TA}{A + B}$$

A = LENGTH OF TORQUE WRENCH, AND HANDLE EXTENSION IF USED.

B = LENGTH OF ADAPTER, AND EXTENSION BETWEEN ADAPTER AND TORQUE WRENCH IF USED.

T = ACTUAL TORQUE ON NUT (FROM FIG. 1 [A])

T1 = INDICATED TORQUE ON WRENCH (CORRECTED TORQUE WRENCH READING)

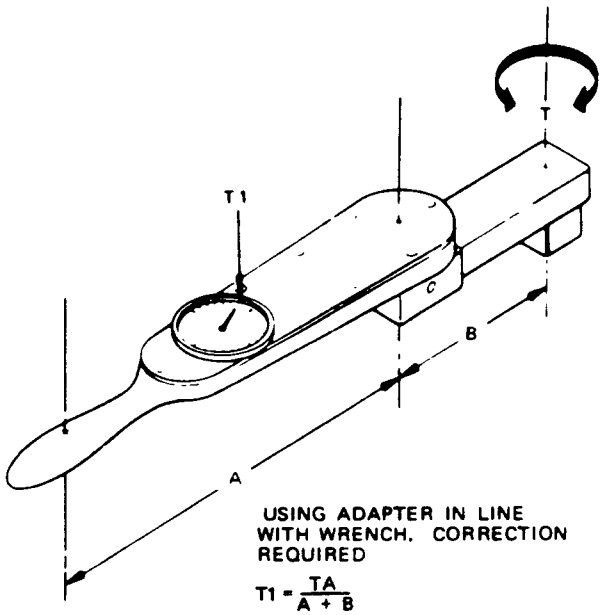
EXAMPLE: A = 12 IN.

B = 3 IN.

T = 160 POUND-INCHES

$$T1 = \frac{160 \times 12}{12 + 3}$$

T1 = 128 POUND-INCHES

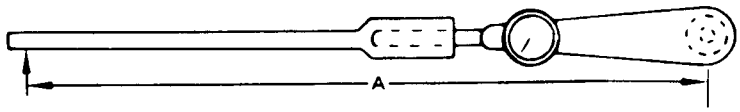


USING ADAPTER IN LINE WITH WRENCH. CORRECTION REQUIRED

$$T1 = \frac{TA}{A + B}$$

METHOD I

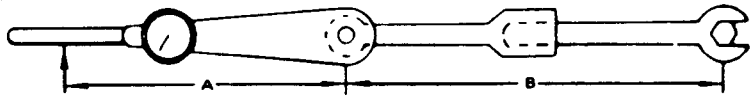
USING HANDLE EXTENSION ONLY
NO CORRECTION NECESSARY



METHOD II

USING ADAPTER WITH EXTENSION BETWEEN ADAPTER AND WRENCH BOTH IN LINE WITH WRENCH. CORRECTION REQUIRED

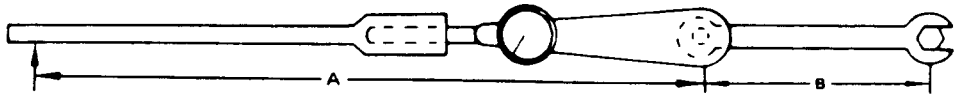
$$T1 = \frac{TA}{A + B}$$



METHOD III

USING BOTH HANDLE EXTENSION AND ADAPTER. CORRECTION REQUIRED [B]

$$T1 = \frac{TA}{A + B}$$

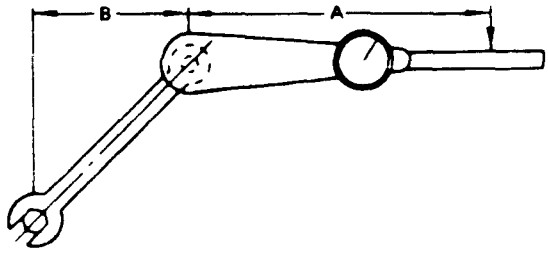


METHOD IV

Torque Wrench Adapters and Extensions
Figure 2 (Sheet 1)

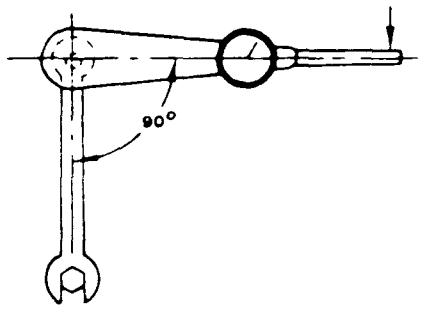
USING ADAPTER AT ANGLE OTHER THAN 90° CORRECTION REQUIRED

$$T1 = \frac{TA}{A + B}$$



METHOD V [C]

USING ADAPTER AT RIGHT ANGLE TO THE WRENCH NO CORRECTION NECESSARY



METHOD VI [C]

NOTES

[A] USE THE MIDDLE 50% OF THE TORQUE RANGE SPECIFIED BY THE TABLES IN FIG. 1 OR BY DRAWING CALLOUT

[B] THE LENGTH OF THE TORQUE WRENCH AND HANDLE EXTENSION MUST BE GREATER THAN THE LENGTH OF THE ADAPTER

[C] THESE METHODS SHOULD BE AVOIDED WHERE POSSIBLE. WHEN NECESSARY TO USE EITHER OF THESE METHODS THE FOLLOWING RESTRICTIONS MUST BE MET

1. THE ADAPTER PLUS ANY EXTENSIONS TO BE USED BETWEEN THE WRENCH AND ADAPTER SHALL NOT EXCEED THE LENGTH OF THE WRENCH
2. WHEN A FORCE IS APPLIED AT 90±3 DEGREES TO THE HANDLE OF THE WRENCH IT IS RECOMMENDED THAT A STIRRUP TYPE HANDLE WITH A POINTER INDICATING ANGLE OF LOADING BE USED TO ENSURE LOADING AT THE CORRECT ANGLE

FASTENER HOLE SIZES

1. General

A. Hole sizes for rivets, bolts, lockbolts and Hi-lok bolts are shown in Fig. 1.

B. Hole sizes for tapered shank fasteners are shown in Fig. 2. They are obtained in practice by the use of a special tool which has been ground to produce a hole within the limits specified, and this should then give the head protrusion before driving shown in 51-2-2.

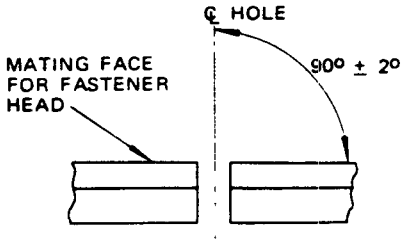
C. Cold working of holes is required in certain locations to improve the fatigue life. This is achieved by reaming an undersize hole and drawing a special tool through the hole to enlarge it by compressing the metal locally around the periphery. Details of reamer sizes, finished hole dimensions and special tools are shown in 51-2-11.

D. To determine the position of existing fastener holes obscured by repair parts, where access to the inner face is not available, a hole finder may be used. A simple form of this tool is shown in Fig. 4. Each hole size requires a tool with a peg of the appropriate diameter.

NOTES

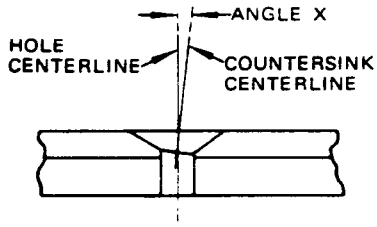
[A] UNLESS OTHERWISE SPECIFIED ON DRAWING OR REPAIR FIGURE

[B] WHERE THICKNESS OF SHEET ADJACENT TO COLLAR IS LESS THAN 0.25 X FASTENER DIAMETER, OR TOTAL MATERIAL THICKNESS IS GREATER THAN 4 X FASTENER DIAMETER, USE CLASS 1 HOLES AS SHOWN IN TABLE III



HOLES FOR ALL PROTRUDING AND FLUSH HEAD FASTENERS MUST BE WITHIN 2° OF PERPENDICULAR TO THE FACE ON WHICH THE FASTENER HEAD BEARS.

DETAIL I



LOCKBOLT DIAMETER	ANGLE X
3/16	4°
1/4	4°
5/16	3°
3/8	2°

PERMISSIBLE COUNTERSINK MALALIGNMENT FOR PULL TYPE SHEAR LOCKBOLTS

DETAIL II

Fastener Hole Sizes
Figure 1 (Sheet 1)

HOLE SELECTION CRITERIA

FASTENER TYPE		HOLE REQUIREMENT [A]	
	FIGURE NUMBER IN 51-2-1	NAS618 DESIGNATION	TABLE
SOLID SHANK RIVETS	FIGURE 2 TABLE I AND II		IV
SOLID SHANK RIVETS IN COLD WORKED HOLES	FIGURE 2 TABLE I AND II		SEE FIG. 3
SOLID SHANK SHEAR HEAD RIVETS	FIGURE 2 TABLE I AND II		V
SOLID SHANK FLUID TIGHT RIVETS	FIGURE 2 TABLE I AND II		VI
BLIND RIVETS	FIGURE 2 TABLE I		VII
BLIND BOLTS	FIGURE 2 TABLE I		VIII
LOCKBOLTS INSTALLED IN ALUMINUM	FIGURE 3 TABLE I	TRANSITION FIT	II [B]
LOCKBOLTS INSTALLED IN STEEL	FIGURE 3 TABLE I	CLOSE REAM	I
HI-LOK BOLTS INSTALLED IN ALUMINUM	FIGURE 4 TABLE I	TRANSITION FIT	II
HI-LOK BOLTS INSTALLED IN STEEL	FIGURE 4 TABLE I	CLOSE REAM	I
CLOSE TOLERANCE BOLTS WITH LESS THAN FOUR FASTENERS IN JOINT	FIGURE 4 TABLE II	CLOSE REAM	I
STANDARD BOLTS AND CLOSE TOLERANCE BOLTS WITH FOUR OF MORE FASTENERS IN JOINT	FIGURE 4 TABLE II	CLASS I	III
TAPERED SHANK FASTENERS	FIGURE 5		SEE FIG. 2

Fastener Hole Sizes
Figure 1 (Sheet 2)

FASTENER DIAMETER	HOLE DIAMETER LIMITS							
	STANDARD		1/64 OVERSIZE		1/32 OVERSIZE		3/64 OVERSIZE	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
3/16	0 1895	0 1905	0.2026	0.2036	0 2182	0.2192	0.2339	0.2349
1/4	0.2495	0.2505	0.2651	0 2661	0.2807	0.2817	0.2963	0.2973
5/16	0 3120	0.3130	0.3276	0 3286	0.3432	0.3442	0.3589	0.3599
3/8	0 3745	0 3755	0.3901	0 3911	0 4057	0 4067	0.4214	0.4224
7/16	0.4370	0.4380	0.4526	0.4536	0 4682	0 4692	0.4838	0.4848
1/2	0 4995	0 5005	0 5151	0.5161	0.5307	0.5317	0.5464	0.5474

CLOSE REAMED HOLES

TABLE I

FASTENER DIAMETER	HOLE DIAMETER LIMITS							
	NORMAL SIZE		1/64 OVERSIZE		1/32 OVERSIZE		3/64 OVERSIZE	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
3/16	0 187	0 190	0.200	0.203	0.216	0.219	0.231	0.234
1/4	0 247	0 250	0 263	0.266	0.278	0 281	0.294	0.297
5/16	0 309	0.313	0.325	0.328	0.341	0.344	0.356	0.360
3/8	0.371	0 375	0 388	0.391	0.403	0 406	0.418	0.422
7/16	0 434	0 438	0 450	0 453	0.466	0.469	0.481	0.485
1/2	0.496	0 500	0.513	0 516	0 528	0 531	0.543	0.547

TRANSITION FIT HOLES

TABLE II

FASTENER DIAMETER	HOLE DIAMETER LIMITS							
	STANDARD		1/64 OVERSIZE		1/32 OVERSIZE		3/64 OVERSIZE	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
5/32	0 164	0 168						
3/16	0 190	0 194	0 203	0.207	0 219	0 223	0.234	0.239
1/4	0.250	0 254	0.266	0 270	0 281	0 285	0.297	0.301
5/16	0 312	0 316	0 328	0 332	0 344	0 348	0.359	0.363
3/8	0 375	0 379	0 391	0 395	0 406	0 410	0.422	0.426
7/16	0 4375	0.4425	0 453	0 458	0 469	0 474	0.484	0.489
1/2	0 500	0 505	0.516	0 521	0 531	0 536	0.547	0.552

CLASS 1 HOLES

TABLE III

Fastener Hole Sizes
Figure 1 (Sheet 3)

RIVET DIAMETER	RECOMMENDED DRILL SIZE STANDARD HOLE	HOLE DIAMETER LIMITS			
		STANDARD		1/32 OVERSIZE	
		MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
3/32	40 (0.098)	0 098	0 103		
1/8	30 (0.128)	0 128	0 135		
5/32	20 (0.161)	0 159	0 171		
3/16	10 (0.194)	0 191	0 202	0 218	0 233
1/4	F (0.257)	0 254	0.265	0 281	0.296
5/16	O (0.316)	0 316	0 327	0 343	0.358
3/8	V (0.377)	0.377	0.390	0 406	0 421

HOLES SIZES FOR STANDARD SOLID SHANK ALUMINUM RIVETS

TABLE IV

RIVET DIAMETER	HOLE DIAMETER			
	STANDARD		1/32 OVERSIZE	
	MIN	MAX	MIN	MAX
5/32	0 159	0 167		
3/16	0 190	0 198	0.223	0 231
1/4	0.255	0.261	0 286	0 294

HOLE SIZES FOR SHEAR HEAD RIVETS BACR15CE AND BACR15DS

TABLE V

RIVET DIAMETER	HOLE DIAMETER			
	STANDARD		1/32 OVERSIZE	
	MIN	MAX	MIN	MAX
3/16	0 190	0 193	0 222	0 223
1/4	0.253	0 256	0 285	0.286
5/16	0 315	0 318	0 348	0 349
3/8	0.378	0.381	0 411	0 412

HOLE SIZES FOR FLUID TIGHT RIVETS

TABLE VI

Fastener Hole Sizes
Figure 1 (Sheet 4)

NOMINAL FASTENER DIAMETER	HOLE DIAMETER			
	NAS 1398 AND NAS 1399		NAS 1738 AND NAS 1739	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
1/8	0.129	0.132	0.143	0.146
5/32	0.160	0.164	0.176	0.180
3/16	0.192	0.196	0.205	0.209
1/4	0.256	0.261	0.271	0.275

HOLE SIZES FOR BLIND RIVETS

TABLE VII

FASTENER DIAMETER	HOLE DIAMETER	
	MINIMUM	MAXIMUM
5/32	0 164	0 167
3/16	0 199	0 202
1/4	0 260	0.263
5/16	0 312	0 315
3/8	0.374	0.378

HOLE SIZES FOR HUCK BLIND BOLTS
BACB30LA AND BACB30LB

TABLE VIII

Fastener Hole Sizes
Figure 1 (Sheet 5)

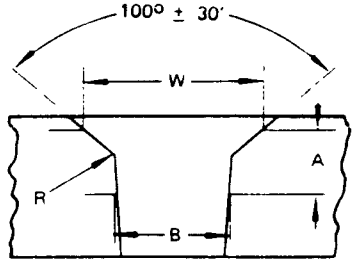
NOTE

- THE DIMENSIONS OF TAPERED HOLES FOR TAPER SHANK BOLTS VARY WITH THE LENGTH OF THE FASTENER. FOR CONVENIENCE THEY ARE DIVIDED INTO GROUPS DETERMINED BY LENGTH, EACH GROUP REQUIRING HOLES OF DIFFERENT DIMENSIONS EVEN THOUGH THE BASIC FASTENER SIZE REMAINS CONSTANT. TO SELECT THE GROUP NUMBER FOR THE FASTENER CALCULATE OR MEASURE THE TOTAL MATERIAL THICKNESS AND REFER TO TABLE 1. THE APPROPRIATE HOLE DIMENSIONS FOR THE GROUP MAY THEN BE DETERMINED FROM TABLE II OR III. IN PRACTICE THESE DIMENSIONS SHOULD BE USED FOR TOOL CHECKING, IN ORDER THAT THE TOOL WILL PRODUCE AN ACCEPTABLE HOLE. THESE TOOLS WILL BE FOUND LISTED IN TABLE IV
- HOLES MUST BE WITHIN 2 DEGREES OF PERPENDICULAR TO THE FACE ON WHICH THE BOLT HEAD IS TO BE INSTALLED

BASIC FASTENER SIZE	THICKNESS OF MATERIAL TO BE BOLTED	STANDARD FASTENER	OVERSIZE FASTENER	DOUBLE OVERSIZE FASTENER	TRIPLE OVERSIZE FASTENER
3/16	0.126 TO 0.500	1	2	3	4
	0.501 TO 1.000	2	3	4	5
	1.001 TO 1.500			5	6
1/4	0.126 TO 0.625	1	2	3	4
	0 626 TO 1.250	2	3	4	5
	1.251 TO 1.875	3	4	5	6
5/16	0.126 TO 0.687	1	2	3	4
	0.688 TO 1.375	2	3	4	5
	1.376 TO 2.062	3	4	5	6
3/8	0 188 TO 0.750	1	2	3	4
	0.751 TO 1.500	2	3	4	5
	1 501 TO 2.250	3	4	5	6
	2.251 TO 3.000	4	5	6	
7/16	0 251 TO 0.875	1	2	3	4
	0 876 TO 1 750	2	3	4	5
	1 751 TO 2.625	3	4	5	6
	2.626 TO 3 500	4	5	6	

TABLE I FASTENER GROUP NUMBERS

Fastener Hole Sizes for Taper Shank Bolts
Figure 2 (Sheet 1)



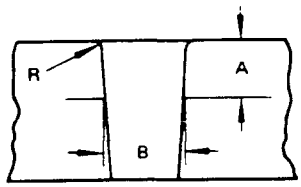
HOLE FOR COUNTERSUNK
FASTENER - SEE TABLE II

INCLUDED TAPER = 0.0208 (± 0.0010)
CONCENTRICITY = 0.001

BASIC FASTENER DIA	GROUP (FROM TABLE I)	DIM. A	DIM. B		RAD. R +0.010 -0.000	DIM. W +0.0002 -0.0000
			MIN	MIX		
3/16	1	0.0706	0.1969	0.1982	0.025	0.2438
	2	0.0662	0.2073	0.2086		
	3	0.0620	0.2177	0.2190		
	4	0.0578	0.2281	0.2302		
	5	0.0689	0.2385	0.2398		0.2808
	6	0.0646	0.2489	0.2502		
1/4	1	0.0812	0.2586	0.2602	0.025	0.3312
	2	0.0758	0.2716	0.2732		
	3	0.0704	0.2846	0.2862		
	4	0.0650	0.2976	0.2992		
	5	0.0789	0.3107	0.3123		0.3770
	6	0.0735	0.3237	0.3253		
5/16	1	0.0872	0.3216	0.3235	0.035	0.4045
	2	0.0813	0.3359	0.3378		
	3	0.0753	0.3503	0.3522		
	4	0.0693	0.3646	0.3665		
	5	0.0858	0.3789	0.3808		0.4582
	6	0.0818	0.3930	0.3949		
3/8	1	0.0962	0.3847	0.3869	0.035	0.4852
	2	0.0898	0.4003	0.4025		
	3	0.0833	0.4159	0.4181		
	4	0.0767	0.4315	0.4337		
	5	0.0957	0.4472	0.4494		0.5462
	6	0.0891	0.4628	0.4650		
7/16	1	0.1088	0.4488	0.4513	0.045	0.5696
	2	0.1013	0.4670	0.4695		
	3	0.0937	0.4852	0.4877		
	4	0.0861	0.5053	0.5060		
	5	0.1105	0.5217	0.5242		0.6498
	6	0.1087	0.5399	0.5424		

TABLE II - HOLES FOR COUNTERSUNK TAPER SHANK BOLTS

Fastener Hole Sizes for Taper Shank Bolts
Figure 2 (Sheet 2)



HOLE FOR PROTRUDING HEAD FASTENER – SEE TABLE III

INCLUDED TAPER = 0.0208 ± 0.0010 PER INCH
CONCENTRICITY = 0.001

BASIC FASTENER DIA	GROUP (FROM TABLE I)	DIM A	DIM B		RAD. R +0.010 -0.000
			MIN	MAX	
3/16	1	0.0555	0.1978	0.1991	0.020
	2		0.2082	0.2095	
	3		0.2186	0.2199	
	4		0.2290	0.2303	
	5		0.2394	0.2407	
	6		0.2498	0.2511	
1/4	1	0.0555	0.2598	0.2614	0.020
	2		0.2728	0.2744	
	3		0.2853	0.2874	
	4		0.2988	0.3004	
	5		0.3119	0.3135	
	6		0.3249	0.3265	
5/16	1	0.0575	0.3229	0.3248	0.025
	2		0.3373	0.3392	
	3		0.3516	0.3535	
	4		0.3659	0.3678	
	5		0.3802	0.3821	
	6		0.3946	0.3965	
3/8	1	0.0605	0.3862	0.3884	0.025
	2		0.4018	0.4040	
	3		0.4174	0.4196	
	4		0.4330	0.4352	
	5		0.4487	0.4509	
	6		0.4643	0.4665	
7/16	1	0.0655	0.4507	0.4532	0.035
	2		0.4689	0.4714	
	3		0.4871	0.4896	
	4		0.5053	0.5078	
	5		0.5236	0.5261	
	6		0.5418	0.5443	

TABLE III - HOLES FOR PROTRUDING HEAD TAPER SHANK BOLTS

Fastener Hole Sizes for Taper Shank Bolts
Figure 2 (Sheet 3)

BASIC FASTENER SIZE	GROUP (SEE TABLE I)	PART NUMBER OF SIX FLUTED REAMER	
		COUNTERSUNK HEAD	PROTRUDING HEAD
3/16	1	TLD2060AR-1-3	TLD2060BR-1-3
	2	-2-3	-2-3
	3	-3-3	-3-3
	4	-4-3	-4-3
	5	-5-3	-5-3
	6	-6-3	-6-3
1/4	1	TLD2060AR-1-4	TLD2060BR-1-4
	2	-2-4	-2-4
	3	-3-4	-3-4
	4	-4-4	-4-4
	5	-5-4	-5-4
	6	-6-4	-6-4
5/16	1	TLD2060AR-1-5	TLD2060BR-1-5
	2	-2-5	-2-5
	3	-3-5	-3-5
	4	-4-5	-4-5
	5	-5-5	-5-5
	6	-6-5	-6-5
3/8	1	TLD2060AR-1-6	TLD2060BR-1-6
	2	-2-6	-2-6
	3	-3-6	-3-6
	4	-4-6	-4-6
	5	-5-6	-5-6
	6	-6-6	-6-6
7/16	1	TLD2060AR-1-7	TLD2060BR-1-7
	2	-2-7	-2-7
	3	-3-7	-3-7
	4	-4-7	-4-7
	5	-5-7	-5-7
	6	-6-7	-6-7

SPECIAL TOOLS
TABLE IV

Fastener Hole Sizes for Taper Shank Bolts
Figure 2 (Sheet 4)

BASIC FASTENER SIZE	GROUP (SEE TABLE I)	PART NUMBER OF SIX FLUTED REAMER	
		COUNTERSUNK HEAD	PROTRUDING HEAD
1/2	2 3	TLD2060AR-2-8 -3-8	TLD2060BR-2-8 -3-8
9/16	3 4	TLD2060AR-3-9 -4-9	TLD2060BR-3-9 -4-9
3/4	2 3	TLD2060AR-2-12 -3-12	TLD2060BR-2-12 -3-12

SPECIAL TOOLS
TABLE IV (CONT.)

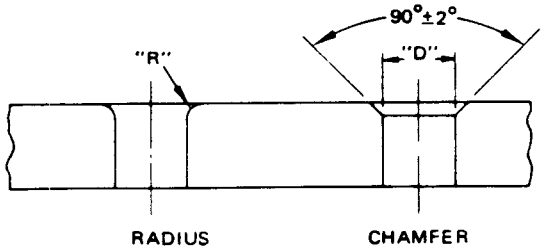
NOTES

- ABOVE TOOLS MAY BE OBTAINED FROM

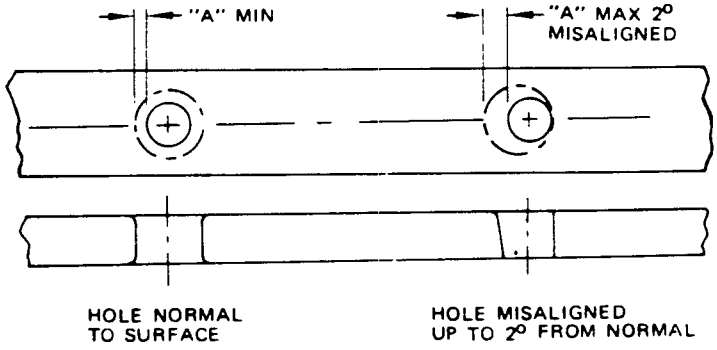
DEUTSCH FASTENER CORPORATION
1315 EAST GRAND AVENUE
EL SEGUNDO, CALIFORNIA 90245

Fastener Hole Size for Taper Shank Bolts
Figure 2 (Sheet 5)

BOLT DIA	BACB30NG		BACB30MT, B30LE, B30MR, B30NH, B30FD, B30NK, B30PN		ALL OTHER PROTRUDING HEAD BOLTS	
	"R" RADIUS	"D" CHAMFER DIA	"R" RADIUS	"D" CHAMFER DIA	"R" RADIUS	"D" CHAMFER DIA
3/16	0.041 – 0.051	0.272 – 0.292	0.041 – 0.051	0.272 – 0.292	0.020 – 0.030	0.230 – 0.250
1/4	0.045 – 0.055	0.340 – 0.360	0.041 – 0.051	0.332 – 0.352	0.020 – 0.030	0.290 – 0.310
5/16	0.050 – 0.060	0.412 – 0.432	0.041 – 0.051	0.394 – 0.414	0.020 – 0.030	0.352 – 0.372
3/8	0.054 – 0.064	0.483 – 0.503	0.057 – 0.067	0.489 – 0.509	0.025 – 0.035	0.425 – 0.445
7/16	0.058 – 0.068	0.553 – 0.573	0.057 – 0.067	0.551 – 0.571	0.025 – 0.035	0.487 – 0.507
1/2	0.063 – 0.073	0.626 – 0.646	0.057 – 0.067	0.614 – 0.634	0.030 – 0.040	0.560 – 0.580



FILLET RELIEF FOR PROTRUDING HEAD STRAIGHT SHANK BOLT HOLES



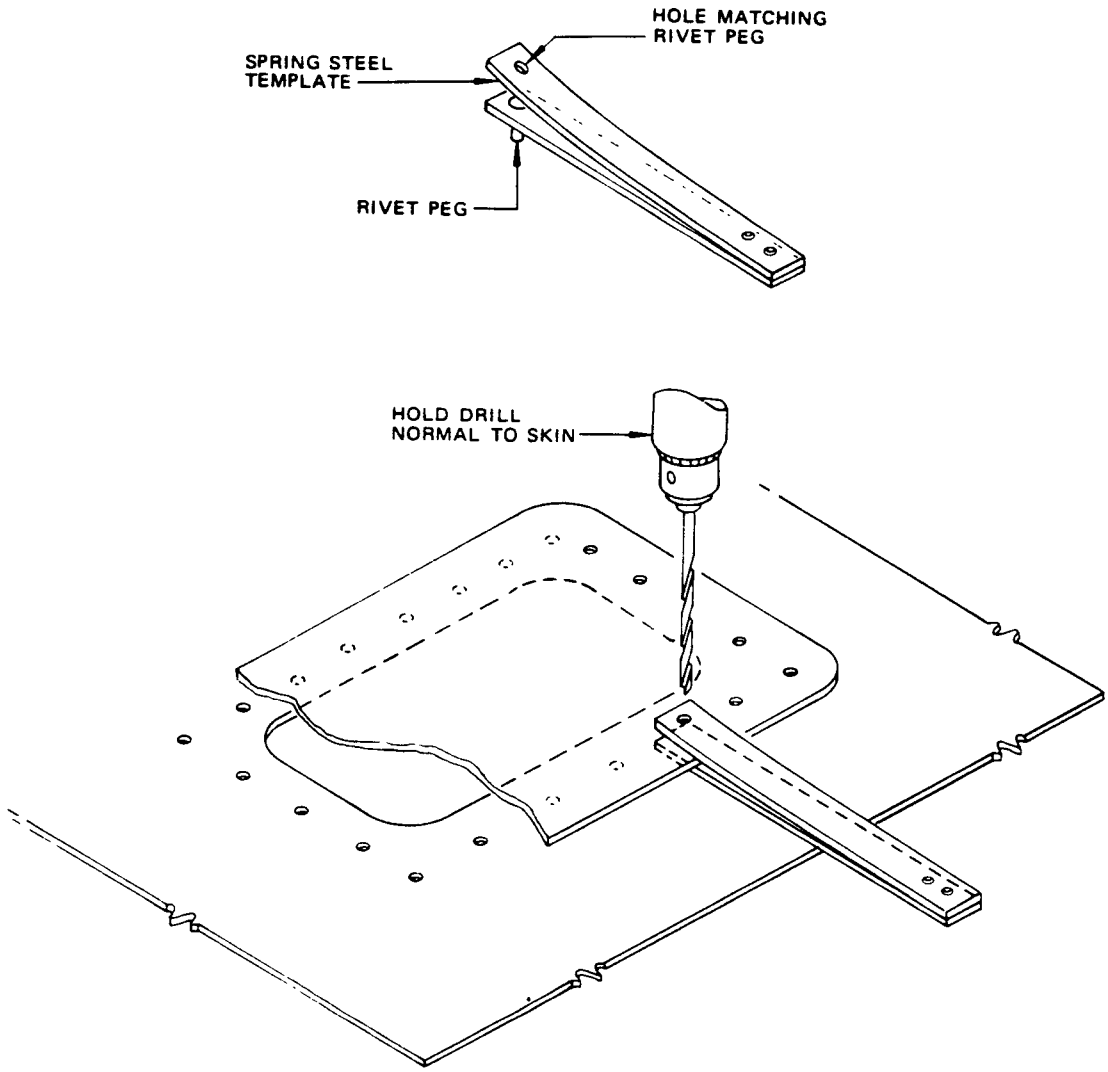
FASTENER DIAMETER	A	
	MIN.	MAX.
1/4	0.015	0.065
5/16	0.020	0.080
3/8	0.020	0.088
7/16	0.030	0.108
1/2	0.030	0.116
9/16	0.063	0.124
3/4	0.063	0.156

NOTE

"A" IS MEASURED AT THE POINT WHERE THE RELIEF IS GREATEST.

FILLET RELIEF LIMITS FOR PROTRUDING HEAD TAPER SHANK BOLT HOLES

Fillet Relief for Protruding Head Bolt Holes
Figure 3



Hole Finder
Figure 4

FASTENER EDGE MARGIN

1. General

A. Fastener edge margins for structural applications are tabulated in figure 1. Table I lists edge margin for standard flush and protruding head rivets installed in aluminum and magnesium alloys. Table II lists edge margins for standard flush and protruding head rivets installed in steel alloys. Table III and IV list edge margins for bolts, lockbolts, hi-shear rivets and blind fasteners installed in aluminum and magnesium alloys. Reduced edge margins may be used when necessary to meet clearance or repair requirements. Minimum edge margins are obtained by subtracting 0.05 from the values given in figure 1.

B. Fastener edge margin as used in this manual is the distance from the center of the hole to the nearest edge of a sheet.

TABLE I. RIVET EDGE MARGINS FOR ALUMINUM AND MAGNESIUM

RIVETED MATERIAL		UNIVERSAL HEAD RIVETS IN STRAIGHT HOLES														100° RIVETS IN DIMPLED HOLES						100 RIVETS IN CSK HOLES						
		SINGLE SHEAR							DOUBLE SHEAR							SINGLE SHEAR						SINGLE SHEAR						
		RIVET DIAMETERS																										
		3/32	1/8	5/32	3/16	1/4	5/16	3/8	3/32	1/8	5/32	3/16	1/4	5/16	3/8	3/32	1/8	5/32	3/16	1/4	5/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8
ALLOY	CAGE	EDGE MARGINS ±.05																										
ALL ALUMINUM ALLOYS EXCEPT CASTINGS	.012	.21							.21	.27	.32					.21												
	.016	.21	.27						.21	.27	.32					.21	.27											
	.018	.21	.27						.21	.27	.32					.21	.27											
	.020	.21	.27	.32					.21	.27	.32					.21	.27	.32										
	.022	.21	.27	.32					.21	.27	.32					.21	.27	.32										
	.025	.21	.27	.32					.21	.27	.32					.21	.27	.32										
	.028	.21	.27	.32					.21	.27	.32					.21	.27	.32										
	.032	.20	.27	.32	.37				.21	.27	.32					.20	.27	.32	.37									
	.036	.19	.26	.32	.37				.21	.27	.32					.19	.26	.32	.37									
	.040	.18	.26	.32	.37	.48			.21	.27	.32	.37	.48			.18	.26	.32	.37	.48	.59	.21	.29	.36	.43	.57		
	.045	.17	.24	.32	.37	.48			.21	.27	.32	.37	.48			.17	.24	.32	.37	.48	.59	.20	.27	.36	.43	.57		
	.050	.17	.23	.32	.37	.48	.58		.21	.27	.32	.37	.48			.17	.23	.32	.37	.48	.59	.20	.26	.35	.42	.56	.67	
	.056	.17	.22	.29	.37	.48	.58		.21	.27	.32	.37	.48	.58		.17	.23	.29	.37	.48		.20	.25	.32	.41	.56	.67	
	.063	.17	.21	.28	.36	.48	.58	.69	.20	.27	.32	.37	.48	.58	.69	.17	.22	.28	.36	.48		.20	.24	.31	.40	.55	.67	.81
	.071		.21	.26	.33	.48	.58	.69		.27	.32	.37	.48	.58	.69		.22	.28	.35				.24	.29	.37	.55	.66	.80
(ALUMINUM ALLOY RIVETS)	.080		.21	.25	.31	.47	.58	.69		.26	.32	.37	.48	.58	.69								.24	.28	.34	.53	.66	.79
	.090		.21	.25	.29	.44	.58	.69		.25	.32	.37	.48	.58	.69								.24	.28	.32	.50	.65	.79
	.100		.21	.25	.29	.41	.58	.69		.23	.31	.37	.48	.58	.69								.24	.28	.32	.46	.64	.79
	.112			.25	.29	.39	.54	.69			.29	.37	.48	.58	.69									.28	.32	.44	.60	.78
	.125			.24	.29	.37	.50	.67			.28	.36	.48	.58	.69									.28	.32	.41	.55	.75
	.140			.25	.29	.37	.47	.62			.26	.33	.48	.58	.69									.28	.32	.40	.52	.70
	.160			.25	.29	.37	.46	.57			.24	.31	.47	.58	.69									.28	.32	.40	.50	.64
	.180				.29	.37	.46	.54				.29	.44	.58	.69										.32	.40	.50	.60
	.190				.29	.37	.46	.54				.29	.43	.58	.69										.32	.40	.49	.60
	.200				.29	.37	.46	.54				.29	.41	.58	.69										.32	.40	.49	.59
	.224				.29	.37	.46	.54				.29	.39	.54	.68										.32	.40	.49	.58
	.250				.29	.37	.46	.54				.29	.37	.50	.67										.32	.40	.49	.58
ADD FOR CASTINGS		.10			.20			.30	.10			.20			.30							.10			.20			.30
ALL MAG ALLOYS EXCEPT CASTINGS	.016	.25	.31						.25							.25												
	.018	.25	.31						.25							.25												
	.020	.25	.31						.25	.31						.25	.31											
	.022	.25	.31						.25	.31						.25	.31											
	.025	.25	.31	.38					.25	.31	.38					.25	.31	.38										
	.028	.25	.31	.38					.25	.31	.38					.25	.31	.38										
	.032	.25	.31	.38	.44				.25	.31	.38	.44				.25	.41	.38	.44									
	.036	.24	.31	.38	.44				.25	.31	.38	.44				.24	.31	.38	.44									
	.040	.24	.31	.38	.44				.25	.31	.38	.44				.24	.31	.38	.44			.27	.34	.42	.50	.67		
	.045	.21	.31	.38	.44				.25	.31	.38	.44				.21	.31	.38	.44			.24	.34	.42	.50	.67		
	.050	.21	.31	.38	.44	.58			.25	.31	.38	.44	.58			.21	.31	.38	.44	.58		.24	.34	.41	.49	.66	.80	
	.056	.21	.29	.38	.44	.58			.25	.31	.38	.44	.58			.21	.29	.38	.44	.58		.24	.32	.41	.49	.66	.80	
	.063	.21	.27	.37	.44	.58	.71		.25	.31	.38	.44	.58	.71		.21	.27	.37	.44	.58	.71	.24	.30	.40	.48	.65	.80	.96
	.071		.26	.34	.44	.58	.71	.84	.25	.31	.38	.44	.58	.71	.84		.26	.34	.44	.58	.71		.29	.37	.48	.65	.79	.95
	.080		.26	.32	.42	.58	.71	.84	.23	.31	.38	.44	.58	.71	.84		.26	.32	.42	.58			.29	.35	.45	.64	.79	.94
(ALUMINUM ALLOY RIVETS)	.090			.32	.39	.56	.71	.84	.22	.31	.38	.44	.58	.71	.84			.32	.39					.35	.42	.64	.78	.94
	.100			.32	.37	.57	.71	.84	.21	.31	.38	.44	.58	.71	.84									.35	.40	.62	.77	.94
	.112				.37	.52	.71	.84	.21	.29	.38	.44	.58	.71	.84									.35	.40	.58	.77	.94
	.125				.37	.49	.69	.84	.21	.27	.37	.44	.58	.71	.84									.35	.40	.53	.74	.93
	.140					.48	.64	.84		.26	.35	.44	.58	.71	.84									.35	.40	.53	.71	.92
	.160					.48	.59	.79		.26	.32	.43	.58	.71	.84									.35	.40	.51	.63	.86
	.180					.48	.58	.73		.26	.32	.39	.58	.71	.84										.40	.51	.63	.81
	.190					.48	.58	.70		.26	.32	.38	.58	.71	.85										.40	.51	.61	.76
	.200					.48	.58	.69		.26	.32	.37	.57	.71	.84										.40	.51	.61	.75
	.224						.58	.69				.37	.52	.71	.84										.40	.51	.61	.75
	.250						.58	.69				.37	.49	.69	.84										.40	.51	.61	.73
ADD FOR CASTINGS		.10			.20		.30		.10			.20		.30								.10			.20			.30

Fastener Edge Margins
Figure 1 (Sheet 1 of 3)

TABLE II. RIVET EDGE MARGINS FOR STEEL

RIVETED MATERIAL		UNIVERSAL HEAD RIVETS IN STRAIGHT HOLES													100° RIVETS IN DIMPLED HOLES						100° RIVETS IN CSK HOLES						
		SINGLE SHEAR							DOUBLE SHEAR							SINGLE SHEAR						SINGLE SHEAR						
		RIVET DIAMETERS																									
		3/32	1/8	5/32	3/16	1/4	5/16	3/8	3/32	1/8	5/32	3/16	1/4	5/16	3/8	3/32	1/8	5/32	3/16	1/4	5/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8
ALLOY	GAGE	EDGE MARGINS ±.05																										
CORROSION RESISTANT STEEL SHEET, AISI 301 AND 302, ALSO ALLOY STEEL HT TO 100,000 PSI OR GREATER (MONEL RIVETS)	.010	.20	.25	.30	.35	.45			.20	.25	.30	.35	.45			.20	.25	.30	.35	.47								
	.012	.20	.25	.30	.35	.45			.20	.25	.30	.35	.45			.20	.25	.30	.35	.47								
	.016	.20	.25	.30	.35	.45			.20	.25	.30	.35	.45			.20	.25	.30	.35	.47								
	.018	.20	.25	.30	.35	.45			.20	.25	.30	.35	.45			.20	.25	.30	.35	.47								
	.020	.20	.25	.30	.35	.45			.20	.25	.30	.35	.45			.20	.25	.30	.35	.45								
	.022	.18	.25	.30	.35	.45			.20	.25	.30	.35	.45			.18	.25	.30	.35	.47								
	.025	.18	.25	.30	.35	.45			.20	.25	.30	.35	.45			.18	.25	.30	.35	.47								
	.028	.18	.24	.30	.35	.45			.20	.25	.30	.35	.45			.18	.24	.30	.35	.47		.21						
	.032	.18	.23	.30	.35	.45			.20	.25	.30	.35	.45			.18	.23	.30	.35	.47		.21						
	.036	.18	.23	.29	.35	.45			.20	.25	.30	.35	.45			.18	.23	.29	.35	.47		.21						
	.040	.18	.23	.28	.35	.45			.20	.25	.30	.35	.45			.18	.23	.28	.35	.47		.21	.26	.31	.41	.53		
	.045	.18	.23	.27	.35	.45			.20	.25	.30	.35	.45			.18	.23	.28	.35	.47		.21	.26	.31	.39	.53		
	.050	.17	.23	.27	.32	.45			.18	.25	.30	.35	.45			.17	.23	.28	.35	.47		.20	.26	.30	.36	.53		
	.056	.17	.22	.27	.32	.41			.18	.23	.30	.35	.45			.17	.23	.28	.35	.47		.20	.25	.30	.36	.49		
	.063	.17	.21	.27	.32	.41			.18	.23	.30	.35	.45			.17	.22	.28	.35	.47		.20	.24	.30	.35	.48		
	.071	.17	.21	.27	.32	.41			.18	.23	.28	.35	.45			.17	.22	.28	.35	.47		.20	.24	.30	.35	.48		
	.080	.17	.21	.25	.32	.40			.18	.23	.27	.35	.45			.17	.22	.28	.35	.47		.20	.24	.28	.35	.46		
	.090		.21	.25	.29	.40			.17	.23	.27	.33	.45			.17	.22	.28	.35	.47			.24	.28	.33	.46		
	.100			.25	.29	.40			.17	.23	.27	.32	.45			.17	.22	.28	.35	.47				.28	.32	.46		
	.112			.25	.29	.39			.17	.22	.27	.31	.44			.17	.22	.28	.35	.47				.28	.32	.44		
	.125				.29	.37			.17	.21	.27	.31	.41			.17	.22	.28	.35	.47					.32	.41		
	.140					.37				.21	.27	.31	.41													.41		
	.160					.37				.21	.25	.31	.40													.40		
	.180					.37				.21	.25	.29	.40													.40		
	.190					.37				.21	.25	.29	.40													.40		
	.200					.37					.25	.29	.40													.40		
	.224					.37					.25	.29	.40													.40		
	.250					.37					.25	.29	.37													.40		

TABLE III. BOLT EDGE MARGINS FOR MAGNESIUM

BOLTED MATERIAL		PROTRUDING HEAD																100° COUNTERSUNK								100° DIMP.		
		SINGLE SHEAR								DOUBLE SHEAR								SINGLE SHEAR										
		BOLT DIAMETERS																										
		3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/16	1/4	5/16
		BOLTS - STEEL - 125,000 - 145,000 PSI																										
ALLOY	GAGE	EDGE MARGIN ±.05																										
MAG	.040	.44	.58							.44	.58															.44	.58	
	.045	.44	.58							.44	.58															.44	.58	
	.050	.44	.58							.44	.58							.50	.67							.44	.58	
	.056	.44	.58							.44	.58							.50	.67							.44	.58	
	.063	.44	.58	.71						.44	.58	.71						.50	.67	.83						.44	.58	.71
	.071	.44	.58	.71	.84					.44	.58	.71	.84					.49	.66	.83	.99					.44	.58	.71
	.080	.44	.58	.71	.84	.97				.44	.58	.71	.84	.97				.49	.66	.82	.98	1.14				.44	.58	.71
	.090	.44	.58	.71	.84	.97	1.10			.44	.58	.71	.84	.97	1.10			.48	.65	.81	.98	1.14	1.30			.44	.58	.71
	.100	.44	.58	.71	.84	.97	1.10			.44	.58	.71	.84	.97	1.10			.48	.65	.81	.98	1.13	1.29			.44	.58	.71
	.112	.44	.58	.71	.84	.97	1.10			.44	.58	.71	.84	.97	1.10			.48	.64	.80	.98	1.13	1.29			.44	.58	.71
	.125	.44	.58	.71	.84	.97	1.10			.44	.56	.71	.84	.97	1.10			.47	.63	.79	.98	1.12	1.28			.44	.58	.71
	.140	.44	.58	.71	.84	.97	1.10			.44	.58	.71	.84	.97	1.10			.47	.63	.79	.95	1.11	1.27					
	.160	.44	.58	.71	.84	.97	1.10			.44	.58	.71	.84	.97	1.10			.47	.62	.78	.93	1.10	1.26					
	.180	.44	.58	.71	.84	.97	1.10			.44	.58	.71	.84	.97	1.10			.47	.62	.77	.93	1.09	1.25					
	.190	.44	.58	.71	.84	.97	1.10			.44	.58	.71	.84	.97	1.10			.47	.62	.77	.93	1.09	1.25					
	.200	.44	.58	.71	.84	.97	1.10			.44	.58	.71	.84	.97	1.10			.47	.61	.76	.91	1.07	1.23					
	.224	.42	.58	.71	.84	.97	1.10			.44	.58	.71	.84	.97	1.10			.43	.61	.76	.91	1.06	1.22					
	.250	.39	.58	.71	.84	.97	1.10			.44	.58	.71	.84	.97	1.10			.42	.61	.75	.90	1.05	1.21					

Fastener Edge Margins
Figure 1 (Sheet 2 of 3)

TABLE IV. BOLT EDGE MARGINS FOR ALUMINUM

BOLTED MATERIAL		PROTRUDING HEAD																100° COUNTERSUNK								100° DIMP.		
		SINGLE SHEAR								DOUBLE SHEAR								SINGLE SHEAR										
		BOLT DIAMETERS																										
		3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/16	1/4	5/16
		BOLTS - STEEL - 160,000 - 180,000 PSI																										
ALLOY	GAGE	EDGE MARGIN ± .05																										
ALUM-INUM	.032	.37	.49							.37	.49															.37	.48	
	.036	.37	.49							.37	.49															.37	.48	
	.040	.37	.49							.37	.49															.37	.48	
	.045	.37	.49							.37	.49															.37	.48	
	.050	.37	.49	.59						.37	.49	.59						.43	.57							.37	.48	.59
	.056	.37	.49	.59						.37	.49	.59						.43	.57							.37	.48	.59
	.063	.37	.49	.59	.69					.37	.49	.59	.69					.43	.57	.70	.84	.97	1.12			.37	.48	.59
	.071	.37	.49	.59	.69					.37	.49	.59	.69					.42	.56	.70	.84	.97	1.11	1.25	1.39	.37	.48	.59
	.080	.37	.49	.59	.69	.79				.37	.49	.59	.69	.79				.42	.56	.69	.83	.96	1.11	1.25	1.39	.37	.48	.59
	.090	.37	.49	.59	.69	.79	.90			.37	.49	.59	.69	.79	.90			.41	.55	.68	.83	.96	1.10	1.24	1.38	.37	.48	.59
	.100	.37	.49	.59	.69	.79	.90	1.01		.37	.49	.59	.69	.79	.90	1.01		.41	.55	.68	.82	.95	1.09	1.24	1.38	.37	.48	.59
	.112	.37	.49	.59	.69	.79	.90	1.01		.37	.49	.59	.69	.79	.90	1.01		.41	.55	.68	.82	.95	1.09	1.23	1.37	.37	.48	.59
	.125	.37	.49	.59	.69	.79	.90	1.01	1.11	.37	.49	.59	.69	.79	.90	1.01	1.11	.40	.53	.66	.81	.94	1.08	1.22	1.36	.37	.48	.59
	.140	.37	.49	.59	.69	.79	.90	1.01	1.11	.37	.49	.59	.69	.79	.90	1.01	1.11	.40	.53	.66	.80	.93	1.06	1.20	1.36			
	.160	.37	.49	.59	.59	.79	.90	1.01	1.11	.37	.49	.59	.69	.79	.90	1.01	1.11	.40	.52	.65	.78	.92	1.06	1.20	1.35			
	.180	.35	.49	.59	.69	.79	.90	1.01	1.11	.37	.49	.59	.69	.79	.90	1.01	1.11	.38	.52	.65	.77	.91	1.05	1.19	1.33			
	.190	.34	.49	.59	.69	.79	.90	1.01	1.11	.37	.49	.59	.69	.79	.90	1.01	1.11	.37	.52	.65	.77	.90	1.04	1.18	1.32			
	.200	.33	.49	.59	.69	.79	.90	1.01	1.11	.37	.49	.59	.69	.79	.90	1.01	1.11	.36	.52	.63	.76	.89	1.03	1.18	1.31			
	.224	.31	.46	.59	.69	.79	.90	1.01	1.11	.37	.49	.59	.69	.79	.90	1.01	1.11	.34	.49	.63	.76	.88	1.02	1.17	1.30			
	.250	.29	.43	.59	.69	.79	.90	1.01	1.11	.37	.49	.59	.69	.79	.90	1.01	1.11	.32	.46	.62	.75	.87	1.01	1.15	1.29			
	.313	.29	.38	.53	.69	.79	.90	1.01	1.11	.37	.49	.59	.69	.79	.90	1.01	1.11	.32	.41	.56	.74	.86	.99	1.12	1.25			
	.375	.29	.37	.48	.63	.79	.90	1.01	1.11	.34	.49	.59	.69	.79	.90	1.01	1.11	.32	.40	.51	.67	.85	.97	1.10	1.23			
	.500	.29	.37	.46	.54	.67	.82	.99	1.11	.29	.43	.59	.69	.79	.90	1.01	1.11	.32	.40	.49	.57	.71	.87	1.06	1.20			
	.625	.29	.37	.46	.54	.62	.72	.86	1.01	.29	.38	.53	.69	.79	.90	1.01	1.11	.32	.40	.49	.57	.65	.76	.92	1.18			
	.750	.29	.37	.46	.54	.62	.70	.78	.90	.29	.37	.48	.63	.79	.90	1.01	1.11	.32	.40	.49	.57	.65	.74	.83	1.17			

COIN DIMPLING

1. General

A. Flush riveting, using 100° countersunk rivets, can be accomplished either by countersinking or by coin dimpling. Countersinking cuts away metal around the rivet or bolt hole and in thinner gages of material will cause considerable weakening of the joint. Coin dimpling produces an interlocking or nesting effect of one sheet into another and results in increased joint strength. Coin dimpling is a standard sheet metal forming process in which the material is formed exactly to the shape of the fastener and may be done with or without heated dies, depending upon the type and alloy of material to be dimpled. Dimples made by the coin dimpling process are less likely to crack than dimples made by other processes.

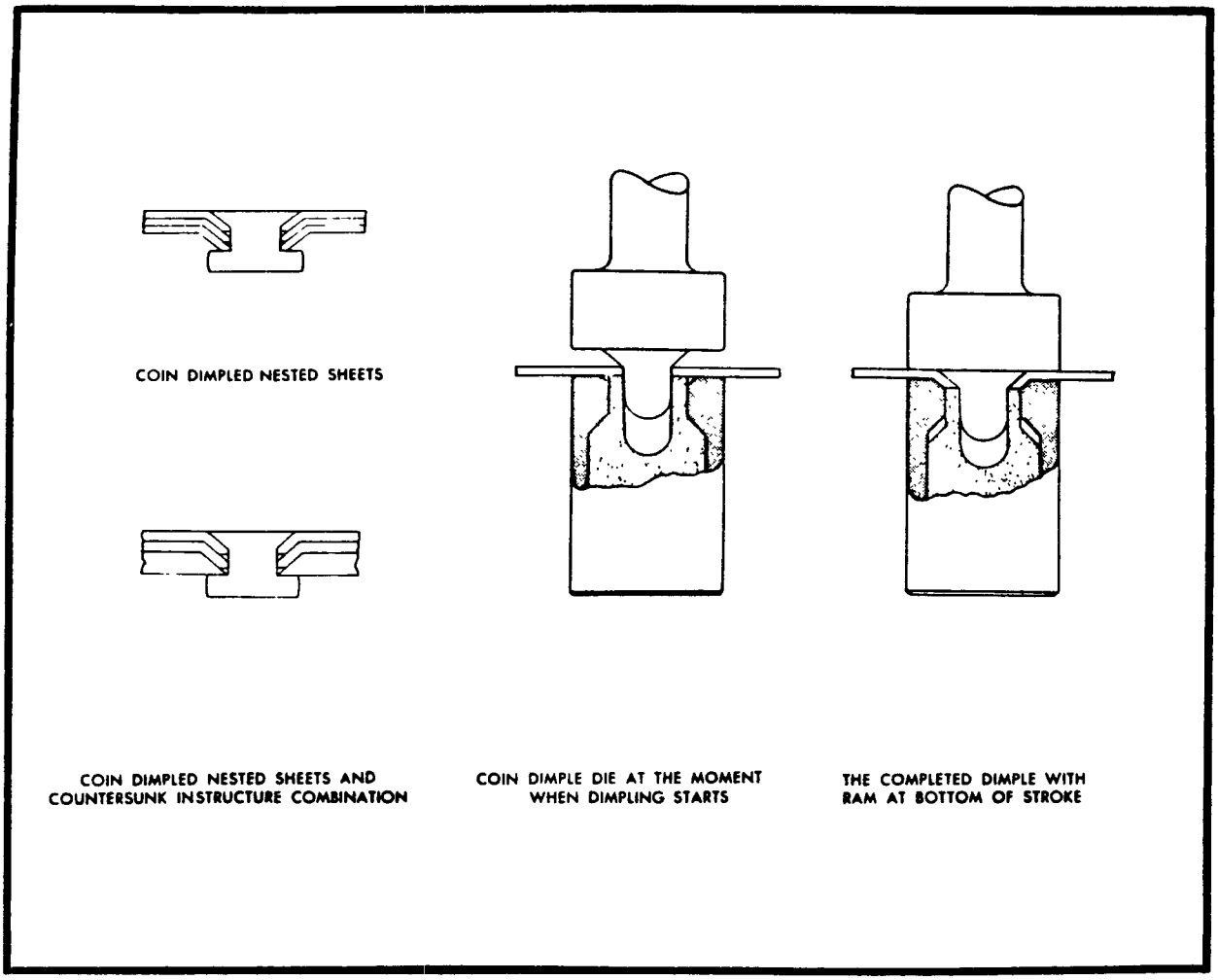
B. The ram coin dimpling process makes use of a male dimpling tool or punch operating under a controlled dimpling force, and a female dimpling tool with an internal coining ram pre-loaded in opposition to the downward pressure of the punch. The preload pressure on the coining ram exerts a pressure on the bottom of the dimple and forces the material to assume the sharp contours of the dimpling tools. Typical ram coin dimpling tools are illustrated in figure 1. The coining ram is preloaded by air pressure through a mechanical linkage or by an internal spring.

C. Standard coin dimpling procedure is to assemble the parts and drill. The parts are then separated and dimpled individually.

NOTE: To obtain a close fit between fastener shank and the dimpled hole when dimpling for non-holefilling steel fasteners, predrill the hole with an undersize drill as indicated in figure 2, dimple and then drill to the final hole size.

D. Any number of coin dimples may be nested in coin dimpled holes or in countersunk holes, as illustrated in figure 1, but dimples formed by other processes are not to be nestled in coin dimpled or countersunk holes. To properly transmit shear, dimples must nest tightly in dimples or in countersunk holes within certain limits. The gap between sheets 1/8 inch from the edge of the dimple should be between 0.0005 to 0.0100 inch before installing the fastener, and between 0.0000 to 0.0100 inch after installing the fastener.

E. Multiple thicknesses of material normally should not be dimpled simultaneously since joint strength will be decreased. Maximum sheet thickness to be dimpled is dependent upon the pressure available from the dimpling equipment, the material being dimpled, and the fastener diameter. Maximum sheet thicknesses for coin dimpling various materials are listed in figure 3.



Coin Dimpling
Figure 1.

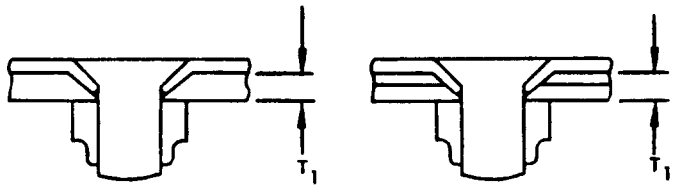
FASTENER TYPE	FASTENER SIZE	DRILL SIZE FOR PILOT HOLE	HOLE SIZE BEFORE DIMPLING	
			MINIMUM	MAXIMUM
HUCK BLIND RIVETS	1/8	NO. 40 (.098)	.098	.103
	5/32	NO. 30 (.128)	.128	.133
	3/16	NO. 20 (.161)	.161	.166
HI-SHEAR RIVETS, DEUTSCH RIVETS AND SHEAR LOCKBOLTS	3/16	NO. 17 (.173)	.173	.188
	1/4	NO. 1 (.228)	.228	.243
	5/16	9/32 (.281)	.281	.296
	3/8	5/16 (.312)	.312	.327
CLOSE TOLERANCE BOLTS & JO-BOLTS	8-32	NO. 29 (.136)	.136	.151
	10-32	NO. 24 (.152)	.152	.167
	1/4-28	NO. 6 (.204)	.204	.219
	5/16-24	1/4 (.250)	.250	.265
	3/8-24	5/16 (.312)	.312	.327

Pre-dimple Hole Size
Figure 2.

MAXIMUM SHEET THICKNESS FOR DIMPLING WITH STATIONARY AND PORTABLE EQUIPMENT AT 90 POUNDS LINE PRESSURE					
NOMINAL DIA. OF FASTENER	ALUMINUM ALLOY		CORROSION RESISTANT STEEL		MAGNESIUM
	2024-T3	7075-T6	ANNEALED	½ HARD	
1/8	.071	.071	.063	.040	.090
5/32	.071	.071	.063	.032	.090
3/16	.071	.071	.063	.025	.090
1/4	.063	.050	.063	.020	.080
5/16	.050	.040	.040		.071

Coin Dimpling Sheet Thickness
Figure 3.

MINIMUM ALLOWABLE SHEET THICKNESS FOR COUNTERSINKING												
SPECIFIED FASTENER DIA.		3/32	1/8	5/32	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
RIVETS, BLIND RIVETS, ALUM. LOCK BOLT	T1	.040	.051	.064	.081	.125	.125	.156				
HI-SHEAR RIVET, SHEAR LOCK BOLT	T1				.052	.066	.073	.093	.102	.112	.121	.131
BOLT, TENSION LOCK BOLT, JO-BOLT HI-STRENGTH BLIND FASTENERS	T1				.085	.110	.138	.167	.196	.222	.249	.279
BAC-R15CE SHEAR HEAD RIVET	T1		.051	.064	.081	.125						



COUNTERSUNK HOLES. Countersinking of holes for fasteners shall be used in preference to dimpling wherever strength is not sacrificed, because it is more economical and facilitates repair. Countersinking is limited by minimum material thicknesses below the minimum T shown in the chart.

Minimum Allowable Thickness for 100° Countersinking of Understructures
Figure 4

F. Instructure under dimpled material should be countersunk where possible, since this type of joint is as strong as an all dimpled joint and also reduces warpage. Minimum thickness of instructure for countersinking is given in figure 4. When countersinking instructure, use a stop countersink tool to obtain the proper countersink depth. Dimensions of the countersink recess should conform to the dimensions of the fastener head.

G. Coin dimpling may be substituted for countersinking, but countersinking shall not be substituted for coin dimpling if the material thickness is below the minimum allowable for countersinking as indicated in figure 4. When substituting countersunk holes for coin dimpled holes, the quantity of fasteners must be increased or a larger diameter fastener must be used as indicated in 51-2-3.

H. Severe material stretching and distortion of the part may occur when using minimum edge margins and dimpling flat flanges of material with a thickness of 0.050 inch or greater. To prevent stretching and distortion, the design edge margin given in 51-2-6 must be increased by 50 percent for flat flanges in this thickness range. Flat flanges with bent up edges or material with thickness less than 0.050 inch are not noticeably affected.

I. Room temperature dimpling is standard for coin dimpling 2024 clad aluminum alloy and corrosion resistant steel. If cracking of the dimple occurs, the coining ram pressure should be increased and/or hot dimpling should be used.

2. Hot Dimpling

A. Hot dimpling is used to prevent cracking. Clamp-on heaters are used to heat the dimpling tools and the time or dwell that heated dies are in contact with the material before the dimple is formed is automatically regulated, since hot dimpling must be controlled to prevent loss of sheet strength. Annealing of aluminum alloy and magnesium sheet will be minimized if dimpling is done within the temperature and dwell limits specified in figure 5.

B. Magnesium alloys and 7075 bare or clad aluminum alloy must be hot dimpled. Other alumunum alloys, bare or clad except bare 2024, may be hot dimpled. Aluminum alloys that have been alodized, anodized, or given a zinc chromate finish treatment, may be dimpled.

NOTE: Bare 2024 aluminum alloy without protective finish shall not be dimpled.

Bare 2024 aluminum alloy with a protective finish shall not be dimpled if used on exterior of the airplane.

3. Coin Dimpling Tools

A. Coin dimpling may be accomplished with stationary or portable equipment using heated or non-heated coin dimpling tools. The preferred method of coin dimpling, when using portable equipment, is by use of a squeeze gun.

TABLE I. MACHINE SETTING FOR MAGNESIUM ALLOY [A]

GAGE MATERIAL TO BE FASTENED	TYPE OF FASTENER																									
	STANDARD SOLID SHANK RIVETS HUCK BLIND RIVET										HI-SHEAR RIVETS DEUTSCH RIVETS SHEAR LOCK BOLTS								JO-BOLTS CLOSE TOLERANCE BOLTS							
	FASTENER DIAMETER																									
	3/32		1/8		5/32		3/16		1/4		3/16		1/4		5/16		3/8		NO. 8		NO. 10		1/4		5/16		3/8	
	DWELL TIME AND PRESSURE																									
	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI
.000-.018	.50	15	.50	15															.50	15						
.018-.022	.50	20	.50	20	.50	20					.50	20	.50	20					1	15	1	15				
.022-.028	1	20	1	20	1	20					1.50	30	1	30					2	15	2	15	2	15		
.028-.038	2	30	2	30	1.50	30	1.50	30			2	40	2	40	1.50	40			2	20	2	20	2	20	2	20
.038-.048	2.50	40	2.50	40	2.50	40	2	40	2	40	2.50	50	2.50	50	2	50	2	50	3	30	3	30	3	30	3	30
.048-.058	4	50	4	50	4	50	3.50	50	3.50	50	4	60	4	60	4	60	3.50	60	4	40	4	40	4	40	5	40
.058-.068	5	60	5	60	5	60	5	60	5	60	5	70	5	70	5	70	5	70	5	50	5	50	5	50	6	50
.068-.078			6	70	6	70	6	70	6	70	6	80	6	80	6	80	6	80			6	60	6	60	6	60
.078-.088					6	80	6	80	6	80			6	90	6	90	6	90					6	70	7	70
.088-.098					7	90	7	90	7	90			7	90	7	90	7	90					7	80	7	80
.098-.108							8	90	8	90					8	90	8	90							8	90
.108-.128									9	90							9	90							9	90

TABLE II. MACHINE SETTING FOR ALUMINUM ALLOY [B]

GAGE MATERIAL TO BE FASTENED	TYPE OF FASTENER																									
	STANDARD SOLID SHANK RIVETS HUCK BLIND RIVET										HI-SHEAR RIVETS DEUTSCH RIVETS SHEAR LOCK BOLTS								JO-BOLTS CLOSE TOLERANCE BOLTS							
	FASTENER DIAMETER																									
	3/32		1/8		5/32		3/16		1/4		3/16		1/4		5/16		3/8		NO. 8		NO. 10		1/4		5/16		3/8	
	DWELL TIME AND PRESSURE																									
	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI	SEC	PSI
.000-.018	.25	30	.25	30															.25	30						
018-.022	.25	40	.25	40	.25	40					.25	40							.50	40	.50	40				
.022-.028	1	40	.50	40	.50	40	.50	40			1	40	.50	40					1	40	1	40	1	40		
028 .038	1.50	50	1.50	50	1	50	1	50	1	50	1.50	50	1	50	1	50			2	50	2	50	2	50	2	50
.038-.048	2	60	2	60	1.50	60	1.50	60	1.50	60	2	60	2	60	1.50	60	1.50	60	3	60	3	60	3	60	3	60
.048-.058	4	70	4	70	4	70	3	70	3	70	4	70	4	70	3	70	3	80	5	70	5	70	5	70	5	70
.058-.068	5	70	5	70	5	70	5	70	4	70	5	80	5	80	5	80	5	80	5	80	5	80	5	80	5	80
.068- 078			6	90	6	90	6	90	6	90	6	90	6	90	6	90	6	90			6	90	6	90	6	90
.078-.088					6	90	6	90	6	90	6	90	6	90	6	90	6	90			6	90	6	90	6	90
.088-.098					6	90	6	90	6	90			6	90	6	90	6	90					6	90	6	90
.098-.108							7	90	7	90					7	90	7	90					6	90	6	90
.108-.125									7	90							7	90							7	90

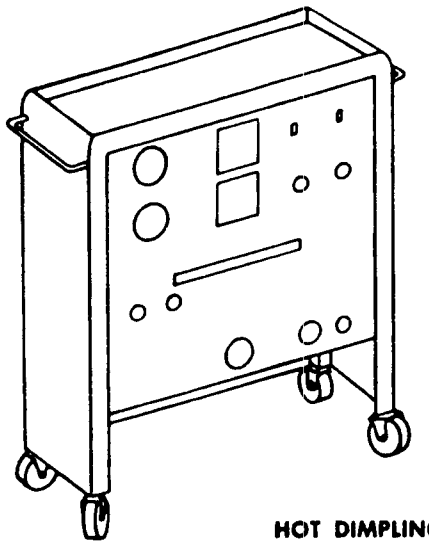
[A] TEMPERATURE SETTINGS:

	HIGH	LOW
SINGLE HEATER CONTROL	675°F	625°F
DOUBLE HEATER CONTROL	625°F	575°F

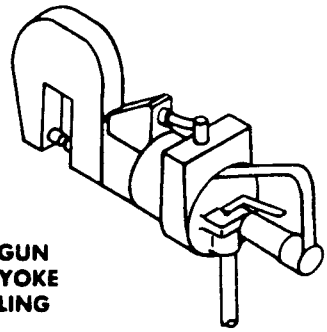
[B] TEMPERATURE SETTINGS:

	HIGH	LOW
SINGLE HEATER CONTROL	700°F	650°F
DOUBLE HEATER CONTROL	600°F	550°F

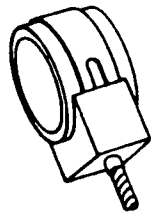
Hot Dimpling
Figure 5.



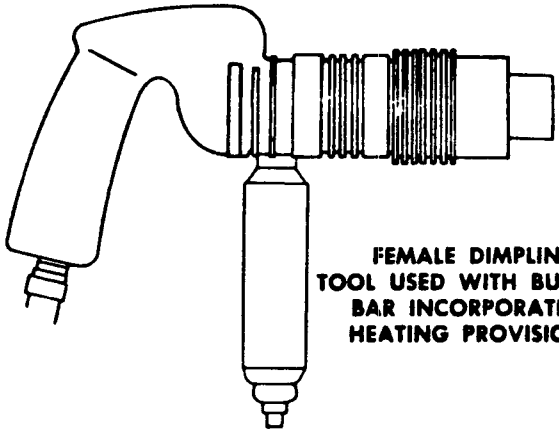
HOT DIMPLING CONTROL PANEL



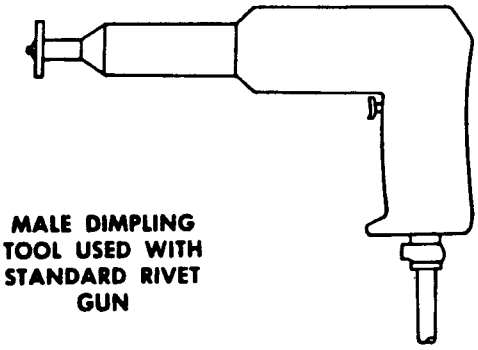
SQUEEZE GUN WITH "C" YOKE FOR DIMPLING



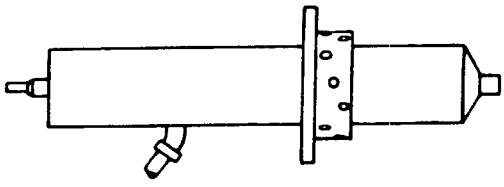
DIMPLING TOOL CLAMP-ON HEATER



FEMALE DIMPLING TOOL USED WITH BUCKING BAR INCORPORATING HEATING PROVISIONS



MALE DIMPLING TOOL USED WITH STANDARD RIVET GUN



FEMALE DIMPLING TOOL USED WITH BUCKING BAR INCORPORATING HEATING PROVISIONS



FEMALE DIMPLING TOOL USED WITH STEEL BUCKING BAR

Portable Coin Dimpling Equipment
Figure 6.

Figure 6 illustrates a Model CP351 pneumatic squeeze gun available from the Chicago Pneumatic Tool Co., 6 East 44th Street, New York 17, New York. The yoke illustrated on the squeeze gun is a standard "C" type yoke. Other types of yokes are available to meet different dimpling conditions. Coin dimpling tools are available in different types and sizes to accommodate various types of fasteners, and heaters are available for the different coin dimpling tools. Portable hot dimpling control panels to control temperature, dwell, and pressure when hot dimpling are available with single or dual circuits for heating one or both dimpling tools. Portable control panels of the type illustrated in figure 6, as well as yokes, tools and tool heaters are available from the Zephyr Manufacturing Co., Inc., Inglewood, California, the Martin Aircraft Tool Co., 10630 South Santa Fe Avenue, South Gate, California or equivalent source.

B. Where accessibility prevents coin dimpling using a squeeze gun, a standard rivet gun may be used. A male dimpling tool or punch is inserted in the rivet gun. The female tool, which incorporates a spring loaded coining ram, is inserted in either a steel bucking bar or a special bucking bar with dimpling tool heating provisions. Both types are illustrated in figure 6. The special bucking bars incorporating heating provisions are available from Zephyr Manufacturing Company or equivalent source.

4. Flow-Form Dimpling

A. The flow-form, or modified radius, dimpling process makes use of a male dimpling tool used in coin dimpling; however, the female dimpling tool does not incorporate the internal coining ram. Flow-form dimpling may also be done with or without heated tools, depending on the material to be dimpled. The flow-form, or modified radius, dimpling process may be used only if ram coin dimpling equipment is not available.

END

COUNTERSINKING

1. Micro-Stop Countersink

   A. For all-around purposes, the micro-stop countersink, fitted with a removable cutter, has been proved the most efficient countersinking tool for use with portable equipment.

   B. The shaft of the micro-stop countersinking tool rotates on a bearing inside an adjustable "locking sleeve and foot piece assembly." The foot piece (or "stop" as it is often called) threads onto the shaft bearing, enabling depth adjustments to be made.

   C. Markings, indicating depth differentials in 0.001 inch increments, surround the bevelled circumference of the locking sleeve to aid in depth adjustments.

   D. The adjustment is made by pulling the sleeve back and turning the stop, to deepen or shallow the cut. The sleeve is then dropped back into its original position to effect a lock.

      NOTE: Make sure that the locking splines intermesh; only then is the adjustment securely locked.

   E. The stop countersink may be adjusted or set up on the part to be countersunk, provided the following precautions are taken:

      (1) Be sure the adjustable foot piece is extended far enough to insure that the cut will not be too deep.

      (2) Gradually increase the depth adjustment until the depth and diameter of the hole are the same as the size of the fastener head.

      (3) If at all doubtful of the accuracy of the adjustment, try the countersink on a piece of scrap sheet stock before using.

2. The Pilot Pin

   A. The pilot pin guides the spinning cutter as it cuts into the material. The pilot pin should be approximately 0.002 inch less in diameter than the diameter of the fastener to be installed. See the table in figure 1. This allows cutter to spin without binding in the hole. Cutter-pilots, which are more than 0.002 inch smaller than fastener size, will allow the cutter to wobble, and result in lop-sided countersink.

B. Cutters are available in a variety of cutting angles. 100° cutters are most frequently used. 82° countersinks are used for NACA type rivet heads of fluid tight rivets. The cutting angle is stamped on each cutter as shown in figure 1.

CAUTION: MAKE CERTAIN THE CUTTER IS TIGHTENED IN THE COUNTERSINK SHAFT BEFORE USING THE STOP COUNTERSINK.

C. When the stop countersinking tool is used, it should be held as shown in figure 1.

D. Keep the following rules in mind when using the stop countersink:

(1) Before using, check countersink cutter for pilot size, sharpness, degrees of cutter, and true running.

(2) Back up the countersink to a safe depth of cut, then gradually increase depth to proper setting.

(3) Hold countersink at a 90° angle to material.

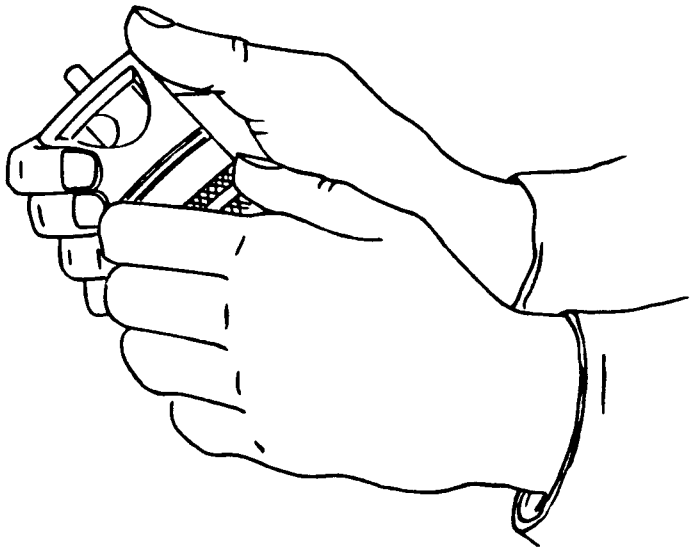
(4) Take full depth of cut each time.

(5) Apply pressure directly behind countersink.

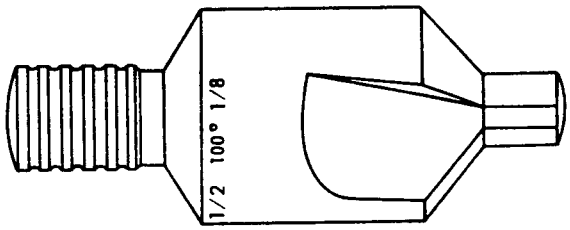
(6) Face on the Stop Countersink must be highly polished to prevent marring the material.

(7) Select the size and length fastener to be installed and use it to judge depth of countersink.

(8) Do not allow the stop to spin on the material.

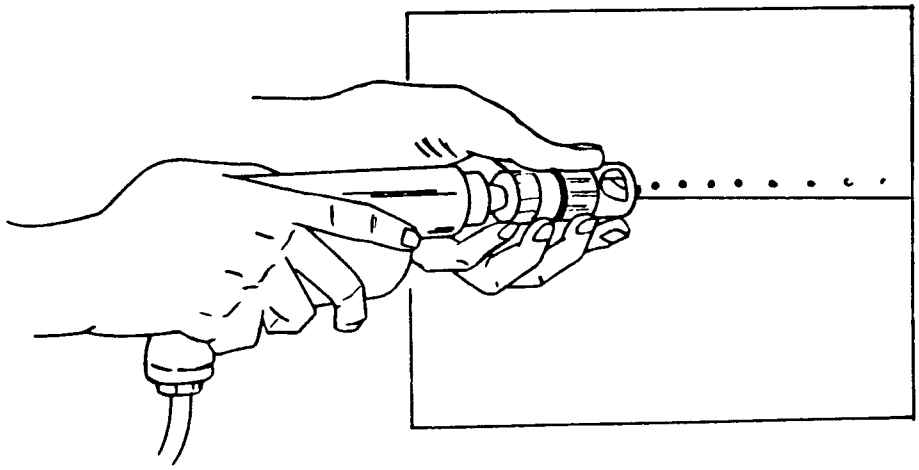


ADJUSTING OF MICRO-STOP COUNTERSINK TOOL



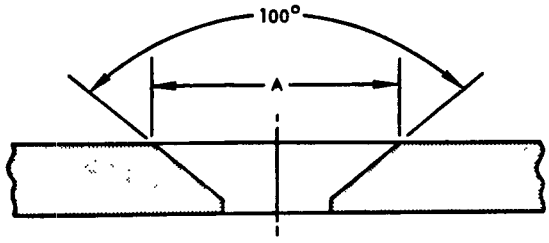
COUNTERSINK CUTTER

CORRECT COUNTERSINK PILOT SIZES FOR RIVET HOLES	
RIVET SIZE	COUNTERSINK PILOT SIZE
3/32	.0917
1/8	.1230
5/32	.1542
3/16	.1855
1/4	.2480
5/16	.3105
3/8	.3730



HOLDING OF MICRO-STOP COUNTERSINK TOOL

Micro-Stop Countersink
Figure 1



RIVET DIAMETER	MAXIMUM COUNTERSINK DIAMETER "A"
1/8	.200
5/32	.250
3/16	.305
1/4	.405

NOTE

COUNTERSINK DIMENSIONS IN THIS TABLE ARE GIVEN IN TERMS OF THE MAXIMUM DIAMETER, BECAUSE THIS IS THE MOST SIGNIFICANT DIMENSION IN ORDER TO AVOID TOO DEEP A COUNTERSINK WHICH MAY PRODUCE A KNIFE-EDGE CONDITION IN THE RIVETED MATERIAL.

MINIMUM COUNTERSINK DIAMETERS ARE DETERMINED BY THE AERODYNAMIC FLUSHNESS REQUIREMENTS GIVEN IN 51-4-1.

IN ACTUAL PRACTICE, THE PROPER DEPTH OF THE COUNTERSINK IS DETERMINED BY DRIVING A TEST RIVET IN A SCRAP PIECE OF METAL. THE DEPTH ADJUSTMENT OF THE MICRO-STOP COUNTERSINK TOOL IS GRADUALLY INCREASED UNTIL A COUNTERSINK DEPTH IS OBTAINED THAT PROVIDES THE REQUIRED FLUSHNESS OF A DRIVEN RIVET. ONCE THE PROPER COUNTERSINK ADJUSTMENT HAS BEEN ESTABLISHED IN THIS MANNER, THE TOOL CAN BE USED FOR COUNTERSINKING ON THE ACTUAL JOB.

Maximum Countersink Diameter for Shear Head Rivets (BAC R15CE)
Figure 2

MINIMUM ALLOWABLE SHEET THICKNESS FOR COUNTERSINKING [A] [C]												
SPECIFIED FASTENER DIA.		3/32	1/8	5/32	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
RIVETS, BLIND RIVETS, ALUM. LOCK BOLT	T1	.040	.051	.064	.081	.125	.125	.156				
	T2 [B]	.032	.040	.040	.050	.063	.063	.063				
HI-SHEAR RIVET, SHEAR LOCK BOLT	T1				.052	.066	.073	.093	.102	.112	.121	.131
	T2				.049	.049	.049	.049	.057	.057	.066	.066
BOLT, TENSION LOCK BOLT, JO-BOLT, HI-STRENGTH BLIND FASTENERS	T1				.085	.110	.138	.167	.195	.222	.249	.279
	T2				.057	.057	.057	.057	.066	.066	.066	.066
BAC-R15CE SHEAR HEAD RIVET	T1		.051	.064	.081	.125						
	T2		.032	.040	.050	.063						

NOTE

THIS TABULATION IS NOT TO BE USED FOR THE SUBSTITUTION OF LARGER FASTENERS THAN THOSE SPECIFIED BY REPAIRS WITHIN THIS MANUAL.

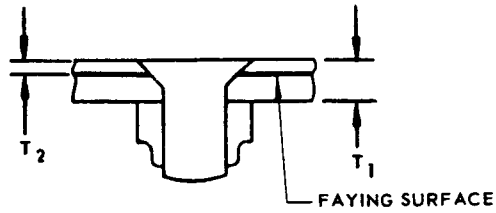
THIS TABULATION IS NOT TO BE USED WHERE INTEGRAL FUEL TANK SEALING IS A REQUIREMENT. FOR FUEL TANK STRUCTURAL SKIN APPLICATIONS SEE 57-2-2.

[A] VALUES APPLY TO ANY COMBINATION OF FASTENER AND FASTENED MATERIAL, AND ARE BASED UPON ZERO FLUSHNESS. WHERE FASTENER HEAD IS PERMITTED BELOW FLUSH, VALUES OF T_1 AND T_2 SHALL BE INCREASED BY AN AMOUNT EQUAL TO THE MAXIMUM PERMITTED BELOW FLUSHNESS.

[B] DOES NOT APPLY TO PRESSURIZED FUSELAGE SKIN.

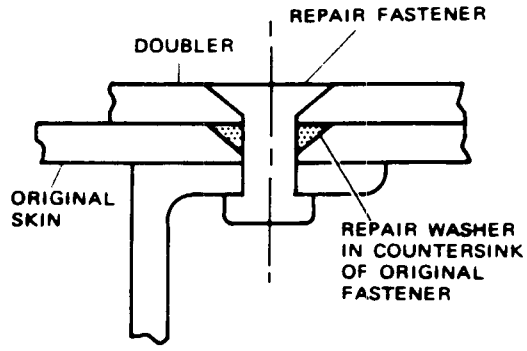
[C] WHEN USING A MINIMUM GAGE COUNTERSUNK TOP SHEET (T_2) AS TABULATED, IN A REPAIR APPLICATION, IT IS RECOMMENDED THAT BONDING AS APPLICABLE PER 51-9-1 PARAGRAPH 2. BE USED AT THE FAYING SURFACE IN ADDITION TO THE FASTENERS.

T_1 = TOTAL THICKNESS OF COUNTERSUNK SHEET
T_2 = THICKNESS OF TOP SHEET



COUNTERSUNK HOLES. Countersinking of holes for fasteners shall be used in preference to dimpling wherever strength is not sacrificed, because it is more economical and facilitates repair. Countersinking is limited by minimum material thicknesses below the minimum T shown in the chart.

Minimum Allowable Sheet Thickness For 100° Countersinking
Figure 3



DETAIL I

REPAIR INSTRUCTIONS

NOTE: Use this special repair washer to plug existing countersinks for repairs where called out in this manual. A typical repair application is illustrated in detail 1.

1. Fabricate the countersink repair washer:

   NOTE: Hole may be omitted from repair washer until after installation.

   WARNING: WHEN USING MEK (METHYL ETHYL KETONE) AVOID BREATHING OF VAPOR OR CONTACT WITH SKIN. WEAR RUBBER GLOVES. WHEN WORKING IN A CONFINED SPACE, ADEQUATE VENTILATION OR RESPIRATORY PROTECTION MUST BE PROVIDED. INJURY TO PERSONNEL MAY OCCUR.

2. Solvent clean:

   A. Clean countersink and the washer with MEK.

   B. Wipe off MEK before it has evaporated with a clean cloth.

   C. Repeat application of clean solvent as necessary to remove oils.

3. Apply Adhesive:

   A. Apply a coat of BMS 5-14 adhesive to the mating surfaces of the countersink and the washer. Refer to 51-1-2 for adhesive procurement.

   B. Allow the adhesive to dry until it is quite tacky but does not transfer to the knuckle when touched.

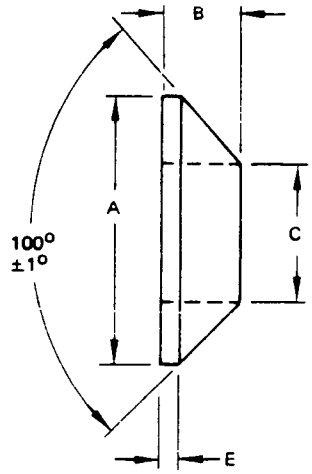
   C. Join surfaces while still tacky with sufficient pressure to ensure good contact.

   D. The assembly may be handled immediately. However, maximum strength is not attained for a week or more. If necessary, cure may be accelerated and bond strength improved by heating the bond at temperature not to exceed 200°F for a period from 1 to 6 hours.

Countersink Repair Washer
Figure 4 (Sheet 1)

ORIGINAL FASTENER TYPE	DIA.	COUNTERSINK REPAIR WASHER				
		DIMENSIONS				MATERIAL [A]
		A ±0.005	B (REF.)	C (DIAMETER)	E ±0.005	
BACR15CE	1/8	0.181	0.030	0.128/0.135	0.006	2024-T4 BAR OR MAKE FROM BACR15CED RIVET
	5/32	0.234	0.037	0.159/0.171	0.006	
	3/16	0.284	0.045	0.191/0.202	0.006	
	7/32	0.284	0.032	0.221/0.233	0.006	
	1/4	0.382	0.060	0.254/0.265	0.006	
	9/32	0.382	0.047	0.284/0.296	0.006	
BACR15BA BACB30ND BACB30NZ BACB30DY BACB30HD BACB30HA NAS1399	1/8	0.216	0.043	0.128/0.135	0.006	2024-T4 BAR OR MAKE FROM BACR15BAD RIVET
	5/32	0.278	0.056	0.159/0.171	0.006	
	3/16	0.344	0.070	0.191/0.202	0.006	
	7/32	0.344	0.057	0.221/0.233	0.006	
	1/4	0.439	0.093	0.254/0.265	0.015	
	9/32	0.439	0.080	0.284/0.296	0.015	
	5/16	0.527	0.105	0.312/0.316	0.015	
	11/32	0.527	0.092	0.344/0.348	0.015	
	3/8	0.657	0.133	0.375/0.379	0.015	
	13/32	0.657	0.120	0.406/0.410	0.015	
	7/16	0.747	0.152	0.437/0.422	0.022	
	15/32	0.747	0.139	0.469/0.474	0.022	
	1/2	0.860	0.173	0.500/0.505	0.022	
	17/32	0.860	0.160	0.531/0.536	0.022	
BACB30LA	5/32	0.319	0.072	0.164/0.167	0.008	2024-T4 BAR
	3/16	0.365	0.080	0.199/0.202	0.011	
	1/4	0.476	0.105	0.260/0.263	0.015	
	5/16	0.591	0 137	0.312/0.315	0.020	
	3/8	0.712	0 165	0.374/0.378	0.023	

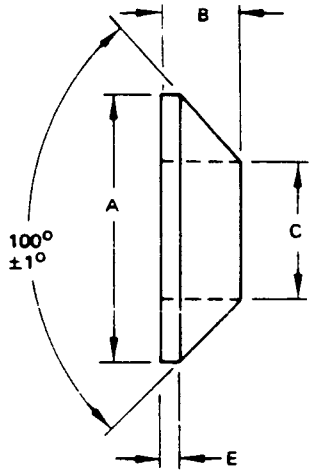
[A] ANODIZE OR ALODIZE AS DESCRIBED IN 51-8-0



Countersink Repair Washer
Figure 4 (Sheet 2)

ORIGINAL FASTENER TYPE	DIA.	COUNTERSINK REPAIR WASHER				
		DIMENSIONS				MATERIAL [A]
		A ±0.005	B (REF)	C (DIAMETER)	E ±0.005	
BACB30FN BACB30GY BACB30EL BACB30NU	3/16	0.277	0.046	0.191/0.194	0.010	2024-T4 BAR
	7/32	0.277	0.034	0.219/0.223	0.010	
	1/4	0.358	0.060	0.250/0.254	0.015	
	9/32	0.358	0.047	0.281/0.285	0.015	
	5/16	0.438	0.068	0.312/0.328	0.015	
	11/32	0.438	0.055	0.344/0.348	0.015	
	3/8	0.525	0.078	0.375/0.379	0.015	
	13/32	0.525	0.065	0.406/0.410	0.015	
	7/16	0.617	0.097	0.437/0.442	0.022	
	15/32	0.617	0.084	0.469/0.474	0.022	
	1/2	0.704	0.108	0.500/0.505	0.022	
	17/32	0.704	0.095	0.531/0.536	0.022	
BACB30JC BACB30NY BACB30LU BACB30MS	3/16	0.344	0.079	0.191/0.194	0.015	
	7/32	0.344	0.068	0.219/0.223	0.015	
	1/4	0.469	0.106	0.250/0.254	0.015	
	9/32	0.469	0.094	0.281/0.285	0.015	
	5/16	0.595	0.133	0.312/0.328	0.015	
	11/32	0.595	0.121	0.344/0.348	0.015	
	3/8	0.722	0.160	0.375/0.379	0.015	
	13/32	0.722	0.148	0.406/0.410	0.015	
	7/16	0.835	0.189	0.437/0.442	0.022	
	15/32	0.835	0.176	0.469/0.474	0.022	
	1/2	0.961	0.217	0.500/0.505	0.022	
	17/32	0.961	0.204	0.531/0.536	0.022	

[A] ANODIZE OR ALODIZE AS DESCRIBED IN 51-8-0



Countersink Repair Washer
Figure 4 (Sheet 3)

Average Hole Diameter of Countersunk Holes
Figure 5

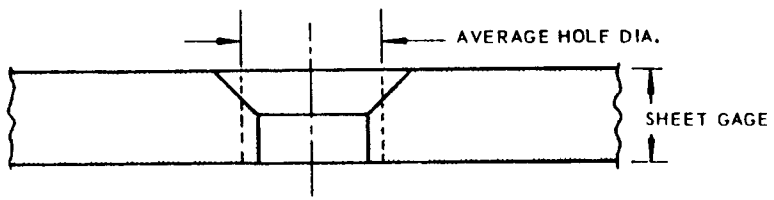
AVERAGE HOLE DIAMETER															
SHEET GAGE	BAC R15CE [A]	BAC B30P, BAC B30GY BAC B30FN, BAC B30NW, BAC B30EL, BAC B30LL, BAC B30NU (SHEAR LOCKBOLTS, BOLTS, HILOKS) BAC R15CE (RIVETS) [A]				NAS330-340, NAS583-590 BAC B30AM, BAC B30AP BAC B30GX, BAC B30JC, BAC B30LP, BAC B30LR, BAC B30LU, BAC B30MS, BAC B30NN, BAC B30NY (TENSION LOCKBOLTS, BOLTS, HILOKS) [B]				MS20426 RIVET BAC R15BA RIVET [C]					
	DIA.	DIAMETER				DIAMETER				DIAMETER					
	5/32	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8	1/8	5/32	3/16	1/4	5/16	3/8
0.040	0.212	0.262	0.356	0.436	0.523	0.351	0.474	0.602	0.730	0.181	0.242	0.309	0.432	0.520	0.650
0.045	0.208	0.256	0.350	0.430	0.517	0.345	0.468	0.596	0.724	0.175	0.236	0.303	0.426	0.514	0.644
0.050	0.204	0.250	0.344	0.424	0.511	0.339	0.462	0.590	0.718	0.170	0.230	0.297	0.420	0.508	0.638
0.056	0.200	0.241	0.337	0.417	0.504	0.332	0.455	0.583	0.711	0.166	0.223	0.290	0.413	0.501	0.631
0.063	0.197	0.235	0.329	0.409	0.496	0.324	0.447	0.575	0.703	0.161	0.216	0.282	0.405	0.493	0.623
0.071		0.230	0.320	0.399	0.486	0.314	0.437	0.565	0.693	0.158	0.210	0.272	0.395	0.483	0.613
0.080		0.226	0.312	0.389	0.475	0.304	0.427	0.555	0.683	0.154	0.204	0.263	0.385	0.473	0.603
0.090		0.222	0.305	0.381	0.465	0.291	0.415	0.543	0.671	0.151	0.199	0.254	0.373	0.461	0.591
0.100		0.218	0.300	0.374	0.456	0.281	0.403	0.531	0.659	0.149	0.195	0.248	0.361	0.449	0.579
0.112		0.215	0.294	0.367	0.447	0.272	0.388	0.516	0.644	0.147	0.191	0.242	0.349	0.435	0.565
0.125		0.213	0.290	0.361	0.440	0.264	0.375	0.501	0.629	0.145	0.188	0.236	0.339	0.422	0.549
0.140		0.210	0.285	0.356	0.433	0.256	0.362	0.483	0.611	0.143	0.185	0.231	0.330	0.411	0.531
0.160		0.208	0.281	0.351	0.425	0.248	0.349	0.462	0.587	0.141	0.182	0.226	0.320	0.399	0.512
0.180		0.206	0.277	0.346	0.420	0.242	0.338	0.446	0.564	0.140	0.179	0.222	0.313	0.389	0.497
0.190		0.205	0.276	0.345	0.417	0.240	0.334	0.439	0.554	0.139	0.178	0.221	0.310	0.386	0.491
0.200		0.204	0.275	0.343	0.415	0.238	0.330	0.433	0.546	0.138	0.177	0.219	0.307	0.382	0.485
0.224		0.202	0.272	0.340	0.411	0.233	0.322	0.420	0.528	0.137	0.175	0.216	0.301	0.375	0.474
0.250		0.201	0.270	0.337	0.407	0.229	0.315	0.409	0.512	0.136	0.173	0.213	0.296	0.369	0.464

NOTES

[A] HEAD 0.002 BELOW FLUSH

[B] HEAD 0.005 BELOW FLUSH

[C] HEAD FLUSH WITH SURFACE



STRENGTH OF FASTENERS

1. General

A. The fastener strength values given in this subject take into consideration the bearing strength of the material in which the fasteners are installed. This means that where the material will fail in bearing before fastener failure, the lower figure will be shown as the strength of the fastener.

B. The fastener strength values assume that the correct holes sizes have been used (Ref 51-2-5) and that edge margin requirements have been met (Ref 51-2-6).

C. Refer to the following table for the location of fastener strengths contained in this subject.

FASTENER		SHEET OR PLATE MATERIAL	LOCATION	
TYPE	PART NUMBER		FIGURE	TABLE
RIVET, UNIVERSAL HEAD, AL	BACR15BB-D BACR15BB-AD BACR15BB-DD MS20470D	2024-T3	1	I
		2024-T4	1	II
		2024-T42	1	II
		2024-T42 TUBE	1	II
		7075-T6	1	III
		7075-T6 BAR/ROD	1	III
		7075-T6, -T6510, -T6511 EXTRUSIONS	1	III
		7178-T6	1	IV
RIVET, 100° FLUSH HEAD, AL	BACR15BA-D BACR15BA-AD BACR15BA-DD MS20426D BACR15CE-D	2024-T3 2024-T42 7075-T6 7178-T6	1	V
RIVET, UNIVERSAL HEAD, MONEL	MS20615M	301-1/4 HARD CRES	1	VI
RIVET, 100° FLUSH HEAD, MONEL	MS20427M	301-1/4 HARD 301-1/2 HARD 301-FULL HARD 302-ANNEALED } CRES	1	VI
RIVET, BLIND, UNIVERSAL HEAD, 5056 AL SLEEVE	NAS1398B	2024-T3	2	I
RIVET, BLIND, UNIVERSAL HEAD, 2017 AL SLEEVE	NAS1398D	2024-T3	2	I
RIVET, BLIND, 100° FLUSH HEAD, 5056 AL SLEEVE	NAS1399B	2024-T3	2	I
RIVET BLIND 100° FLUSH HEAD, 2017 AL SLEEVE	NAS1399D	2024-T3	2	I
RIVET, BLIND, UNIVERSAL HEAD	NAS1738E	2024-T3 7075-T6	2	II
RIVET, BLIND, 100° FLUSH HEAD	NAS1739E	2024-T3 7075-T6	2	II
BOLT, BLIND, UNIVERSAL HEAD	BACB30LB MS90354	2024-T3	2	III
		7075-T6	2	IV
BOLT, BLIND, 100° FLUSH HEAD	BACB30LA MS90353	2024-T3	2	III
		7075-T6	2	IV

FASTENER			SHEET OR PLATE MATERIAL	LOCATION	
TYPE	PART NUMBER			FIGURE	TABLE
PROTRUDING HEAD BOLTS, LOCKBOLTS, HEX-DRIVE BOLTS	BACB30DX BACB30LJ BACB30LK BACB30LM BACB30LN BACB30MB BACB30MR BACB30NE BACB30NF BACB30NM BACB30NR BACB30NT	BACB30NX BACB30PF BACB30PU BACB30PW MS20004-24 NAS623 NAS673-678 NAS1218 NAS1223-1235 NAS1303-1320 NAS1465-1472 NAS6965-6972	2024-T3	3	I
			2024-T4	3	II
			2024-T42	3	II
			2024-T42 TUBE	3	II
			7075-T6	3	III
			7075-T6 BAR/ROD	3	III
			7075-T6, -T6510, -T6511 EXTRUSION	3	III
			7178-T6	3	IV
STANDARD FLUSH HEAD BOLTS, LOCKBOLTS, HEX-DRIVE BOLTS	BACB30AB BACB30EM BACB30FL BACB30GX BACB30JC BACB30LH BACB30LP BACB30LR BACB30LU BACB30MS	BACB30NN BACB30NY BACB30PC NAS333-340 NAS517 NAS583-590 NAS663-668 NAS1221 NAS1456-1462	2024-T3	4	I
			7075-T6	4	II
			7178-T6	4	III
SHEAR FLUSH HEAD BOLTS, SHEAR, FLUSH AND PROTRUDING HEAD LOCKBOLTS AND HEX-DRIVE BOLTS	BACB30EL BACB30FB BACB30FM BACB30FN BACB30GW BACB30GY	BACB30LL BACB30MY BACB30NU BACB30NW NAS1436-1442 NAS1446-1452	2024-T3	5	I
			7075-T6	5	II
			7178-T6	5	III
SHEAR FLUSH HEAD TAPER SHANK BOLTS	BACB30KD		7075-T6	6	I
70° HEAD RADIUS LEAD-IN BOLTS	BACB30PT		7075-T6	7	I

RIVET DIAMETER			1/8		5/32		3/16			1/4		5/16		3/8	
MATERIAL			2117	2017	2117	2017	2117	2017	2024	2017	2024	2017	2024	2017	2024
CODE			XC	BM XZK	XC	BM XZK	XC	BM XZK	XD	BM XZK	XD	BM XZK	XD	BM XZK	XD
SINGLE SHEAR (LBS)			369	467	575	730	830	1050	1130	1870	2010	2910	3140	4180	4510
SINGLE SHEAR ALLOWABLE (LBS)	MATERIAL GAGE	0.025 0.032 0.040	319 356 367	319 408 465	 510 555	 510 635	 765	 765	 765						
		0.050 0.056 0.063			570 575	725 730	805 815 830	955 1030 1050	955 1070 1130	1270 1430 1650	1270 1430 1650	 2070	 2070		
		0.071 0.080 0.090								1830 1860 1870	1860 2000 2010	2330 2620 2850	2330 2620 2950	2800 3150 3540	2800 3150 3540
		0.100 0.112 0.125										2890 2910	3120 3140	3940 4120 4180	3940 4410 4510
DOUBLE SHEAR ALLOWABLE (LBS)	MATERIAL GAGE	0.050 0.056 0.063	635 670 690	635 715 825	795 890 1000	795 890 1030	955 1070 1240	955 1070 1240	955 1070 1240	1270 1430 1650	1270 1430 1650	 2070	 2070		
		0.071 0.080 0.090	715 730 738	900 925 934	1040 1080 1110	1160 1310 1410	1400 1480 1530	1400 1570 1770	1400 1570 1770	1860 2100 2360	1860 2100 2360	2330 2620 2950	2330 2620 2950	2800 3150 3540	2800 3150 3540
		0.100 0.112 0.125			1140 1150	1450 1460	1580 1620 1660	1970 2050 2100	1970 2200 2260	2620 2940 3280	2620 2940 3280	3280 3670 4100	3280 3670 4100	3940 4410 4920	3940 4410 4920
		0.160 0.190 0.250								3710 3740	3990 4020	5300 5700 5820	5300 6150 6280	6300 7500 8360	6300 7500 9020

UNIVERSAL HEAD RIVETS IN: CLAD OR BARE 2024-T3 SHEET

FASTENER CODE:

XC = BACR15BB-AD
BM = MS20470D
XD = BACR15BB-DD
XZK = BACR15BB-D

TABLE I

Strengths of Solid Rivets
Figure 1 (Sheet 1)

RIVET DIAMETER			1/8		5/32		3/16			1/4		5/16		3/8	
MATERIAL			2117	2017	2117	2017	2117	2017	2024	2017	2024	2017	2024	2017	2024
CODE			XC	BM XZK	XC	BM XZK	XC	BM XZK	XD	BM XZK	XD	BM XZK	XD	BM XZK	XD
SINGLE SHEAR (LBS)			369	467	575	730	830	1050	1130	1870	2010	2910	3140	4180	4510
SINGLE SHEAR ALLOWABLE (LBS)	MATERIAL GAGE	0.025 0.032 0.040	244 312 367	244 312 390	390 487	390 487	585	585	585						
		0.050 0.056 0.063		467	570 575	610 680 730	730 815 830	730 820 990	730 820 990	975 1090 1320	975 1090 1320	1650	1650		
		0.071 0.080 0.090						1050	1120 1130	1490 1680 1870	1490 1680 1890	1860 2100 2360	1860 2100 2360	2240 2520 2830	2240 2520 2830
		0.100 0.112 0.125									2010	2620 2910	2620 2940 3140	3150 3530 3940	3150 3530 3940
		0.140 0.160												4180	4410 4510
DOUBLE SHEAR ALLOWABLE (LBS)	MATERIAL GAGE	0.050 0.056 0.063	487 545 660	487 545 660	610 680 825	610 680 825	730 820 990	730 820 990	730 820 990	975 1090 1320	975 1090 1320	1650	1650		
		0.071 0.080 0.090	715 730 738	745 840 934	930 1050 1110	930 1050 1180	1120 1260 1420	1120 1260 1420	1120 1260 1420	1490 1680 1890	1490 1680 1890	1860 2100 2360	1860 2100 2360	2240 2520 2830	2240 2520 2830
		0.100 0.112 0.125			1140 1150	1310 1460	1570 1620 1660	1570 1760 1970	1570 1760 1970	2100 2350 2620	2100 2350 2620	2620 2940 3280	2620 2940 3280	3150 3530 3940	3150 3530 3940
		0.160 0.190 0.250 0.312						2100	2260	3360 3740	3360 3990 4020	4200 4990 5820	4200 4990 6200	5050 6000 7450 8360	5050 6000 7450 9020

UNIVERSAL HEAD RIVETS IN:
- CLAD 2024-T4 SHEET
- BARE 2024-T4 SHEET
- CLAD 2024-T42 SHEET
- BARE 2024-T42 SHEET
- 2024-T42 TUBE

FASTENER CODE:
- XC = BACR15BB-AD
- BM = MS20470D
- XD = BACR15BB-DD
- XZK = BACR15BB-D

TABLE II

Strengths of Solid Rivets
Figure 1 (Sheet 2)

RIVET DIAMETER			1/8		5/32		3/16			1/4		5/16		3/8	
MATERIAL			2117	2017	2117	2017	2117	2017	2024	2017	2024	2017	2024	2017	2024
CODE			XC	BM XZK	XC	BM XZK	XC	BM XZK	XD	BM XZK	XD	BM XZK	XD	BM XZK	XD
SINGLE SHEAR (LBS)			369	467	575	730	830	1050	1130	1870	2010	2910	3140	4180	4510
SINGLE SHEAR ALLOWABLE (LBS)	MATERIAL GAGE	0.025 0.032 0.040	334 356 367	334 428 465	 530 555	 535 680	 775	 815	 815						
		0.050 0.056 0.063			570 575	725 730	805 815 830	1020 1030 1050	1020 1110 1130	1360 1530 1730	1360 1530 1730	 2170	 2170		
		0.071 0.080 0.090								1830 1860 1870	1950 2000 2010	2440 2750 2850	2440 2750 3080	2930 3300 3710	2930 3300 3710
		0.100 0.112 0.125										2890 2910	3120 3140	4060 4120 4180	4120 4450 4510
DOUBLE SHEAR ALLOWABLE (LBS)	MATERIAL GAGE	0.050 0.056 0.063	640 670 690	680 765 865	850 955 1000	850 955 1080	1020 1140 1300	1020 1140 1300	1020 1140 1300	1360 1530 1730	1360 1530 1730	 2170	 2170		
		0.071 0.080 0.090	715 730 738	900 925 934	1040 1080 1110	1220 1370 1410	1410 1480 1530	1460 1650 1860	1460 1650 1860	1950 2200 2470	1950 2200 2470	2440 2750 3090	2440 2750 3090	2930 3300 3710	2930 3300 3710
		0.100 0.112 0.125			1140 1150	1450 1460	1580 1620 1660	2000 2050 2100	2060 2210 2260	2750 3080 3440	2750 3080 3440	3440 3850 4300	3440 3850 4300	4120 4620 5150	4120 4620 5150
		0.160 0.190 0.250								3710 3740	3990 4020	5500 5700 5820	5500 6150 6280	6600 7850 8360	6600 7850 9020

UNIVERSAL HEAD RIVETS IN:
CLAD 7075-T6 SHEET
BARE 7075-T6 SHEET
7075-T6 BAR OR ROD
7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.188 THICK)

FASTENER CODE:
XC = BACR15BB-AD
BM = MS20470D
XD = BACR15BB-DD
XZK = BACR15BB-D

TABLE III

Strengths of Solid Rivets
Figure 1 (Sheet 3)

RIVET DIAMETER			1/8		5/32		3/16			1/4		5/16		3/8	
MATERIAL			2117	2017	2117	2017	2117	2017	2024	2017	2024	2017	2024	2017	2024
CODE			XC	BM XZK	XC	BM XZK	XC	BM XZK	XD	BM XZK	XD	BM XZK	XD	BM XZK	XD
SINGLE SHEAR (LBS)			369	467	575	730	830	1050	1130	1870	2010	2910	3140	4180	4510
SINGLE SHEAR ALLOWABLE (LBS)	MATERIAL GAGE	0.025 0.032 0.040	339 356 367	403 450 465	 530 555	 645 705	 775	 965	 965						
		0.050 0.056 0.063			570 575	725 730	805 815 830	1020 1030 1050	1100 1110 1130	1660 1760 1800	1660 1860 1930	 2620	 2620		
		0.071 0.080 0.090								1830 1860 1870	1970 2000 2010	2750 2800 2850	2950 3030 3080	3540 3900 3980	3540 3990 4300
		0.100 0.112 0.125										2890 2910	3120 3140	4060 4120 4180	4380 4450 4510
DOUBLE SHEAR ALLOWABLE (LBS)	MATERIAL GAGE	0.050 0.056 0.063	640 670 690	815 845 875	905 955 1000	1040 1160 1270	1170 1260 1340	1250 1400 1570	1250 1400 1570	1660 1860 2090	1660 1860 2090	 2620	 2620		
		0.071 0.080 0.090	715 730 738	900 925 934	1040 1080 1110	1330 1370 1410	1410 1480 1530	1770 1870 1940	1770 1990 2090	2360 2660 2990	2360 2660 2990	2950 3320 3740	2950 3320 3740	3540 3990 4490	3540 3990 4490
		0.100 0.112 0.125			1140 1150	1450 1460	1580 1620 1660	2000 2050 2100	2150 2210 2260	3250 3380 3500	3320 3640 3760	4160 4650 5050	4160 4650 5200	4990 5600 6250	4990 5600 6250
		0.160 0.190 0.250								3710 3740	3990 4020	5500 5700 5820	5900 6150 6280	7450 7850 8360	8000 8450 9020

UNIVERSAL HEAD RIVETS IN:
CLAD OR BARE 7178-T6 SHEET

FASTENER CODE:
XC = BACR15BB-AD
BM = MS20470D
XD = BACR15BB-DD
XZK = BACR15BB-D

TABLE IV

Strengths of Solid Rivets
Figure 1 (Sheet 4)

			100° COUNTERSUNK HEAD								100° SHEAR HEAD			
RIVET DIAMETER			5/32		3/16			1/4		5/16	1/8	5/32	3/16	1/4
MATERIAL			2117	2017	2117	2017	2024	2017	2024	2017	2017			
CODE			XA	BE XZG	XA	BE XZG	XB	BE XZG	XB	BE XZG	XF			
SINGLE SHEAR (LBS)			575	730	830	1050	1130	1870	2010	2915	467	730	1050	1870
SINGLE SHEAR ALLOWABLE (LBS)	MATERIAL GAGE	0.025 0.028 0.032	300								195 230 280	315		
		0.036 0.040 0.045	349 398 435	405 455	409 525						325 360 395	375 435 500	485 575	
		0.050 0.056 0.063	481 495 525	520 550 600	585 655 705	630 680 775	760 830 885	915	1210	1630	430 467	560 620 675	665 760 840	780 925 1090
		0.071 0.080 0.090	540 560 575	690 720 730	740 770 795	835 935 1010	940 990 1030	1060 1180 1290	1350 1470 1580	1760 1970 2040		730	925 1010 1050	1280 1440 1580
		0.100 0.112 0.125			820 830	1050	1070 1130	1520 1700 1770	1670 1780 1880	2460 2520 2580				1720 1870
		0.160 0.180						1870	2000 2010	2740 2830				

COUNTERSUNK HEAD RIVETS IN:
CLAD OR BARE 2024-T3, 2024-T42, 7075-T6, 7178-T6 SHEET

FASTENER CODE:
XA = BACR15BA-AD
BE = MS20426D
XB = BACR15BA-DD
XF = BACR15CE-D
XZG = BACR15BA-D

TABLE V

Strengths of Solid Rivets
Figure 1 (Sheet 5)

	MS20615M				MS20427M								
	CODE: LN				CODE: BF								
	UNIVERSAL HEAD IN 301-1/4 HARD CRES SHEET				100° FLUSH HEAD IN 301-1/4 HARD CRES SHEET			100° FLUSH HEAD IN 301-1/2 HARD AND 301 FULL HARD CRES SHEET			100° FLUSH HEAD IN 302 ANNEED CRES SHEET		
RIVET DIAMETER	1/8	5/32	3/16	1/4	1/8	5/32	3/16	1/8	5/32	3/16	1/8	5/32	3/16
SINGLE SHEAR (LBS)	605	940	1350	2410	605	940	1350	605	940	1350	605	940	1350
MATERIAL GAGE	SINGLE SHEAR ALLOWABLES (LBS)												
0.020					300			321			193		
0.025	555				361	463		396	496		243	295	
0.032	585	870			431	590	705	431	625	765	309	384	457
0.040	600	905	1260		439	665	860	439	665	915	388	481	580
0.050	605	935	1310	2220	468	675	955	447	675	955	486	605	720
0.063		940	1350	2320	595	730	970	540	690	970	605	760	905
0.071				2360	605	830	990	605	740	985		855	1030
0.080				2400		935	1120		850	995		940	1160
0.090				2410		940	1250		940	1130			1300
0.100							1350			1280			1350
0.125										1350			

MS20615M AND MS20427M RIVETS IN CRES SHEET

TABLE VI

Strengths of Solid Rivets
Figure 1 (Sheet 6)

	UNIVERSAL HEAD								100° RIVETS IN COUNTERSUNK HOLES							
	NAS1398B				NAS1398D				NAS1399B				NAS1399D			
	CODE: RK				CODE: RL				CODE: RO				CODE: RP			
RIVET DIAMETER	1/8	5/32	3/16	1/4	1/8	5/32	3/16	1/4	1/8	5/32	3/16	1/4	1/8	5/32	3/16	1/4
SINGLE SHEAR (LBS)	388	595	860	1550	495	755	1090	1970	388	595	860	1550	495	755	1090	1970
TENSION (LBS)	230	375	540	1000	230	375	540	1000	230	375	540	1000	230	375	540	1000
67% TENSION (LBS)	154	251	361	670	154	251	361	670	154	251	361	670	154	251	361	670
MATERIAL GAGE	SINGLE SHEAR ALLOWABLES (LBS)															
0.020	155	180			155	180			35	45			35	45		
0.025	210	240	260		215	245	260		50	60	65		50	60	70	
0.032	260	325	375	445	270	340	375	445	70	75	90	110	70	75	95	115
0.036	285	365	430	530	300	380	455	530	80	90	100	125	80	90	105	130
0.040	305	405	490	620	320	415	510	620	95	105	115	145	95	105	140	150
0.045	330	450	545	705	345	460	570	750	115	125	140	175	120	130	155	180
0.050	350	475	595	805	370	495	625	840	135	150	165	195	150	160	180	200
0.056	370	515	655	905	395	535	680	935	170	175	190	230	190	200	235	240
0.063		545	700	1010	425	580	735	1050	200	215	230	265	230	245	310	320
0.071		570	760	1110	450	610	795	1160	250	260	280	320	290	295	390	400
0.080			810	1210	480	650	845	1250	330	340	350	375	340	360	490	500
0.090			815	1290		700	910	1350	370	405	415	455	415	455	580	625
0.100				1380		740	965	1450		510	520	540	480	535	695	755
0.112				1440			1030	1540		570	635	650		630	850	915
0.125							1060	1640			815	825		740	985	1090
0.140								1750				980			1060	1370
0.160								1870				1320				1670

NAS1398 AND NAS1399 RIVETS IN 2024-T3 BARE OR CLAD SHEET

NOTES

- MINIMUM BLIND SIDE SHEET THICKNESS ALLOWED IS EQUAL TO 1/4 RIVET DIAMETER. FOR THINNER MATERIAL USE NAS1738E OR NAS1739E RIVETS (SEE TABLE II).
- ALLOWABLES ABOVE THE THICK LINE ARE FOR GAGES LESS THAN THE RECOMMENDED MINIMUM.
- USE 67% TENSION FOR PRIMARY STRUCTURE OR WHERE REVERSING LOADS ARE EXPECTED.

TABLE I

Strength of Blind Fasteners
Figure 2 (Sheet 1)

	NAS1739E			NAS1738E					
	CODE: AAV			CODE: AAP					
	100° FLUSH HEAD IN 2024-T3 OR 7075-T6, BARE OR CLAD			UNIVERSAL HEAD IN 2024-T3, BARE OR CLAD			UNIVERSAL HEAD IN 7075-T6, BARE OR CLAD		
RIVET DIAMETER	1/8	5/32	3/16	1/8	5/32	3/16	1/8	5/32	3/16
SINGLE SHEAR (LBS)	620	935	1260	620	935	1260	620	935	1260
TENSION (LBS)	345	530	710	345	530	710	345	530	710
67% TENSION (LBS)	232	356	476	232	356	476	232	356	476
MATERIAL GAGE	SINGLE SHEAR ALLOWABLES (LBS)								
0.020				157			268		
0.025				200	244		292	409	
0.032	201			252	318	361	328	454	570
0.036	228	277		286	351	411	355	477	600
0.040	256	309	352	316	394	454	372	500	630
0.045	286	352	410	354	435	510	396	535	675
0.050	324	394	454	396	486	570	426	565	710
0.056	360	445	510	447	545	635	459	615	755
0.063	407	500	575	486	620	720	500	665	815
0.071	449	560	660	530	685	810	540	710	875
0.080	497	635	740	580	750	920	590	770	940
0.090	545	695	835	615	820	1000	615	840	1020
0.100	600	765	915		895	1080		900	1110
0.112	615	840	1000		935	1170		935	1200
0.125		920	1090			1260			1260
0.140		935	1210						
0.160			1260						

NAS1738E AND NAS1739E RIVETS IN 7075-T6 AND 2024-T3 BARE OR CLAD SHEET

NOTES

- ACTUAL RIVET DIAMETERS ARE APPROX 1/64 LARGER THAN NOMINAL SIZE SHOWN.
- ALLOWABLES ABOVE THE THICK LINE ARE FOR GAGES LESS THAN THE RECOMMENDED MINIMUM.
- USE 67% TENSION FOR PRIMARY STRUCTURE OR WHERE REVERSING LOADS ARE EXPECTED.

TABLE II

Strength of Blind Fasteners
Figure 2 (Sheet 2)

FASTENER	BLIND BOLT MS90353,MS90354,BACB30LA AND BACB30LB				
HEAD	100° FLUSH AND UNIVERSAL HEAD				
FASTENER DIAMETER	5/32	3/16	1/4	5/16	3/8
SHEAR (LBS)	2340	3450	5900	8500	12200
TENSION (LBS)	1350	2100	3650	5200	7500
67% TENSION (LBS)	905	1407	2445	3484	5025
MATERIAL GAGE	SINGLE SHEAR ALLOWABLES (LBS)				
0.040	327				
0.045	402				
0.050	498	520			
0.056	590	640			
0.063	710	755	800		
0.071	825	960	995		
0.080	980	1130	1240	1280	
0.090	1150	1300	1540	1650	1660
0.100	1300	1510	1790	1840	1960
0.112	1510	1770	2090	2370	2480
0.125	1720	2000	2440	2730	3000
0.140	1880	2320	2830	3240	3510
0.160	2020	2730	3340	3810	4330
0.190	2200	3000	4140	4810	5350
0.250	2340	3450	5150	6700	7750
0.312			5900	7600	9950
0.375				8500	11000
0.437					11900
0.500					12200

MS90353,MS90354 AND BACB30LA,BACB30LB BLIND BOLTS IN 2024-T3 CLAD OR BARE SHEET

NOTES

- USE 67% TENSION FOR PRIMARY STRUCTURE OR WHERE REVERSING LOADS ARE EXPECTED
- ALLOWABLES ABOVE THE THICK LINE ARE FOR GAGES LESS THAN THE RECOMMENDED MINIMUM (100° FLUSH HEAD ONLY)

TABLE III

Strengths of Blind Fasteners
Figure 2 (Sheet 3)

FASTENER	BLIND BOLT MS90353,MS90354,BACB30LA AND BACB30LB				
HEAD	100° FLUSH AND UNIVERSAL HEAD				
FASTENER DIAMETER	5/32	3/16	1/4	5/16	3/8
SINGLE SHEAR (LBS)	2340	3450	5900	8500	12200
TENSION (LBS)	1350	2100	3650	5200	7500
67% TENSION (LBS)	905	1407	2445	3484	5025
MATERIAL GAGE	SINGLE SHEAR ALLOWABLES (LBS)				
0.040	384				
0.045	520				
0.050	635				
0.056	765	815			
0.063	960	1020			
0.071	1130	1240	1240		
0.080	1290	1510	1590		
0.090	1450	1780	1990	2080	
0.100	1580	1980	2390	2590	2590
0.112	1690	2140	2840	3100	3100
0.125	1850	2390	3260	3750	3820
0.140	1980	2550	3660	4370	4750
0.160	2160	2870	4000	4980	5800
0.190	2340	3200	4620	5700	7050
0.250		3450	5500	7050	8700
0.312			5900	8100	10400
0.375				8500	11700
0.437					12200

MS90353,MS90354 AND BACB30LA,BACB30LB BLIND BOLTS IN 7075-T6 CLAD OR BARE SHEET

NOTES

- USE 67% TENSION FOR PRIMARY STRUCTURE OR WHERE REVERSING LOADS ARE EXPECTED
- ALLOWABLES ABOVE THE THICK LINE ARE FOR GAGES LESS THAN THE RECOMMENDED MINIMUM (100° FLUSH HEAD ONLY)

TABLE IV

Strengths of Blind Fasteners
Figure 2 (Sheet 4)

FASTENER PART NUMBERS			BACB30DX BACB30LJ BACB30LK BACB30LM BACB30LN BACB30MB BACB30MR	BACB30NE BACB30NF BACB30NM BACB30NR BACB30NT BACB30NX BACB30PF	BACB30PU BACB30PW MS20004-24 NAS623 NAS673-678 NAS1218 NAS1223-1235			NAS1303-1320 NAS1465-1472 NAS6965-6972	
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
SINGLE SHEAR (LBS)			2690	4650	7250	10400	14200	18600	23600	29150
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.063	1260	1650	2070					
		0.071	1420	1860	2330	2800				
		0.080	1600	2100	2620	3150	3670			
		0.090	1790	2360	2950	3540	4130			
		0.100	1990	2620	3280	3940	4600	5250		
		0.112	2230	2940	3670	4410	5150	5900	6600	
		0.125	2490	3280	4100	4920	5750	6550	7400	8200
		0.140	2690	3710	4640	5550	6500	7400	8350	9250
		0.160		4240	5300	6350	7400	8500	9550	10600
		0.180		4650	5950	7150	8350	9550	10700	11900
		0.200			6600	7950	9250	10600	11900	13200
		0.224			7250	8900	10400	11900	13400	14800
		0.250				9900	11600	13200	14900	16600
		0.312				10400	14200	16500	18600	20700
		0.375						18600	22400	24800
		0.500							23600	29150
		0.562								
		0.625								

95 KSI PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN CLAD OR BARE 2024-T3 SHEET OR PLATE

TABLE I

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 3 (Sheet 1)

FASTENER PART NUMBERS			BACB30DX BACB30LJ BACB30LK BACB30LM BACB30LN BACB30MB BACB30MR	BACB30NE BACB30NF BACB30NM BACB30NR BACB30NT BACB30NX BACB30PF	BACB30PU BACB30PW MS20004-24 NAS623 NAS673-678 NAS1218 NAS1223-1235		NAS1303-1320 NAS1465-1472 NAS6965-6972		
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
SINGLE SHEAR (LBS)			2690	4650	7250	10400	14200	18600	23600	29150
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.063	1000	1320	1650					
		0.071	1130	1490	1860	2240				
		0.080	1280	1680	2100	2520				
		0.090	1440	1890	2360	2830	3310	3780	4250	
		0.100	1600	2100	2620	3150	3670	4200	4720	
		0.112	1790	2350	2940	3530	4120	4900	5300	
		0.125	1990	2620	3280	3940	4590	5250	5900	6550
		0.140	2230	2940	3670	4410	5150	5900	6600	7350
		0.160	2550	3360	4200	5050	5900	6700	7550	8400
		0.180	2690	3780	4720	5650	6600	7550	8500	9450
		0.200		4200	5250	6300	7350	8400	9450	10500
		0.224		4650	5900	7050	8250	9400	10600	11800
		0.250			6200	7450	9000	9950	11200	12400
		0.312			7250	9300	10900	12400	14000	15500
		0.375				10400	13000	14900	16800	18600
		0.500					14200	18600	22400	24800
		0.562							23600	27900
		0.625								29150

95 KSI PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:

2024-T42 CLAD OR BARE, SHEET OR PLATE
2024-T4 CLAD SHEET OR PLATE
2024-T42 TUBE

TABLE II

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 3 (Sheet 2)

FASTENER PART NUMBERS			BACB30DX BACB30LJ BACB30LK BACB30LM BACB30LN BACB30MB BACB30MR	BACB30NE BACB30NF BACB30NM BACB30NR BACB30NT BACB30NX BACB30PF	BACB30PU BACB30PW MS20004-24 NAS623 NAS673-678 NAS1218 NAS1223-1235		NAS1303-1320 NAS1465-1472 NAS6965-6972		
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
SINGLE SHEAR (LBS)			2690	4650	7250	10400	14200	18600	23600	29150
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.063	1320	1730	2170					
		0.071	1480	1950	2440	2930				
		0.080	1670	2200	2750	3300	3850			
		0.090	1880	2470	3090	3710	4330			
		0.100	2090	2750	3440	4120	4810	5500		
		0.112	2340	3080	3850	4620	5400	6150		
		0.125	2610	3440	4300	5150	6000	6850	7750	8600
		0.140	2690	3850	4810	5750	6750	7700	8650	9600
		0.160		4400	5500	6600	7700	8800	9900	11000
		0.180		4650	6200	7400	8650	9900	11100	12400
		0.200			6850	8250	9600	11000	12400	13700
		0.224			7250	9250	10800	12300	13900	15400
		0.250				10100	11800	13500	15200	16900
		0.312				10400	14200	16800	19000	21100
		0.375						18600	22800	25300
		0.500							23600	29150
		0.562								
		0.625								

95 KSI PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:

7075-T6 CLAD OR BARE, SHEET OR PLATE
7075-T6 BAR OR ROD
7075-T6, -T6510, -T6511 EXTRUSION (LESS THAN 0.188 THICK)

TABLE III

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 3 (Sheet 3)

FASTENER PART NUMBERS			BACB30DX BACB30LJ BACB30LK BACB30LM BACB30LN BACB30MB BACB30MR	BACB30NE BACB30NF BACB30NM BACB30NR BACB30NT BACB30NX BACB30PF	BACB30PU BACB30PW MS20004-24 NAS623 NAS673-678 NAS1218 NAS1223-1235			NAS1303-1320 NAS1465-1472 NAS6965-6972	
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
SINGLE SHEAR (LBS)			2690	4650	7250	10400	14200	18600	23600	29150
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.063	1590	2090	2620					
		0.071	1790	2360	2950	3540				
		0.080	2020	2660	3320	3990	4650			
		0.090	2270	2990	3740	4490	5250			
		0.100	2530	3320	4160	4990	5800	6650		
		0.112	2690	3720	4650	5600	6500	7450		
		0.125		4160	5200	6250	7250	8300	9350	10400
		0.140		4650	5800	7000	8150	9300	10500	11600
		0.160			6650	8000	9300	10600	12000	13300
		0.180			7250	9000	10500	12000	13500	15000
		0.200				9950	11600	13300	15000	16600
		0.224				10400	13000	14900	16800	18600
		0.250					13700	15600	17600	19500
		0.312					14200	18600	21900	24400
		0.375							23600	29150
		0.500								
		0.562								
		0.625								

95 KSI PROTRUDING HEAD BOLTS, LOCKBOLTS AND HEX-DRIVE BOLTS IN:
CLAD OR BARE 7178-T6 SHEET OR PLATE

TABLE IV

Strengths of Protruding Head Bolts, Lockbolts, and Hex-Drive Bolts
Figure 3 (Sheet 4)

FASTENER PART NUMBERS			BACB30AB BACB30EM BACB30FL BACB30GX BACB30JC BACB30LH BACB30LP	BACB30LR BACB30LU BACB30MS BACB30NN BACB30NY BACB30PC NAS333-340	NAS517 NAS583-590 NAS663-668 NAS1221 NAS1456-1462				
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
SINGLE SHEAR (LBS)			2690	4650	7250	10400	14200	18600	23600	29150
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.063	1080	1430						
		0.071	1220	1630	1920					
		0.080	1380	1840	2250					
		0.090	1550	2070	2580	2950				
		0.100	1720	2300	2870	3350	3750	4900		
		0.125	2150	2870	3590	4310	5000	5600		
		0.140	2410	3220	4020	4830	5650	6450	7250	
		0.160	2690	3680	4600	5500	6450	7350	8250	
		0.180		4140	5150	6200	7250	8300	9300	
		0.190		4320	5400	6550	7650	8750	9800	
		0.200		4480	5750	6900	8050	9200	10300	
		0.224		4650	6450	7700	9000	10300	11600	
		0.250			6900	8600	10000	11500	12900	
		0.312			7250	10400	12500	14300	16100	
		0.375					14200	17100	19400	
		0.438						18600	22200	
		0.500							23600	

95 KSI STANDARD FLUSH HEAD BOLTS, LOCKBOLTS, AND HEX-DRIVE BOLTS IN:
CLAD OR BARE 2024-T3 SHEET OR PLATE

TABLE I

Strengths of Standard Flush Head Bolts, Lockbolts, and Hex Drive Bolts
Figure 4 (Sheet 1)

FASTENER PART NUMBERS			BACB30AB BACB30EM BACB30FL BACB30GX BACB30JC BACB30LH BACB30LP	BACB30LR BACB30LU BACB30MS BACB30NN BACB30NY BACB30PC NAS333-340	NAS517 NAS583-590 NAS663-668 NAS1221 NAS1456-1462				
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
SINGLE SHEAR (LBS)			2690	4650	7250	10400	14200	18600	23600	29150
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.063	1180	1690	1900					
		0.071	1270	1870	2390	2570				
		0.080	1420	2020	2700	3000				
		0.090	1590	2170	2980	3640	3940			
		0.100	1800	2370	3180	4050	4720	5000		
		0.125	2460	2920	3710	4680	5800	6750	7600	
		0.140	2690	3370	4140	5050	6200	7450	8500	
		0.160		4080	4770	5600	6800	8100	9500	
		0.180		4640	5450	6250	7400	8750	10300	
		0.190		4650	5950	6650	7700	9100	10600	
		0.200			6350	7100	8100	9500	11000	
		0.224			7240	8300	9100	10400	11700	
		0.250			7250	9900	10600	11800	13200	
		0.312				10400	14200	15600	17100	
		0.375						18500	22000	
		0.500						18600	23600	

95 KSI STANDARD FLUSH HEAD BOLTS, LOCKBOLTS, AND HEX-DRIVE BOLTS IN:
CLAD OR BARE 7075-T6 SHEET OR PLATE

TABLE II

Strengths of Standard Flush Head Bolts, Lockbolts, and Hex Drive Bolts
Figure 4 (Sheet 2)

FASTENER PART NUMBERS			BACB30AB BACB30EM BACB30FL BACB30GX BACB30JC BACB30LH BACB30LP		BACB30LR BACB30LU BACB30MS BACB30NN BACB30NY BACB30PC NAS333-340		NAS517 NAS583-590 NAS663-668 NAS1221 NAS1456-1462			
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
SINGLE SHEAR (LBS)			2690	4650	7250	10400	14200	18600	23600	29150
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.063	1250	1830	2060					
		0.071	1370	1980	2590	2780				
		0.080	1510	2140	2920	3250				
		0.090	1690	2320	3160	3940	4260			
		0.100	1920	2500	3360	4340	5100	5400		
		0.125	2590	3080	3910	4970	6200	7300	8200	
		0.140	2690	3550	4390	5350	6600	8050	9200	
		0.160		4300	5150	5900	7200	8750	10100	
		0.180		4650	5750	6600	7800	9300	11000	
		0.190			6250	7000	8150	9650	11300	
		0.200			6700	7450	8550	10000	11700	
		0.224			7250	8700	9600	11000	12300	
		0.250				10400	11100	12700	14300	
		0.312					14200	16300	18400	
		0.375						18600	23100	
		0.500							23600	

95 KSI STANDARD FLUSH HEAD BOLTS, LOCKBOLTS, AND HEX-DRIVE BOLTS IN:
CLAD OR BARE 7178-T6 SHEET OR PLATE

TABLE III

Strengths of Standard Flush Head Bolts, Lockbolts, and Hex Drive Bolts
Figure 4 (Sheet 3)

FASTENER PART NUMBERS			BACB30EL BACB30FB BACB30FM BACB30FN BACB30GW BACB30GY BACB30LL			BACB30MY BACB30NU BACB30NW NAS1436-1442 NAS1446-1452				
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
SINGLE SHEAR (LBS)			2690	4650	7250	10400	14200	18600	23600	29150
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.063	1080	1450	1810					
		0.071	1220	1630	2040	2450				
		0.080	1380	1840	2290	2760	3220			
		0.090	1550	2070	2580	3100	3620	4140		
		0.100	1720	2300	2870	3450	4030	4600	5150	
		0.125	2020	2870	3590	4310	5050	5750	6450	7200
		0.140	2130	3220	4020	4830	5650	6450	7250	8050
		0.160	2170	3490	4590	5500	6450	7350	8250	9200
		0.180	2250	3670	5200	6200	7250	8300	9300	10300
		0.190	2290	3730	5450	6550	7650	8750	9800	10900
		0.200	2330	3790	5600	6900	8050	9200	10300	11500
		0.224	2430	3920	5750	7700	9000	10300	11600	12900
		0.250	2540	4050	5950	8300	10100	11500	12900	14400
		0.312	2690	4650	6350	8650	11300	14200	16200	18000
		0.375			6500	8900	11800	14900	18300	21500
		0.500					12900	16200	19800	23700

95 KSI SHEAR FLUSH HEAD BOLTS, SHEAR FLUSH AND PROTRUDING HEAD LOCKBOLTS AND HEX-DRIVE BOLTS IN:

CLAD OR BARE 2024-T3 SHEET OR PLATE

TABLE I

Strengths of Shear Flush Head Bolts, Shear Flush and Protruding Head Lockbolts and Hex-Drive Bolts

Figure 5 (Sheet 1)

FASTENER PART NUMBERS			BACB30EL BACB30FB BACB30FM BACB30FN BACB30GW BACB30GY BACB30LL		BACB30MY BACB30NU BACB30NW NAS1436-1442 NAS1446-1452					
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
SINGLE SHEAR (LBS)			2690	4650	7250	10400	14200	18600	23600	29150
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.063	1270	1700	2120					
		0.071	1430	1910	2390	2870				
		0.080	1620	2150	2700	3240	3780			
		0.090	1820	2430	3030	3640	4250	4850		
		0.100	2020	2700	3370	4050	4720	5400	6050	
		0.125	2530	3370	4220	5050	5900	6750	7600	8450
		0.140	2680	3780	4720	5650	6600	7550	8500	9450
		0.160	2690	4320	5400	6500	7550	8650	9700	10800
		0.180		4580	6050	7300	8500	9700	10900	12100
		0.190		4650	6350	7600	8900	10100	11400	12700
		0.200			6500	8100	9450	10800	12100	13500
		0.224				8900	10600	12100	13600	15100
		0.250					11800	13500	15200	16900
		0.312					12900	16400	19000	21100
		0.375							19900	24000
		0.500								

95 KSI SHEAR FLUSH HEAD BOLTS, SHEAR FLUSH AND PROTRUDING HEAD LOCKBOLTS AND HEX-DRIVE BOLTS IN:

CLAD OR BARE 7075-T6 SHEET OR PLATE

TABLE II

Strengths of Shear Flush Head Bolts, Shear Flush and Protruding Head Lockbolts and Hex-Drive Bolts
Figure 5 (Sheet 2)

FASTENER PART NUMBERS			BACB30EL BACB30FB BACB30FM BACB30FN BACB30GW BACB30GY BACB30LL			BACB30MY BACB30NU BACB30NW NAS1436-1442 NAS1446-1452				
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8
SINGLE SHEAR (LBS)			2690	4650	7250	10400	14200	18600	23600	29150
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.063	1380	1840	2300					
		0.071	1560	2080	2600	3110				
		0.080	1750	2340	2920	3510	4090			
		0.090	1970	2630	3290	3940	4610	5250		
		0.100	2190	2920	3660	4390	5100	5850	6600	
		0.125	2690	3660	4570	5500	6400	7300	8250	9150
		0.140		4090	5100	6150	7150	8200	9200	10200
		0.160		4650	5850	7000	8200	9350	10500	11700
		0.180			6500	7900	9200	10500	11800	13200
		0.190				8350	9700	11100	12500	13900
		0.200				8750	10200	11700	13200	14600
		0.224				8900	11500	13100	14700	16400
		0.250					12800	14600	16400	18300
		0.312					12900	16400	19900	22900
		0.375								24000
		0.500								

95 KSI SHEAR FLUSH HEAD BOLTS, SHEAR FLUSH AND PROTRUDING HEAD LOCKBOLTS AND HEX-DRIVE BOLTS IN:

CLAD OR BARE 7178-T6 SHEET OR PLATE

TABLE III

Strengths of Shear Flush Head Bolts, Shear Flush and Protruding Head Lockbolts and Hex-Drive Bolts

Figure 5 (Sheet 3)

FASTENER PART NUMBER			BACB30KD (ALLOY STEEL)					
FASTENER DIAMETER			3/16	1/4	5/16	3/8	7/16	1/2
SINGLE SHEAR (LBS)			3050	5300	8250	11900	16200	21200
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.100	2430					
		0.112	2570					
		0.125	2910	3740	4440			
		0.140	3050	4200	5150			
		0.160		4830	6000	7000	8000	
		0.180		5100	6700	8000	9100	
		0.190		5250	7000	8500	9750	10900
		0.200		5300	7200	8850	10400	11600
		0.224			7300	10000	11700	13200
		0.250			8150	11100	13200	14900
		0.312			8250	11600	15300	19000
		0.375				11900	15800	20100
		0.437					16200	20900
		0.500						21200

108 KSI SHEAR FLUSH HEAD TAPER SHANK BOLT IN CLAD OR BARE 7075-T6 SHEET OR PLATE

TABLE I

Strengths of Shear Flush Head Taper Shank Bolts
Figure 6

FASTENER PART NUMBER			BACB30PT		
FASTENER DIAMETER			1/4	5/16	3/8
SINGLE SHEAR (LBS)			4800	7450	10700
SINGLE SHEAR BEARING STRENGTH (LBS)	MATERIAL GAGE	0.071	1970		
		0.080	2270		
		0.090	2580	3120	
		0.100	2870	3530	4100
		0.125	3280	4460	5250
		0.140	3530	4760	6000
		0.160	3870	5150	6650
		0.190	4360	5850	7400
		0.200	4530	6000	7600
		0.224	4800	6500	8200
		0.250		7050	8900
		0.312		7450	10400
		0.375			10700

95 KSI 70° HEAD RADIUS LEAD-IN BOLT IN CLAD OR BARE 7075-T6 SHEET OR PLATE

TABLE I

Strengths of 70° Head Radius Lead-In Bolts
Figure 7

HOLE PREPARATION AND STOPDRILLING OF CRACKS

1. General

A. Hole sizes listed in 51-2-5, Figure 1, and used for the normal repairs within this manual require the use of properly sized and maintained drills. When necessary, use a bushing tool as a guide for obtaining a hole not larger than the drill size and perpendicular to the work surface. Use the proper drill speed (feet per minute) which will leave a smooth, bright finish throughout the hole surface. A hole which indicates a rough or galled surface should be properly enlarged by a hand-reaming operation to obtain a smooth hole surface. Strict adherence to the recommendations indicated will contribute to the service life of repairs and preventive modifications.

B. Rework of Existing Fastener Holes

The following procedure is recommended for oversizing an existing fastener hole to remove small cracks and fatigue damaged material and for preparation of the hole prior to a coldworking operation.

(1) Ream the hole 1/64 inch oversize from its nominal size to remove irregularities or corrosion products. Such corrosion products will affect eddy current readings.

(2) Inspect the hole by the Eddy Current Method per the instructions in 5-5-1 of D6-7170, Nondestructive Test Document.

(a) If no cracks are detected, enlarge the hole an additional 1/16 inch in diameter to remove fatigue damaged material.

(b) If cracks are detected, enlarge the hole until reinspection by eddy current shows that no crack remains. Enlarge the hole an additional 1/16 inch in diameter to remove any fatigue damaged material.

NOTE: The total amount that a hole may be enlarged must be determined for each specific case dependent upon the load pattern and stress levels in the particular area. In some cases it will be necessary to install a plug through which the original size fastener can be reamed.

(3) Ream the hole to the finished size for installation of the fastener and/or the plug.

(4) When a coldworking operation is required, ream the hole to the required size and proceed with coldworking.

C. Installation of Stopdrill Holes at Crack Ends

The following procedure is recommended for the installation of a hole to prevent further propogation of a crack.

(1) Drill or counterbore a .25 inch diameter crack stop hole through a structure at each end of a crack. Locate each stop hole so that the center of the hole is .10 inch beyond the visible end of the crack.

(2) Make an Eddy Current Method inspection of each stopdrilled hole to confirm that there is no further cracking on the side of the hole opposite the crack. See B.(2) above.

(a) If the crack has not continued to the other side of the hole, enlarge the hole to .312 inch diameter to insure removal of fatigued material.

(b) If the crack has continued to the other side of the hole, enlarge the hole by additional 1/16 inch diametral increments until the crack indication is removed. Enlarge the hole an additional 1/16 inch in diameter to remove any fatigue damaged material.

NOTE: The total amount that the stopdrill hole may be enlarged must be determined for each specific case dependent upon the load pattern and stress level in that area.

(3) Install a 2017-T3 flush plug rivet in the stopdrill hole, if required.

COLD WORKING OF HOLES FOR FATIGUE IMPROVEMENT

1. General

A. The fatigue properties of aluminum structures can be improved by compressing the material locally around the periphery of fastener holes. This is achieved by pulling a mandrel through an undersize hole, thus enlarging the hole and compressing the metal. The cold working operation causes a radial plastic flow of metal and produces a residual compressive stress in the area surrounding the hole which, in the case of the high interference cold working process, extends approximately half the hole diameter from the edge of the hole.

B. There are two types of cold working used, the high interference process and the low interference process. The low interference process compresses the metal to a lesser degree than the high interference process. For the high interference process and as an option in the low interference process a disposable steel sleeve is interposed between the mandrel and the hole. This prelubricated sleeve is not reuseable.

C. To be effective an edge margin of twice the hole diameter is required on cold worked holes. Smaller edge margin would result in less compressive stress around the hole.

D. Any countersinking or countersink enlargement necessary should not be carried out until the cold working process has been completed.

E. Where broaches are used to provide close tolerance holes a suitable broach puller will be required.

F. Each of the puller kits specified in Fig. 1 and 2 require a hydraulic power source such as 4MITBAC5973 or equivalent.

G. For suppliers of cold working tools, see Fig. 3.

2. High Interference Cold Working Process

A. The sequence of operations for the high interference cold working process is as follows. A simplified pictorial sequence of operations is shown in Fig. 1.

(1) Ensure that the parts to be cold worked are firmly held together by clamps or fasteners. It should not be possible to insert a 0.002-inch feeler gage between parts and contact a fastener.

(2) Enlarge the existing hole, or introduce a new hole as appropriate, to the required starting hole size shown in Fig. 1, Table I for the size of fastener to be used. To achieve a hole within the tolerances given with the required surface finish of 125 microinches or better, reaming or broaching will normally be necessary. Cetyl alcohol or lauric acid may be used as a lubricant.

NOTE: Hole inspection criteria for starting holes are the same as those specified for finished holes as described in par. 2.B.

(3) Select the appropriate tools from Fig. 1, Table II or III or any commercially available equivalent. The length of disposable sleeve selected must be equal or greater than the thickness of material to be cold worked.

(4) Slide the sleeve over the mandrel up to the nose piece of the puller.

CAUTION: AVOID GETTING LUBRICANT ON THE OUTSIDE OF THE SLEEVE.

(5) Insert the mandrel and sleeve into the hole.

(6) Actuate the puller to pull the mandrel through the sleeve.

(7) Remove the sleeve from the hole and discard it.

(8) Broach or ream the hole to the finished hole size specified in Fig. 1, Table I, with a surface finish of 125 microinches or better. A suitable broach puller will be required for use with a broach. Cetyl alcohol or lauric acid may be used as a lubricant.

B. Inspect the hole to ensure that it meets the following criteria:

(1) Holes shall be normal to the surface within 2 degrees.

(2) Holes shall be free from burrs at the interface.

(3) Holes shall be free from scratches, nicks or cuts with the exception of the following surface defects which are acceptable:

(a) Circumferential scratches which are a minimum of 1/16 inch or 10% of the part thickness from the surface of the part, whichever is smaller.

(b) Helical scratches which are a minimum of 1/16 inch or 25% of the part thickness from the surface of the part, whichever is smaller.

(c) Longitudinal scratches not more than 50% of length of hole in any one part and which neither start nor end within 1/16 inch or 25% of the part thickness from the surface of the part, whichever is smaller.

(d) Surface roughness which does not exceed 125 microinches.

(e) The finished hole may contain a region near the entry, exit or interface that does not totally clean up during the sizing operation. The hole will be acceptable provided the region does not extend 0.020 inch or 10% of the detail thickness, whichever is less.

C. Holes failing to meet the inspection requirements may be enlarged by 1/64 inch without further cold working, using special reamers.

3. Low Interference Cold Working Process

A. Low interference cold working may be achieved either with or without a sleeve interposed between the mandrel and the hole. The sequence of operations is as follows. A simplified pictorial sequence of operations is shown in Fig. 2.

(1) Ensure that the parts to be cold worked are firmly held together by clamps or fasteners. It should not be possible to insert a 0.002-inch feeler gage between parts and contact a fastener.

(2) Enlarge the existing hole, or introduce a new hole as appropriate, to the required starting hole size shown in Fig. 2, Table I for the size of fastener to be used. A finish of 125 microinches is required where the sleeve process is to be used and 63 microinches for the nonsleeve process. Reaming or broaching will be required to achieve the tolerance and finish required. Cetyl alcohol or lauric acid may be used as a lubricant

NOTE: The nonsleeve process necessitates a closer tolerance starting hole than the sleeve process.

Hole inspection criteria for starting holes are the same as those specified for finished holes as described in par. 3.B. except for the finish requirement given above.

(3) Select the appropriate tools from Fig. 2, Table II or III. Where the sleeve process is chosen, the length of disposable sleeve selected must be equal to or greater than the thickness of material to be cold worked.

(4) For the sleeve process only, slide the sleeve over the mandrel up to the nose piece of the puller.

CAUTION: AVOID GETTING LUBRICANT ON THE OUTSIDE OF THE SLEEVE.

(5) Insert the mandrel or mandrel and sleeve assembly, as appropriate, into the hole.

(6) Actuate the puller to pull the mandrel through the hole. Cetyl alcohol or lauric acid should be used as a lubricant on both mandrel and hole in the case of the nonsleeve process.

(7) Remove the sleeve, if used, from the hole and discard it.

(8) The hole should not require any further work unless it fails to meet the inspection requirements of par. 3.B.

B. Inspect the hole to ensure that it meets the following criteria:

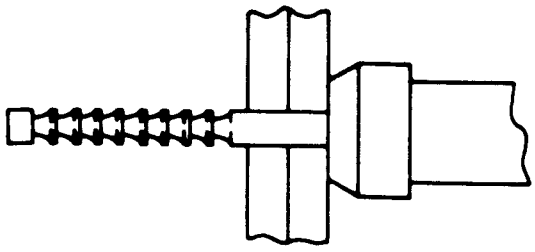
(1) Hole shall be normal to the surface within 2 degrees unless otherwise specified.

(2) A surface finish of 125 microinches or better is required.

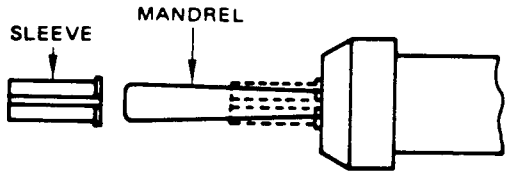
(3) Tapering of the hole when the sleeve process is used is acceptable provided that it does not exceed a maximum of 0.001 inch above the maximum diameter of the finished hole size.

(4) Longitudinal ridges left by cold working sleeves are acceptable.

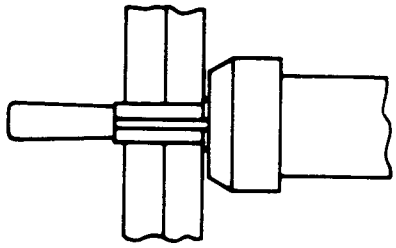
(5) Holes shall be free from longitudinal scratches and rifling which intersect the shear plane.



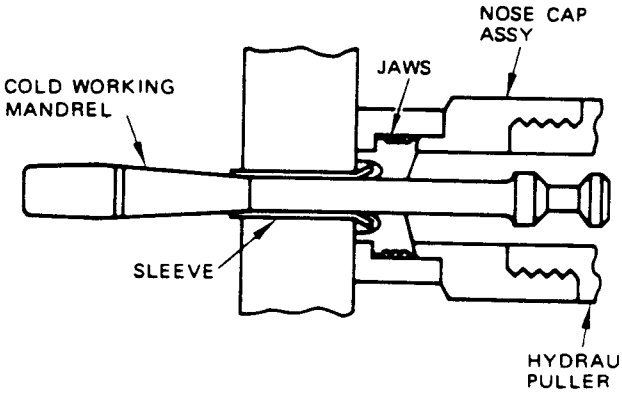
STEP 1 BROACH OR REAM HOLE TO STARTING SIZE SHOWN IN TABLE 1



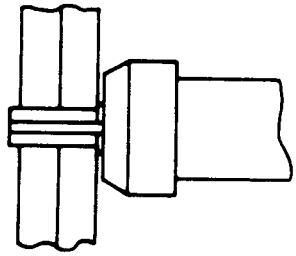
STEP 2 SLIDE SLEEVE OVER MANDREL UP TO NOSE PIECE OF PULLER



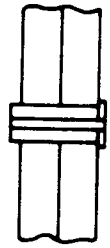
STEP 3 INSERT MANDREL AND SLEEVE INTO HOLE



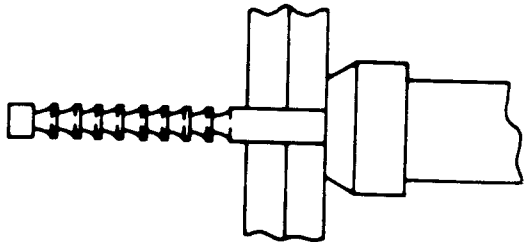
TYPICAL ASSEMBLY
(PRIOR TO COLD WORKING)



STEP 4 ACTUATE PULLER TO PULL MANDREL THROUGH SLEEVE



STEP 5 REMOVE AND DISCARD SLEEVE



STEP 6 BROACH OR REAM HOLE TO FINAL SIZE SHOWN IN TABLE 1

SIMPLIFIED SEQUENCE OF OPERATIONS
(REFER TO TEXT FOR COMPREHENSIVE SEQUENCE OF OPERATIONS)

High Interference Cold Working Process
Figure 1 (Sheet 1)

NOM FASTENER SIZE	STARTING HOLE SIZE	FINISHED HOLE SIZE
5/32	0.146 0.143	HOLE SIZE VARIES WITH TYPE OF FASTENER INSTALLED, REFER TO 51-2-5 UNLESS HOLE SIZE IS SPECIFIED ON DRAWING OR REPAIR.
11/64	0.162 0.159	
3/16	0.180 0.177	
13/64	0.196 0.193	
7/32	0.212 0.209	
15/64	0.228 0.225	
1/4	0.238 0.235	
17/64	0.254 0.251	
9/32	0.269 0.266	
19/64	0.286 0.283	
5/16	0.300 0.297	
21/64	0.316 0.313	
11/32	0.331 0.328	
23/64	0.347 0.344	
3/8	0.362 0.359	
25/64	0.378 0.375	
13/32	0.394 0.391	
27/64	0.409 0.406	
7/16	0.424 0.421	
29/64	0.440 0.437	
15/32	0.453 0.450	
31/64	0.468 0.465	
1/2	0.477 0.474	
33/64	0.493 0.490	
17/32	0.508 0.505	

NOM FASTENER SIZE	STARTING HOLE SIZE	FINISHED HOLE SIZE
35/64	0.524 0.521	HOLE SIZE VARIES WITH TYPE OF FASTENER INSTALLED, REFER TO 51-2-5 UNLESS HOLE SIZE IS SPECIFIED ON DRAWING OR REPAIR.
9/16	0.540 0.537	
37/64	0.556 0.553	
19/32	0.571 0.568	
39/64	0.586 0.583	
5/8	0.600 0.597	
41/64	0.616 0.613	
21/32	0.634 0.631	
43/64	0.649 0.646	
11/16	0.662 0.659	
45/64	0.678 0.675	
23/32	0.693 0.690	
47/64	0.709 0.706	
3/4	0.721 0.718	
49/64	0.737 0.734	
25/32	0.752 0.749	
51/64	0.768 0.765	
13/16	0.785 0.782	
53/64	0.801 0.798	
27/32	0.814 0.811	
55/64	0.829 0.826	
7/8	0.844 0.841	
57/64	0.860 0.857	
29/32	0.882 0.879	
59/64	0.897 0.894	

HOLE SIZES FOR HIGH INTERFERENCE COLD-WORKED HOLES

TABLE I

NOM FASTENER SIZE	STARTING HOLE SIZE	FINISHED HOLE SIZE
15/16	0.904 0.901	HOLE SIZE VARIES WITH TYPE OF FASTENER INSTALLED, REFER TO 51-2-5 UNLESS HOLE SIZE IS SPECIFIED ON DRAWING OR REPAIR.
61/64	0.920 0.917	
31/32	0.936 0.933	
63/64	0.952 0.949	
1	0.968 0.965	
1	0.952 0.949 G	
1-1/64	0.984 0.981	
1-1/64	0.968 0.965 G	
1-1/32	1.000 0.997	
1-3/64	1.016 1.013	
1-1/8	1 078 1.075	
1-1/8	1.062 1.059 G	
1-9/64	1.094 1.091	
1-9/64	1.078 1.075 G	
1-5/32	1 110 1 107	
1-11/64	1 126 1.123	
1-3/16	1.140 1.136	
1-3/16	1 124 1.120 G	
1-13/64	1 156 1 152	
1-13/64	1.139 1 136 G	
1-7/32	1 172 1.168	
1-15/64	1 188 1.184	
1-1/4	1 203 1 195	
1-1/4	1 187 1.183 G	
1-17/64	1.219 1.215	

NOM FASTENER SIZE	STARTING HOLE SIZE	FINISHED HOLE SIZE
1-17/64	1.202 1.199 G	HOLE SIZE VARIES WITH TYPE OF FASTENER INSTALLED, REFER TO 51-2-5 UNLESS HOLE SIZE IS SPECIFIED ON DRAWING OR REPAIR.
1-9/32	1.235 1.231	
1-19/64	1.251 1.247	
1-3/8	1.320 1.316	
1-3/8	1.304 1.300 G	
1-25/64	1.340 1.336	
1-25/64	1.324 1.320 G	
1-13/32	1.356 1.352	
1-27/64	1.372 1.368	
1-1/2	1.431 1.427	
1-1/2	1.415 1.411 G	
1-33/64	1.447 1.443	
1-33/64	1.431 1.427 G	
1-17/32	1 463 1.459	
1-35/64	1 479 1.475	
1-5/8	1.563 1.559	
1-5/8	1.547 1.543 G	
1-41/64	1.579 1.575	
1-41/64	1.563 1.559 G	
1-21/32	1.595 1 591	
1-43/64	1.611 1.607	

HOLE SIZES FOR HIGH INTERFERENCE COLD-WORKED HOLES
TABLE I (CONT)

NOM FASTENER SIZE	MANDREL ST5300-CBM [F][I]	SLEEVE ST5300-CBS [A]	UNIVERSAL KIT NO. MITBAC 5973 [D]			UNIVERSAL KIT NO. 2MITBAC 5973 [D]		
			NOSE CAP ST5300-CBC	JAW ASSY ST5300-CBC [B]	CHUCK ASSY ST1350A	NOSE CAP ST1350A-C	JAW ASSY ST5300-CBC [B]	CHUCK ASSY ST5300-C
5/32	-5-0-N-"E"	-5-0-N-"A"-"B"	-3	-"C"-23	-29	-12	-"C"-23	-227
11/64	-5-1-N-"E"	-5-1-N-"A"-"B"	-3	-"C"-23	-29	-12	-"C"-23	-227
3/16	-6-0-N-"E"	-6-0-N-"A"-"B"	-3	-"C"-24	-29	-12	-"C"-24	-227
13/64	-6-1-N-"E"	-6-1-N-"A"-"B"	-3	-"C"-24	-29	-12	-"C"-24	-227
7/32	-6-2-N-"E"	-6-2-N-"A"-"B"	-3	-"C"-24	-29	-12	-"C"-24	-227
15/64	-6-3-N-"E"	-6-3-N-"A"-"B"	-3	-"C"-24	-29	-12	-"C"-24	-227
1/4	-8-0-N-"E"	-8-0-N-"A"-"B"	-3	-"C"-25	-29	-12	-"C"-25	-227
17/64	-8-1-N-"E"	-8-1-N-"A"-"B"	-3	-"C"-25	-29	-12	-"C"-25	-227
9/32	-8-2-N-"E"	-8-2-N-"A"-"B"	-3	-"C"-25	-29	-12	-"C"-25	-227
19/64	-8-3-N-"E"	-8-3-N-"A"-"B"	-3	-"C"-25	-29	-12	-"C"-25	-227
5/16	-10-0-N-"E"	-10-0-N-"A"-"B"	-3	-"C"-26	-29	-12	-"C"-26	-227
21/64	-10-1-N-"E"	-10-1-N-"A"-"B"	-3	-"C"-26	-29	-12	-"C"-26	-227
11/32	-10-2-N-"E"	-10-2-N-"A"-"B"	-3	-"C"-26	-29	-12	-"C"-26	-227
23/64	-10-3-N-"E"	-10-3-N-"A"-"B"	-3	-"C"-26	-29	-12	-"C"-26	-227
3/8	-12-0-N-"E"	-12-0-N-"A"-"B"	-3	-"C"-27	-29	-12	-"C"-27	-227
25/64	-12-1-N-"E"	-12-1-N-"A"-"B"	-3	-"C"-27	-29	-12	-"C"-27	-227
13/32	-12-2-N-"E"	-12-2-N-"A"-"B"	-3	-"C"-27	-29	-12	-"C"-27	-227
27/64	-12-3-N-"E"	-12-3-N-"A"-"B"	-3	-"C"-27	-29	-12	-"C"-27	-227

COLD WORKING TOOLS FOR HOLES LESS THAN 7/16 INCH DIAMETER – HIGH INTERFERENCE, SLEEVE TYPE
TABLE II

NOM FASTENER SIZE	MANDREL ST5300–CBM [C] [I]	SLEEVE ST5300–CBS [A]	UNIVERSAL KIT NO. 2 [illegible] ITBAC 5973			
			NOSECAP ST1350A–C	JAW ASSY ST5300–CBC	CHUCK ASSY [E]	
					[illegible]–JAW ST1350A–C	THREADED ST1350A–C
7/16	–14–0–N–"D"	–14–0–N–"A"–"B"	–12	–28–S	–21	–33
29/64	–14–1–N–"D"	–14–1–N–"A"–B	–12	–28–S	–21	–33
15/32	–14–2–N–"D"	–14–2–N–"A"–"B"	–12	–28–S	–21	–33
31/64	–14–3–N–"D"	–14–3–N–"A"–"B"	–12	–28–S	–21	–33
1/2	–16–0–N–"D"	–16–0–N–"A"–"B"	–12	–29–S	–21	–33
33/64	–16–1–N–"D"	–16–1–N–"A"–"B"	–12	–29–S	–21	–33
17/32	–16–2–N–"D"	–16–2–N–"A"–"B"	–12	–29–S	–21	–33
35/64	–16–3–N–"D"	–16–3–N–"A"–"B"	–12	–29–S	–21	–33
9/16	–18–0–N–"D"	–18–0–N–"A"–"B"	–12	–30–S	–21	–33
37/64	–18–1–N–"D"	–18–1–N–"A"–"B"	–12	–30–S	–21	–33
19/32	–18–2–N–"D"	–18–2–N–"A"–"B"	–12	–30–S	–21	–33
39/64	–18–3–N–"D"	–18–3–N–"A"–"B"	–12	–30–S	–21	–33
5/8	–20–0–N–"D"	–20–0–N–"A"–"B"	–12	–31–S	–21	–33
41/64	–20–1–N–"D"	–20–1–N–"A"–"B"	–12	–31–S	–21	–33
21/32	–20–2–N–"D"	–20–2–N–"A"–"B"	–12	–31–S	–21	–33
43/64	–20–3–N–"D"	–20–3–N–"A"–"B"	–12	–31–S	–21	–33
11/16	–22–0–N–3	–22–0–N–"A"–"B"	–12	–32–S	–	–33
45/64	–22–1–N–3	–22–1–N–"A"–"B"	–12	–32–S	–	–33
23/32	–22–2–N–3	–22–2–N–"A"–"B"	–12	–32–S	–	–33
47/64	–22–3–N–3	–22–3–N–"A"–"B"	–12	–32–S	–	–33
3/4	–24–0–N–3	–24–0–N–"A"–"B"	–12	–33–S	–	–33
49/64	–24–1–N–3	–24–1–N–"A"–"B"	–12	–33–S	–	–33
25/32	–24–2–N–3	–24–2–N–"A"–"B"	–12	–33–S	–	–33
51/64	–24–3–N–3	–24–3–N–"A"–"B"	–12	–33–S	–	–33
13/16	–26–0–N–3	–26–0–N–"A"–"B"	–12	–34–S	–	–33
53/64	–26–1–N–3	–26–1–N–"A"–"B"	–12	–34–S	–	–33
27/32	–26–2–N–3	–26–2–N–"A"–"B"	–12	–34–S	–	–33
55/64	–26–3–N–3	–26–3–N–"A"–"B"	–12	–34–S	–	–33
7/8	–28–0–N–3	–28–0–N–"A"–"B"	–12	–35–S	–	–33
57/64	–28–1–N–3	–28–1–N–"A"–"B"	–12	–35–S	–	–33
29/64	–28–2–N–3	–28–2–N–"A"–"B"	–12	–35–S	–	–33
59/64	–28–3–N–3	–28–3–N–"A"–"B"	–12	–35–S	–	–33
15/16	–30–0–N–3	–30–0–N–"A"–"B"	–12	–36–S	–	–33
61/64	–30–1–N–3	–30–1–N–"A"–"B"	–12	–36–S	–	–33

COLD WORKING TOOLS FOR HOLES 7/16 INCH DIAMETER AND GREATER – HIGH INTERFERENCE, SLEEVE TYPE

NOM FASTENER SIZE	MANDREL ST5300–CBM [C][I]	SLEEVE ST5300–CBS [A]	UNIVERSAL KIT NO. 2 MITBAC 5973			
			NOSECAP ST1350A–C	JAW ASSY ST5300–CBC	CHUCK ASSY [E]	
					3–JAW ST1350A–C	THREADED ST1350A–C
31/32	–30–2–N–3	–30–2–N–"A"–"B"	–12	–36–S	–	–33
63/64	–30–3–N–3	–30–3–N–"A"–"B"	–12	–36–S	–	–33
1	–32–0–N–3	–32–0–N–"A"–"B"	–12	–305–S	–	–33
1 [H]	–32–0–S–3	–32–0–S–"A"–"B"	–12	–305–S	–	–33
1–1/64	–32–1–N–3	–32–1–N–"A"–"B"	–12	–305–S	–	–33
1–1/64 [H]	–32–1–S–3	–32–1–S–"A"–"B"	–12	–305–S	–	–33
1–1/32	–32–2–N–3	–32–2–N–"A"–"B"	–12	–305–S	–	–33
1–3/64	–32–3–N–3	–32–3–N–"A"–"B"	–12	–305–S	–	–33
1–1/8	–36–0–N–3	–36–0–N–"A"–"B"	–12	–307–S	–	–33
1–1/8 [H]	–36–0–S–3	–36–0–S–"A"–"B"	–12	–307–S	–	–33
1–9/64	–36–1–N–3	–36–1–N–"A"–"B"	–12	–307–S	–	–33
1–9/64 [H]	–36–1–S–3	–36–1–S–"A"–"B"	–12	–307–S	–	–33
1–5/32	–36–2–N–3	–36–2–N–"A"–"B"	–12	–307–S	–	–33
1–11/64	–36–3–N–3	–36–3–N–"A"–"B"	–12	–307–S	–	–33
1–3/16	–38–0–N–3	–38–0–N–"A"–"B"	–12	–308–S	–	–33
1–3/16 [H]	–38–0–S–3	–38–0–S–"A"–"B"	–12	–308–S	–	–33
1–13/64	–38–1–N–3	–38–1–N–"A"–"B"	–12	–380–S	–	–33
1–13/64 [H]	–38–1–S–3	–38–1–S–"A"–"B"	–12	–308–S	–	–33
1–7/32	–38–2–N–3	–38–2–N–"A"–"B"	–12	–308–S	–	–33
1–15/64	–38–3–N–3	–38–3–N–"A"–"B"	–12	–308–S	–	–33
1–1/4	–40–0–N–3	–40–0–N–"A"–"B"	–12	–309–S	–	–33
1–1/4 [H]	–40–0–S–3	–40–0–S–"A"–"B"	–12	–309–S	–	–33
1–17/64	–40–1–N–3	–40–1–N–"A"–"B"	–12	–309–S	–	–33
1–17/64 [H]	–40–1–S–3	–40–1–S–"A"–"B"	–12	–309–S	–	–33
1–9/32	–40–2–N–3	–40–2–N–"A"–"B"	–12	–309–S	–	–33
1–19/64	–40–3–N–3	–40–3–N–"A"–"B"	–12	–309–S	–	–33
1–3/8	–44–0–N–3	–44–0–N–"A"–"B"	–12	–311–S	–	–33
1–3/8 [H]	–44–0–S–3	–44–0–S–"A"–"B"	–12	–311–S	–	–33
1–25/64	–44–1–N–3	–44–1–N–"A"–"B"	–12	–311–S	–	–33
1–25/64 [H]	–44–1–S–3	–44–1–S–"A"–"B"	–12	–311–S	–	–33
1–13/32	–44–2–N–3	–44–2–N–"A"–"B"	–12	–311–S	–	–33
1–27/64	–44–3–N–3	–44–3–N–"A"–"B"	–12	–311–S	–	–33
1–1/2	–48–0–N–3	–48–0–N–"A"–"B"	–12	–313–S	–	–33
1–1/2 [H]	–48–0–S–3	–48–0–S–"A"–"B"	–12	–313–S	–	–33

COLD WORKING TOOLS FOR HOLES 7/16 INCH DIAMETER AND GREATER – HIGH INTERFERENCE, SLEEVE TYPE

TABLE III (CONT)

NOM FASTENER SIZE	MANDREL ST5300–CBM [C]	SLEEVE ST5300–CBS [A]	UNIVERSAL KIT NO. 2 MITBAC 5973			
			NOSECAP ST1350A–C	JAW ASSY ST5300–CBC	CHUCK ASSY [E]	
					3–JAW ST1350A–C	THREADED ST1350A–C
1–33/64	–48–1–N–3	–48–1–N–"A"–"B"	–12	–313–S	–	–33
1–33/64 [H]	–48–1–S–3	–48–1–S–"A"–"B"	–12	–313–S	–	–33
1–17/32	–48–2–N–3	–48–2–N–"A"–"B"	–12	–313–S	–	–33
1–35/64	–48–3–N–3	–48–3–N–"A"–"B"	–12	–313–S	–	–33
1–5/8	–52–0–N–3	–52–0–N–"A"–"B"	–12	–315–S	–	–33
1–5/8 [H]	–52–0–S–3	–52–0–S–"A"–"B"	–12	–315–S	–	–33
1–41/64	–52–1–N–3	–52–1–N–"A"–"B"	–12	–315–S	–	–33
1–41/64 [H]	–52–1–S–3	–52–1–S–"A"–"B"	–12	–315–S	–	–33
1–21/32	–52–2–N–3	–52–2–N–"A"–"B"	–12	–315–S	–	–33
1–43/64	–52–3–N–3	–52–3–N–"A"–"B"	–12	–315–S	–	–33

COLD WORKING TOOLS FOR HOLES 7/16 INCH DIAMETER AND GREATER – HIGH INTERFERENCE, SLEEVE TYPE

TABLE III (CONT)

NOTES

[A] "A" IS THE LENGTH OF THE SLEEVE IN 1/16 OF AN INCH WHICH MUST EQUAL OR EXCEED THE HOLE DEPTH. SLEEVES ARE MADE IN 1/4-INCH INCREMENTS ONLY, FROM 3/4 INGH TO 1-1/2 INCHES LONG. SLEEVES MAY BE STACKED FOR DEEP HOLES

"B" IS THE TYPE OF SLEEVE DENOTED BY THE SUFFIX F FOR FLARED TYPE OR S FOR STRAIGHT TYPE. FOR HOLES LESS THAN 7/16 DIA THE FLARED TYPE IS PREFERRED, BUT IF STACKED THE ADDITIONAL SLEEVES MUST BE OF THE STRAIGHT TYPE. FOR HOLE SIZES 7/16 DIA AND GREATER ONLY THE STRAIGHT TYPE WILL BE USED

EXAMPLE: ST5300CBS-10-0-N-8-F

THIS IS A FLARED SLEEVE (INDICATED BY -F) FOR A 5/16 DIA HOLE WITH A LENGTH OF 1/2 INCH (INDICATED BY -8)

[B] "C" IS THE TYPE OF JAW ASSY REQUIRED TO SUIT THE TYPE OF SLEEVE BEING USED. USE THE SUFFIX F FOR FLARED TYPE OR S FOR STRAIGHT TYPE

[C] "D" IS THE TYPE OF MANDREL REQUIRED TO SUIT THE CHUCK. SPECIFY 2 FOR THE TYPE II MANDRELS USED WITH A 3-JAW CHUCK OR 3 FOR THE TYPE III MANDRELS USED WITH A THREADED CHUCK. TYPE III MANDRELS ARE REQUIRED FOR HOLES 11/16 DIA AND LARGER

EXAMPLE: ST5300-CBM-18-0-N-2

THIS IS A MANDREL FOR A 9/16-INCH DIAMETER HOLE FOR USE WITH A 3-JAW CHUCK (INDICATED BY -2)

[D] KIT #MITBAC5973 AND KIT #2MITBAC5973 ARE ALTERNATIVES

[E] 3-JAW CHUCKS OR THREADED CHUCKS ARE ALTERNATIVES FOR SIZES LESS THAN 11/16-INCH DIAMETER

[F] "E" IS THE TYPE OF MANDREL REQUIRED TO SUIT THE CHUCK. SPECIFY 1 FOR THE TYPE I MANDRELS USED WITH A 3-JAW CHUCK OR 1A FOR TYPE TYPE IA MANDRELS USED WITH A THREADED CHUCK

EXAMPLE: ST5300-CBM-12-0-N-1

THIS IS A MANDREL FOR A 3/8-INCH DIAMETER HOLE FOR USE WITH A 3-JAW CHUCK (INDICATED BY -1)

[G] STARTING HOLE SIZE FOR SPECIAL SLEEVES

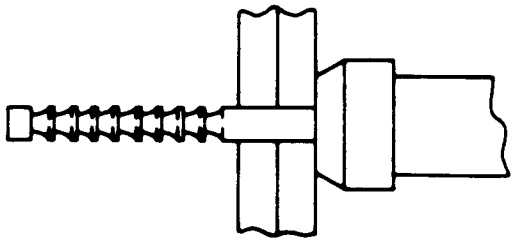
[H] INDICATIVE OF SPECIAL MANDRELS TO BE USED IN CONJUNCTION WITH SPECIAL SLEEVES

[I] MANDREL MATERIAL MUST BE SPECIFIED. SPECIFY H FOR H-11 OR H-13 TOOL STEEL OR V FOR VASCOJET TOOL STEEL. USE H-11 OR H-13 (H) TOOL STEEL FOR COLD WORKING HOLES IN ALUMINUM. USE VASCOJET (V) TOOL STEEL FOR COLD WORKING HOLES IN STEEL OR AULUMINUM.

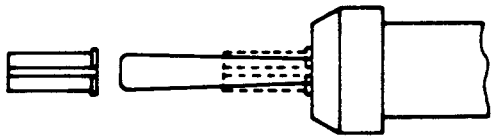
EXAMPLE: ST5300-CBM-22-0-N-3-V

THIS IS A MANDREL MADE FROM VASCOJET TOOL STEEL.

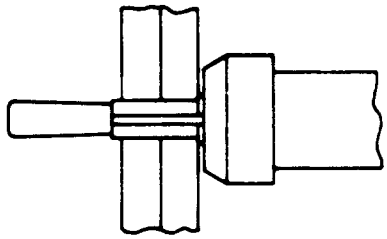
High Interference Cold Working Process
Figure 1 (Sheet 8)



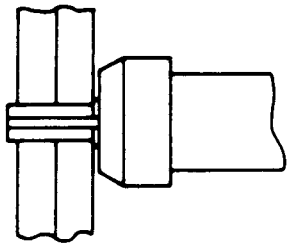
STEP 1 BROACH OR REAM HOLE TO STARTING SIZE SHOWN IN TABLE 1



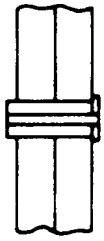
STEP 2 IF SLEEVE IS BEING USED, SLIDE SLEEVE OVER MANDREL UP TO NOSE PIECE OF PULLER



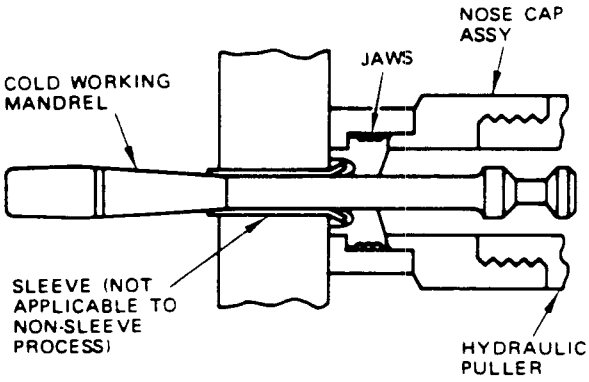
STEP 3 INSERT MANDREL OR MANDREL AND SLEEVE ASSY INTO HOLE



STEP 4 ACTUATE PULLER TO PULL MANDREL THROUGH HOLE



STEP 5 REMOVE AND DISCARD SLEEVE IF ONE HAS BEEN USED



TYPICAL ASSEMBLY
(PRIOR TO COLD WORKING)

SIMPLIFIED SEQUENCE OF OPERATIONS

(REFER TO TEXT FOR COMPREHENSIVE SEQUENCE OF OPERATIONS)

Low Interference Cold Working Process
Figure 2 (Sheet 1)

NOM HOLE SIZE	BOLTS AND OPEN HOLES			LOCKBOLTS AND HI-LOKS			RIVETS		
	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)
3/16	0.1922 0.1894	0.1880 0.1850	0.1880 0.1870	0.190 0.187	0.1860 0.1830	0.1860 0.1850	0.193 0.190	0.1895 0.1865	0.1895 0.1885
13/64	0.2078 0.2050	0.2036 0.2006	0.2036 0.2026	0.203 0.200	0.1990 0.1960	0.1990 0.1980			
7/32	0.2234 0.2206	0.2192 0.2162	0.2192 0.2182	0.219 J 0.216 J	0.2135 J 0.2105 J	0.2135 J 0.2125 J	0.223 0.220	0.2190 0.2160	0.2190 0.2180
15/64	0.2392 0.2364	0.2349 0.2319	0.2344 0.2339						
1/4	0.2548 0.2520	0.2505 0.2475	0.2505 0.2495	0.250 0.247	0.2460 0.2430	0.2460 0.2450	0.256 0.253	0.2525 0.2495	0.2525 0.2515
17/64	0.2704 0.2676	0.2661 0.2631	0.2661 0.2651	0.266 0.263	0.2620 0.2590	0.2620 0.2610			
9/32	0.2861 0.2833	0.2817 0.2787	0.2817 0.2807	0.281 J 0.278 J	0.2755 J 0.2725 J	0.2755 J 0.2745 J	0.286 0.283	0.2815 0.2785	0.2815 0.2805
19/64	0.3018 0.2990	0.2974 0.2944	0.2974 0.2964						
5/16	0.3175 0.3145	0.3130 0.3100	0.3130 0.3120	0.313 0.309	0.3085 0.3055	0.3085 0.3075	0.320 0.317	0.3145 0.3115	0.3145 0.3135
21/64	0.3331 0.3301	0.3286 0.3256	0.3286 0.3276	0.328 0.325	0.3235 0.3205	0.3235 0.3225			
11/32	0.3488 0.3458	0.3442 0.3412	0.3442 0.3432	0.344 J 0.341 J	0.3385 J 0.3335 J	0.3385 J 0.3375 J	0.348 0.345	0.3440 0.3410	0.3440 0.3430
23/64	0.3647 0.3615	0.3599 0.3569	0.3599 0.3589						
3/8	0.3803 0.3771	0.3755 0.3725	0.3755 0.3745	0.375 0.371	0.3700 0.3670	0.3700 0.3690	0.381 0.378	0.3755 0.3725	0.3755 0.3745
25/64	0.3960 0.3928	0.3911 0.3881	0.3911 0.3901	0.391 0.388	0.3870 0.3830	0.3870 0.3860			
13/32	0.4117 0.4083	0.4067 0.4037	0.4067 0.4057	0.406 J 0.403 J	0.4020 J 0.3990 J	0.4020 J 0.4010 J	0.411 0.408	0.4065 0.4035	0.4065 0.4055

SIZES FOR LOW INTERFERENCE COLD WORKED HOLES
TABLE I

Low Interference Cold Working Process
Figure 2 (Sheet 1A)

NOM HOLE SIZE	BOLTS AND OPEN HOLES			LOCKBOLTS AND HI-LOKS			RIVETS		
	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)	FINISHED HOLE SIZE	STARTING HOLE SIZE (SLEEVE PROCESS)	STARTING HOLE SIZE (NON-SLEEVE PROCESS)
27/64	0.4275 0.4241	0.4224 0.4194	0.4224 0.4214						
7/16	0.4432 0.4396	0.4380 0.4350	0.4380 0.4370	0.438 0.434	0.4315 0.4285	0.4315 0.4305	0.444 0.441	0.4370 0.4340	0.4370 0.4360
29/64	0.4589 0.4551	0.4536 0.4530	0.4536 0.4526	0.453 0.450	0.4465 0.4435	0.4465 0.4655			
15/32	0.4746 0.4708	0.4692 0.4662	0.4692 0.4682	0.469 [J] 0.466 [J]	0.4630 [J] 0.4600 [J]	0.4630 [J] 0.4620 [J]			
31/64	0.4905 0.4865	0.4849 0.4819	0.4849 0.4839						
1/2	0.5064 0.5020	0.5005 0.4975	0.5005 0.4995						
33/64	0.5220 0.5176	0.5161 0.5131	0.5161 0.5151						
17/32	0.5376 0.5332	0.5317 0.5287	0.5317 0.5307						
35/64	0.5533 0.5489	0.5474 0.5444	0.5474 0.5464						
9/16	0.5691 0.5647	0.5630 0.5600	0.5630 0.5620						
37/64	0.5847 0.5803	0.5786 0.5756	0.5786 0.5776						
19/32	0.6003 0.5959	0.5942 0.5912	0.5942 0.5932						
39/64	0.6160 0.6116	0.6094 0.6084	0.6094 0.6084						
5/8	0.6316 0.6272	0.6255 0.6225	0.6255 0.6245						

SIZES FOR LOW INTERFERENCE COLD WORKED HOLES

TABLE I (CONT)

NOMINAL HOLE SIZE		MANDREL ST5300-CWM [A]	SLEEVE ST5300-CWS [B]	UNIVERSAL KIT NO. MITBAC5973 [D]				UNIVERSAL KIT NO. 2 MITBAC 5973 [D]			
				NOSE CAP ST5300 -CBC	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY		NOSE CAP ST1350A -C	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY	
						3-JAW ST1350A	THREADED ST1350A			3-JAW ST5300-C	THREADED ST1350A-C
1/8	0.1281	-1267-"E"-"F"	-1267-"G"-"H"	-3	-"C"-23	-29	-38	-12	-"C"-23	-227	-35
9/64	0.1437	-1423-"E"-"F"	-1423-"G"-"H"	-3	-"C"-23	-29	-38	-12	-"C"-23	-227	-35
5/32	0.1594	-1580-"E"-"F"	-1580-"G"-"H"	-3	-"C"-23	-29	-38	-12	-"C"-23	-227	-35
11/64	0.1751	-1737-"E"-"F"	-1737-"G"-"H"	-3	-"C"-24	-29	-38	-12	-"C"-24	-227	-35
3/16	0.1908	-1894-"E"-"F"	-1894-"G"-"H"	-3	-"C"-24	-29	-38	-12	-"C"-24	-227	-35
13/64	0.2064	-2050-"E"-"F"	-2050-"G"-"H"	-3	-"C"-24	-29	-38	-12	-"C"-24	-227	-35
7/32	0.2220	-2206-"E"-"F"	-2206-"G"-"H"	-3	-"C"-24	-29	-38	-12	-"C"-24	-227	-35
15/64	0.2378	-2364-"E"-"F"	-2364-"G"-"H"	-3	-"C"-25	-29	-38	-12	-"C"-25	-227	-35
1/4	0.2534	-2520-"E"-"F"	-2520-"G"-"H"	-3	-"C"-25	-29	-38	-12	-"C"-25	-227	-35
17/64	0.2690	-2676-"E"-"F"	-2676-"G"-"H"	-3	-"C"-25	-29	-38	-12	-"C"-25	-227	-35
9/32	0.2847	-2833-"E"-"F"	-2833-"G"-"H"	-3	-"C"-26	-29	-38	-12	-"C"-26	-227	-35
19/64	0.3004	-2990-"E"-"F"	-2990-"G"-"H"	-3	-"C"-26	-29	-38	-12	-"C"-26	-227	-35
5/16	0.3160	-3145-"E"-"F"	-3145-"G"-"H"	-3	-"C"-26	-29	-38	-12	-"C"-26	-227	-35
21/64	0.3316	-3301-"E"-"F"	-3301-"G"-"H"	-3	-"C"-26	-29	-38	-12	-"C"-26	-227	-35
11/32	0.3473	-3458-"E"-"F"	-3458-"G"-"H"	-3	-"C"-27	-29	-38	-12	-"C"-27	-227	-35
23/64	0.3631	-3615-"E"-"F"	-3615-"G"-"H"	-3	-"C"-27	-29	-38	-12	-"C"-27	-227	-35
3/8	0.3787	-3771-"E"-"F"	-3771-"G"-"H"	-3	-"C"-27	-29	-38	-12	-"C"-27	-227	-35
25/64	0.3944	-3928-"E"-"F"	-3928-"G"-"H"	-3	-"C"-28	-29	-38	-12	-"C"-28	-227	-35
13/32	0.4100	-4083-"E"-"F"	-4083-"G"-"H"	-3	-"C"-28	-29	-38	-12	-"C"-28	-227	-35
27/64	0.4258	-4241-"E"-"F"	-4241-"G"-"H"	-3	-"C"-28	-29	-38	-12	-"C"-28	-227	-35
7/16	0.4414	-4396-"E"-"F"	-4396-"G"-"H"	-3	-"C"-28	-29	-38	-12	-"C"-28	-227	-35
29/64	0.4570	-4551-"E"-"F"	-4551-"G"-"H"	-3	-"C"-29	-29	-38	-12	-"C"-29	-227	-35
15/32	0.4727	-4708-"E"-"F"	-4708-"G"-"H"	-3	-"C"-29	-29	-38	-12	-"C"-29	-227	-35

BOLTS AND OPEN HOLES - LOW INTERFERENCE SLEEVE TYPE COLD WORKING TOOLS
TABLE II

Low Interference Cold Working Process
Figure 2 (Sheet 2)

NOMINAL HOLE SIZE		MANDREL ST5300-CWM [A]	SLEEVE ST5300-CWS [B]	UNIVERSAL KIT NO. [D] MITBAC5973				UNIVERSAL KIT NO. 2 [D] MITBAC 5973			
				NOSE CAP ST5300 -CBC	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY		NOSE CAP ST1350A -C	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY	
						3-JAW ST1350A	THREADED ST1350A			3-JAW ST5300-C	THREADED ST1350A-C
31/64	0.4885	-4865-"E"-"F"	-4865-"G"-"H"	-3	-"C"-29	-29	-38	-12	-"C"-29	-227	-35
1/2	0.5042	-5020-"E"-"F"	-5020-"G"-"H"	-3	-"C"-29	-29	-38	-12	-"C"-29	-227	-35
33/64	0.5198	-5176-"E"-"F"	-5176-"G"-"H"	-3	-"C"-30	-29	-38	-12	-"C"-30	-227	-35
17/32	0.5354	-5332-"E"-"F"	-5332-"G"-"H"	-3	-"C"-30	-29	-38	-12	-"C"-30	-227	-35
35/64	0.5511	-5489-"E"-"F"	-5489-"G"-"H"	-3	-"C"-30	-29	-38	-12	-"C"-30	-227	-35
9/16	0.5669	-5647-"E"-"F"	-5647-"G"-"H"	-3	-"C"-31	-29	-38	-12	-"C"-31	-227	-35
37/64	0.5825	-5803-"E"-"F"	-5803-"G"-"H"	-3	-"C"-31	-29	-38	-12	-"C"-31	-227	-35
19/32	0.5981	-5959-"E"-"F"	-5959-"G"-"H"	-3	-"C"-31	-29	-38	-12	-"C"-31	-227	-35
39/64	0.6138	-6116-"E"-"F"	-6116-"G"-"H"	-3	-"C"-31	-29	-38	-12	-"C"-31	-227	-35
5/8	0.6294	-6272-"E"-"F"	-6272-"G"-"H"	-3	-"C"-31	-29	-38	-12	-"C"-31	-227	-35
41/64	0.6451	-6429-"E"-"F"	-6429-"G"-"H"	-3	-"C"-32	-29	-38	-12	-"C"-32	-227	-35
21/32	0.6607	-6585-"E"-"F"	-6585-"G"-"H"	-3	-"C"-32	-29	-38	-12	-"C"-32	-227	-35
43/64	0.6764	-6742-"E"-"F"	-6742-"G"-"H"	-3	-"C"-32	-29	-38	-12	-"C"-32	-227	-35
11/16	0.6921	-6899-"E"-"F"	-6899-"G"-"H"	-3	-"C"-33	-29	-38	-12	-"C"-33	-227	-35
45/64	0.7077	-7055-"E"-"F"	-7055-"G"-"H"	-3	-"C"-33	-29	-38	-12	-"C"-33	-227	-35
23/32	0.7234	-7212-"E"-"F"	-7212-"G"-"H"	-3	-"C"-33	-29	-38	-12	-"C"-33	-227	-35
47/64	0.7391	-7369-"E"-"F"	-7369-"G"-"H"	-3	-"C"-33	-29	-38	-12	-"C"-33	-227	-35
3/4	0.7548	-7525-"E"-"F"	-7525-"G"-"H"	-3	-"C"-33	-29	-38	-12	-"C"-33	-227	-35
49/64	0.7704	-7681-"E"-"F"	-7681-"G"-"H"	-3	-"C"-34	-29	-38	-12	-"C"-34	-227	-35
25/32	0.7860	-7837-"E"-"F"	-7837-"G"-"H"	-3	-"C"-34	-29	-38	-12	-"C"-34	-227	-35
51/64	0.8018	-7995-"E"-"F"	-7995-"G"-"H"	-3	-"C"-34	-29	-38	-12	-"C"-34	-227	-35
13/16	0.8174	-8151-"E"-"F"	-8151-"G"-"H"	-3	-"C"-35	-29	-38	-12	-"C"-35	-227	-35
53/64	0.8317	-8307-"E"-"F"	-8307-"G"-"H"	-3	-"C"-35	-29	-38	-12	-"C"-35	-227	-35

BOLTS AND OPEN HOLES - LOW INTERFERENCE SLEEVE TYPE COLD WORKING TOOLS
TABLE II (CONT)

Low Interference Cold Working Process
Figure 2 (Sheet 3)

NOMINAL HOLE SIZE		MANDREL ST5300-CWM [A]	SLEEVE ST5300-CWS [B]	UNIVERSAL KIT NO. MITBAC5973 [D]				NOSE CAP ST1350A -C	UNIVERSAL KIT NO. 2 MITBAC 5973 [D]		
				NOSE CAP ST5300 -CBC	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY			JAW ASSY ST5300 -CBC [C]	CHUCK ASSY	
						3-JAW ST1350A	THREADED ST1350A			3-JAW ST5300-C	THREADED ST1350A-C
27/32	0.8487	-8464-"E"-"F"	-8464-"G"-"H"	-3	-"C"-35	-29	-38	-12	-"C"-35	-227	-35
55/64	0.8644	-8621-"E"-"F"	-8621-"G"-"H"	-3	-"C"-35	-29	-38	-12	-"C"-35	-227	-35
7/8	0.8801	-8778-"E"-"F"	-8778-"G"-"H"	-3	-"C"-36	-29	-38	-12	-"C"-36	-227	-35
57/64	0.8957	-8934-"E"-"F"	-8934-"G"-"H"	-3	-"C"-36	-29	-38	-12	-"C"-36	-227	-35
29/32	0.9114	-9091-"E"-"F"	-9091-"G"-"H"	-3	-"C"-36	-29	-38	-12	-"C"-36	-227	-35
59/64	0.9271	-9248-"E"-"F"	-9248-"G"-"H"	-3	-"C"-36	-29	-38	-12	-"C"-36	-227	-35
15/16	0.9428	-9404-"E"-"F"	-9404-"G"-"H"	-3	-"C"-36	-29	-38	-12	-"C"-36	-227	-35
61/64	0.9584	-9560-"E"-"F"	-9560-"G"-"H"	-3	-"C"-36	-29	-38	-12	-"C"-36	-227	-35
31/32	0.9740	-9716-"E"-"F"	-9716-"G"-"H"	-3	-"C"-36	-29	-38	-12	-"C"-36	-227	-35
63/64	0.9898	-9874-"E"-"F"	-9874-"G"-"H"	-303	-"C"-36	-29	-38	-12	-"C"-36	-227	-35
1	1.0054	-10030-"E"-"F"	-10030-"G"-"H"	-303	-"C"-36	-29	-38	-12	-"C"-36	-227	-35
1-1/64	1.0211	-10187-"E"-"F"	-10187-"G"-"H"	-303	-"C"-36	-29	-38	-12	-"C"-36	-227	-35
1-1/32	1.0367	-10343-"E"-"F"	-10343-"G"-"H"	-303	-"C"-36	-29	-38	-12	-"C"-36	-227	-35

BOLTS AND OPEN HOLES - LOW INTERFERENCE SLEEVE TYPE COLD WORKING TOOLS
TABLE II (CONT)

Low Interference Cold Working Process
Figure 2 (Sheet 4)

NOMINAL HOLE SIZE		MANDREL ST5300-CWM [A]	SLEEVE ST5300-CWS [B]	UNIVERSAL KIT NO. [D] MITBAC5973				UNIVERSAL KIT NO. 2 MITBAC 5973 [D]			
				NOSE CAP ST5300 -CBC	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY		NOSE CAP ST1350A -C	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY	
						3-JAW ST1350A	THREADED ST1350A			3-JAW ST5300-C	THREADED ST1350A-C
3/16	0.1885	-1870 -"E"-"F"	-1870 -"G"-"H"	-3	-"C"-24	-29	-38	-12	-"C"-24	-227	-35
13/65	0.2015	-2000 -"E"-"F"	-2000 -"G"-"H"	-3	-"C"-24	-29	-38	-12	-"C"-24	-227	-35
7/32	0.2175	-2160 -"E"-"F"	-2160 -"G"-"H"	-3	-"C"-25	-29	-38	-12	-"C"-25	-227	-35
1/4	0.2485	-2470 -"E"-"F"	-2470 -"G"-"H"	-3	-"C"-25	-29	-38	-12	-"C"-25	-227	-35
17/64	0.2645	-2630 -"E"-"F"	-2630 -"G"-"H"	-3	-"C"-25	-29	-38	-12	-"C"-25	-227	-35
9/32	0.2795	-2780 -"E"-"F"	-2780 -"G"-"H"	-3	-"C"-26	-29	-38	-12	-"C"-26	-227	-35
5/16	0.3110	-3090 -"E"-"F"	-3090 -"G"-"H"	-3	-"C"-26	-29	-38	-12	-"C"-26	-227	-35
21/64	0.3265	-3250 -"E"-"F"	-3250 -"G"-"H"	-3	-"C"-26	-29	-38	-12	-"C"-26	-227	-35
11/32	0.3425	-3410 -"E"-"F"	-3410 -"G"-"H"	-3	-"C"-27	-29	-38	-12	-"C"-27	-227	-35
3/8	0.3730	-3710 -"E"-"F"	-3710 -"G"-"H"	-3	-"C"-27	-29	-38	-12	-"C"-27	-227	-35
25/64	0.3895	-3880 -"E"-"F"	-3880 -"G"-"H"	-3	-"C"-27	-29	-38	-12	-"C"-27	-227	-35
13/32	0.4055	-4030 -"E"-"F"	-4030 -"G"-"H"	-3	-"C"-28	-29	-38	-12	-"C"-28	-227	-35
7/16	0.4360	-4340 -"E"-"F"	-4340 -"G"-"H"	-3	-"C"-28	-29	-38	-12	-"C"-28	-227	-35
29/64	0.4515	-4500 -"E"-"F"	-4500 -"G"-"H"	-3	-"C"-28	-29	-38	-12	-"C"-28	-227	-35
15/32	0.4675	-4660 -"E"-"F"	-4660 -"G"-"H"	-3	-"C"-29	-29	-38	-12	-"C"-29	-227	-35

HEX-DRIVE BOLTS AND LOCKBOLTS - LOW INTERFERENCE SLEEVE TYPE COLD WORKING TOOLS
TABLE II (CONT)

Low Interference Cold Working Process
Figure 2 (Sheet 5)

NOMINAL HOLE SIZE		MANDREL ST5300-CWM [A]	SLEEVE ST5300-CWS [B]	UNIVERSAL KIT NO. [D] MITBAC5973				UNIVERSAL KIT NO. 2 [D] MITBAC 5973			
				NOSE CAP ST5300 -CBC	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY		NOSE CAP ST1350A -C	JAW ASSY ST5300 -CBC [C]	CHUCK ASSY	
						3-JAW ST1350A	THREADED ST1350A			3-JAW ST5300-C	THREADED ST1350A-C
1/8	0.1295	-1280-"E"-"F"	-1280-"G"-"H"	-3	-"C"-23	-29	-38	-12	-"C"-23	-227	-35
5/32	0.1605	-1590-"E"-"F"	-1590-"G"-"H"	-3	-"C"-23	-29	-38	-12	-"C"-23	-227	-35
3/16	0.1915	-1900-"E"-"F"	-1900-"G"-"H"	-3	-"C"-24	-29	-38	-12	-"C"-24	-227	-35
7/32	0.2215	-2200-"E"-"F"	-2200-"G"-"H"	-3	-"C"-24	-29	-38	-12	-"C"-24	-227	-35
1/4	0.2545	-2530-"E"-"F"	-2530-"G"-"H"	-3	-"C"-25	-29	-38	-12	-"C"-25	-227	-35
9/32	0.2845	-2830-"E"-"F"	-2830-"G"-"H"	-3	-"C"-25	-29	-38	-12	-"C"-25	-227	-35
5/16	0.3185	-3170-"E"-"F"	-3170-"G"-"H"	-3	-"C"-26	-29	-38	-12	-"C"-26	-227	-35
11/32	0.3465	-3450-"E"-"F"	-3450-"G"-"H"	-3	-"C"-26	-29	-38	-12	-"C"-26	-227	-35
3/8	0.3795	-3780-"E"-"F"	-3780-"G"-"H"	-3	-"C"-27	-29	-38	-12	-"C"-27	-227	-35
13/32	0.4095	-4080-"E"-"F"	-4080-"G"-"H"	-3	-"C"-27	-29	-38	-12	-"C"-27	-227	-35
7/16	0.4425	-4410-"E"-"F"	-4410-"G"-"H"	-3	-"C"-28	-29	-38	-12	-"C"-28	-227	-35

RIVETS - LOW INTERFERENCE SLEEVE TYPE COLD WORKING TOOLS
TABLE II (CONT)

Low Interference Cold Working Process
Figure 2 (Sheet 6)



NOMINAL HOLE SIZE		MANDREL						UNIVERSAL KIT NO. MITBAC5793 [I]		UNIVERSAL KIT NO. 2MITBAC5793 [I]		KIT NO. 3MITBAC 5793 [I]
		ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H K]	ST5300-A [K]	ST5300-AB	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	CHUCK ST5300J-C
1/8	0.1281	-1281	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	—	-1281-"M"	—	—	-12	-21	—	—	—
9/64	0.1437	-1437	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	—	-1437-"M"	—	—	-12	-21	—	—	—
5/32	0.1594	-1594	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	—	-1594-"M"	—	—	-12	-21	—	—	—
11/64	0.1751	-1751	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	—	-1751-"M"	—	—	-12	-21	—	—	—
3/16	0.1908	-1908	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	—	-1908-"M"	—	—	-12	-21	—	—	—
13/64	0.2064	-2064	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	—	-2064-"M"	—	—	-12	-21	—	—	—
7/32	0.2220	-2220	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	—	-2220-"M"	—	—	-12	-21	—	—	—
15/64	0.2378	-2378	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	—	-2378-"M"	—	—	-12	-21	—	—	—
1/4	0.2534	-2534	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	-2534	—	—	—	—	—	—	—	-4
		—	—	—	-2534-"M"	—	—	-12	-21	—	—	—
17/64	0.2690	-2690	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	—	-2690-"M"	—	—	-12	-21	—	—	—
9/32	0.2847	-2847	—	—	—	—	—	-12	-29	-12	-227	-5
		—	—	—	-2847-"M"	—	—	-12	-21	—	—	—

BOLTS AND OPEN HOLES - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS

TABLE III

Low Interference Cold Working Process
Figure 2 (Sheet 7)

NOMINAL HOLE SIZE		MANDREL						UNIVERSAL KIT NO. MITBAC5793 [I]		UNIVERSAL KIT NO. 2MITBAC5793 [I]		KIT NO. 3MITBAC 5793 [I]
		ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H K]	ST5300-A [K]	ST5300-AB	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	CHUCK ST5300J-C
		-3004	—	—	—	—	—	-12	-29	-12	-227	-5
19/64	0.3004	—	—	—	-3004-"M"	—	—	-12	-21			
		-3160	—	—	-3160-"M"	—	—	-12	-29	-12	-227	-5
5/16	0.3160	—	—	-3160	—	—	—	-12				-4
21/64	0.3316	-3316	—	—	-3316	—	—	-12	-29	-12	-227	-5
11/32	0.3473	-3473	—	—	-3473	—	—	-12	-29	-12	-227	-5
23/64	0.3631	-3631	—	—	-3631	—	—	-12	-29	-12	-227	-5
		-3787	—	—	-3787-"M"	—	—	-12	-29	-12	-227	-5
3/8	0.3787	—	—	-3787	—	—	—					-5
25/64	0.3944	-3944	—	—	-3944	—	—	-12	-29	-12	-227	-5
13/32	0.4100	-4100	—	—	-4100	—	—	-12	-29	-12	-227	-5
27/64	0.4258	-4258	—	—	-4258	—	—	-12	-29	-12	-227	-5
7/16	0.4414	-4414	—	—	-4414	—	—	-12	-29	-12	-227	-5
29/64	0.4570	-4570	—	—	-4570	—	—	-12	-29	-12	-227	-5

BOLTS AND OPEN HOLES - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)

Low Interference Cold Working Process
Figure 2 (Sheet 8)



NOMINAL HOLE SIZE		MANDREL						UNIVERSAL KIT NO. MITBAC5793 [I]		UNIVERSAL KIT NO. 2MITBAC5793 [I]		KIT NO. 3MITBAC 5793 [I]
		ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H K]	ST5300-A [K]	ST5300-AB	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	CHUCK ST5300J-C
15/32	0.4727	-4727	—	—	-4727-"M"	—	—	-12	-29	-12	-227	-5
31/64	0.4885	-4885	—	—	-4885-"M"	—	—	-12	-29	-12	-227	-5
1/2	0.5042	-5042	—	—	-5042-"M"	—	—	-12	-29	-12	-227	-5
33/64	0.5198	-5198	-5198	—	—	-5198	—	-12	-29	-12	-227	-5
17/32	0.5354	-5354	-5354	—	—	-5354	—	-12	-29	-12	-227	-5
35/64	0.5511	—	-5511	—	—	-5511	—	-12	-29	-12	-227	-5
9/16	0.5669	—	-5669	—	—	-5669	—	-12	-29	-12	-227	-5
37/64	0.5825	—	-5825	—	—	-5825	—	-12	-29	-12	-227	-5
19/32	0.5981	—	-5981	—	—	-5981	—	-12	-29	-12	-227	-5
39/64	0.6138	—	-6138	—	—	-6138	—	-12	-29	-12	-227	-5
5/8	0.6294	—	-6294	—	-6294	-6294	—	-12	-29	-12	-227	-5

BOLTS AND OPEN HOLES - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)

Low Interference Cold Working Process
Figure 2 (Sheet 9)

NOMINAL HOLE SIZE		MANDREL						UNIVERSAL KIT NO. MITBAC5793 [I]		UNIVERSAL KIT NO. 2MITBAC5793 [I]		KIT NO. 3MITBAC 5793 [I]
		ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H K]	ST5300-A [K]	ST5300-AB	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	CHUCK ST5300J-C
41/64	0.6451	—	-6451	—	-6451-"M"	-6451	—	-12	-29	-12	-227	-5
21/32	0.6607	—	-6607	—	-6607-"M"	-6607	—	-12	-29	-12	-227	-5
43/64	0.6764	—	-6764	—	—	-6764	—	-12	-29	-12	-227	-5
11/16	0.6921	—	-6921	—	—	-6921	—	-12	-29	-12	-227	-5
45/64	0.7077	—	-7077	—	—	-7077	—	-12	-29	-12	-227	-5
23/32	0.7234	—	-7234	—	—	-7234	—	-12	-29	-12	-227	-5
47/64	0.7391	—	-7391	—	—	-7391	—	-12	-29	-12	-227	-5
3/4	0.7548	—	-7548	—	—	-7548	-7548	-12	-29	-12	-227	-5
49/64	0.7704	—	-7704	—	—	-7704	-7704	-12	-29	-12	-227	-5
25/32	0.7860	—	-7860	—	—	-7860	-7860	-12	-29	-12	-227	-5
51/64	0.8018	—	-8018	—	—	-8018	-8018	-12	-29	-12	-227	-5

BOLTS AND OPEN HOLES - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)

Low Interference Cold Working Process
Figure 2 (Sheet 10)

NOMINAL HOLE SIZE		MANDREL						UNIVERSAL KIT NO. M1TBAC5793 [I]		UNIVERSAL KIT NO. 2M1TBAC5793 [I]		KIT NO. 3M1TBAC 5793 [I]
		ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H K]	ST5300-A [K]	ST5300-AB	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	CHUCK ST5300J-C
13/16	0.8174	—	-8174	—	—	-8174	-8174	-12	-29	-12	-227	-5
53/64	0.8330	—	-8330	—	—	-8330	—	-12	-29	-12	-227	-5
27/32	0.8487	—	-8487	—	—	-8487	—	-12	-29	-12	-227	-5
55/64	0.8644	—	-8644	—	—	-8644	—	-12	-29	-12	-227	-5
7/8	0.8801	—	-8801	—	—	-8801	—	-12	-29	-12	-227	-5
57/64	0.8957	—	-8957	—	—	-8957	—	-12	-29	-12	-227	-5
29/32	0.9114	—	-9114	—	—	-9114	—	-12	-29	-12	-227	-5
59/64	0.9271	—	-9271	—	—	-9271	—	-12	-29	-12	-227	-5
15/16	0.9428	—	-9428	—	—	-9428	—	-12	-29	-12	-227	-5
61/64	0.9584	—	-9584	—	—	-9584	—	-12	-29	-12	-227	-5
31/32	0.9740	—	-9740	—	—	-9740	—	-12	-29	-12	-227	-5

BOLTS AND OPEN HOLES - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)

Low Interference Cold Working Process
Figure 2 (Sheet 11)

BOLTS AND OPEN HOLES - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS

TABLE III (CONT)

NOMINAL HOLE SIZE		MANDREL						UNIVERSAL KIT NO. MITBAC5793 [I]		UNIVERSAL KIT NO. 2MITBAC5793 [I]		KIT NO. 3MITBAC 5793 [I]
		ST5300A [E]	ST5300B [E]	ST5300J [G]	ST5300K [H]	ST5300-A [K]	ST5300-AB	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	CHUCK ST5300J-C
63/64	0.9898	—	-9898	—	—	-9898	—	-12	-29	-12	-227	-5
1	1.0054	—	-10054	—	—	-10054	—	-12	-29	-12	-227	-5
1-1/64	1.0211	—	-10211	—	—	-10211	—	-12	-29	-12	-227	-5
1-1/32	1.0367	—	-10367	—	—	-10367	—	-12	-29	-12	-227	-5
1-7/32	1.2229	—	-12229	—	—	-12229	-12229	-12	-29	-12	-227	-5

Low Interference Cold Working Process
Figure 2 (Sheet 12)

NOMINAL HOLE SIZE		MANDREL			UNIVERSAL KIT NO. MITBAC5793 [I]		UNIVERSAL KIT NO. 2MITBAC5793 [I]		KIT NO. 3MITBAC 5793 [I]
		ST5300A [E]	ST5300A-A [F]	ST5300K [H] [K]	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	CHUCK ST5300J-C
3/16	0.1885	-1885	-1885 -"L"-"X"	—	-12	-29	-12	-227	-5
		—	—	-1885 -"M"	-12	-21	—	—	—
13/64	0.2015	-2015	-2015 -"L"-"X"	—	-12	-29	-12	-227	-5
		—	—	-2015 -"M"	-12	-21	—	—	—
7/32	0.2175	—	-2175 -"L"-"X"	—	-12	-29	-12	-227	-5
		—	—	-2175 -"M"	-12	-21	—	—	—
1/4	0.2485	-2485	-2485 -"L"-"X"	—	-12	-29	-12	-227	-5
		—	—	-2485 -"M"	-12	-21	—	—	—
17/64	0.2645	-2645	-2645 -"L"-"X"	—	-12	-29	-12	-227	-5
		—	—	-2645 -"M"	-12	-21	—	—	—
9/32	0.2795	—	-2795 -"L"-"X"	—	-12	-29	-12	-227	-5
		—	—	-2795 -"M"	-12	-21	—	—	—
5/16	0.3110	-3110	-3110 -"L"-"X"	—	-12	-29	-12	-227	-5
		—	—	-3110 -"M"	-12	-21	—	—	—
21/64	0.3265	-3265	-3265 -"L"-"X"	-3265 -"M"	-12	-29	-12	-227	-5
11/32	0.3425	—	-3425 -"L"-"X"	-3425 -"M"	-12	-29	-12	-227	-5
3/8	0.3730	-3730	-3730 -"L"-"X"	-3730 -"M"	-12	-29	-12	-227	-5
25/64	0.3895	-3895	-3895 -"L"-"X"	-3895 -"M"	-12	-29	-12	-227	-5

HEX-DRIVE BOLTS AND LOCKBOLTS - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS
TABLE III (CONT)

Low Interference Cold Working Process
Figure 2 (Sheet 13)

HEX-DRIVE BOLTS AND LOCKBOLTS - LOW INTERFERENCE NON-SLEEVE PULL TYPE COLD WORKING TOOLS

TABLE III (CONT)

NOMINAL HOLE SIZE		MANDREL			UNIVERSAL KIT NO. MITBAC5793 [I]		UNIVERSAL KIT NO. 2MITBAC5793 [I]		KIT NO. 3MITBAC 5793 [I]
		ST5300A [E]	ST5300A-A [F]	ST5300K [H][K]	NOSE CAP ST1350A	CHUCK ST1350A	NOSE CAP ST1350A-C	CHUCK ST5300-C	CHUCK ST5300J-C
13/32	0.4045	—	-4045-"L"-"X"	-4045-"M"	-12	-29	-12	-227	-5

Low Interference Cold Working Process
Figure 2 (Sheet 14)

NOTES

[A] "E" IS -24 FOR STACKUPS UP TO 1-1/2 INCHES OR -48 FOR STACKUPS UP TO 3 INCHES

"F" IS THE TYPE OF MANDREL REQUIRED TO SUIT A 3-JAW OR THREADED CHUCK. SPECIFY -1 FOR 3-JAW CHUCK OR -3 FOR THREADED CHUCK. A THREADED CHUCK IS PREFERRED FOR SIZES OVER 0.4045 DIA

EXAMPLE: ST5300-CWM-2485-24-3

THIS IS A MANDREL FOR STACKUPS LESS THAN 1-1/2 INCHES (INDICATED BY -24) FOR USE WITH A THREADED CHUCK (INDICATED BY -3) FOR COLD WORKING A HOLE WITH A NOMINAL SIZE OF 0.2485 DIA

[B] "G" IS THE LENGTH OF THE SLEEVE IN 1/16 OF AN INCH WHICH MUST EQUAL OR EXCEED THE HOLE DEPTH. SLEEVES ARE MADE IN 1/4-INCH INCREMENTS ONLY, FROM 3/4 INCH TO 1-1/2 INCHES LONG. SLEEVES MAY BE STACKED FOR DEEP HOLES

"H" IS THE TYPE OF SLEEVE DENOTED BY THE SUFFIX "F" FOR FLARED TYPE OR "S" FOR STRAIGHT TYPE. FLARED SLEEVES ARE PREFERRED FOR HOLES UP TO 0.3447 DIA, BUT IF STACKED THE ADDITIONAL SLEEVES MUST BE THE STRAIGHT TYPE

EXAMPLE: ST5300-CWS-2485-8-F

THIS IS A FLARED SLEEVE (INDICATED BY -F) FOR A 0.2485 DIA HOLE WITH A LENGTH OF 1/2 INCH (INDICATED BY -8)

[C] "C" IS THE TYPE OF JAW ASSY REQUIRED TO SUIT THE TYPE OF SLEEVE BEING USED. USE THE SUFFIX F FOR FLARED TYPE OR S FOR STRAIGHT TYPE

[D] KIT MITBAC5973 AND KIT 2MITBAC5973 ARE ALTERNATIVES

[E] THIS MANDREL FOR USE IN EXTREMELY LIMITED ACCESS AREAS ONLY WHERE MATERIAL STACKUP DOES NOT EXCEED 5/8 INCH

[F] "L" IS THE THICKNESS OF MATERIAL STACKUP IN 1/8 OF AN INCH INCREMENTS

"X" IS TYPE-1 FOR NORMAL USE OR TYPE-2 IF REQUIRED FOR USE WITH THE OFFSET PULLER INCLUDED WITH KIT MITBAC5973

BOTH TYPE-1 AND TYPE-2 MANDRELS ARE FOR USE IN LIMITED ACCESS AREAS ONLY

[G] THIS MANDREL FOR USE WHERE MATERIAL STACKUP DOES NOT EXCEED 3/8 INCH

[H] "M" IS THE PILOT LENGTH IN 1/4-INCH INCREMENTS. THE PILOT LENGTH IS NOT CRITICAL FOR THE PROCESS DESCRIBED IN THIS SUBJECT

[I] KITS ARE ALTERNATIVES PROVIDED THAT THE CORRECT CORRESPONDING MANDREL IS USED

[J] FOR HI-LOKS ONLY.

[K] SUITABLE FOR GENERAL USE WHERE ACCESS IS AVAILABLE.

Low Interference Cold Working Process
Figure 2 (Sheet 15)

TOOL NOMENCLATURE AND NUMBER	SOURCE
SLEEVE ST5300-CBS ST5300-CWS ALL DASH NUMBERS	INDUSTRIAL WIRE AND METAL FORMING INCORPORATED 1208 ANDOVER PARK E. TUKWILA, WASHINGTON 98188
MANDREL ST5300-CBM ST5300-CWM MANDREL PULLER KIT [A] MITBAC5973 2MITBAC5973 3MITBAC5973	INDUSTRIAL WIRE AND METAL FORMING INCORPORATED 1208 ANDOVER PARK E. TUKWILA, WASHINGTON 98188 WEST COAST INDUSTRIES 1111 NORTH 92ND SEATTLE, WASHINGTON 98103 NORAL PRECISION COMPANY 32 G STREET N.W. AUBURN, WASHINGTON 98002 PACIFIC TOOL INCORPORATED 3530 RAINIER AVE. SO. SEATTLE, WASHINGTON 98144
POWER SOURCE (4MITBAC5973) POWER UNIT MODEL NO. H&A MODIFIED PA130	HYDRAULIC AND AIR EQUIPMENT CO. 4401 AIRPORT WAY SO. SEATTLE, WASHINGTON 98108

NOTES [A] KIT INCLUDES HYDRAULIC PULLER COMPLETE WITH THREADED NOSE CAP ASSEMBLIES, CHUCKS AND THREADED ADAPTER, OFFSET ADAPTER, QUICK-DISCONNECT FITTINGS, SET OF JAW ASSEMBLIES AND SET OF DRAWINGS OF TOOL DETAILS.

Tools for Cold Working of Holes
Figure 3

EXTRUSIONS AND FORMED SECTIONS

1. General

A. This chapter contains information pertaining to the extrusions and formed sections used throughout the structure and for repairs.

B. These sections are arranged in numerical sequence by AND and BAC part numbers for identification.

C. The properties of these sections are tabulated and shown by illustration.

D. An index is provided for convenience.

E. The die manufacturers of these sections are represented by the following code:

[B] Bridgeport Brass Co.
[D] Dow Chemical Co.
[H] Harvey Aluminum & Brass Co.
[K] Kaiser Aluminum & Chemical Co.
[M] Molding Inc.
[R] Reynolds Metals Co.
[L] Alsco Die Co.
No Symbol indicates Alcoa Die.

F. Extrusions and formed sections are used in the production of structural members, in the as-produced and modified shapes. When modified, the cross-sectional shape is altered either throughout the entire length of the structural member or at specific locations on the member.

EXTRUSION NO.	PAGE NO.
AND10133 -0501	7
-0502	7
-0503	7
-0601	7
-0602	7
-0701	7
-1001	7
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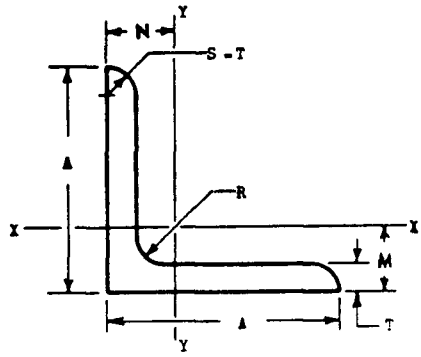
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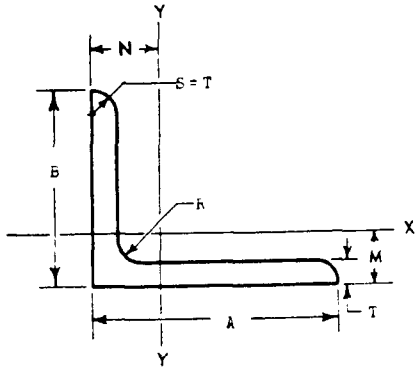
AND10133

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0503	.1068	.625	.094	.094	.184	.0035
0601	.0908	.750	.063	.094	.206	.0047
0602	.130	.750	.094	.094	.215	.0063
0701	.107	.875	.063	.094	.236	.0075
1001	.128	1.000	.063	.188	.260	.0118
1002	.183	1.000	.094	.188	.273	.0160
1003	.235	1.000	.125	.188	.285	.0202
1201	.159	1.250	.063	.188	.322	.0234
1202	.230	1.250	.094	.188	.335	.0330
1203	.298	1.250	.125	.188	.347	.0414
1204	.427	1.250	.188	.188	.368	.0561
1403	.360	1.500	.125	.188	.409	.0741
1404	.521	1.500	.188	.188	.431	.1021
2004	.924	2.000	.250	.250	.574	.3222
2403	1.17	2.500	.250	.250	.699	.6628
1401	.191	1.500	.063	.188	.384	.0411



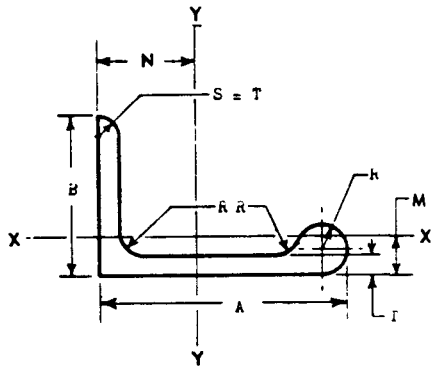
AND10134

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2401	.558	2.500	1.250	.156	.188	.260	.876	.0594	.3540
0602	.0818	.750	.625	.063	.063	.162	.222	.0027	.0044
1001	.100	1.000	.625	.063	.125	.140	.320	.0029	.0100
1003	.108	1.000	.750	.063	.125	.178	.299	.0051	.0106
1005	.116	1.000	.875	.063	.125	.220	.281	.0079	.0111
1006	.167	1.000	.875	.094	.125	.231	.292	.0110	.0155
1204	.139	1.250	1.000	.063	.125	.239	.361	.0124	.0217
1205	.202	1.250	1.000	.094	.125	.250	.373	.0171	.0306
1206	.262	1.250	1.000	.125	.125	.260	.384	.0215	.0383
1403	.228	1.500	1.000	.094	.156	.228	.472	.0182	.0512
1404	.295	1.500	1.000	.125	.156	.239	.485	.0226	.0647
1405	.361	1.500	1.000	.156	.156	.249	.495	.0265	.0772
0601	.0739	.750	.500	.063	.063	.120	.243	.0014	.0041
1407	.327	1.500	1.250	.125	.156	.321	.444	.0436	.0698
1408	.400	1.500	1.250	.156	.156	.331	.455	.0518	.0834
1601	.327	1.750	1.000	.125	.156	.222	.591	.0236	.0998
1602	.358	1.750	1.250	.125	.156	.300	.545	.0465	.1078
1603	.389	1.750	1.500	.125	.156	.383	.506	.0776	.1144
1604	.478	1.750	1.500	.156	.156	.393	.517	.0928	.1377
2003	.392	2.000	1.250	.125	.188	.279	.647	.0473	.1576
3004	1.17	3.000	2.000	.250	.250	.478	.972	.3627	1.034
2005	.568	2.000	1.250	.188	.188	.300	.670	.0643	.2197
2006	.423	2.000	1.500	.125	.188	.358	.603	.0806	.1675
2007	.519	2.000	1.500	.156	.188	.369	.615	.0965	.2016
2008	.615	2.000	1.500	.188	.188	.379	.626	.1114	.2346
2010	.558	2.000	1.750	.156	.188	.454	.577	.1511	.2125
2402	.662	2.500	1.250	.188	.188	.271	.889	.0684	.4137
2403	.597	2.500	1.500	.156	.188	.331	.824	.1023	.3773
2405	.636	2.500	1.750	.156	.188	.408	.778	.1608	.3978
0702	.100	.875	.750	.063	.125	.190	.250	.0082	.0123
1201	.124	1.250	.750	.063	.125	.159	.403	.0054	.0197
1202	.179	1.250	.750	.094	.125	.170	.416	.0074	.0276
2001	.358	2.000	1.000	.125	.156	.208	.701	.0244	.1453
2002	.439	2.000	1.000	.156	.156	.219	.712	.0287	.1745



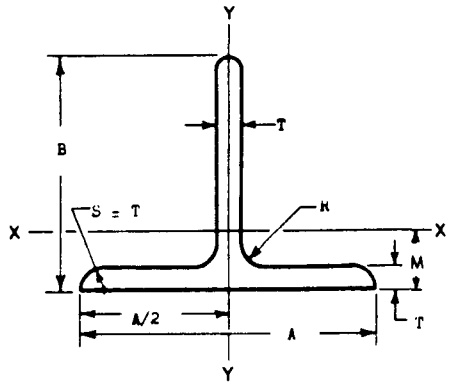
AND10135

DASH NO.	AREA	A	B	T	R	M	N	Ixx	Iyy
0501	.0698	.625	.563	.050	.075	.138	.245	.0016	.0035
1003	.162	1.000	.750	.078	.117	.178	.415	.0061	.0209
1004	.172	1.000	.875	.078	.117	.213	.394	.0096	.0222
1005	.181	1.000	1.000	.078	.117	.251	.375	.0142	.0233
1401	.211	1.500	.875	.078	.117	.181	.623	.0106	.0621
1602	.351	1.750	1.250	.109	.136	.282	.653	.0412	.1337
1201	.191	1.250	.875	.078	.117	.195	.507	.0101	.0392



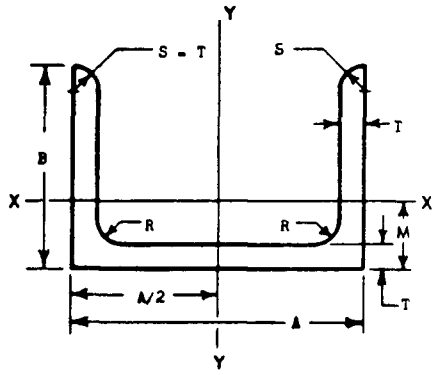
AND10136

DASH NO.	AREA	A	B	T	R	M	Ixx	Iyy
1304	.216	1.3750	1.000	.094	.125	.242	.0182	.0188
1401	.141	1.500	.750	.063	.125	.141	.0052	.0169
1503	.212	1.6250	1.125	.078	.125	.254	.0228	.0263
1505	.275	1.6250	1.375	.094	.125	.345	.0475	.0314
1702	.263	1.875	1.000	.094	.125	.207	.0197	.0486
1703	.342	1.875	1.000	.125	.125	.219	.0249	.0635
1704	.373	1.875	1.250	.125	.125	.294	.0479	.0634
2001	.231	2.000	1.000	.078	.125	.194	.0171	.0496
2002	.275	2.000	1.000	.094	.125	.200	.0200	.0592
2003	.358	2.000	1.000	.125	.125	.212	.0253	.0770
2004	.251	2.000	1.250	.078	.125	.265	.0325	.0495
2005	.299	2.000	1.250	.094	.125	.272	.0383	.0592
2401	.346	2.500	1.250	.094	.125	.241	.0403	.1168
2402	.452	2.500	1.250	.125	.125	.254	.0513	.1530
1302	.150	1.3750	1.000	.063	.125	.228	.0131	.0129
2404	.381	2.500	1.625	.094	.125	.351	.0858	.1168
1201	.0937	1.250	.625	.050	.094	.121	.0028	.0077
1403	.193	1.500	1.000	.078	.125	.225	.0160	.0200
2008	.451	2.000	1.750	.125	.125	.451	.1278	.0772
2407	.545	2.500	2.000	.125	.125	.487	.1991	.1531
3005	.670	3.000	2.500	.125	.125	.611	.3929	.2669
1303	.183	1.3750	1.000	.078	.125	.235	.0156	.0158
2006	.389	2.000	1.250	.125	.125	.285	.0488	.0770
2403	.554	2.500	1.250	.156	.125	.265	.0616	.1881
1404	.228	1.500	1.000	.094	.125	.232	.0186	.0245
1405	.212	1.500	1.250	.078	.125	.307	.0301	.0206
2007	.346	2.000	1.750	.094	.125	.438	.0995	.0592



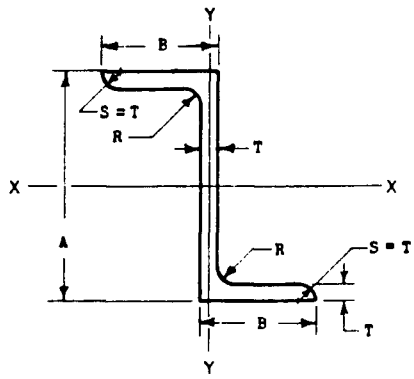
AND10137

DASH NO.	AREA	A	B	T	R	M	Ixx	Iyy
1011	.265	1.000	1.250	.078	.125	.460	.0417	.0460
2004	.361	2.000	1.000	.094	.125	.274	.0324	.2194
2404	.625	2.500	1.375	.125	.125	.394	.1093	.6030
1112	.279	1.125	1.000	.094	.125	.341	.0269	.0569
1407	.728	1.500	1.750	.156	.125	.654	.2176	.2675
2602	.689	2.750	1.000	.156	.125	.257	.0522	.7069
1111	.236	1.125	1.000	.078	.125	.336	.0232	.0495
1604	.338	1.750	1.000	.094	.125	.290	.0311	.1603
1113	.359	1.125	1.000	.125	.125	.352	.0331	.0695
2005	.469	2.000	1.000	.125	.125	.284	.0405	.2752



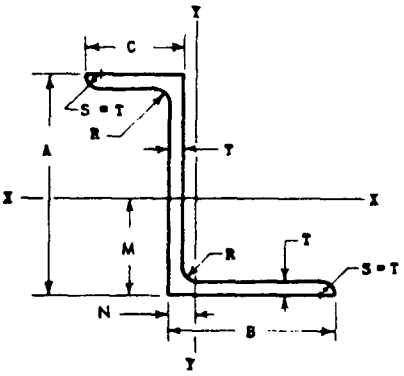
AND10138

DASH NO.	AREA	A	B	T	R	Ixx	Iyy
1205	.284	1.250	1.250	.078	.125	.0765	.0887
1602	.284	1.750	1.000	.078	.125	.1377	.0439
0709	.178	.875	1.000	.063	.125	.0236	.0367
1206	.338	1.250	1.250	.094	.125	.0886	.1039
2402	.323	2.500	.875	.078	.125	.2890	.0288
2404	.408	2.500	1.000	.094	.125	.3723	.0512
2002	.361	2.000	1.000	.094	.125	.2194	.0511



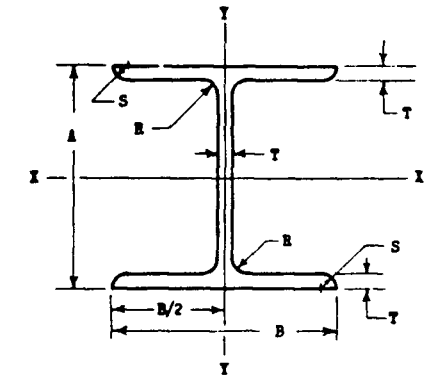
AND10139

DASH NO.	AREA	A	B	C	T	R	M	N	Ixx	Iyy
1006	.155	1.000	1.000	.500	.063	.125	.406	.175	.0232	.0171
1202	.187	1.250	.750	.500	.078	.125	.564	.0983	.0407	.0097
1301	.186	1.375	1.000	.625	.063	.125	.604	.129	.0547	.0207
1404	.359	1.500	1.000	.625	.125	.125	.660	.157	.1133	.0351
2004	.361	2.000	1.250	.750	.094	.125	.876	.168	.2138	.0577
1301	.186	1.375	1.000	.625	.063	.125	.604	.129	.0547	.0207
0704	.110	.875	.875	.500	.050	.094	.367	.136	.0135	.0102
0705	.139	.875	.875	.500	.063	.125	.368	.141	.0164	.0124
1405	.314	1.500	1.250	.750	.094	.125	.645	.187	.1082	.0559
2403	.516	2.500	1.125	.750	.125	.125	1.142	.140	.4426	.0559
2005	.516	2.000	1.500	.875	.125	.125	.858	.229	.3061	.1235



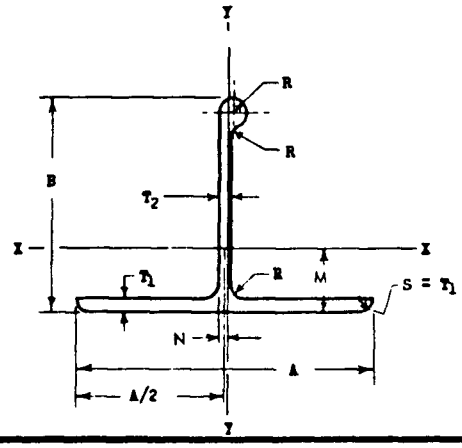
AND10140

DASH NO.	AREA	A	B	T	R	Ixx	Iyy
1002	.388	1.000	1.625	.094	.125	.0676	.0626
4004	.152	4.000	3.000	.156	.188	4.136	.6586
3002	.851	3.000	2.000	.125	.156	1.262	.1547
4003	.969	4.000	2.000	.125	.125	2.424	.1547
4001	.542	4.000	1.500	.078	.125	1.298	.0413



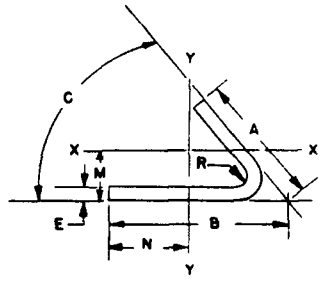
AND10141

DASH NO.	AREA	A	B	T1	T2	R	M	N	Ixx	Iyy
1402	.167	1.500	1.125	.060	.050	.094	.339	.0370	.0273	.0162
1403	.215	1.500	1.375	.070	.060	.109	.449	.0443	.0539	.0189
2001	.234	2.000	1.000	.070	.050	.125	.288	.0472	.0296	.0453
2002	.256	2.000	1.250	.070	.060	.125	.379	.0492	.0524	.0452



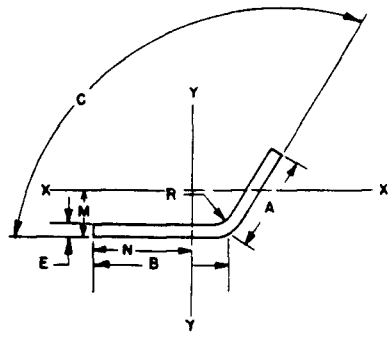
BAC1489

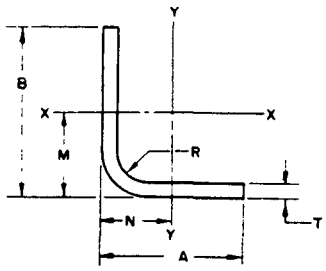
DASH NO.	AREA	A	B	C	E	R	Ixx	Iyy	M	N
235	.13948	.87	1.50	85°	.063	.13				
144	.103	.875	.875	87°	.063	.13				



BAC1489

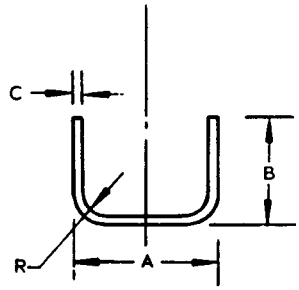
DASH NO.	AREA	A	B	C	E	R	Ixx	Iyy	M	N
228	.13536	1.02	1.18	107°	.064	.13	.0125	.0265	.2554	.9119
217	.123	1.00	1.00	108°	.064	.13				
145	.103	.875	.875	93°	.064	.13				
267	.2557	.90	3.20	135°	.063	.25				





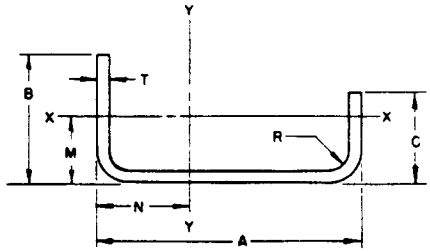
BAC1490

DASH NO.	DIE NO.	AREA	A	B	T	R	Ixx	Iyy	M	N
45	A-1038M	.061	.62	1.00	.040	.09	.00652	.00203	.334	.138
2585		.055	.75	.75	.040	.160	.00311	.00311	.214	.214
2513		.069	.75	.051	.75	.190	.00383	.00383	.221	.221
2609		.061	.75	.85	.040	.060	.00451	.00332	.246	.195
2759		.0632	.75	.92	.04	.09	.0056	.0034	.2763	.1888
53	A-1039M	.066	.75	1.00	.040	.090	.00699	.00347	.309	.181
2630		.0937	.80	.80	.064	.130	.0058	.0058	.234	.234
2548		.106	.80	1.00	.064	.130	.0109	.0063	.314	.210
2740		.0926	.80	1.12	.051	.09	.122	.0054	.355	.191
2690		.097	1.00	1.00	.051	.09	.0097	.0097	.276	.276
2575		.164	1.00	1.00	.091	.190	.0159	.0159	.299	.299
2684		.155	1.00	1.10	.081	.19	.0187	.0148	.334	.282
2510		.175	1.00	1.12	.091	.190	.0218	.0165	.347	.283
2770		.166	1.13	1.13	.080	.19				
2763		.18558	1.13	1.13	.090	.19				
2685		.3258	1.38	2.40	.091	.19	.2007	.0520	.819	.294
61	A-1036M	.119	.70	1.30	.064	.13	.02127	.00466	.463	.152
2554		.057	.75	.75	.040	.080	.00318	.00318	.208	.208
2573		.075	.75	1.25	.040	.160	.01259	.00366	.423	.163
2594		.105	1.25	1.50	.040	.160	.0249	.0161	.437	.308
2711		.0916	.90	1.00	.051	.09	.0093	.0072	.290	.238
2715		.079	.75	.90	.051	.09	.00655	.00419	.273	.195
2722		.069	.90	.90	.040	.06	.0056	.0056	.244	.244
2734		.1755	1.00	1.88	.064	.13	.0666	.0142	.654	.203
2764		.21062	1.13	1.20	.100	.22				
2583		.133	1.00	1.00	.072	.130	.0131	.0131	.287	.287
2700		.118	.70	.80	.091	.19	.00732	.00528	.265	.212
2540		.117	1.00	1.00	.064	.220	.0116	.0116	.290	.290
2640		.116	1.00	1.38	.051	.090	.0234	.0107	.438	.234
2506		.086	.80	1.00	.051	.090	.0089	.0052	.305	.202
2526		.063	.50	.88	.051	.19	.0503	.00128	.323	.119
2527		.106	.80	1.04	.064	.220	.0118	.0063	.339	.211
2689		.071	.50	1.00	.051	.09	.00750	.00136	.365	.106
2749		.1764	1.00	1.60	.072	.13				
2760		.080	1.00	1.09	.04	.09				
2778		.0769	.80	1.20	.04	.06				
2780		.19847	1.00	1.38	.091	.19				
2693		.102	.75	.82	.072	.13	.00678	.00545	.252	.216
2743		.057	.50	.72	.051	.09	.00303	.00124	.241	.127



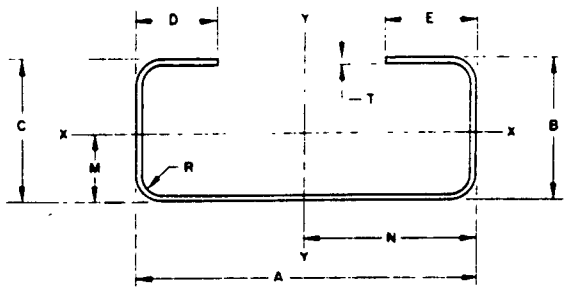
BAC1493

DASH NO.	A	B	C	R
572	.76	.60	.050	.12
573	.60	1.00	.063	.30



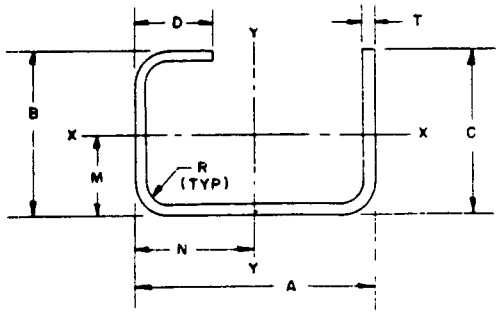
BAC1493

DASH NO.	DIE NO.	AREA	A	B	C	T	R	Ixx	Iyy	M	N
46	U-632 M	.0597	1.000	.500	.500	.032	.063	.00148	.00915	.1418	.5000
493		.2412	1.35	1.00	1.00	.081	.19				
209		.1384	1.000	1.000	1.000	.051	.190	.01432	.02363	.3778	.5000
413		.169	1.00	1.00	1.00	.064	.22	.01722	.02806	.3880	.5000
519		.2345	1.00	1.00	1.00	.090	.19				
246		.1954	1.000	1.000	1.000	.072	.130	.01997	.03234	.3796	.5000
470		.247	1.00	3.65	.40	.051	.09				
494		.2308	1.50	1.00	1.00	.072	.13				
144	U-615 M	.1034	1.500	.630	.630	.040	.090	.00390	.03429	.1645	.7500
273		.1058	2.000	.750	.750	.032	.130	.00561	.06175	.1796	1.000
513		.06536	.64	1.00	.20	.040	.12				
521		.0815	.64	1.00	.20	.050	.09				
489		.0809	.65	.85	.30	.051	.09	.0053	.0046	.2626	.2220
515		.13009	.70	1.00	.25	.081	.16				
522		.1399	.70	1.00	.25	.090	.19				
514		.11034	.74	1.00	.25	.064	.12				
520		.127	.75	1.00	1.00	.050	.09				
574			.60	1.00	.25	.063	.13				



BAC1494

DASH NO.	DIE NO.	AREA	A	B	C	D	E	T	R	Ixx	Iyy	M	N
121		.1640	1.400	.800	.800	.400	.400	.051	.190	.0148	.0458	.3289	.7000

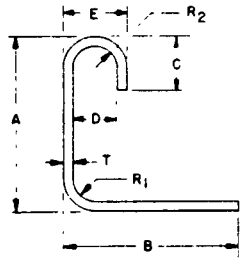


BAC1495

DASH NO.	DIE NO.	AREA	A	B	C	D	T	R	Ixx	Iyy	M	N
162		.21025	1.47	.75	2.00	.30	.050	.09				
151		.0915	2.00	.75	.83	.30	.025	.09	.0068	.0554	.2233	.9708
131		.1395	2.000	.800	.800	.250	.040	.160	.00982	.08168	.2233	.9710

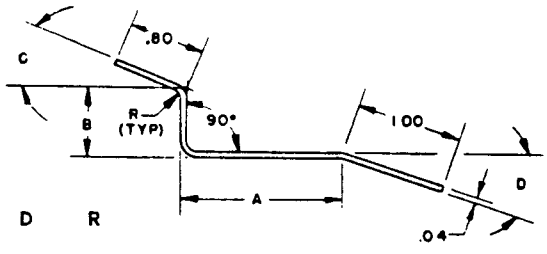
BAC1496

DASH NO.	DIE NO.	AREA	A	B	C	T	R1	R2
267			.700	.720	.130	.040	.060	.090



BAC1496

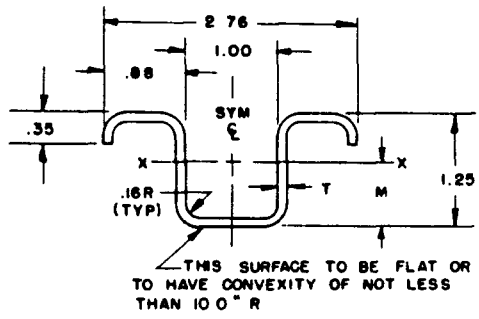
DASH NO.	DIE NO.	AREA	A	B	C	D	R
340		.14574	1.60	.38	11°	14°	.06
338		.15236	1.72	.52	12°	20°	.19

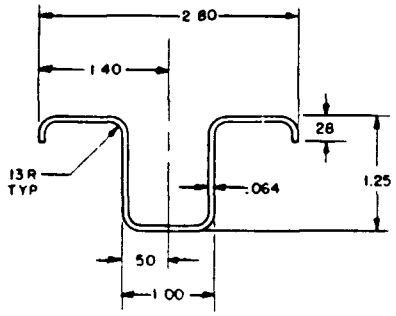


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BAC1498

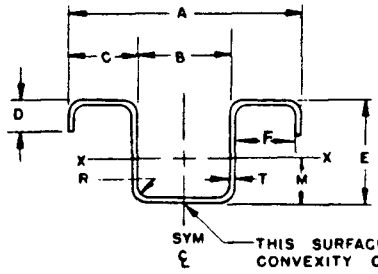
DASH NO.	DIE NO.	AREA	T	M	Ixx
101		.3982	.081	.72	.088
102		.4403	.091	.72	.094





BAC1498

DASH NO.	DIE NO.	AREA
92		.3319



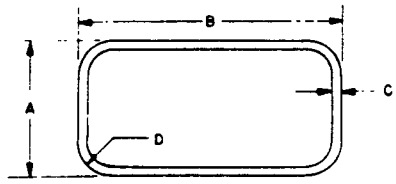
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BAC 1480 CORRUGATION TOLERANCES APPLY

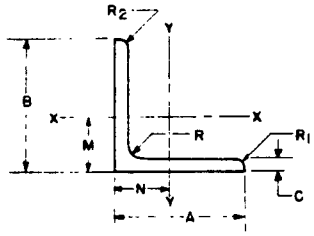
DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	R	T	M	Ixx
108		.1443	2.24	.76		.20	1.19		.13	.032		
107		.1783	2.24	.76		.20	1.19		.13	.04		
95		.1458	2.24	.76	.74	.20	1.25		.13	.032	.74	.034
96		.1796	2.24	.76	.74	.20	1.25		.13	.040	.72	.042
106		.2050	2.24	.76	.74	.20	1.25		.13	.045		
97		.2302	2.24	.76	.74	.25	1.25		.13	.051	.72	.052
114		.2870	2.24	.76		.25	1.25		.13	.063		
110		.2724	2.26	.76		.25	1.25		.13	.056		
109		.2574	2.74	1.00		.30	1.25		.16	.050		
98		.2817	2.76	1.00	.88	.30	1.25		.16	.056	.73	.064
99		.317	2.76	1.00	.88	.30	1.25		.16	.064	.71	.078
100		.3519	2.76	1.00	.88	.30	1.25		.16	.072	.71	.082
104		.2489	2.50	.54	.98	.35	1.25		.13	.051		
112		.2203	2.24	.76		.20	1.19		.13	.050		
113		.2295	2.76	1.00	.88	.25	1.25		.16	.045		
124		.331	2.90	.82	1.04	.30	1.25		.16	.063		
105		.3181	2.48	.58		.31	1.27		.12	.064		
125		.3683	2.90	.82	1.04	.30	1.25		.16	.071		
133		.241914	2.60	.62		.25	1.22		.16	.050		
131		.4788		.81	1.1	.40	1.26		.19	.090		
137		.2772	2.24	.76	.74	.25	1.18		.13	.063		
146		.3958		1.00		.34	1.25	.70	.19	.080		
147		.4437		1.00		.34	1.25	.70	.19	.090		
149		.320	2.24	.76		.25	1.25		.13	.071		

BAC1501

DASH NO.	DIE NO.	AREA	A	B	C	D
8301		.803	2.000	2.000	1.20	.531

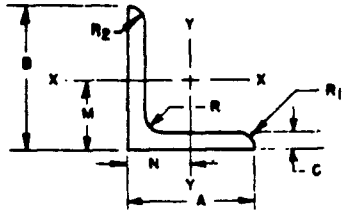


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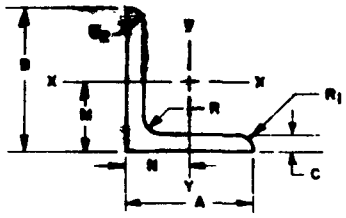


DASH NO.	DIE NO.	AREA	A	B	C	R	R1	R2	Ixx	Iyy	M	N
1021	734-18 P	.082	.625	.750	.062	.062	.032	.032	.0045	.0029	.225	.164
	P-4420											
1061	14594 R	.097	.625	1.000	.062	.031			.0096	.0031	.331	.144
	P-4406 P											
1430	44076 H	.075	.750	.750	.051	.063			.0041	.0041	.205	.205
	223321											
1491	22878	.097	.750	.875	.062	.062	.031	.031	.0074	.0050	.256	.194
	P-4082 R											
	50612 D											
1512	1288	.1180	.750	1.000	.070	.063	.031	.031	.0119	.0058	.310	.186
	P&G-1627 R											
	14723 H											
100030	59408	.1231	.80	1.000	.070	.120			.0121	.0069	.298	.200
100026	15645 H	.1413	.800	1.000	.081	.120			0138	.0078	.303	.205
	52564											
	66561											
1761	22895	.097	.813	.813	.062	.062	.031	.031	.0061	.0061	.224	.224
	18329 R											
100045	50766 D	.090	.83	1.00	.05	.06			.0091	.0057	.290	.205
	16985 H											
	66084											
100044	59342	.107	.83	1.00	.06	.06			.0108	.0068	.294	.209
100043	59341	.124	.83	1.00	.07	.06			.0124	.0078	.298	.213
100049	56870	.148	.84	1.10	.080	.100	.080	.080	.0175	.0088	.334	.206
1762	9484	.122	.787	.787	.079	.126			.0070	.0070	.223	.223
100138	18765	.13196	.875	.95	.075	.09			.0113	.0093	.269	.237
2729	K-15046	.100	1.00	1.00	.050	.125	.031	.031	.0097	.0097	.261	.261
	P-2174 R											
	DC-1482 D											
4203	734CC	.329	1.250	1.500	.125	.187	.125	.125	.0700	.0438	.442	.320
	P-2379 R											
1591	22990	.139	.750	1.500	.062	.125			.0332	.0058	.513	.147
	18215 P											

BAC1503



DASH NO.	DIE NO.	AREA	A	B	C	R	R1	R2	Ixx	Iyy	M	N
2731	78-J DC-1691 6203 13827	.121	1.000	1.000	.062	.062	.031	.031	.0117	.0117	.271	.271
100096	71369	.1414	1.000	1.000	.072	.13			.0134	.0134	.271	.271
2733	77B P&G-118 12148 15055	.234	1.000	1.000	.125	.125	.094	.094	.0208	.0208	.290	.290
100028	15564 59128	.1928	1.000	1.120	.094	.125			.0234	.0175	.327	.267
4223	734-2 5739	.340	1.250	1.625	.125	.125	.125	.125	.0874	.0447	.495	.310
4245	19095 734-0 17055	.527	1.250	1.750	.187	.187	.125	.125	.1555	.0653	.570	.324
100075	60756	.5275	1.25	2.20	.16	.10			.2632	.0632	.759	.286
100119	H-2824 53721 82461	.580	1.25	3.50	.125	.125			.7500	.0555	1.3405	.2112
100079	71492	.253	1.38	1.82	.080	.12			.0865	.0436	.542	.324
5824	10468 P-3996 16766 H-3058	.446	1.500	1.500	.156	.156	.078	.078	.0929	.0929	.427	.427
6633	78EE	.391	1.625	1.625	.125	.187	.125	.125	.0955	.0955	.440	.440
2771	22896 5732 14783 50634	.139	1.000	1.250	.062	.125			.0223	.0127	.361	.242
100018	52147 68461	.2308	1.000	1.250	.109	.109	.109	.109	.0343	.0193	.379	.255
100019	11516 52178	.3309	1.000	1.250	.156	.156			.0490	.0276	.401	.277
100022	60849 50443	.3910	1.000	1.250	.188	.125			.0569	.0320	.414	.290
100066	60242 19213	.183	1.00	1.70	.07	.09	.09	.07	.0550	.0145	.554	.207
100140	83938	.5689	1.00	4.75	.10	.15						
10874	30412	.325	1.000	2.500	.094	.156			.2162	.0219	.917	.177
2963	734-19 P-4074 14956	.426	1.000	2.500	.125	.187	.094	.094	.2757	.0264	.925	.188
100103	76124	.2745	1.00	1.30	.125	.13			.0451	.0231	.409	.261
100054	66250 M-1896	.208	1.20	2.00	.062	.25			.0869	.0240	.614	.240

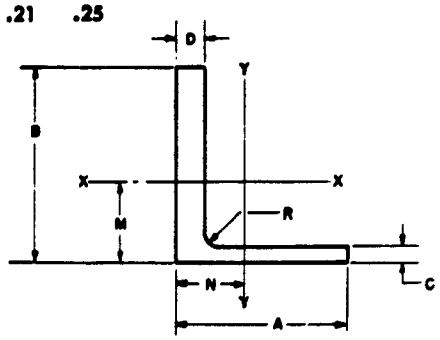


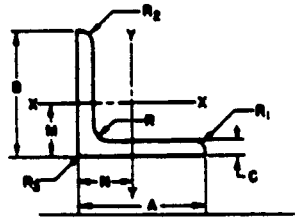
BAC1503

DASH NO.	DIE NO.	AREA	A	B	C	R	R^1	R^2	Ixx	Iyy	M	N
2773	734-HH N P&G-1320 R 13034 H	.267	1.000	1.250	.125	.125	.062	.062	.0404	.0228	.388	.265
2812	44903 15825	.4075	1.250	1.500	.156	.160	.078	.078	.0877	.0551	.460	.337
4162	78Y P-2382	.227	1.250	1.250	.094	.094	.047	.047	.0339	.0339	.344	.344
4205	734LL P-4087 R 14971 H	.480	1.250	1.500	.187	.187	.125	.125	.1001	.0624	.469	.346
5903	734-TT P&G-1314 R	.423	1.500	2.000	.125	.187	.125	.125	.1674	.0806	.603	.358
7672	K-13816 14861 H	.4897	1.75	3.50	.094	.156			.6484	.1169	1.191	.326
11780	30413	.372	1.000	3.000	.094	.156			.3551	.0226	1.148	.160
100014	51470	.6176	1.500	1.750	.200	.200			.1798	.1214	.540	.417
100027	57961 52571	.1084	.80	1.000	.062	.090			.0108	.0062	.296	.198
100084	51005 R 67763	.51211	1.75	2.50	.125	.125	.125	.125				
100093	71189 M-1903	.2132	1.25	2.15	.064	.06			.1033	.0273	.6940	.2541
100134	54061 R	.0703	.60	.80	.05	.12			.0045	.0021	.2407	.1445
100135		.4507	1.60	3.00	.10	.09			.4342	.0917	1.0126	.3159
100136	54062 R 24595 H	.1132	.90	1.00	.06	.12			.0111	.0086	.279	.233
2730	K-12422 6314 P	.289	1.000	1.000	.156	.156	.078	.078	.0254	.0254	.302	.302
2732	78F P-4085 R 11111 H	.179	1.000	1.000	.094	.125	.094	.094	.0168	.0168	.290	.290
100081	11517 R 18376 H	.2429	1.00	1.10	.125	.125	.125	.125	.0264	.0206	.324	.275
2811	K-11472 P-4075 R 14969 H	.152	1.000	1.500	.062	.062	.031		.0358	.0131	.470	.222
2842	14263	.251	1.000	1.750	.094	.094	.047		.0802	.0197	.588	.215
1531	22969	.1158	.750	1.125	.062	.125			.0151	.0054	.353	.171
1831	22889	.127	.813	1.250	.062	.125			.0206	.0067	.396	.177
9741	30410	.313	1.17	2.20	.094	.156			.1608	.0335	.744	.235
1662	22894	.246	.750	1.937	.094	.094			.0968	.0088	.731	.142
100068	60356	.354	1.42	2.44	.09	.18			.2176	.0565	.791	.291

BAC1503

DASH NO.	DIE NO.	AREA	A	B	C	D	R	Ixx	Iyy	M	N
100069	51152 B	.2498	1.000	1.350	.125	.100	.125				
100095		.4436	1.46	1.68	.08	.20	.19				
100121	80234	.80546	2.25	3.50	.18	.12	.12				
100113	76952	1.932	2.83	2.85	.25	.47	.25				
100149	105474	.8695	1.18	3.25	.18	.21	.25				
100157	106554	1.1073	2.50	3.25	.18	.21	.25				



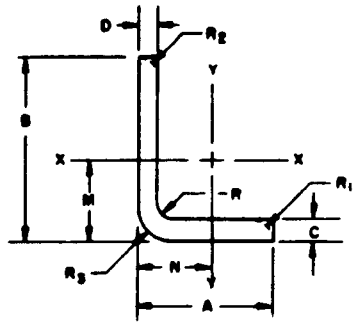


BAC1503

DASH NO.	DIE NO.	AREA	A	B	C	R	R1	R2	R3	Ixx	Iyy	M	N
100071	72915	.150	.93	1.00	.081	.125	.081	.081	.03	.0140	.0111	.281	.253
100053	71268 60654	.399	1.00	1.75	.156	.156	.156	.156	.031	.1195	.0277	.602	.232

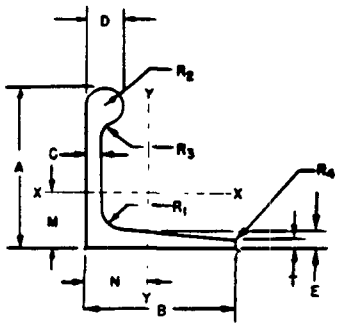
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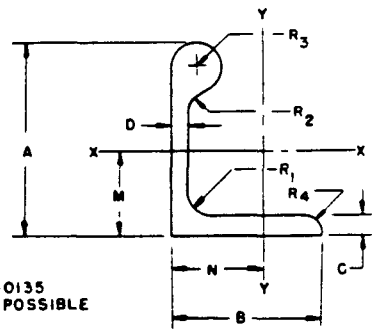
DASH NO.	DIE NO.	AREA	A	B	C	D	R	R_3	Ixx	Iyy	M	N
100122	82157 80573	.2682	.92	1.60	.08	.13	.125	.16	.0706	.0135	.6257	.1753



BAC1504

DASH NO.	AREA	A	B	C	D	E	R1	R2	R3	R4	T	I_{xx}	I_{yy}	M	N
2563	13642 6183[R]	.156	1.000	.875	.078	.172	.078	.125	.086	.156	.078	.0183	.0101	.341	.222
2583	13839 14852[H] M-1450 DC-1587[D] DC-1709	.203	1.000	1.000	.090	.240	.090	.100	.120	.100	.090	.0249	.0168	.362	.265
4266	24121	.350	1.250	.875	.172	.344	.125	.125	.172	.125	.125			.516	.208





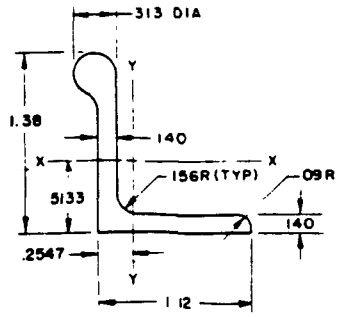
USE AND10135
WHEREVER POSSIBLE

BAC1504

DASH NO.	DIE NO.	AREA	A	B	C	D	R1	R2	R3	Ixx	Iyy	M	N
8181	59421	.134	1.00	1.00	.062	.062	.094	.125	.078	.01626	.01178	.3320	.2525
8180	59420	.138	.90	1.00	.065		.09	.09	.09				

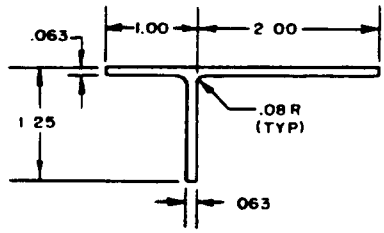
BAC1504

DASH NO.	DIE NO.	AREA	Ixx	Iyy
8186	10773[R] 53379[B]	.3779	.0838	.0409



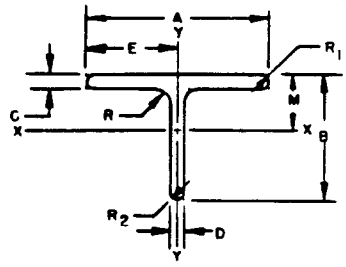
BAC1505

DASH NO.	DIE NO.	AREA
100290	82155	.2653



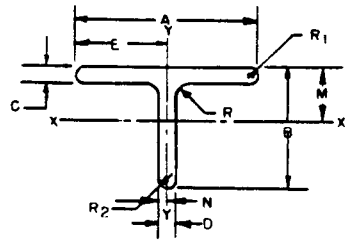
BAC1505

DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	R1	R2	Ixx	Iyy	M
100137	8265	.303	2.25	1.00	.094	.094	1.00	.125	.016	.016			
100022	51937	.1861	1.750	1.200	.064	.064	.875	.064	.016	.016	.0237	.0284	.2661



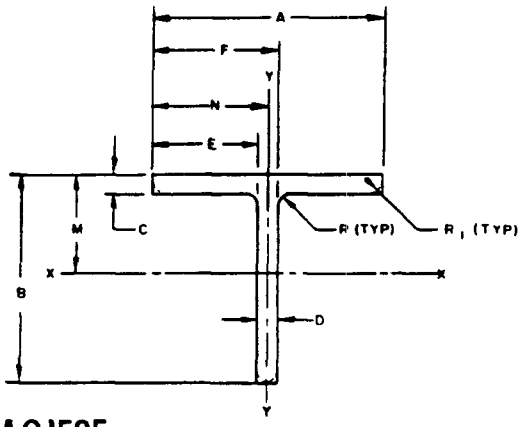
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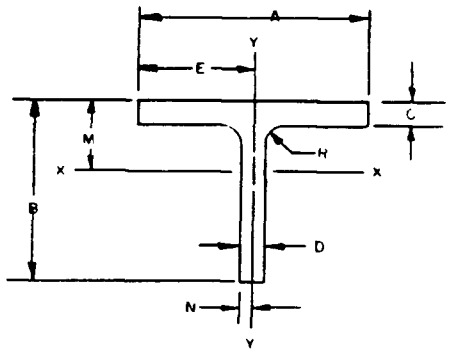
DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	R1	R2	Ixx	Iyy	M	N
100202	18389 [R] 71064	.361	2.00	1.25	.125	.094	1.00	.125	.031	.031				
29063	16885	.432	2.000	1.500	.125	.125	1.000	.156			.0851	.0837	.363	
100230	20171 [H] 18561 [R]	.5853	2.02	2.13	.16	.13	1.01	.13	.031	.031	.2453	.1095	.5459	
100164	50752 [B]	.198	2.20	1.00	.062	.062	1.10	.09	.016	.016	.0145	.0548	.1784	
100166	69163	.342	2.25	2.03	.08	.08	1.12	.12	.016	.016	.1363	.0758	.5038	.0426
100120	16439 [H]	.217	2.40	1.00	.064	.064	1.20	.094	.016	.016	.0151	.0734	.170	
100199	51153 [B]	.4305	2.40	1.35	.125	.10	1.40	.125	.031	.031				
5251	2281	.100	.750	.750	.062	.070	.343	.125	.031	.035				
100040	66336 18277	.5005	2.120	3.000	.125	.080	1.060	.125	.030	.030				



BAC1505

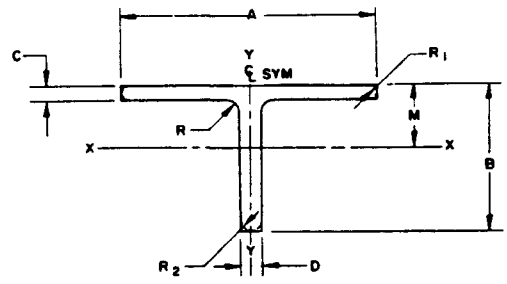
DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	Ixx	Iyy	M	N
100038	52179	.7089	2.500	3.250	.125	.125	1.000	.125	.7785	.1730	.9573	.1725
100168	71132	.370	2.60	2.03	.08	.08	1.30	.12				
100008	51468	.8394	2.800	2.700	.187	.125	1.400	.062	.5249	.3425	.5989	
100275		.4224	2.90	1.40	.10	.10	1.00	.094				
100190	71024	1.1463	3.00	1.75	.30	.16	1.50	.19				
100185	16016 R	2.064	3.50	2.00	.50	.20	1.75	.19				
100158	50761 B 10248 B	.476	3.60	1.40	.094	.094	1.75	.188	.0618	.3652	.2300	.0825
58412	4408	.495	3.687	1.250	.094	.125	1.844	.062				
100364		.34986	2.50	2.00	.078	.078	1.13	.12				
100081	52710	.7093	4.500	2.600	.100	.100	2.250	.150				
100114	50397 B 65664	.319	2.880	1.130	.081	.081	1.440	.070	.0274	.1596	.190	
100231	18600 R 72812	1.832	5.00	4.30	.18	.22	2.50	.25	3.3951	1.8794	1.155	
100152	69162	.456	2.60	2.00	.10	.10	1.30	.12	.1676	.1463	.467	





BAC1505

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	R	R1	Ixx	Iyy	M	N
100539	151034	.839	2.30	1.50	.30	.12		1.06	.125					
100540	41779 R	.610	2.00	1.90	.20	.12		1.06	.125					
100608			2.30	1.58	.38	.12		1.06	.125					
100299	82214	.4319	2.00	2.35	.10	.10	1.05		.13		.2443	.0681	.6619	1.0000
100310		.497	2.00	3.00	.10	.10	1.05		.13					
100017	51735	.211	.800	1.000	.125	.125	.40		.062					
100216	10920 R 54089 B	1.5699	2.80	2.18	.46	.16	1.40		.16	.09	.3587	.8363	.4220	1.4146
100124	59832 11548 R 53322 B	.705	3.00	2.00	.156	.125		1.40	.125		.2199	.3537	.4053	1.4453
100268	53137 B	.7178	3.30	1.96	.16	.10	1.60		.16					
100269	53138 B	1.06582	3.40	2.31	.25	.10	1.62		.16					
100265	H-2781 K	.60542	2.78	1.95	.15	.10	1.48		.15					
100289	18846 R	1.15424	3.84	2.12	.20	.20		1.60	.09					

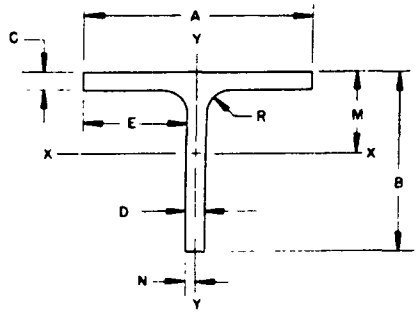


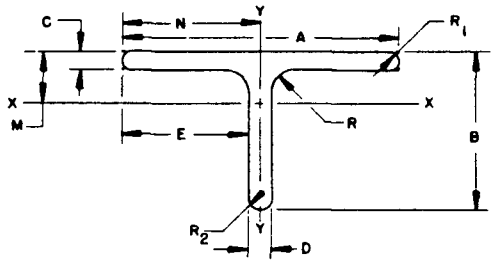
BAC1505

DASH NO.	DIE NO.	AREA	A	B	C	D	R	R1	R2	Ixx	Iyy	M
100352	21836	.2642	3.10	1.12	.063	.063	.09					
100270	82478	.2157	2.40	1.00	.063	.063	.125	.031	.031			
	H-2821											
100372	82124	.2554	1.92	1.05	.10	.06	.125	.016	.016			
100282	54063B	.9724	3.90	2.25	.14	.20	.16	.06	.09			
100285	53749B	.49596	2.65	1.35	.14	.10	.10					
18660	22982	.117	1.500	.812	.050	.050	.094			.0060	.0141	.159
18721	27477	.152	1.500	1.000	.062	.062	.062	.031		.0132	.0170	.223
100272	53206B	.3987	1.77	1.04	.16	.125	.125	.031	.031			
26400	8845	.151	1.875	1.125	.050	.050	.094			.0161	.0275	.2260
100287	53748B	.2297	1.80	1.00	.09	.07	.10	.016	.016			
100361	82314	.3555	3.00	1.75	.075	.075	.12					
100052	18330B	.2032	2.000	1.200	.063	.063	.125	.030	.030			
	52414											
	22001M											
100255	71725	.3015	2.00	1.30	.10	.08	.125	.031	.031			
29222	29119	.378	2.000	2.000	.094	.094	.156			.1478	.0629	.5237
	4529B											
	14901											
100261	71802	.260	2.00	2.10	.063	.063	.125	.031	.031			
100273	53182B	.4435	2.05	1.04	.16	.125	.125	.031	.031			
100362	54415B	.2398	2.20	1.00	.075	.075	.125	.031	.031	.0168	.0656	.1809
	54243B											
100254	71727	.4755	2.25	1.04	.16	.125	.125	.031	.031			
	53177B											
100203	16213B	.2054	2.30	1.10	.06	.06	.12	.03	.03			
100186	73286	.4083	2.38	2.00	.094	.094	.125	.031	.031			
100214	71125	.960	2.38	2.25	.18	.25	.19	.03	.03	.4849	.2043	.697
39042	12482	.469	2.500	2.437	.094	.094	.187			.2734	.1227	.6205
39375	43874B	1.046	2.500	3.500	.250	.125	.188					
	P-4157											
45585	30539	.287	2.880	1.000	.075	.075	.070			.0182	.1493	.1586
47783	14776M	.625	3.000	2.000	.125	.125	.180					
	L-29275											
100263	71825	.6273	3.000	2.10	.125	.125	.125	.031	.031			
100253	71824	1.074	3.25	2.75	.18	.18	.25	.016	.016			
60000	43854	2.236	5.000	3.500	.350	.150	.180	.031	.031			
100227	72823	3.726	7.15	1.55	.50	.13	.19	.031	.016	.1669	15.2201	.2796
34222	22973	.465	2.250	2.000	.094	.125	.187					
48423	29414	.881	3.000	4.000	.125	.125	.250	.063	.063			
18641	22897	.136	1.500	.750	.062	.062	.062	.031		.0058	.0170	.149
	5783R											
	16136M											
100365	85845	.4542	2.00	1.25	.156	.125	.125	.031	.031			

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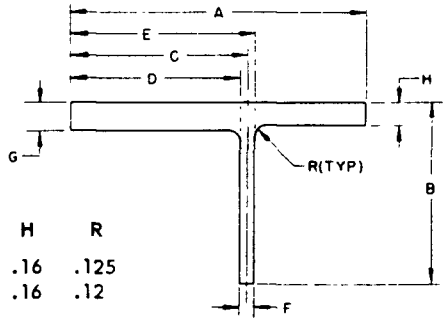
DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	Ixx	Iyy	M	N
100353	54162	.3753	2.00	1.30	.12	.11	.94	.125	.0504	.0797	.2844	.0574
100354	82317	.43197	2.00	1.30	.15	.11	.94	.125	.0512	.0988	.2676	.0580
100246	59092	.319	2.00	2.00	.080	.080	.96	.125	1.2565	.0526	.5203	
100032	52444	.2773	2.000	1.000	.109	.063	.787	.090				





BAC1505

DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	R1	R2	Ixx	Iyy	M	N
100366	85899	.698258	2.85	2.40	.12	.15	1.40	.19	.031	.031				
100329	54564 R	2.0738	6.40	1.50	.30	.12	3.20	.16	.031	.031				
100201	54925 B	1.1963	2.50	2.00	.34	.20	1.00	.19	.031	.031				
	19834 M													
38983	46186	.738	2.500	1.500	.210	.160	1.170	.130	.031	.031				
	14420 M													
100155	61572	.246	2.40	1.75	.06	.06	1.06	.06	.030	.030	.1691	.0688	.3886	1.1541
100174	73285	.2696	2.50	1.80	.060	.060	1.25	.19	.016	.016				
100067	52552	.7440	2.710	1.340	.234	.094	1.036	.125	.016	.016	.0535	.3948	.2117	1.3146
100172	53475 B	.472	2.95	1.8	.10	.10	1.55	.13	.016	.016				
100119	59782	2.216	4.80	3.30	.30	.25	2.50	.25	.031	.031	1.9163	2.7904	.7104	2.4789
100073	59871	.920	3.38	1.58	.21	.15	1.52	.12	.030	.030				
100332	24461 M	3.08426	5.20	1.60	.55	.20	2.50	.19	.031	.031				
100049	52367	.8113	4.000	2.500	.130	.120	1.94	.130	.016	.016	.4215	.6929	.504	2.000
	18059 R													

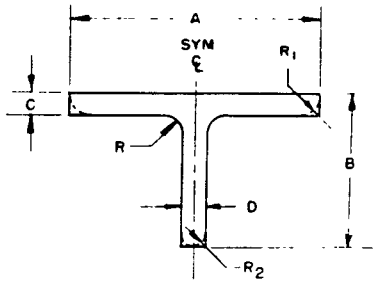


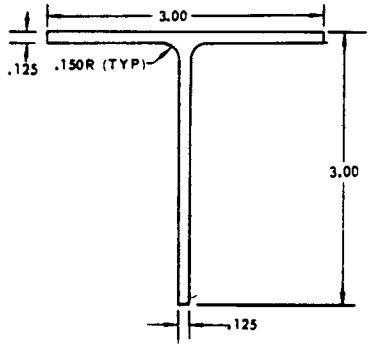
BAC1505

DASH NO.	DIE NO.	AREA	A	B	D	E	F	G	H	R
100331	24072 M	1.08087	2.73	5.70	1.31		.12	.14	.16	.125
100264	H-2822 K	.46185	2.10	1.90		1.00	.10	.10	.16	.12
	23942 M									
100257	H-2782 K	.90086	2.10	5.70	1.00		.11	.11	.16	.125
	54414									
	23943 M									

BAC1505

DASH NO.	DIE NO.	AREA	A	B	C	D	R	R1	R2
100207	10924 A	.5004	2.25	1.30	.16	.125	.125	.125	.062
100206	51317 B	.4448	2.25	1.45	.125	.125	.125	.25	.062
100205	51318 C	.7966	4.35	1.60	.14	.125	.18	.125	.062

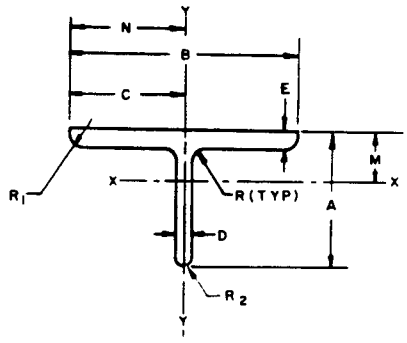




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DASH NO.

100393

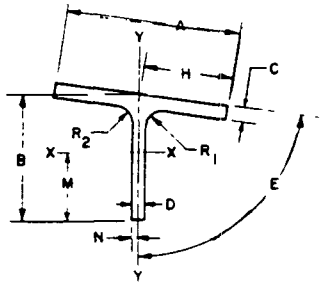


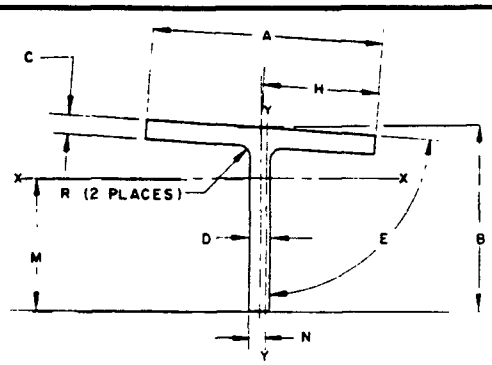
BAC1505

DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	R1	R2	I_{xx}	I_{yy}	M	N
100340		.5495	1.50	2.30	1.15	.15	.15	.16	.12	.075	.0967	.1419	.3411	1.1500

BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E	H	R1	R2	Ixx	Iyy	M	N
1026	73290	.117	1.37	1.00	.050	.050	89.2°	.685	.064	.064	.0104	.0106	.7760	.0258
1053	76244	.120	1.38	1.06	.050	.050	89.2°	.69	.06	.06	.0120	.0105	.8152	.0236
403	52276	.163	1.500	1.000	.064	.064	77°	.80	.125	.125				
118	30490	.331	1.500	2.000	.094	.094	72°	.750	.156	.156	.1375	.0238	1.4081	.0425
530	60832	.1914	2.020	1.000	.063	.063	84°	1.010	.120	.120				



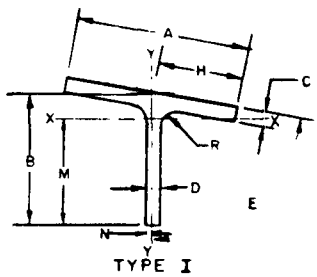


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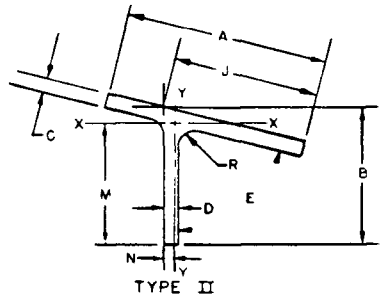
DASH NO.	DIE NO.	AREA	A	B	C	D	E	H	R	Ixx	Iyy	M	N
1237	19044 R	1.206	3.80	2.26	.25	.12	78°	1.90	.18	.3728	1.0887	1.9050	.0448
1054	82068	.2574	2.56	1.30	.064	.064	85.75°	1.28	.19				
1067	76305	1.199	5.60	1.00	.20	.094	85.50°	2.80	.09				
1037	71452	.221	2.50	1.00	.064	.064	85.25°	1.66	.064	.0138	.0906	.8121	.3435
1104	16735 R	.4913	3.15	2.10	.094	.094	77°	2.10	.13				
	54420 R												
540	52650	2.705	3.50	3.00	.40	.50	85°	1.750	.125				

BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E	H	J	R	Ixx	Iyy	M	N
994	20231 R	.1733	1.75	1.00	.064	.064	83.5°	.875		.064	.0143	.0281	.7979	.0315
729	8268 R	.177	1.80	1.00	.064	.064	79°		.90	.06				
714	59863	.230	1.90	1.25	.08	.064	80°	.95		.09	.0280	.046	1.0230	.0200
990	16214 R	.276	2.00	1.00	.094	.094	83°	1.00		.09	.0214	.0619	.7995	.0445
1328	54547 R	.1823	2.00	1.00	.06	.06	88°	1.00		.12				
1308	18789 R	.2542	2.00	1.25	.078	.078	76°	1.00		.13	.0357	.0475	.9832	.0351
539	52649	.495	2.70	1.330	.125	.125	88°	1.350		.130				
927	54554	.947	3.75	2.30	.16	.16	82.50°	2.00		.13	.4176	.690	1.8059	.0924
	71103													



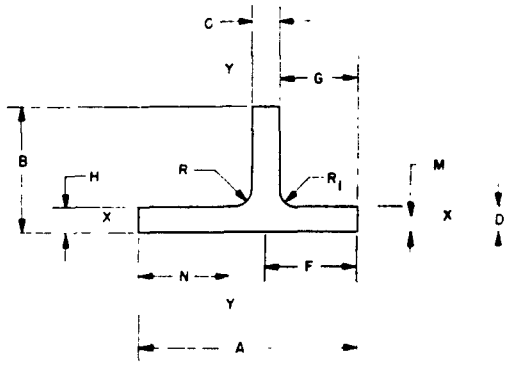
TYPE I

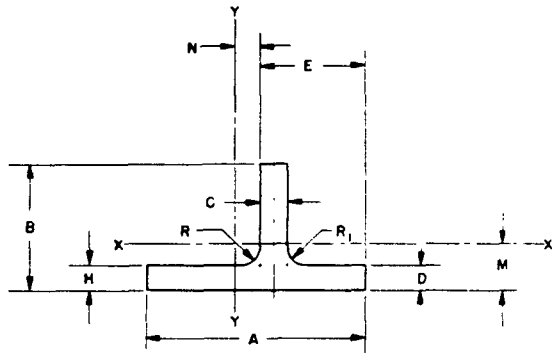


TYPE II

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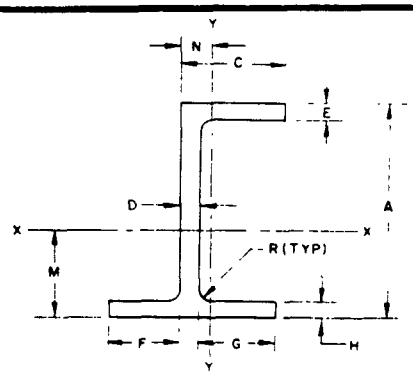
DASH NO.	DIE NO.	AREA	A	B	C	D	E	H	R	R1	Ixx	Iyy	M	N
1045	73383	1.2239	3.95	2.02	.21	.21	1.40	.21	.19	.19	.3638	1.1795	.4171	.3541





BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	F	G	H	R	R1	Ixx	Iyy	M	N
923	10887R	.793	1.65	3.70	.10	.27		.55	.27	.12	.12	.9952	.1098	.9373	.9238
1092	71740	.347	2.08	2.00	.094	.06		.98	.094	.13	.13				
1119	80240	.560	2.25	1.75	.10	.10		1.075	.25	.15	.15				
865	71043	.599	2.25	2.25	.12	.15	1.00		.15	.16	.16				
921	71097	.4429	2.85	1.80	.09	.10		1.48	.10	.13	.13				
887	10877R	.7502	2.90	1.80	.12	.19		1.50	.19	.13	.13				
922	51299	.7819	3.00	3.00	.10	.10		1.20	.21	.12	.12	.5836	.3608	.6246	1.4398

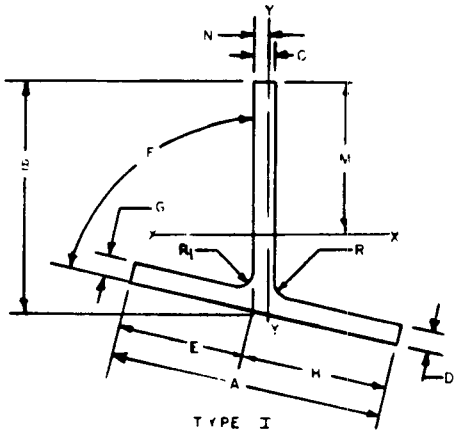


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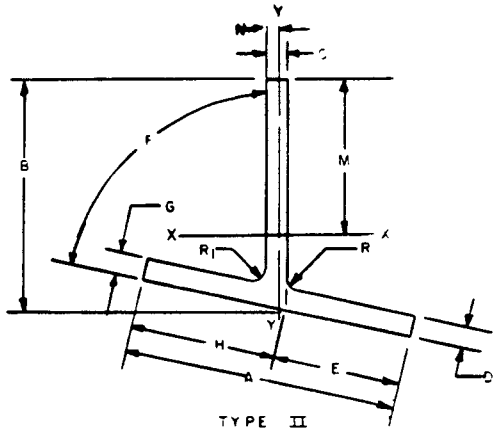
DASH NO.	DIE NO.	AREA	A	C	D	E	F	G	H	R	Ixx	Iyy	M	N
1227	54073B	3.1373	2.74	1.15	.105	.60	1.45	1.25	.82	.125	2.3960	1.7724	.9070	.0932
1230	54075B	3.9939	2.70	1.45	.160	.77	1.65	1.55	.80	.125	3.1116	3.0788	.9802	.2230
1307	54210B	6.1750	2.65	1.92	.160	.74	2.80	2.75	.80	.125				
992	16215R	.838	3.75	1.40	.09	.15	1.205	1.205	.12	.16				
993	16216R	1.1113	3.75	1.40	.125	.25	1.185	1.19	.13	.16				

BAC1506

DASH NO.	DIE NO.	AREA	TYPE	A	B	C	D	E	F	G	H	R	R1	Ixx	Iyy	M	N
1056	82316	.3545	II	2.38	1.12	.10	.10	1.26	87.50°	.10		.19	.19	.0312	.1117	.9024	.1282
1058	73446	.231	II		2.25	.06	.06	.73	89.2°	.06	.92	.06	.06	.0220	.1212	1.5839	.0015
834	71231	.2896	II	2.38	1.12	.08	.08	1.26	80.83°	.080		.19	.19	.0286	.0877	.9213	.1404
916	72675	.4119	I	2.00	1.35	.125	.125		73°	.125	1.08	.125	.125				
1016	51851	.505	I	2.00	1.50	.16	.14	.92	82.5°	.14		.125	.125	.1057	.0910	1.1096	.0827
1332	54468	.1953	I	2.00	1.05	.063	.063	1.00	76.50°	.063		.125	.125				
1289	85575	.4992	II	2.50	2.80	.094	.094	1.15	77.5°	.094		.16	.16	.3921	.1134	2.0250	.0674



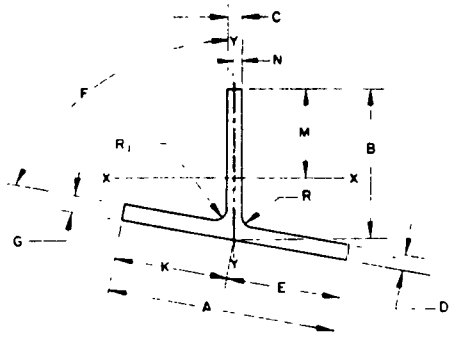
TYPE I

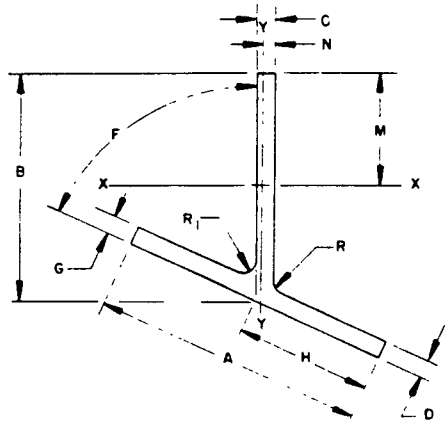


TYPE II

BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	F	G	H	R	R1
920	71098	.575	2.70	1.50	.12	.15	69°	.15	1.35	.12	.12
1162	54067	2.247	4.50	2.45	.30	.35	87.85°	.35	2.40	.31	.31



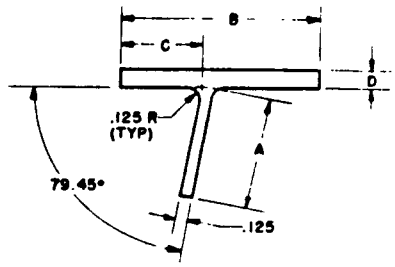


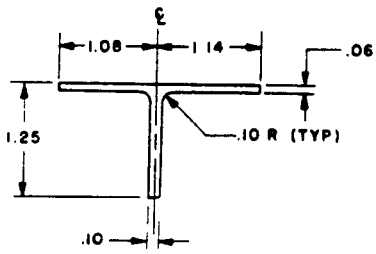
BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	K	R	R1	Ixx	Iyy	M	N
975	20320	1.0197	4.20	1.60	.125	.20	2.04	80°	.20		.125	.125	.1577	1.1786	1.3564	.0879
1055		.2222	2.00	1.30	.064	.064	.70	82.50°	.064		.19	.19				
655	68255	.235	2.52	1.00	.06	.070		88°	.070	1.26	.09	.09	.0146	.0917	.8424	.0065

BAC1506

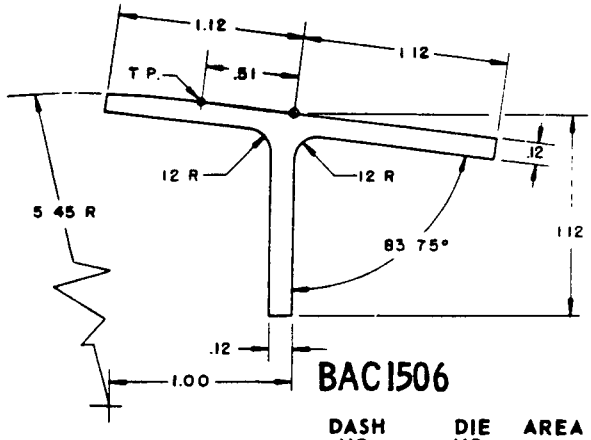
DASH NO.	DIE NO.	AREA	A	B	C	D
938	10971	.5789	1.24	2.18	.89	.19
939	71139	.5695	1.54	2.65	1.25	.14





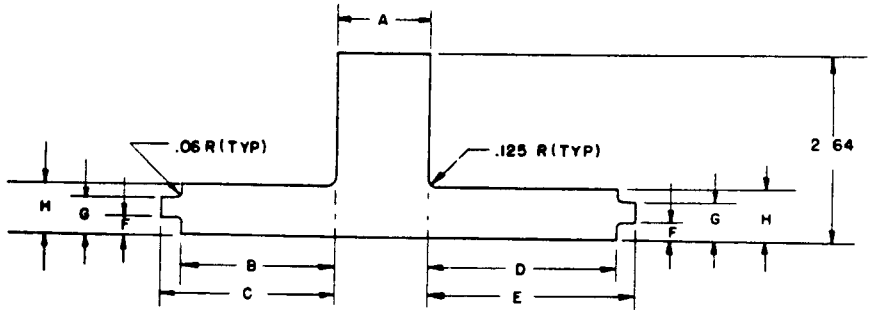
BAC1506

DASH NO.	DIE NO.	AREA
1155		.2553



BAC1506

DASH NO.	DIE NO.	AREA
1039	73319	.383

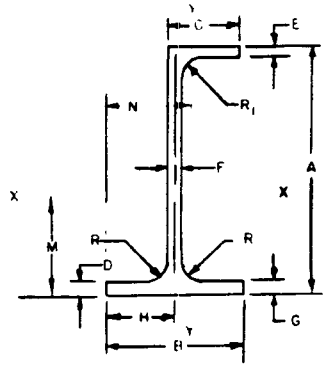


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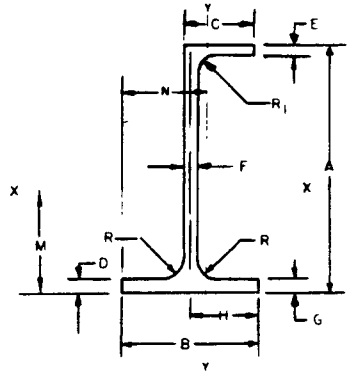
DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	H
1149	81236	5.713	1.62	.35	.65	1.48	1.78	.19	.49	.68
1150		7.7203	1.62	1.72	2.02	2.74	3.04	.22	.52	.73

BAC1506

DASH NO.	DIE NO.	AREA	TYPE	A	B	C	D	E	F	G	H	R	R¹	Ixx	Iyy	M	N
1110	16722	.2983	I	1.50	1.75	.75	.064	.125	.064	.064	.907	.125	.125				
1111	16723	.3262	I	1.75	1.92	.75	.072	.125	.072	.062	1.16	.06	.06				
674	7672	.256	I	1.50	1.75	.75	.064	.064	.064	.064	.907	.125	.125	.0866	.0351	.5294	.9315
111	30400	.283	I	1.600	1.770	.750	.072	.072	.072	.062	1.160	.060	.060				
1341		.3741	II	1.00	2.41	.50	.10	.125	.08	.10	1.16	.125	.125				
1329	82485	.321	I	1.75	1.68	.75	.07	.125	.07	.07	.93	.06	.06				



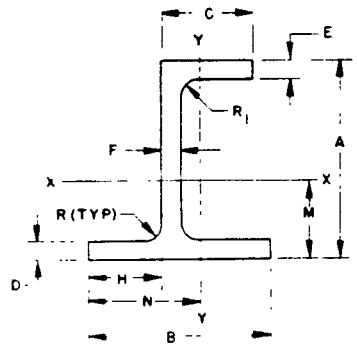
TYPE I



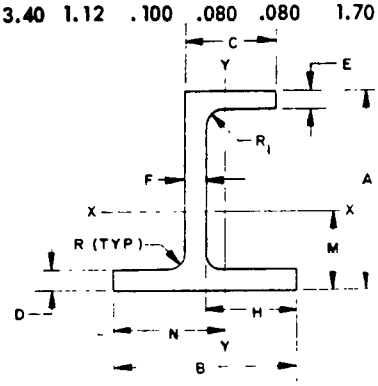
TYPE II

BAC1506

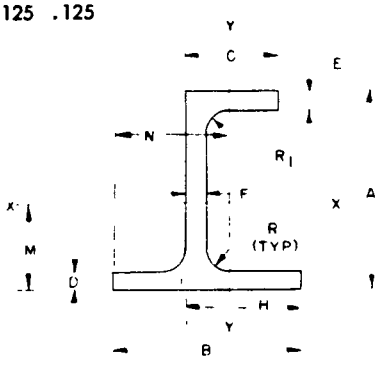
DASH NO.	DIE NO.	AREA	TYPE	A	B	C	D	E	F	H	R	R1	Ixx	Iyy	M	N
855	19721	1.038	II	2.50	3.92	1.00	.160	.125	.125	1.90	.125	.125	.8265	.8398	.6820	2.0095
854	71025	.730	II	2.50	3.34	1.00	.125	.094	.094	1.62	.094	.094				
856	19628	.855	I	2.50	3.40	1.12	.125	.125	.125	1.64	.125	.125	.7885	.4502	.8504	1.7822
857	54553 71027	1.182	I	2.50	3.92	1.20	.160	.160	.160	1.88	.160	.160	1.0298	.8477	.8148	2.0520
914	10882	.702	I	2.50	2.94	1.00	.125	.09	.09	1.42	.25	.25	.6068	.2857	.7549	1.5307
915	10883	1.361	II	2.50	3.23	1.30	.22	.18	.18	1.55	.25	.25	1.1782	.7060	.8403	1.7012
1116	531216	.81205	I	4.00	1.80	1.07	.20	.14	.08	.86	.13	.13				
864	19800	1.0009	I	4.00	1.96	1.35	.15	.250	.10	1.25	.13	.13	2.6451	.2894	2.0452	1.4229
1327	85448	.492	III	1.50	1.75	.90	.125	.16	.10	.95	.12	.12				
1080	71675 52558	.356	III	1.50	2.00	1.00	.08	.08	.08	1.00	.12	.12				
1118	53107	1.076	I	2.50	3.23	1.30	.17	.14	.14	1.59	.25	.25				
1343	82942	.624	II	2.50	3.40	1.12	.100	.080	.080	1.70	.125	.125				



TYPE I



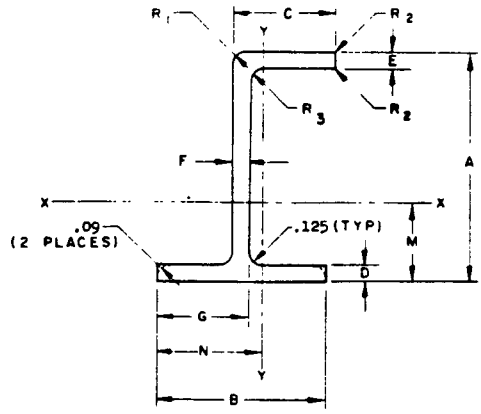
TYPE II

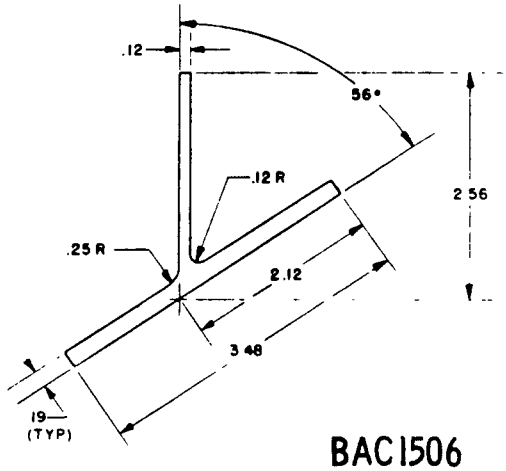


TYPE III

BAC1506

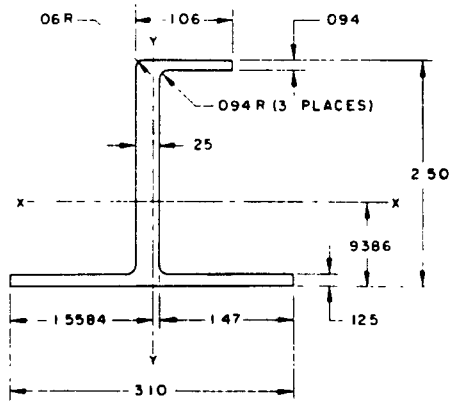
DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	R1	R2	R3	Ixx	Iyy	M	N
1112	H-2793	1.341	2.40	2.54	1.40	.120	.120	.40	1.55	.06	.06	.125				
1098	H-2791	1.384	2.40	2.90	1.54	.150	.150	.34	1.59	.06	.06	.125				
1099	H-2792	1.260	2.40	2.98	1.46	.130	.130	.32	1.61	.19	.04	.125				
1100	H-2794	1.830	2.40	3.16	1.77	.190	.190	.44	1.77	.06	.06	.125				
1234		1.4866	2.46	2.54	1.40	.120	.24	.40	1.55	.06	.06	.125	1.1284	.2893	1.2018	1.4468
1241		1.6443	2.46	2.90	1.54	.150	.35	.34	1.59	.06	.06	.125				
1233		1.4333	2.46	2.98	1.46	.130	.26	.32	1.61	.06	.04	.125				
1236		2.1484	2.46	3.16	1.77	.190	.41	.44	1.77	.06	.06	.125	1.7722	.8866	1.2087	1.7827
884	51387	.505	2.50	2.17	1.13	.090	.090	.090	1.13	.190	.040	.140	.4946	.1046	1.0057	1.1898
1259		.8758	2.50	2.29	1.19	.09	.09	.24	1.30	.06		.14	.6878	.1206	1.1152	1.2299
1101	H-2788	3.028	2.52	3.02	1.63	.640	.380	.32	1.63	.20	.06	.125				
1102	H-2790	4.483	2.52	4.40	1.67	.680	.540	.46	2.36	.25	.06	.125				
1103	H-2789	1.624	2.62	2.20	1.25	.320	.320	.26	1.22	.06	.04	.125				





BAC1506

DASH NO.	DIE NO.	AREA
333	51238	.9503

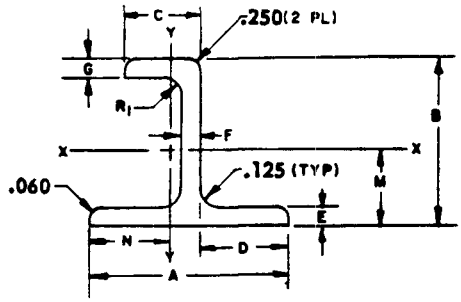


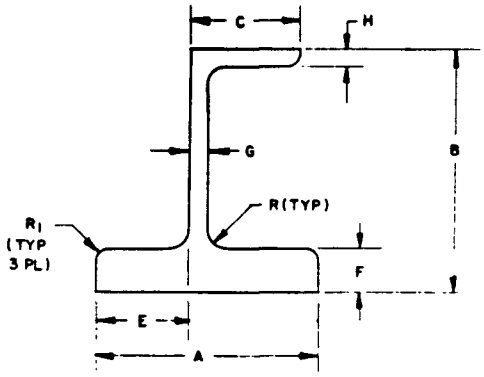
BAC1506

DASH NO.	DIE NO.	AREA	Ixx	Iyy
1260		1.0611	.8294	.3300

BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	R1	Ixx	Iyy	M	N
871	71126	.6392	1.88	2.50	1.12	.88	.125	.125	.125	.156	.5974	.1024	1.0304	.8429
872	10917 [R] H-3059 [K]	.8743	3.00	2.50	1.16	1.43	.140	.140	.140	.125	.7957	.3674	.8612	1.4097



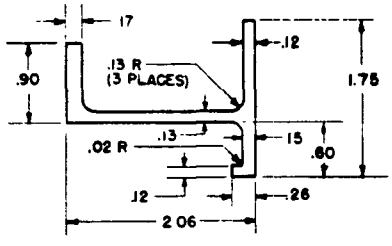


BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	E	F	G	H	R	R1	Ixx	Iyy	M	N
950	51355	1.7724	2.36	2.70	1.20	1.02	.51	.16	.20	.16	.09				

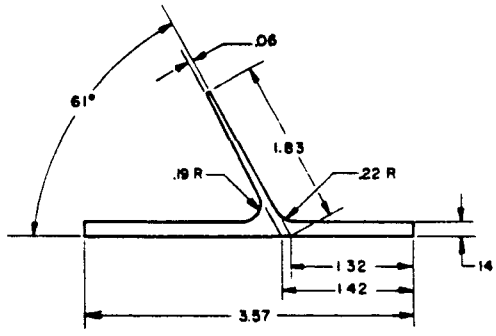
BAC1506

DASH NO.	DIE NO.	AREA
889	10778 [R]	.633



BAC1506

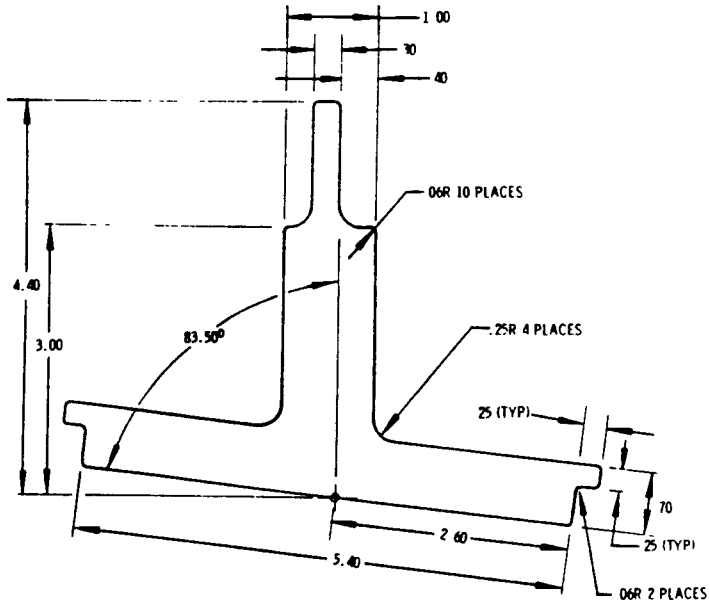
DASH NO.	DIE NO.	AREA
937	72892	.65018



BAC1506

DASH NO.

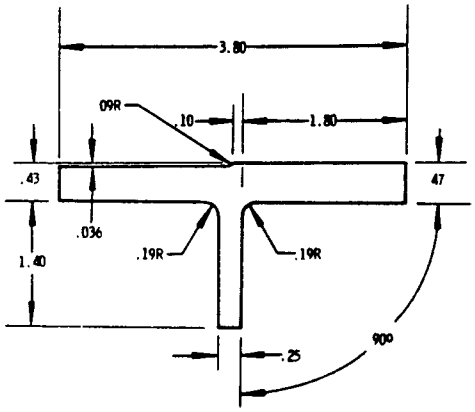
1291



BAC1506

DASH NO.

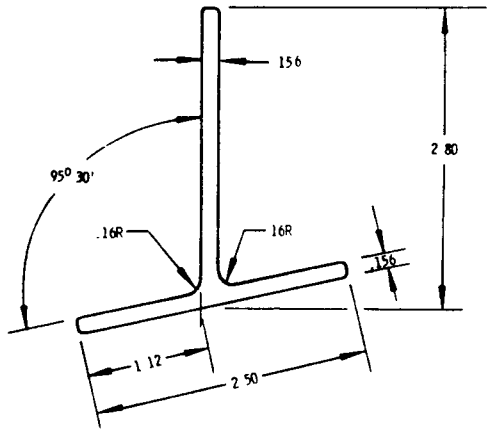
1257



BAC1506

DASH NO.

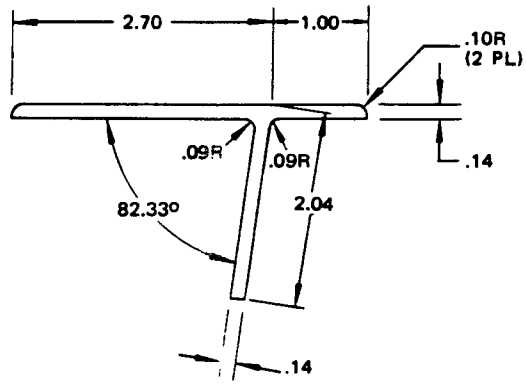
1290



BAC1506

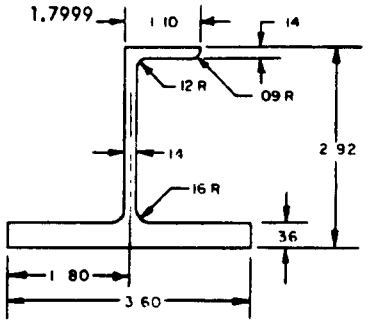
DASH NO.

2381



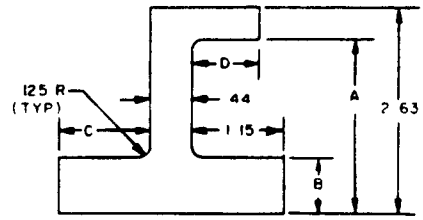
BAC1506

DASH NO.	DIE NO.	AREA
1165	54068	1.7999



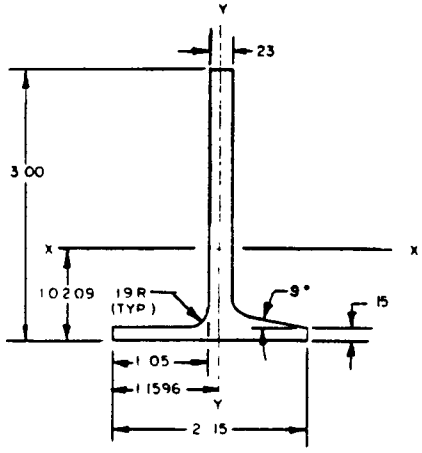
BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D
1128	22064 M 53383 D	3.5482	2.19	.72	1.56	.98



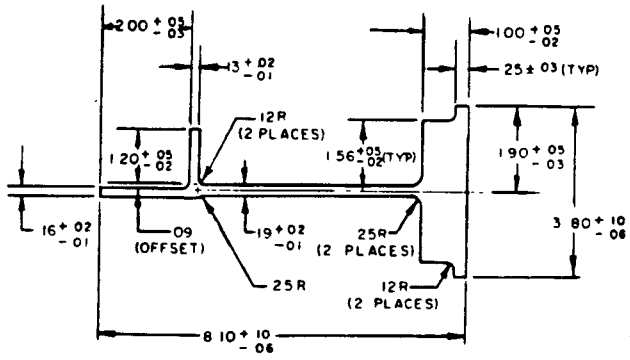
BAC1506

DASH NO.	DIE NO.	AREA	Ixx	Iyy
980	72953	1.051	.9783	.2627



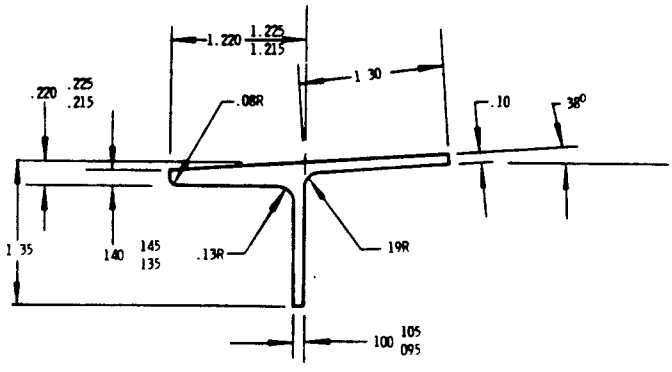
BAC1506

DASH NO.	DIE NO.	AREA
869	74164 52917 D	4.788



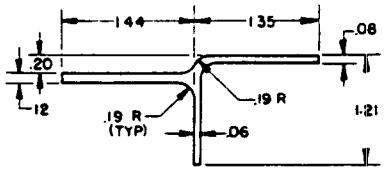
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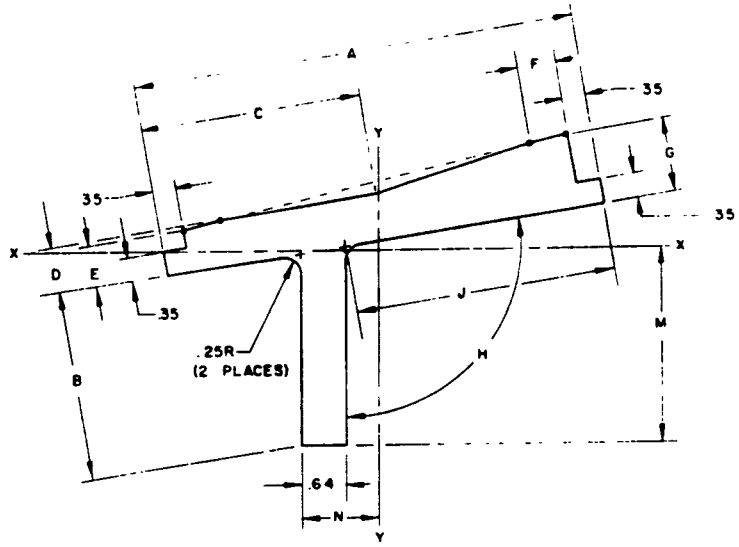
DASH NO.
1294



BAC1506

DASH NO.	DIE NO.	AREA
1001	20138 [H]	.367



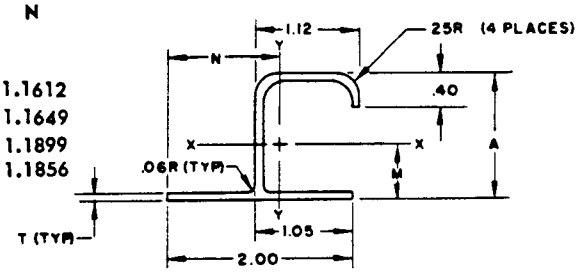


BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	H	J	Ixx	Iyy	M	N
879	69718 HH-1062 [K]	6.505	6.35	2.88	3.18	.65	.60	.55	1.09	99°	3.76	7.8682	15.2327	2.9383	1.1079

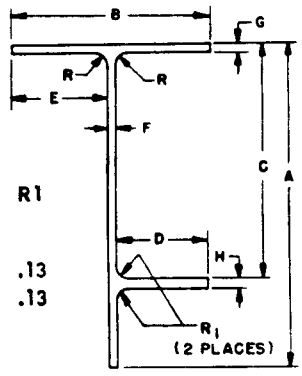
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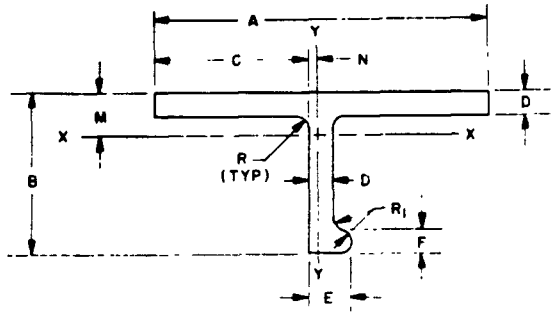
DASH NO.	DIE NO.	AREA	A	T	Ixx	Iyy	M	N
943	16003 [R]	.344	2.00	.064	.2284	.0795	.8877	1.1612
934	51473 [B]	.5223	2.00	.10	.1195	.3300	.8749	1.1649
935	51474 [B]	.4623	1.40	.10	.1469	.1193	.5959	1.1899
944	16004 [R]	.306	1.40	.064	.0996	.0778	.6011	1.1856



BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	H	R	R1
1014	71327	.762	4.06	2.80	2.55	1.20	1.20	.094	.094	.094	.13	.13
1134	53166 [B]	.9559	4.84	2.52	2.35	1.15	1.27	.10	.096	.19	.19	.13



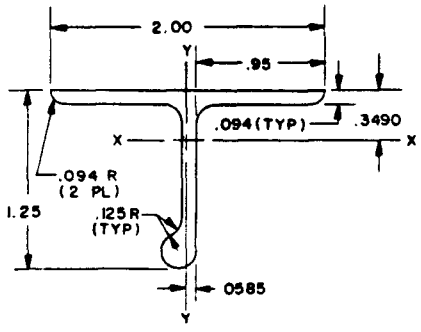


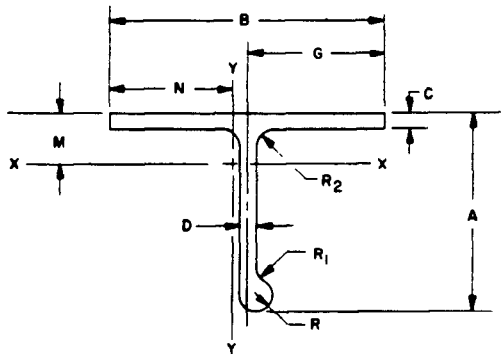
BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	R1	Ixx	Iyy	M	N
905	10808	.7004	2.00	1.75	.91	.18	.38	.18	.12	.2377	.1240	.5494	.0370

BAC1506

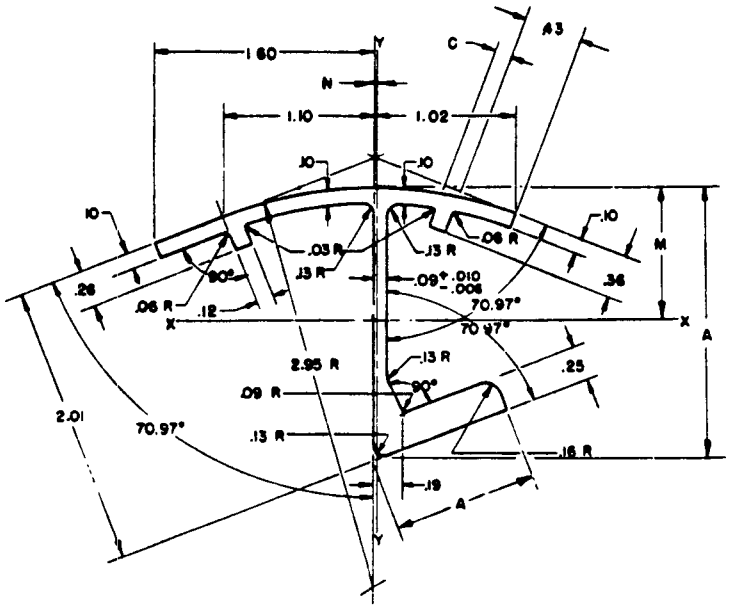
DASH NO.	DIE NO.	AREA	Ixx	Iyy
964	18574 72806	.332	.0579	.0604





BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	G	R	R1	R2	Ixx	Iyy	M	N
656	59641	.239	.90	2.54	.065	.065	1.27	.09	.09	.09	.0181	.0882	.1895	1.2763

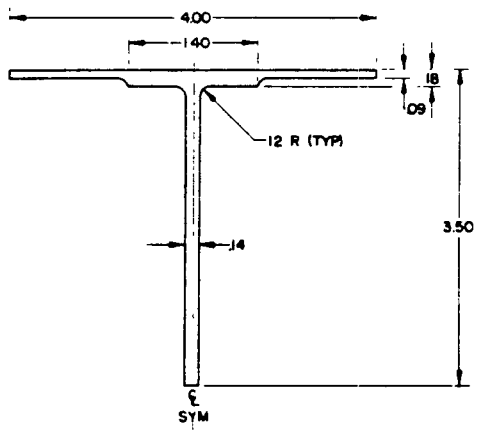


BAC1506

DASH NO.	DIE NO.	AREA	A	B	C
1096	16718 M	.688	.90	1.903	.16

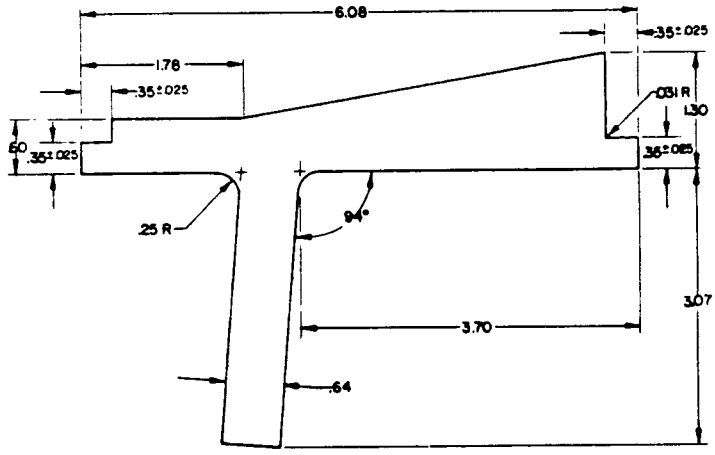
BAC1506

DASH NO.	DIE NO.	AREA
1108	H-2783 L 54460 B	.959967



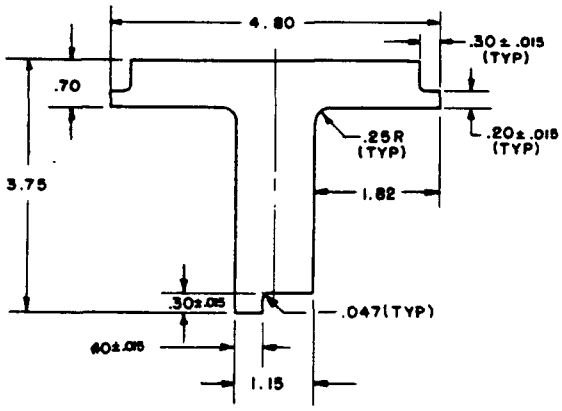
BAC1506

DASH NO.	DIE NO.	AREA
1090	HH-1042 L 23636 M	6.8362



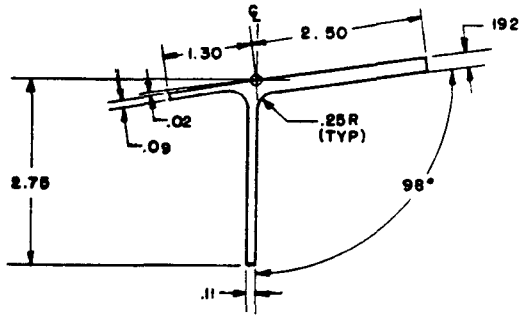
BAC1506

DASH NO.	DIE NO.	AREA
979	72952	6.376



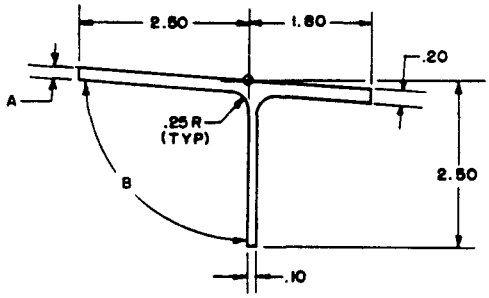
BAC1506

DASH NO.	DIE NO.	AREA
985	51865	.911



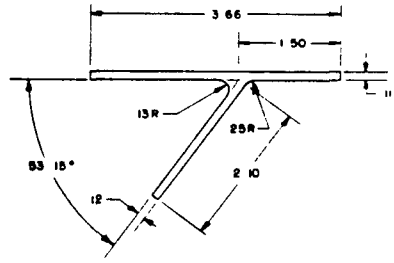
BAC1506

DASH NO.	DIE NO.	AREA	A	B
982	51852	1.0906	.19	92°±1°



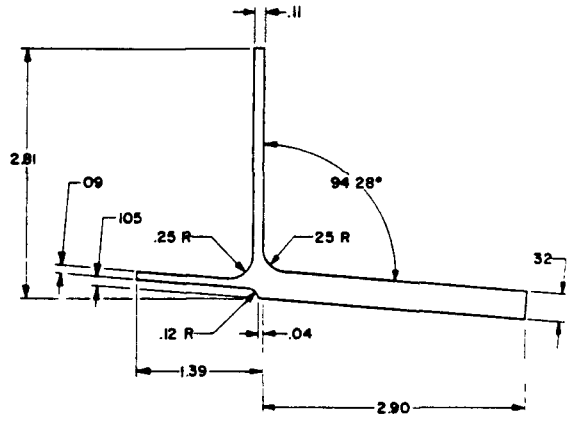
BAC1506

DASH NO.	DIE NO.	AREA
963	71159	.676



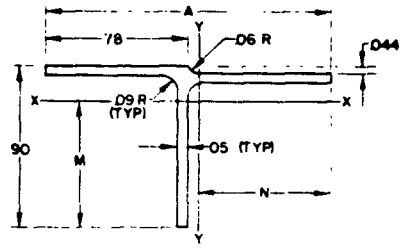
BAC1506

DASH NO.	DIE NO.	AREA
1129	16975	1.3794



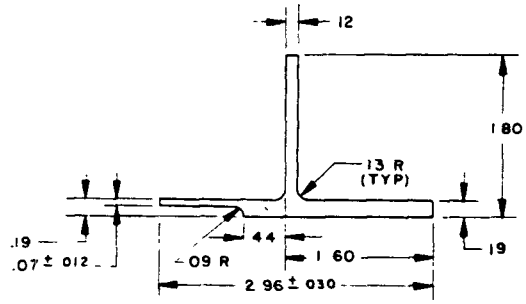
BAC1506

DASH NO.	DIE NO.	AREA	A	Ixx	Iyy	M	N
1068		.12439	1.56	.0075	.0159	.7097	.7920
1069		.1454	1.98	.0079	.0336	.7248	1.0727



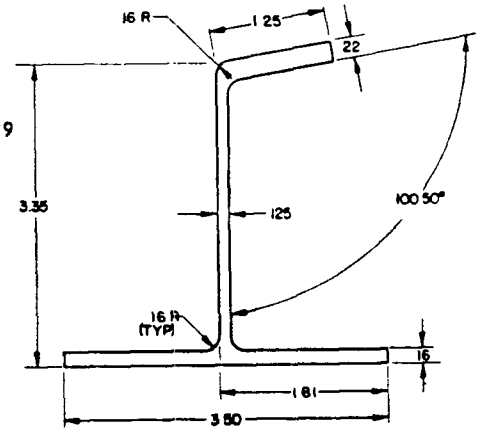
BAC1506

DASH NO.	DIE NO.	AREA
888	71105	.658



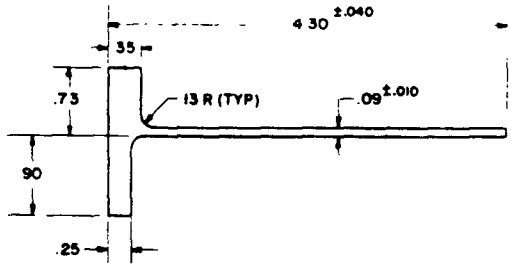
BAC1506

DASH NO.	DIE NO.	AREA
1335	24418	1.2219



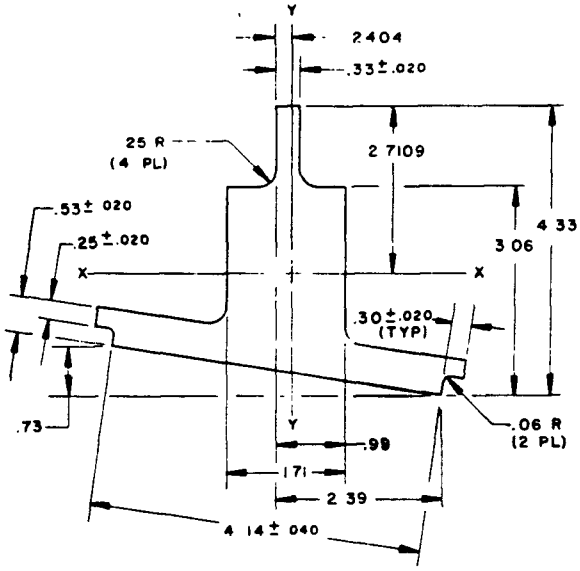
BAC1506

DASH NO.	DIE NO.	AREA
919	71109	.842



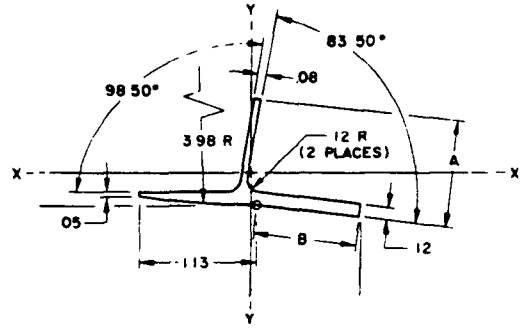
BAC1506

DASH NO.	DIE NO.	AREA	Ixx	Iyy
997	74411	6.432	6.1749	4.7471



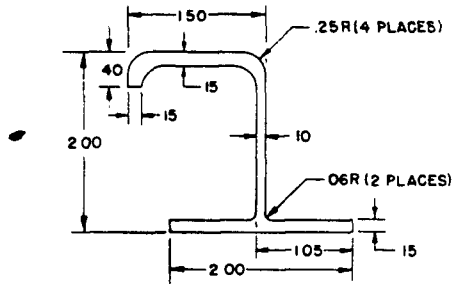
BAC1506

DASH NO.	DIE NO.	AREA	A	B
1061		.3957	1.56	1.30



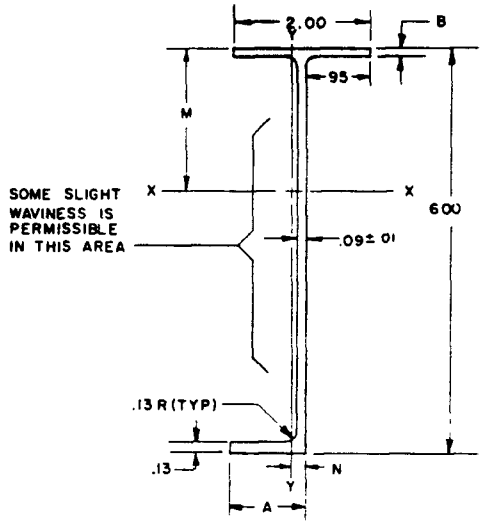
BAC1506

DASH NO.	DIE NO.	AREA
1217		.73281



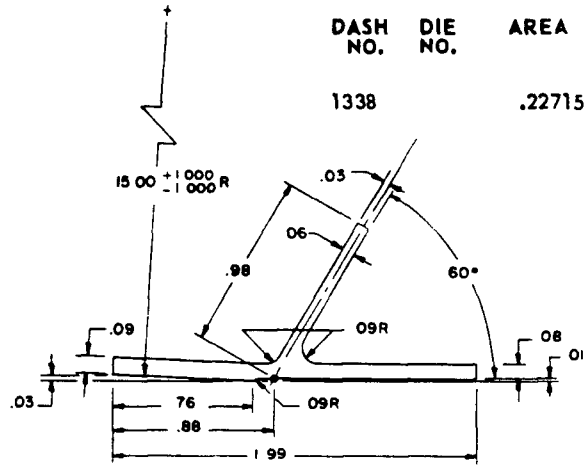
BAC1506

DASH NO.	DIE NO.	AREA	A	B	Ixx	Iyy	M	N
1117	80161	.9634	1.07	.15				
1318	18800	1.1773	1.10	.26	5.9440	.2153	2.1065	.1070
	54419							



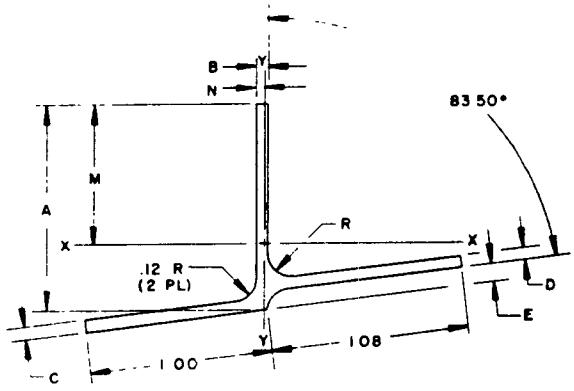
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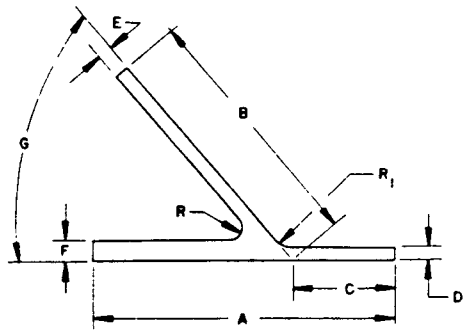
DASH NO.	DIE NO.	AREA
1338		.22715



BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	Ixx	Iyy	M	N
987	74511	.200	1.18	.06	.06	.06	.11	.12				
1258	85299	.2458	1.19	.07	.07	.08	.11	.16	.0248	.0550	.9117	.1008
1157	80632	.1986	1.18	.06	.06	.06	.07	.12				



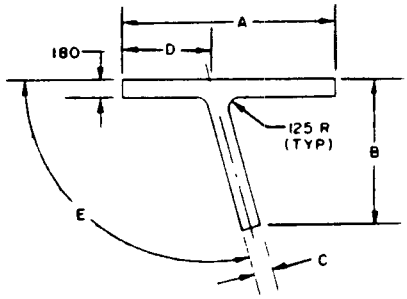


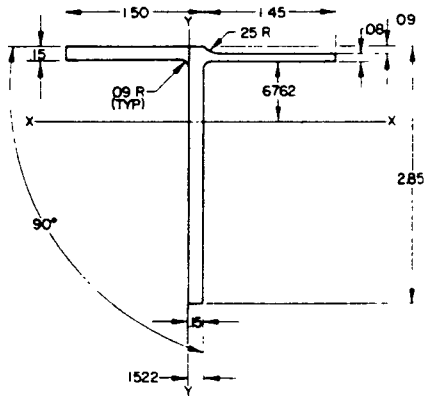
BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	R	R1
867	19799 M	.9621	3.50	2.10	1.10	.15	.15	.22	51.75°	.13	.13

BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E
913	71740	.561	1.950	1.350	.180	.820	104°
910	51247	.605	2.50	1.30	.120	1.00	111.58°



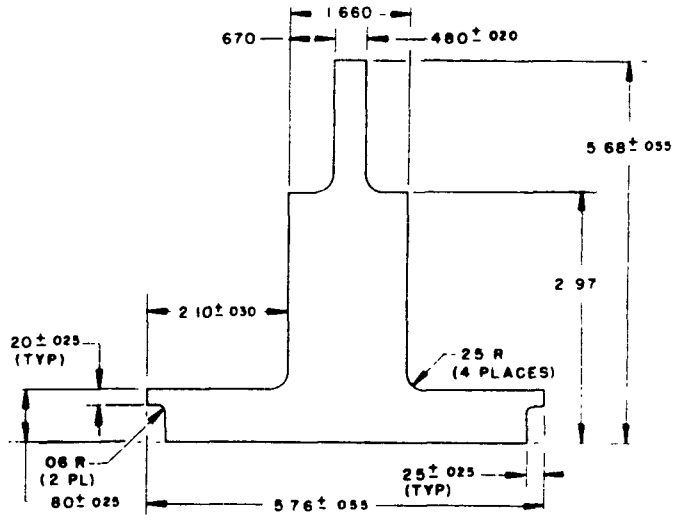


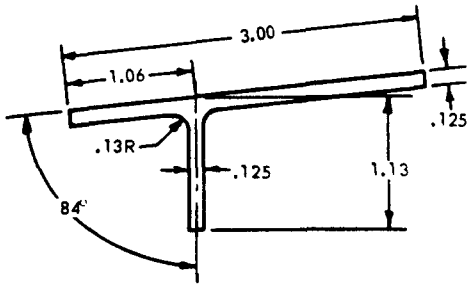
BAC1506

DASH NO.	DIE NO.	AREA	Ixx	Iyy
1310	85385	.7543	.6135	.2334

BAC1506

DASH NO.	DIE NO.	AREA
996	74409	9.263





BAC1506

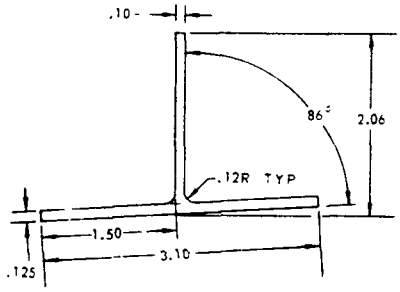
DASH NO.

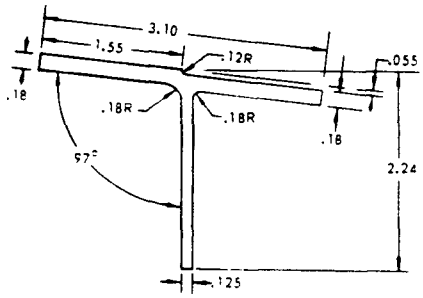
478

BAC1506

DASH NO.

1455





BAC1506

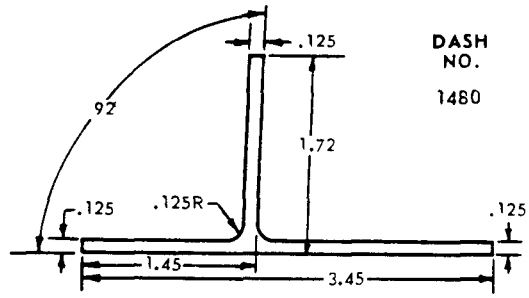
DASH NO.

1456

BAC1506

DASH NO.

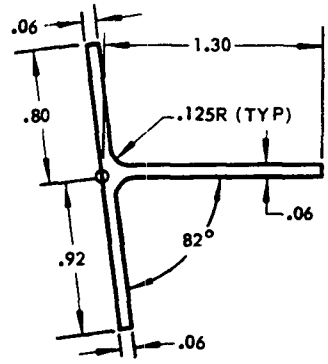
1480



BAC1506

DASH NO.

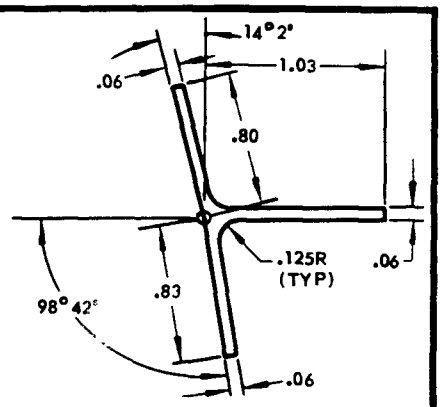
1132



BAC1506

DASH NO.

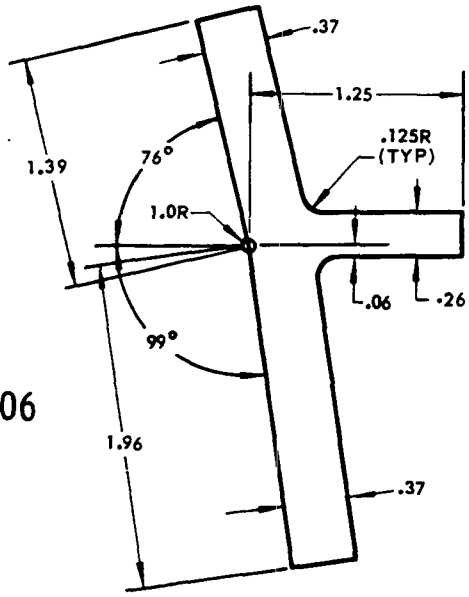
1133



BAC1506

DASH NO.

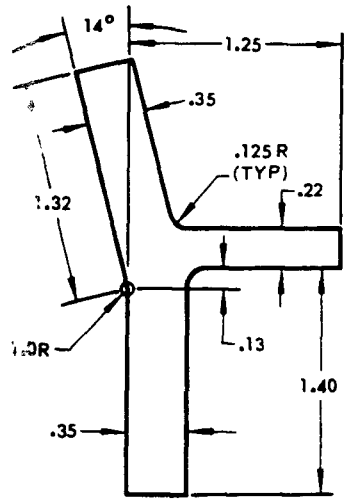
1140

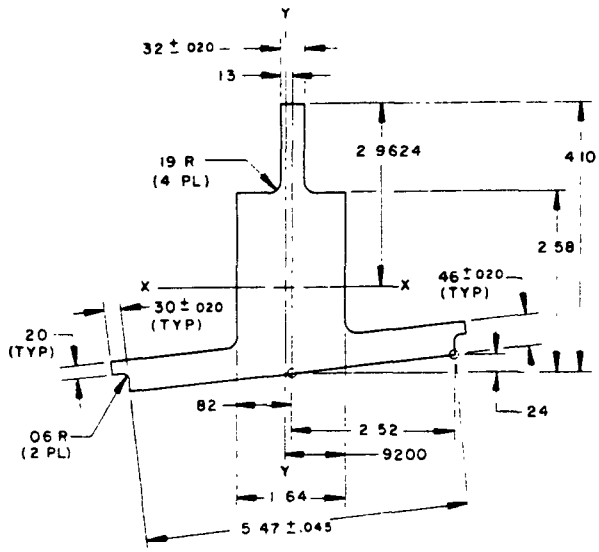


BAC1506

DASH NO.

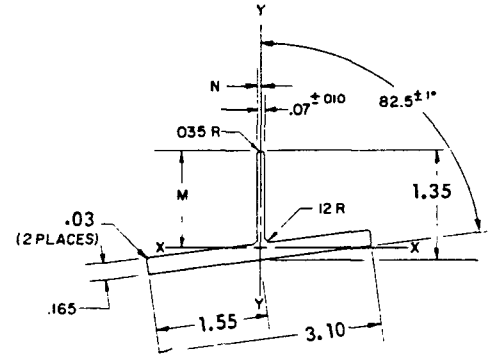
1141





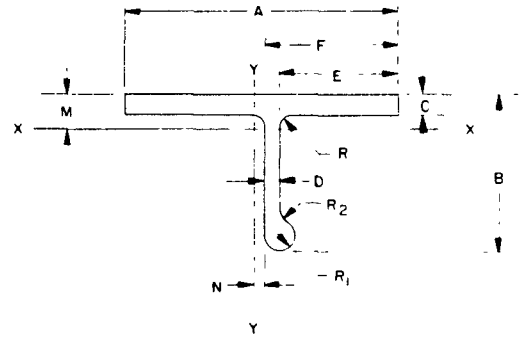
BAC1506

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
998	74410	6.618	6.4823	8.0227



BAC1506

DASH NO.	DIE NO.	AREA	Ixx	Iyy	M	N
1022	51703D	.5998	.0491	.3990	1.1701	.0262

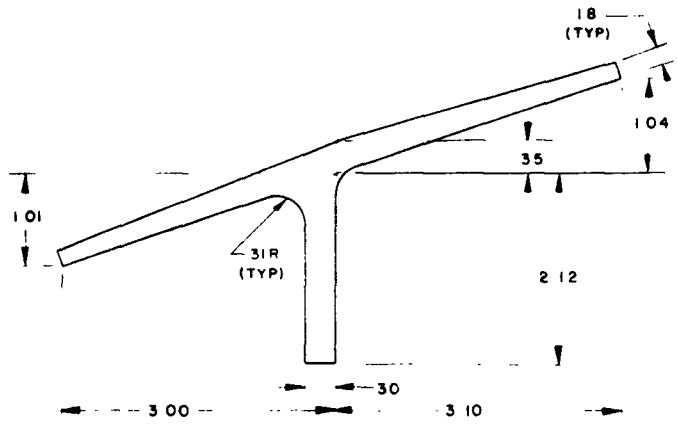


BAC1506

DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	R^1	R^2	I_{xx}	I_{yy}	M	N
1226	54632D	.2619	2.30	1.00	.07	.06	.80	.125	.125	.125				
1300	54186D	1.4295	3.80	1.92	.29	.16	1.55	.125	.19	.15	.3692	1.3416	.3891	.1181

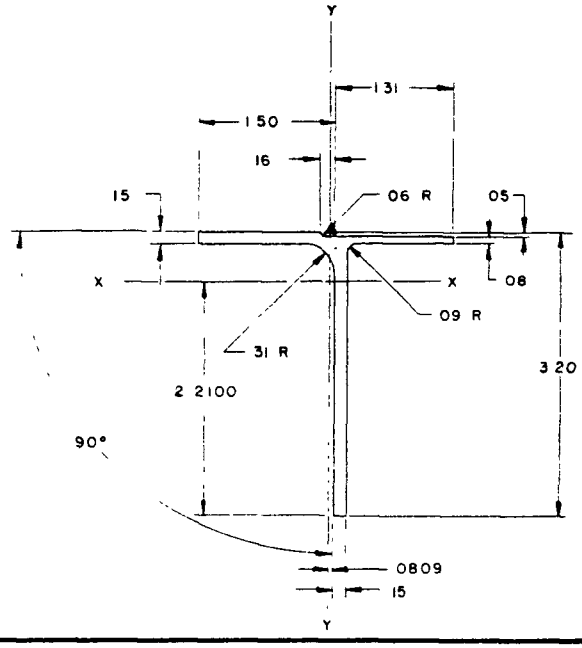
BAC1506

DASH NO.	DIE NO.	AREA
1161	54066	2.318



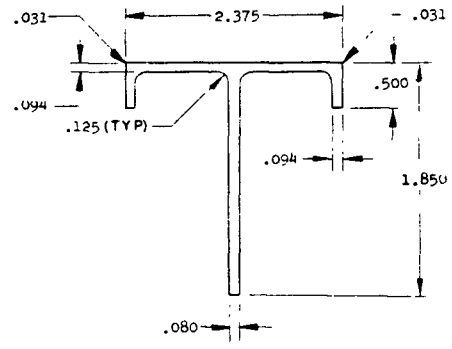
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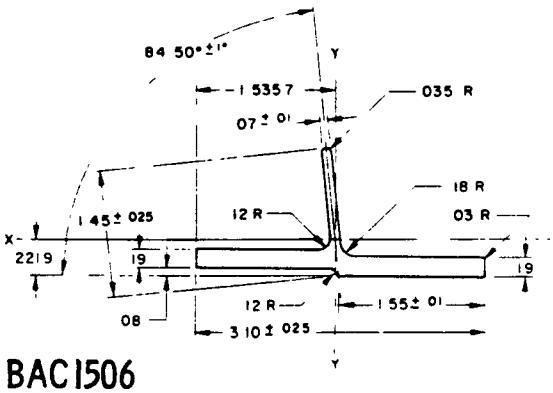
DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1283		.8005	.8444	.2242



BAC1506

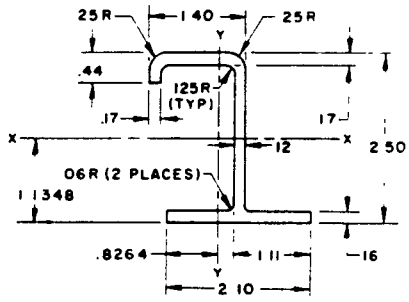
DASH NO.	DIE NO.	AREA
110		.452





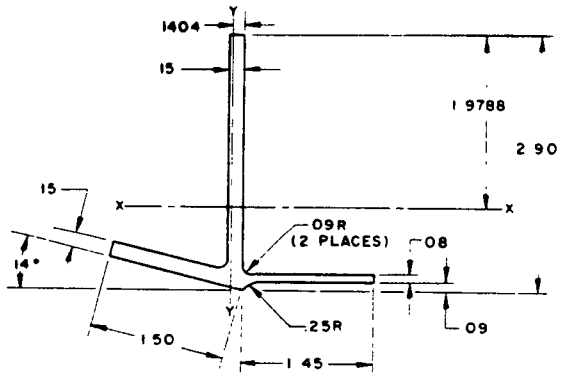
BAC1506

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1023	51704 ■ 19123 ■	.683	.0486	.4689



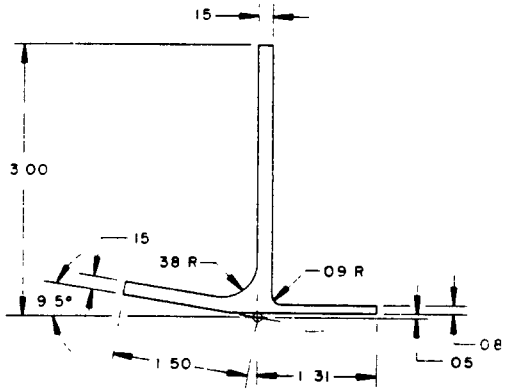
BAC1506

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1225		.8605	.8772	.2650



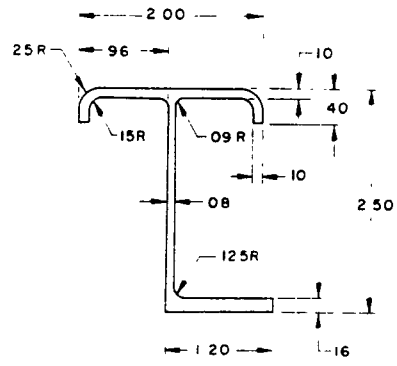
BAC1506

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1309		.7557	.5855	.2205



BAC1506

DASH NO.	DIE NO.	AREA
1284		.8035

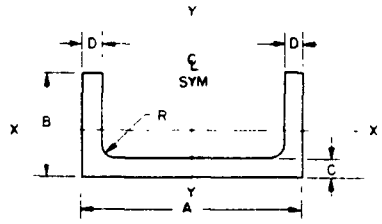


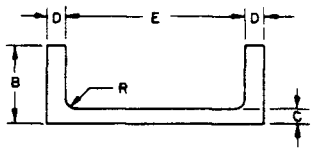
BAC1506

DASH NO.	DIE NO.	AREA
1167		.6197

BAC1509

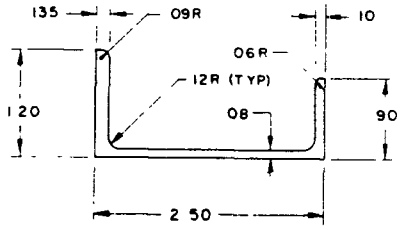
DASH NO.	DIE NO.	AREA	A	B	C	D	R
100118	72893	1.106	1.90	2.00	.20	.20	.13
100049		.9474	3.00	1.25	.17	.20	.125
100013	51336	.2837	2.00	1.000	.072	.072	.13





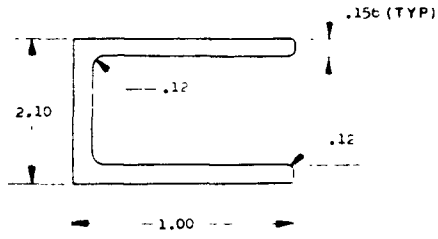
BAC1509

DASH NO.	DIE NO.	AREA	B	C	D	E	R
100027	59135	.6295	1.80	.12	.14	1.00	.125
100152	80962	1.2802	1.650	.250	.250	1.770	.180



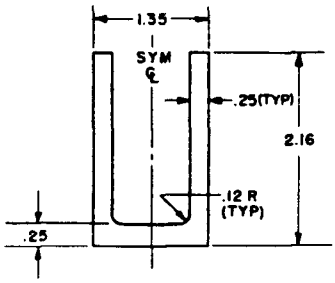
BAC1509

DASH NO.	DIE NO.	AREA
100153	82195	.43605



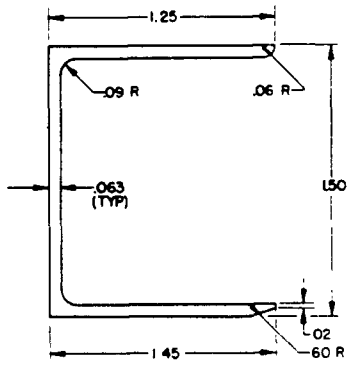
BAC1509

DASH NO.	DIE NO.	AREA
100159		.59016



BAC1509

DASH NO.	DIE NO.	AREA
100132	52063 B	1.298

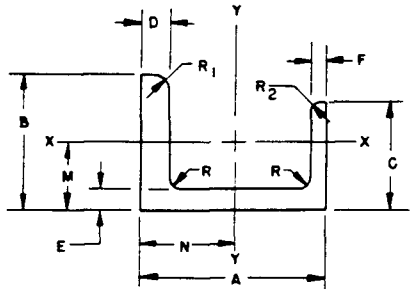


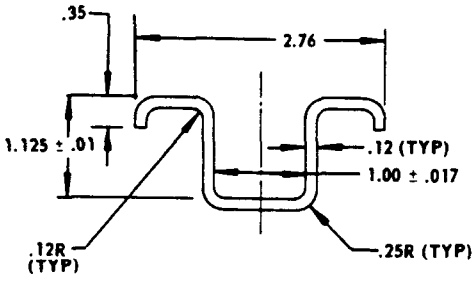
BAC1509

DASH NO.	DIE NO.	AREA
100172	82564	.2556

BAC1509

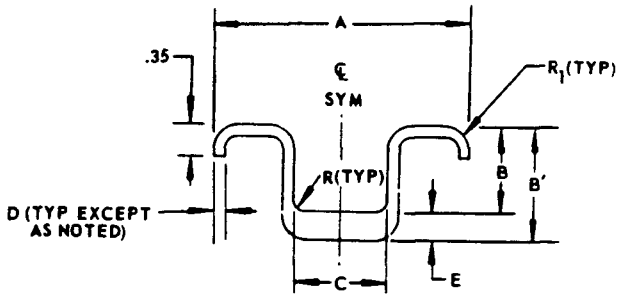
DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	R	R1	R2
100146	82021	.1638	1.00	.90	.75	.063	.063	.063	.125	.063	.063





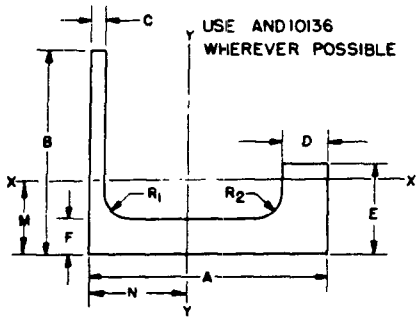
BAC1509

DASH NO.	AREA
100203	.60



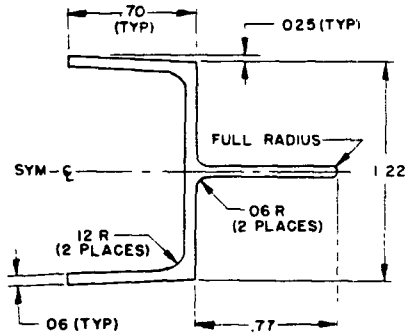
BAC1509

DASH NO.	DIE NO.	AREA	A	B	B'	C	D	E	R	R_1
100204		.8088	2.76	1.125	1.25	1.00	.12	.30	.12	.25
100235	152644 41671	.410	2.76		1.25	1.00	.08	.08	.16	.24
100236	41672	.456	2.76		1.25	1.00	.09	.09	.16	.25



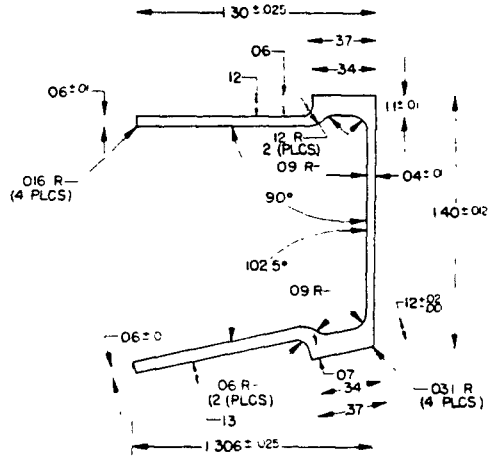
BAC1510

DASH NO,	DIE NO.	AREA	A	B	C	D	E	F	R1	R2	Ixx	Iyy	M	N
317	16607 R	.31397	1.25	1.25	.08	.31	.45	.08	.125	.125				
292	71336	.5667	1.25	1.85	.188	.125	.70	.125	.19	.19	.1803	.1076	.6374	.3933



BAC1510

DASH NO.	DIE NO.	AREA
296	76133	.2032

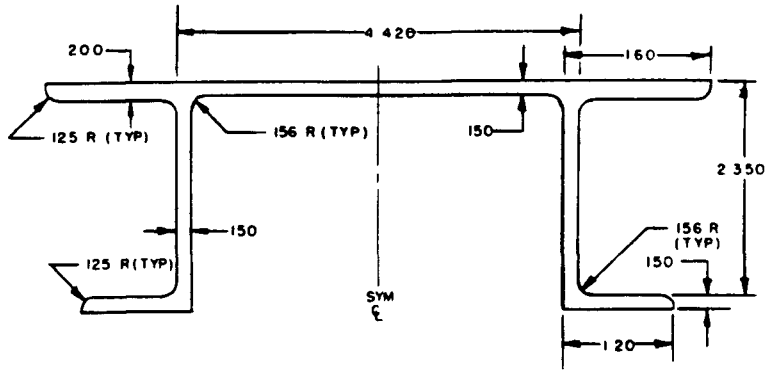


BAC1510

DASH NO.	DIE NO.	AREA
366		.2504

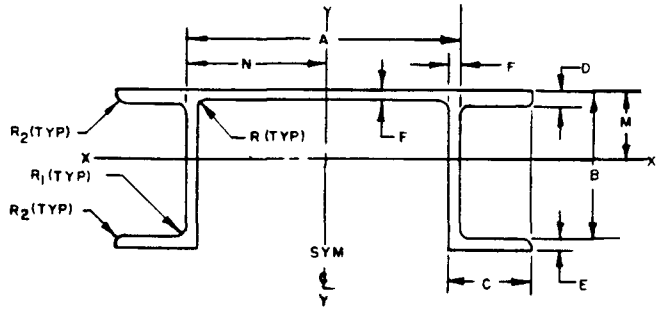
BAC1510

DASH NO.	DIE NO.	AREA
320	53582 B	2.2597
	21801 H	

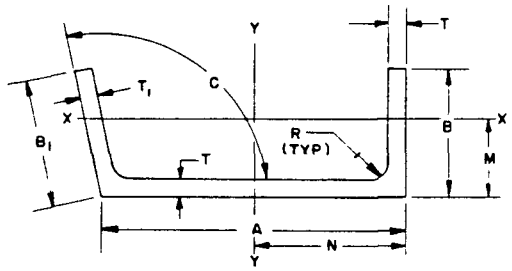


BAC1510

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	R	R1	R2	Ixx	Iyy	M	N
268	72446	1.799	4.375	2.375	1.120	.200	.125	.125	.125	.125	.09	1.5845	8.1638	.8153	2.1875
	19066 R														
267	19102 R	2.3225	4.420	2.330	1.20	.200	.170	.170	.156	.156	.125	10.5519	2.0698	.8720	2.2100
	72439														
	52064 B														



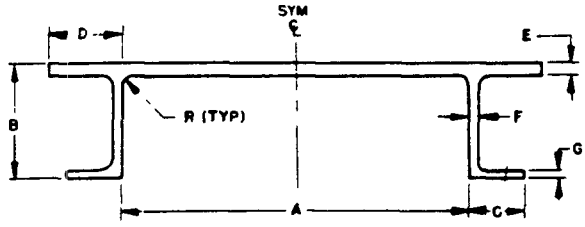
BAC1510



DASH NO.	DIE NO.	AREA	A	B	B_1	C	R	T	T_1
277	71129	.2786	1.13	.88	1.00	102°	.13	.08	.13
276	10879 B	1.121	3.32	1.45	1.45	102°	.19	.19	.19

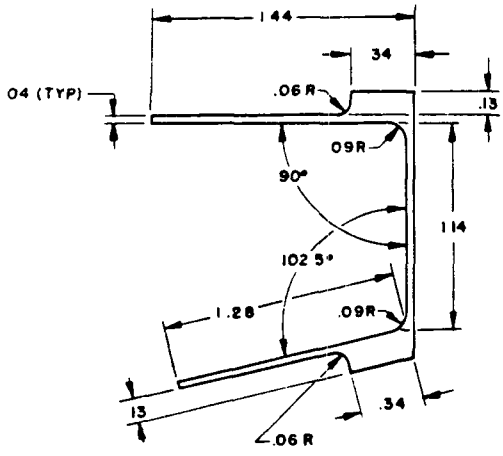
BAC1510

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	R
326	HH-1075 [A] 54044 [B]	3.1815	8.93	2.50	1.26	1.66	.18	.13	.13	.25



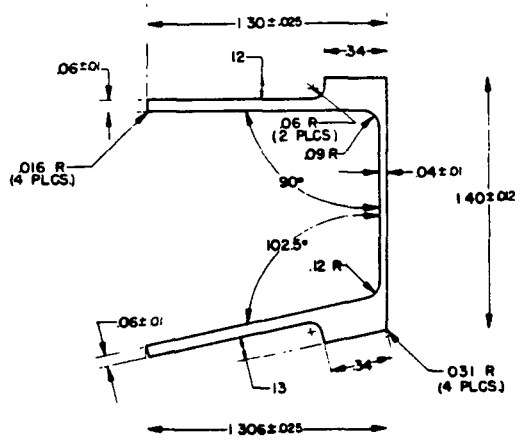
BAC1510

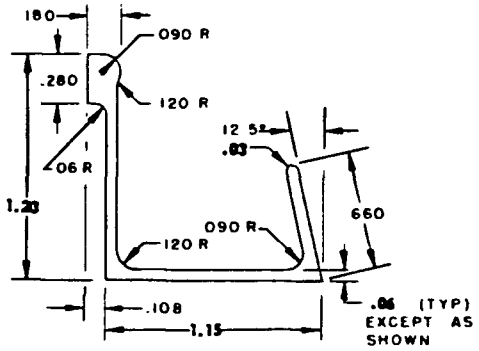
DASH NO.	DIE NO.	AREA
303		.253



BAC1510

DASH NO.	DIE NO.	AREA
367		.29005



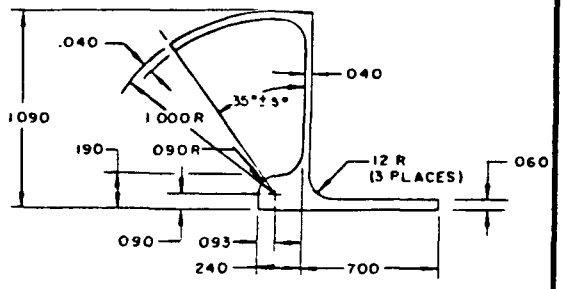


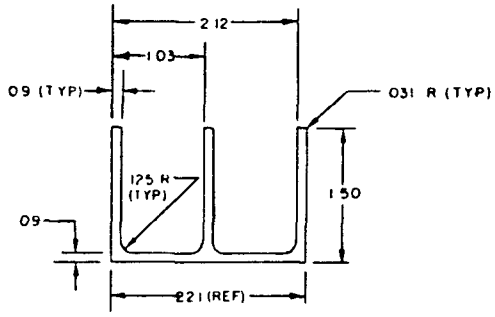
BAC1510

DASH NO.	DIE NO.	AREA	A	B	C	R
365	24387	.212	1.23	.060	1.15	.03

BAC1510

DASH NO.	AREA
372	.16576



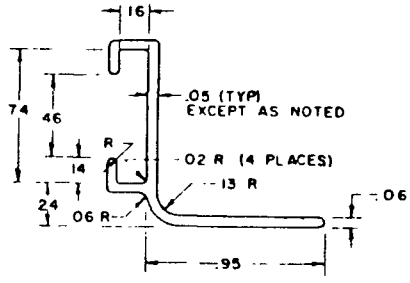


BAC1510

DASH NO.	DIE NO.	AREA
363	82462	.591

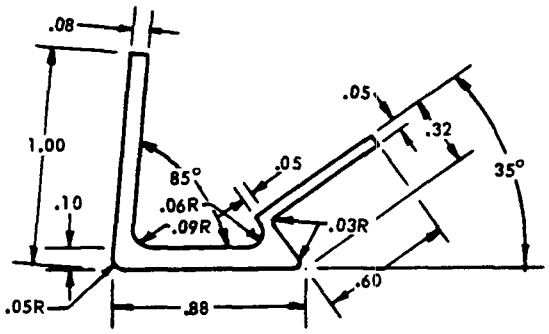
BAC1510

DASH NO.	DIE NO.	AREA
386	100494	.1360



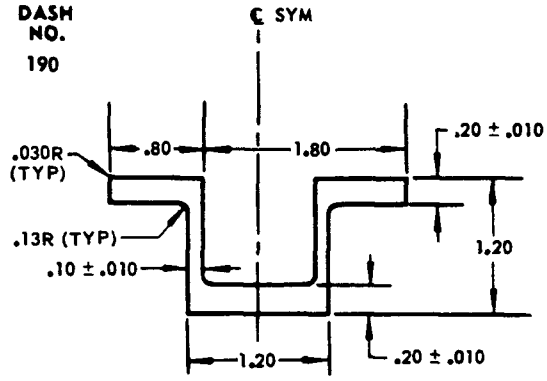
BAC1510

DASH NO.
435



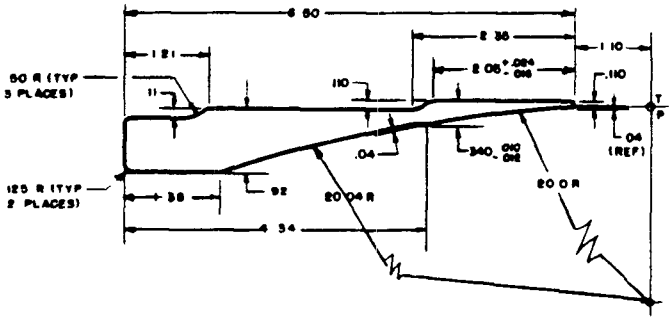
BAC1510

DASH NO.
190



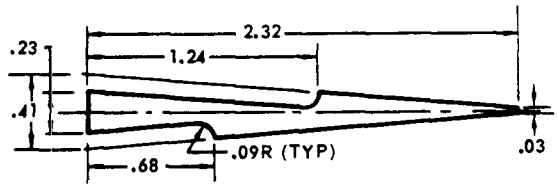
BAC1513

DASH NO.	DIE NO.	AREA
245		3.07



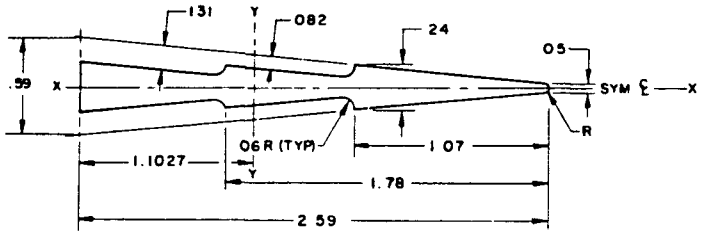
BAC1513

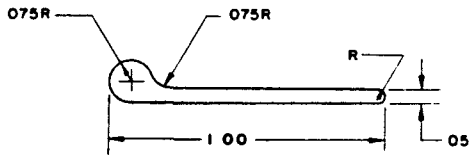
DASH NO.
350



BAC1513

DASH NO.	DIE NO.	AREA	Ixx	Iyy
291		.4547	.0016	.2416



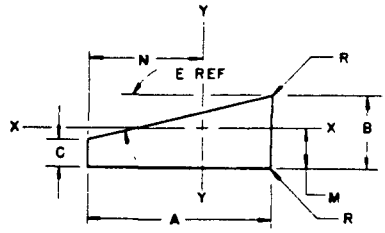


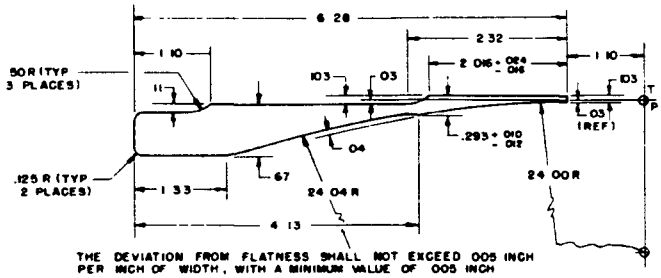
BAC1513

DASH NO.	DIE NO.	AREA
286	18225 S 85136	.0623

BAC1513

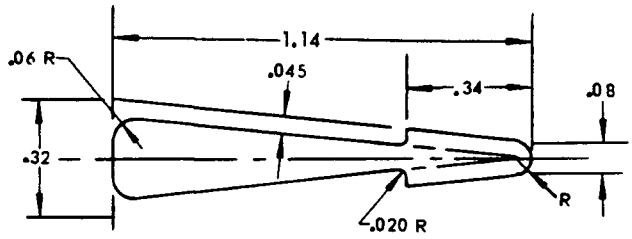
DASH NO.	DIE NO.	AREA	A	B	C	E	R
150		.0185	.420	.080	.010	9.46°	.03





BAC1513

DASH NO.	DIE NO.	AREA
244	2374 D	2.1905

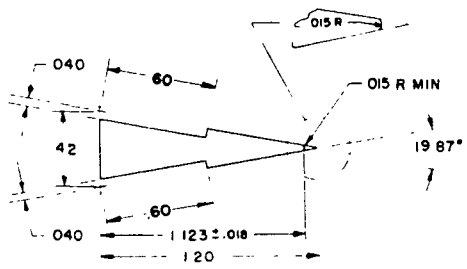


BAC1513

DASH NO.
334

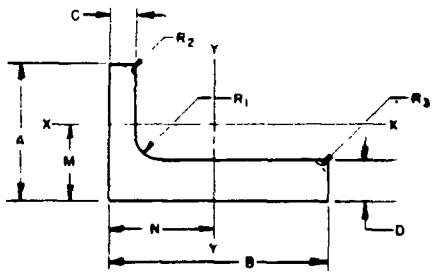
BAC1513

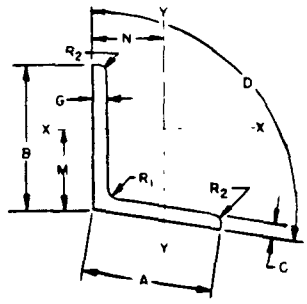
DASH NO.	DIE NO.	AREA
279	2612 D	.1967



BAC1514

DASH NO.	DIE NO.	AREA	A	B	C	D	R1	R2	R3	Ixx	Iyy	M	N
658	11533, [R] 51921	.149	1.000	1.000	.090	.064	.100			.0154	.0129	.313	.239
405	44955, 14494 [H]	.3016	1.000	1.200	.200	.100	.110			.0304	.0330	.348	.299
123	80433	.453	1.000	1.500	.120	.240	.200			.0243	.1039	.222	.602
715	52421	.2938	1.10	1.25	.15	.12	.12	.12	.12	.0326	.0398	.325	.344
301	44410 15897 [H]	.363	1.120	1.250	.120	.200	.120			.0326	.0574	.271	449
1166	71113	.4954	1.13	2.25	.20	.13	.16	.09		.0533	.2453	.2904	.7013
867	60830	.243	1.000	1.06	.156	.094	.125			.0245	.0216	.337	.264
967	59997, 16984 [R]	.484	1.25	1.50	.12	.24	.125			.0331	.0432	.277	.573
944	59931	.329	1.12	1.50	.06	.18	.12			.0195	.0757	.187	.620
1089	10834 [R]	.411	1.40	1.80	.15	.12	.13			.0755	.1265	.3884	.5066
1168	51341 [B]	.3867	1.24	1.38	.13	.18	.13	.09	.09	.0462	.0730	.3096	.4617
156	30953 15799 [H]	.601	1.500	2.000	.250	.125	.180			.1367	.1962	.493	.491
1087	19952 [H]	.6015	1.50	2.90	.20	.11	.16						
1096	19940 [H]	.5376	1.50	3.25	.15	.10	.13						
1391	54101 [B]	.3073	1.75	2.00	.075	.09	.12			.0847	.1295	.3950	.6063
228	43403	.989	1.750	2.000	.200	.350	.200			.2060	.3984	.425	.738
1083	71158	.8567	2.00	2.00	.20	.25	.19			.2932	.3290	.5336	.6236
329	18307 [R] 46353	.989	2.030	2.100	.375	.125	.250			.4193	.2477	.796	.419
79	30367 15828 [H]	.200	1.000	1.080	.072	.125	.100		.030	.0149	.0241	.221	.376
90	39443 15887 [H]	.706	1.50	1.920	.180	.250	.187	.125	.125	.1138	.2597	.359	.674
1422	82615 56476 [B]	.1381	.88	.95	.094	.063	.09						

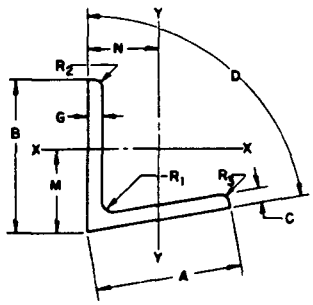


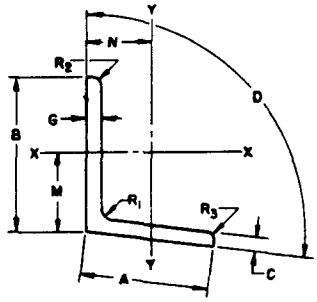


BAC1514

DASH NO.	DIE NO.	AREA	A	B	C	D	G	R1	R2	Ixx	Iyy	M	N
1392	54241 [B]	.129579	.85	.95	.075	101.5°	.075	.125	.075	.0134	.0079	.2305	.2180
912	59799	.122	1.00	1.00	.062	110°	.062	.125	.031	.01762	.01058	.171	.259
925	59876	.124	1.000	1.000	.063	97.5°	.063	.125	.050				

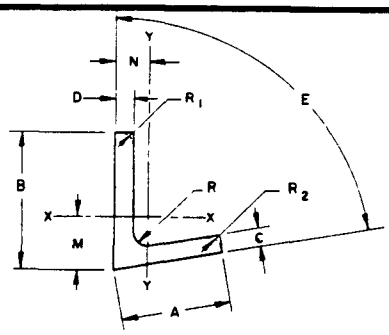
BAC1514

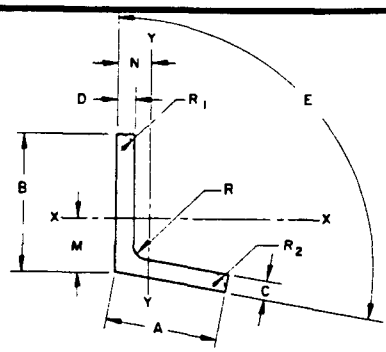




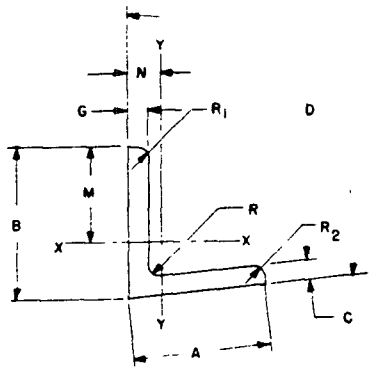
DASH NO.	DIE NO.	AREA	A	B	C	D	G	R^1	R^2	R^3	Ixx	Iyy	M	N
1290	22501	1.3019	2.50	2.85	.25	116.31°	.25	.25						
1337	18848	.8834	2.80	2.83	.15	111.07°	.15	.25			1.0300	.5611	.5053	.7047
1338	18849	.8341	2.80	2.83	.15	92.58°	.15	.25			.6828	.6335	.7173	.7488
1346	18850	.6451	2.04	2.70	.14	82.33°	.14	.09						
1102	71037	.02591	1.000	1.350	.125	101.22°	.100	.125						
1103	71038	.25645	1.000	1.350	.125	95.65°	.100	.125						
1344	82224	.14867	1.00	1.13	.07	81°	.071	.125	.07	.07	.0153	.0125	1.3539	.2464
1057	20342	.161	1.00	1.08	.080	103°	.080	.09			.02424	.01477	.251	.265
1124	10793	.217	1.00	1.16	.125	100.55°	.091	.125			.0306	.0195	.2603	.2917
1237	71367	.205	1.00	1.25	.094	95.42°	.094	.125			.0347	.0178	.3561	.2510
533	28973	.142	1.000	1.240	.064	95.25°	.064	.120			.02424	.01285	.339	.242
1241	71442	.327	1.12	1.50	.094	86°	.156	.13			.0712	.0262	.5675	.2273
813	15325 59904	.184	1.00	1.00	.094	85.50°	.094	.19	.09	.09	.01456	.01597	.291	.271
837	50364	.262	1.00	1.80	.093	74°	.093	.187			.0736	.0172	.6519	.1997
1101	71036	.2541	1.000	1.350	.125	106.52°	.100	.125						
591	52299	.322	1.750	1.750	.094	95°	.094	.094						
1110	51364	.665	1.25	1.80	.20	112°	.25	.13			.2904	.0662	.5495	.3058
534	28972	.143	1.000	1.240	.064	84.75°	.064	.120			.01909	.01261	.379	.237
915	59902	.143	1.00	1.25	.063	66°	.063	.125	.031	.031	.01595	.01023	.447	.217
830	59550	.278	2.00	2.40	.064	93°	.064	.06			.1756	.1073	.6472	.4810
672	72962	.5254	1.75	1.75	.156	87.53°	.156	.156			.1436	.1510	.5169	.4888

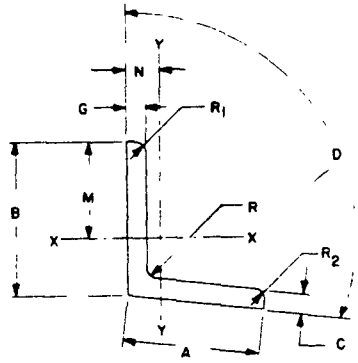
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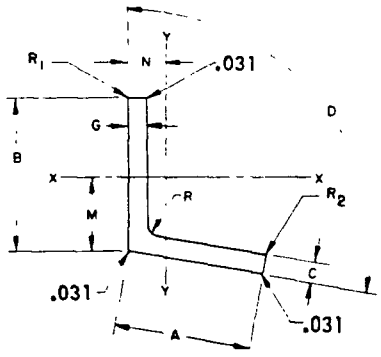
DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	R^1	R^2	Ixx	Iyy	M	N
812	85543 15264	.298	1.25	1.25	1.25	1.25	82°	.19	.125	.125	.0349	.0402	.3890	.3421
892	61763	.383	1.20	1.64	.20	.100	92.75°	.18	.18		.0858	.0561	.3782	.3915
1130	72888	.586	1.25	2.00	.188	.188	102.50°	.188			.2758	.0708	.6194	.3097
518	23054	.225	1.250	1.250	.094	.094	83°	.094			.0297	.0333	.3850	.3412
1113	71093	.3287	1.25	1.25	.125	.15	102°	.19			.0649	.0438	.3197	.3313
934	59833	.332	1.25	1.50	.125	.125	82°	.156			.0644	.0454	.4885	.3253



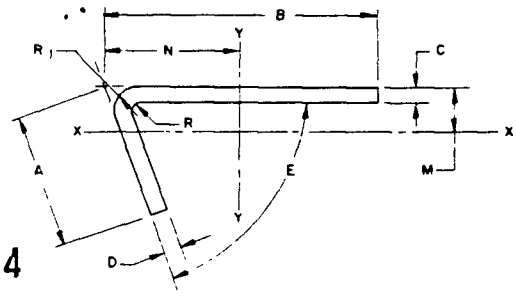


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DASH NO.	DIE NO.	AREA	A	B	C	D	G	R	R1	R2	Ixx	Iyy	M	N
1172	71157	.456	1.50	1.50	.16	95°	.16	.125			.1054	.0960	1.1044	.4303
1266	71812	1.050	1.55	2.80	.34	85.5°	.21	.19						
1279	80177	1.1645	2.50	2.75	.10	92°	.34	.25			.9067	.3887	1.1145	.3672
1128	72894	2.437	2.55	3.25	.30	102°	.55	.25			3.1304	.9781	1.1411	.5943
326	44489	.937	1.500	1.900	.300	93°	.300	.125			.3312	.1715	1.2780	.4401
	264 [A]													
1313	24075 [H]	.7889	1.70	2.12	.22	85.3°	.22	.09			.3176	.1927	.7055	.4537
1126	10810 [R]	1.242	1.90	2.50	.35	116.31°	.25	.25						
1272	71855	.4104	1.38	1.58	.08	80°	.20	.12			.0915	.0440	.9334	.2556
1311	82439	.556	1.50	2.12	.16	96°	.16	.09						
1371	H-3579 [K]	.505	1.50	1.50	.180	80.50°	.180	.19	.12	.12	.0827	.0966	.9966	.4221
1108	10875 [R]	1.1099	2.10	2.10	.17	103°	.38	.18			.6428	.3062	.6969	.4640



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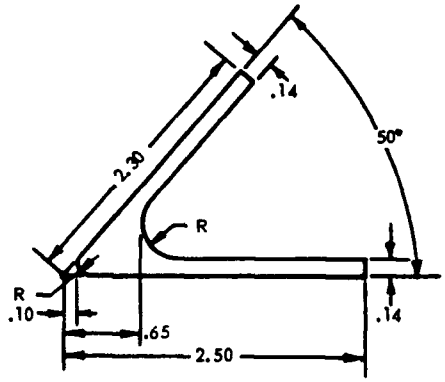
DASH NO.	AREA	A	B	C	D	R	R1
1419	.2076	1.30	1.40	.081	.081	.13	.13

DASH NO.	DIE NO.	AREA	A	B	C	D	G	R	R¹	R²	Ixx	Iyy	M	N
1121	71063	.204	1.00	1.16	.11	117.08°	.091	.125	.091	.11	.0422	.0153	.1968	.2593
1367		.2347	1.00	1.37	.120	126.13°	.091	.125	.091	.12	.0707	.0145	.2364	.2339
1368		.2311	1.00	1.34	.120	120.05°	.091	.125	.091	.12	.0613	.0162	.2416	.2486
1369		.2280	1.00	1.31	.120	113.37°	.091	.125	.091	.12	.0522	.0177	.2602	.2612
1370		.2228	1.00	1.26	.120	106.38°	.091	.125	.091	.12	.0418	.0190	.2651	.2767

BAC1514

DASH NO.

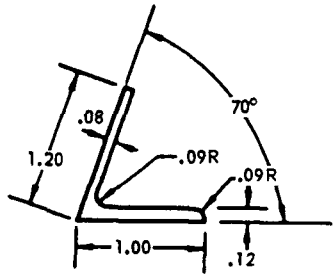
1495



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DASH NO.

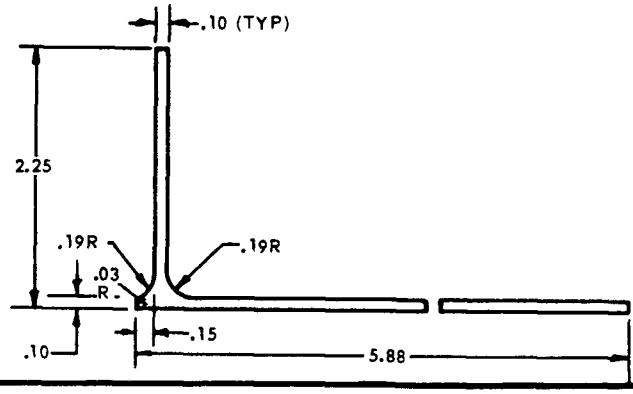
1497

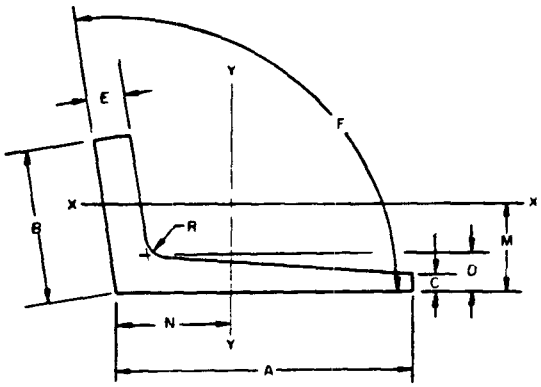


BAC1514

DASH NO.

1498



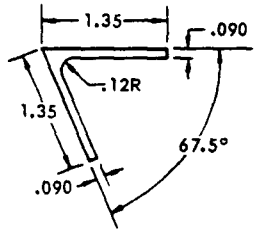


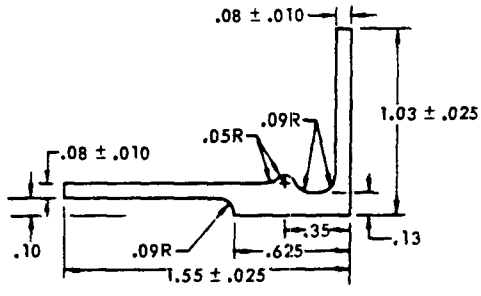
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DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	R	Ixx	Iyy	M	N
1387	24950	.747	2.42	1.54	.05	.19	.31	98.5°	.27	.1789	.2918	.5254	.4220

DASH NO.

1488

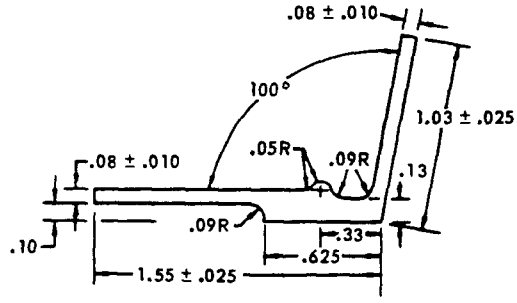




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DASH NO.

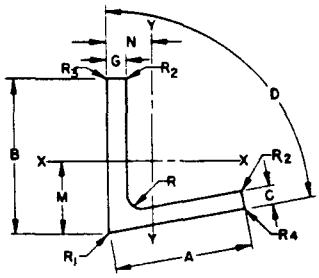
1486

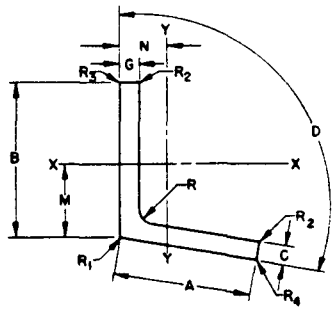


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DASH NO.

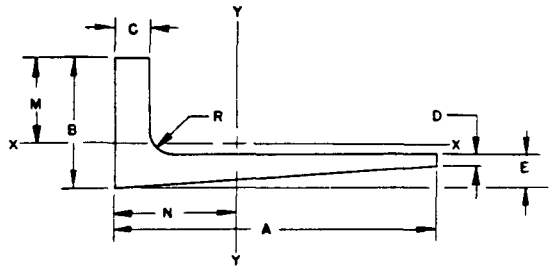
1485





BAC1514

DASH NO.	DIE NO.	AREA	A	B	C	D	G	R	R1	R2	R3	R4	Ixx	Iyy	M	N
906	71248, 76009	.2065	1.062	1.250	.094	99.3°	.094	.094	.031	.094	.016	.016	.0361	.0200	.3248	.2736
1105	71178	.574	1.13	2.37	.28	94°	.125	.19	.19	.031	.031	.031	.3124	.0692	.6586	.3363
1107	16020 R	.751	1.50	2.94	.28	93°	.125	.19	.19	.031	.031	.031	.6098	.1644	.7705	.4475
1273	16776 R	.5334	1.93	3.75	.125	84°	.08	.13	.06	.016	.016	.016				
1104	71177	.574	1.13	2.37	.28	86°	.125	.19	.19	.031	.031	.031	.2820	.0677	.7046	.3349
1109	10874 R	1.775	2.50	2.50	.35	103°	.41	.19	.25	.031	.031	.031	.9235	1.3854	.7224	.3384

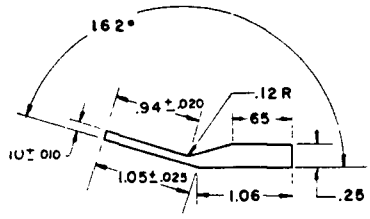


BAC1514

DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	Ixx	Iyy	M	N
1216	20332 M	.653	1.35	1.60	.10	.30	.50	.125	.0711	.1096	1.1786	.5185

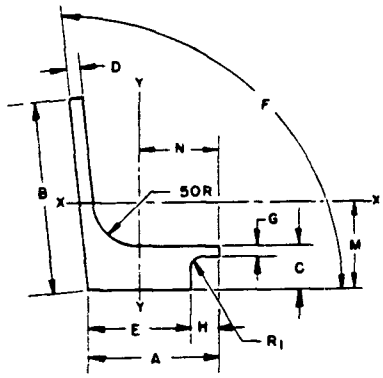
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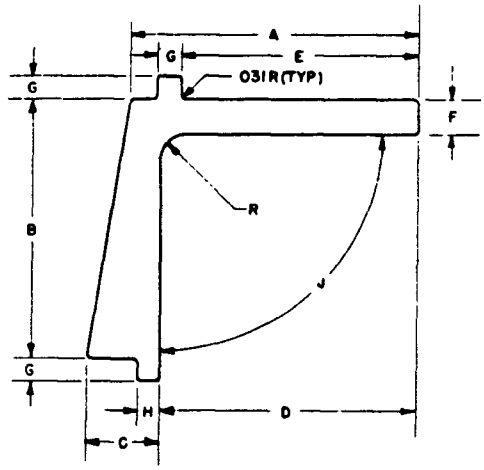
DASH NO.	DIE NO.	AREA
1278	71842	.347568



BAC1514

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	H	R1	Ixx	Iyy	M	N
1144	16090K H-3263K	5.9397		4.65	.75	.70	4.00	97.52°	.30	.35	.06	11.4796	11.1992	1.4583	3.2580



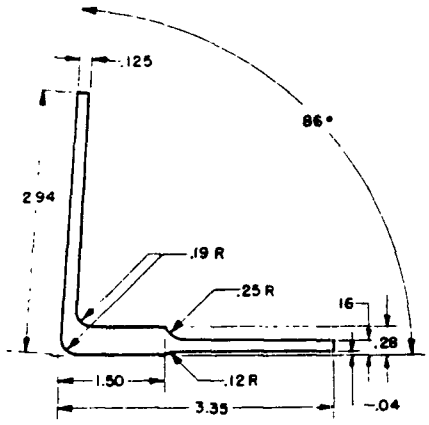


BAC1514

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	H	J	R
1091	51089P	4.872	4.12	3.84	1.02	3.70	3.40	.50	.35	.30	90°	.38
1265	52900S	5.440	4.12	3.84	1.19	3.53	3.40	.50	.35	.30	90°	.38
1090	69719P	10.114	4.58	5.25	1.57	3.88	3.88	1.00	.35	.35	90°	.38

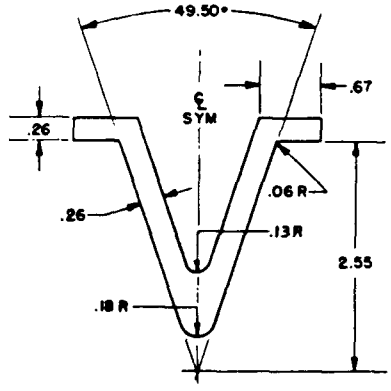
BAC1514

DASH NO.	DIE NO.	AREA
1106	19998M	.981



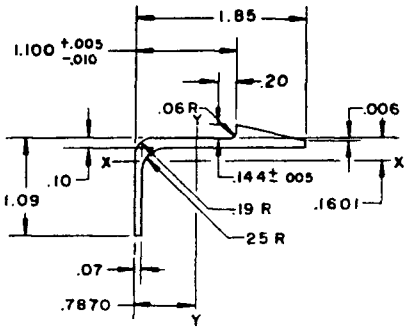
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DASH NO.	DIE NO.	AREA
1097	19951M	1.649



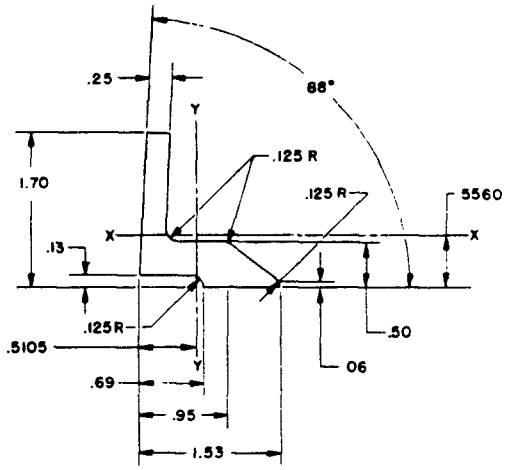
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DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1408	24501 B	.315	.0229	.1225



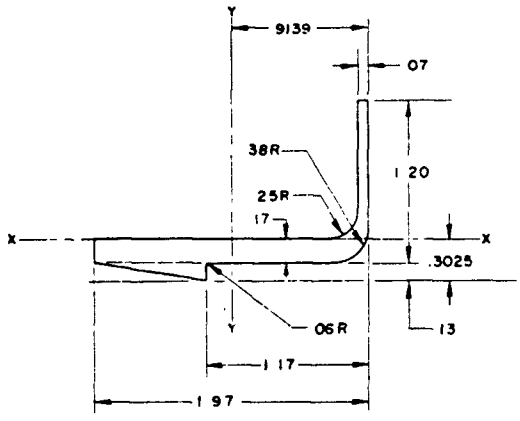
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DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1233	51773 B	.8451	.1817	.1378



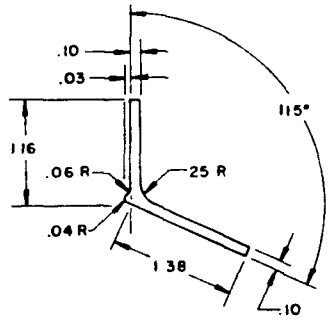
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DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1221	20291 H	.442	.0306	.1684



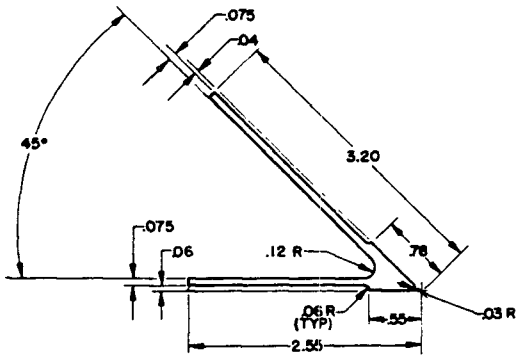
BAC1514

DASH NO.	AREA
1418	.255



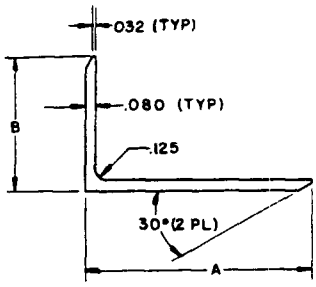
BAC1514

DASH NO.	DIE NO.	AREA
1415		.4837



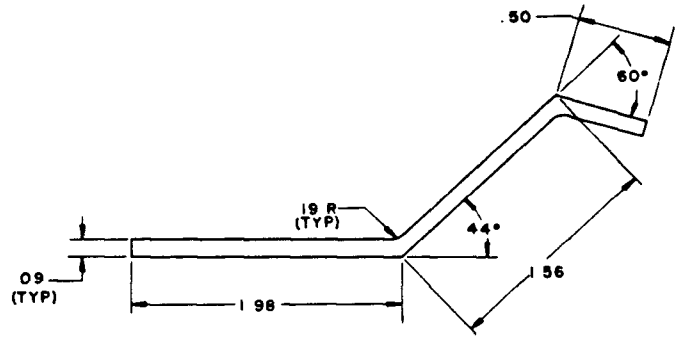
BAC1514

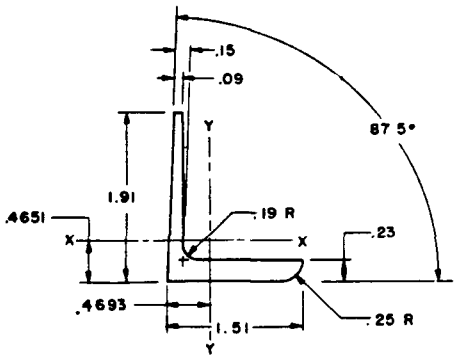
DASH NO.	DIE NO.	AREA	A	B	C
524	K-14203	.313	2.500	1.500	112.5°



BAC1514

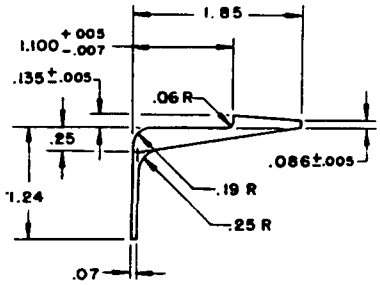
DASH NO.	DIE NO.	AREA
1289	18060	.3571





BAC1514

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1388		3.1512	1.0722	13.7922

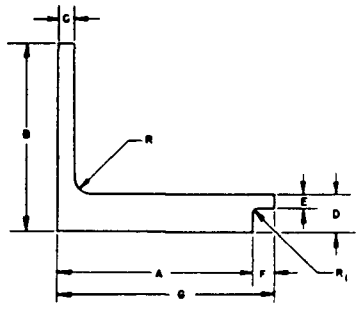


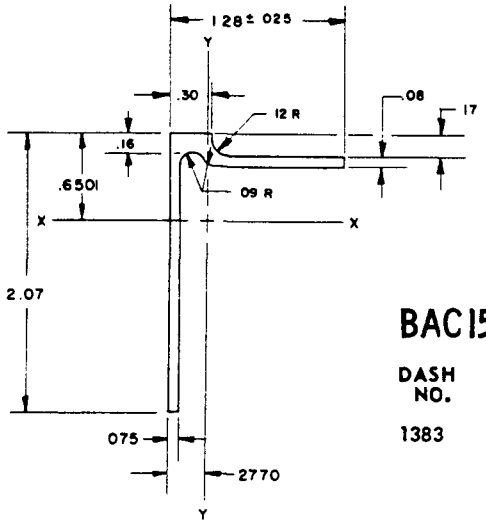
BAC1514

DASH NO.	DIE NO.	AREA
1407	82430	3944

BAC1514

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	R	R1
1085	20038	2.108	2.82	2.75	.22	.55	.20	.30	.25	.06



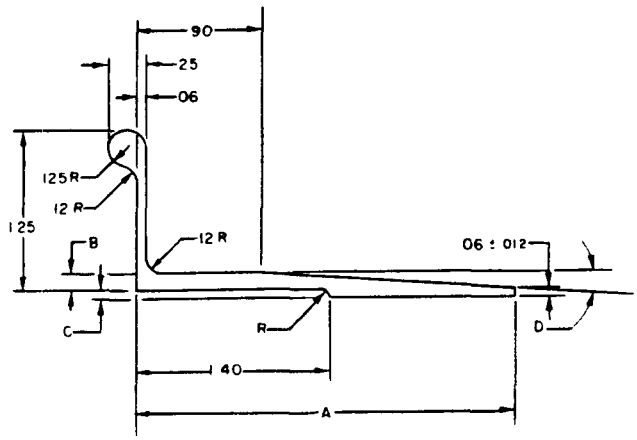


BAC1514

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1383	82205	.279	.1055	.0354

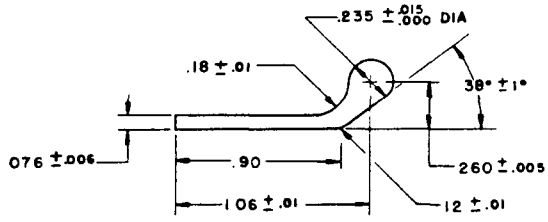
BAC1515

DASH NO.	DIE NO.	AREA	A	B	C	R
525	71220	.3477	2.76	.09	.030	.12



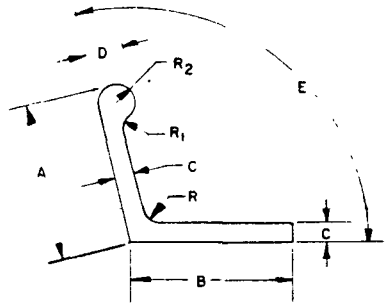
BAC1515

DASH NO.	DIE NO.	AREA
526	82725	.13535



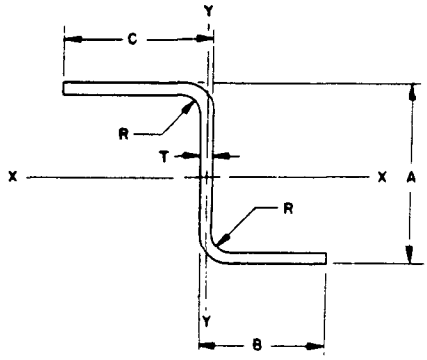
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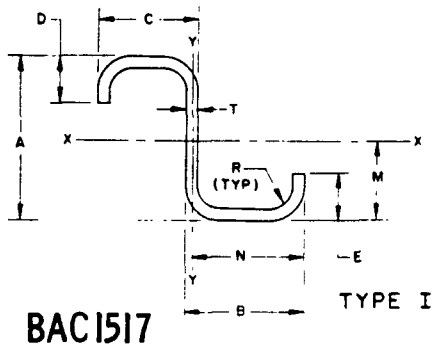
DASH NO.	DIE NO.	AREA	A	B	C	D	E	R	R^1	R^2
531	53222	.1324	1.13	1.20	.05	.156	104°	.125	.125	.078



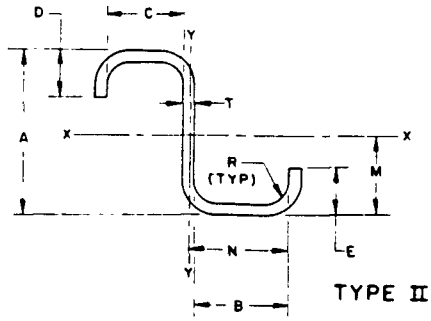
BAC1517

DASH NO.	DIE NO.	AREA	A	B	C	T	R
1168		.1058	2.00	.75	.75	.032	.13
1008		.047	.60	.70	.60	.025	.09
117			1.000	1.060	.640	.051	.125
1307		.1901	1.02	1.05	1.00	.071	.12
462		.093	1.00	.66	.82	.040	.06





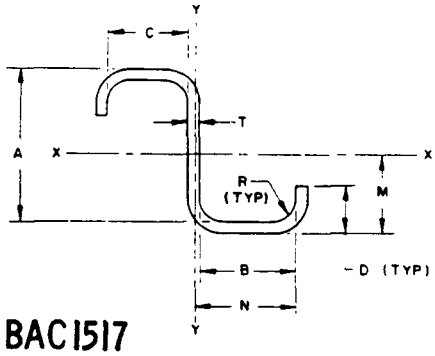
TYPE I



TYPE II

BAC1517

DASH NO.	AREA	TYPE	A	B	C	D	E	T	R	Ixx	Iyy	M	N
481	.148	I	1.50	.70	.62	.25	.25	.051	.09	.0487	.0143	.7301	.6530
1062	.2505	II	2.49	.90	.90	.33	.33	.056	.25	.2223	.0503	1.2450	.9280
1080	.3603	II	2.50	.90	.90	.50	.50	.081	.25				
1004	.3450	II	2.50	.90	.90	.50	.50	.071	.25				
1099	.247	I	3.75	1.00	1.00	.45	.45	.040	.16				

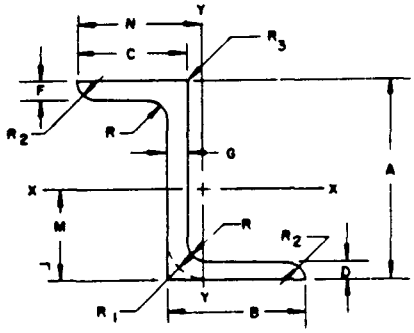


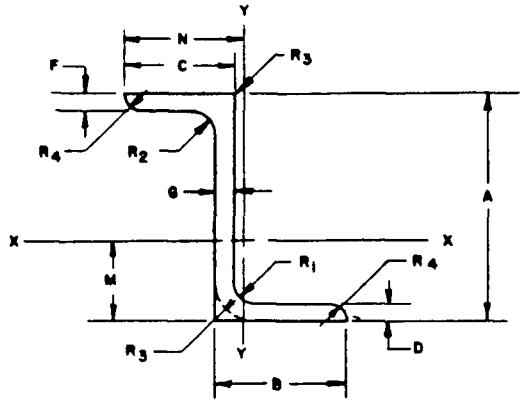
BAC1517

DASH NO.	DIE NO.	AREA	A	B	C	D	T	R	Ixx	Iyy	M	N
705	Z-2097 M		2.44	.90	.90	.33	.051	.25				
706	Z-2098 M		2.44	.90	.90	.33	.064	.25	.2559	.0581	1.2520	.9320
1147		.2018	2.46	.90	.90	.33	.045	.25				
1256		.4288	2.41	.90	.90	.50	.090	.25				

BAC1517

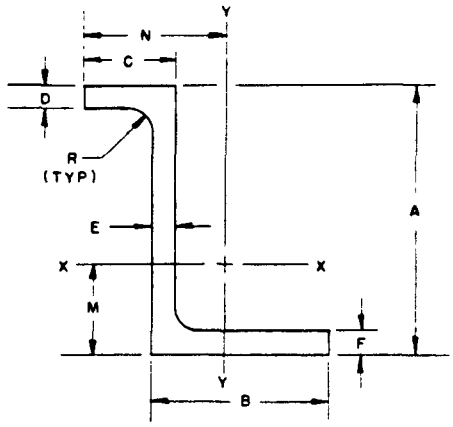
DASH NO.	DIE NO.	AREA	A	B	C	D	F	G	R	R1	R2	R3	Ixx	Iyy	M	N
1167	54373 [B] 82020	.164	1.00	.90	.75	.063	.063	.063	.125		.063					
1068	71030 18536 [R]	.22146	1.000	1.000	.500	.120	.080	.070	.125				.0302	.0279	.3494	.6768
1069	54556 [B] 71031	.25346	1.000	1.000	.900	.120	.080	.070	.125				.0407	.0495	.4283	.9646
1070	82518 10742 [R]	.26636	1.125	1.000	.600	.125	.090	.090	.125				.0479	.0338	.4363	.7172
1071	71033	.24946	1.250	1.000	.500	.120	.080	.080	.125				.0540	.0290	.4562	.6447
1072	24421 [H] 10743 [R]	.28146	1.250	1.000	.900	.120	.080	.080	.125				.0698	.0496	.5375	.9517
1318	82566	.19101	1.50	.80	.80	.063	.063	.063	.12		.063					
476	60355	.295	1.75	1.00	.68	.11	.08	.08	.125	.031		.031	.1354	.0355	.7305	.7557
1079	10798 [R] 54379 [B]	.4054	1.75	1.00	.75	.125	.125	.125	.125		.125		.1766	.0420	.8115	.7485
1169	18387 [R] 24342 [H]	.4679	1.75	1.00	1.00	.125	.16	.125	.125		.125					





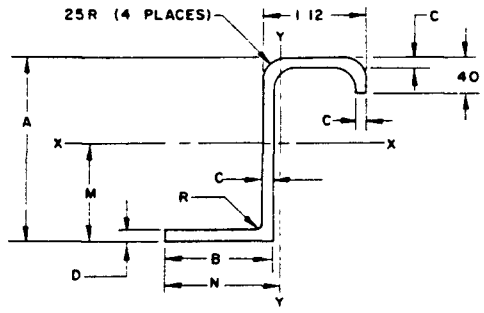
BAC1517

DASH NO.	DIE NO.	AREA	A	B	C	D	F	G	R1	R2	R3	R4	Ixx	Iyy	M	N
1258		1.16029	2.48	1.63	1.35	.23	.15	.28	.125	.125	.16		.9282	.3189	1.1041	1.3308
1061	20043 [H]	.5543	2.50	1.10	1.10	.135	.135	.10	.19	.19			.5242	.1036	1.25	1.050
1148	16693 [R]	.39767	2.50	1.12	1.12	.085	.085	.085	.156	.156						
1049	71013 52099 [B]	.56558	2.50	1.12	1.12	.125	.125	.125	.125	.125		.06	.5212	.0966	1.2530	1.0546
1149	52901 [B]	.56842	2.50	1.20	1.20	.120	.120	.120	.156	.156						
1150	16692 [R]	.65602	2.50	1.20	1.20	.140	.140	.140	.156	.156						
1050	71028 16909 [R]	.740	2.50	1.20	1.20	.16	.16	.16	.156	.156		.06	.6738	.1477	1.2531	1.1156
1151		.74452	2.50	1.35	1.25	.19	.140	.140	.156	.156						
1054	51075 [B]	.88299	2.50	1.35	1.35	.18	.18	.18	.188	.188		.06	.8165	.2380	1.2610	1.2541
1057	19783 [H]	.9876	2.50	1.40	1.40	.20	.20	.20	.188	.188		.125	.8915	.2796	1.2528	1.2983
1135		.97994	2.57	1.40	1.40	.20	.20	.19	.188	.188		.125				
1162	53184 [B]	.58556	3.70	1.25	1.25	.13	.13	.08	.25	.25	.31					



BAC1517

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	R	Ixx	Iyy	M	N
39	16648	.145	1.250	.750	.375	.064	.064	.064	.063	.0317	.0076	.5251	.4308
	50637[A]												
205	51526	.5470	1.500	1.420	.750	.160	.160	.160	.160				
316	52600	.4396	2.00	.90	1.15	.15	.10	.10	.125	.2626	.0770	1.1595	.9761
	52012[B]												
1261	54134[B]	2.1895	2.40	1.57	1.57	.40	.37	.68	.125	1.5105	.9261	.10960	1.5054

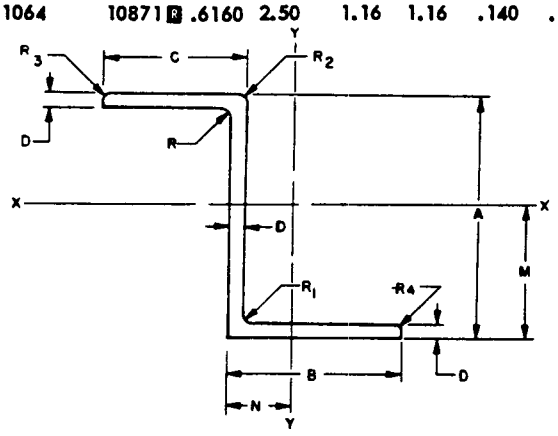


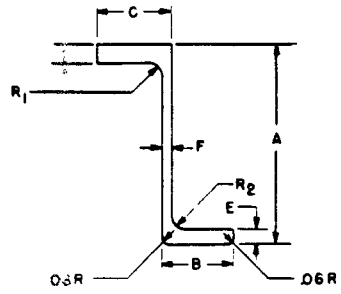
BAC1517

DASH NO.	DIE NO.	AREA	A	B	C	D	R	Ixx	Iyy	M	N
1084	71221	.2793	2.00	1.00	.064	.064	.125				
	51475[B]										
1081	71164	.422	2.00	1.00	.10	.10	.06	.2492	.0938	1.0751	1.0480
1082	20042	.4727	2.00	1.50	.10	.10	.09				

BAC1517

DASH NO.	DIE NO.	AREA	A	B	C	D	R	R1	R2	R3	R4	Ixx	Iyy	M	N
1334	82972	.5038	2.50	1.17	1.20	.110	.125	.125		.25					
1065	51319 H	.3886	2.50	1.00	1.00	.094	.188	.125	.250	.25		.3413	.0427	1.1809	.0767
1063	10923 P	.5517	2.50	1.12	1.12	.125	.156	.125	.250	.250	.060	.4895	.0889	1.2041	.0755
	H-3056 R														
1064	10871 P	.6160	2.50	1.16	1.16	.140	.156	.125	.250	.250	.060	.5608	.1217	1.2262	.0623



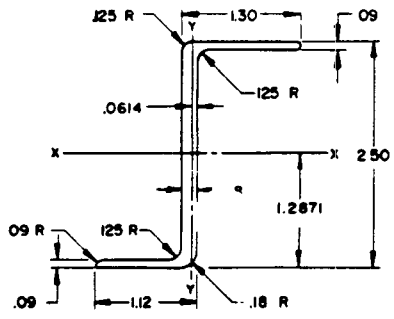


BAC1517

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	R1	R2
1034	10797 B	.407	1.50	.75	1.00	.156	.125	.125	.125	.125
	51000 B									

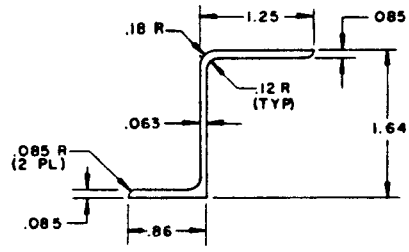
BAC1517

DASH NO.	DIE NO.	AREA	Ixx	Iyy
1257		.6294	.4927	.0832



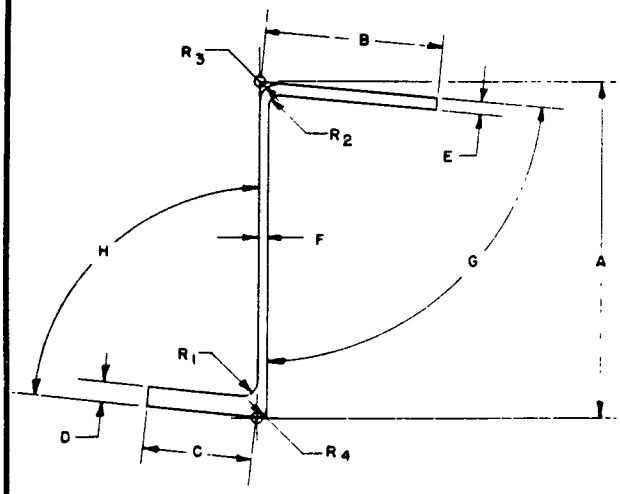
BAC1517

DASH NO.	DIE NO.	AREA
1317	82565	.2665



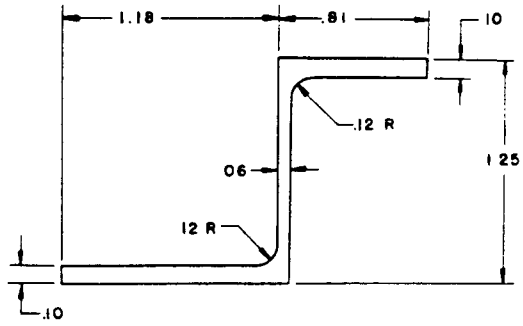
BAC1517

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	H	R1	R2	R3	R4
1154	16777 B	.765	3.69	1.93	1.20	.20	.125	.08	85°	84.5°	.16	.13	.19	.06
1153	71853	.62525	3.70	2.27	1.12	.10	.10	.08	80°	80°	.12			



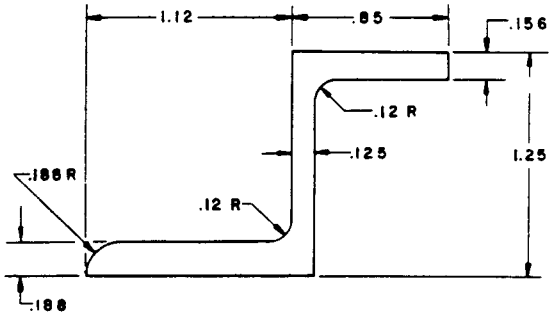
BAC1517

DASH NO.	DIE NO.	AREA
1160	16823 B	.2729



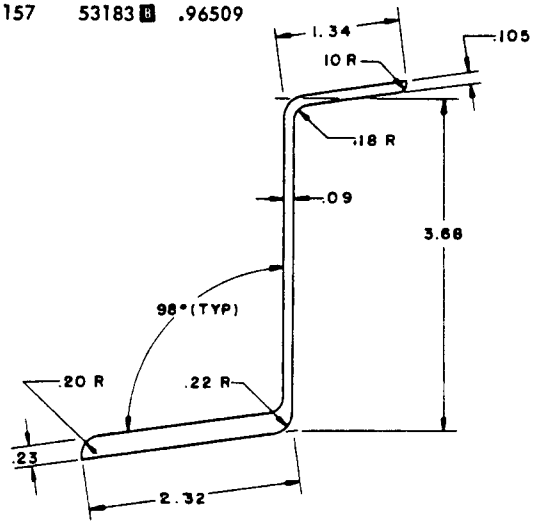
BAC1517

DASH NO.	DIE NO.	AREA
1161	16824 B	.47748



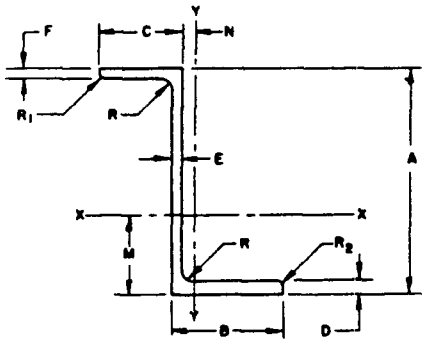
BAC1517

DASH NO.	DIE NO.	AREA
1157	53183 B	.96509



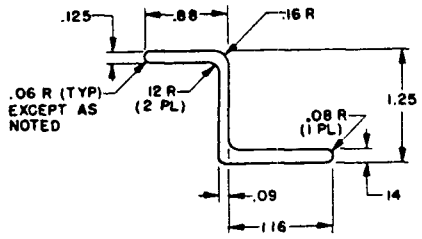
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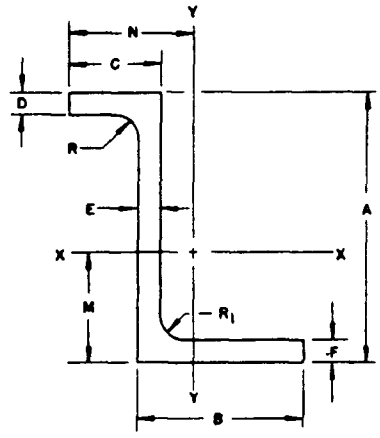
DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	R	R1	R2	Ixx	Iyy	M	N
1078	71065	.2675	1.50	1.00	.63	.125	.07	.08	.125	.08	.12	.0892	.0328	.5731	.1223
1172	54083	.4360	2.50	1.20	.90	.135	.08	.10	.12	.06	.09				



BAC1517

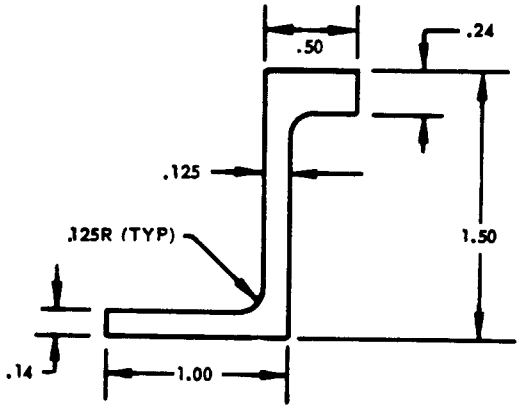
DASH NO.	DIE NO.	AREA
1246	82234	.3573





BAC1517

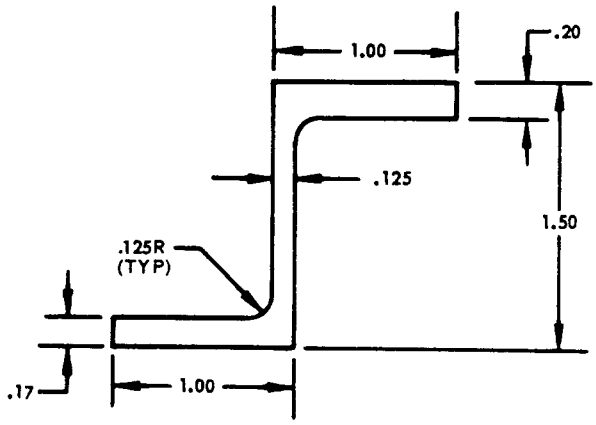
DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	R	R1	Ixx	Iyy	M	N
1087	10922 R	.5946	1.75	1.12	.94	.16	.16	.19	.12	.16	.2617	.1022	.8019	.9314
198	10078 W	.5704	1.50	1.40	.750	.156	.156	.188	.10	.19				
	54047													
	17278 R													



BAC1517

DASH NO.

1373



BAC1517

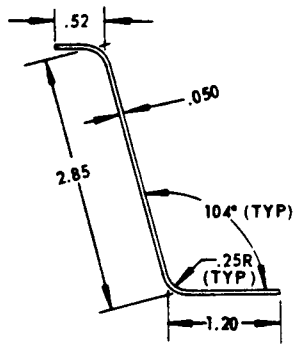
DASH NO.

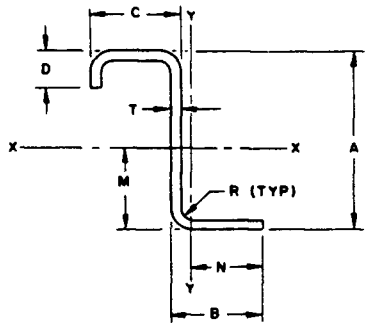
1374

BAC1517

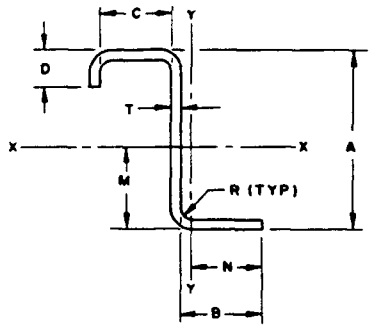
DASH NO.

1443





TYPE I



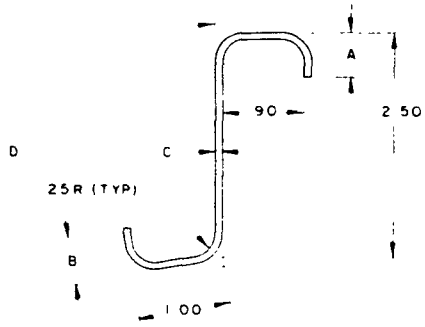
TYPE II

BAC1517

DASH NO.	AREA	TYPE	A	B	C	D	T	R	Ix-x	Iy-y	M	N
1109	.0895	II	2.00	.80	.70	.30	.025	.09				
328	.1447	II	2.00	.90	.70	.30	.040	.19				
497	.241	I	1.40	1.00	1.00	.40	.072	.13	.0729	.0574	.7255	1.0278
1315	.24856	I	1.47	.85	.85	.45	.080	.16				
1312	.11932	I	1.47	.75	.75	.25	.040	.06				
1313	.01492	I	1.47	.75	.75	.30	.050	.09				
1314	.02192	I	1.44	1.31	.75	.35	.063	.12				
1277	.2564	I	1.43	1.06	1.00	.25	.080	.19				
321	.1367	I	1.00	.80	.50	.25	.064	.13				
107		I	2.00	.90	.80	.33	.081	.081				
1316	.11827	I	2.00	.80	.80	.30	.032	.06				

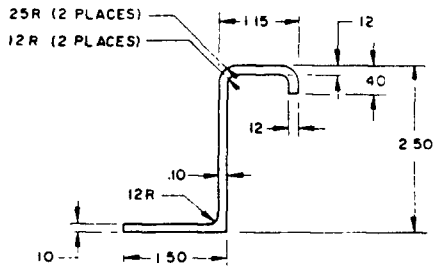
BAC1517

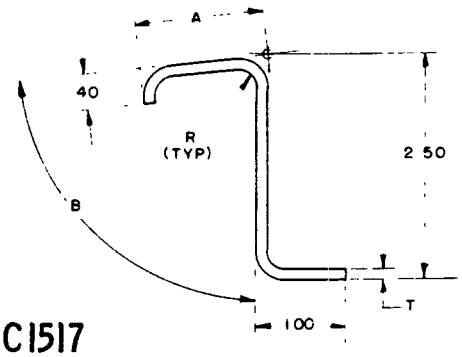
DASH NO.	AREA	A	B	C	D
1163	.2511	.33	.33	.056	96°
1194	.2998	.44	.44	.064	100°
1193	.3444	.50	.50	.072	100°
1164	.2521	.33	.33	.056	100°



BAC1517

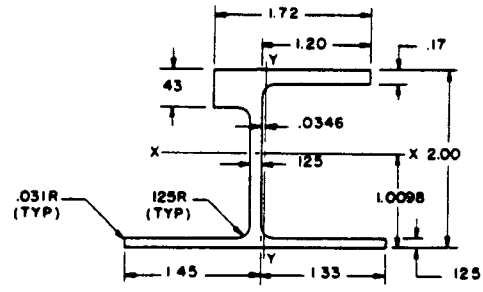
DASH NO.	DIE NO.	AREA
1249		.53102





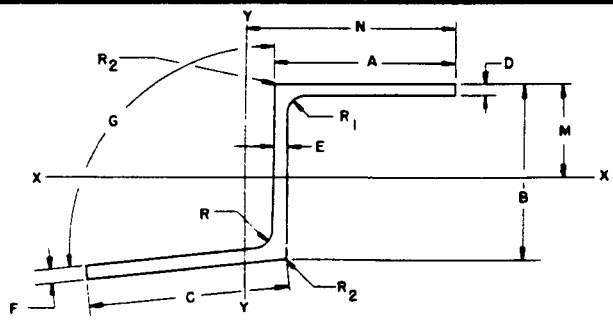
BAC1517

DASH NO.	DIE NO.	AREA	A	B	T	R
1107		.4855	1.55	88.67	102	.22



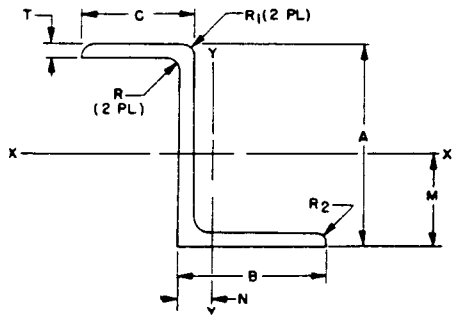
BAC1517

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1278		.964136	.6529	.3359



BAC1517

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G
1306	82447	.274	.75	2.56	1.00	.06	.06	.08	94.5°

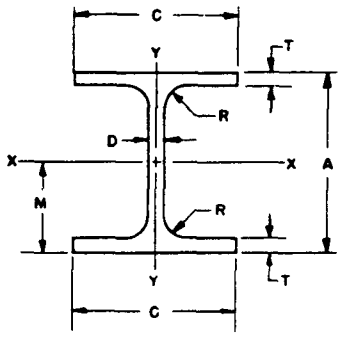


BAC1517

DASH NO.	DIE NO.	AREA	A	B	C	T	R	R1	R2
1146	H-27878 82405	.6569	2.50	1.20	1.20	.145	.156	.250	.06

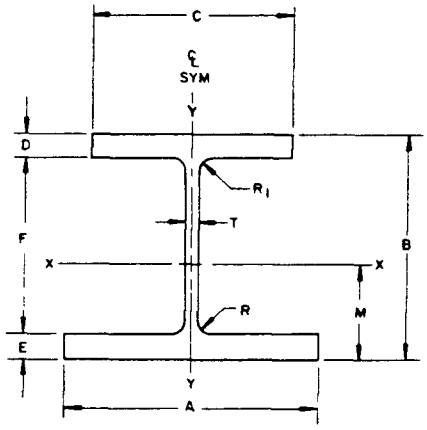
BAC1518

DASH NO.	DIE NO.	AREA	A	C	D	T	R	Ixx	Iyy	M
196	53092 L 72678 23293 H	1.2634	6.10	2.70	.10	.12	.19	7.6649	.3878	3.053



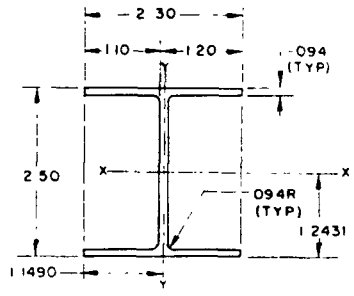
BAC1518

DASH NO.	DIE NO.	AREA	A	B	C	D	E	T	R	R1	Ixx	Iyy	M
205	51365 B	.9339	2.00	3.00	2.00	.13	.15	.13	.16	.16	1.3951	.1852	1.4456
212	72580	1.3958	2.00	5.50	2.00	.156	.22	.12	.188	.188			
256	16869 L	.7808	3.00	3.00	1.75	.08	.135	.08	.125	.125			
191	51520 B	2.078	4.00	3.66	4.00	.125	.25	.16	.25	.25			
294	54307 B	1.26399	2.80	3.00	2.00	.28	.135	.12	.16	.16	1.9416	.4119	1.6678
304		2.562	3.10	3.00	2.50	.55	.25	.18	.16				
307	24412 H	1.4003	3.50	3.55	1.60	.20	.19	.125	.16	.16			



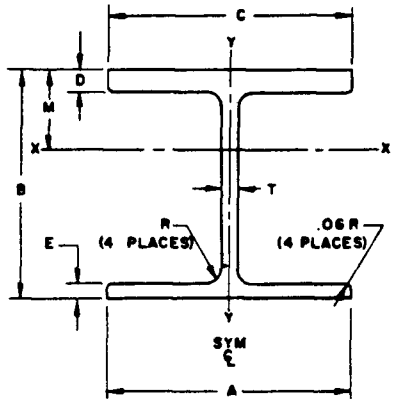
BAC1518

DASH NO.	DIE NO.	AREA	Ixx	Iyy
209	19114 H 71057	.6565	.7285	.1888



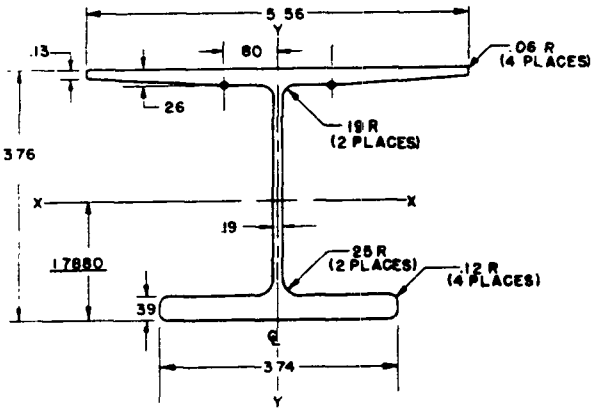
BAC1518

DASH NO.	DIE NO.	AREA	A	B	C	D	E	T	R	Ixx	Iyy	M
192	51077	1.392	2.65	2.50	2.65	.25	.15	.15	.156	1.4389	.6077	1.0351



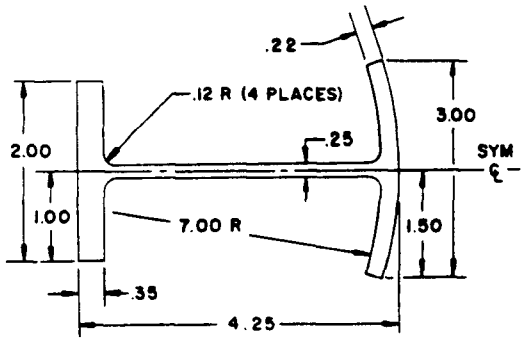
BAC1518

DASH NO.	DIE NO.	AREA	Ixx	Iyy
280	54085	3.2646	8.3463	4.1268



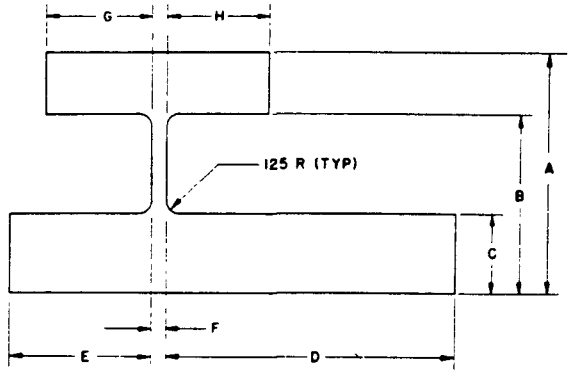
BAC1518

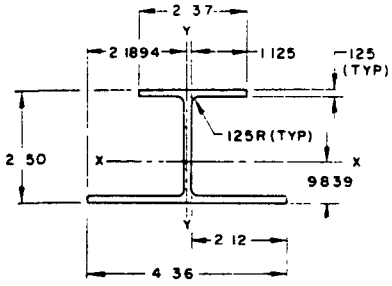
DASH NO.	DIE NO.	AREA
195	19950	2.291



BAC1518

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	H
259	53012 B	3.8840	2.63	2.21	.75	1.25	1.25	.44	1.00	1.00
	91098									
260	78582	4.1909	2.77	2.20	1.00	3.07	3.07	.20	2.18	2.18
248	76948	3.8599	2.79	2.19	.67	.94	1.23	.37	1.28	.99
251	53384 B									
246	52919 H	5.3569	2.84	2.23	.70	2.51	2.51	.125	1.21	1.21
258	53105 B	5.6388	2.84	2.23		2.72	2.72	.125	1.20	1.20
249	78666 B	4.0424	2.85	2.19	.70	1.38	1.38	.125	1.32	1.32
	52922 B									
	52920 B	6.2716	2.89	2.00	.98	1.96	1.54	.16	1.33	1.33
250	52918 B	6.2303	2.91	2.23	.98	2.12	1.55	.20	1.62	1.38
245	78569	8.0689	2.92	2.21	.93	3.05	3.05	.16	1.35	1.35
	53382 B									
	23456 H									
247	52921 B	5.80	2.99	2.13	.91	1.79	1.39	.18	1.37	1.37
	18591 R									
263	53671 B	7.766	2.89	2.00	1.08	2.28	2.28	.16	1.33	1.33



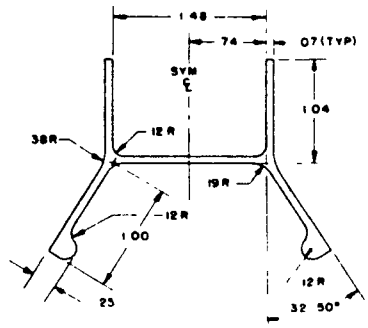


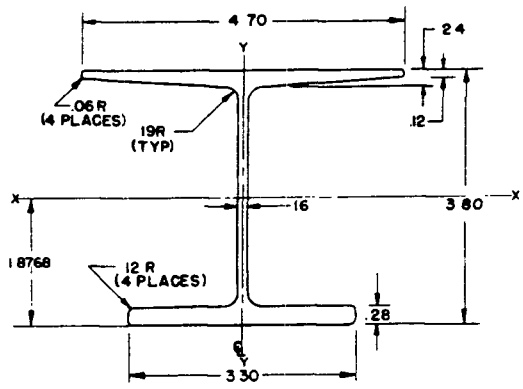
BAC1518

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
210	51201 H	1.134	1.2496	1.0169

BAC1518

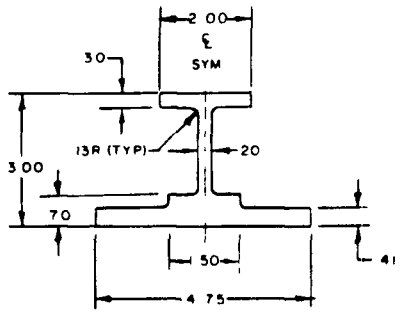
DASH NO.	DIE NO.	AREA
222		.488





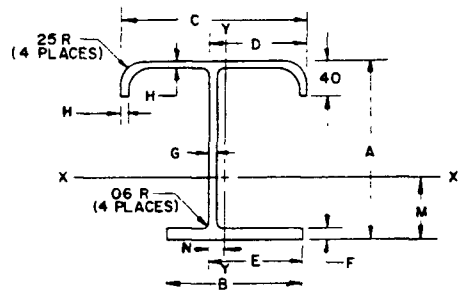
BAC1518

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
279	54173	2.3179	6.1481	2.0880



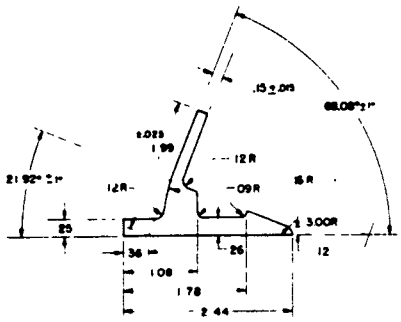
BAC1518

DASH NO.	DIE NO.	AREA
206	72666	3.402



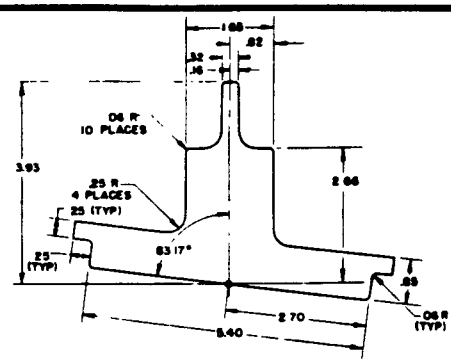
BAC1518

DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	H	I_{xx}	I_{yy}	M	N
289	18767	.568244	2.00	1.50	2.04	1.06	1.02	.14	.08	.08	.3953	.1461	1.0051	.1236
290	54263	.729644	2.50	2.02	2.02	1.06	1.06	.13	.10	.09	.7818	.1959	1.2024	.0500



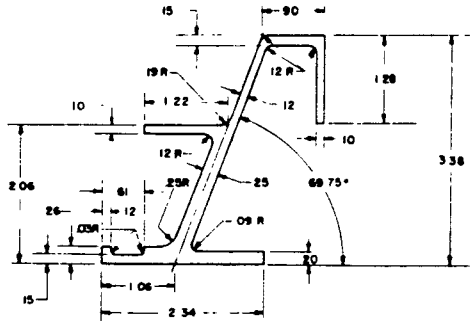
BAC1520

DASH NO.	DIE NO.	AREA
693	71094	1.022



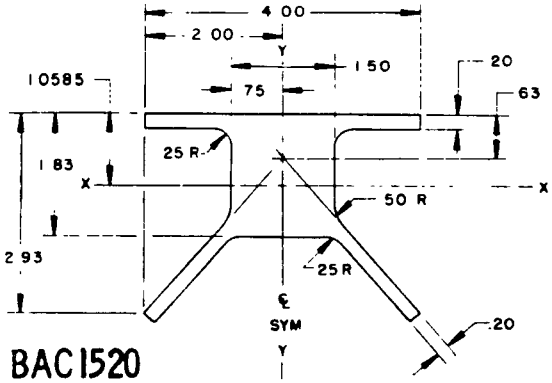
BAC1520

DASH NO.	DIE NO.	AREA
735	20116 H	8.156



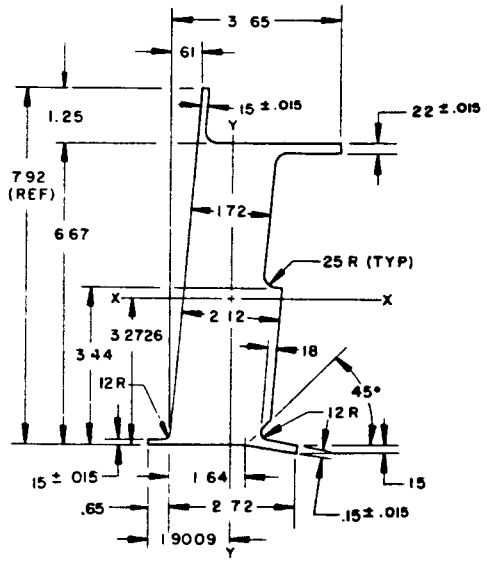
BAC1520

DASH NO.	DIE NO.	AREA
713	72588	1.500



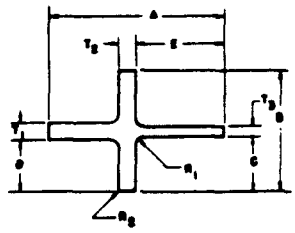
BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
921	54313 B	3.986	2.5105	2.8461



BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
992	54102 B	13.379	54.8340	5.4811

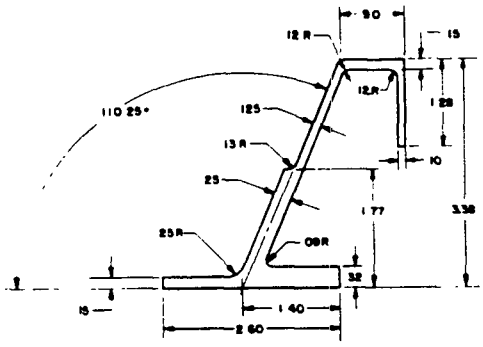


BAC1520

DASH NO.	DIE NO.	AREA	A	B	C	D	E	T1	T2	T3	R1	R2
706	72985	.4801	2.38	2.20	1.06	1.06	1.00	.08	.13	.08	.13	.016

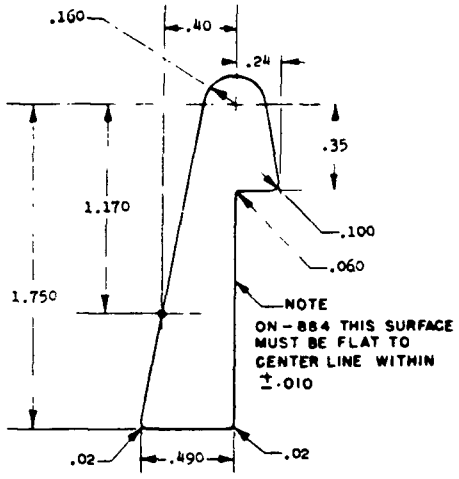
BAC1520

DASH NO.	DIE NO.	AREA
694	16183 R	1.483



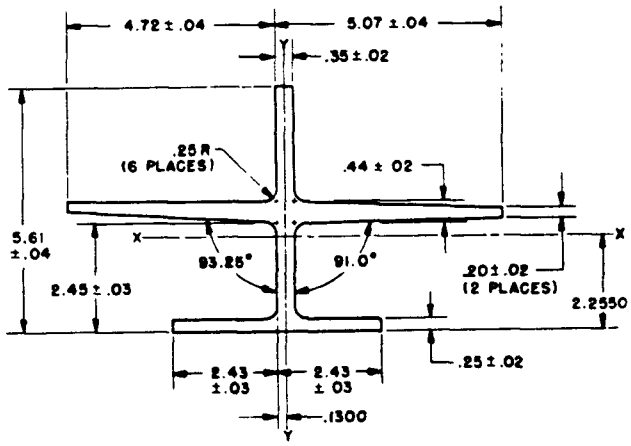
BAC1520

DASH NO.	DIE NO.	AREA
884	29755 H	.6930



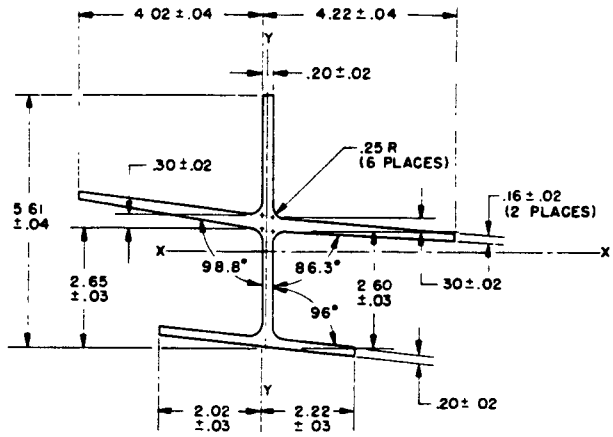
BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
887		6.819518	11.4889	23.1934



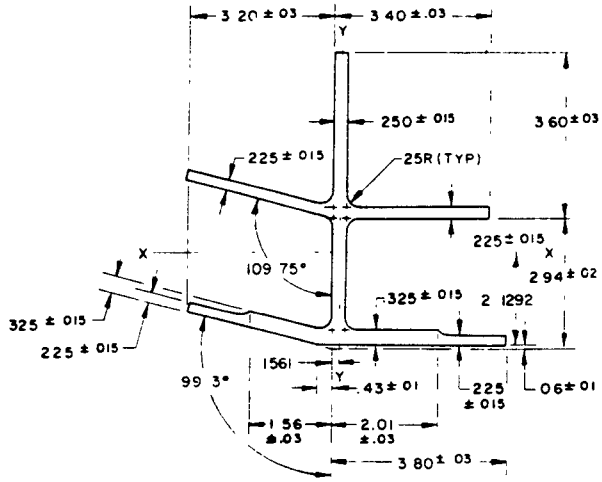
BAC1520

DASH NO.	DIE NO.	AREA
888		3.683902



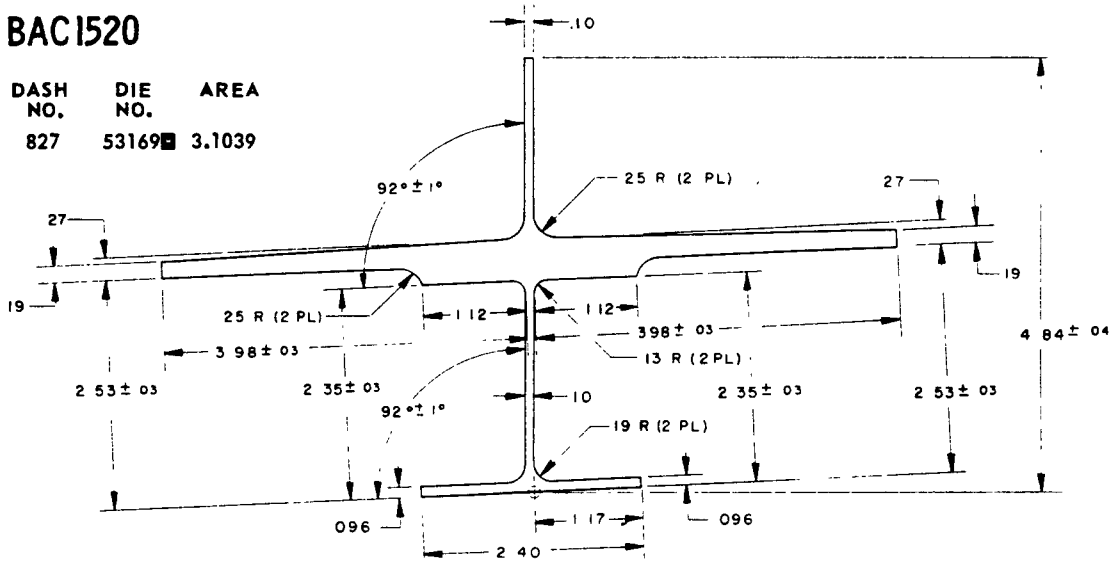
BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
1009		5.0405	16.6792	12.4213



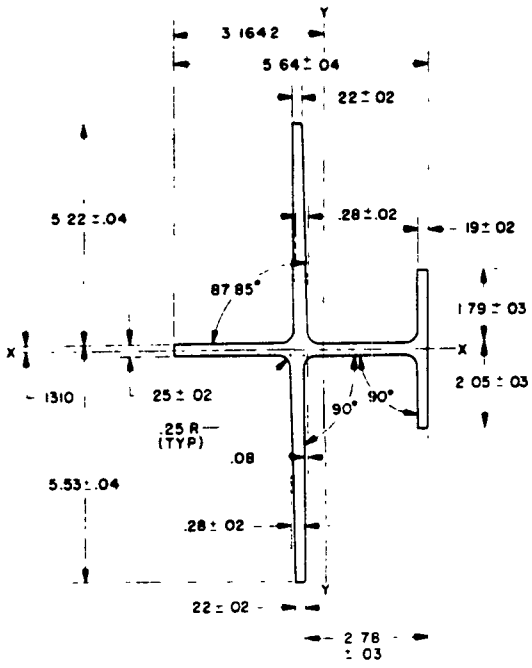
BAC1520

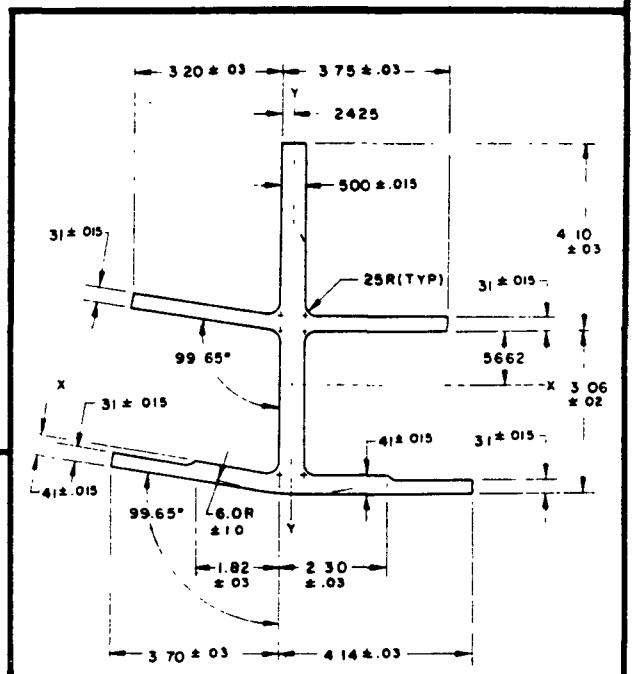
DASH NO.	DIE NO.	AREA
827	53169■	3.1039



BAC1520

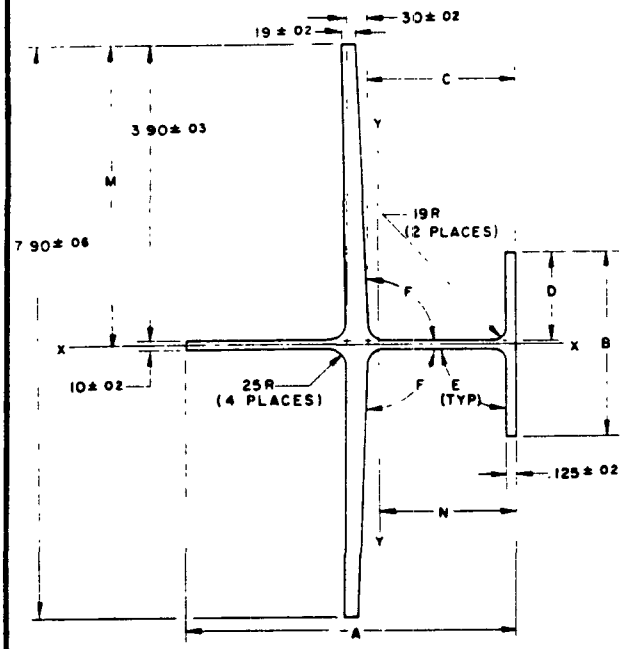
DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
890		4.78941	24.9714	8.3683





BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
886		8.3383	33.6800	21.7854



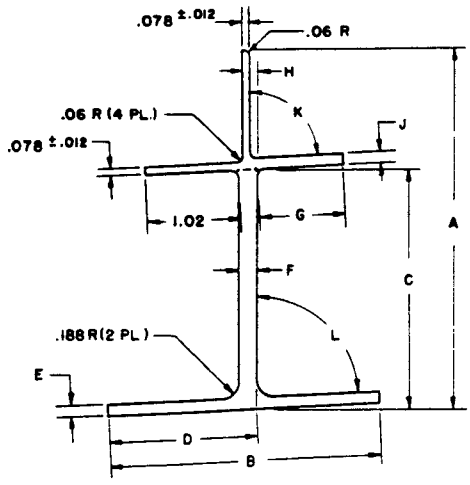
BAC1520

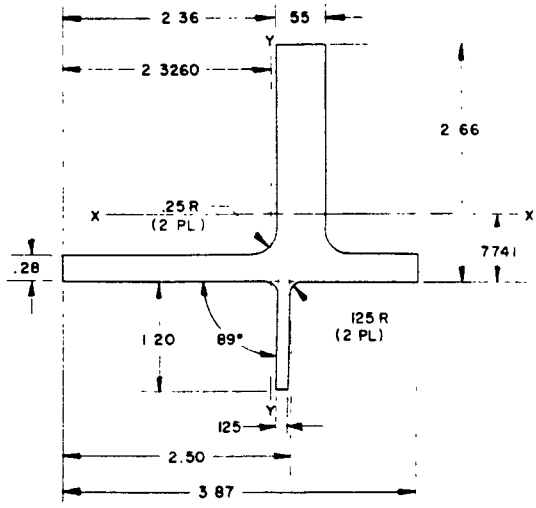
DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	I_{xx}	I_{yy}	M	N
702	69951	2.785	4.80	2.70	2.14	1.30	90°	92.08°	9.2867	2.5017	3.9500	2.0640
704	69952	2.713	4.35	2.50	2.33	1.20	90°	92.27°	8.9845	2.3332	3.9500	2.1833

53110 B

BAC1520

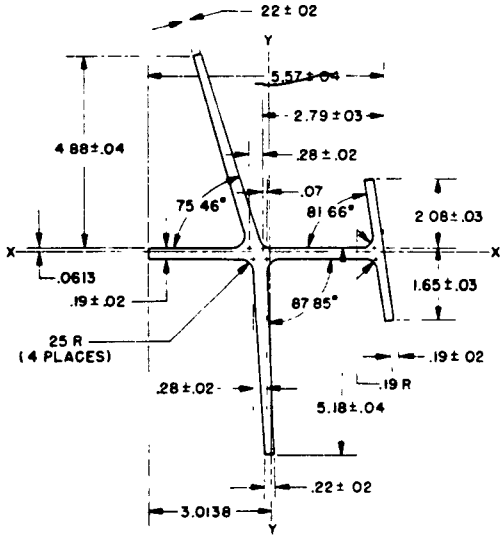
DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	H	J	K	L
797	H-2810	1.177	4.02	3.00	2.65	1.64	.125	.20	.94	.15	.10	87.50°	87.50°





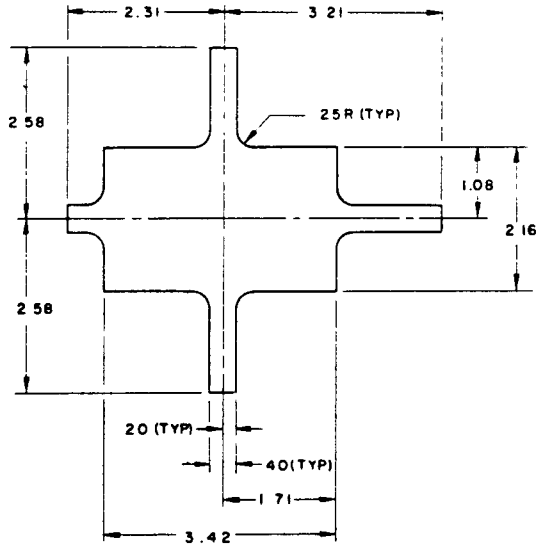
BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
991		2.5748	2.0138	1.6851



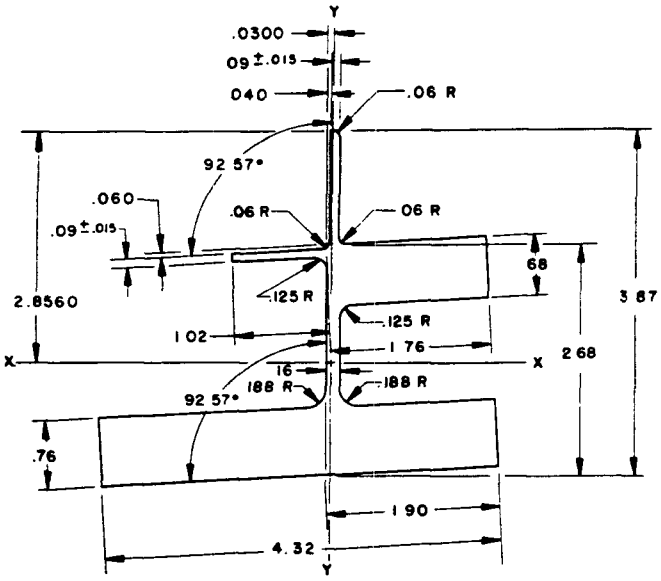
BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
889		4.26725	20.6640	8.1476



BAC1520

DASH NO.	DIE NO.	AREA
857	53572	9.525

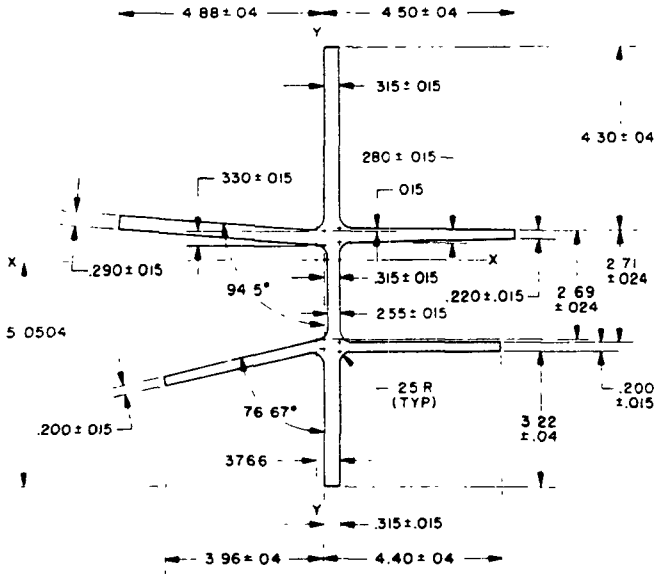


BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
949	54087	4.9063	4.5972	6.5480

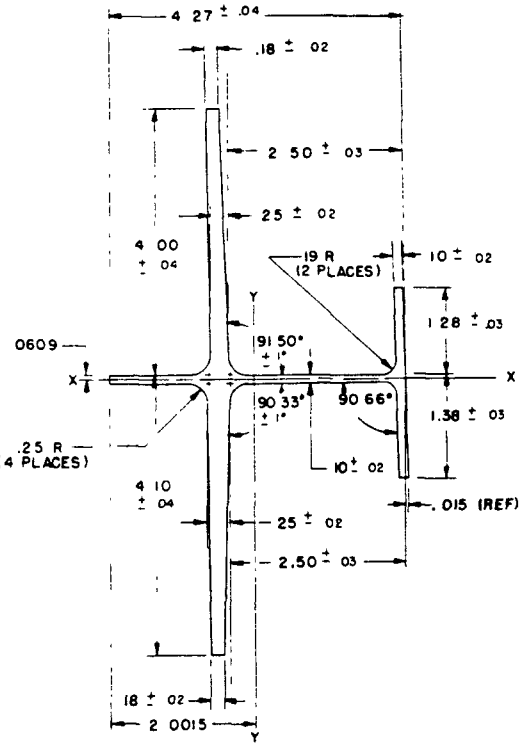
BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
891		7.455272	38.8924	28.7354



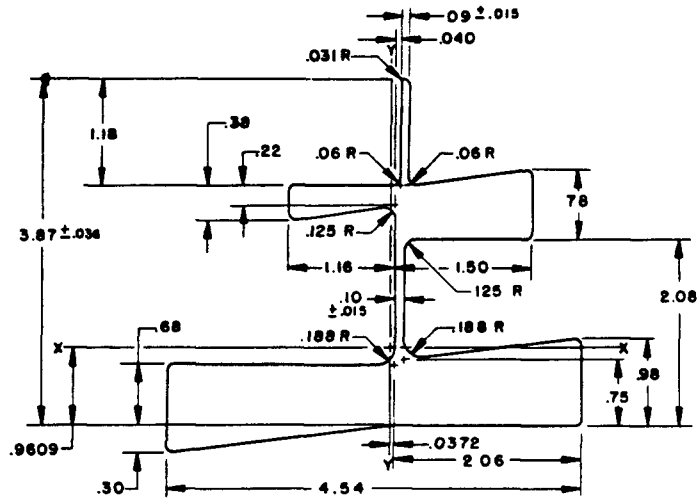
BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
929	54086	2.4571	8.7691	2.2203



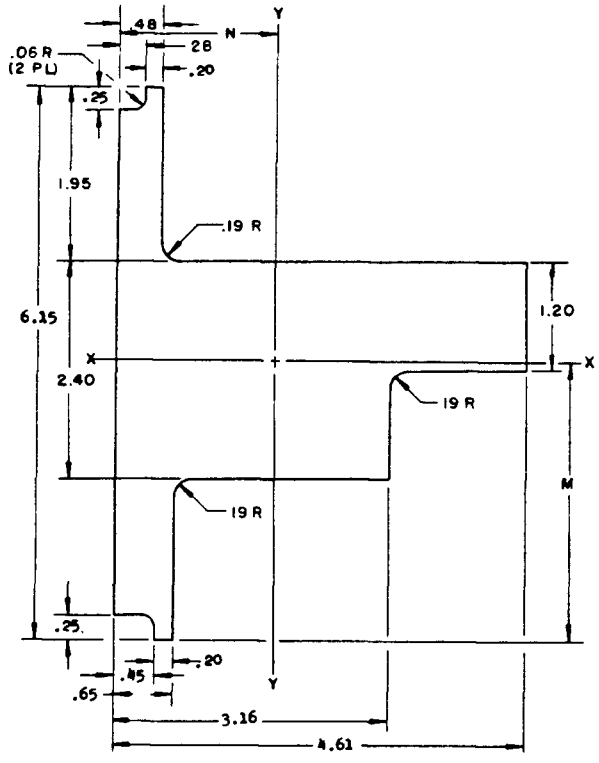
BAC1520

DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
950	54088 B	5.476	5.4148	8.1403



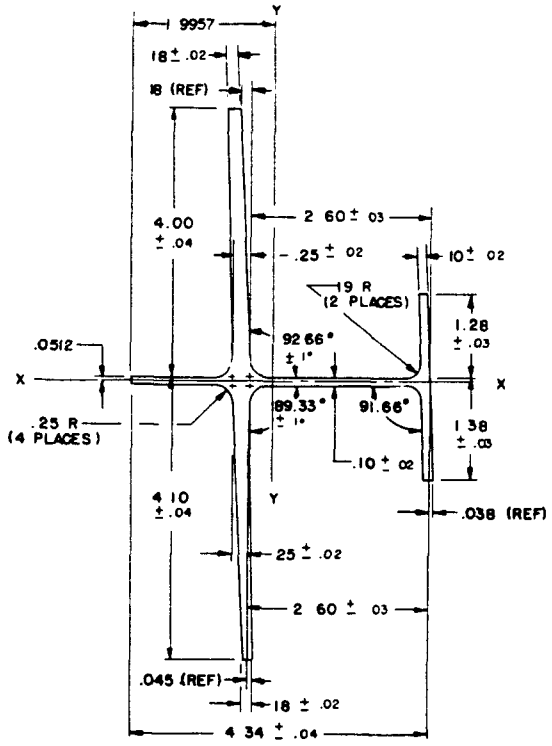
BAC1520

DASH NO.	DIE NO.	AREA
817	73870	11.270



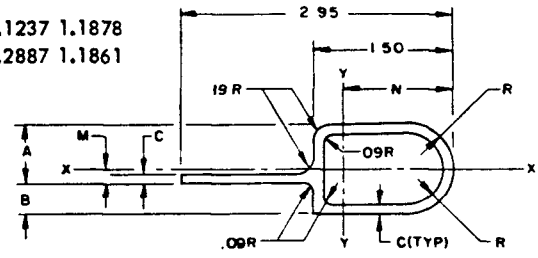
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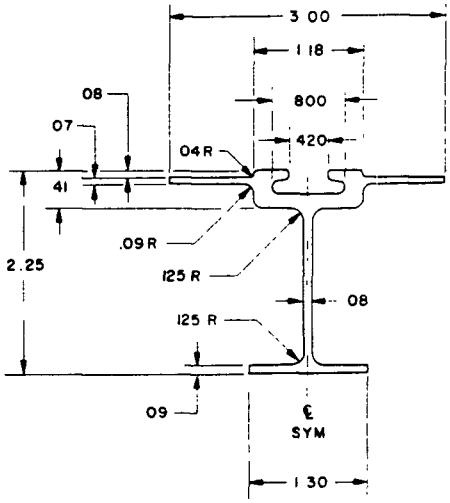
DASH NO.	DIE NO.	AREA	I_{xx}	I_{yy}
928	86178	2.4768	8.8873	2.4277

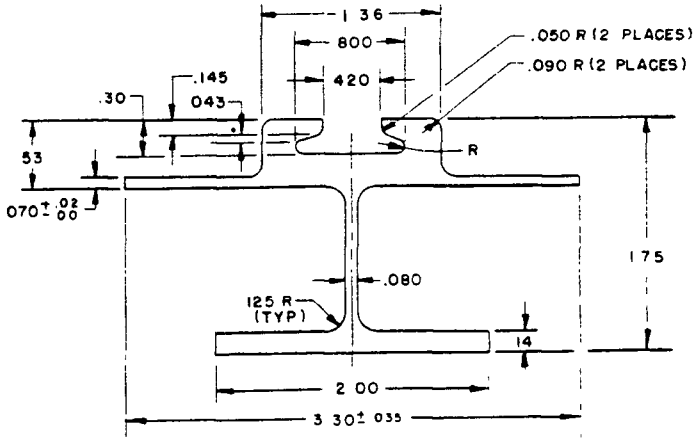


BAC1520

DASH NO.	DIE NO.	AREA	A	B	C	Ixx	Iyy	M	N
753	74529	.571	.66	.34	.10	.0598	.3462	.1237	1.1878
752	71348	.460	.89	.11	.08	.0587	.2782	.2887	1.1861

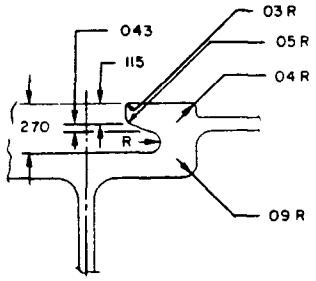






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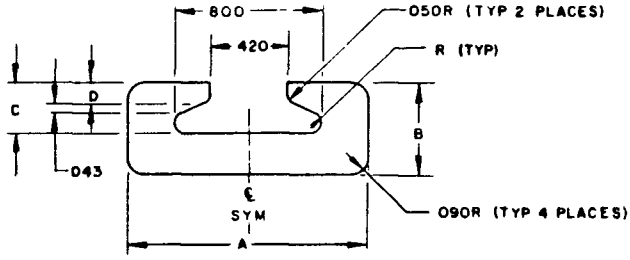
DASH NO.	DIE NO.	AREA
792	71957 53328 B	1.0650

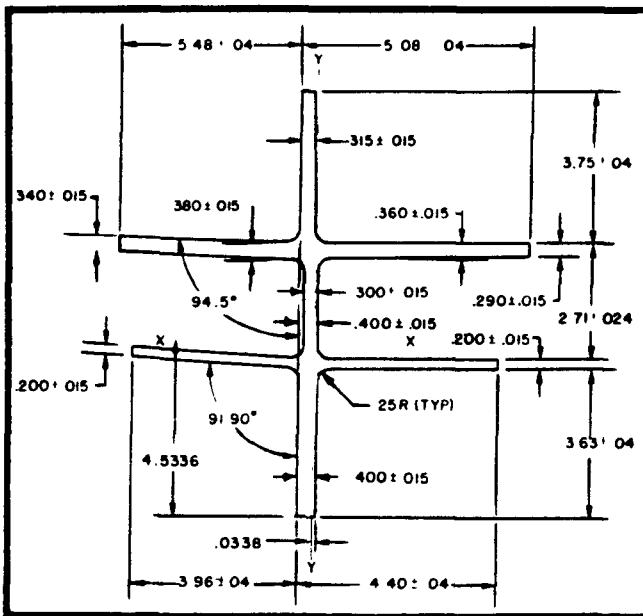


BAC1520

DASH NO.	DIE NO.	AREA
843	80472	.7158

DASH NO.	DIE NO.	AREA	A	B	C	D
841	71954	.538202	1.360	.530	.300	.145
1336	T-12542 X	.594	1.360	.57	.300	.145



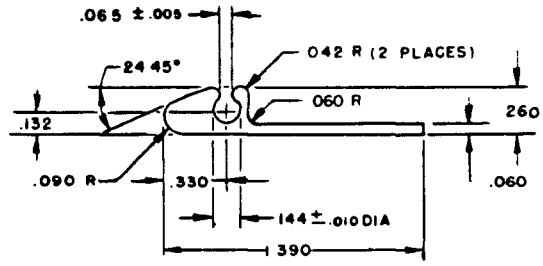


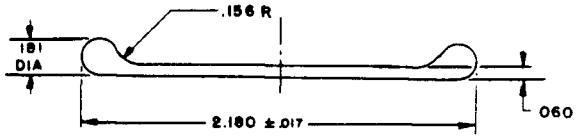
BAC1520

DASH NO.	AREA	Ixx	Iyy
892	8.788532	40.3126	43.1545

BAC1520

DASH NO.	AREA
793	.1327



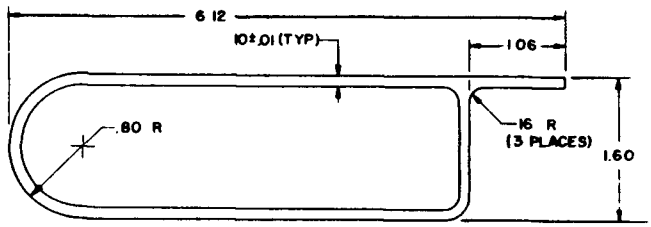


BAC1520

DASH NO.	DIE NO.	AREA
794		.1688

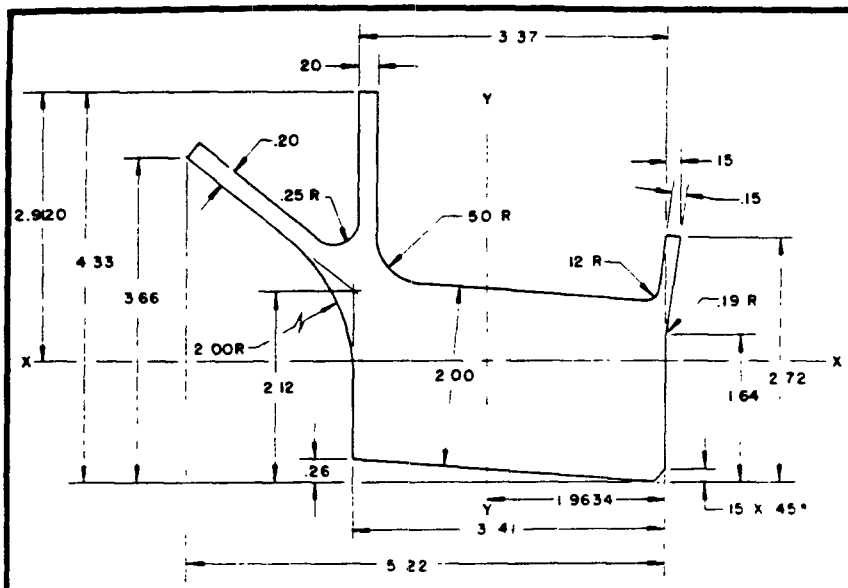
BAC1520

DASH NO.	AREA
1067	1.34379



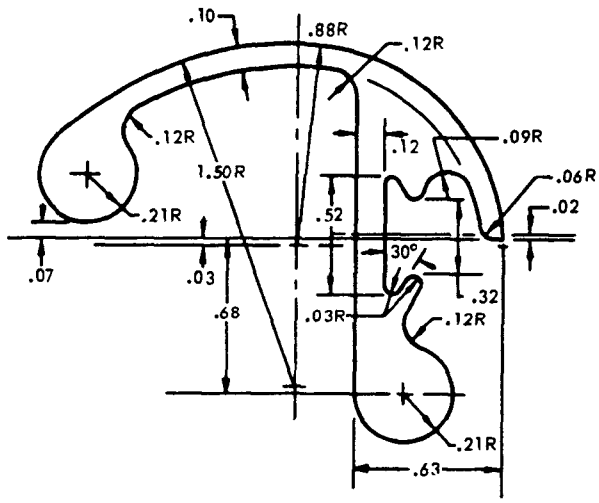
BAC1520

DASH NO.	AREA	Ixx	Iyy
951	8.0308	5.9251	11.2491



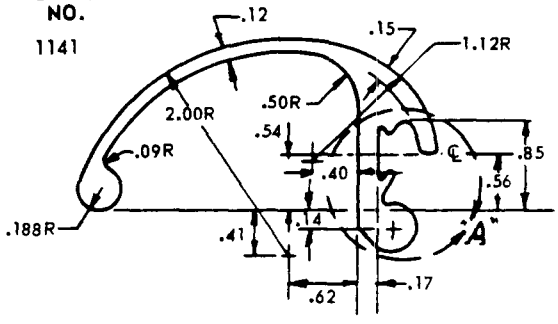
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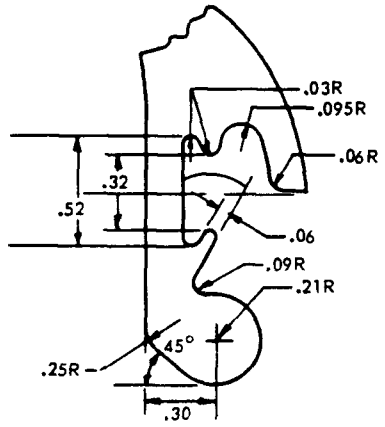
DASH NO.
1155



BAC1520

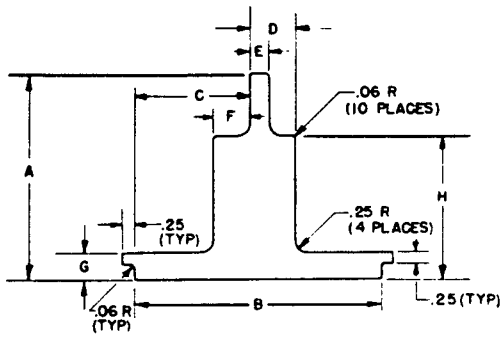
DASH NO.
1141

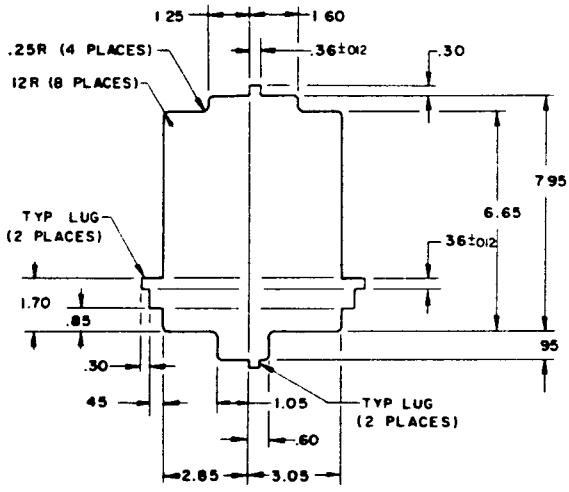




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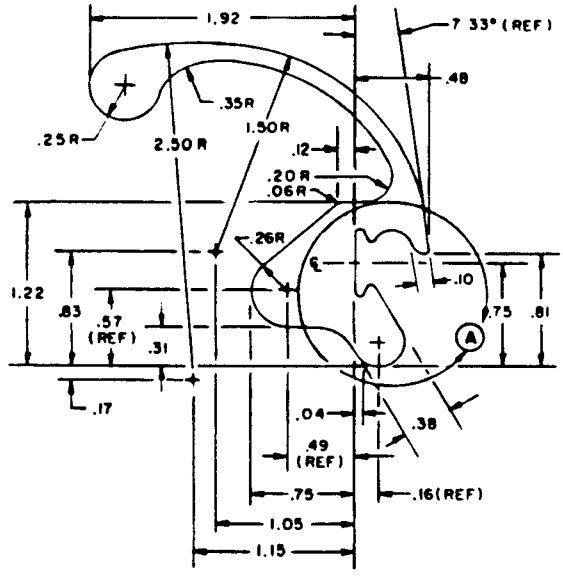
DASH NO.	DIE NO.	AREA	A	B	C	D	E	F	G	H
734	16189 R	8.8285	4.70	5.36	2.58	.98	.40	.88	.60	3.20
820	16972 R	3.2995	5.20	6.16	2.98	1.40	.40	1.30	.70	3.75





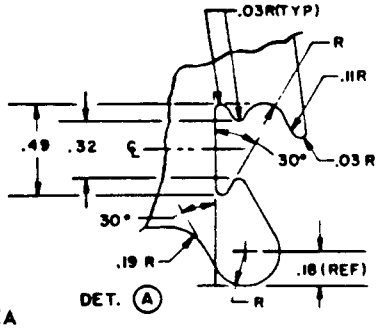
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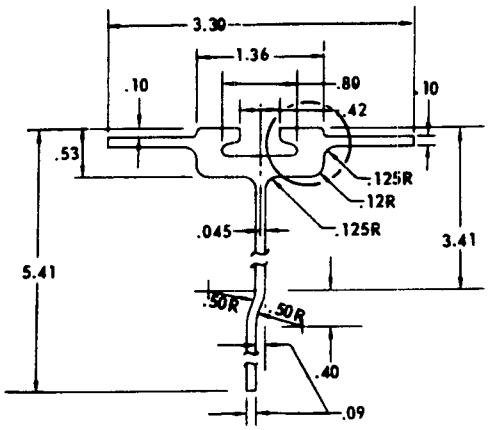
DASH NO.	DIE NO.	AREA
868	81909	45.733



BAC1520-1142

DASH NO.	DIE NO.	AREA
1142	36349	13100

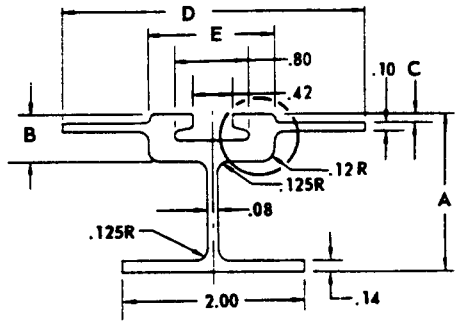




BAC1520

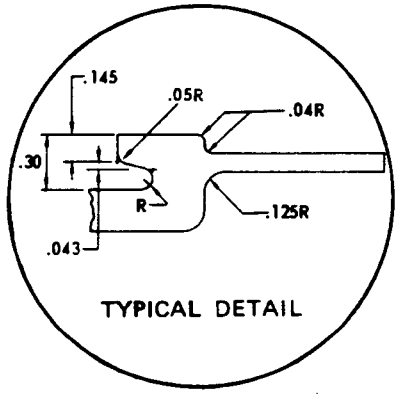
DASH NO.

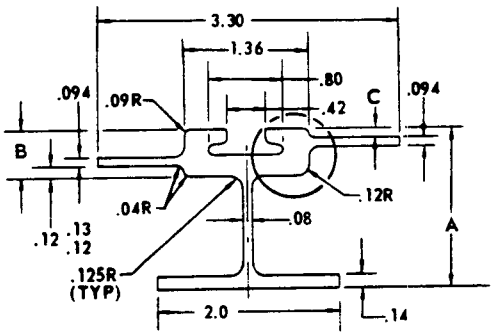
1224



BAC1520

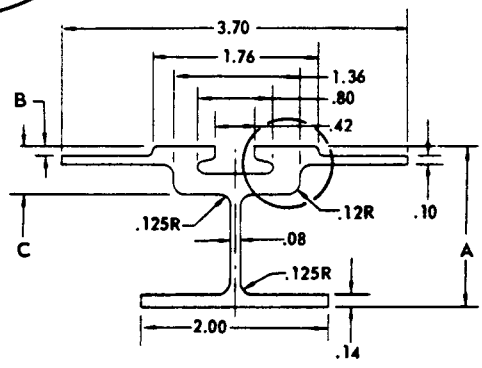
DASH NO.	A	B	C	D	E
1251	1.75	.53	.10	3.30	1.36
1338	1.79	.57	.14	3.30	1.36
1250	1.75	.53	.10	3.70	1.76





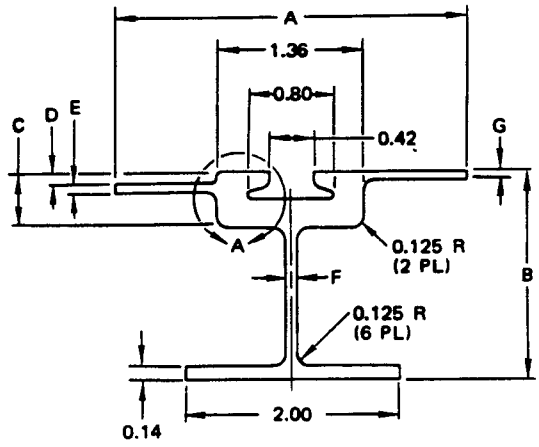
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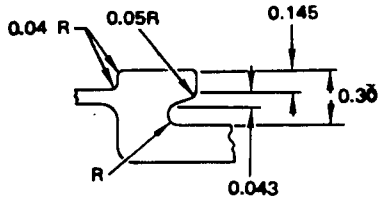
DASH NO.	A	B	C
1257	1.75	.53	.10
1337	1.79	.57	.14



BAC1520

DASH NO.	A	B	C
1264	1.75	.10	.53
1340	1.79	.14	.57





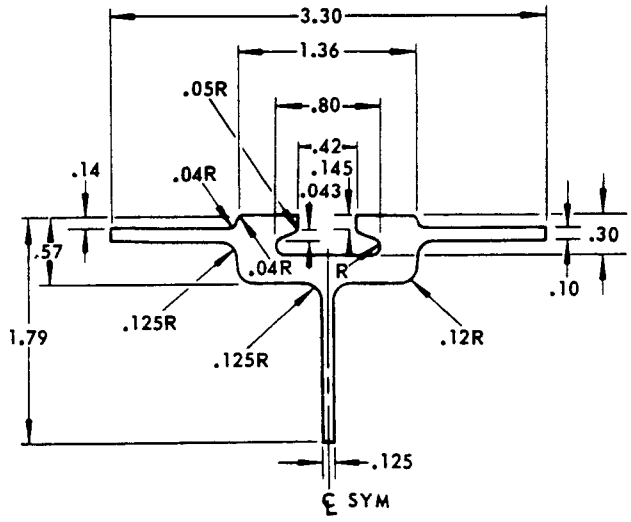
DETAIL A

BAC 1520

DASH NUMBER	A	B	C	D	E	F	G
1221	3.30	1.75	.53	.10	.080	.080	.10
1339	3.30	1.79	.57	.14	.080	.08	.14

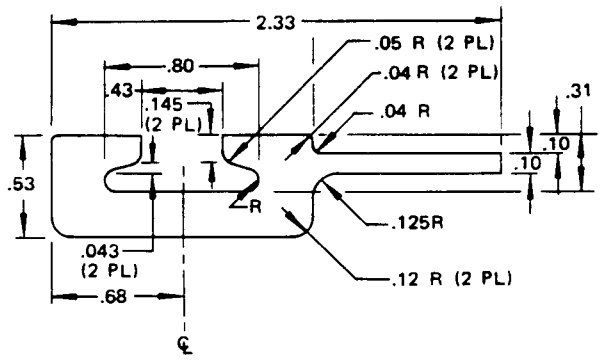
BAC1520

DASH NO.	DIE NO.	AREA
1341		



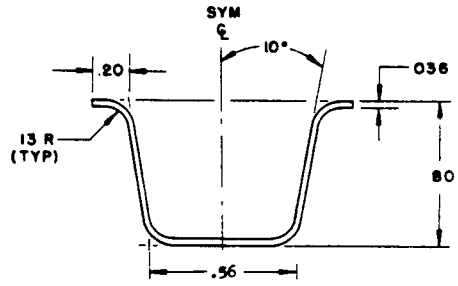
BAC1520

DASH NO.
1433



BAC1650

DASH NO.	DIE NO.	AREA
2		.0777



NONMETALLIC MATERIAL

1. General

A. This subject lists materials used when making repairs contained within this manual, and sources of supply. These materials are also called out with the applicable repair information. The purpose of this list is to show which subject the materials are used in and if they are common to more than one subject. The materials listed are not only those used in the actual repair, but also those used for preparation and accomplishment.

B. Refer to the following figures for lists of materials:

Protective Coatings, Sealants, Adhesives and Cleaners. . . .Figure 1
Fiberglass and Plastics. . . . . .Figure 2
Abrasives. . . . . .Figure 3

MATERIAL	SUBJECT															SUPPLIER
	51-2-8	51-8-0	51-8-1	51-9-1	51-9-2	51-10-1	51-10-2	51-10-3	51-11-1	51-13-1	53-1-3	54-2-1	57-2-2	57-2-3		
MATERIALS FOR PROTECTIVE TREATMENT																
ALODINE 1000		X														A
ALODINE 1200		X	X							X		X				A
ALODINE 1200S		X														A
TURCO PREPAINT		X														B
KELITE POLYCOTE		X														C
PHOSPHORIC ACID		X														—
BUTYL CELLOSOLVE		X														—
TRITON X-100 WETTING AGENT		X														—
MIL-P-8585 ZINC CHROMATE PRIMER		X														—
MIL-C-11796 CLASS 3 CORROSION PREVENTATIVE COMPOUND		X														—
BMS 10-11 TYPE 1 PRIMER		X		X		X										D E
EC 843 SPRAY TOPCOAT		X														F
BMS 10-20:																
PR 1560																G
DESOTO 823-010																E
FINCH 454-4-1																D
LPS-3 CORROSION PREVENTING COMPOUND		X														AI
SEALANTS																
BMS 5-26 CLASS A:				X						X			X			
PRO-SEAL 890 A-1/2 OR A-2											X		X			H
PR 1422 A-1/2 OR A-2													X			G
PR 1440 A-2																G
BMS 5-26 CLASS B:													X			
PRO-SEAL 890 B-1/2 OR B-2				X						X	X					H
BMS 5-63 CLASS B:																
093-004																J
BMS 5-79:				X			X			X	X					
PRO-SEAL 898 B-1/2, B-2, B-8, C-24, C-48 OR D-2																H
3C414 B-2 OR B-4											X					I
PR1431G TYPE 1											X					G

MATERIAL	SUBJECT															SUPPLIER
	51-2-8	51-8-0	51-8-1	51-9-1	51-9-2	51-10-1	51-10-2	51-10-3	51-11-1	51-13-1	53-1-3	54-2-1	57-2-2	57-2-3		
SEALANTS (CONTINUED)																
BMS 5-95 CLASS B										X						
PR 1436G B-2																G
PRO-SEAL 870 B-2																H
BMS 5-95 CLASS C				X												
PR 1436G TYPE 1										X						G
PRO-SEAL 870 C-20																H
93-007-1/8				X												J
EC 5922				X												F
ADHESIVE COMPONENTS																
BMS 5-14	X															
PRO-SEAL 590M																M
M6249																K
BMS 5-28 TYPE 1						X										
EPOCAST 167 WITH EPOCAST 9832 HARDENER																L
BMS 5-28 TYPE 2																
EPOCAST 168 WITH EPOCAST 995 HARDENER																L
BMS 5-28 TYPE 3																
EPOCAST 1511 WITH EPOCAST 9614 HARDENER									X							L
BMS 5-28 TYPE 5							X		X							
DS-20-62 RESIN AND HARDENER																M
XA8-H399 WITH XH-H400 HARDENER																N
EPOCAST 8219 MOD 11A WITH EPOCAST 8219-111-B HARDENER																L
MAGNABOND 79-4M PARTS A AND B																Q
BMS 5-29 TYPE 1																
EPON 823 AND EPON 812 MIXED WITH VERSAMID 115 AND VERSAMID 125						X			X							P Q
KIT 80055-30 OR 80055-31																P
BMS 5-29 TYPE 2																
HYSOL 4405 WITH HYSOL 3538																N
SACO 2862 COMPONENTS 1 AND 2																S
522 WITH 542																T
183-C-417 WITH 183-C-418																U
J1170-1 WITH E-18-1																V
BMS 5-51 TYPE 2, GRADE 5									X							
AF 126 OR AF126-2																F
BMS 5-126 ALL TYPES						X			X							T V AJ AK AL AM
EPON 828 WITH CURING AGENT T									X							P
EPON 815 WITH CURING AGENT T									X							P
EPOCAST 1835 WITH EPOCAST 9816 HARDENER									X							L
EPOCAST 1835 WITH EPOCAST 951 HARDENER									X							L
EPOCAST 1835 WITH EPOCAST 946 HARDENER									X							L
EPOCAST 156 WITH EPOCAST 941 HARDENER																L
EPOCAST 8442 MOD III WITH EPOCAST 8442B HARDENER																L

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 2)

MATERIAL	SUBJECT																SUPPLIER
	51-2-8	51-8-0	51-8-1	51-9-1	51-9-2	51-10-1	51-10-2	51-10-3	51-11-1	51-13-1	53-1-3	54-2-1	57-2-2	57-2-3			
ADHESIVE COMPONENTS (CONTINUED)																	
EPOCAST 991A WITH EPOCAST 941 HARDENER									X								[I]
EPOCAST 1835 WITH EPOCAST 146 HARDENER									X								[L]
REFCOA EPOXY RESIN 87-3 (PART A) WITH REFCOA HARDENER QX-2648-T (PART B)									X								[W]
RESIN NO. 49X2 WITH MEK PEROXIDE									X								[X]
RESIN 5318S WITH RESIN 8318C HARDENER																	[Y]
EPOX-O-WELD									X								[Y]
EPO TEK 417F PARTS A AND B																	[Z]
LAMINAC 4146																	[AA]
LAMINAC 4147																	[AA]
PLASKON 951																	[AB]
LUPERCO ATC CATALYST																	[AC]
GAROX BZP CATALYST																	[AD]
LUPERCOL DDM CATALYST																	[AC]
GAROX MEK CATALYST																	[AD]
COBALT NAPHTHALATE 6% COBALT SOLUTION																	—
ANTIMONY TRI-OXIDE FIRE INHIBITOR																	—
EC 2216 B/A				X							X						[J]
ADHESIVE PRIMERS																	
EC 776 SR					X	X											[F]
RTV 1200				X													[J]
DESOTO 513-707 WITH 910-787 CURING SOLUTION AND 020-702 THINNING SOLVENT				X							X						[I]
BMS 5-89 (CIAP)																	
BR-127				X	X												[AN]
EC-3950																	[F]
SOLVENTS AND CLEANERS																	
METHYL ETHYL KETONE (MEK)	X		X		X				X								—
METHYL ISOBUTYL KETONE (MIBK)			X	X		X											—
ACETONE									X								—
TRICHLORETHYLENE			X														—
BMS 11-5 TYPE 1																	
T-4127																	[B]
75-C-252																	[U]
BMS 11-7								X						X			
PPL-307-56																	[S]
T-2279A																	[AE]
TURCO 4460																	[B]
FORMULA NO. C32																	[AF]
PRE-SEALING CLEANING SOLVENT T825														X			[AG]
TL 4119																	[U]

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 3)

[A] AMCHEM PRODUCTS INCORPORATED
SPRING GARDEN STREET
AMBLER, PENNSYLVANIA

[B] TURCO PRODUCTS INCORPORATED
24600 S. MAIN STREET
CARSON, CALIFORNIA 90749

[C] RITCHARDSON CHEMICAL CO.,
ALLIED-KELITE PRODUCTS DIV.
1250 N MAIN STREET
LOS ANGELES, CALIFORNIA 90051

[D] FINCH PAINT AND CHEMICAL COMPANY
20846 S. NORMANDY
TORRANCE, CALIFORNIA 90502

[E] DE SOTO CHEMICAL COATINGS
INCORPORATED
FOURTH AND CEDAR STREETS
BERKELEY, CALIFORNIA 94710

[F] MINNESOTA MINING AND MANUFACT-
URING COMPANY
3M CENTER STREET
ST. PAUL, MINNESOTA 55101

[G] PRODUCTS RESEARCH AND CHEMICAL
CORPORATION
2919 EMPIRE AVENUE
BURBANK, CALIFORNIA 91504

[H] TELEDYNE COAST PRO-SEAL & MANU-
FACTURING CO.,
19451 SUSANA ROAD
COMPTON, CALIFORNIA 90221

[I] CHURCHILL CHEMICAL CORPORATION
3137 E 26TH STREET
LOS ANGELES, CALIFORNIA 90023

[J] DOW CORNING CORPORATION
S SAGINAW ROAD
MIDLAND, MICHIGAN 48641

[K] UNIROYAL INCORPORATED
312 N HILL STREET
MISHAWKA, INDIANA 46544

[L] FURANE PLASTICS INCORPORATED
5121 SAN FERNANDO ROAD W
LOS ANGELES, CALIFORNIA 90039

[M] REN PLASTICS INCORPORATED
5656 S CEDAR STREET
LANSING, MICHIGAN 48909

[N] HYSOL CORPORATION OF CALIFORNIA
9640 TELESTAR AVENUE
EL MONTE, CALIFORNIA 91731

[O] MAGNOLIA PLASTICS INCORPORATED
5547 PEACHTREE INDUSTRIAL BLVD.,
CHAMBLEE, GEORGIA 30005

[P] SHELL CHEMICAL COMPANY
9901 PARAMOUNT BLVD.,
DOWNEY, CALIFORNIA 90240

[Q] GENERAL MILLS INCORPORATED
P.O. BOX 191
KANKAKEE, ILLINOIS 60901

[R] FENWALL INCORPORATED
400 MAIN STREET
ASHLAND, MASSACHUSETTS 01721

[S] SHERWOOD SOLVENTS., INC
P.O. BOX 8147
WICHITA, KANSAS

[T] TECHNICAL RESEARCH COMPANY
13635 MONSTER ROAD S
SEATTLE, WASHINGTON 98178

[U] FULLER-OBRIEN CORPORATION
450 E GRAND AVE S
SAN FRANCISCO, CALIFORNIA 94080

[V] TA CON
55 NORTH STREET
MEDFORD, MASSACHUSETTS 02155

[W] KING FIBERGLASS CORPORATION
366 W. NICKERSON ST.
SEATTLE, WASH. 98119

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 4)

[X] SYNRES CHEMICAL CORP
1211 N GLIVE P O BOX 3400
ANAHEIM, CALIFORNIA 92807

[Y] FIBER-RESIN CORPORATION
170 W PROVIDENCIA
BURBANK, CALIFORNIA 91502

[Z] EPOXY TECHNOLOGY
65 GROVE STREET
WATERTOWN, MASSACHUSETTS 02172

[AA] AMERICAN CYANAMID CORPORATION
PLASTICS DIVISION
BERDAN AVENUE
WAYNE, NEW JERSEY 07472

[AB] ALLIED CHEMICAL CORPORATION
P.O. BOX 132 M
MORRISTOWN, NEW JERSEY 07960

[AC] PENNWALT CORPORATION
CHEMICAL SPECIALTIES
2700 SO. EASTERN AVE.,
LOS ANGELES, CALIF. 90022

[AD] RAM CHEMICALS INCORPORATED
210 E ALONDRA BLVD
GARDENA, CALIFORNIA 90247

[AE] ENMAR INCORPORATED
630 E 13TH
ANDOVER, KANSAS 67002

[AF] COMMERCIAL CHEMICAL COMPANY INC.
20 PROVICE ST.
BOSTON, MASS. 02116

[AG] ANDREW BROWN CO.,
P.O. BOX 22066
LOS ANGELES, CALIFORNIA 90040

[AH] DELETED

[AI] LPS LABORATORIES INC
2040 COTNER AVE
LOS ANGELES, CALIFORNIA 90025

[AJ] HYSOL DIVISION
THE DEXTER CORPORATION
FRANKLIN STREET
OLEAN, NEW YORK 14760

[AK] AMERICAN MINERAL SPIRITS CO.,
2100 E. 37TH STREET
WICHITA, KANSAS 67208

[AL] FULLER O'BRIEN CORP
450 E. GRAND AVENUE
SOUTH SAN FRANCISCO, CA 94080

[AM] M&T CHEMICALS, INC.,
FUNCTIONAL PLASTICS DIVISION
5121 SAN FERNANDO ROAD W.,
LOS ANGELELS, CA 90039

[AN] AMERICAN CYANAMID
BLOOMINGDALE DIVISION
HARVE DE GRACE
MARYLAND, 21078

Protective Coatings, Sealants, Adhesives and Cleaners
Figure 1 (Sheet 5)

MATERIAL	SUBJECT															SUPPLIER
	51-9-2	51-10-1	51-10-2	51-10-3	51-11-1	51-13-1										
NONMETALLIC HONEYCOMB																
BMS 8-124 CLASS 1 TYPE 1 GRADE 4.0:		X														
HRP 3/16 - 4.0																[A]
HRP B 3/16 - 4.0																[A]
BMS 8-124 CLASS 1 TYPE 1 GRADE 5.5:																
HRP 3/16 - 5.5																[A]
HRP B 3/16 - 5.5																[A]
BMS 8-124 CLASS 1 TYPE 1 GRADE 9.0:																
HRP 3/16 - 9.0																[A]
HRP B 3/16 - 9.0																[A]
HRH-10/F50-5.0					X											[A]
HRP 3/16-5.5					X											[A]
HRP 3/16-11					X											[A]
FIBERGLASS CLOTH																
STYLE 120, VOLAN A FINISH																[B][C][D][E][L][M]
STYLE 181 OR 1581, VOLAN A FINISH	X	X			X											[B][C][D][E][L][M]
STYLE 182, VOLAN A OR GARAN RS49 FINISH																[B][C][D][E][L][M]
BMS 8-79 CLASS II EPOXY PREPREG					X											[H][I]
FIBERGLASS MAT, BINDER TYPE NO. 216																[F]
BMS 9-3 TYPE D.H.H2 CLASS 7						X										—
FILLERS FOR RESIN MIXES																
MILLED GLASS FIBERS, 1/32 INCH LENGTH		X			X											[F]
PHENOLIC MICROBALLONS BJO-0930		X			X											[G]
BLEEDER CLOTH																
OSNABURG CLOTH UNBLEACHED CCC-C-429		X			X											—
PARTING FILMS AND VACUUM BAG MATERIAL																
PARTING FILM	X	X		X	X											
POLYVINYL CHLORIDE (PVC)			X													[J]
POLYVINYL FLUORIDE (PVF) (TEDLAR)					X											[K]
FLUOROCARBON (FEP OR TFE)																
POLYVINYL ALCOHOL (PVA)	X	X	X		X											[J]
POLYETHYLENE (PE)			X													
MYLAR					X											[J]
CELLOPHANE																
VACUUM BAG FILM																
POLYVINYL ALCOHOL (PVA)																
NYLON																
MYLAR																
POLYVINYL FLUORIDE (PVF) (TEDLAR)					X											
CHROMATE TAPE					X											

NOTES

[A] HEXCEL CORPORATION
VALLEY INDUSTRIAL PARK
P.O. BOX 961
CASA GRANDE, ARIZONA 85222
OR
HEXCEL CORPORATION
338 NORTH PENNSYLVANIA
GRAHAM, TEXAS 76046

[B] UNIGLASS INDUSTRIES
1407 BROADWAY
NEW YORK, N.Y. 10018

[C] CLARK-SCHWEBEL
INTERNATIONAL S. A.
BATTICE, BELGIUM

[D] BURLINGTON INDUSTRIAL
FABRICS COMPANY
DIVISION OF BURLINGTON
INDUSTRIES
1345 AVE. OF THE AMERICAS
NEW YORK, NEW YORK 10019

[E] J.P. STEVENS AND COMPANY INC.
BROADWAY AT 41ST
NEW YORK, NEW YORK 10036

[F] OWENS CORNING FIBERGLAS CORP.
608 MADISON AVE.
TOLEDO, OHIO 43604

[G] UNION CARBIDE CANADA, LTD.
PLASTICS AND CHEMICALS DIV.
BELLEVILLE, ONTARIO
CANADA

[H] U.S. POLYMERIC INC.
700 EAST OYER ROAD
SANTA ANA, CALIFORNIA 92707

[I] WHITTAKER CORPORATION
NARMCO MATERIALS DIVISION
600 VICTORIA ST.
COSTA MESA, CALIFORNIA 92627
OR
WHITTAKER CORPORATION
NARMCO MATERIALS DIVISION
1440 N. KRAMER
ANAHEIM, CALIFORNIA 92806

[J] REYNOLDS METAL CO.
2819 FIRST AVE.
SEATTLE, WASH. 98121

[K] E.I. DUPONT DE NEMOURS & CO.
5500 UNION PACIFIC AVE.
LOS ANGELES, CALIF. 90022

[L] BAY MILLS, LTD.
365 EVANS AVENUE
TORONTO, CANADA M8Z 1K2

[M] HEXCEL CORP.
11711 DUBLIN BLVD
DUBLIN, CALIF. 94566

MATERIAL	SUBJECT															SUPPLIER
	51-8-1	51-10-1	51-11-1	51-13-1	54-2-1											
ABRASIVES																
ALUMINUM OXIDE ABRASIVE PAPER NO. 240 GRIT				X												—
ALUMINUM OXIDE ABRASIVE PAPER NO. 320 GRIT																—
ALUMINUM OXIDE ABRASIVE PAPER NO. 400 GRIT	X															—
SANDPAPER NO. 180 GRIT			X		X											—
EMERY CLOTH NO. 160 GRIT																—
TYCRO TYPE 3A ALUMINUM OXIDE WHEELS																[A]
SCOTCHBRITE PAD TYPE A, VERY FINE, ALUMINUM OXIDE																[A]
SILICONE CARBIDE CLOTH MESH NO. 400 GRIT																—
SPIRAPOINT CONES				X												[B]
ALUMINUM OXIDE DISCS FOR MUSHROOM SANDING PAD																[B]
ALUMINUM OXIDE ABRASIVE FOR DRUM SANDER				X												—
GRIND-O-FLEX SANDING WHEEL WITH NO. 180 GRIT ALUMINUM OXIDE ABRASIVE			X	X												[C]
EMERY WHEEL NO. 180 GRIT				X												—
NO. 180 GRIT FOR GRIT BLASTING																—
ALUMINUM WOOL	X			X												—
DUTCH HOUSEHOLD CLEANSER		X														—

NOTE

[A] MINNESOTA MINING AND MANUFACTURING CO.
3M CENTER ST.
ST PAUL, MINNESOTA 55101

[B] NORTON CO.
COATED ABRASIVE AND TAPE DIVISION
10TH AVE - 27TH ST.
TROY, N.Y. 12181

[C] MERIT ABRASIVE PRODUCTS, INC
5515 W 104TH ST
LOS ANGELES, CALIFORNIA 90009

AERODYNAMIC SMOOTHNESS

1. General

A. The 707 airplane requires an aerodynamically clean shape and smooth exterior for high performance. Unrepaired damage, unfilled dents or repairs which change the shape or roughen the surface will be reflected in reduced performance. Every effort should be made to maintain original contour and exterior surface smoothness. Exterior surface aerodynamic smoothness is classified in two categories: critical and noncritical areas. The critical areas are defined as those areas requiring a high degree of aerodynamic smoothness. Figure 1 illustrates the critical areas as follows:

(1) Wing leading edge rearward to 1 inch aft of rear spar skin splice joint - upper and lower surfaces.

(2) Vertical stabilizer leading edge rearward to 1 inch aft of rear spar skin splice joint - both sides.

(3) Horizontal stabilizer leading edge rearward to 1 inch aft of rear spar skin splice joint - upper and lower surfaces.

(4) Fuselage nose back to fuselage station 620.

(5) Front of the nacelle back to the 50% chord line of the nacelle strut. Both internal and external surfaces of the nose ring cowl. On airplanes with turbofan engines, surfaces of critical smoothness include the inner skin of the fan sleeve and the entire external surfaces of the cowl panel and aft translation sleeve.

The condition of the finish in critical areas is of considerable importance. See 51-2-0 of the Maintenance Manual for finish requirements. Protect the finish in critical upper surface areas as applicable, from scuffing or other damage due to foot traffic, by requiring the use of soft soled shoes when walking or working in these areas. Repair any scuffed finish in a critical area as soon as possible since the performance loss can be considerable.

B. The noncritical areas are considered as all other exterior surfaces of the airplane. The smoothness criteria that apply to permanent and temporary repairs in the various areas of the airplane are illustrated in Figure 1.

2. Joints - Critical Areas

A. Airplanes with Non-Turbofan Engines

(1) Skin joints are flush in the critical areas. Lap joints are permitted in the body provided they are parallel to the airstream. All other skin joints in the critical areas are butt joints. Maintain close tolerance control on fastener head flushness. Use aerodynamic smoother, BMS 5-13 per 51-3-0 of the Maintenance Manual to fill and fair window to fuselage skin gaps, wing skin gaps, and nonremovable bolts and screws in critical areas.

B. Airplanes with Turbofan Engines, JT3D

(1) Airplanes with turbofan engine installations have the same smoothness criteria as in A. above except for the more rigid requirements as indicated in tabulation figure 1.

3. Joints - Noncritical Areas

A. Airplanes with Non-Turbofan Engines

(1) In noncritical areas no special consideration is given to aerodynamic smoothness; however to all upper trailing edge joints, except around access panels, apply aerodynamic smoother. Chordwise lap joints are allowed aft of the wing rear spar and on control surfaces. Fastener flushness tolerances are greater in noncritical areas. No filler is required on skin joints, screws and bolt heads.

B. Airplanes with Turbofan Engines, JT3D

(1) Airplanes with turbofan engine installations have the same smoothness criteria as in A. above except for the more rigid requirements as indicated in tabulation figure 1.

4. Fastener Aerodynamic Flushness

A. Body Critical Areas, All Airplanes

(1) Fastener flushness tolerances to be maintained for aerodynamic smoothness in the critical areas of the body are as follows: Drive flush aluminum rivets, in countersunk skins from +0.002 to +0.007 protrusion and shave rivets to within +0.000 to +0.002 head protrusion. Drive hi-shear rivets, in countersunk skins, to within -0.003 to +0.003 head protrusion. Install heads of removable bolts and screws to within -0.003 to +0.003 head protrusion. Shear head rivets are to be driven as follows: 90% must be flush within -0.000 to +0.004; 10% may be flush within -0.005 to +0.007. Do not shave shear head rivets.

B. Body Noncritical Areas, All Airplanes

(1) Fastener flushness tolerances to be maintained for aerodynamic smoothness in noncritical areas of the body are as follows: Drive all aluminum rivets in countersunk skins to within +0.002 and +0.015 head protrusion. Drive hi-shear rivets in countersunk skins, to within -0.003 and +0.005 head protrusion. Install lockbolts in countersunk skins to within -0.003 to +0.005 head protrusion. Install removable bolts and screws to within -0.010 to +0.005 head protrusion. Shear head rivets are to be driven as follows: 90% must be flush within -0.000 to +0.005; 10% may be flush within -0.005 to +0.007. Do not shave shear head rivets.

C. Wing, Empennage, Nacelle and Strut Critical Areas, Airplanes with Turbojet Engines

(1) Fastener flushness tolerances to be maintained for aerodynamic smoothness in critical areas of the wing, empennage, nacelles and struts are as follows: Drive all rivets in countersunk skins, to within +0.001 to +0.003 head protrusion. Install lockbolts so that 90% are flush with -0.003 to +0.003, 10% may be flush within -0.005 to +0.003. Drive hi-shear rivets so that 90% are flush within -0.003 to +0.003, 10% may be flush within -0.005 to +0.003. Drive shear head rivets so that 90% are flush within -0.000 to +0.003: 10% may be flush within -0.005 to +0.006. Do not shave shear head rivets. Install nonremovable screws and bolts -0.000 to 0.015 below the skin to allow for aerodynamic filler. Install removable screws and bolts to within -0.010 to +0.002 head protrusion; no aerodynamic filler is to be used. NACA (82°) type rivets in the integral tank areas shall be driven to fill countersink and shaved down +0.001 to +0.003 protrusion. On nose cowls, install 5/32 diameter aluminum alloy lockbolts so that they are flush from -0.002 to +0.003. Do not shave the protruding head of a 5/32 diameter aluminum lockbolt more than 0.005.

D. Wing, Empennage, Nacelle and Strut Critical Areas, Airplanes with Turbofan Engines.

(1) Fastener flushness tolerances to be maintained for aerodynamic smoothness in critical areas of wing, empennage, nacelles and struts are as follows: Drive all rivets in countersunk skins, to within +0.001 to +0.003 head protrusion. Install lockbolts so that 90% are flush with -0.003 to +0.003, 10% may be flush within -0.005 to +0.003. Drive hi-shear rivets so that 90% are flush within -0.003 to +0.003, 10% may be flush within -0.005 to +0.003. Drive shear head rivets so that 90% are flush within -0.000 to +0.003: 10% may be flush within -0.005 to +0.006. Do not shave shear head rivets. Install nonremovable screws and bolts -0.000 to 0.015 below the skin to allow for aerodynamic filler. Install removable screws and bolts to within -0.010 to +0.002 head protrusion; no aerodynamic filler is to be used. NACA (82°) type rivets in the integral tank areas shall be driven to fill countersink and shaved down +0.001 to +0.003 protrusion. On nose cowls, install 5/32 diameter aluminum alloy lockbolts so that they are flush from

-0.002 to +0.003. Do not shave the protruding head of a 5/32 diameter aluminum lockbolt more than 0.005. On side cowl panels of 0.050 inch thickness (See 54-3-1), drive all fasteners (except as noted below) in the exterior skin flush within 0.000 to +0.005 inch and shave the heads to within 0.000 to 0.002 inch of the skin surface.

NOTE: Install a 5/32 diameter aluminum lock bolt as follows. Countersink the sheet to a depth of 0.040 to 0.045 inch. Shave head of the lockbolt to within 0.000 to +0.002 inch of the skin surface after installation.

E. Wing, Empennage, Nacelle and Strut Noncritical Areas, All Airplanes.

(1) Fastener flushness tolerances to be maintained for aerodynamic smoothness in the noncritical areas of the wing, nacelles and empennage are as follows: Drive all aluminum rivets to within +0.005 to +0.015 head protrusion. Drive shear head rivets so that 90% are flush within -0.000 to +0.005, 10% may be flush within -0.005 to +0.007. Install lockbolts to within -0.003 to +0.005 head protrusion. Install removable and nonremovable bolts and screws to within -0.010 to +0.005 head protrusion.

5. Microshaving of Aluminum Alloy Rivets

A. A rivet microshaver shown in figure 3 is used to shave aluminum alloy rivets to meet surface flushness requirements. The microshaver is a pistol-grip air motor with an adjustable micro-stop. A cutter shaves the rivet head to within .002 in. of the sheet surface. Spring-loaded rubber feet mounted in a free turning stabilizer, prevent slipping of the cutter.

B. When shaving rivets, the following practices must be observed in order to maintain rivet strength.

(1) Head protrusion shall not exceed "H" Table 1 after driving and prior to shaving.

(2) Head diameter shall not be less than "D" Table 1, after shaving.

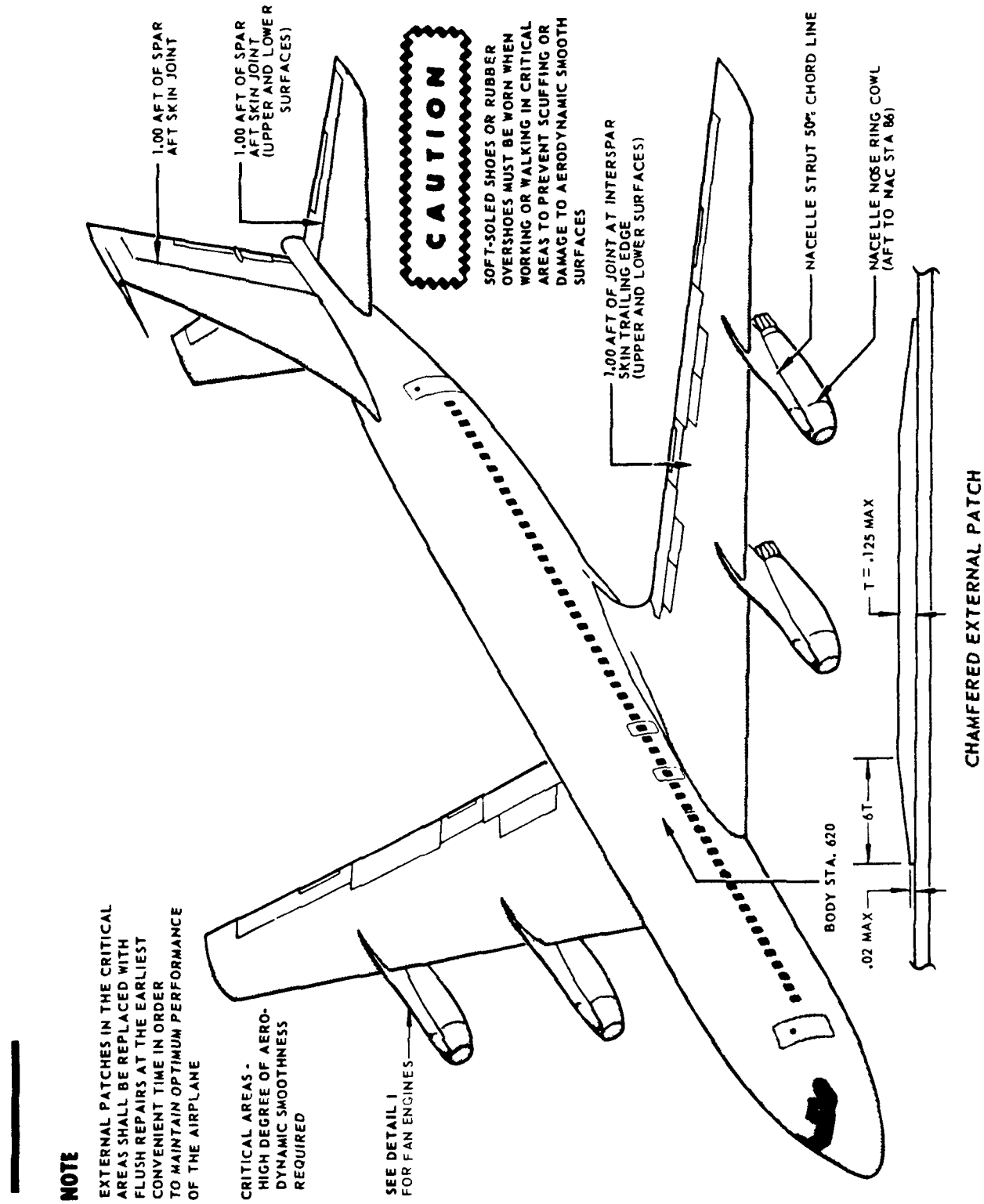
(3) Select a cutter larger in diameter than the rivet head. See Table 2 for recommended cutter diameters.

(4) Adjust the stop of shaver to extend .001 in. to .002 in. beyond the cutter and test this setting on scrap stock prior to use, to avoid damaging sheet surface.

(5) Use steady pressure on the tool to obtain a constant speed.

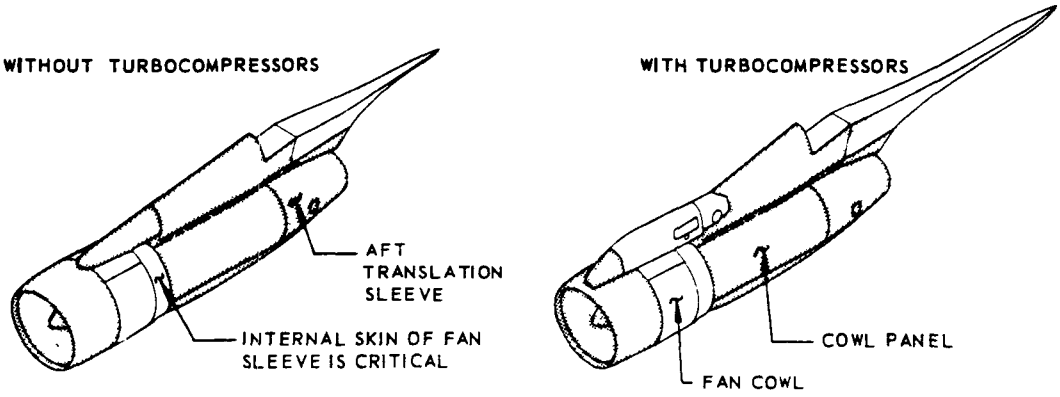
(6) Rock the shaver lightly on contoured surfaces to trim all edges of the rivet.

(7) Refinish the shaved rivet heads per 51-8-1 where external surfaces are painted.



Aerodynamic Smoothness Critical Areas
Figure 1 (Sheet 1 of 2)

DETAIL I - AERODYNAMIC SMOOTHNESS (JT3D FAN ENGINE)



AERODYNAMIC SMOOTHNESS FOR JT3D FAN ENGINE INSTALLATION

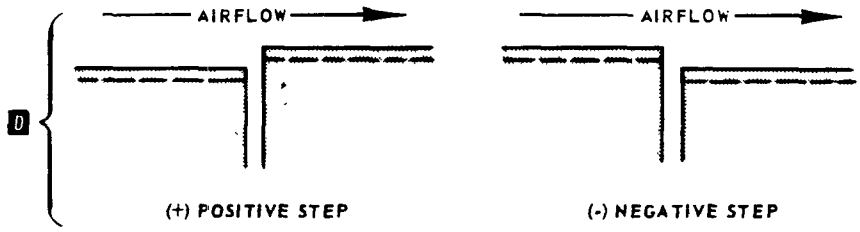
		CONDITION	LOCATION	CRITICAL	NON-CRITICAL
1		WAVE DEPTH TO LENGTH RATIO (INCLUDING DISHING AT FASTENERS)	BETWEEN FRAMES	.0025 B	.0050
			ACROSS FASTENERS	.0050 A C	.0100 C
2	GAPS	LONGITUDINAL (STREAMWISE) BUTT JOINTS MAX GAPS	FIXED SKINS	.040	.040
			REMOVABLE PANELS	.060	.060
3		TRANSVERSE (NORMAL TO AIRSTREAM) BUTT JOINT GAP	FIXED SKINS	.00 TO .03	.00 TO .06
			REMOVABLE PANELS AND HINGED COWL PANELS	.01 TO .07	.01 TO .07
4	FLUSHNESS	LONGITUDINAL JOINT FLUSHNESS	FIXED SKINS	.00 TO .03	.00 TO .03
			REMOVABLE PANELS AND HINGED COWL PANELS	.00 TO .06	.00 TO .06
5		TRANSVERSE JOINT FLUSHNESS	FIXED SKINS	-.02 TO +.00 D	-.03 TO +.02 D
			REMOVABLE PANELS AND HINGED COWL PANELS	-.04 TO +.02 D	-.04 TO +.02 D

NOTE

A DETERMINE BY USE OF A 6.0 SPLINE AND FEELER GAGE

B DETERMINE BY USE OF A 0.5 X 0.5 X 48.0 MAPLE SPLINE AND FEELER GAGE

C .015 ALLOWED ON 20% OF FASTENERS



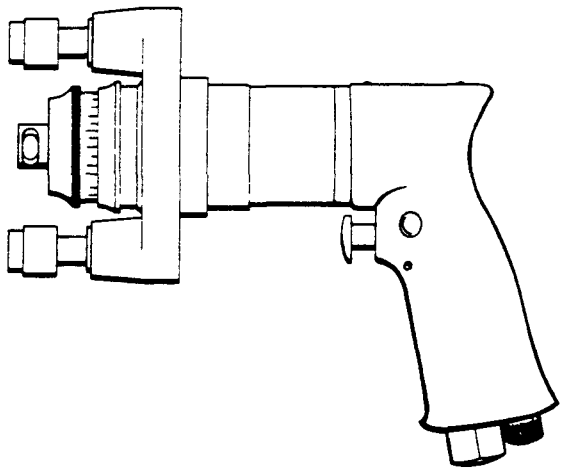
Aerodynamic Smoothness Critical Areas
Figure 1 (Sheet 2 of 2)

TABLE 1

CHECKING DIMENSIONS – RIVET SHAVING 100° HEADS						
NOMINAL RIVET DIAMETER	1/8	5/32	3/16	1/4	5/16	3/8
Head Type	100°	100°	100°	100°	100°	100°
H Maximum Head Protrusion Prior to Shaving	.007	.009	.010	.012	.014	.016
D Minimum Head Diameter After Shaving	.204	.262	.326	.443	.526	.650

TABLE 2

Rivet Diameter	1/8	5/32	3/16	1/4	5/16	3/8
Cutter Diameter	3/8	1/2	1/2	5/8	3/4	1



Model	Manufacturer
ZT306 ZT405 ZT208 (ELECTRIC)	Zephyr Manufacturing Co. Englewood, Calif.
TD-300-OAD TD-300A-OAID TD-300-OAID	Ingersoll Co. New York, N.Y.
AT-429	Aircraft Tools Co. Los Angeles, Calif.

Microshaving of Aluminum Alloy Rivets
Figure 2

HARDNESS TESTING OF METALS

1. General

A. Unknown structural materials may be identified by running comparative hardness tests with samples of known materials. Hardness tests may be made using a portable hand held impact-type tester, which depresses the surface of the metal being tested, or by using an electronically operated tester of the Eddy current type. Both types require access to only one side of the component being tested. Tests made with the impact-type testers do not provide satisfactory results for all materials, but tests made with the electronic type of tester produce accurate results. (This form of test is particularly useful when assessing fire-damaged structures.)

B. Portable hardness testers are available from the Barber-Coleman Co., Rockford, Illinois as the Barcol Portable Hardness Tester, Model GY2J 934-1 (Fig. 1) and the Ernst Portable Hardness tester, Models RAR and RBR (Fig. 2) from the Newage Industries Inc., 2300 Maryland Road, Willow Grove, Pennsylvania, 19090. A spring-loaded diamond-pointed indentor is employed on both Ernst testers to penetrate the metal; while a spring-loaded steel ball in the Barcol tester is used to depress the metal. The Ernst RAR tester is used on hardened steels, while the Ernst RBR and Barcol testers are used on low-strength steels and nonferrous metals.

C. Carry out hardness tests, using the portable hardness testers as follows:

CAUTION: GRINDING MUST NOT BE USED TO REMOVE PLATING MATERIALS. CHROMIUM OR NICKEL PLATING MAY HAVE BEEN EMPLOYED IF PLATING RESISTS REMOVAL: REMOVE USING STANDARD METHODS AND PROCEDURES. IF NECESSARY, POSITIVELY IDENTIFY THE PLATING AS DESCRIBED IN 51-8-1, PAR. 5. DO NOT CHEMICAL SPOT TEST IN AREA WHERE PLATING IS REMOVED.

(1) Remove the protective finish from an area approximately 1/2 inch in diameter (using abrasive blasting or by hand sanding).

(2) Set dial of tester to 0.

NOTE: The Barcol tester must be checked on glass or other hard surfaced material before use. A "0" reading should be obtained during this check. Recalibrate the instrument if gage reading is more than one point in error.

(3) Hold the indenter perpendicular to the surface and apply pressure.

CAUTION: AVOID SIDE THRUST ON POINT OF INDENTER WHEN APPLYING PRESSURE.

(4) Take several readings over the surface of the structure being tested.

(5) Determine from figure 3 the heat-treat value of the metal.

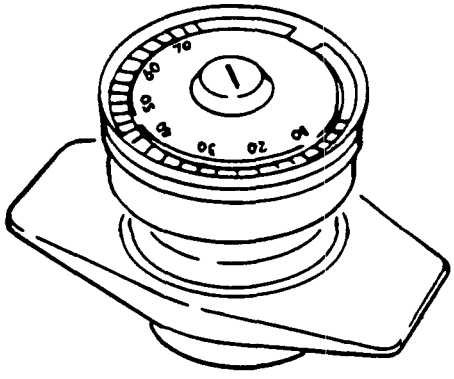
D. Material identification using an eddy-current testing instrument may be made using the procedures detailed in the Nondestructive Test Manual, Boeing Document D6-7170 and those recommended by the equipment manufacturer. Readings may be checked against the hardness values obtained for samples of known materials.

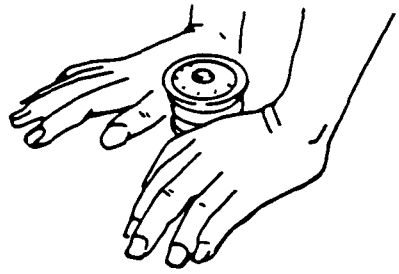
E. The following precautionary measures must be observed when using the portable hardness testers to prevent further damage to existing structures:

(1) Do not use these testers on material which is too thin to prevent distortion of the test piece under the impact of the indenter. Carry out tests on comparative samples.

(2) Do not apply the indenter too near the edge of material. Buckling may occur.

(3) Ensure that clad aluminum structure is checked against bare aluminum test pieces. Hardness values obtained from clad aluminum alloys will vary due to the pure aluminum of the clad surface. Clean away the cladding from a small area of the surface to be tested.





MODEL RAR	ROCKWELL A RANGE 35–75
MODEL RBR	ROCKWELL B RANGE 5–100

Ernst Portable Metal Hardness Tester
Figure 1



Barcol Portable Hardness Tester
Figure 2

BARE OR CLAD REMOVED ALUMINUM				
ALLOY [A]	ROCKWELL HARDNESS "B" SCALE		ROCKWELL HARDNESS "E" SCALE [B]	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
2024–0	–	–	54	62
–T3XXX	70.0	83.5	96	104
–T4XXX	70.0	83.5	96	104
–T6XXX	77.0	86.0	100	106
–T8XXX	77.0	86.0	100	106
2219–0	–	–	–	70
–T6X	65.5	–	93	–
–T8XXX	73.0	–	98	–
6061–0	–	–	18	25
–T4	–	–	68	–
–T6	53.5	80.0	85	102
7075–0	–	–	56	65
–T6XXX	83.5	94.0	104	112
–T73XXX	79.5	89.0	102	107.5
7079–T6XX	86.0	94.0	106	112
7178–0	–	–	–	65
–T6XXX	89.5	94.0	108	112

BARE STEEL	
TENSILE STRENGTH (PSI)	ROCKWELL HARDNESS "A" SCALE
110,000	61.0
126,000	64.0
150,000	67.5
181,000	70.5
201,000	72.0
220,000	73.2

NOTES

- AFTER MEASUREMENTS ARE TAKEN APPLY A PROTECTIVE ALODINE COATING TO CLAD REMOVED AREAS PER 51–8–0

[A] FOR BARE ALUMINUM ALLOYS 0.060 INCH THICK AND OVER

[B] ROCKWELL "B" SCALE IS PREFERRED WHEN "E" SCALE READINGS EXCEED 100

Hardness Values of Aircraft Materials
Figure 3

FIRE DAMAGE EVALUATION

1. Examine any portion of an airplane which has been exposed to excessive heat to determine whether such overheating has weakened the structure, by the eddy-current method as outlined in Part 6 of the Nondestructive Test Manual, D6-7170.

2. Repair, or replace, fire damaged areas and parts which are shown to be unacceptable by the method in par. 1. above.

MERCURY SPILLAGE CORRECTIVE ACTION

1. General

A. It is assumed that any significant quantity of mercury on board an airplane is properly contained, packaged and labeled for loading in a cargo compartment.

B. The spillage of mercury or a mercury compound, within an airplane, requires immediate action for its isolation and recovery to prevent possible corrosion damage to and possible embrittlement of aluminum alloy structural components. See the Maintenance Manual, Chapter 51, "Mercury Spillage - Conditional Inspection," for procedures to be taken in case of mercury spillage.

C. Mercury, by the amalgamation process, can penetrate any break in the finish, paint or sealing coating of a metal structural element. An oxide coating on a dry metallic surface will tend to inhibit an immediate action while a bright, polished, shining or scratched surface will hasten the process. Moisture will also promote the amalgamation process. Soils, greases or other inert contaminants present on the metal surfaces, will prevent the start of the action. The corrosion and embrittlement which results from an initial penetration can be extremely rapid in structural members under load. Once it has begun, there is no known method of stopping it. Complete destruction of the load carrying capacity of the metal will result.

D. Damage to an aluminum alloy structural component by mercury, appears externally as a grayish, powdery dust or fuzzy coating. Such external evidence may be an indication of damage beyond an allowable amount by embrittlement. The extent of such damage should be determined by an X-ray examination. See Boeing Document D6-7170, Part 2, for procedures generally adaptable to mercury spillage and corrosion.

E. Damage which has been determined to be embrittlement by X-ray examination as in par. D above, is not allowable. See 51-13-1 for definition of allowable damage.

F. See Chapter 53 for repairs to fuselage structure which has been damaged as in par. E above.

ALIGNMENT CHECK PROCEDURES

1. General

A. An alignment check can be performed on an airplane to aid in determining if structural deformation has occurred. Items that may cause structural deformations are:

(1) When the airplane has been subjected to severe structural stresses due to a hard landing.

(2) When the airplane has experienced severe flight conditions due to unusual weather or atmospheric conditions.

(3) When the airplane has been subjected to severe flight maneuvers.

(4) When the airplane has been subjected to sudden depressurization.

(5) When the pilot reports that the airplane has unusual flight characteristics.

(6) After a major structural repair.

(7) Other conditions as determined by operator's requirements.

B. For a detailed evaluation of alignment checks, refer to notes on Fig. 16.

2. General Requirements

A. Place airplane in an enclosed area on a hard and fairly level surface in order to obtain reliable alignment data.

(1) Shut off all air circulating equipment, if any.

(2) Close all outside doors during windy weather.

B. Conform with the following additional requirements if no enclosed area is available.

(1) Head airplane into the wind.

(2) Do not raise the airplane when wind velocities exceed 35 mph.

(3) Perform alignment check:

(a) When wind velocity is less than 10 mph.

(b) During the night or

(c) In shade covering entire airplane during the day in order to avoid exposure to direct sun heat or

(d) In any hard and level area during cloudy days.

C. De-fuel airplane per 707 Maintenance Manual, 12-1-41.

D. Check that airplane gross weight does not exceed 170,000 lbs.

E. Do not perform alignment check for at least an hour after airplane has been exposed to direct sun heat or after any engines have been in operation.

F. When ready to conduct alignment check, procure equipment per Fig. 1.

3. Prepare Airplane for Raising

A. Ascertain that the general requirements for alignment check are complied with as prescribed in par. 2.

B. Check if landing gear down locks are in place.

C. Open nose landing gear doors.

(1) Pull down manual release handle located in main external power receptacle box.

WARNING: STAND CLEAR OF DOOR ACTION WHEN RELEASE HANDLE IS BEING PULLED DOWN.

NOTE: Landing gear control handle in control cabin must be in "OFF" position (Ref 32-5-0, 707 Maintenance Manual).

(2) Latch down release handle to keep doors open.

D. Partially disassemble nose landing gear flap door.

(1) See Fig. 13, Detail I.

(2) Remove fiberglass door panel from door fitting casting by removing 6 bolts.

(3) Disconnect flap door link at the forward end.

(4) Swing flap door fitting to its lowest position to provide clearance for plumb bob line at body point X.

E. Open main landing gear L.H. wheel well doors.

(1) Pull down manual release handle located in lower wing area forward of landing gear strut.

WARNING: STAND CLEAR OF DOOR ACTION WHEN HANDLE IS BEING PULLED DOWN.

NOTE: Landing gear control handle in control cabin must be in "OFF" position (Ref 32-3-0, 707 Maintenance Manual).

(2) Latch down release handle to keep doors open.

F. Install jack pads. See Fig. 2 for jack pad locations and BAC part numbers.

(1) Install jack pads at wing points I and I as well as body points III and VI.

G. Locate jacks. See Fig. 1 and 2 for jack specifications and locations.

(1) Place jacks under wing points I and II as well as body points II and VI.

(2) Extend rams and extension screws snug against jack pads.

(3) Lower ram locknuts within approximately 1.00 of jack head.

H. Remove landing gear wheel chocks.

J. Release parking brakes.

K. Hang plumb bob from bracket (directly above leveling scale) installed at the upper L.H. side of keel beam in main landing gear L.H. wheel well (Fig. 10).

L. Position one man at each jack to:

(1) Operate jack.

(2) Watch the pressure gage.

NOTE: Chalk or crayon mark jack gage dial glass at the maximum allowable load for each jack. See figure 2 for maximum allowable loads at wing and body jacking points.

(3) Ascertain that ram lock nut is approximately 1.00 from jack head throughout the raising operations.

M. Position one man at leveling scale in main landing gear L.H. wheel well to ascertain that airplane is raised in its level attitude so that plumb bob point is longitudinally and transversely within 0.20 of the zero mark on the leveling scale (Fig. 10).

4. Raise Airplane

WARNING: DO NOT RAISE AIRPLANE IN AN EXPOSED AREA SUBJECT TO WIND VELOCITIES ABOVE 35 MPH.

A. Raise airplane 24.00 to 26.00 or until the landing gear wheels clear the floor by approximately 2.00 by simultaneously lifting at wing points I and II and body point III.

CAUTION: DO NOT EXCEED ALLOWABLE JACK LOADS AS MARKED ON THE PRESSURE GAGE DIAL GLASS. SEE FIGURE 2 TO ASCERTAIN THAT GAGES ARE PROPERLY MARKED.

DO NOT APPLY ANY LOAD ON JACK AT BODY POINT VI. FOLLOW UP MOVEMENT OF THIS POINT BY KEEPING RAM SNUG AGAINST PAD. JACK AT THIS POINT IS USED ONLY TO LONGITUDINALLY STABILIZE THE AIRPLANE.

DO NOT RAISE BODY POINT III AHEAD OF WING POINTS I AND II. THIS OPERATION WILL OVERLOAD JACKS AT BODY POINTS III AND VI.

NOTE: The use of the hand pump is preferred to the pneumatically operated pump to achieve precise leveling.

(1) Ascertain that airplane is being raised in its level attitude by observing that plumb bob point against leveling scale is within 0.20 of zero mark in both longitudinal as well as transverse direction (Fig. 10).

(2) Ascertain that during raising operations ram lock nuts are approximately 1.00 from jack head.

(3) Allow nose landing gear oleo to extend to its fully extended position.

5. Level Airplane

A. Preliminary level airplane by using plumb bob and leveling scale mounted in main landing gear L.H. wheel well (Fig. 10).

(1) Level airplane transversely by operating wing jacks at points I and II.

CAUTION: FOLLOW UP UPWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF LEVELING OPERATION CAUSES AIRPLANE TO UNDERGO A LEFT-HAND ROLL.

FOLLOW UP DOWNWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF LEVELING OPERATION CAUSES AIRPLANE TO UNDERGO A RIGHT-HAND ROLL.

NOTE: The use of the hand pump is preferred to the pneumatically operated pump to achieve precise leveling.

(2) Level airplane longitudinally by operating body jacks at points III and VI.

CAUTION: FOLLOW UP UPWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF LEVELING OPERATION CAUSES AIRPLANE NOSE TO GO UP.

FOLLOW UP DOWNWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF LEVELING OPERATION CAUSES AIRPLANE NOSE TO GO DOWN.

(3) Consider airplane preliminary leveled if plumb bob point against the leveling scale is within 0.10 of the zero mark (Fig. 10).

CAUTION: ASCERTAIN THAT LANDING GEAR WHEELS DO NOT TOUCH FLOOR DURING LEVELING OPERATIONS.

ASCERTAIN THAT DURING LEVELING OPERATIONS RAM LOCK NUTS ARE APPROXIMATELY 1.00 FROM JACK HEAD.

B. Final level airplane by using engineer's transit or dumpy level.

(1) Set up dumpy level or engineer's transit at airplane leveling and elevation reading position as shown in figure 3.

(2) Close main landing gear L.H. wheel well doors.

(a) Return manual release handle to its normal position.

WARNING: STAND CLEAR OF DOOR ACTION WHEN RELEASE HANDLE IS BEING RETURNED TO ITS NORMAL POSITION.

NOTE: Landing gear control handle in control cabin must be in "DOWN" position (Ref 32-3-0, 707 Maintenance Manual).

(3) Transversely level airplane as follows (Fig. 3 and 4):

(a) Place a measuring assembly against L.H. wing point G.

NOTE: Use ladder or aerostand as required.

(b) Sight and record reading.

(c) Place a measuring assembly against R.H. wing point G.

(d) Sight and record reading.

(e) Level airplane transversely per par. A(1) until L.H. and R.H. readings are within 0.020. Calculate the average of these two readings and record.

(4) Longitudinally level airplane as follows:

(a) Place a measuring assembly against leveling pad mounted on L.H. side of nose landing gear wheel well (Fig. 11).

NOTE: Use ladder or aerostand as required.

(b) Sight and record readings. Subtract 6.99 from this reading.

(c) Level airplane longitudinally per par. A(2) until reading per step (4)(b) is within 0.020 reading determined at step (3)(e).

NOTE: Ascertain that landing gear wheels do not touch floor during leveling operations.

Ascertain that during leveling operations ram locknuts are approximately 1.00 from jack head.

Do not disturb transit or dumpy level set up.

6. Lock All Jacks

A. Lower and hand-tighten ram locknuts against jack head on all jacks.

B. Wrench-tighten ram locknut set screws on all jacks.

7. Bleed All Jacks

A. Gradually open release valve not more than 1-1/2 turn.

B. Check if pressure gage reads zero.

WARNING: ON SOME HYDRAULIC JACK MODELS IN POOR CONDITION THE RAM LOCK NUT TURNS ALLOWING RAM TO MOVE DOWNWARD AFTER RELEASE VALVE IS OPENED EVEN THOUGH LOCK NUT SET SCREW IS WRENCH TIGHTENED. OBSERVE CAREFULLY FOR SUCH MALFUNCTIONING AND IF DISCOVERED, IMMEDIATELY CLOSE RELEASE VALVE. CONTINUE WITH ALIGNMENT CHECK OPERATIONS. IF DUE TO LEAKY RELEASE VALVE RAM CONTINUES TO MOVE DOWNWARD, LOWER AIRPLANE PER PARAGRAPHS 26 AND 27 AND REPLACE FAULTY JACK.

8. Check Attitude of Airplane

A. Take final readings at the L.H. and R.H. wing points G. Calculate the average of these two readings.

B. Take final reading at nose gear wheel well leveling pad. Subtract 6.99 from this reading.

C. Consider airplane leveled within required tolerance if final readings taken at steps A and B are within .020.

9. Re-level Airplane As Follows if After Bleeding Jacks the Airplane Attitude is Not Within Required Tolerance

A. Proceed as follows if L.H. (or R.H.) wing point G is low.

(1) Operate jack at body point VI.

(a) Loosen ram lock nut set screw.

(b) Slowly raise ram just enough to relieve load on lock nut so that it is free to turn.

(c) Turn ram lock nut to raise it about .50.

(2) Operate jack next to L.H. (or R.H.) point G.

(a) Loosen ram lock nut set screw.

(b) Slowly raise ram the exact distance that the point G is low.

NOTE: Use feeler gages between ram lock nut and jack head.

Do not turn lock nut at this step.

(c) Remove feeler gages.

(d) Hand-tighten ram lock nut against jack head.

(e) Wrench-tighten ram lock nut set screw.

NOTE: Ascertain that lock nut is not turned when tightening set screw.

(f) Bleed jack.

CAUTION: BEFORE RAISING LOW POINT G ASCERTAIN IN WHICH DIRECTION AIRPLANE WILL TEND TO ROLL. FOLLOW UP UPWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF LEVELING OPERATION CAUSES AIRPLANE TO UNDERGO A LEFT-HAND ROLL. FOLLOW UP DOWNWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF PRESSURE GAGE AT THIS JACK INDICATES THAT AIRPLANE IS TENDING TO UNDERGO A RIGHT-HAND ROLL.

(g) Check if pressure gage reads zero.

(3) Take readings at L.H. and R.H. points G and record. Calculate the average of L.H. and R.H. point G readings.

(4) Repeat steps 2 and 3 until the low point is brought within .020 of opposite point G.

(5) Take a reading at nose gear landing gear wheel well leveling pad. Subtract 6.99 from this reading.

(6) Consider airplane leveled within required tolerance if readings determined at steps 3 and 5 are within .020.

(7) Operate jack at body point VI.

(a) Lower and hand-tighten ram lock nut against jack head.

(b) Wrench-tighten lock nut set screw.

(c) Bleed jack.

(d) Check if pressure gage reads zero.

B. Proceed as follows if L.H. (or R.H.) point G is high.

(1) Operate jack at body point VI.

(a) Loosen ram lock nut set screw.

(b) Slowly raise ram just enough to relieve load on lock nut so that it is free to turn.

(c) Turn ram lock nut to raise it about .50.

(2) Operate jack next to high L.H. (or R.H.) point G.

(a) Loosen ram lock nut set screw.

(b) Slowly raise ram just enough to relieve load on lock nut so that it is free to turn.

NOTE: Do not turn lock nut at this step.

(c) Hand-turn ram lock nut to raise it by the exact amount that point G is high.

NOTE: Use feeler gages between lock nut and jack head.

(d) Remove feeler gages.

(e) Wrench-tighten ram lock nut set screw.

NOTE: Ascertain that lock nut is not turned when tightening set screw.

(f) Bleed jack.

CAUTION: BEFORE BLEEDING JACK ASCERTAIN IN WHICH DIRECTION AIRPLANE WILL TEND TO ROLL. FOLLOW UP UPWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF LEVELING OPERATION CAUSES AIRPLANE TO UNDERGO A LEFT-HAND ROLL. FOLLOW UP DOWNWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF PRESSURE GAGE AT THIS JACK INDICATES THAT AIRPLANE IS TENDING TO UNDERGO A RIGHT-HAND ROLL.

(g) Check if pressure gage reads zero.

(3) Take readings at L.H. and R.H. points G. Calculate the average of L.H. and R.H. point G readings.

(4) Repeat steps 2 and 3 until high point G is brought within .020 of opposite point G.

(5) Take a reading at nose landing gear wheel well leveling pad. Subtract 6.99 from this reading.

(6) Consider airplane leveled within required tolerance if readings determined at steps 3 and 5 are within .020.

(7) Operate jack at body point VI.

(a) Lower and hand-tighten ram lock nut against jack head.

(b) Wrench-tighten lock nut set screw.

(c) Bleed jack.

(d) Check if pressure gage reads zero.

C. Proceed as follows if leveling pad in nose landing gear wheel well is low.

(1) Record distance in inches that the leveling pad is low.

(a) Multiply this distance by 1.71.

(2) Operate jack at body point VI.

(a) Loosen ram lock nut set screw.

(b) Slowly raise ram just enough to relieve load on lock nut so that it is free to turn.

(c) Turn ram lock nut to raise it about .50.

(3) Operate jack at body point III.

(a) Loosen ram lock nut set screw.

(b) Slowly raise ram just enough to relieve load on lock nut so that it is free to turn.

NOTE: Do not turn ram lock nut at this step.

(c) Turn ram lock nut to raise it by the distance determined at step 1.

NOTE: Use feeler gages between lock nut and jack head.

(d) Remove feeler gages.

(e) Wrench-tighten ram lock nut set screw.

NOTE: Ascertain that lock nut is not turned when tightening set screw.

(f) Bleed jack.

(g) Check if pressure gage reads zero.

(4) Take a reading at leveling pad in nose landing gear wheel well. Subtract 6.99 from this reading.

(5) Repeat steps 1, 3 and 4 until leveling pad in nose landing gear wheel well is brought within .020 of previous average reading of wing points G.

(6) Recheck L.H. and R.H. wing point G readings and record.

(7) Consider airplane leveled within required tolerance if readings determined at steps 4 and 6 are within .020.

(8) Operate jack at body point VI.

(a) Snug up ram against jack pad.

(b) Lower and hand-tighten ram lock nut against jack head.

(c) Bleed jack.

(d) Check if pressure gage reads zero.

D. Proceed as follows if leveling pad in nose landing gear wheel well is high.

(1) Record distance in inches that the leveling pad in nose landing gear wheel well is high.

(a) Multiply this distance by 1.71.

(2) Operate jack at body point VI.

(a) Loosen ram lock nut set screw.

(b) Slowly raise ram just enough to relieve load on lock nut.

(c) Turn lock nut to raise it about .50.

(d) Lower ram by approximately .25 inches or twice the distance that the leveling pad is high, whichever is greater.

(3) Operate jack at body point III.

(a) Loosen ram lock nut set screw.

(b) Slowly raise ram just enough to relieve load on lock nut so that it is free to turn.

NOTE: Do not turn lock nut at this step.

(c) Slowly raise ram through distance determined at step 1.

NOTE: Use feeler gages between lock nut and jack head.

(d) Remove feeler gages.

(e) Lower and hand-tighten ram lock nut against jack head.

(f) Wrench-tighten ram lock nut set screw.

NOTE: Ascertain that lock nut is not turned while tightening set screw.

(g) Bleed jack.

(h) Check if pressure gage reads zero.

(4) Take a reading at leveling pad in nose landing gear wheel well.

(5) Repeat steps 1, 3 and 4 until leveling pad in nose landing gear wheel well is within .020 of previous average reading of wing points G.

(6) Re-check L.H. and R.H. wing point G readings and record.

(7) Consider airplane leveled within required tolerance if readings determined at steps 4 and 6 are within .020.

(8) Operate jack at body point VI.

(a) Snug up ram against jack pad.

(b) Lower and hand-tighten ram locknut against jack head.

(c) Wrench-tighten locknut set screw.

(d) Bleed jack and check if pressure gage reads zero.

10. Calculate Eye-piece Elevation

A. Use calculated average of final readings at wing points G.

B. Subtract this average reading from 163.81 to obtain eye-piece elevation reading.

11. Place Floor Mark Labels

A. Remove ventral fin to expose point "L".

B. Hang plumb bob from body point M. Place floor mark label directly under plumb bob point. Repeat this step for body points, X, Y, Z and L (Fig. 9, 11, 12, 13, 141 and 15).

C. Hang plumb bob from centerline of nose landing gear oleo by using plumb bob line holder per Fig. 5. Place floor mark label directly under plumb bob point (Fig. 13, Detail I).

D. Hang plumb bob from forward main landing gear tow rings by using plumb bob line holder per Fig. 6. Place floor mark labels directly under plumb bob point. Repeat this step at aft tow rings (Fig. 13, Detail II).

E. Hang plumb bob from L.H. and R.H. nacelle points U and R. Place floor mark labels directly under plumb bob point (Fig. 11 and 14).

NOTE: Make use of weighed down sheet metal or plywood pieces for providing a base for floor mark labels if airplane is located on an unpaved surface.

12. Place Index Cards Under Body Points M, X, Y and L, and at Nose Landing Gear Oleo Centerline

A. Place index card so that its mark coincides with the cross mark on floor mark label (Fig. 9, 11, 12, 13, 14 and 15).

B. Secure this index card to floor either by weighing it down or by means of masking tape.

13. Place and Set Up Engineer's Transit

A. Place instrument directly over floor mark under body point Z at body station 1200.78 (Fig. 3 and 14).

B. Set up instrument eye-piece approximately 24.00 below body point Z.

C. Sight on index card line at floor mark under body point X and set the transit base to zero azimuth.

14. Trim Stabilizer

A. See Fig. 12.

B. Set trammels so that distance between its points is 37.74 ±0.03 (Fig. 8).

C. Trim stabilizer to obtain 3 degrees AIRPLANE NOSE DOWN position by using power controls in control cabin (Ref 27-10-0, 707 Maintenance Manual).

D. Check stabilizer trim by means of trammels set to 37.74 ±0.03.

E. If trammel check indicates improper trim setting, proceed as follows:

(1) De-energize stabilizer trim control system by throwing trim cutout switch in direction indicated. The switch is located next to R.H. stabilizer trim control wheel in the control cabin (Ref 27-10-0, 707 Maintenance Manual).

(2) Manually adjust stabilizer trim by rotating trim control wheel until the distance between upper and lower gimbal centerlines is within 37.74 ±0.10.

NOTE: Entire stabilizer trimming operation may be accomplished manually per step E.2. if no power is available.

15. Take Elevation Readings

A. Add eye-piece elevation as calculated in par. 10 to all elevation readings.

B. Take elevation readings with instrument located at airplane leveling and elevation reading position as shown on Fig. 3, 4 and 14.

C. Take elevation readings at body points X and Y, as well as nacelle points U (UU) and R (RR) using a measuring tape.

NOTE: Use ladder or aerostand as required.

D. Take readings at wing points F, V and S as well as body points M and Z using a measuring tape.

NOTE: Use ladder or aerostand as required.

(1) Calculate (V - S) distance for LH and RH wings and record.

NOTE: Elevation reading at body point Z may be taken prior to setting up the transit at point Z or after the transit has been moved to point K (Fig. 15).

E. Take elevation readings at wing points Q, P, N and W as well as body point L using a measuring assembly (Fig. 4).

(1) Calculate (Q-P) and (N-W) distances for L.H. and R.H. wings and record.

F. Take elevation readings at stabilizer points H, J and T using a measuring assembly (Fig. 4). Add eye-piece elevation reading as calculated in par. 10 and record.

G. Calculate wing point G elevation.

(1) Add eye-piece elevation (per par. 10) to average point G reading (per par. 8.A) and record.

H. Calculate nose landing gear leveling pad elevation.

(1) Add eye-piece elevation (per par. 10) to final scale reading taken at step 8.B.

NOTE: Do not subtract 6.99 from the final scale reading.

J. See Fig. 16 for alignment check data and tolerances.

16. Take Body, Wing, Nose Gear Oleo and Stabilizer Azimuth Readings

A. Take readings with engineer's transit located under the body point Z (Fig. 3).

B. Take azimuth reading at index card placed under body point M. Indicate whether to the left or right.

C. Take azimuth reading at index card placed at centerline of nose landing gear oleo. Indicate whether to the left or right.

D. Take azimuth reading at index card placed under body point Y. Indicate whether to the left or right.

E. Take azimuth readings at L.H. and R.H. wing points F, G, V, S, P, Q, N and W by sighting on plumb bob line. Use plumb bob line holder per figure 7.

F. Take azimuth readings at L.H. and R.H. stabilizer points T, H and J by sighting on plumb bob line. (See figure 12.) Use plumb bob line holder per figure 7.

NOTE: Ascertain that stabilizer has been trimmed per paragraph 14.

G. Take azimuth reading at index card placed under body point L. Indicate whether to the left or right.

H. See figure 16 for alignment data.

17. Check Main Landing Gear Alignment

A. See figure 13, detail II.

B. Stretch a hundred-foot measuring steel tape across floor marks under main landing gear forward tow rings. Sight on measuring tape through engineer's transit located at body point Z and with the transit base set at zero azimuth. Read and record dimensions b_R and b_L.

C. Repeat step B for the aft floor marks under main landing gear aft tow rings in order to obtain dimensions c_R and c_L.

D. Calculate (b_R - c_R) and (b_L - c_L) values and record.

E. With a hundred-foot steel measuring tape measure and record distances d_R and d_L from floor marks under main landing gear aft tow rings to floor mark under body point Z.

F. See figure 16 for alignment data.

18. Check Nacelle Alignment

A. See figure 14.

B. Stretch a hundred-foot measureing steel tape across floor marks under L.H. and R.H. nacelle points U. Sight on measuring tape through engineer's transit located at body point Z and with the transit set at a zero azimuth. Read and record L.H. and R.H. BBL (body buttock lines).

C. Repeat step B for L.H. and R.H. nacelle points R.

D. See figure 16 for alignment data.

19. Check Nose Landing Gear Longitudinal Alignment

A. See Fig. 13, Detail I.

B. Measure and record distance from floor mark under nose landing gear oleo centerline to floor mark under body point X using a measuring tape.

C. See Fig. 16 for alignment data and tolerances.

20. Set Up Engineer's Transit for Fin Tip Azimuth Reading

A. See Fig. 15.

B. With engineer's transit at body point Z, set transit base on 180-degree mark with eye-piece pointing aft.

C. With a hundred-foot measuring steel tape locate a point approximately 50 feet aft of floor mark under body point L.

D. Place an index card prepared per Fig. 9, Detail II in the vicinity of point located at step C.

E. Sight on this index card. Locate index card so that the mark on index card coincides with instrument hair line. This locates floor mark K.

F. Place floor mark label with its cross mark at the vertical line n index card (See Fig. 9, Detail II). Remove index card.

G. Set up engineer's transit directly over floor mark at point K.

H. Sight on vertical line on index card placed under body point X and set transit base on zero azimuth.

21. Take Fin Tip Azimuth Reading

A. See Fig. 15.

B. Swing eye-piece over to fin tip. Sight and record azimuth. Indicate whether to the left or right.

C. See Fig. 16 for alignment data and tolerances.

22. Reassemble Nose Landing Gear Door

A. See Fig. 13, Detail I.

B. Connect the forward end of flap door link to nose landing gear strut.

C. Install flap door panel.

23. Close Nose Landing Gear Doors

A. Return manual release handle to its normal position located in main external power receptacle box.

WARNING: STAND CLEAR OF DOOR ACTION WHEN HANDLE IS BEING RETURNED TO ITS NORMAL POSITION.

NOTE: Landing gear control handle in control cabin must be in "DOWN" position. See 707 Maintenance Manual, section 32-5-0.

24. Open Main Landing Gear L.H. Wheel Well Doors

A. See paragraph 3.E.

25. Take Plumb Bob - Leveling Scale Reading

A. See figure 10.

B. Take plumb bob point reading against leveling scale and record.

26. Prepare Airplane for Lowering

A. Remove aero-stands, ladders and any other equipment which may interfere with airplane structure during lowering operation.

B. Check if all landing gear down locks are in place.

C. Set parking brakes.

D. Place wheel chocks under all landing gear wheels.

E. Loosen ram lock nut set screws on all jacks.

F. Shut off release valves on all jacks.

G. Position one man at each jack.

H. Position one man in main landing gear L.H. wheel well next to plumb bob leveling scale in order to insure that airplane is lowered in its level attitude.

J. Slowly raise rams on all jacks just enough to relieve load on ram lock nuts so that it is free to turn.

K. Turn ram lock nuts on all jacks to raise them approximately 1.00.

27. Lower Airplane

A. Simultaneously lower all jacks by gradually opening release valves not more than 1 1/2 turns.

CAUTION: DO NOT ALLOW RAMS AT WING POINTS I AND II AND BODY POINT VI TO GO DOWN AHEAD OF BODY POINT III. SUCH AN OPERATION WILL PERMIT NOSE LANDING GEAR WHEEL TO TOUCH THE FLOOR AND OVERLOAD JACK AT BODY POINT III.

DO NOT ALLOW RAMS AT WING POINTS I AND II TO GO DOWN AHEAD OF BODY JACKS III AND VI. SUCH AN OPERATION WILL OVERLOAD JACKS AT BODY POINTS III AND VI.

IF JACK "HANGS UP" REFUSING TO GO DOWN WHEN PRESSURE IS RELIEVED, SLIGHTLY RAISE AND LOWER THE JACK RAM UNTIL IT IS FREE TO MOVE DOWNWARD. SHORE AIRPLANE WITHIN THE AREA OF FAULTY JACK USING SUPPORTS PER 51-7-1, REMOVE AND REPLACE FAULTY JACK, IF "HANG UP" CONDITION CANNOT BE CORRECTED.

ASCERTAIN THAT DURING LOWERING OPERATIONS RAM LOCK NUTS ARE APPROXIMATELY 1.00 FROM JACK HEAD.

B. Continue lowering airplane in its level attitude until pressure gages on all jacks read zero and rams are clear of jack pads.

28. Remove Plumb Bob

A. Remove plumb bob located in the main landing gear wheel well. (See figure 10.)

29. Remove Jacks and Jack Pads

30. Close Main Landing Gear L.H. Wheel Well Doors

A. See paragraph 5.B.2.

ITEM	NO. REQ'D	IDENTIFICATION	SOURCE.
HYDRAULIC JACK WING POINTS I & II [A]	2	MODEL 989R CAPACITY: 40 TONS (USA) MIN. HEIGHT: 60, 78 OR 96 INCHES RAM STROKE: 44 INCHES MAX SCREW EXTENSION: 16 INCHES	REGENT MFG. CO., DOWNEY, CALIF. OR EQUIVALENT
HYDRAULIC JACK BODY POINT III [A]	1	MODEL B4A CAPACITY: 30 TONS USA MIN. HEIGHT: 55, 73, 91, 109, 127 OR 145 INCHES RAM STROKE: 40 INCHES MAX. SCREW EXTENSION: 15 INCHES	
HYDRAULIC JACK BODY POINT VI [A]	1	MODEL B4A CAPACITY: 30 TONS (USA) MIN. HEIGHT: 55, 73, 91, 109, 127 OR 145 INCHES RAM STROKE: 40 INCHES MAX SCREW EXTENSION: 15 INCHES	
JACK PAD WING POINTS I & II	2	PART NO. F71156	BOEING AIRPLANE COMPANY
JACK PAD BODY POINT III	1	PART NO. F71138	BOEING AIRPLANE COMPANY
JACK PAD BODY POINT VI	1	PART NO. F71139	BOEING AIRPLANE COMPANY
ENGINEER'S TRANSIT [B]	1	THEODOLITE	HENRY WILD SURVEYING INSTRUMENT SUPPLY COMPANY OF AMERICA, BROOKLYN, N. Y. OR KEUFFEL AND ESSER COMPANY, NEW YORK, N. Y.
LEVEL [C]	1	DUMPY LEVEL	KEUFFEL AND ESSER COMPANY, NEW YORK, N. Y.
FLEXIBLE MEASURING TAPE	1		ANY SOURCE
MEASURING ASSEMBLY	1	SEE FIGURE 4.	FABRICATE
ROD LEVEL	1	NO. 6614	EUGENE DIETZGEN COMPANY, SAN FRANCISCO, CALIF.

Alignment Check Equipment
Figure 1 (Sheet 1)

ITEM	NO. REQ'D	IDENTIFICATION	SOURCE
MEASURING TAPE 100-FOOT STEEL	1	NO. 9100 GRADUATED IN .10 OF AN INCH	THE A. LIETZ COMPANY SAN FRANCISCO, CALIF.
PLUMB BOB LINE HOLDER NLG OL EO CENTER LINE	1	SEE FIGURE 5	FABRICATE
PLUMB BOB LINE HOLDER MLG TOW RING	2	SEE FIGURE 6	FABRICATE
PLUMB BOB LINE HOLDER CONTOURED SURFACE	1	SEE FIGURE 7	FABRICATE
PLUMB BOB	1	NO. 87	THE L. S. STARRETT COMPANY ATHOL, MASS.
PLUMB BOB LINE	15 FT	24 LBS TEST TROLLING LINE	WESTERN MFG. CO., GLENDALE, CALIF.
TRAMMELS	1	SEE FIGURE 8	FABRICATE
FLOOR MARK LABEL SEE FIGURE 9.	14	1½" x 2" SIZE NO. 7590, KUM-KLEEN SELF-ADHESIVE LABELS OR NO. 201 PERFORATED LABELS	AVERY ADHESIVE LABEL CORP., MONROVIA, CALIF. DENNISON MFG. CO., FRAMINGHAM, MASS.
INDEX CARD SEE FIGURE 9.	5	3" x 5" SIZE OR LARGER	ANY SOURCE
MASKING TAPE	ROLL	1" WIDE	ANY SOURCE
EXTENSION LIGHT	2	100-FOOT EXTENSION CORD	ANY SOURCE
BASE FLOOR MARK LABEL [D]	14	0.032" x 6" x 8" SHEET METAL OR 1/8" x 6" x 8" PLYWOOD OR 1/2" x 6" x 8" LUMBER	ANY SOURCE
WEIGHT FLOOR MARK LABEL BASE [D]	14	5 to 10 LBS, ANY MATERIAL	ANY SOURCE

NOTES

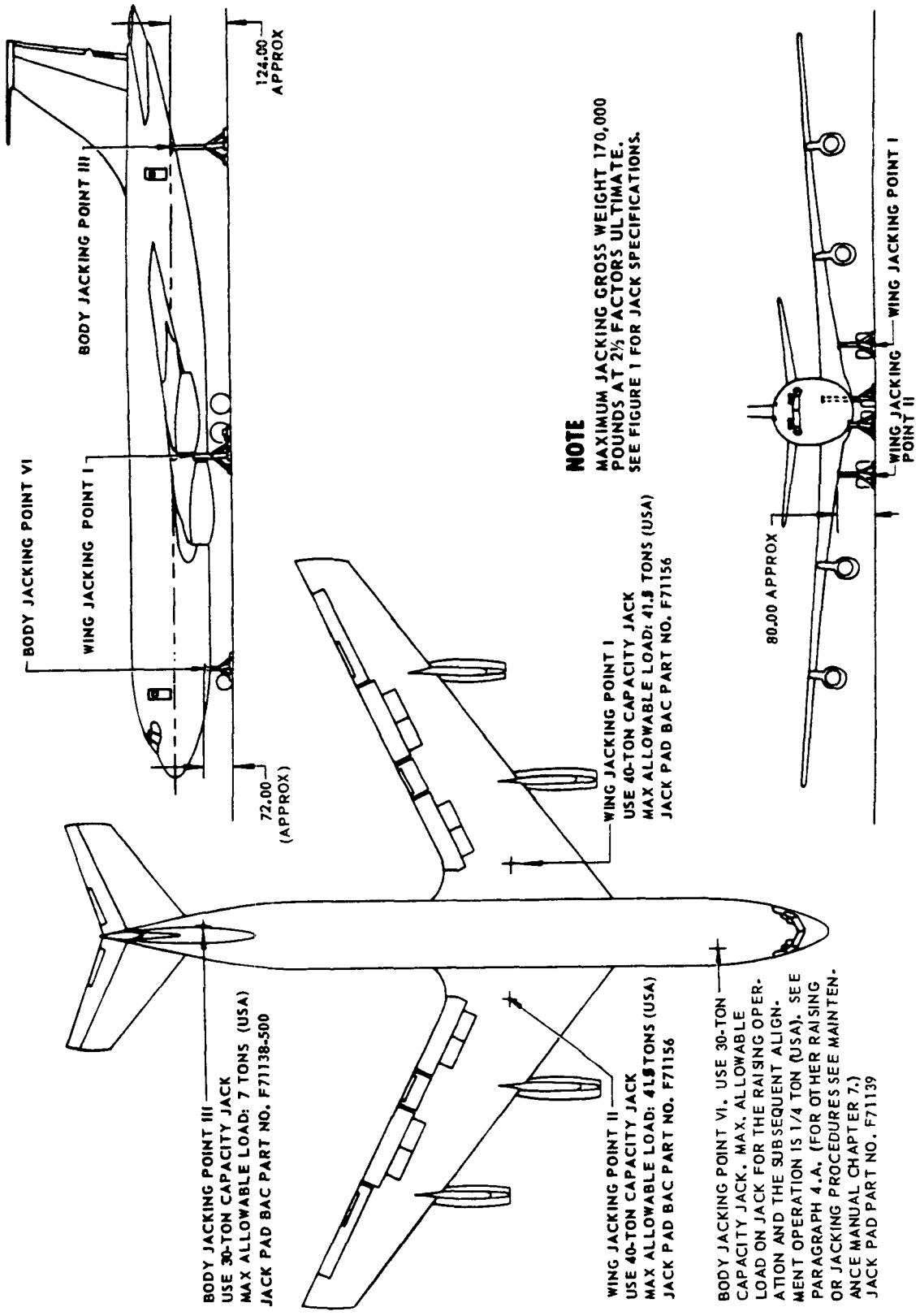
[A] ALL HYDRAULIC JACKS MUST BE EQUIPPED WITH GAGES READING DIRECTLY IN TONS (USA) OR POUNDS. IF GAGES READ IN PSI THEN A CONVERSION CHART MUST BE AVAILABLE TO CONVERT PSI READINGS INTO TONS (USA) OR POUNDS.

[B] MANDATORY.

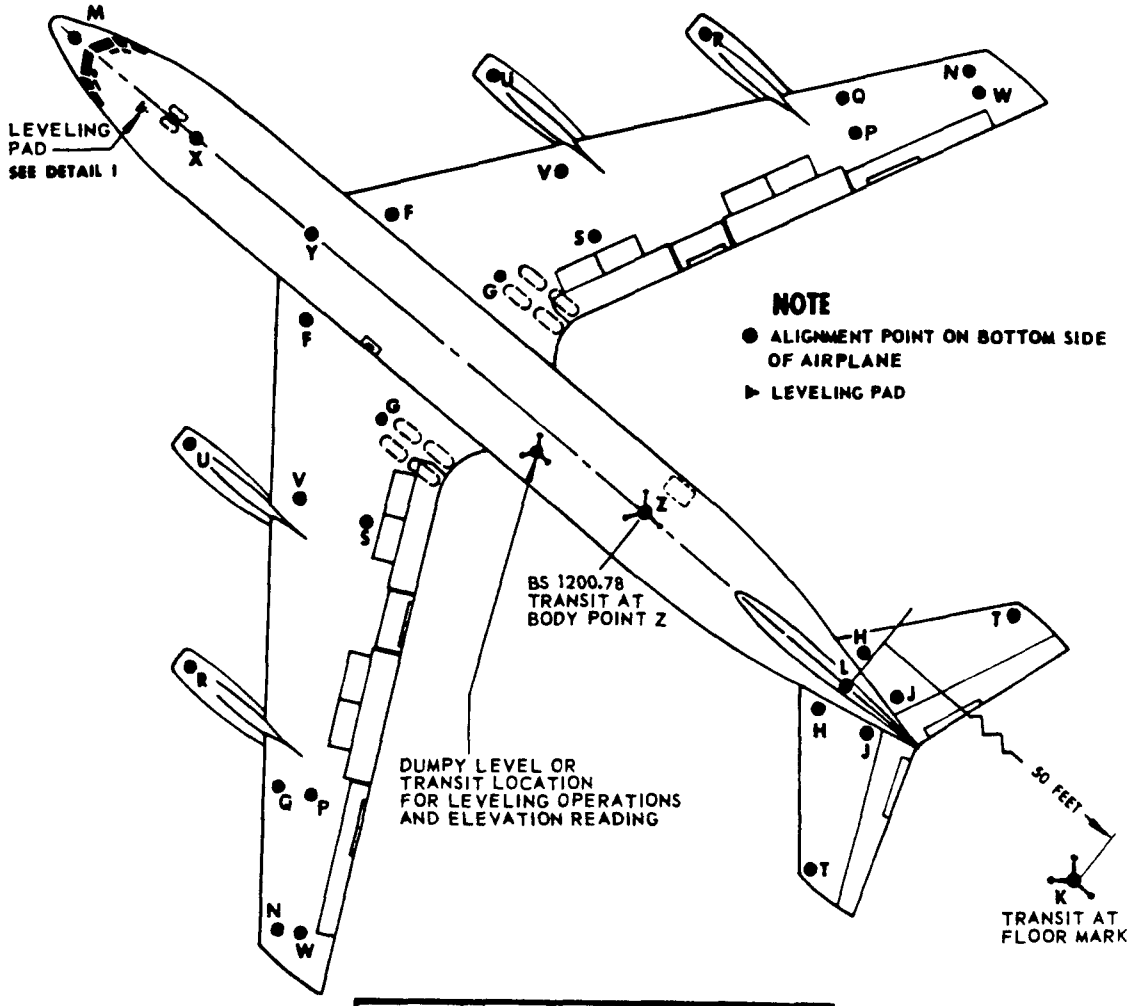
[C] OPTIONAL. WITH DUMPY LEVEL AVAILABLE, ONE CREW MAY BE TAKING ELEVATION READINGS WHILE THE OTHER IS TAKING AZIMUTH READINGS WITH THE ENGINEER'S TRANSIT.

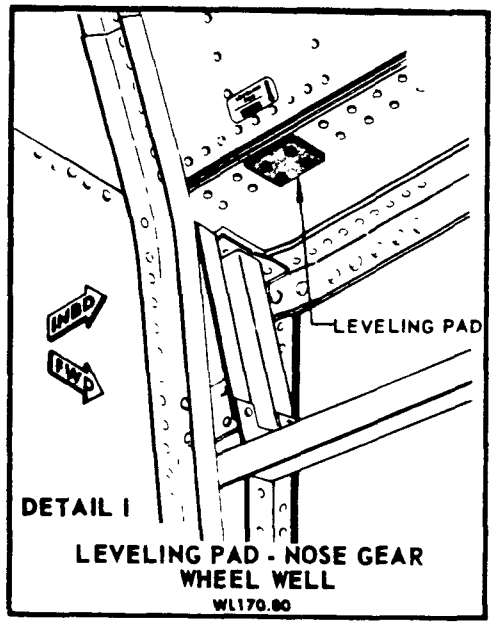
[D] PROCURE THESE ITEMS IF AIRPLANE IS LOCATED ON AN UNPAVED SURFACE.

Alignment Check Equipment
Figure 1 (Sheet 2)

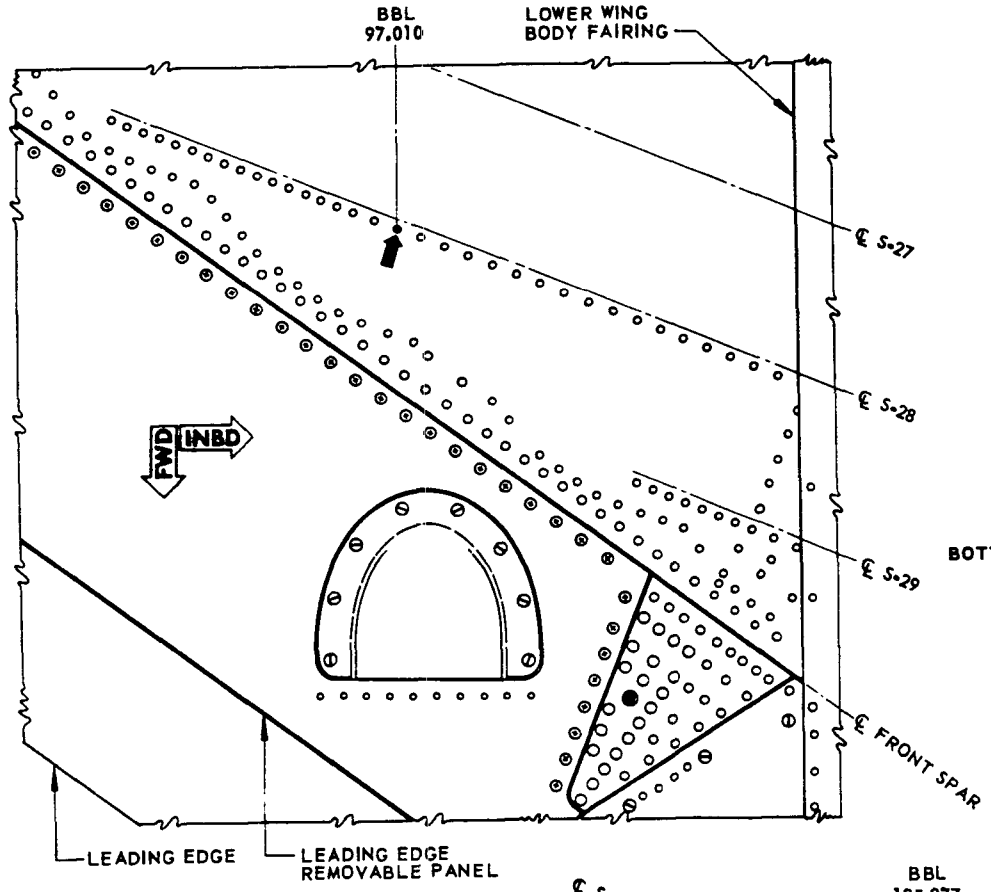


Jacking Diagram
Figure 2

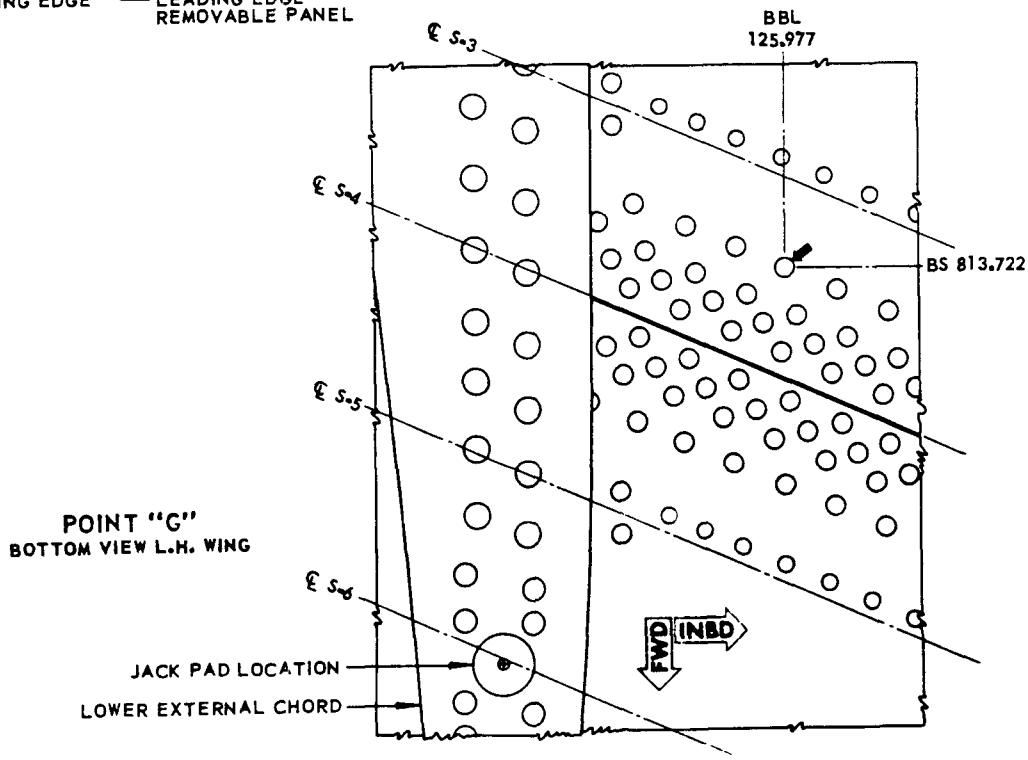




Alignment Point and Nose Wheel Well Leveling Pad Location
Figure 3 (Sheet 1 of 7)

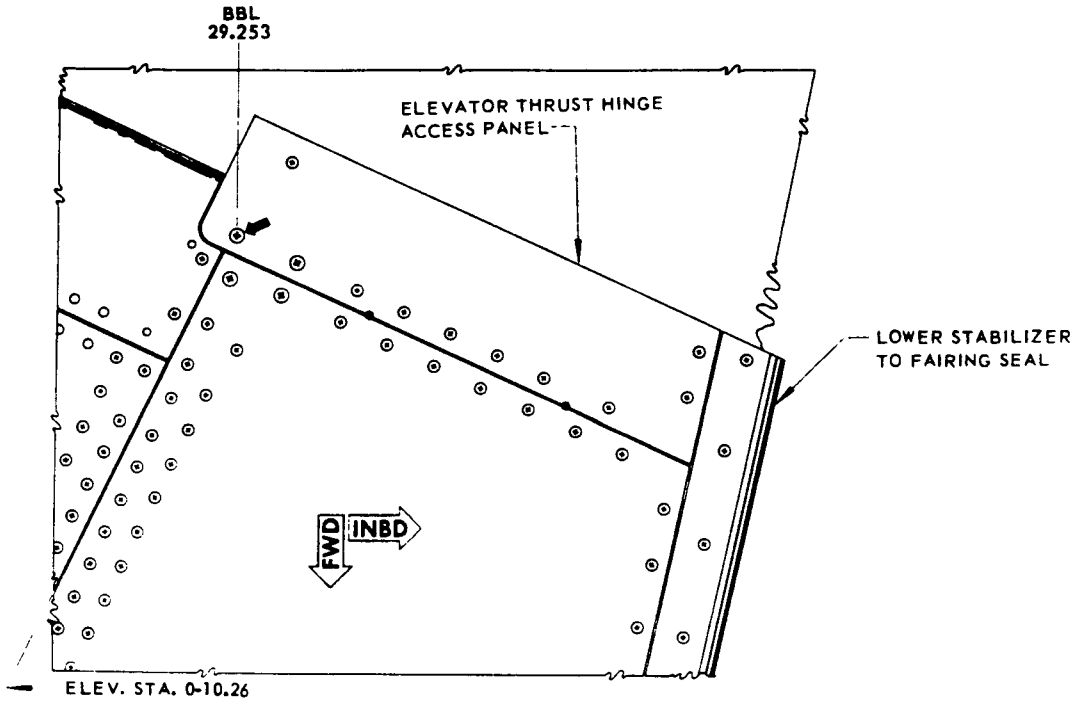


POINT "F"
BOTTOM VIEW L.H. WING

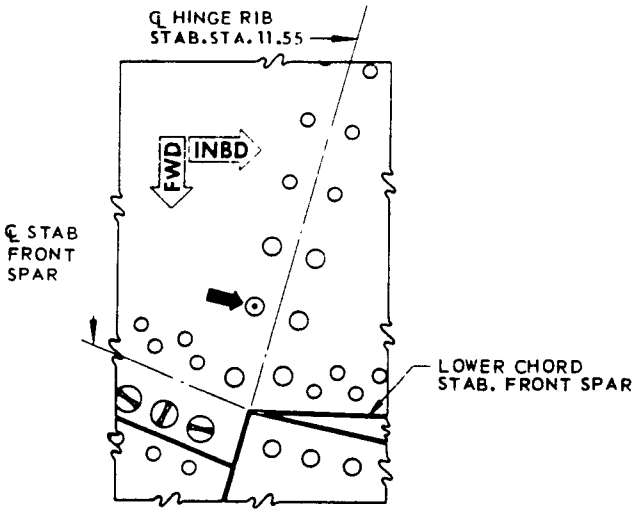


POINT "G"
BOTTOM VIEW L.H. WING

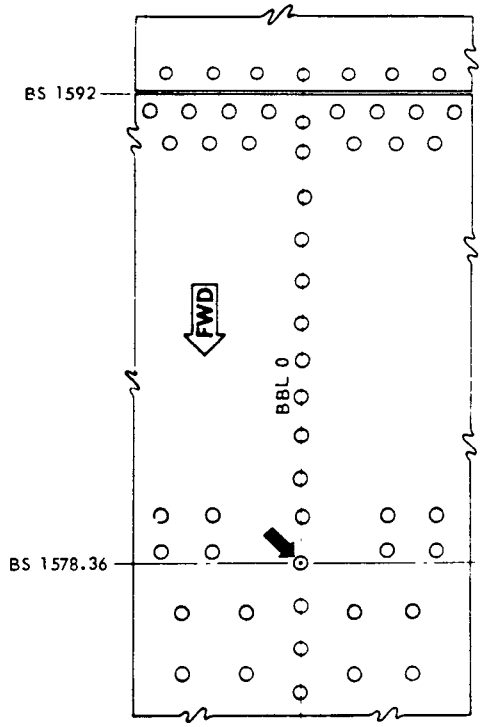
Alignment Point and Nose Wheel Well Leveling Pad Location
Figure 3 (Sheet 2 of 7)



POINT "J"
BOTTOM VIEW
L.H. HORIZONTAL STABILIZER



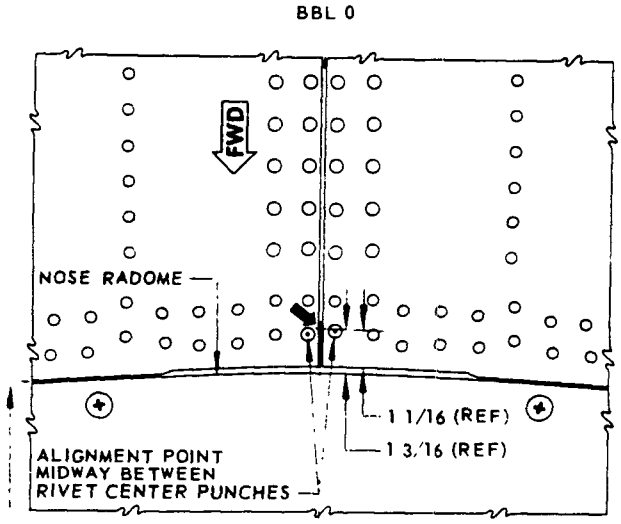
POINT "H"
BOTTOM VIEW
L.H. HORIZONTAL STABILIZER



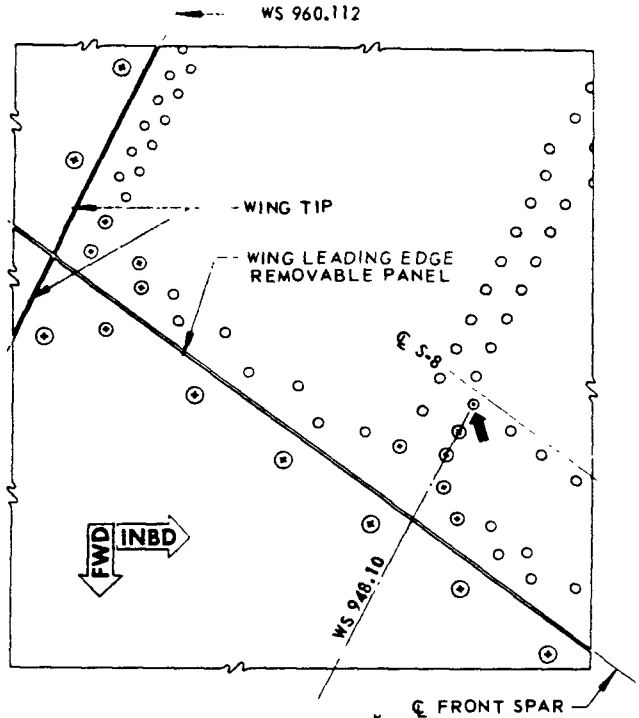
POINT "L"
BOTTOM VIEW

REMOVE VENTRAL FIN
TO EXPOSE POINT "L."

Alignment Point and Nose Wheel Well Leveling Pad Location
Figure 3 (Sheet 3 of 7)

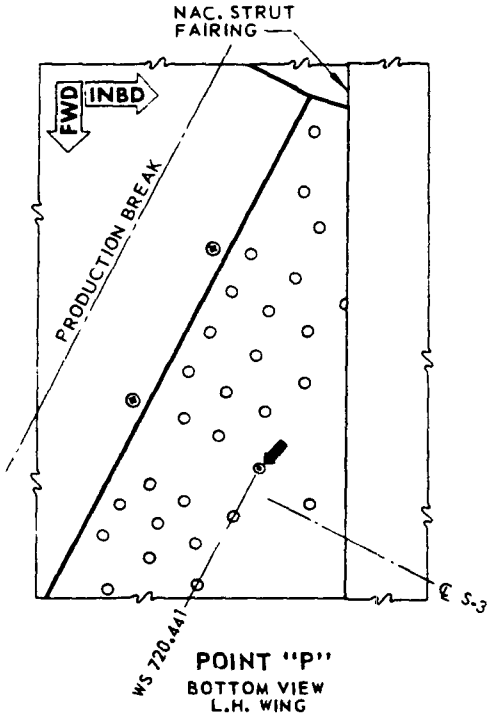


POINT "M"
BOTTOM VIEW

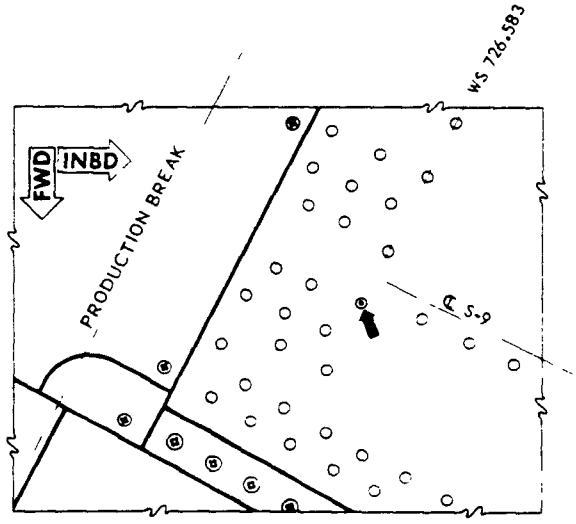


POINT "N"*
BOTTOM VIEW L.H. WING

* FOR TURBOFAN AIRPLANES
SEE PAGE 26A

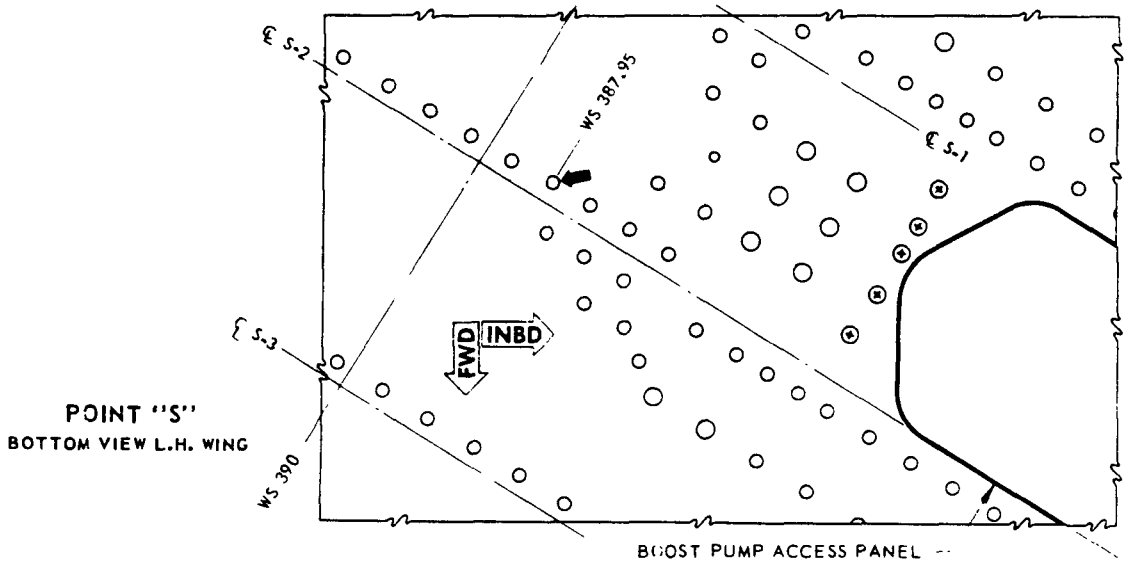


POINT "P"
BOTTOM VIEW
L.H. WING

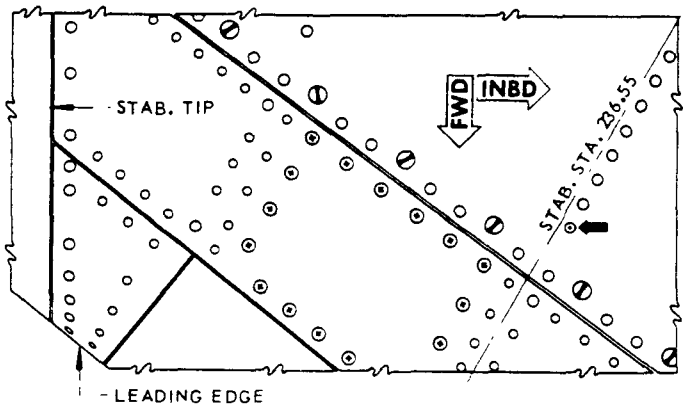


POINT "Q"
BOTTOM VIEW L.H. WING

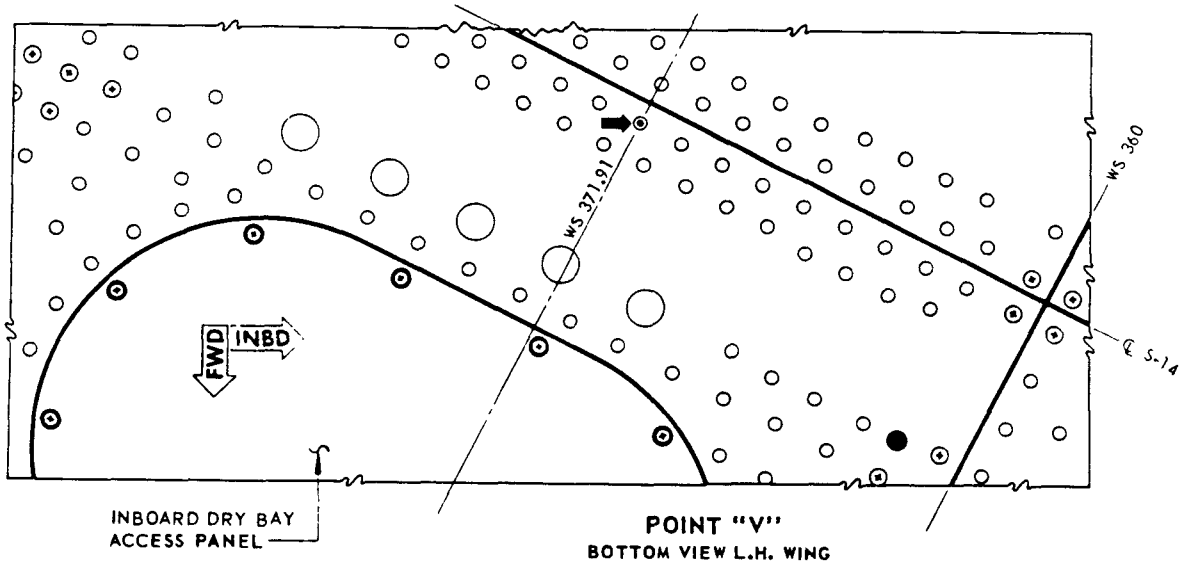
Alignment Point and Nose Wheel Well Leveling Pad Location
Figure 3 (Sheet 4 of 7)



POINT "S"
BOTTOM VIEW L.H. WING

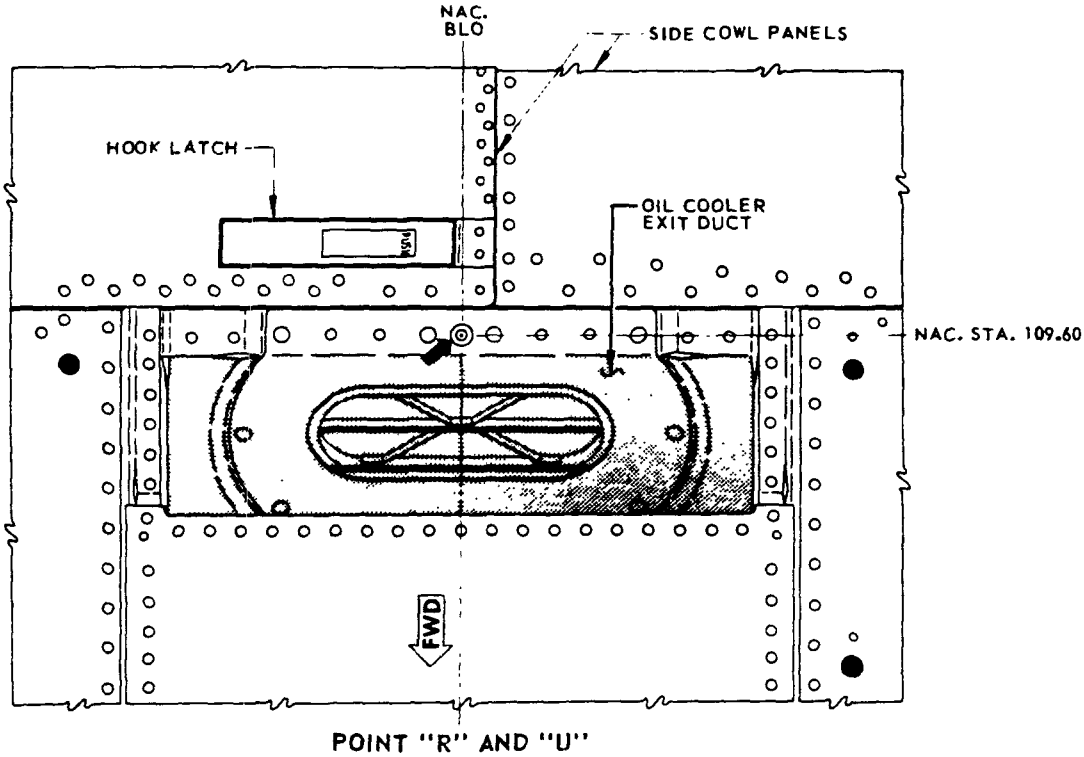


POINT "T"
BOTTOM VIEW
L.H. HORIZONTAL STABILIZER



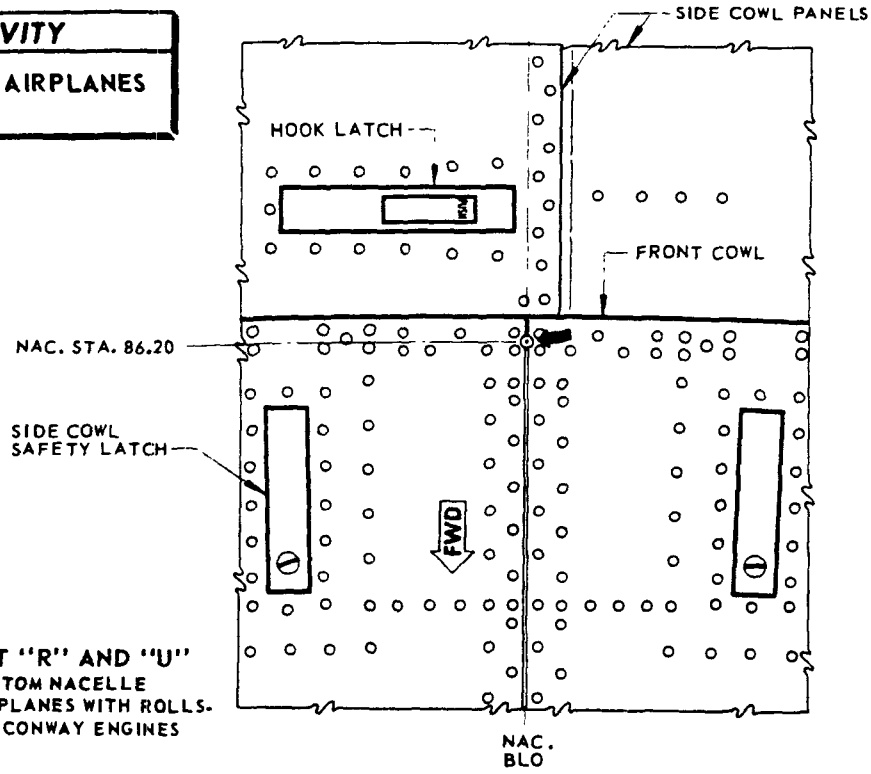
POINT "V"
BOTTOM VIEW L.H. WING

Alignment Point and Nose Wheel Well Leveling Pad Location
Figure 3 (Sheet 5 of 7)



POINT "R" AND "U"
BOTTOM NACELLE
FOR AIRPLANES WITH JT4 ENGINES

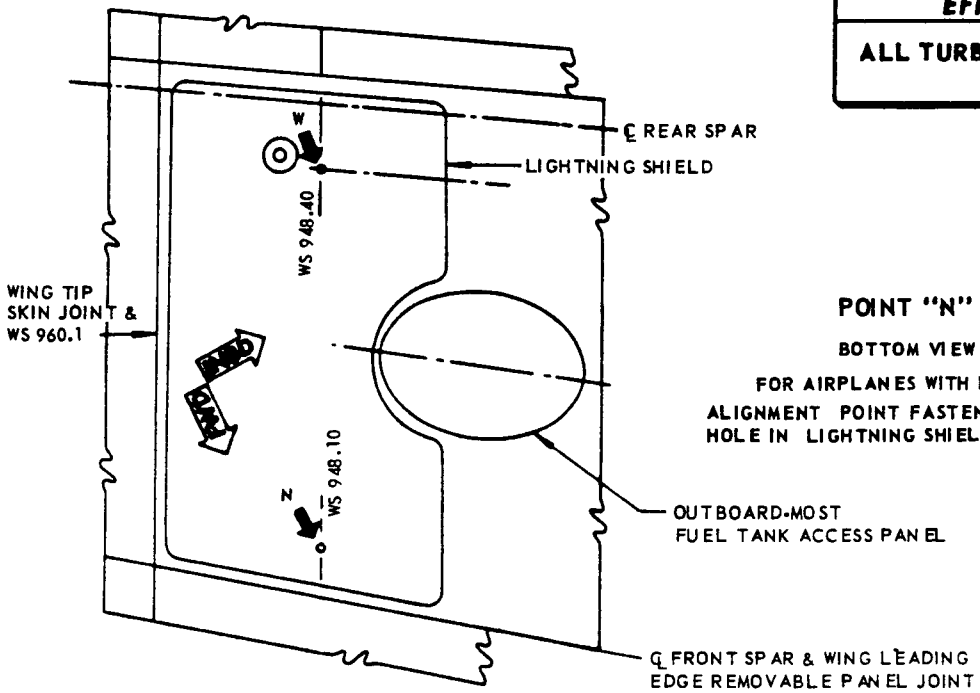
EFFECTIVITY
ALL TURBOJET AIRPLANES



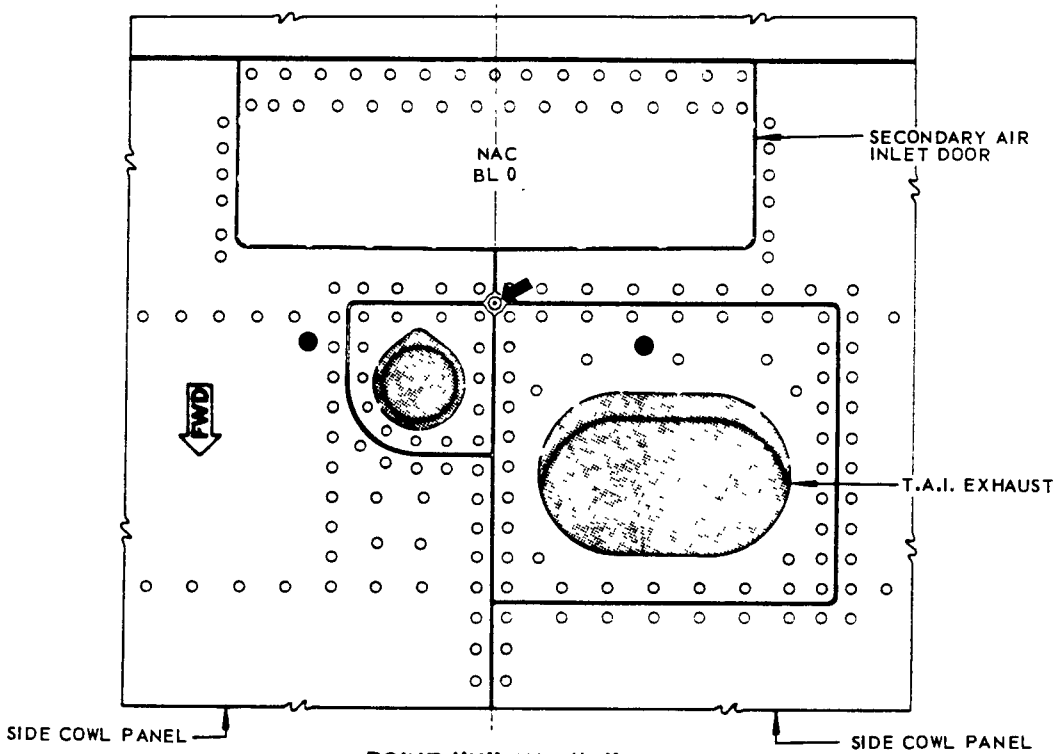
POINT "R" AND "U"
BOTTOM NACELLE
FOR AIRPLANES WITH ROLLS-ROYCE CONWAY ENGINES

Alignment Point and Nose Wheel Well Leveling Pad Location
Figure 3 (Sheet 6 of 7)

EFFECTIVITY
ALL TURBOFAN AIRPLANES

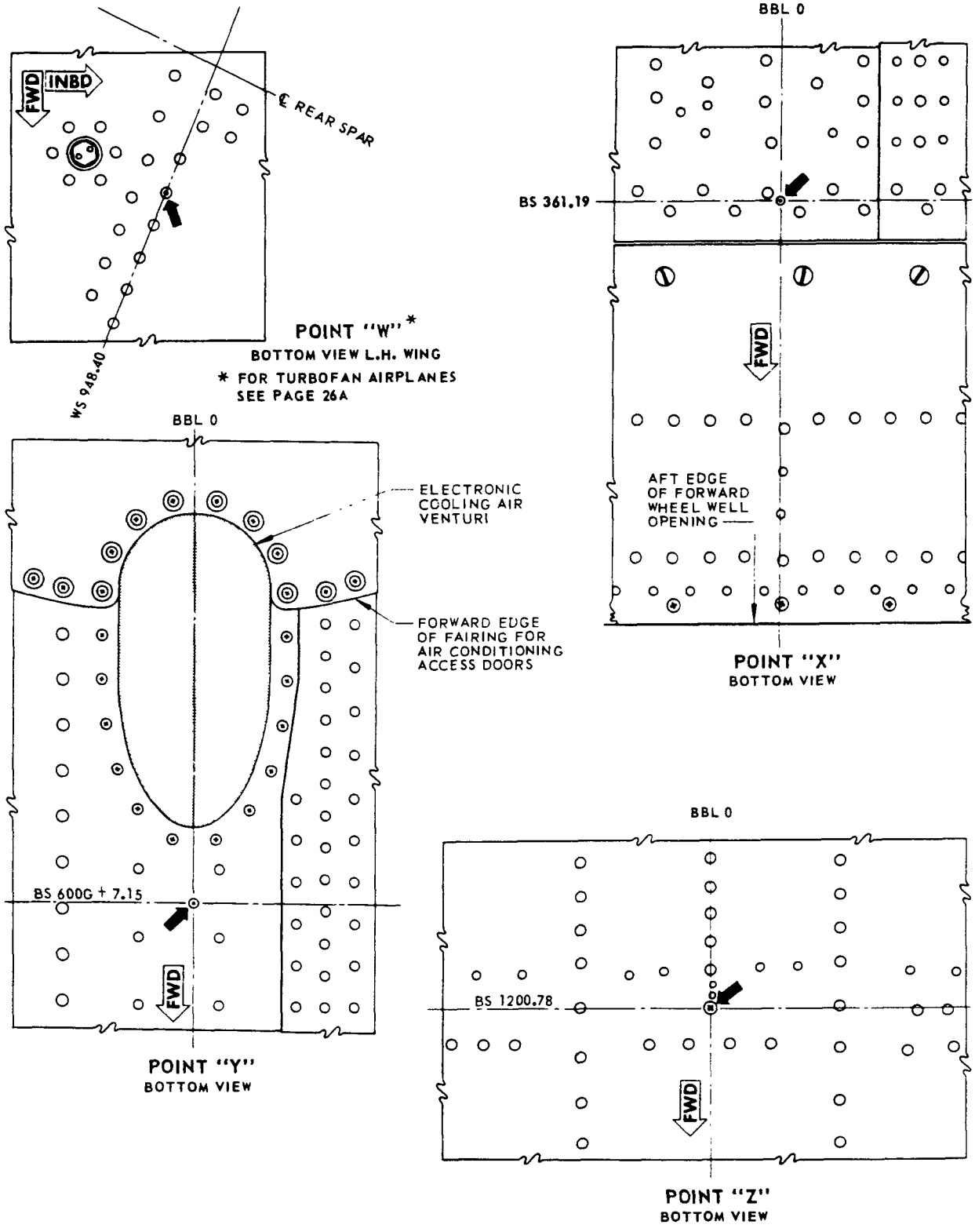


POINT "N" AND "W"
BOTTOM VIEW L.H. WING
FOR AIRPLANES WITH LIGHTNING SHIELD.
ALIGNMENT POINT FASTENER IS EXPOSED THRU HOLE IN LIGHTNING SHIELD.

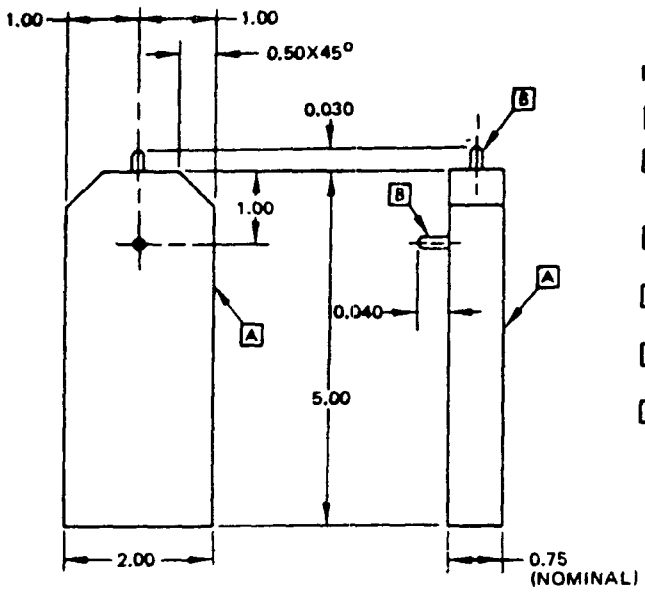


POINT "U" AND "R"
BOTTOM NACELLE
FOR JT3D ENGINE

Alignment Point and Nose Wheel Well Leveling Pad Location
Figure 3 (Sheet 6A of 7)



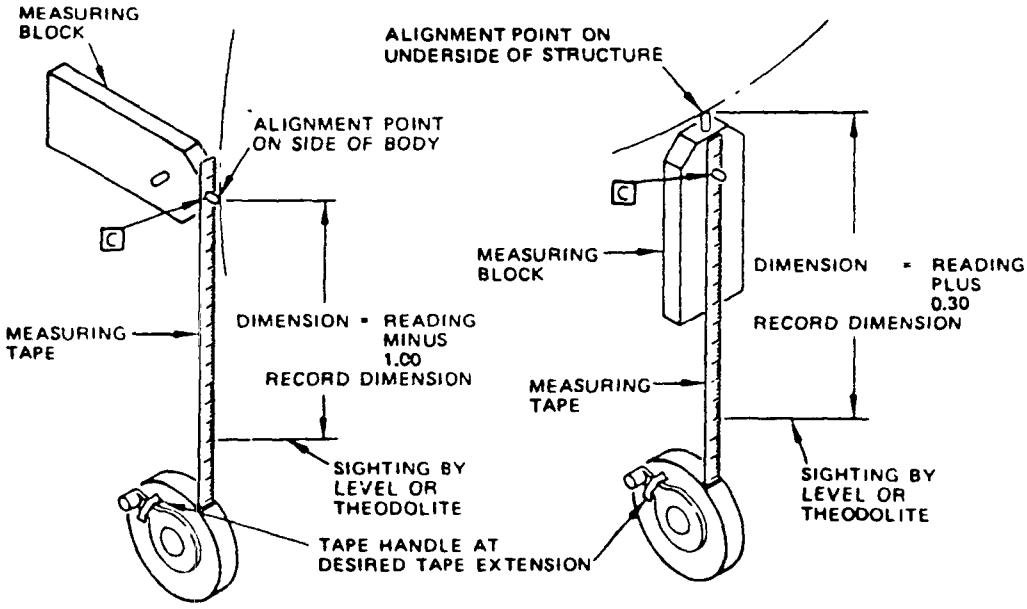
Alignment Point and Nose Wheel Well Leveling Pad Location
Figure 3 (Sheet 7 of 7)



NOTES

- A MAKE FROM CLEAR FINISHED WOOD
- B MAKE FROM NO. 6 WOOD SCREW. SCREW IN TO FULL DEPTH OF THREAD. CUT OFF HEAD AND ROUND OFF END.
- C DRILL HOLE IN MEASURING TAPE TO FIT PIN AT 1.00 INCH FROM END OF TAPE
- D MAKE FROM NAIL. CUT OFF HEAD AND ROUND OFF END.
- E DRILL 1/8 DIAMETER HOLE IN TAB OF FLEXIBLE SCALE
- F ALLOW SCALE TO HANG VERTICALLY. DO NOT DEFLECT SCALE BY TILTING DOWEL TOO FAR OFF VERTICAL

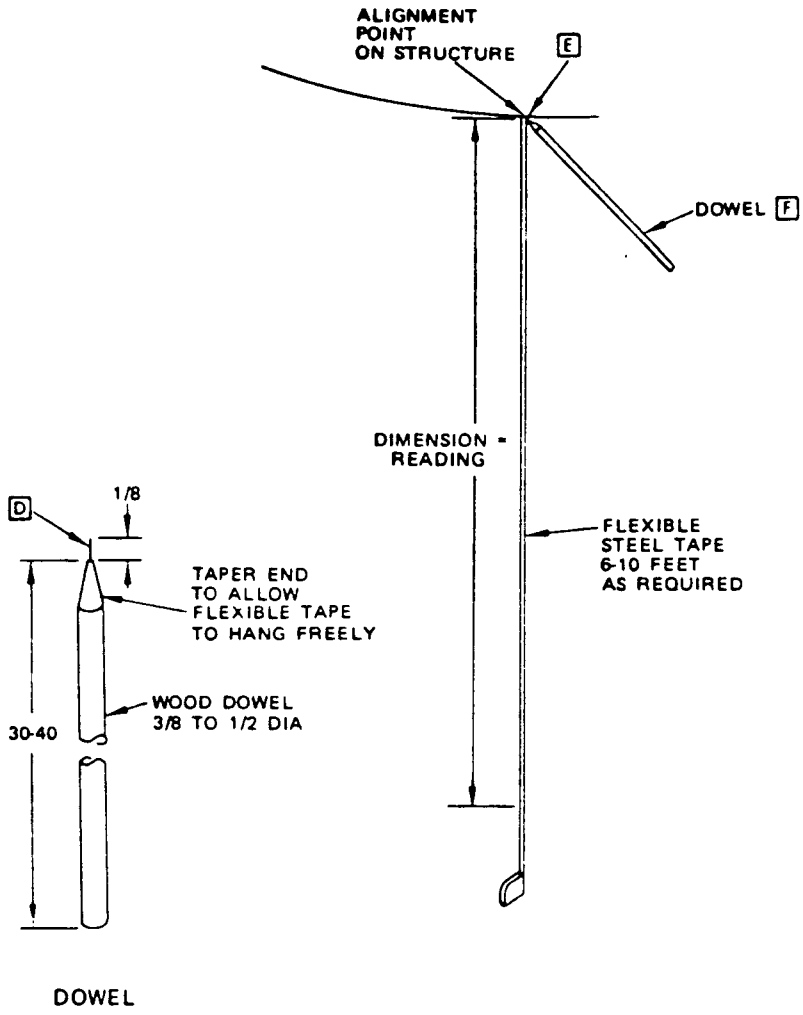
MEASURING BLOCK



MEASURING METHODS WITH MEASURING BLOCK AND FLEXIBLE MEASURING TAPE ASSEMBLY

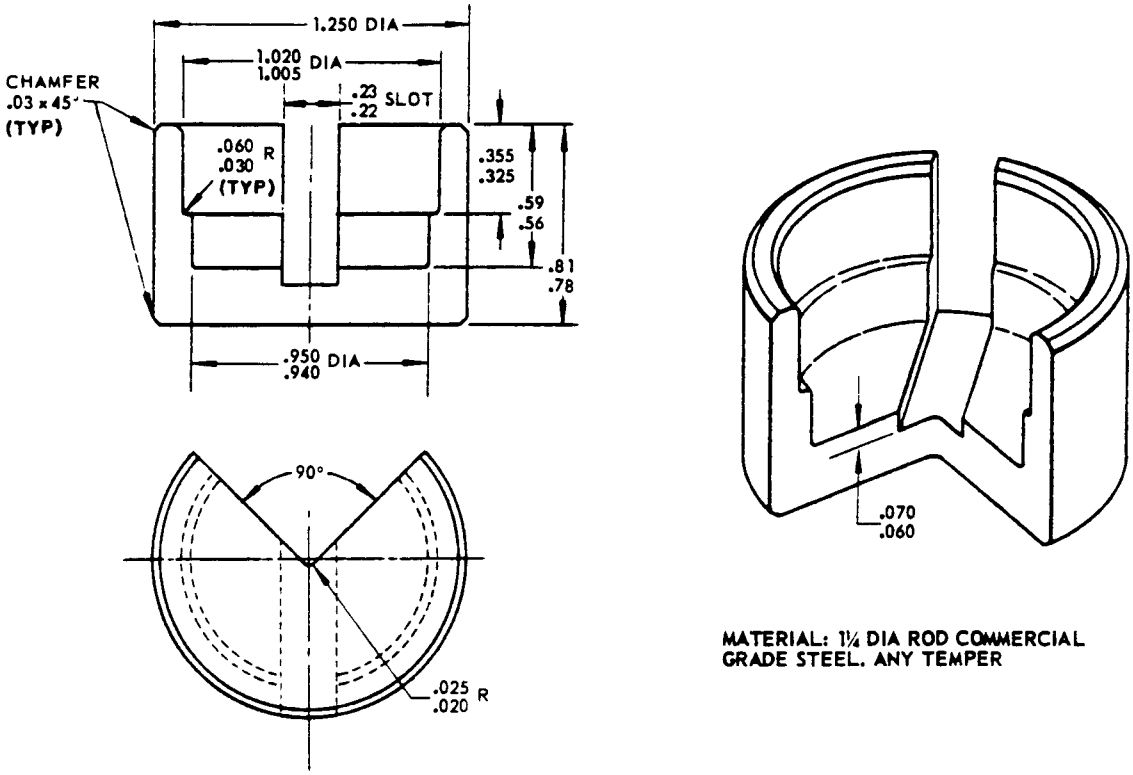
METHOD USING MEASURING BLOCK

Measuring Methods and Details
Figure 4 (Sheet 1)

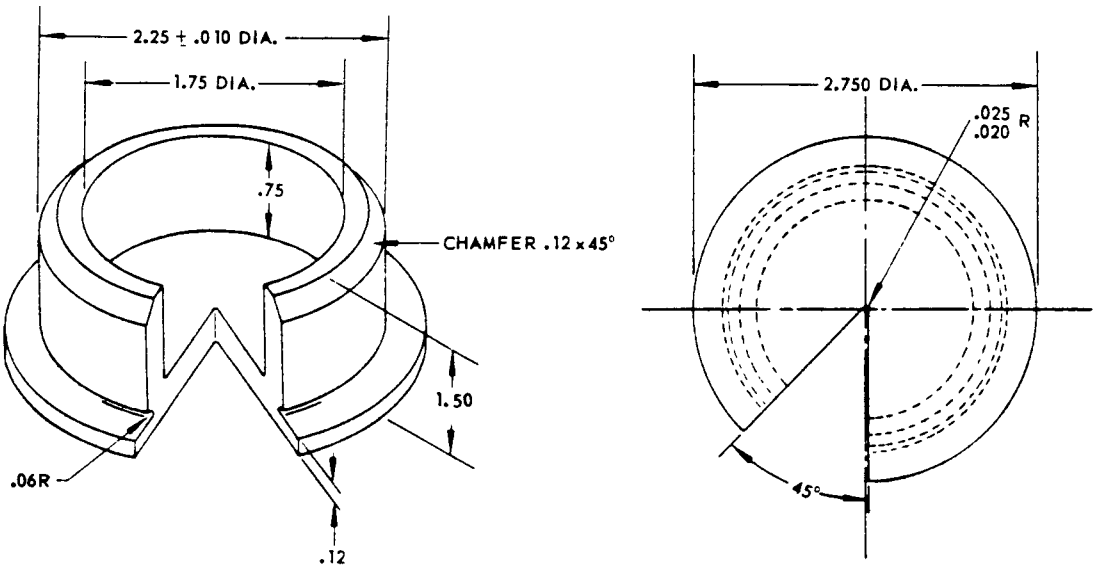


METHOD USING DOWEL

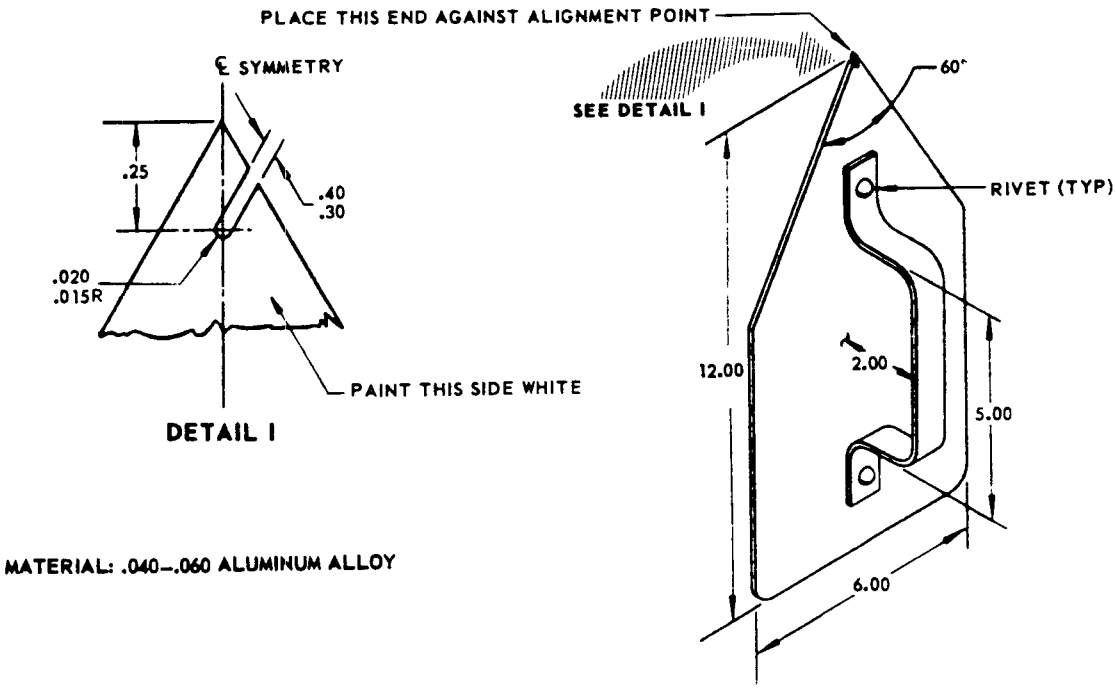
Measuring Methods and Details
Figure 4 (Sheet 2)



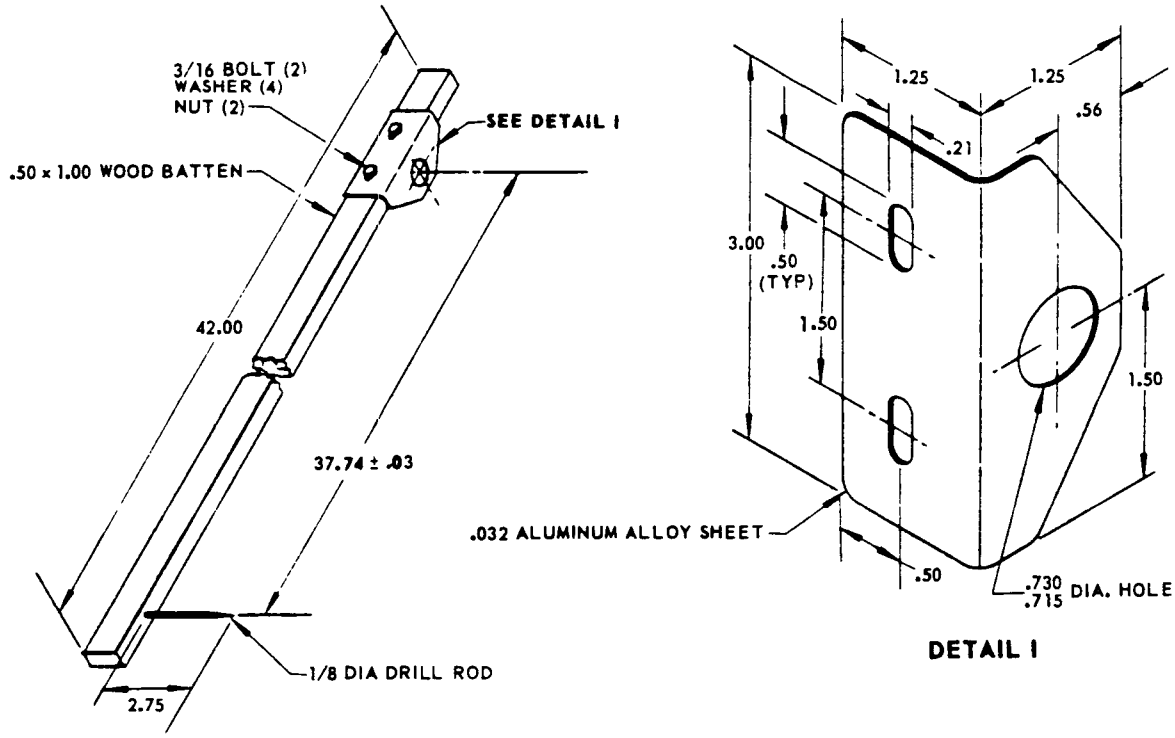
Plumb Bob Line Holder at **Nose Landing Gear** Oleo Center Line
Figure 5



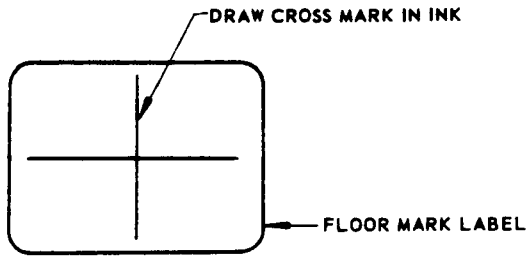
Plumb Bob Line Holder at **Main Landing Gear** Tow Ring
Figure 6

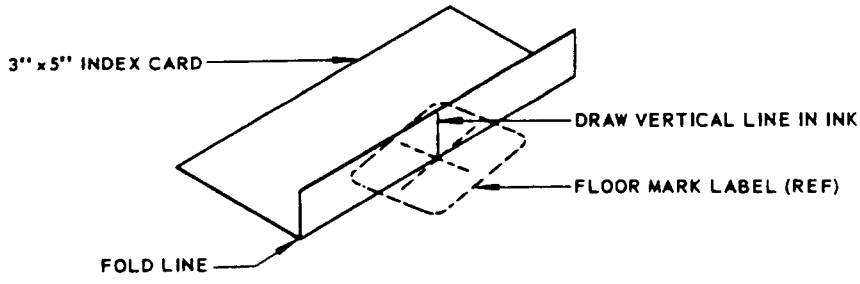


Plumb Bob Line Holder Assembly for Alignment Points on Contoured Surface
Figure 7

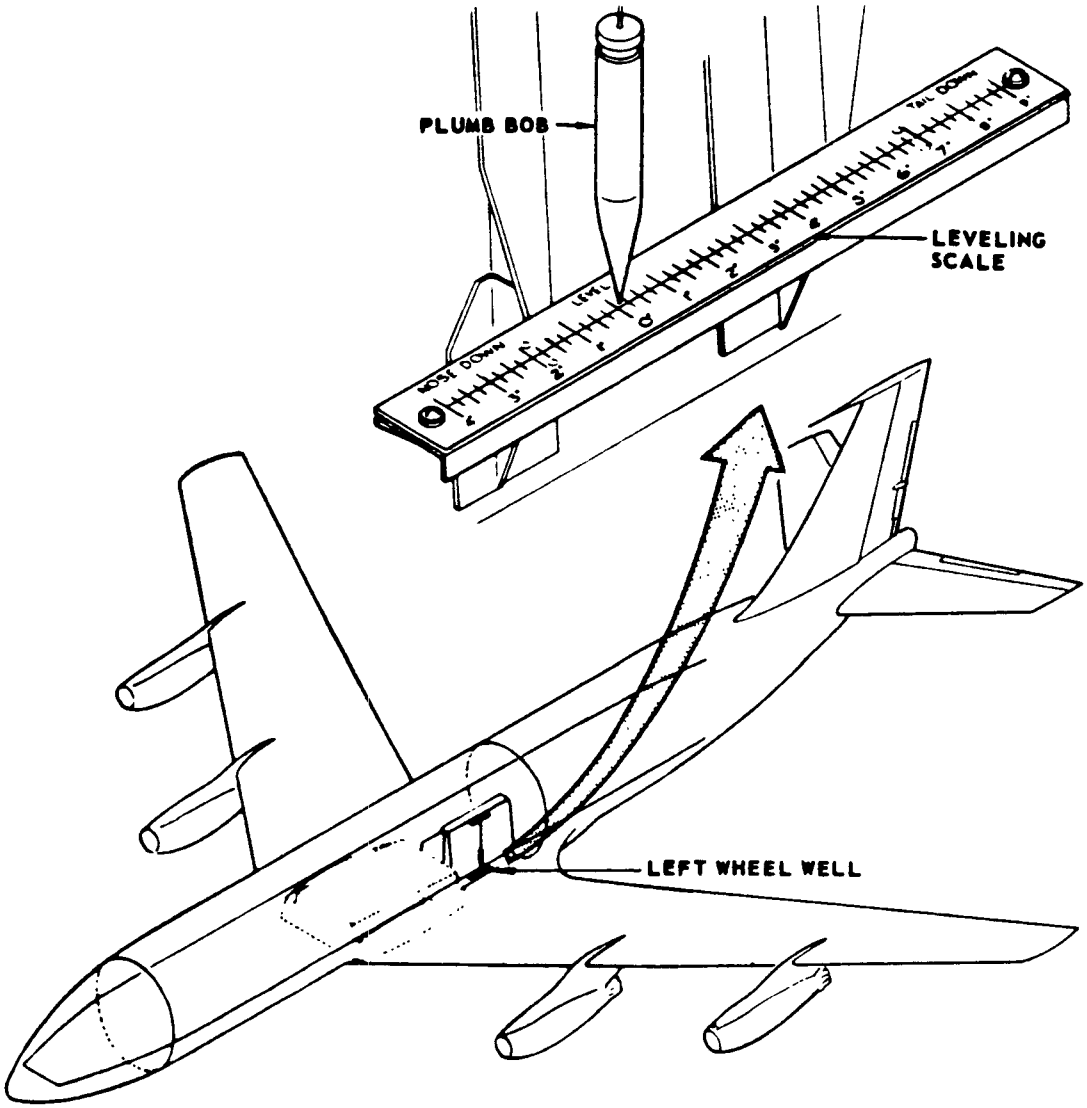


Trammel Assembly
Figure 8

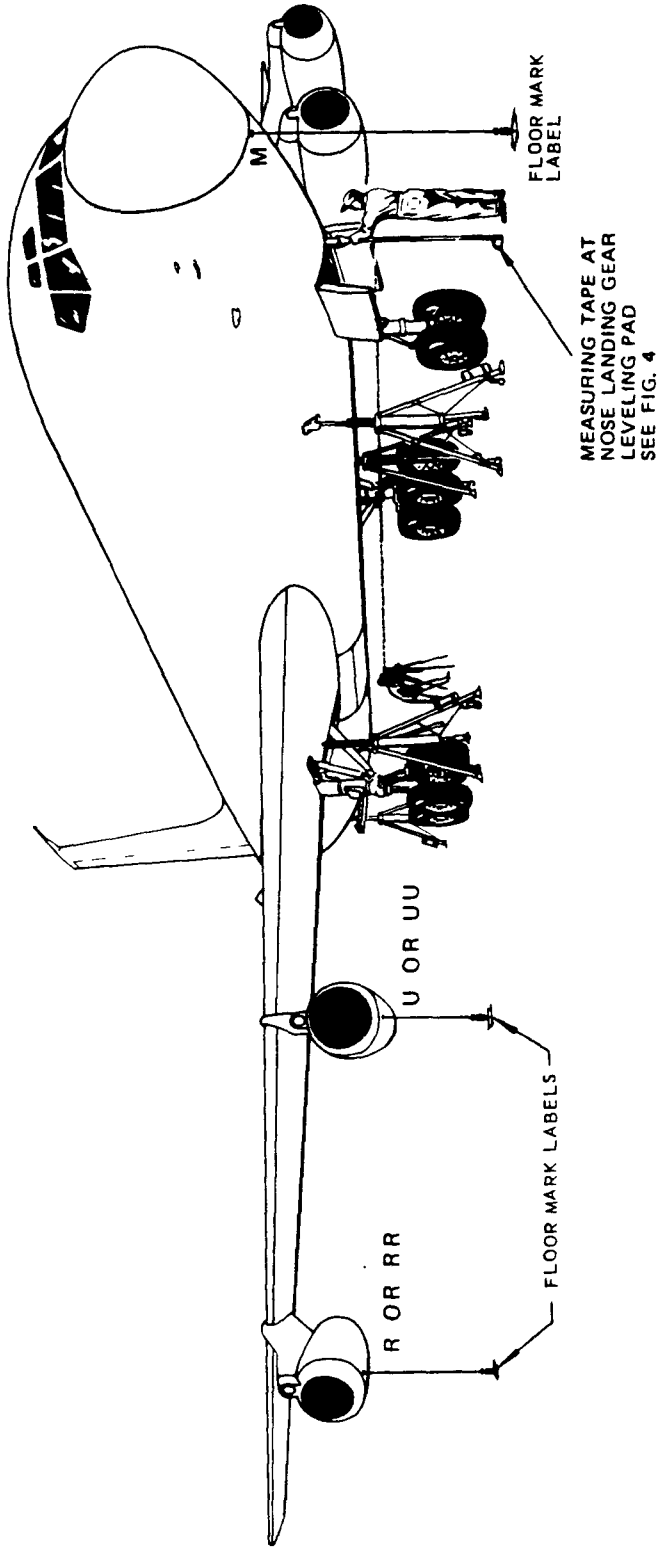




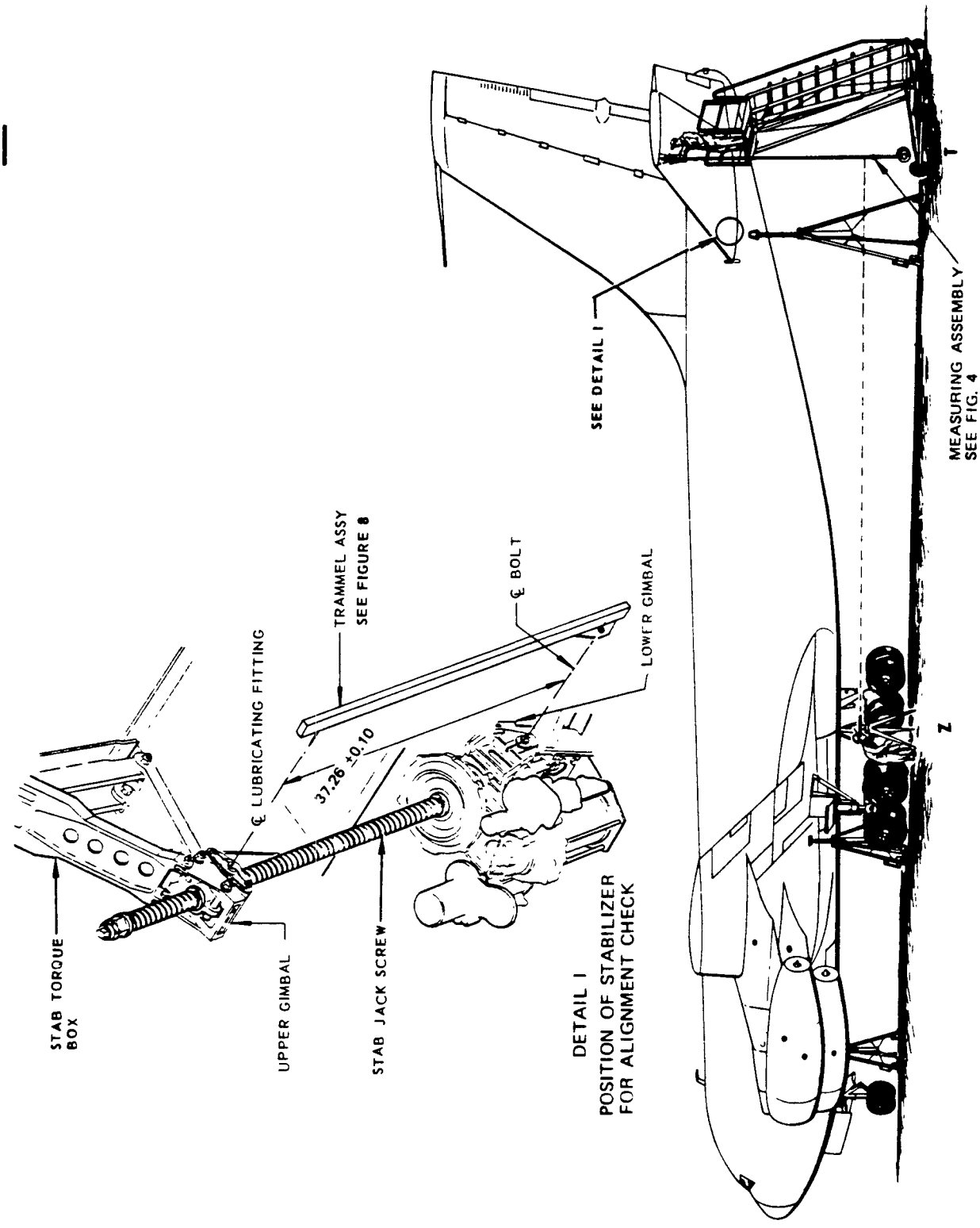
Preparation of Floor Mark Labels and Index Cards
Figure 9



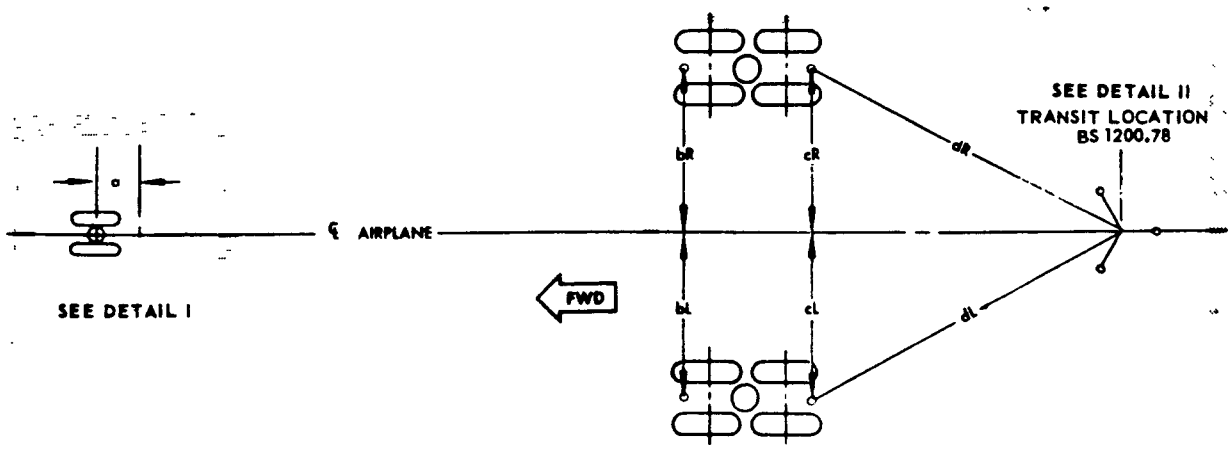
Airplane Leveling Using Plumb Bob
Figure 10



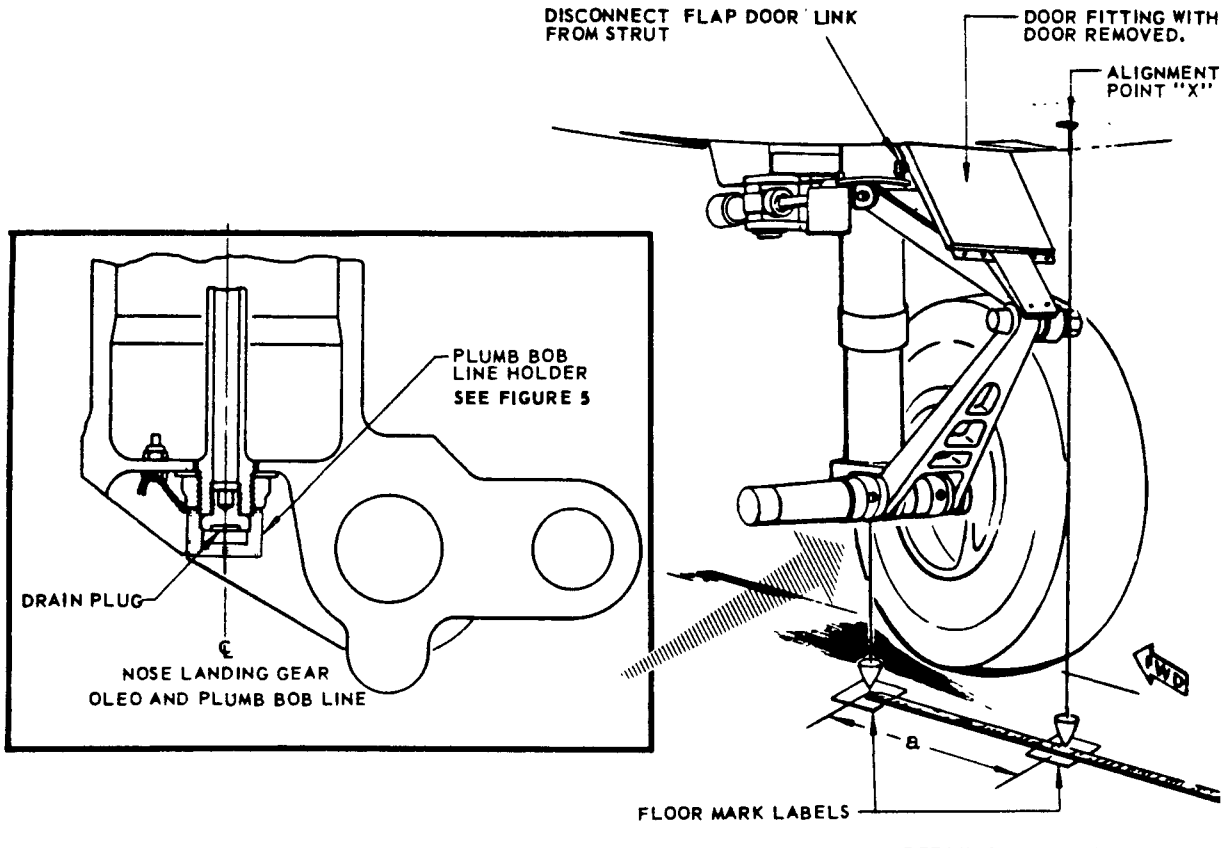
Airplane Leveling Using Engineer's Transit or Dumpy Level
Figure 11



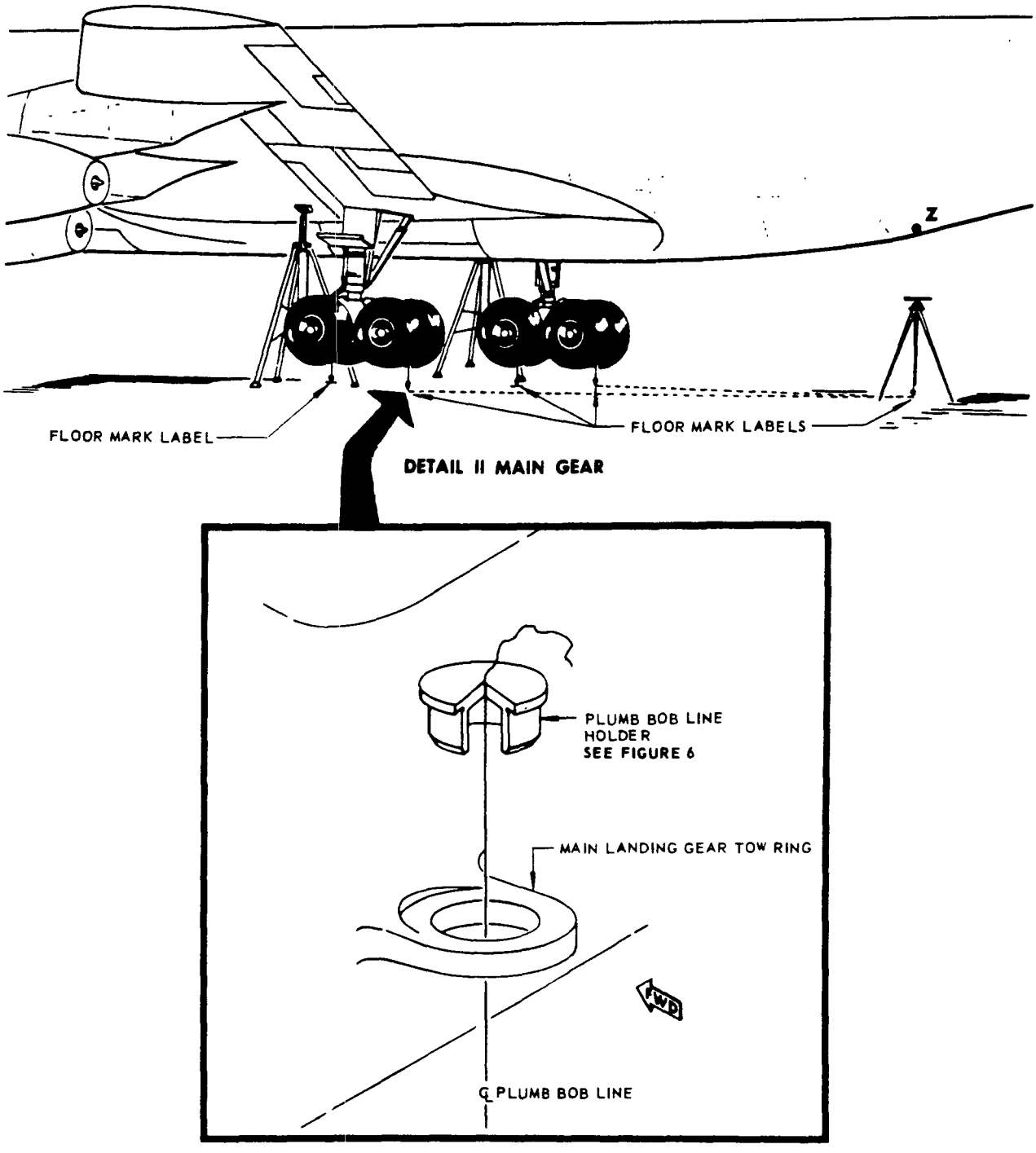
Stabilizer Alignment Check
Figure 12



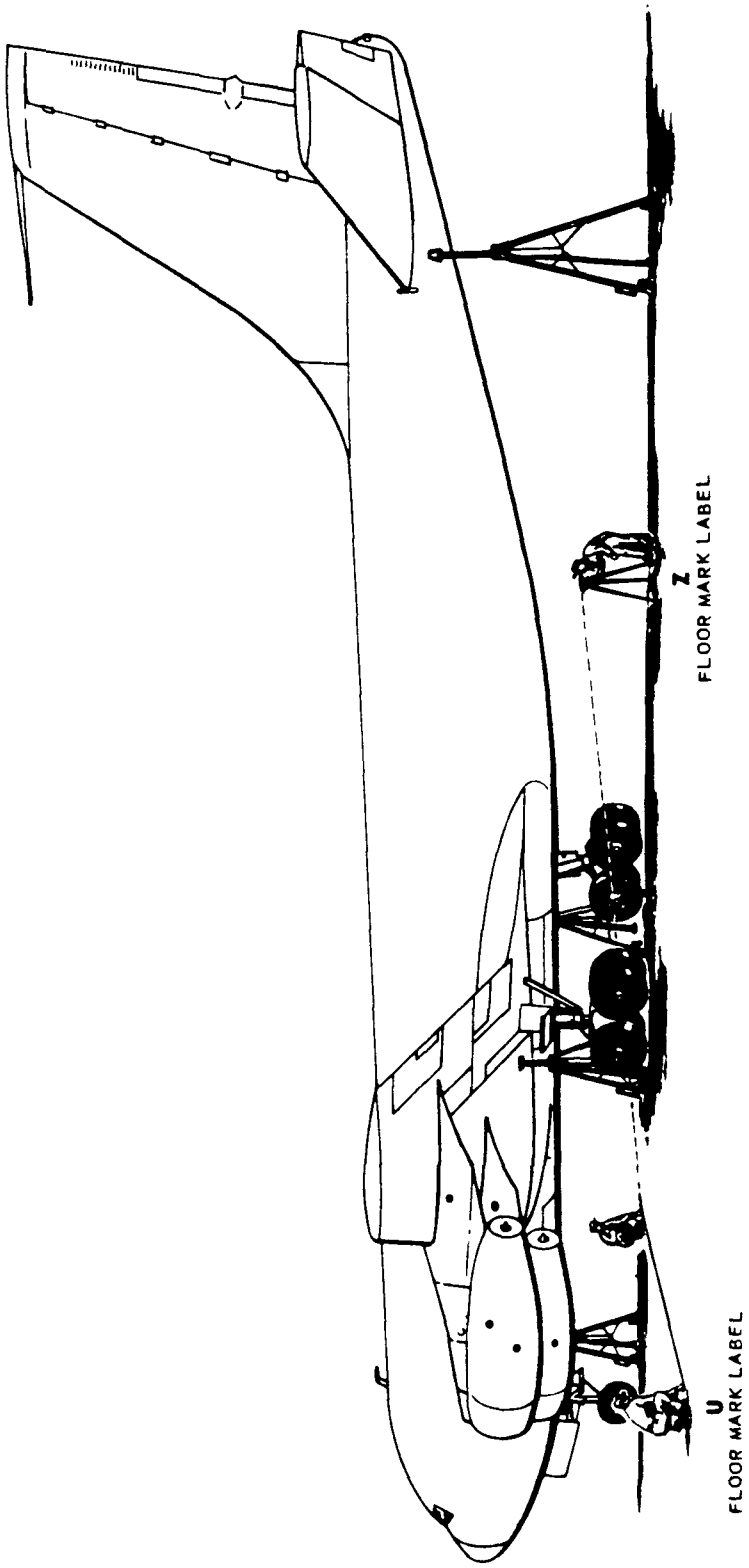
LANDING GEAR ALIGNMENT CHECK DIAGRAM



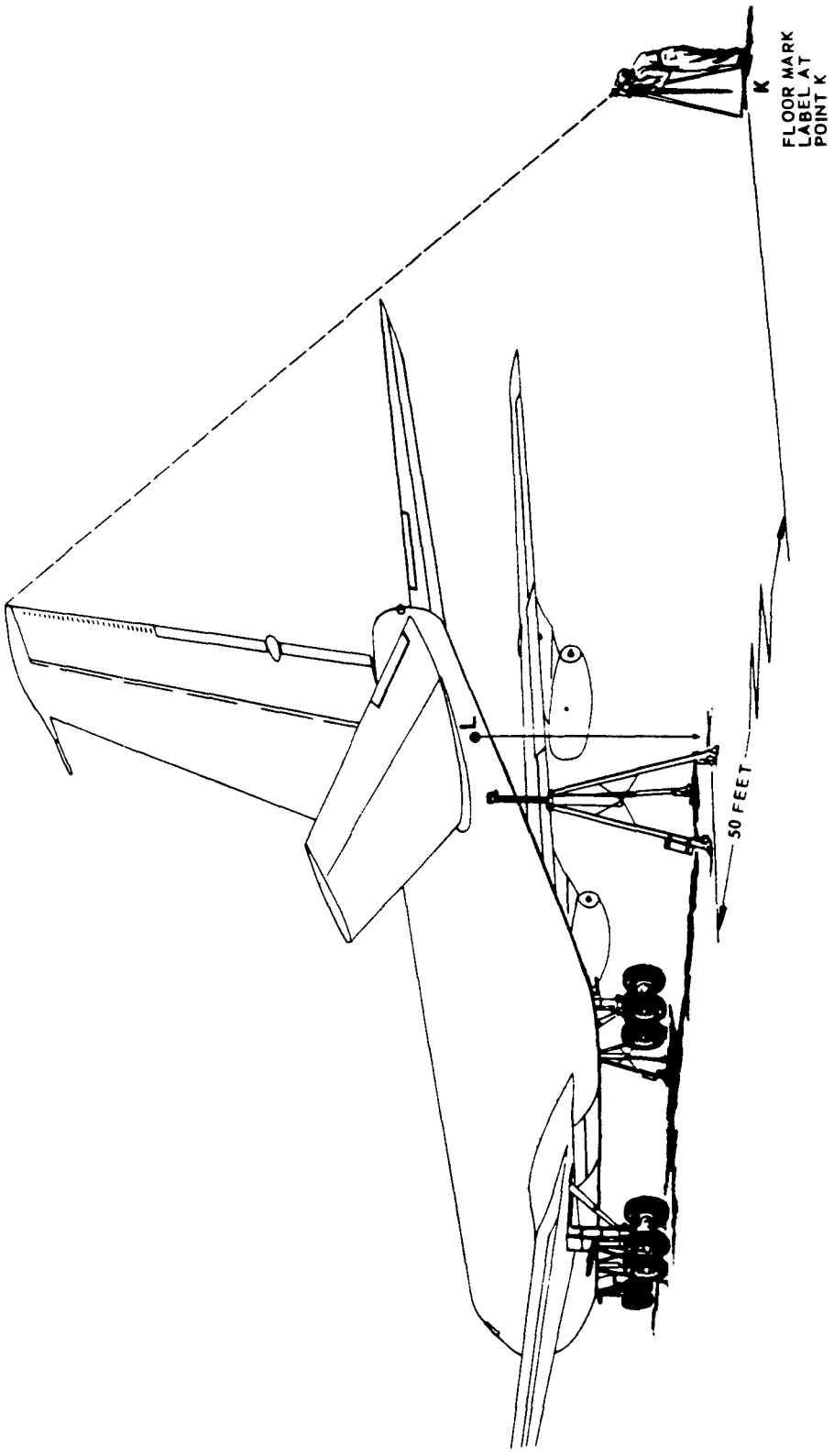
DETAIL I NOSE GEAR



Landing Gear Alignment Check
Figure 13 (Sheet 2 of 2)



Nacelle Alignment Check
Figure 14



Fin Tip Alignment Check
Figure 15

FOR TURBOJET AIRPLANES (JT4 ENGINES)

SECTION	POINT	ELEVATION (DEFLECTED) AVERAGE	± VARIATION C	± VARIATION D	AZIMUTH COMPUTED	± VARIATION C	± VARIATION D	DISTANCE AVERAGE	± VARIATION C	± VARIATION D
WING A	F	161.80	.20	.10	8°45'	1'	1'			
	G	163.81 INDEX	.02	.02	16°26'	1'	1'			
	V	196.39	.25	.20	40°58'	2'	2'			
	S	189.89	.15	.20	45°35'	2'	2'			
	V-S	6.50	.20	.20	—	—	—			
	Q	224.25	.70	.20	72°15'	2'	2'			
	P	218.95	.60	.20	74°35'	2'	2'			
	Q-P	5.36	.30	.10	—	—	—			
	N	239.00	1.00	.50	84°57'	3'	3'			
	W	236.00	1.00	.50	86°37'	3'	3'			
	N-W	3.00	.20	.10	—	—	—			
EMPENNAGE A	H	261.42	1.10	.20	166°45'	2'	2'			
	J	254.97	1.60	.20	176°03'	2'	2'			
	T	285.68	1.30	.50	151°20'	2'	2'			
	FIN TIP	—	—	—	0°0'	6' E	—			
BODY A	M	174.76	.35	—	0°0'	1' E	—			
	LEVELING PAD NLG	170.80 INDEX	.02	.02	—	—	—			
	X	136.46	.15	—	0°0'	INDEX				
	Y	135.86	.20	—	0°0'	1'	—			
	Z	151.04	.40	—	0°0'	INDEX				
	L	227.31	.65	—	180°0'	2' E	—			
NACELLE A	U F	123.04	.40	.25	—	—	—	EBL 398.88	1.00	.70
	U B	128.75	.40	.50	—	—	—			
	R F	146.22	.85	.50	—	—	—	BBL 626.71	1.00	.70
	R B	151.14	.50	.50	—	—	—			
NOSE LANDING GEAR	OLEO ℄	—	—	—	0°0'	1' E	—	—	—	—
	a	—	—	—	—	—	—	25.10	.20	—
MAIN LANDING GEAR	b	—	—	—	—	—	—	132.55	.40	.40
	c	—	—	—	—	—	—	132.57	.40	.40
	b-c	—	—	—	—	—	—	.25	.40	.10
	d	—	—	—	—	—	—	349.67	.90	.10

Alignment Data
Figure 16 (Sheet 1 of 3)

NOTE

ABOVE SHOWN DATA ARE FACTORY MEASUREMENTS AND VARIATIONS EXPERIENCED ON NEW AIRPLANES WITH ZERO FLIGHT TIME. THESE DATA ARE TO BE USED AS A GUIDE IN APPRAISING THE STRUCTURAL AND AERODYNAMIC CONDITION OF AN AIRPLANE AFTER MAJOR REPAIRS OR AFTER AN AIRPLANE HAS BEEN SUBJECTED TO MANEUVERS REQUIRING AN ALIGNMENT CHECK.

DISCREPANCIES FROM GIVEN VARIATIONS WILL NOT NECESSARILY INDICATE THAT THE AIRPLANE IS NON-AIRWORTHY. DISCREPANCIES MAY BE DUE TO NORMAL OR ABNORMAL SERVICE LOADS. THESE DISCREPANCIES MUST BE APPRAISED FROM THE STRUCTURAL AND AERODYNAMIC POINTS OF VIEW IN ORDER TO DETERMINE THEIR CAUSE AND THE EFFECT OF THESE CAUSES ON FLIGHT SAFETY.

THE CAUSES MAY BE DUE TO LOCALIZED OR NON-LOCALIZED PERMANENT SET IN THE STRUCTURE. A MISLOCATED ALIGNMENT POINT WILL RESULT IN A FALSE READING.

A RELATIVELY LARGE DISCREPANCY FROM GIVEN VARIATIONS DUE TO NON-LOCALIZED PERMANENT SET IN THE STRUCTURE WILL NOT AFFECT FLIGHT SAFETY PROVIDED THAT UPON VISUAL INSPECTION IT IS FOUND THAT THERE ARE NO

1. LOCALIZED STRUCTURAL FAILURES SUCH AS:
   - A. BUCKLED OR CRACKED SKINS, SPAR WEBS OR CHORDS, STIFFENERS, CASTINGS, FORGINGS OR MACHINED PARTS,
   - B. LOOSE OR TILTED FASTENERS OR
   - C. FASTENER FAILURE IN TENSION OR SHEAR.
2. INDICATIONS OF STRUCTURAL FAILURES SUCH AS:
   - A. FUEL LEAKS IN THE WING FUEL TANK AREAS,
   - B. AIR LEAKS IN BODY PRESSURIZED AREAS,
   - C. PEELED-OFF PAINT,
   - D. INTERFERENCE OF MOVING PARTS OF A MECHANISM,
   - E. REFUSAL TO CLOSURE OF DOORS AND ACCESS PANELS DUE TO SURROUNDING STRUCTURE DISTORTION,
   - F. HYDRAULIC FLUID LEAKS,
   - G. FUEL LINE LEAKS,
   - H. AIR DUCT OR PNEUMATIC LINE LEAKS,
   - J. ELECTRIC CIRCUIT SHORTS OR
   - K. REQUIRED EXCESSIVE CONTROL SURFACE TRIM LIMITING CONTROL RANGE.

FOR EXAMPLE, IF A NEW ENGINE IS INSTALLED SO THAT IT IS OUT OF PARALLEL BEYOND GIVEN VARIATIONS OR IF THE WING CHORD TWIST AS GIVEN BY V-S, Q-P OR N-W VALUES IS OUTSIDE GIVEN VARIATION VALUES, THE AIRPLANE IS AIRWORTHY PROVIDED IT CAN BE AERODYNAMICALLY TRIMMED WITHOUT LOSS OF PRESCRIBED CONTROL RANGE OR IF THE RESULTANT POWER AND RANGE LOSS IS ACCEPTABLE.

ON THE OTHER HAND A RELATIVELY SMALL DISCREPANCY FROM GIVEN VARIATIONS MAY BE DUE TO LOCALIZED PERMANENT SET IN THE STRUCTURE AS DESCRIBED IN PARAGRAPHS 1 AND 2. UNDER THESE CIRCUMSTANCES THE AIRPLANE IS NOT AIRWORTHY AND REQUIRES ATTENTION.

IN VIEW OF ABOVE CONSIDERATIONS IT IS OBVIOUS THAT IT IS IMPRACTICAL TO DEFINE THE PERMISSIBLE VARIATIONS IN TERMS OF MAXIMUM AMOUNT IN MINUTES (FOR AZIMUTH READINGS) OR MAXIMUM AMOUNT IN INCHES (FOR ELEVATION OR DISTANCE READINGS). FOR EXAMPLE, A 2.00 DISCREPANCY FROM FACTORY VARIATION AT THE WING TIP ALIGNMENT POINTS N AND W MAY BE ACCEPTABLE PROVIDED THERE ARE NO LOCALIZED STRUCTURAL FAILURES, OR INDICATIONS OF LOCALIZED FAILURES OR AERODYNAMIC AND/OR MECHANICAL MALFUNCTIONING. WHEREAS A 1.00 DISCREPANCY FROM FACTORY VARIATION OF SAME WING ALIGNMENT POINTS N AND W MAY NOT BE ACCEPTABLE IF THERE ARE LOCALIZED FAILURES IN THE STRUCTURE, OR INDICATIONS OF LOCALIZED FAILURE OR AERODYNAMIC AND/OR MECHANICAL MALFUNCTIONING.

THE INSPECTION OF AN AIRPLANE AND THE APPRAISAL OF INSPECTION RESULTS UNDER SUCH CIRCUMSTANCES MUST BE PERFORMED BY A QUALIFIED STRUCTURAL AND/OR AERODYNAMICS ENGINEER.

A FINAL ELEVATION READING IS EQUAL TO SCALE READING PLUS EYE-PIECE ELEVATION (PER PARAGRAPH 10).

B FOR AIRPLANES WITH ROLLS-ROYCE CONWAY ENGINES

C FACTORY EXPERIENCED VARIATIONS APPLICABLE TO DIMENSIONS BETWEEN DIFFERENT AIRPLANES OF SAME MODEL.

D FACTORY EXPERIENCED VARIATIONS APPLICABLE TO SYMMETRICAL L.H. AND R.H. DIMENSIONS OF SAME AIRPLANE.

E INDICATE WHETHER TO THE LEFT OR RIGHT.

F FOR AIRPLANES WITH JT4 ENGINES

FOR TURBOFAN AIRPLANES (JT3D ENGINES)

SECTION	POINT	ELEVATION (DEFLECTED) AVERAGE	±VARIATION C	±VARIATION D	AZIMUTH COMPUTED	±VARIATION C	±VARIATION D	DISTANCE AVERAGE	±VARIATION C	±VARIATION D
WING A	F	161.83	.20	.10	8° 45'	1'	1'			
	G	163.81 INDEX	.02	.02	16 26'	1'	1'			
	V	196.23	.25	.20	40° 58'	2'	2'			
	S	189.75	.15	.20	45° 35'	2'	2'			
	V-S	6.32	.20	.20	——	—	—			
	Q	223.65	.70	.20	72° 15'	2'	2'			
	P	218.23	.60	.20	74° 35'	2'	2'			
	Q-P	5.25	.30	.10	——	—	—			
	N	237.47	1.00	.50	84° 57'	3'	3'			
	W	234.42	1.00	.50	86° 37'	3'	3'			
	N-W	3.00	.20	.10	——	—	—			
EMPENNAGE A	H	259.95	1.10	.20	166° 45'	2'	2'			
	J	253.22	1.60	.20	176° 03'	2'	2'			
	T	283.81	1.30	.50	151° 20'	2'	2'			
	FIN TIP	——	—	—	0° 0'	6' E	—			
BODY A	M	174.96	.35	—	0° 0'	1' E	—			
	LEVELING PAD NLG	170.80 INDEX	.02	.02	——	—	—			
	X	136.47	.15	—	0° 0'	INDEX				
	Y	135.96	.20	—	0° 0'	1' E	—			
	Z	150.14	.40	—	0° 0'	INDEX				
	L	225.91	.65	—	180° 0'	2' E	—			
NACELLE A	U	127.08	.40	.25	——	—	—	BBL 398.50	1.00	.70
	R	149.35	.85	.50	——	—	—	BBL 625.80	1.00	.70
NOSE LANDING GEAR	OLEO ℄	——	—	—	0° 0'	1' E	—	——	—	—
	a	——	—	—	——	—	—	25.25	.20	—
MAIN LANDING GEAR	b	——	—	—	——	—	—	132.53	.40	.40
	c	——	—	—	——	—	—	132.60	.40	.40
	b-c	——	—	—	——	—	—	.25	.40	.10
	d	——	—	—	——	—	—	349.80	.90	.10

ALIGNMENT DATA FIG. 17

MEASUREMENTS WHICH SATISFIED THE FOLLOWING DATA WERE EXPERIENCED IN AN ALIGNMENT CHECK OF A REWORKED 707-320 AIRFRAME WHICH WAS EXTENSIVELY DAMAGED IN THE BODY AND TO A LESSER EXTENT IN THE WING. THIS DATA IS ACCEPTABLE FOR AN AIRFRAME HAVING REPAIRED STRUCTURE.

STRUCTURE SURROUNDING THE REPAIRED AREA MUST BE EXAMINED FOR DEFECTS AS DIRECTED IN "NOTE" OF FIGURE 16.

ALIGNMENT POINT	H	L	N	Q	R	U	W	Z	N-W	Q-P	V-S
ELEVATION	261.64 ± 2.0	227.75 ± 1.85	239.00 ± 1.65	224.25 ± .90	146.22 ± 1.50	123.04 ± 1.00	236.00 ± 1.80	150.55 ± 1.0	3.00 ± .40	5.30 ± .80	6.33 ± .25

SUPPORT OF STRUCTURE FOR REPAIRS

1. General

A. Support airplane in jig position per 51-7-1 for performing wing and fuselage major repairs and for removal of all wing-spar-to-body attachment bottle pins. See Maintenance Manual, 57-1-1, for removal of bottle pins.

B. Support airplane in non-jig position per 51-7-2 for removal of only one wing-spar-to-body attachment bottle pin. See Maintenance Manual, 57-1-1, for removal of bottle pins.

C. Support removable structural components per 51-7-3 for performing major repairs. See 51-7-3, figure 1, for removal procedures of appropriate component.

END

SUPPORT OF AIRPLANE IN JIG POSITION

1. Raise Airplane per 51-7-4
2. Procure Equipment per Figure 1
3. Level Airplane per 51-7-5
4. Support Airplane per Figure 2
   - A. After airplane is supported, check if airplane attitude is per 51-7-5, figure 2.
   - B. Periodically check airplane attitude per 51-7-5, paragraph M.
5. After Required Repairs are Performed Lower Airplane per 51-7-6

ITEM	NO. REQ'D	IDENTIFICATION	SOURCE
HYDRAULIC JACK WING POINTS IV AND V [A]	2	MODEL B4A CAPACITY: 30 TONS (USA) MIN. HEIGHT: 55, 73, 91, 109, 127 OR 145 INCHES RAM STROKE: 40 INCHES MAX. SCREW EXTENSION: 15 INCHES	REGENT MFG. CO., OR EQUIVALENT
JACK PAD WING POINTS IV AND V	2	PART NO. F70009	BOEING AIRPLANE COMPANY
FUSELAGE SUPPORT JIGS AND CRADLES	3	SEE FIGURES 4 AND 5	FABRICATE
WING SUPPORT JIGS AND CRADLES [B]	6 JIGS OR 3 CRADLES	SEE FIGURE 6	
SCREW JACK OR HYDRAULIC JACK	2 PER FUSELAGE SUPPORT JIG	10-TON AUTOMOTIVE SEE FIGURES 4 AND 6	ANY SOURCE
	1 PER WING [B] SUPPORT JIG		

NOTE

[A] ALL HYDRAULIC JACKS MUST BE EQUIPPED WITH GAGES READING IN TONS (USA) OR POUNDS. IF GAGES READ IN PSI THEN A CONVERSION CHART MUST BE AVAILABLE TO CONVERT PSI. READINGS INTO TONS (USA) OR POUNDS.

[B] THESE ITEMS MAY BE OMITTED WHEN NO ENGINES ARE REMOVED. SEE FIGURE 2.

Support Equipment for Jig Position
Figure 1

SEE FIGURES 4 AND 5 FOR FUSELAGE SUPPORT JIGS AND CRADLES.

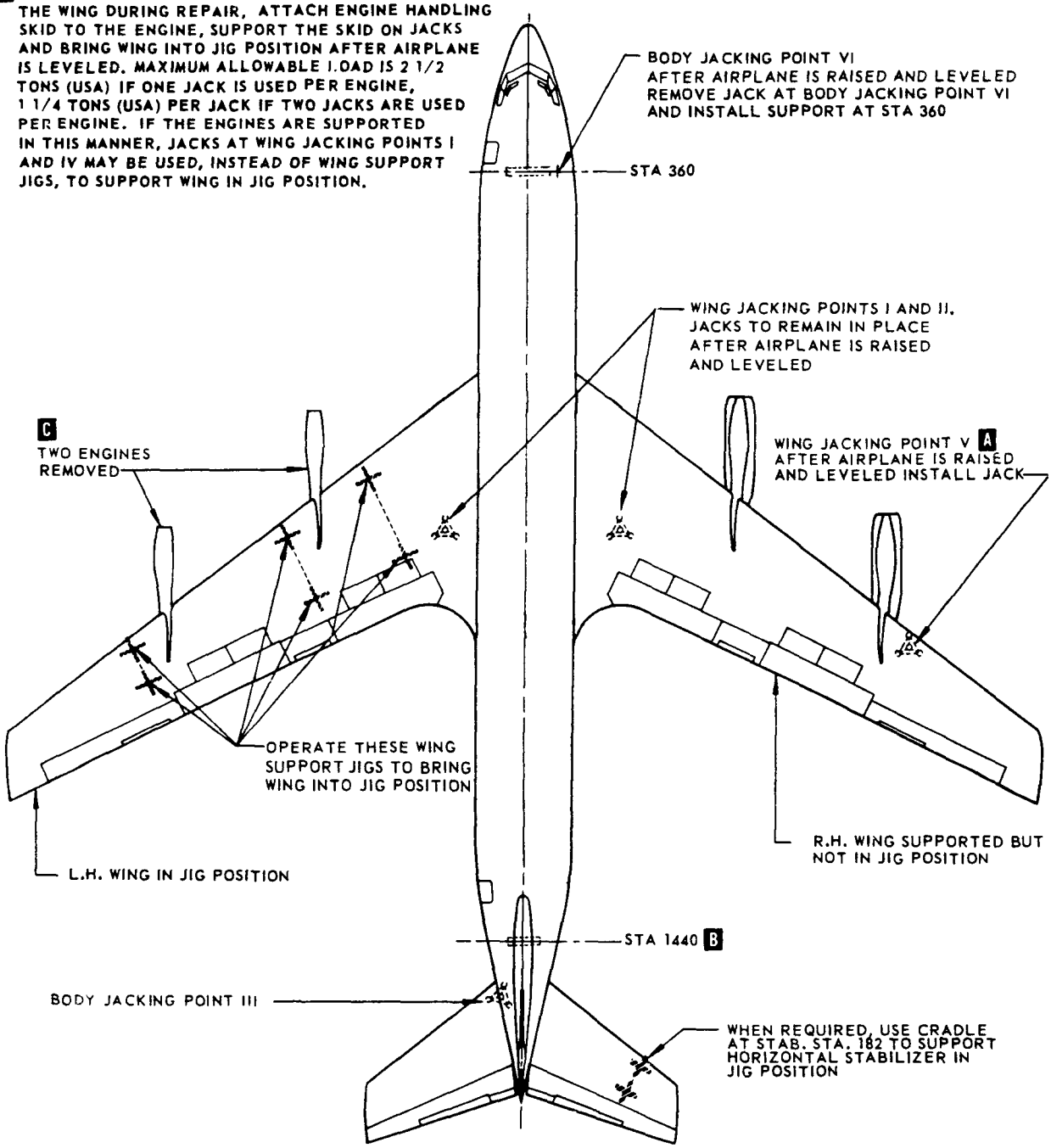
SEE FIGURE 6 FOR WING AND HORIZONTAL STABILIZER SUPPORT JIGS AND CRADLES.

SEE TEXT FOR AIRPLANE RAISING, LEVELING AND LOWERING PROCEDURE.

[B] REMOVE VENTRAL FIN BEFORE INSTALLING SUPPORT.

[C] IF IT IS DESIRED TO LEAVE THESE ENGINES ON THE WING DURING REPAIR, ATTACH ENGINE HANDLING SKID TO THE ENGINE, SUPPORT THE SKID ON JACKS AND BRING WING INTO JIG POSITION AFTER AIRPLANE IS LEVELED. MAXIMUM ALLOWABLE LOAD IS 2 1/2 TONS (USA) IF ONE JACK IS USED PER ENGINE, 1 1/4 TONS (USA) PER JACK IF TWO JACKS ARE USED PER ENGINE. IF THE ENGINES ARE SUPPORTED IN THIS MANNER, JACKS AT WING JACKING POINTS I AND IV MAY BE USED, INSTEAD OF WING SUPPORT JIGS, TO SUPPORT WING IN JIG POSITION.

[A] MAX ALLOWABLE LOAD: 6 TONS (USA) PER JACK
JACK PAD BAC PART NO. F70009
APPROXIMATE JACK PAD ELEVATION: 136.00



Support of Airplane in Jig Position
Figure 2

NOTE

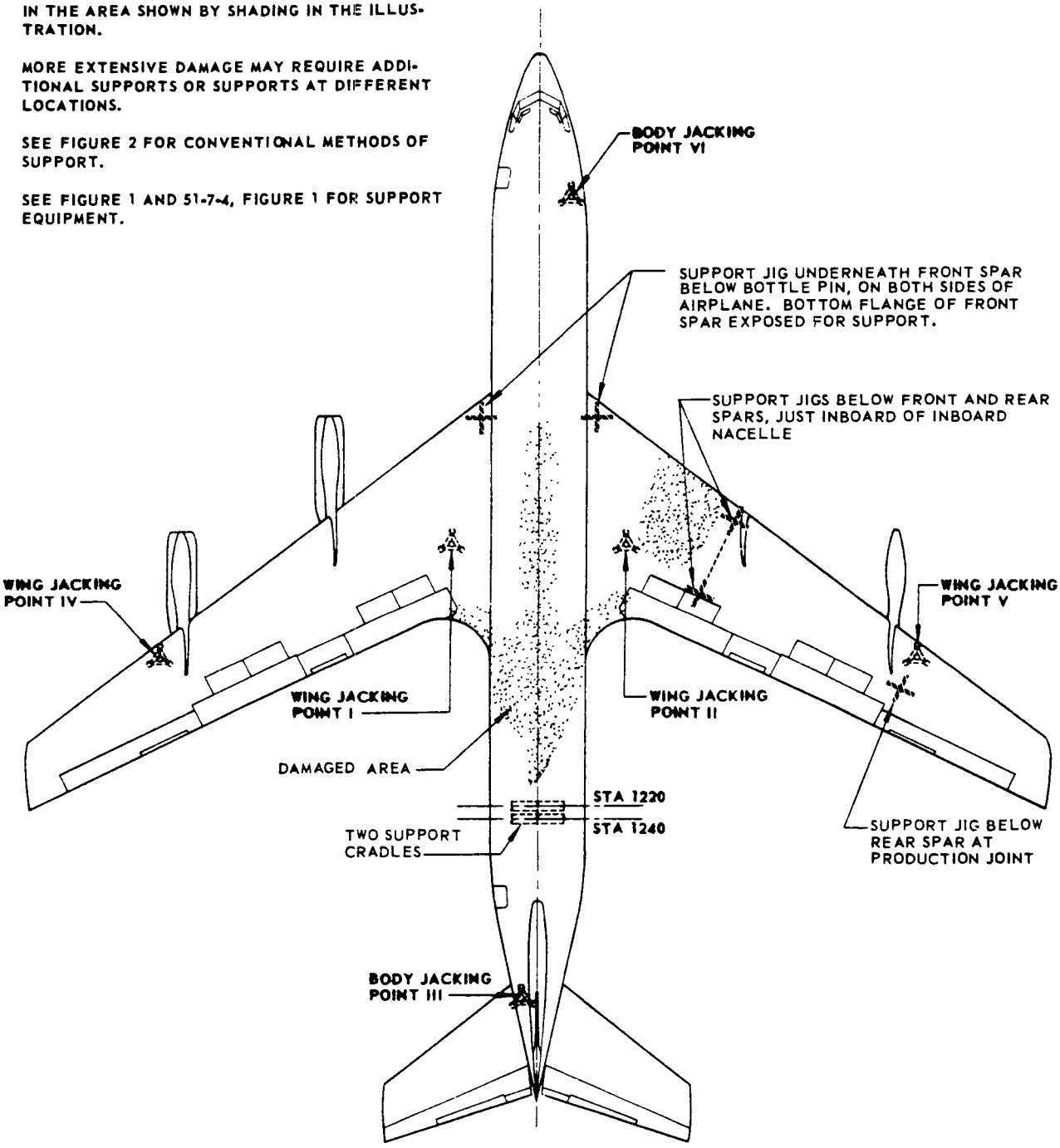
SUPPORT RIGHT HAND WING AND CENTER PORTION OF BODY IN JIG POSITION BY JACKS AT ALL 6 JACKING POINTS AND BY JIGS AT ADDITIONAL LOCATIONS AS ILLUSTRATED.

THIS PARTICULAR METHOD OF SUPPORT WAS USED TO REPAIR A 707 INTERCONTINENTAL AIRPLANE WHICH HAD DAMAGED BOTTOM SKIN AND STIFFENERS IN THE AREA SHOWN BY SHADING IN THE ILLUSTRATION.

MORE EXTENSIVE DAMAGE MAY REQUIRE ADDITIONAL SUPPORTS OR SUPPORTS AT DIFFERENT LOCATIONS.

SEE FIGURE 2 FOR CONVENTIONAL METHODS OF SUPPORT.

SEE FIGURE 1 AND 51-7-4, FIGURE 1 FOR SUPPORT EQUIPMENT.

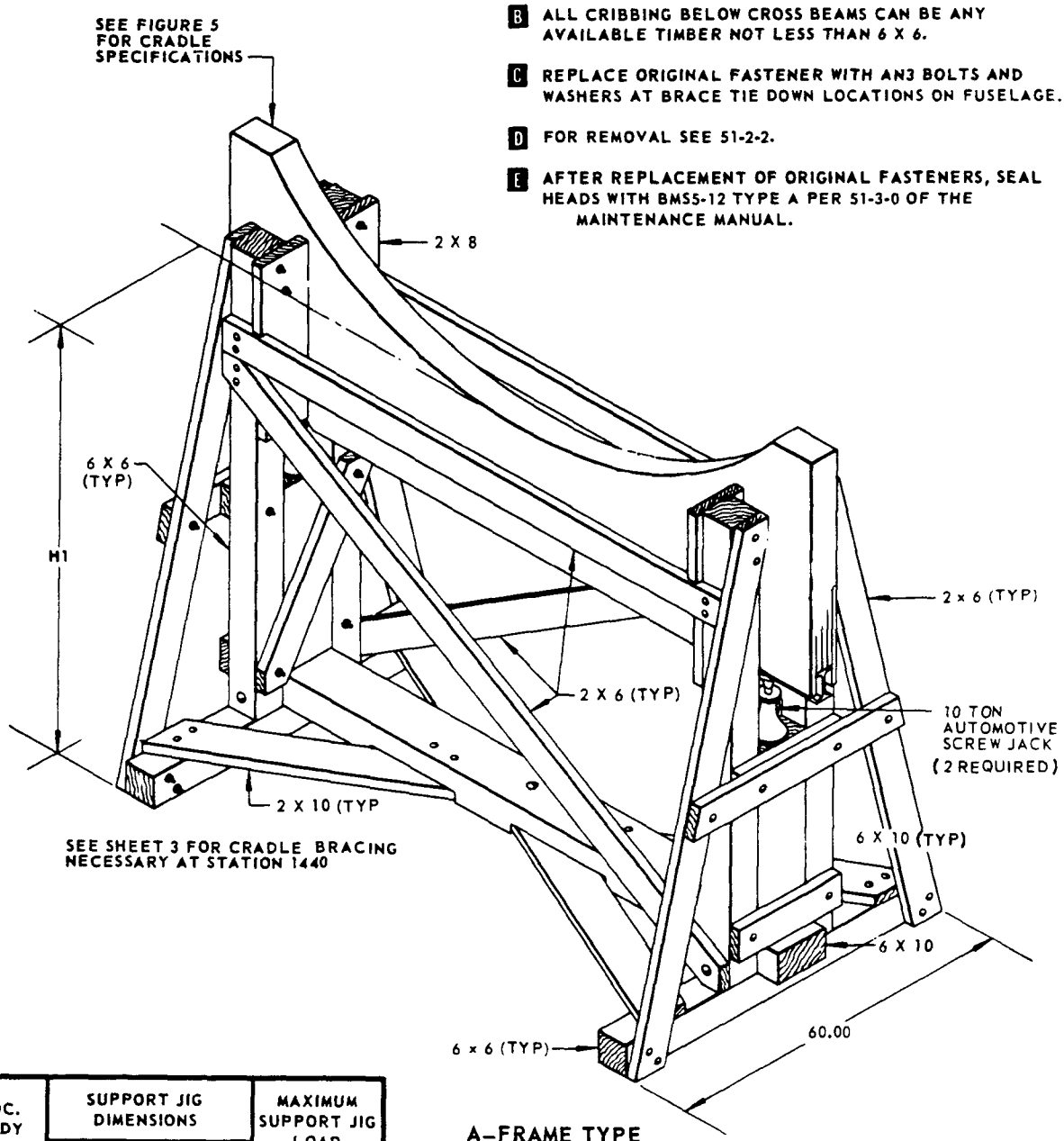


Support of Airplane for Belly Landing Damage Repair
Figure 3

NOTE

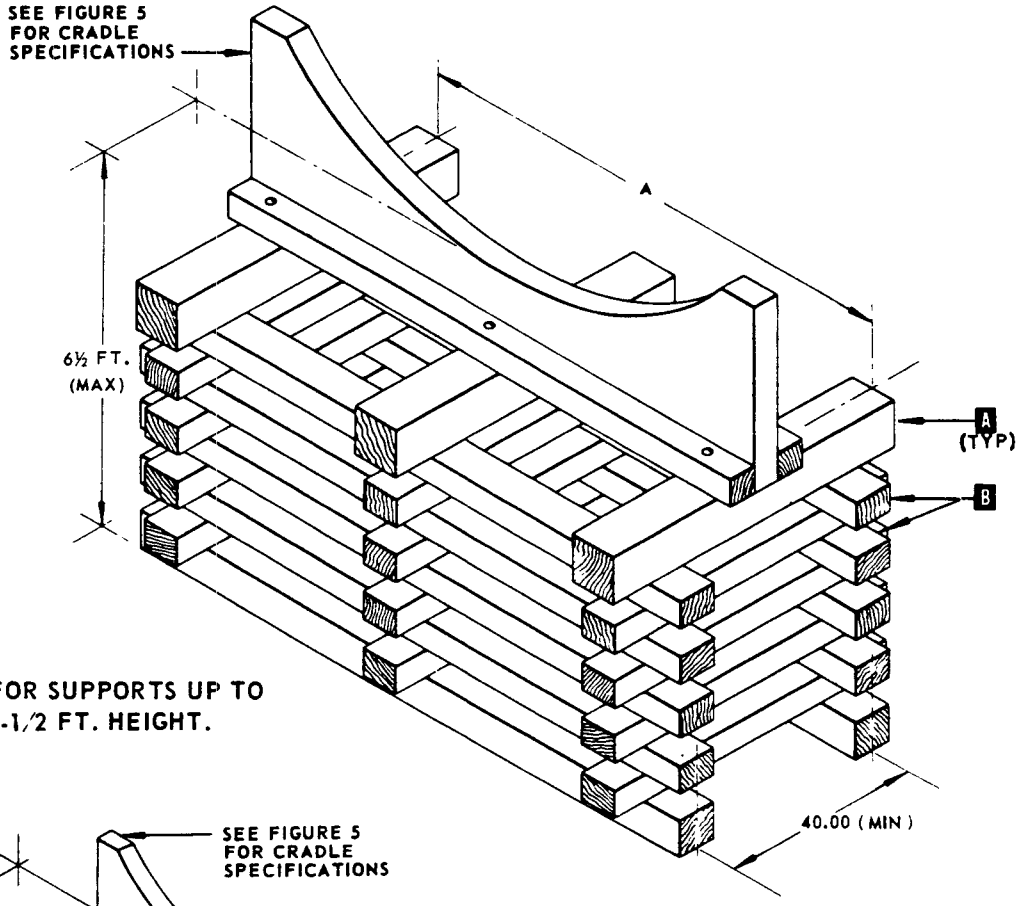
PROCURE CLEAR LUMBER FREE FROM KNOTS, SHAKES OR CHECKS WITH PHYSICAL PROPERTIES EQUIVALENT TO STRUCTURAL GRADE DOUGLAS-FIR, WEST COAST REGION.

- **A** MINIMUM SIZE 8 X 10 OR 10 X 10 TIMBER.
- **B** ALL CRIBBING BELOW CROSS BEAMS CAN BE ANY AVAILABLE TIMBER NOT LESS THAN 6 X 6.
- **C** REPLACE ORIGINAL FASTENER WITH AN3 BOLTS AND WASHERS AT BRACE TIE DOWN LOCATIONS ON FUSELAGE.
- **D** FOR REMOVAL SEE 51-2-2.
- **E** AFTER REPLACEMENT OF ORIGINAL FASTENERS, SEAL HEADS WITH BMS5-12 TYPE A PER 51-3-0 OF THE MAINTENANCE MANUAL.

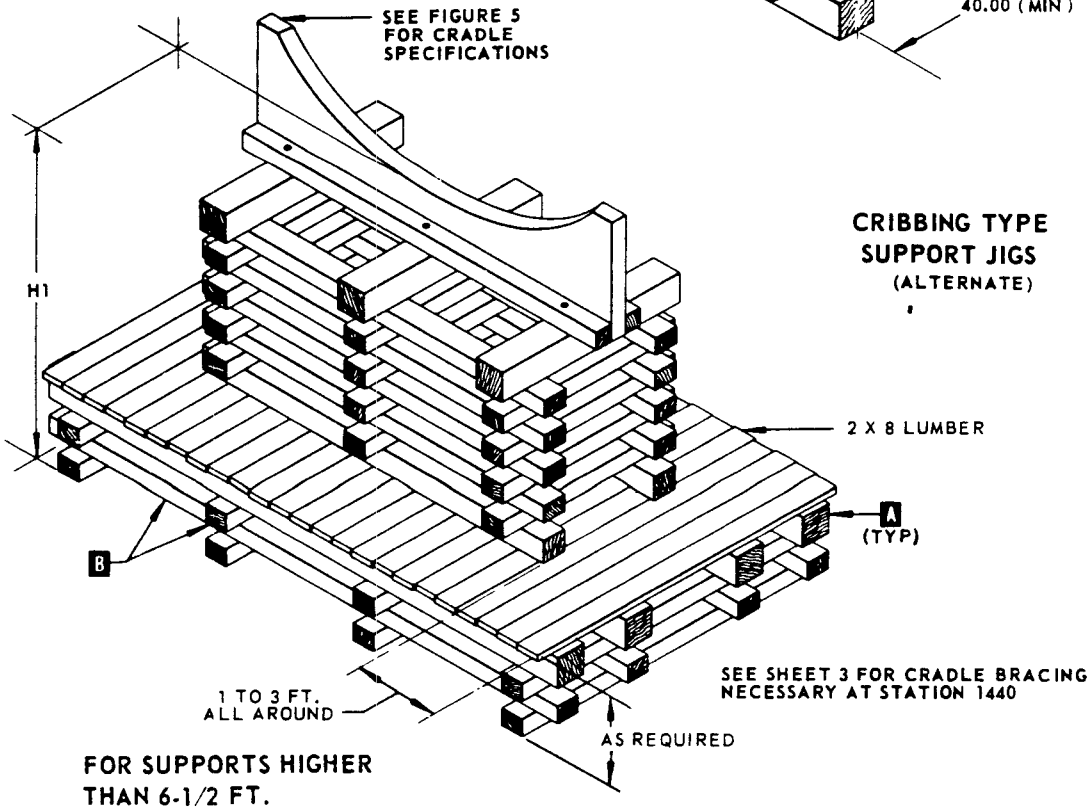


A-FRAME TYPE SUPPORT JIG

LOC. BODY STA.	SUPPORT JIG DIMENSIONS		MAXIMUM SUPPORT JIG LOAD POUNDS
	H1	A	
360	76.5	96.0	15,000
1440	138.3	76.0	15,000



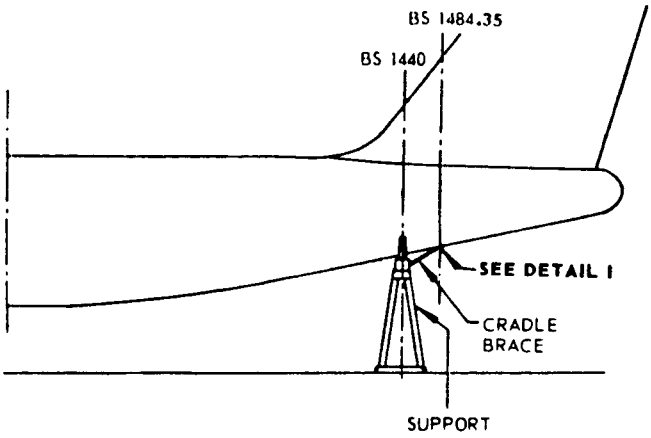
FOR SUPPORTS UP TO
6-1/2 FT. HEIGHT.

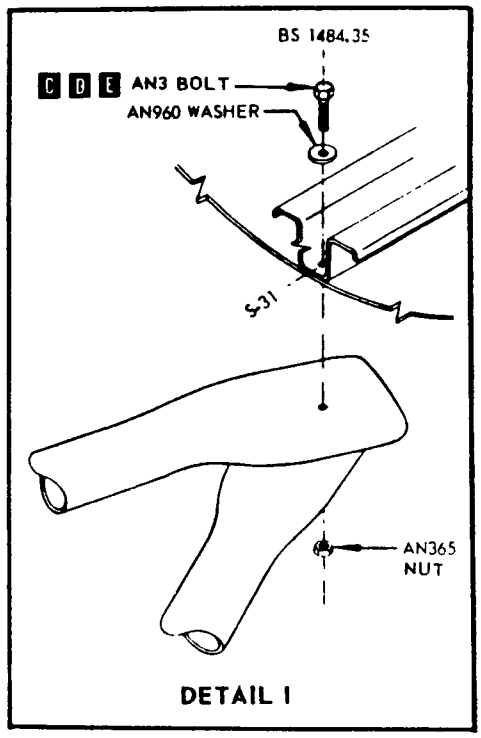


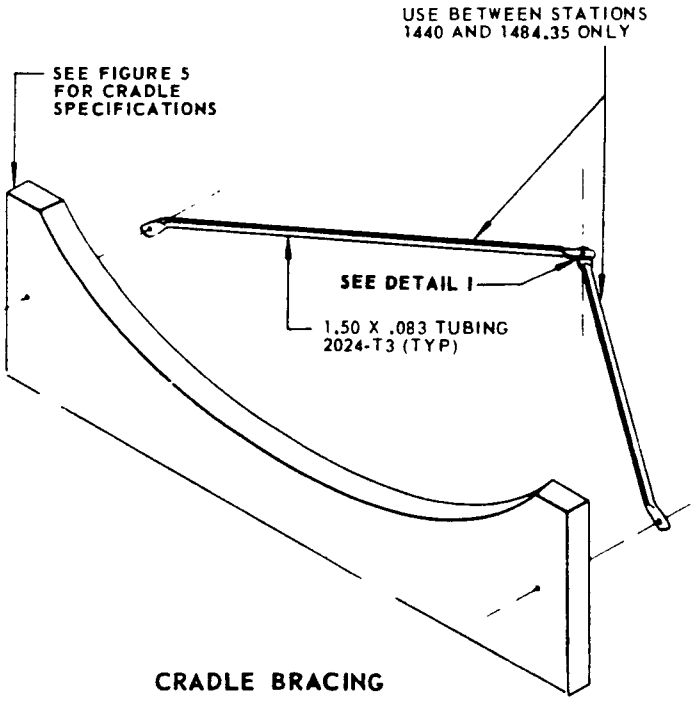
CRIBBING TYPE
SUPPORT JIGS
(ALTERNATE)

FOR SUPPORTS HIGHER
THAN 6-1/2 FT.

Support Jigs - Fuselage
Figure 4 (Sheet 2 of 3)







CRADLE BRACING

Support Jigs - Fuselage
Figure 4 (Sheet 3 of 3)

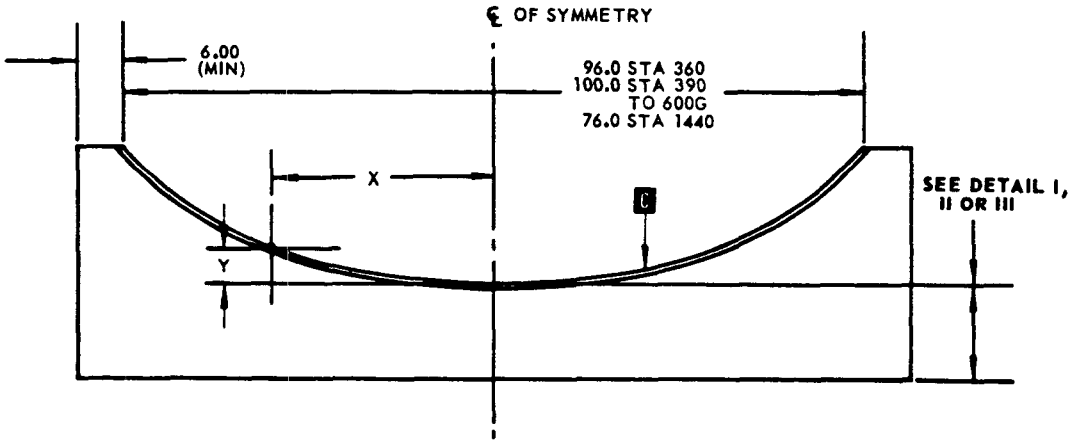
NOTE

[A] 5 PIECES OF 1.00AB GRADE OR BETTER EXTERIOR FIR PLYWOOD

[B] PROCURE CLEAR LUMBER FREE FROM KNOTS, SHAKES OR CHECKS WITH PHYSICAL PROPERTIES EQUIVALENT TO STRUCTURAL GRADE DOUGLAS-FIR WEST COAST REGION.

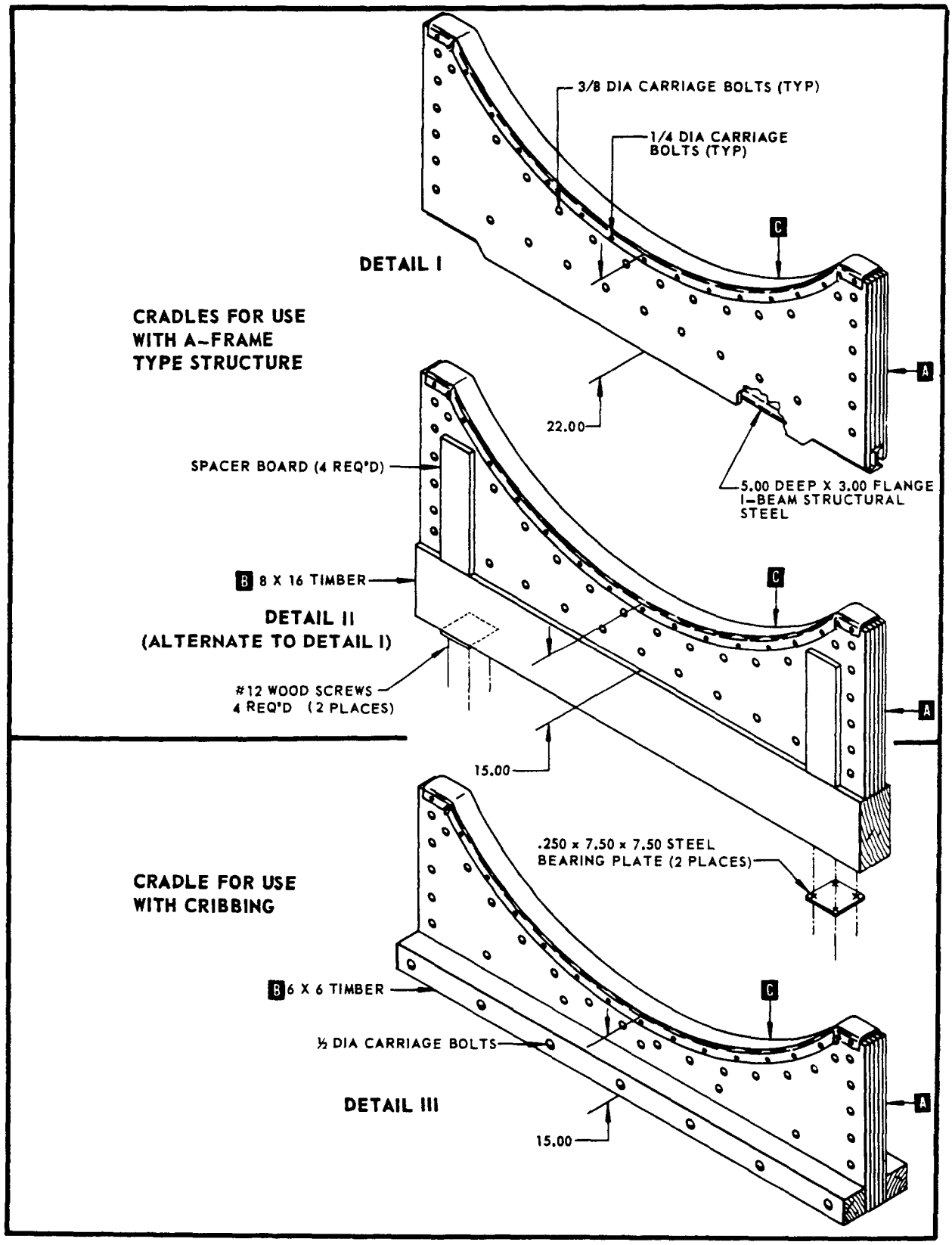
[C] PAD WITH FELT OR RUBBER

X	Y		
	STA 360	STA 390 TO STA 600G	STA 1440
0	0	0	0
5	0.16	0.16	0.25
10	0.66	0.66	1.01
15	1.53	1.52	2.27
20	2.80	2.79	4.12
25	4.53	4.49	6.61
30	6.77	6.69	9.87
35	9.61	9.45	14.19
40	13.14	12.88	19.57
45	17.54	17.10	---
50	23.02	22.33	---

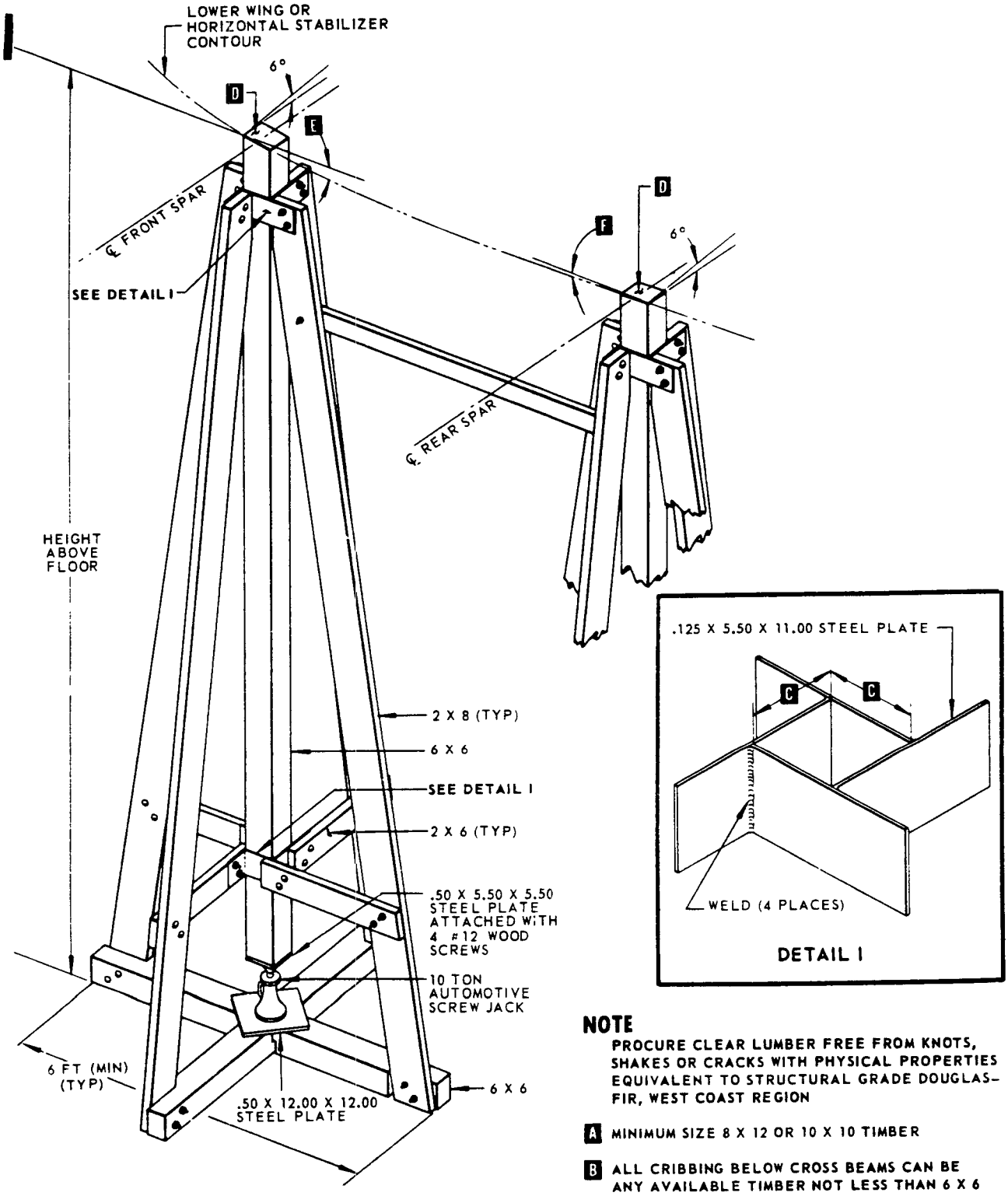


CRADLE FOR FUSELAGE

Support Cradles - Fuselage
Figure 5 (Sheet 1 of 2)



Support Cradles - Fuselage
Figure 5 (Sheet 2 of 2)



NOTE

PROCURE CLEAR LUMBER FREE FROM KNOTS, SHAKES OR CRACKS WITH PHYSICAL PROPERTIES EQUIVALENT TO STRUCTURAL GRADE DOUGLAS-FIR, WEST COAST REGION

A MINIMUM SIZE 8 X 12 OR 10 X 10 TIMBER

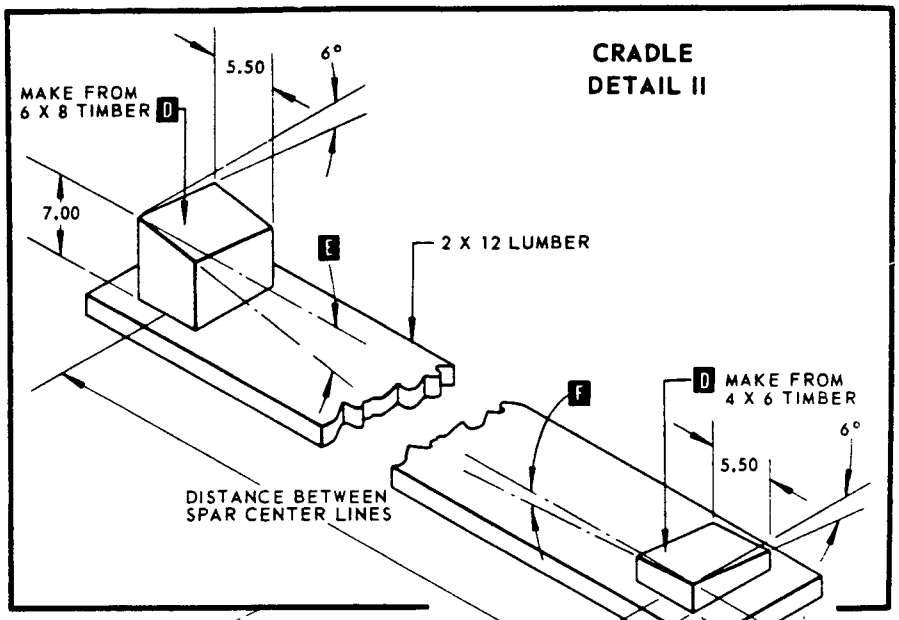
B ALL CRIBBING BELOW CROSS BEAMS CAN BE ANY AVAILABLE TIMBER NOT LESS THAN 6 X 6

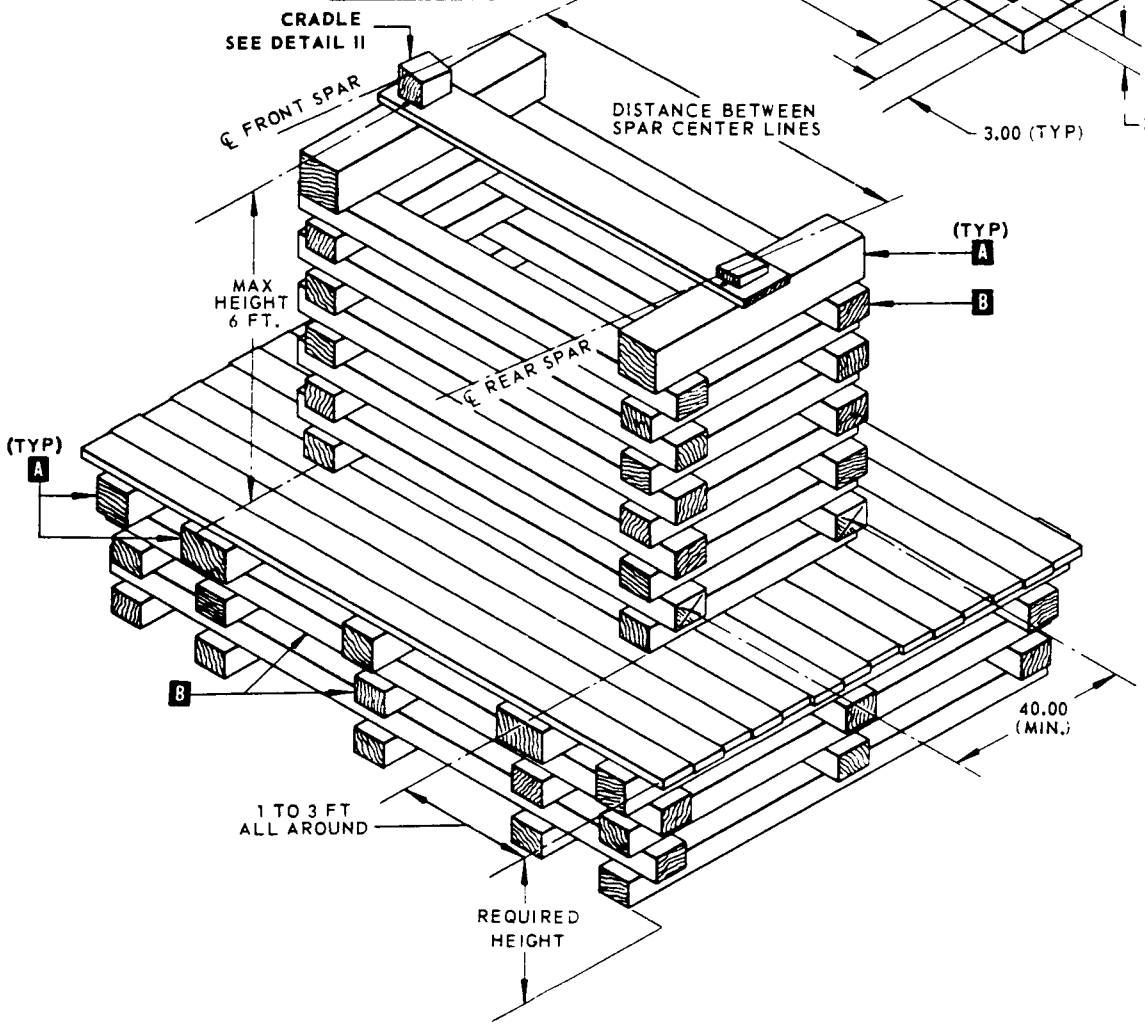
C MAKE TO FIT SNUG AROUND 6 X 6 COLUMN

D PAD WITH FELT OR RUBBER

Support Jigs and Cradles - Wing and Horizontal Stabilizer
Figure 6 (Sheet 1 of 2)

WING STATION	E	F
175 TO 210	13°	1°
210 TO 245	12°	2°
245 TO 285	11°	3°
285 TO 335	10°	3°
335 TO 385	9°	3°
385 TO 435	8°	2°
435 TO 520	7°	1.5°
520 TO 548	6°	1°
HORIZONTAL STAB. STA.		
182	10°	0°





Support Jigs and Cradles - Wing and Horizontal Stablizer
Figure 6 (Sheet 2 of 2)

SUPPORT OF AIRPLANE IN NON-JIG POSITION

1. Raise Airplane per 51-7-4

2. Procure Equipment per Figure 1

3. Plumb Bob Level Airplane per 51-7-5, Paragraph 1

4. Support Airplane per Figure 2

   A. Check the plumb bob periodically, to see that the airplane maintains its level position while supported.

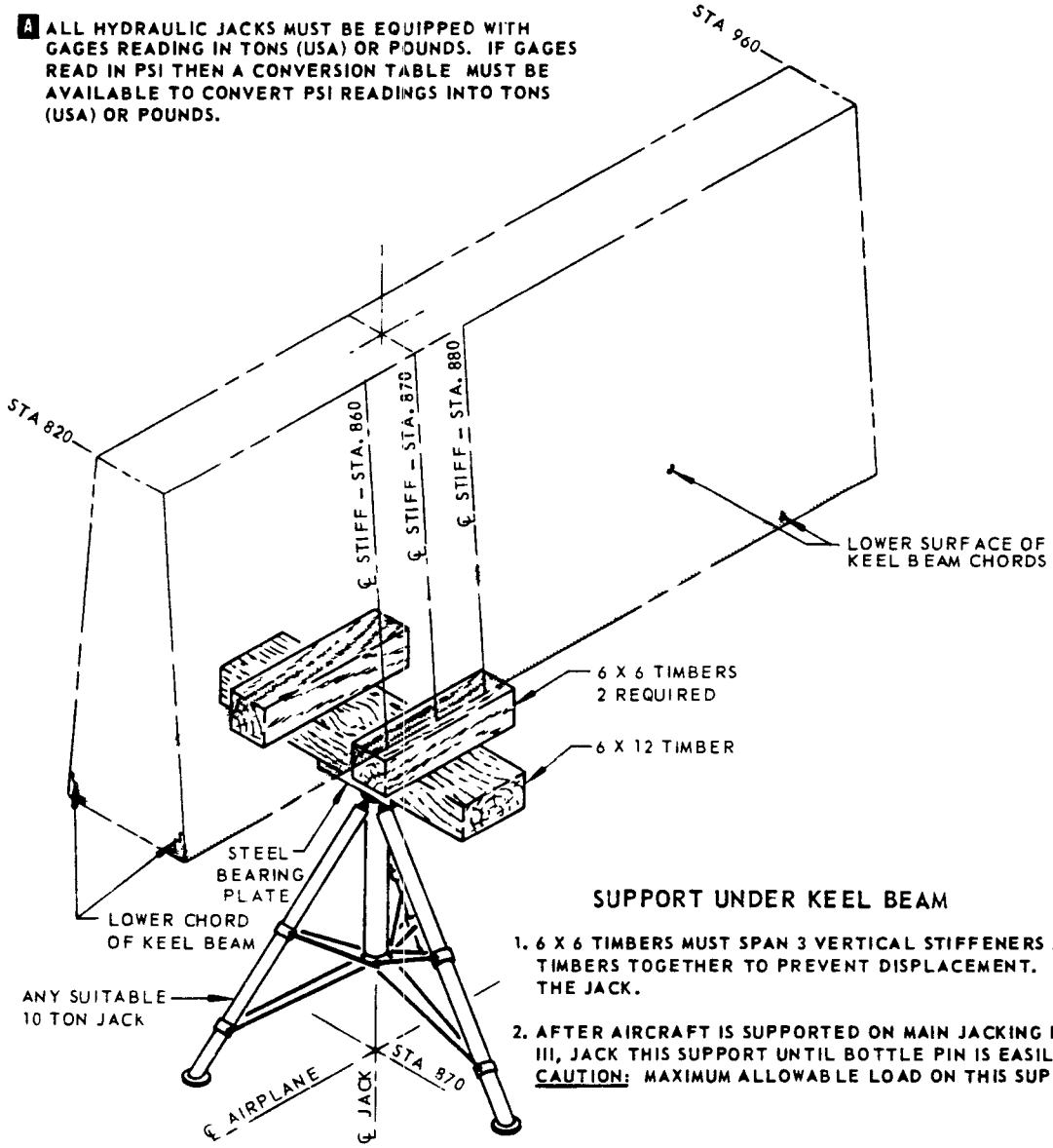
5. Lower Airplane per 51-7-6 after Required Repairs Are Performed

ITEM	NO. REQ'D	IDENTIFICATION	SOURCE
HYDRAULIC JACK WING POINTS IV AND V [A]	2	MODEL B4A CAPACITY: 30 TONS (USA) MIN. HEIGHT: 55, 73, 91, 109, 127 OR 145 INCHES RAM STROKE: 45 INCHES MAX SCREW EXTENSION: 15 INCHES	REGENT MFG. CO., OR EQUIVALENT
JACK PAD WING POINTS IV AND V	2	PART NO. F70009	BOEING AIRPLANE COMPANY
SUPPORT UNDER KEEL BEAM	1	SEE DETAIL BELOW	FABRICATE

NOTE

SEE 51-7-4, FIGURE 1, FOR EQUIPMENT FOR AIRPLANE RAISING

[A] ALL HYDRAULIC JACKS MUST BE EQUIPPED WITH GAGES READING IN TONS (USA) OR POUNDS. IF GAGES READ IN PSI THEN A CONVERSION TABLE MUST BE AVAILABLE TO CONVERT PSI READINGS INTO TONS (USA) OR POUNDS.



SUPPORT UNDER KEEL BEAM

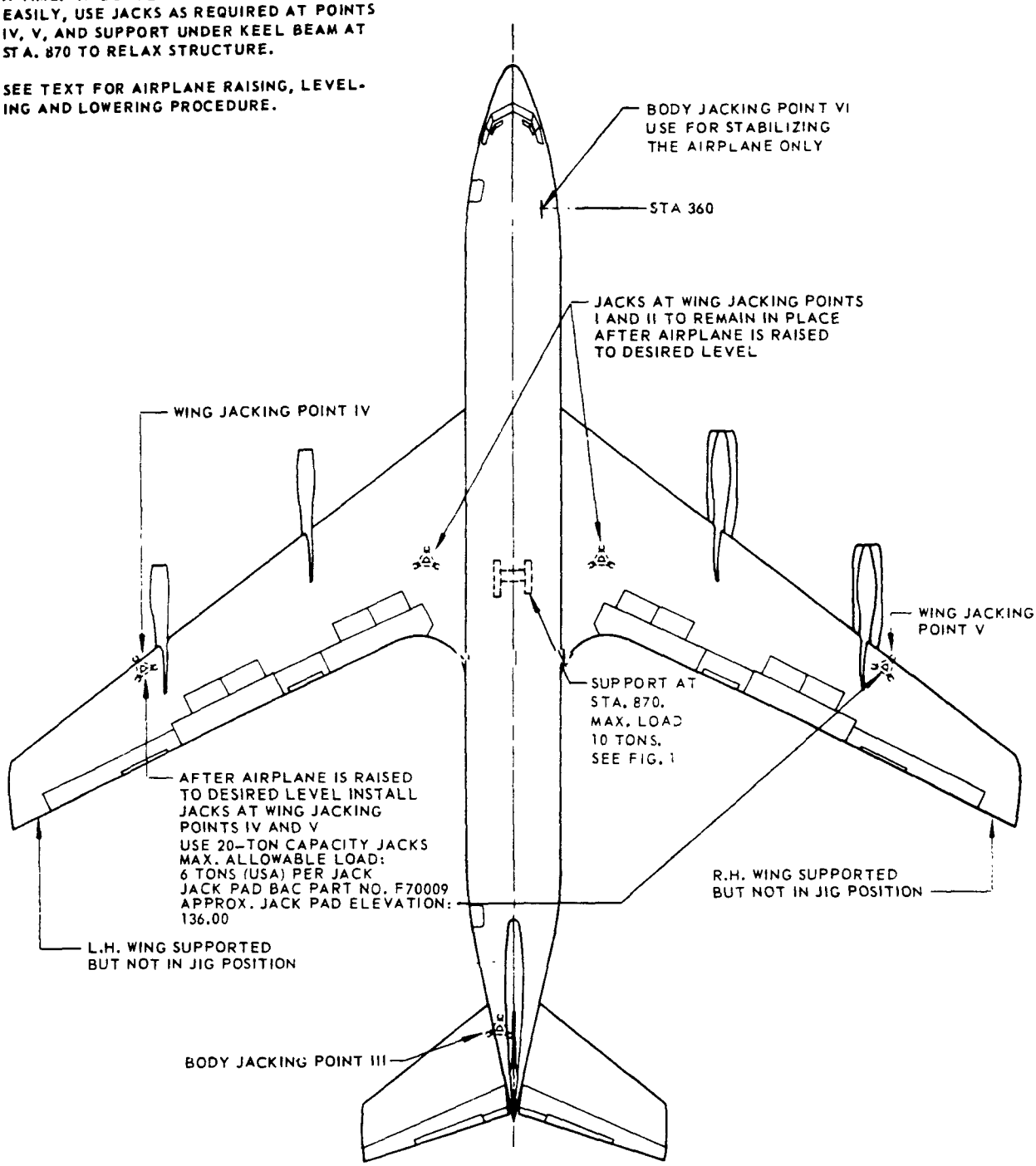
1. 6 X 6 TIMBERS MUST SPAN 3 VERTICAL STIFFENERS AS SHOWN. TIE TIMBERS TOGETHER TO PREVENT DISPLACEMENT. ALSO SECURE THE JACK.
2. AFTER AIRCRAFT IS SUPPORTED ON MAIN JACKING POINTS I, II AND III, JACK THIS SUPPORT UNTIL BOTTLE PIN IS EASILY REMOVABLE. CAUTION: MAXIMUM ALLOWABLE LOAD ON THIS SUPPORT IS 10 TONS.

Support Equipment for Non-Jig Position
Figure 1

NOTE

JACKS AT MAIN JACKING POINTS I, II AND III, WITH POSSIBLE USE OF OUTBOARD WING JACKS FOR STABILIZING, IS CONSIDERED ADEQUATE SUPPORT FOR REMOVAL AND REINSTALLATION OF ONE BOTTLE PIN AT A TIME. IF BOTTLE PIN DOES NOT COME OUT EASILY, USE JACKS AS REQUIRED AT POINTS IV, V, AND SUPPORT UNDER KEEL BEAM AT STA. 870 TO RELAX STRUCTURE.

SEE TEXT FOR AIRPLANE RAISING, LEVELING AND LOWERING PROCEDURE.



Support of Airplane in Non-Jig Position
Figure 2

SUPPORT OF REMOVABLE STRUCTURAL COMPONENTS

General

A. Perform minor repairs, if possible, without detaching removable structural component from airplane.

B. Perform major repairs after detachment of removable structural component from airplane.

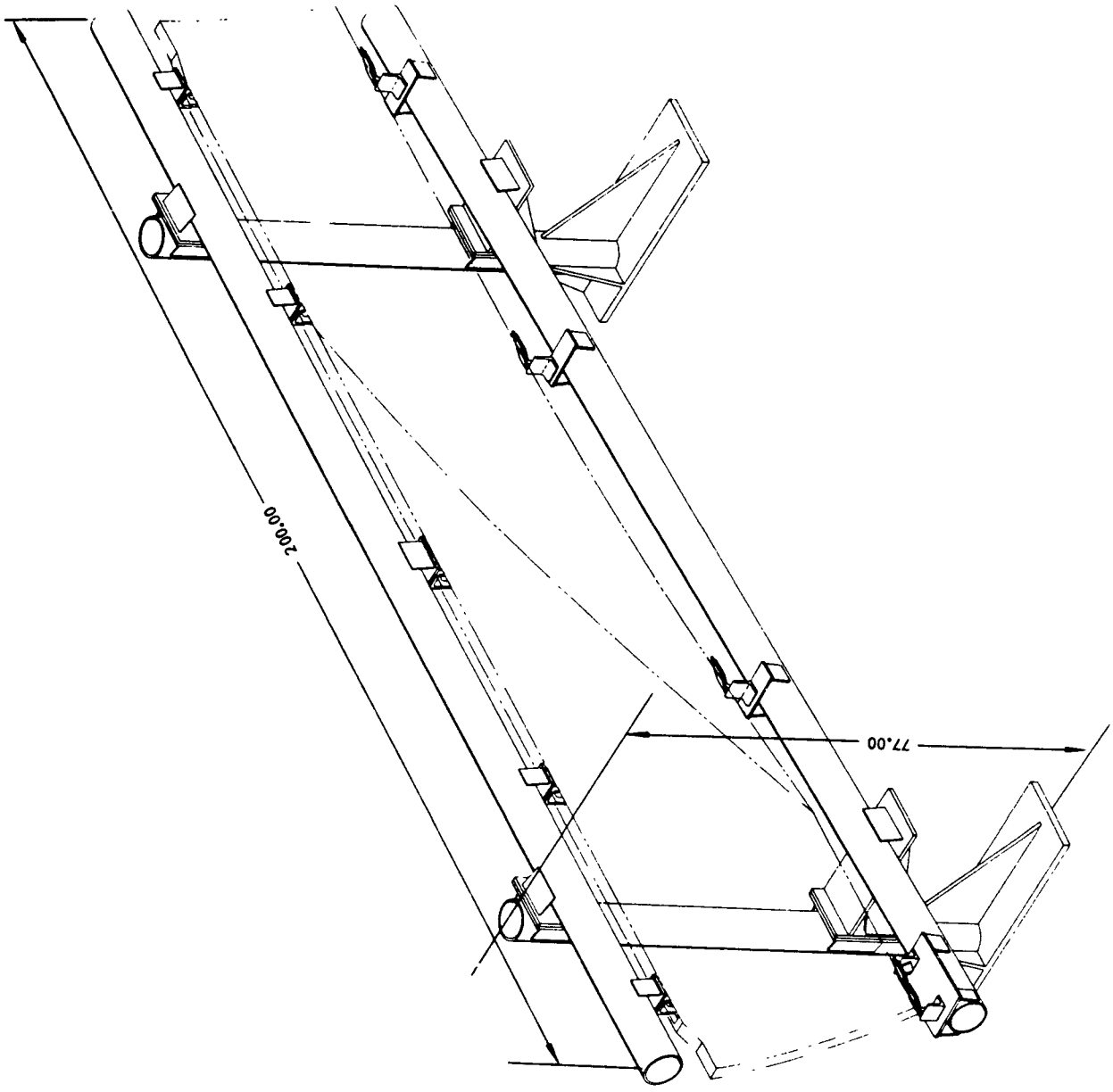
(1) See figure 1 for Equipment and Removal Procedures Index.

(2) Use appropriate repair jig for supporting the removed component, mastering interchangeable points and checking contour conformity.

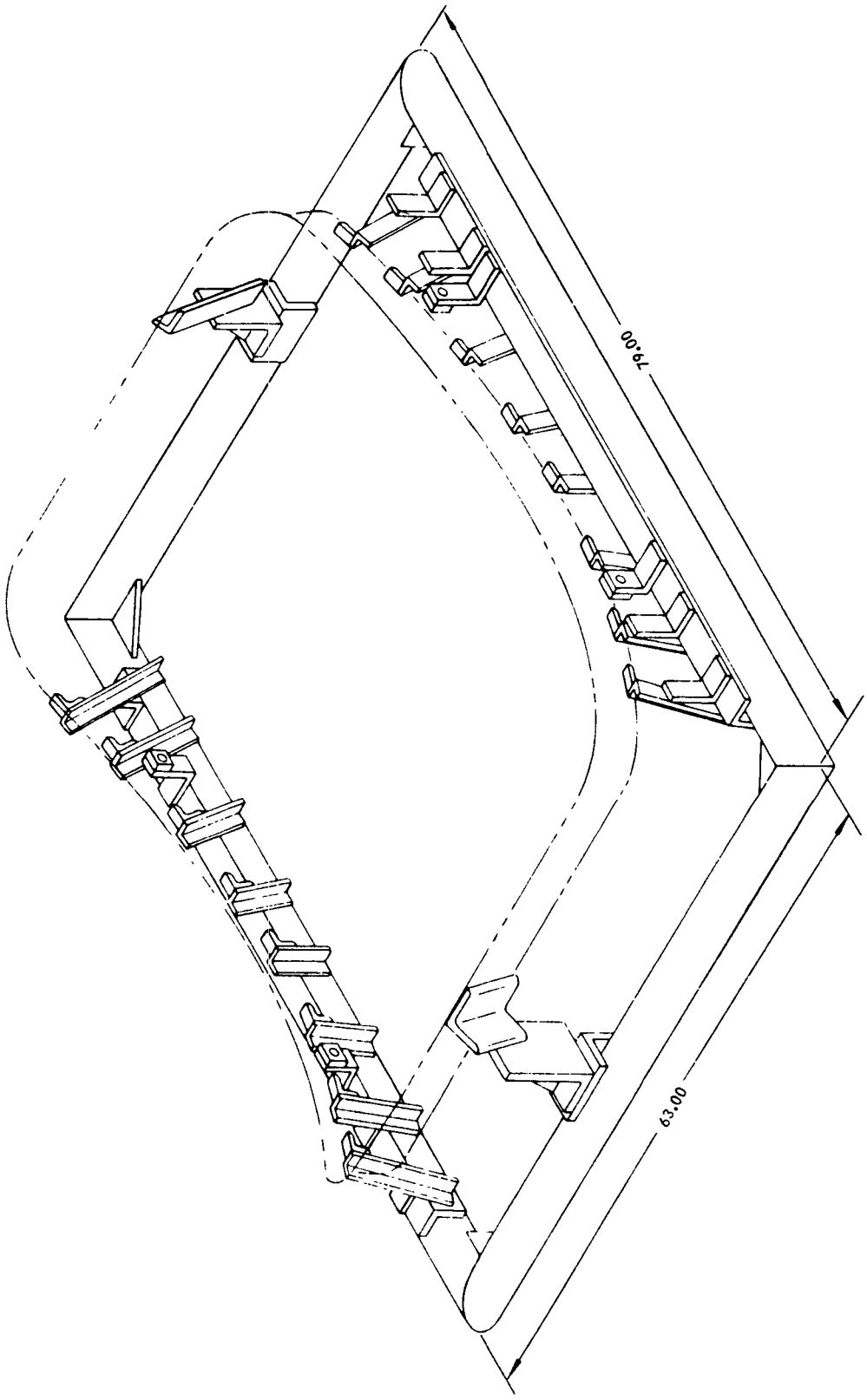
REPAIR JIG FIGURE NO.	STRUCTURAL COMPONENT	REMOVAL PROCEDURE SECTION NO. SEE 707 MAINTENANCE MANUAL	REPAIR JIG BAC DRAWING NO. [A]	EFFECTIVITY
2	ACCESS DOOR - AIR CONDITIONING	12-2-0	SC 5-86312	
3	CARGO DOOR - FORWARD	52-3-0	SC 50-7944	
4	CARGO DOOR - CENTER		SC 50-7990	
5	CARGO DOOR - AFT		SC 50-7991	PAA, BOAC, AF, SABENA, DLH, AII, VARIG AND SAA
6	ENTRY DOOR - FORWARD	52-1-1	SC 50-7945	
7	ENTRY DOOR - AFT		SC 50-7988	
8	GALLEY DOOR - FORWARD	52-2-0	SC 50-7954	
9	GALLEY DOOR - AFT	52-2-0	SC 50-7983	
10	HATCH - EMERGENCY	52-6-0	SC 50-7978-33	
11	DOOR - NLG WHEEL WELL	32-5-1	SC 5-73140	
12	DOOR - MLG WHEEL WELL INBOARD AND OUTBOARD	32-3-1	SC 5-86308 INBD 2SC 5-86308 OUTBD	
13	COWLING ENGINE	71-2-11	SC 65-2549 L.H. SC 65-2550 R.H.	
14	SPOILER - INBOARD AND OUTBOARD	27-4-1	SC 5-84479	
15	FLAP - FILLET	27-6-1	SC 5-96781-3	
16	FLAP - INBOARD	27-6-11	SC 5-86892-95	
17	FLAP - OUTBOAPD	27-6-21	SC 5-87851-121	
18	AILERON - INBOARD	27-2-21	SC 5-86072	
19	AILERON - OUTBOARD		SC 5-86190	
20	ELEVATOR	27-7-1	SC 5-96190	
21	RUDDER	27-3-1	SC 5-95500	

NOTE

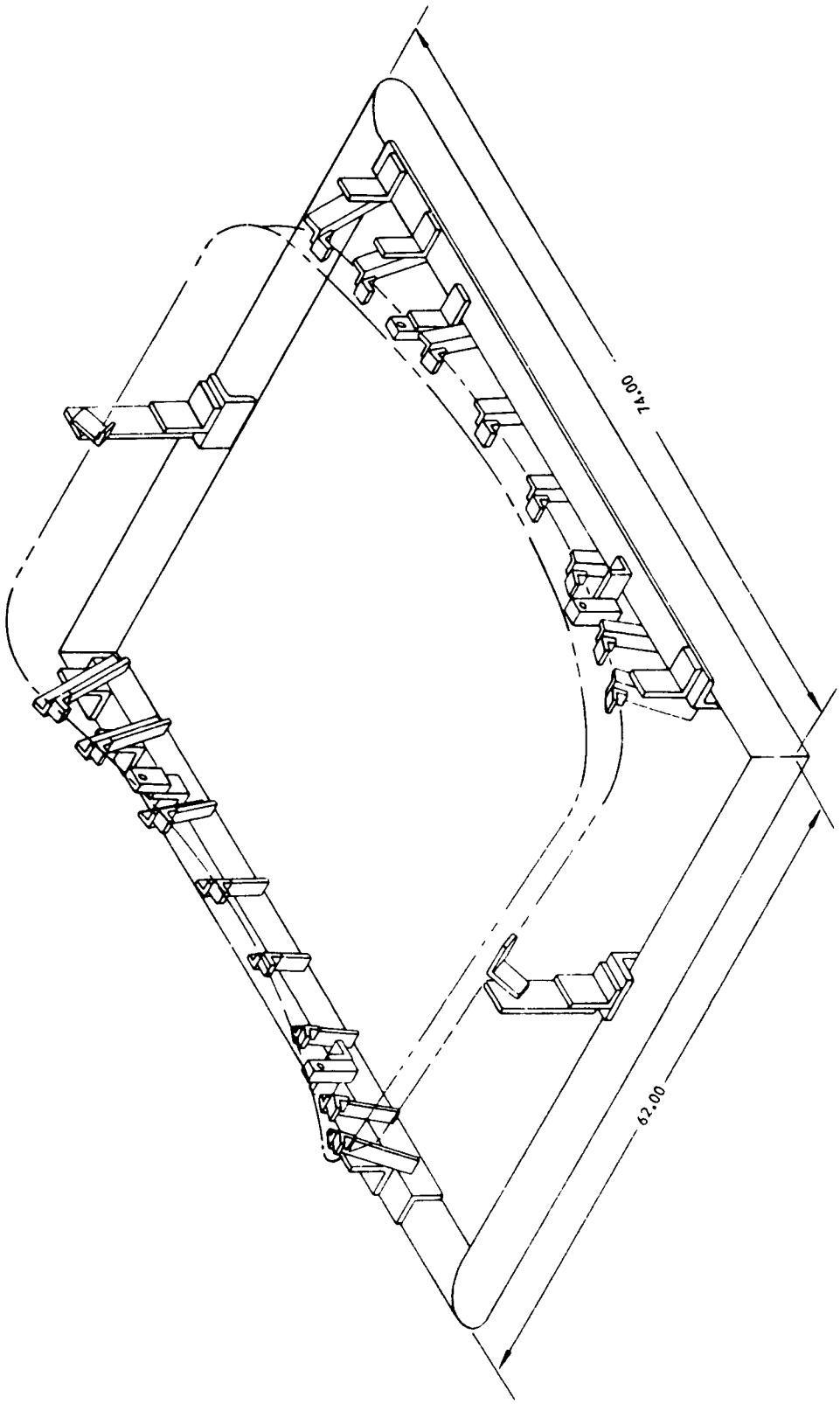
[A] THE BAC TOOL DRAWINGS SHOW SUGGESTED DESIGNS FOR REMOVABLE STRUCTURAL COMPONENT JIGS OF THE 707 STRATOLINER SERIES AIRPLANES. USE THESE DRAWINGS AS A GUIDE FOR DESIGN OF JIGS FOR THE 707 INTERCONTINENTAL SERIES COMPONENTS.



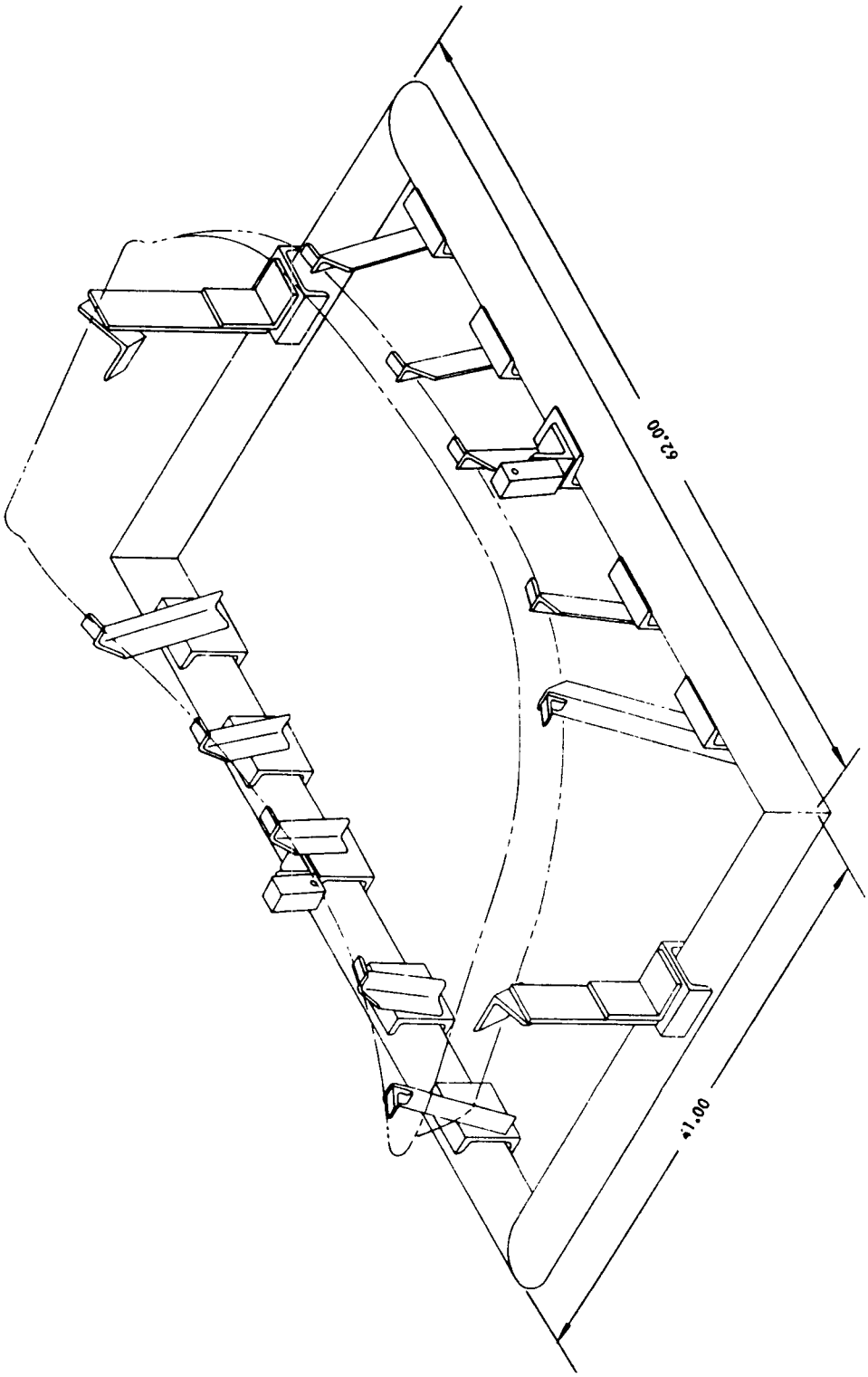
Access Door Repair Jig - Air Conditioning
Figure 2



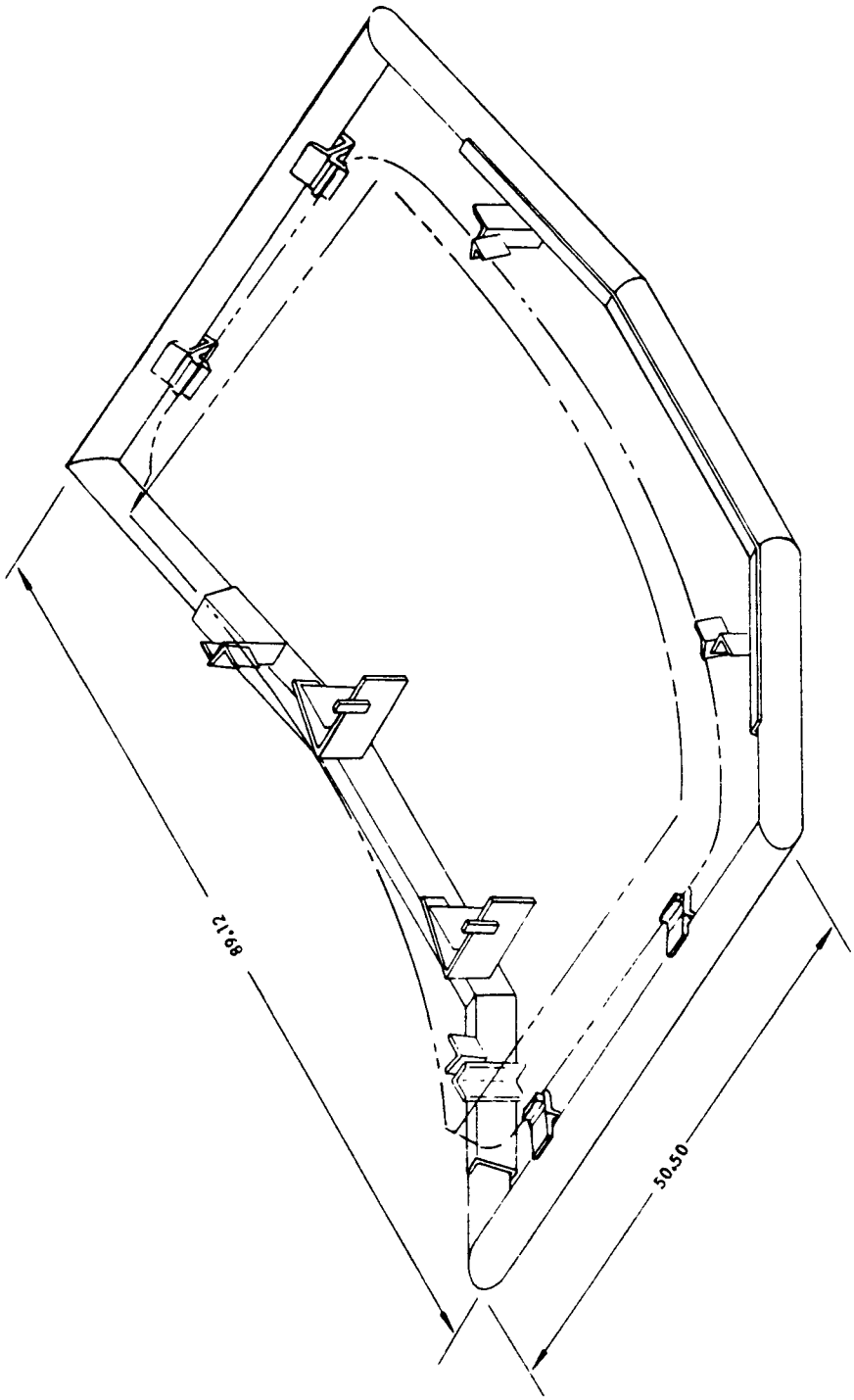
Cargo Door Repair Jig - Forward
Figure 3



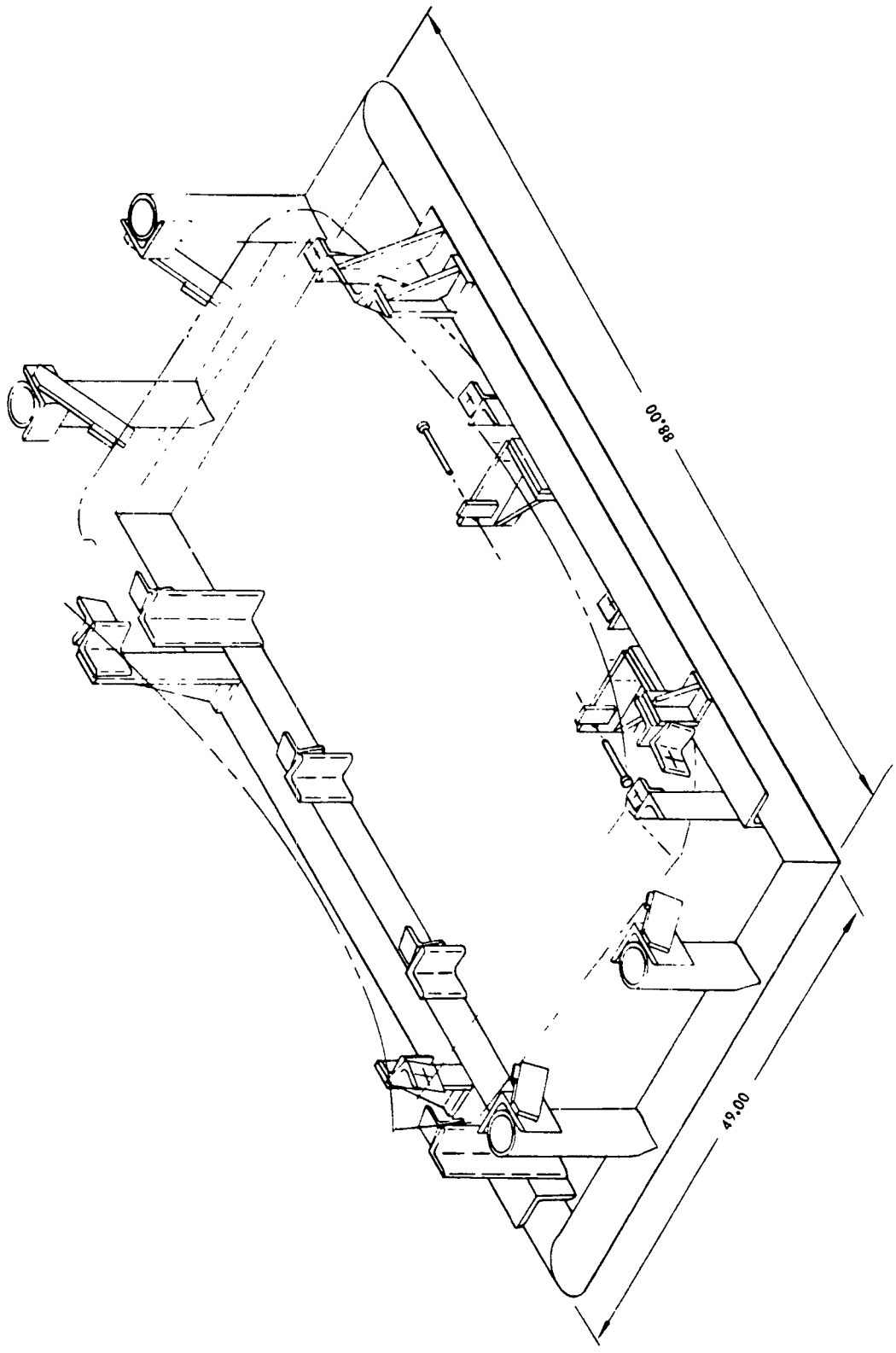
Cargo Door Repair Jig - Center
Figure 4



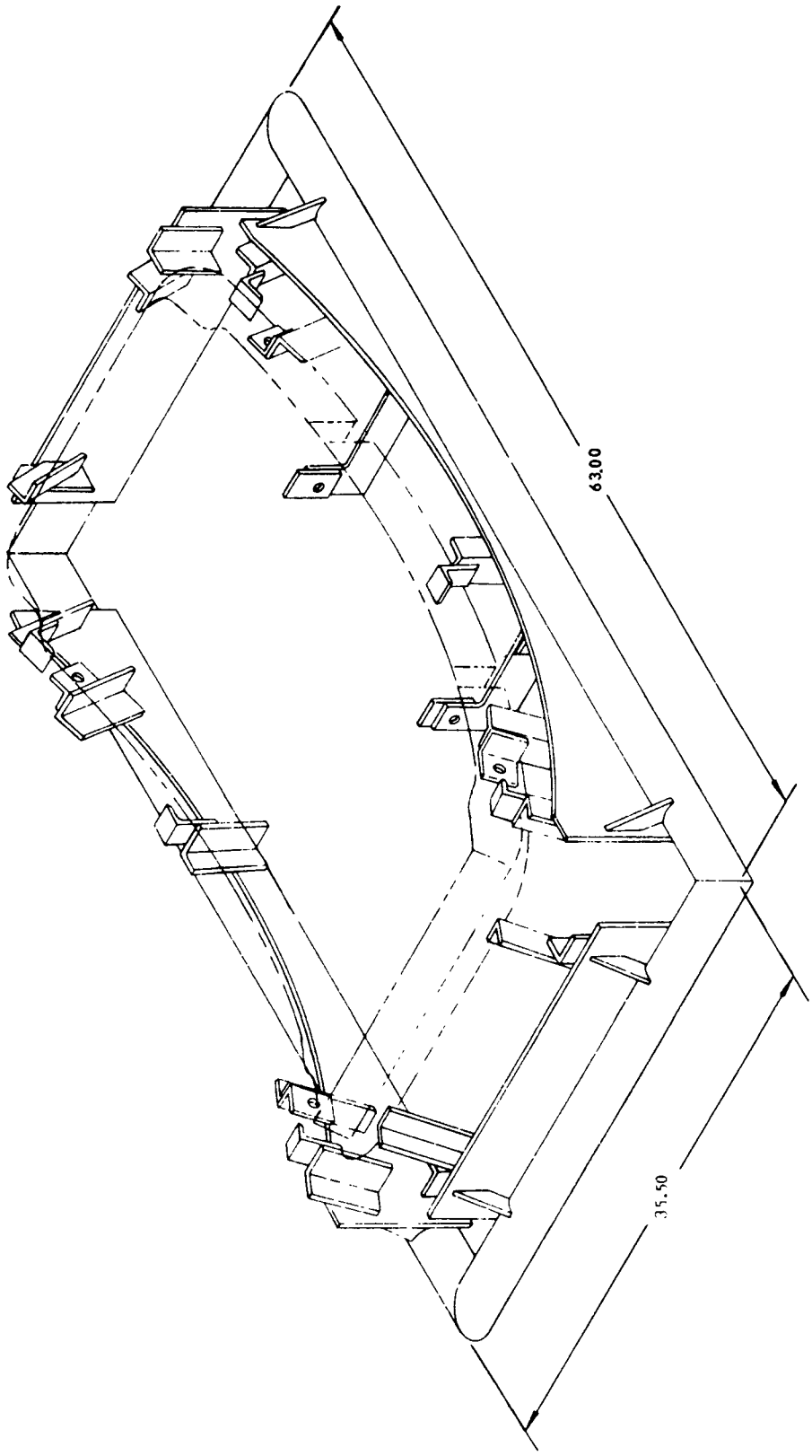
Cargo Door Repair Jig - Aft
Figure 5



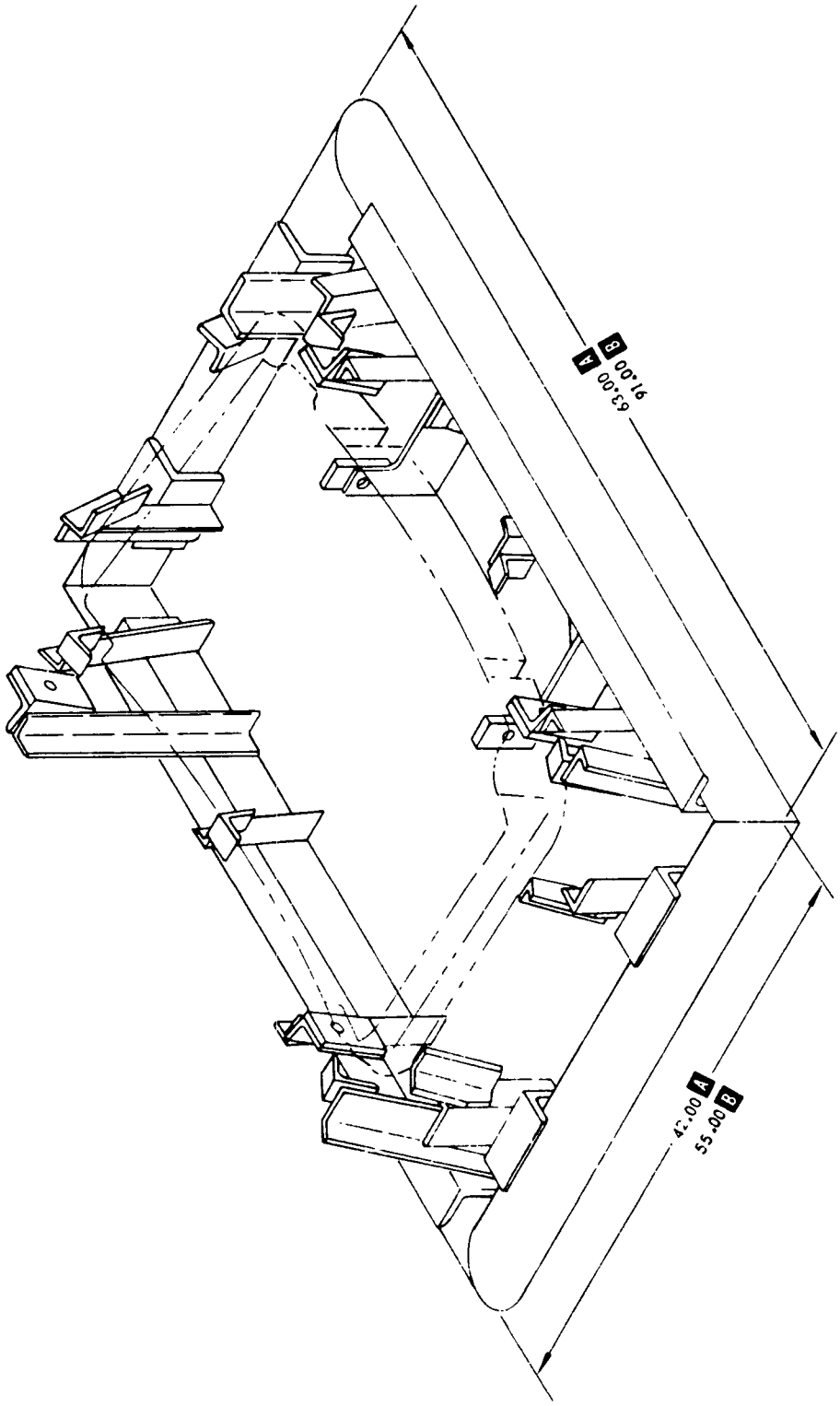
Entry Door Repair Jig - Forward
Figure 6



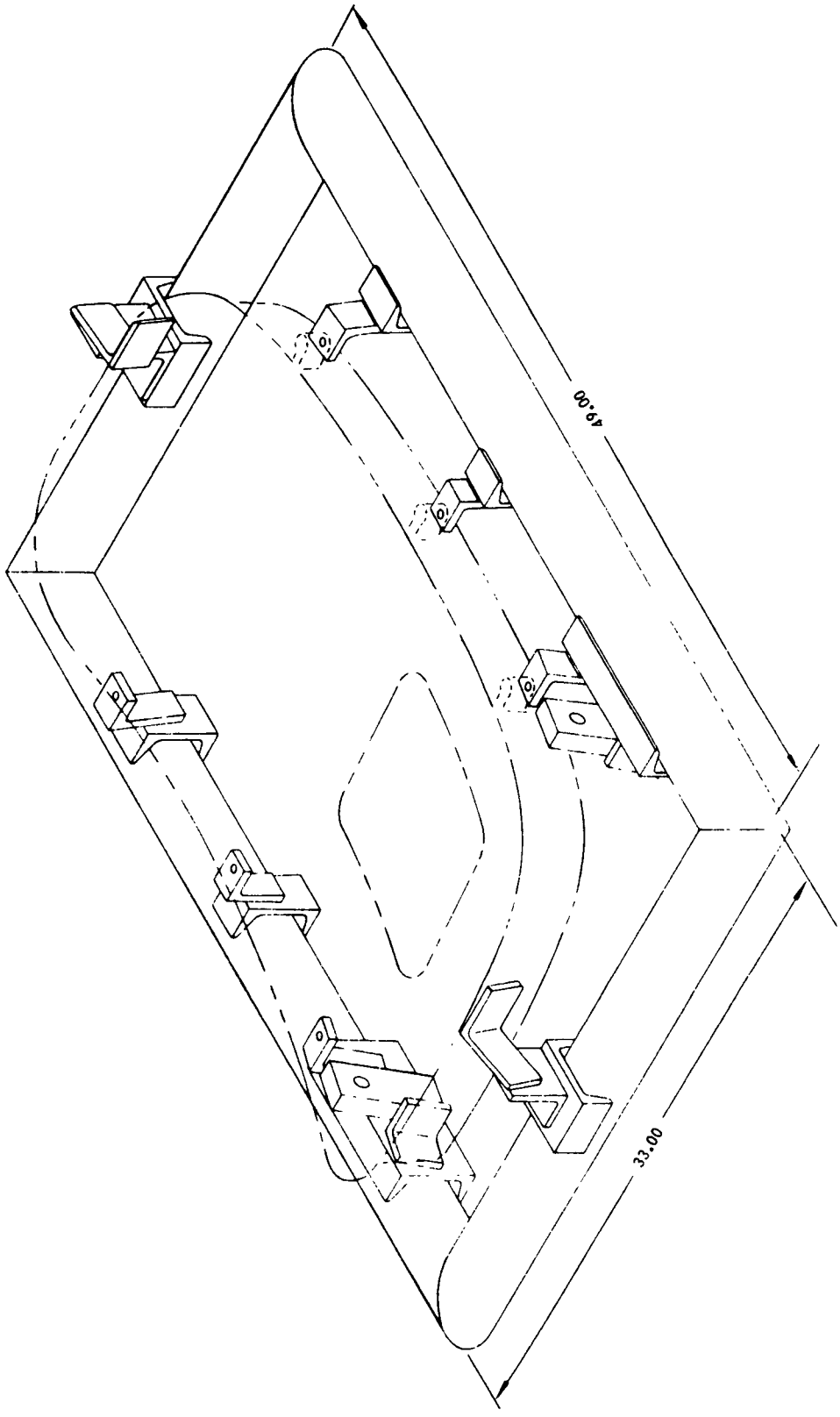
Entry Door Repair Jig - Aft
Figure 7



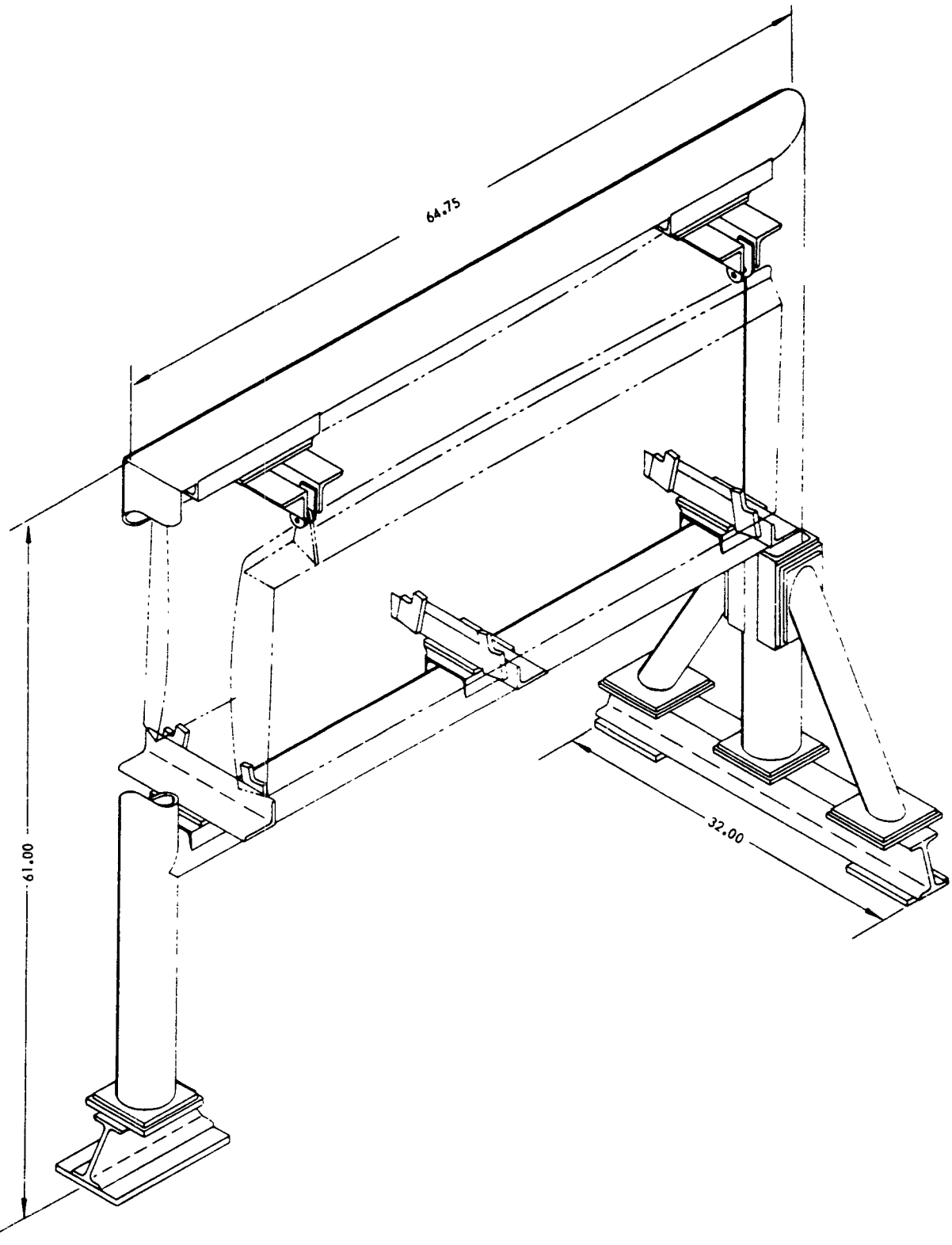
Galley Door Repair Jig - Forward
Figure 8



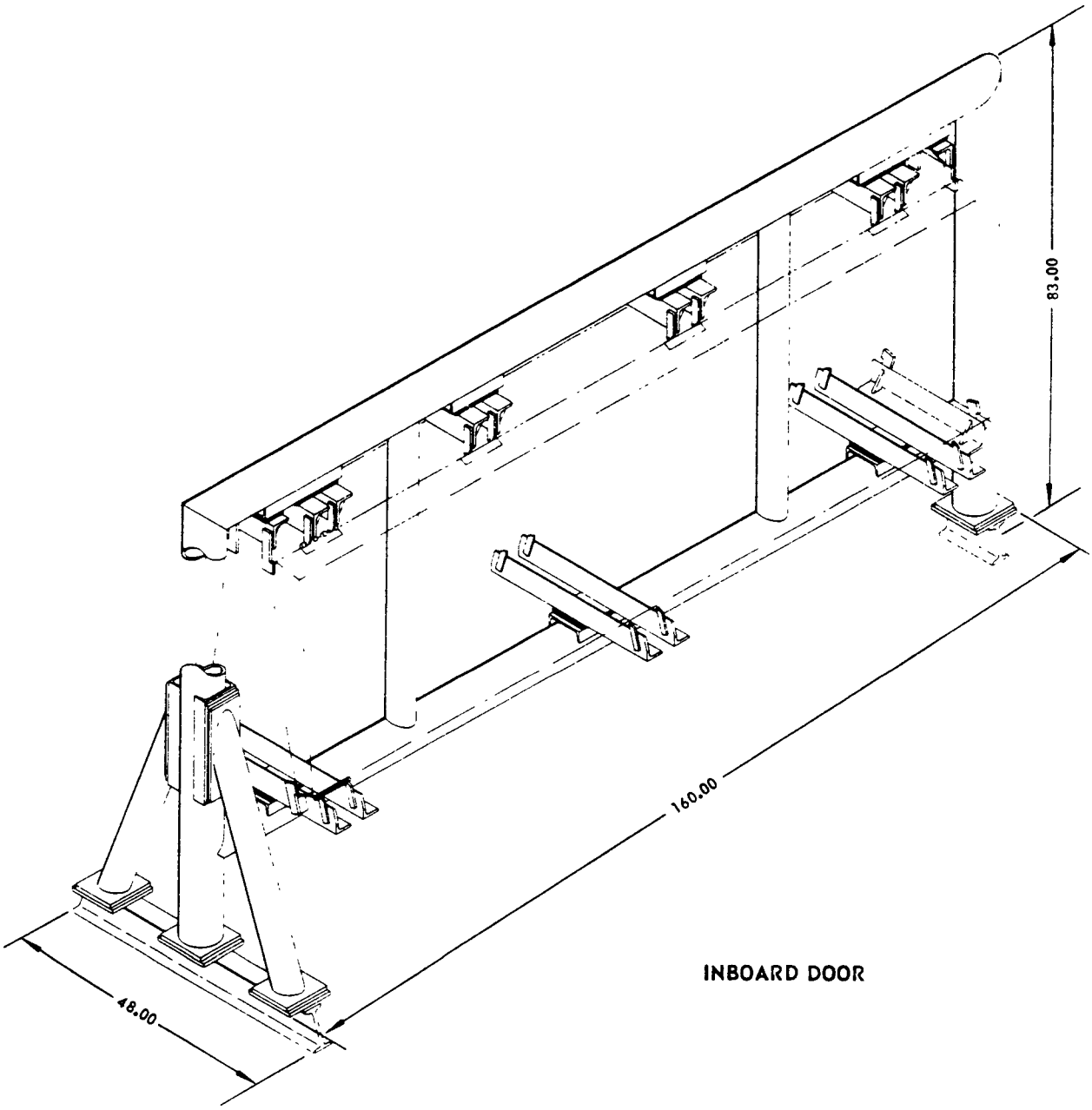
Galley Door Repair Jig - Aft
Figure 9



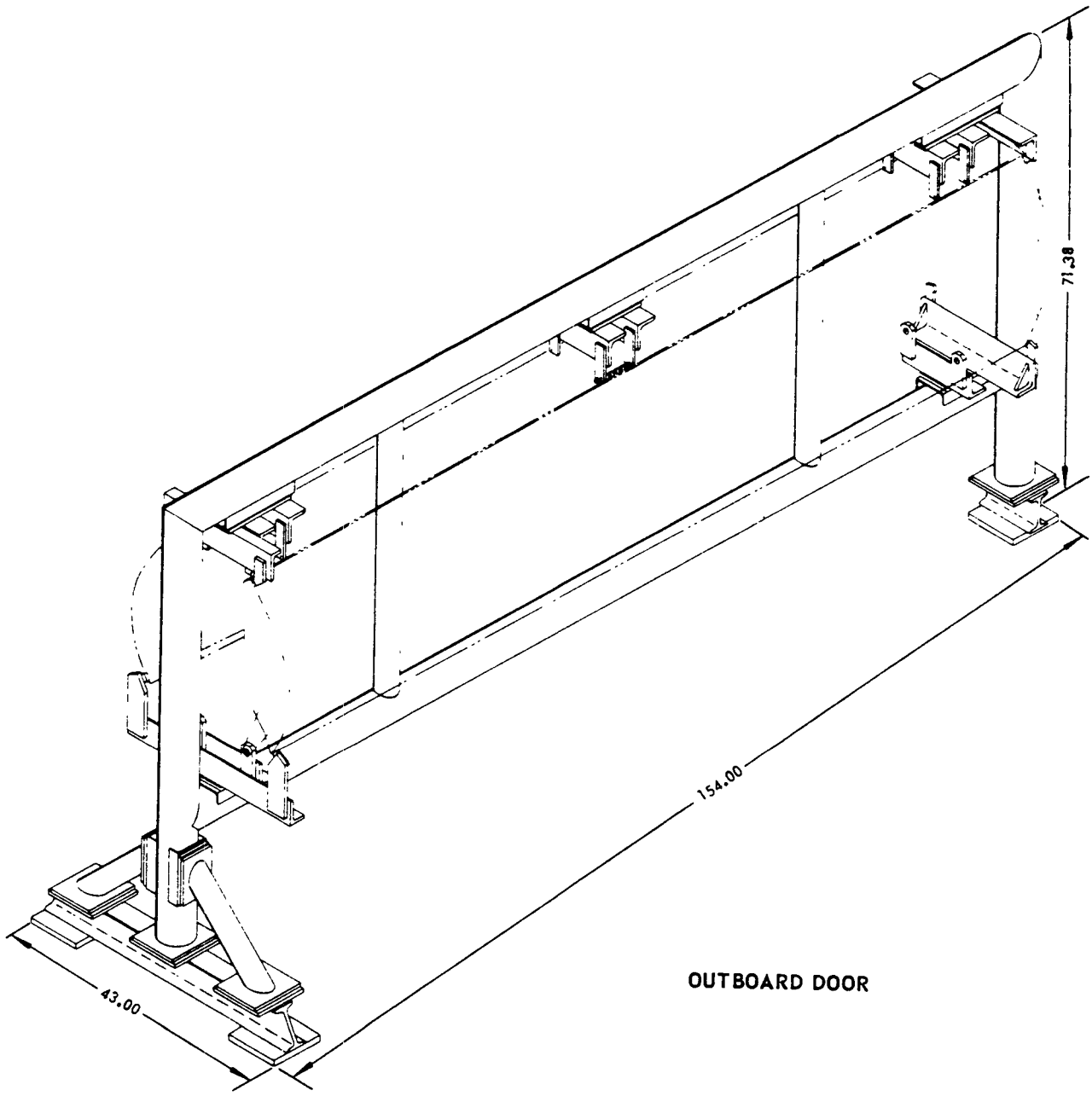
Hatch Repair Jig - Emergency
Figure 10



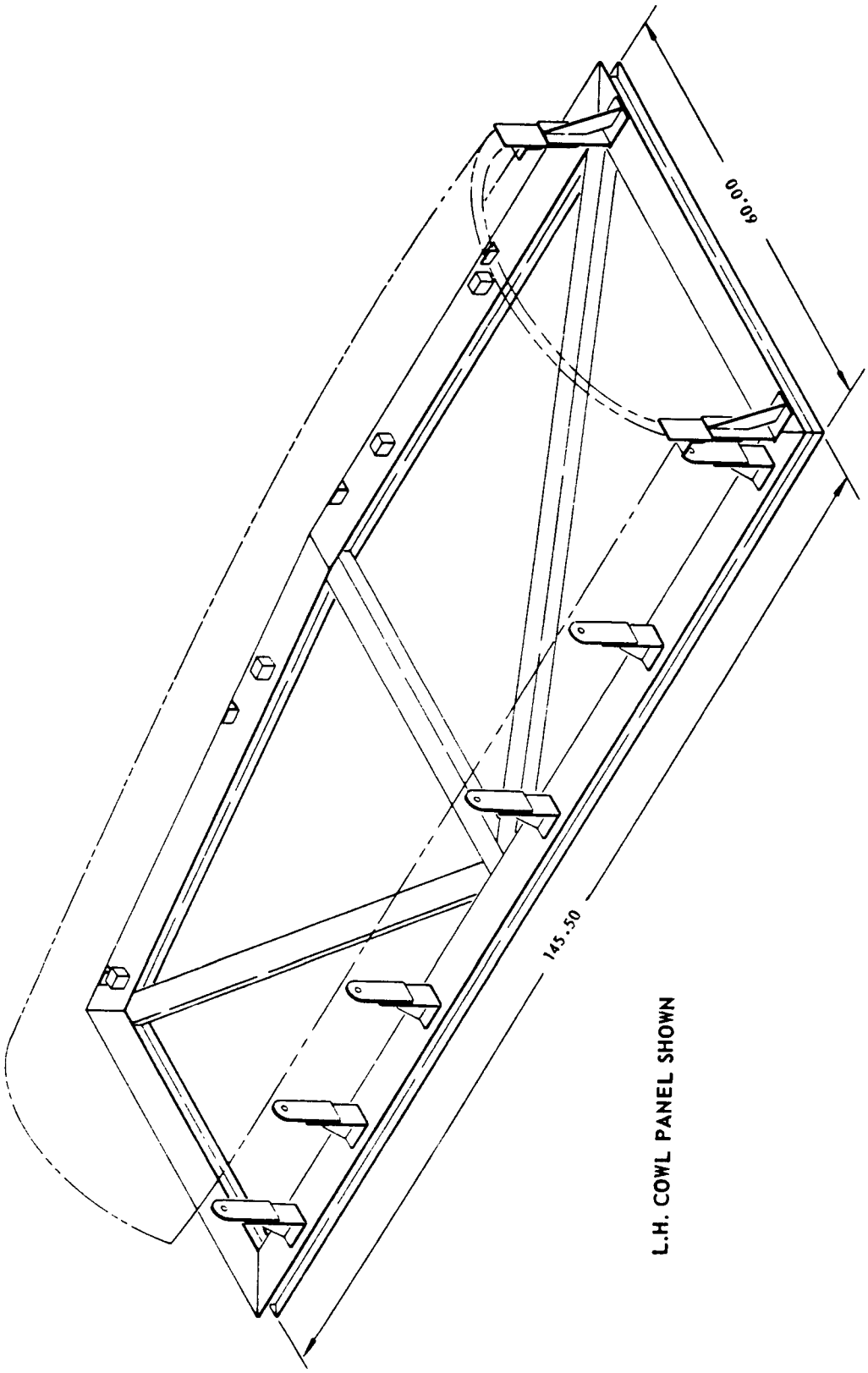
Wheel Well Door Repair Jig - Nose Landing Gear
Figure 11



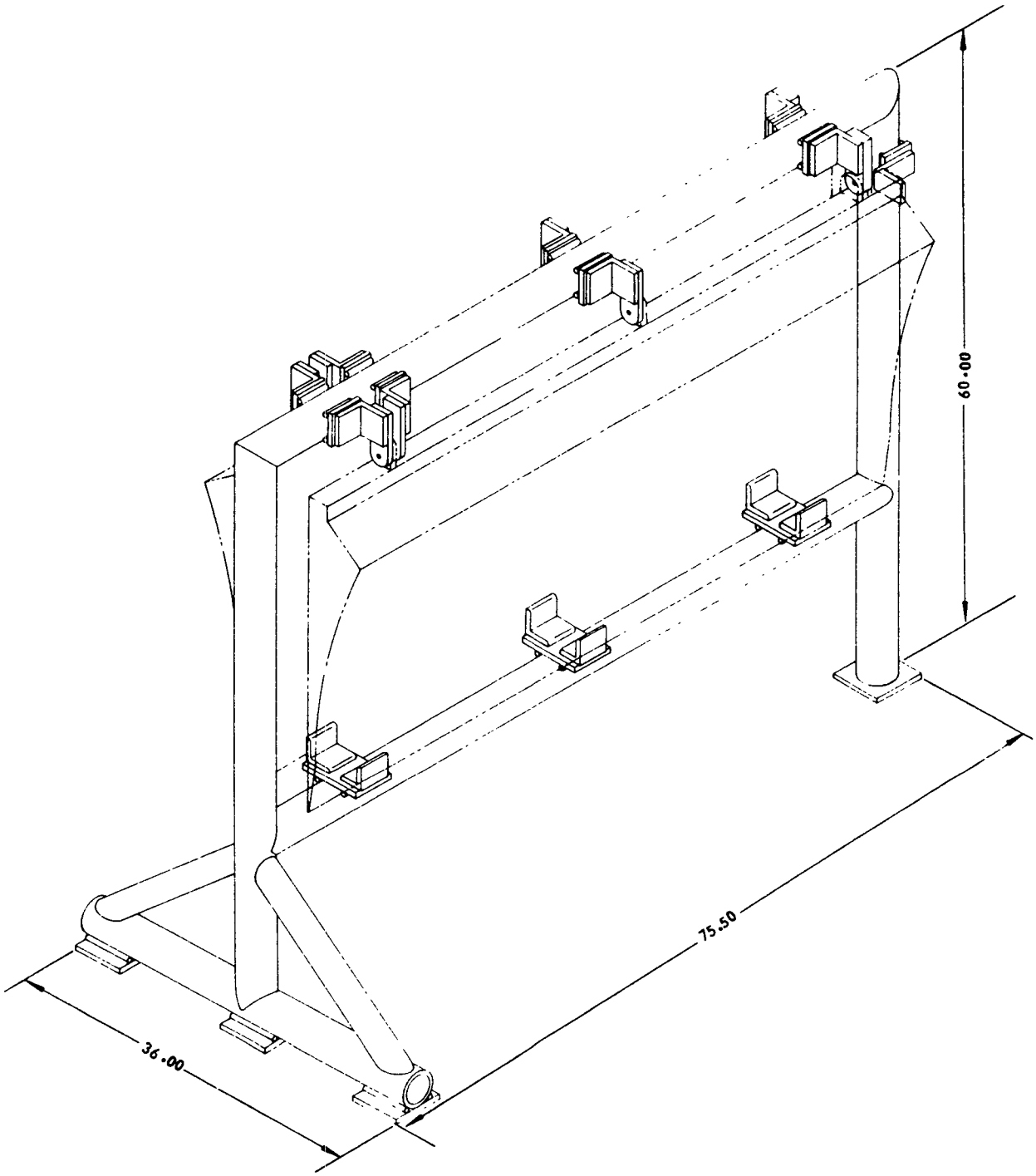
Wheel Well Door Repair Jig - Main Landing Gear
Figure 12 (Sheet 1 of 2)



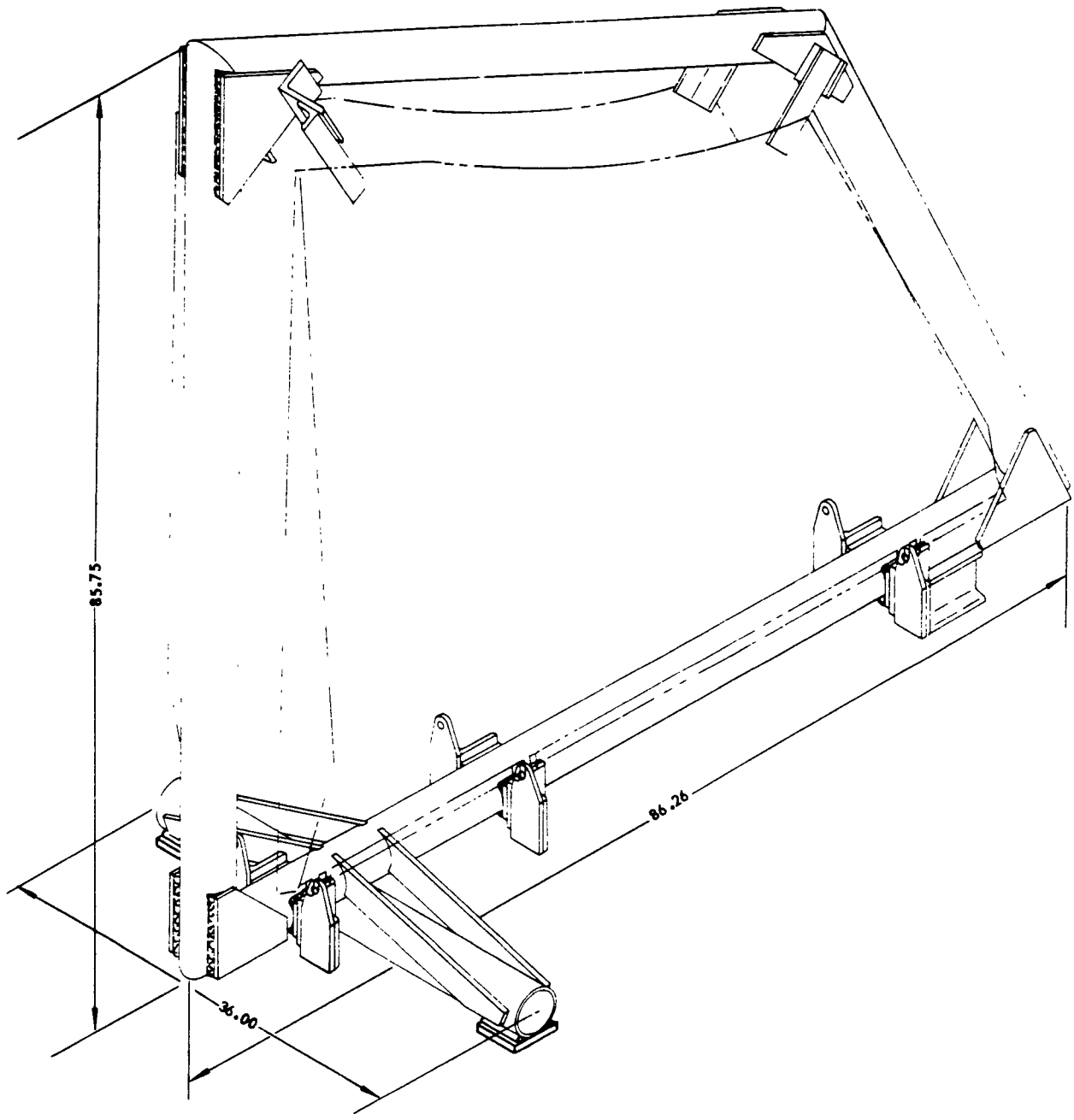
Wheel Well Door Repair Jig - Main Landing Gear
Figure 12 (Sheet 2 of 2)



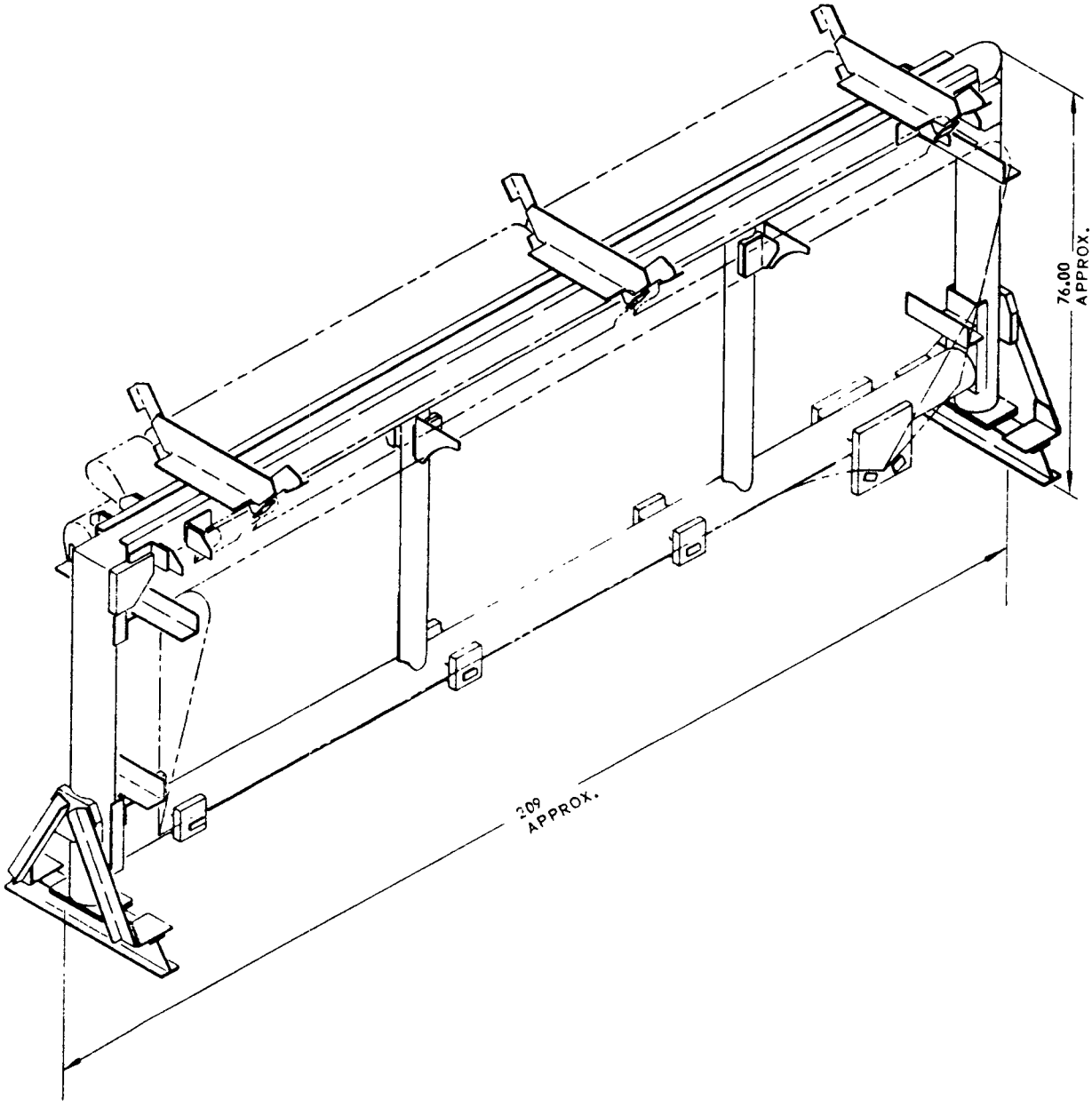
Cowling Repair Jig - Engine
Figure 13



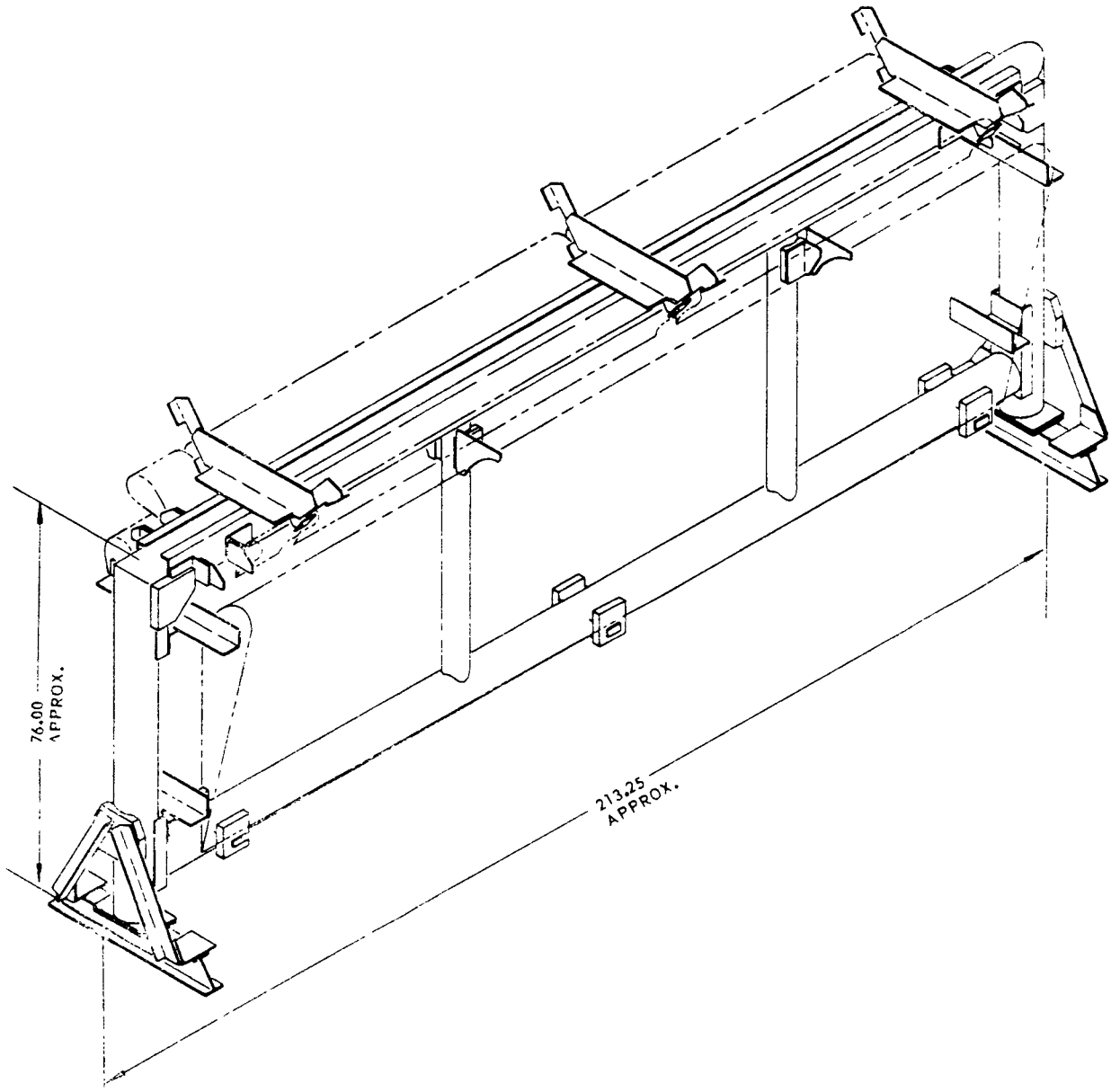
Spoiler Repair Jig - Inboard and Outboard
Figure 14



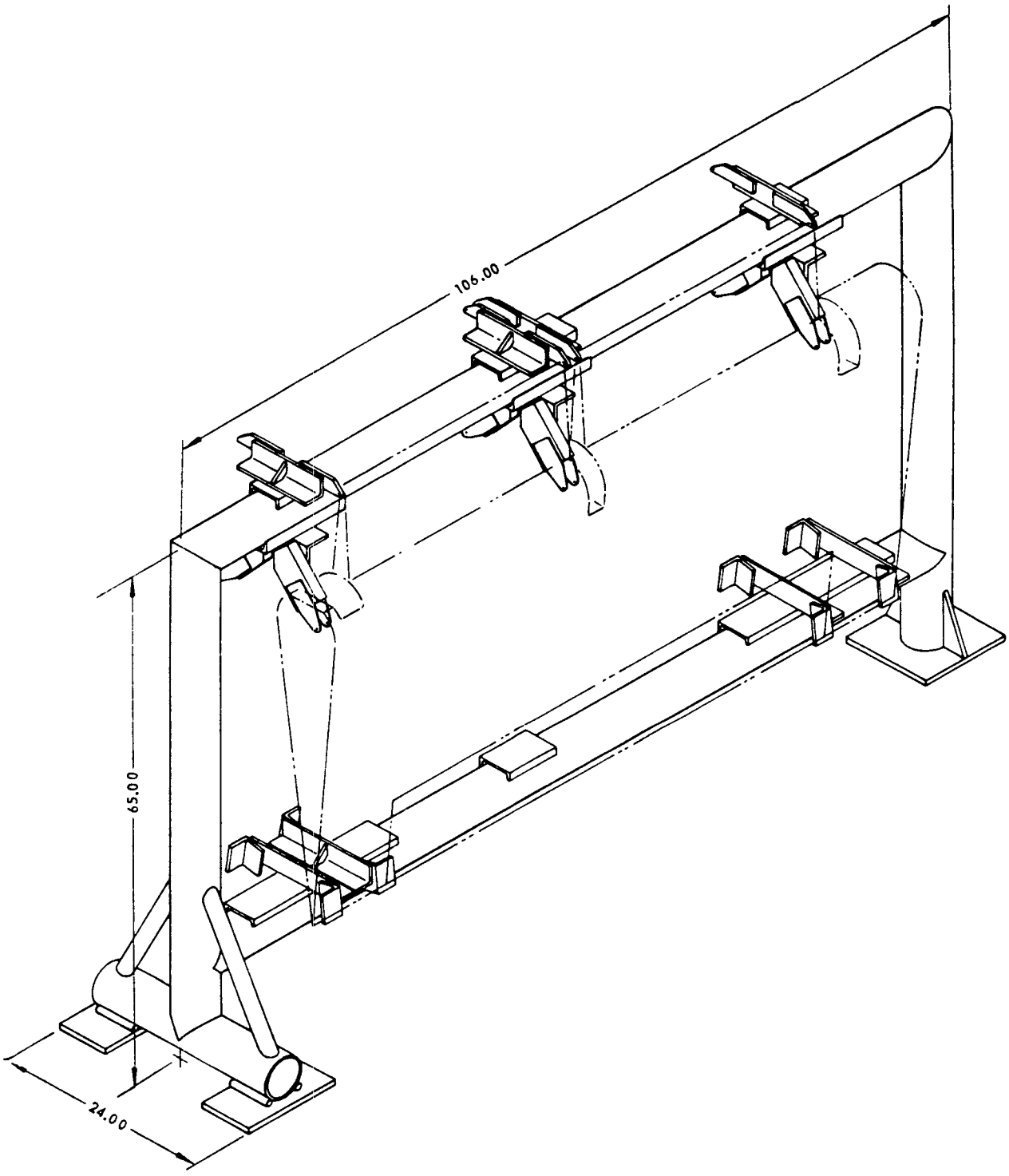
Flap Repair Jig - Fillet
Figure 15



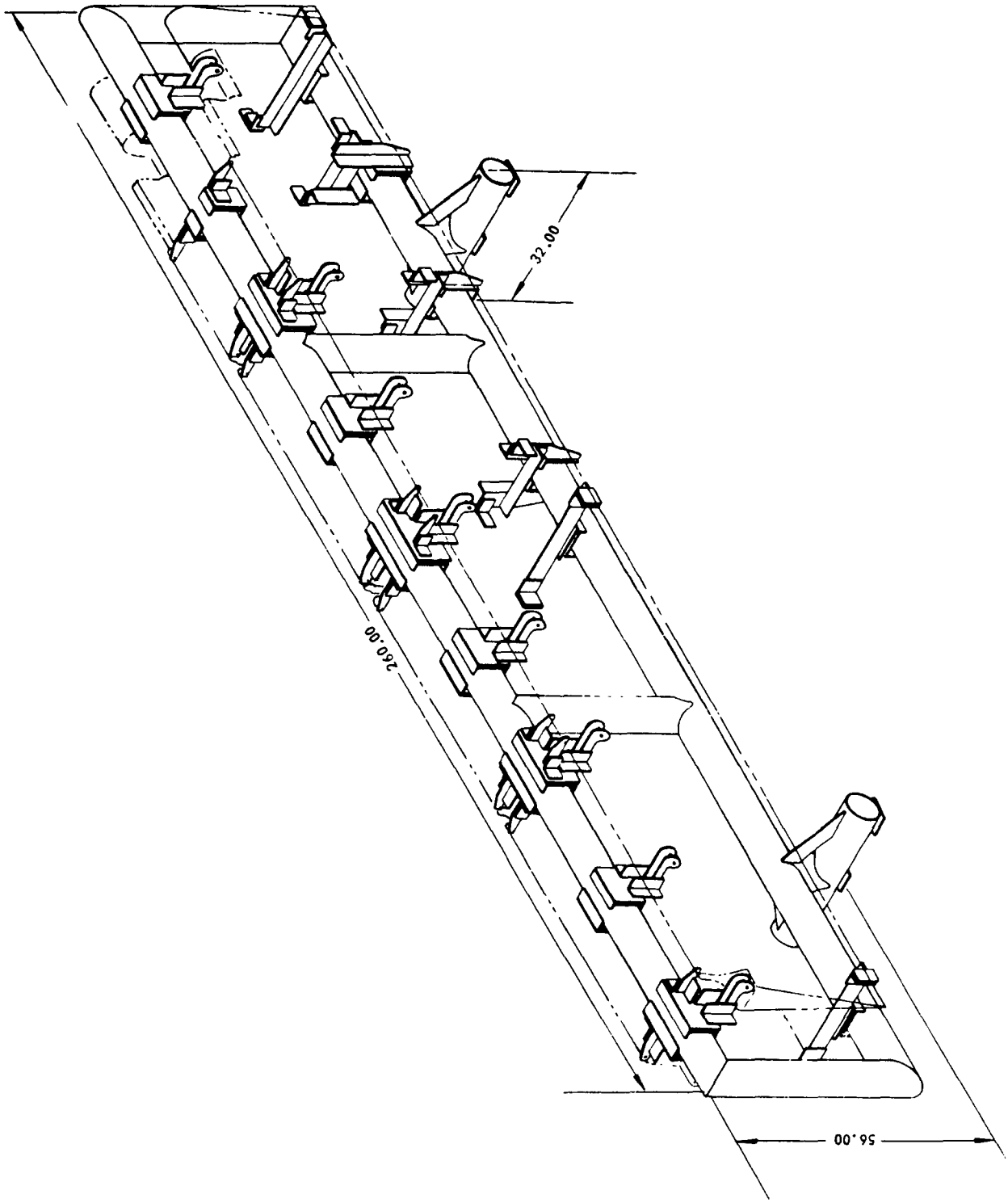
Flap Repair Jig - Inboard
Figure 16



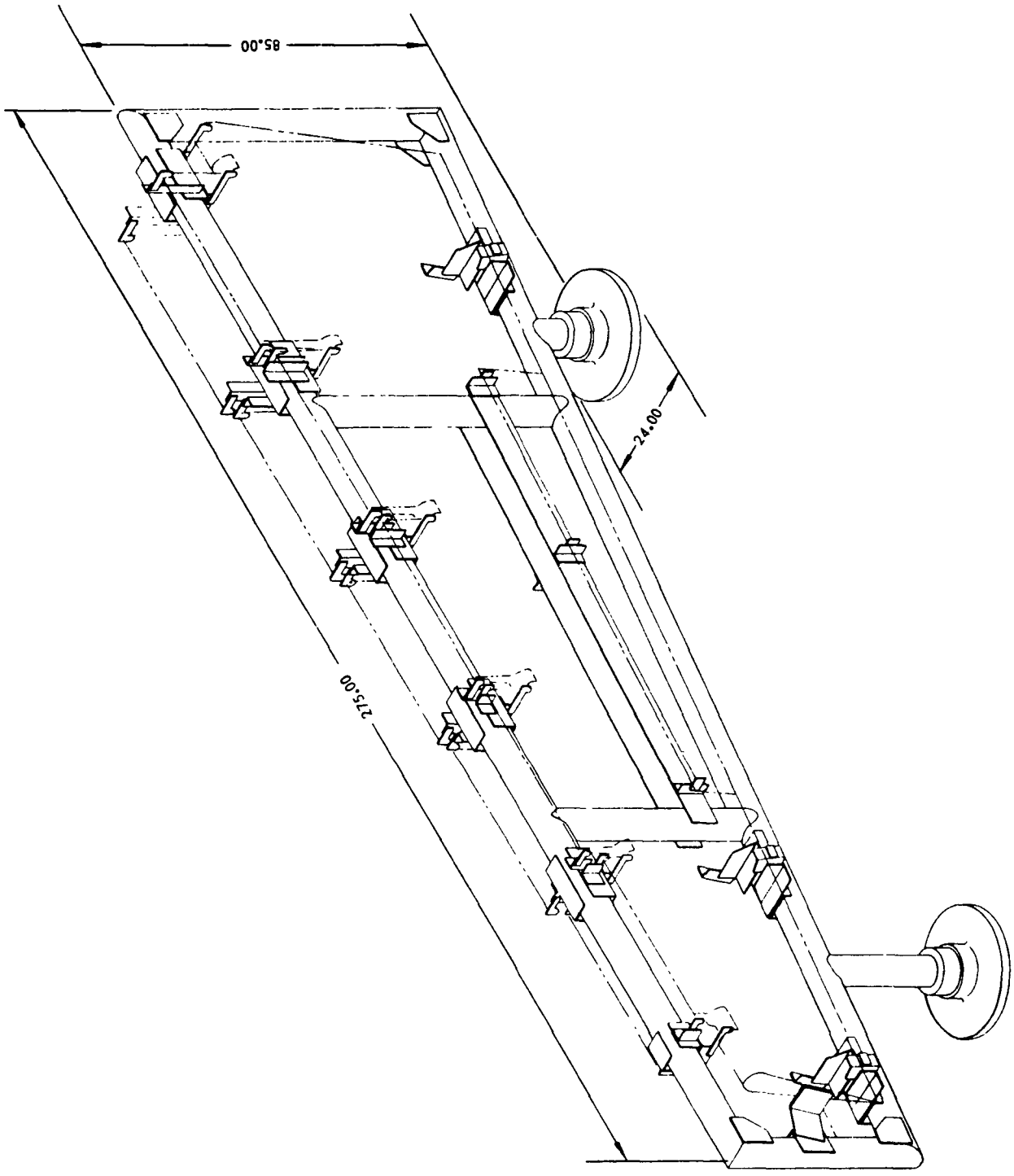
Flap Repair Jig - Outboard
Figure 17



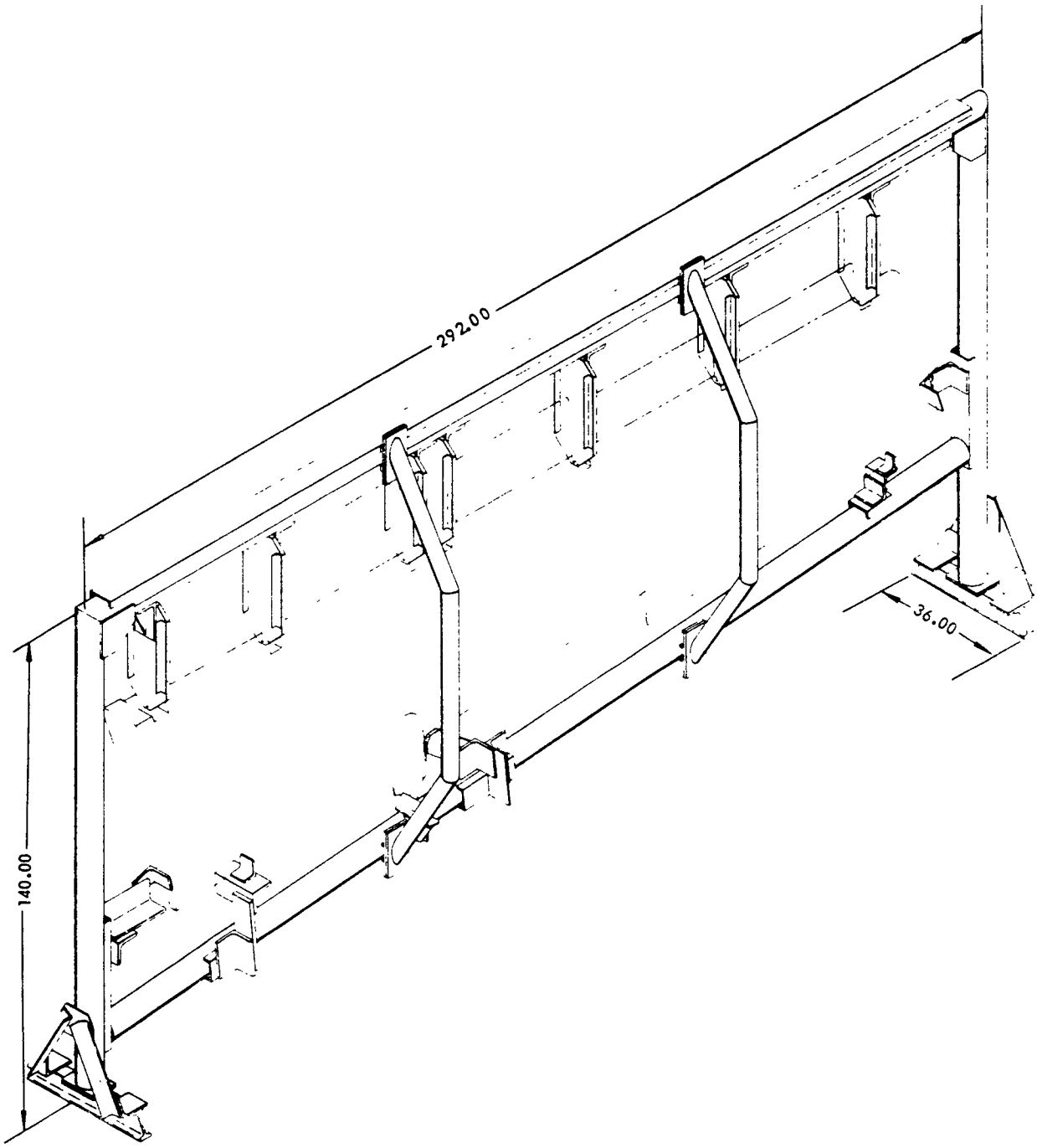
Aileron Repair Jig - Inboard
Figure 18



Aileron Repair Jig - Outboard
Figure 19



Elevator Repair Jig
Figure 20



Rudder Repair Jig
Figure 21

AIRPLANE RAISING

1. Procure Equipment per Figure 1

2. Check Placement of Airplane

   A. Place airplane in an enclosed area on a hard and fairly level surface.

   B. Conform with the following requirements if no enclosed area is available.

      (1) Head airplane into the wind.

      (2) Do not raise airplane in wind velocities exceeding 35 mph.

      (3) Level airplane for jig position:

         (a) When wind velocity is less than 10 mph.

         (b) During the night or

         (c) In shade covering entire airplane during the day in order to avoid exposure to direct sun heat or

         (d) In any hard and fairly level area during cloudy days.

3. Prepare Airplane for Raising

   A. Defuel airplane per 707 Maintenance Manual, Section 12-1-41.

   B. Check that airplane gross weight does not exceed 170,000 lbs. or as permitted by the first sentence of 7-1-1, paragraph 1.C. of the Maintenance Manual.

   C. Check if landing gear downlocks are in place.

   D. Open nose landing gear door (for support of airplane in jig position).

      (1) Pull down manual release handle located in main external power receptacle box.

         WARNING: STAND CLEAR OF DOOR ACTION WHEN RELEASE HANDLE IS BEING PULLED DOWN.

         NOTE: Landing gear control handle in control cabin must be in "OFF" position. See 707 Maintenance Manual, Section 32-5-0.

      (2) Latch down release handle to keep doors open.

   E. Open main landing gear doors.

      (1) Pull down manual release handle located in lower wing area forward of landing gear strut.

         WARNING: STAND CLEAR OF DOOR ACTION WHEN HANDLE IS BEING PULLED DOWN.

NOTE: Landing gear control handle in control cabin must be in "OFF" position. Refer to 707 Maintenance Manual, Section 32-3-0.

(2) Latch down release handle to keep doors open.

F. Install jack pads and place jacks per figure 2.

G. Extend jack rams and extension screws snug against jack pads, and lower ram lock nuts within approximately 1.00 of jack head.

H. Remove landing gear wheel chocks.

J. Release parking brakes.

K. Hang plumb bob from bracket (directly above leveling scale) installed at the upper LH side of keel beam in the main landing gear LH wheel well (Ref 51-6-1, Fig. 10).

L. Position one man at each jack to:

(1) Operate jack.

(2) Watch the pressure gage.

NOTE: Chalk or crayon mark gage dial glass at the maximum allowable load for each jack. See figure 2 for maximum allowable loads.

(3) Ascertain that ram lock nut is approximately 1.00 from jack head throughout the raising operations.

M. Position one man at leveling scale in the main landing gear LH wheel well to ascertain that airplane is raised in its level attitude so that plumb bob point is longitudinally and transversely within 0.20 of zero mark on leveling scale.

4. Raise Airplane

WARNING: DO NOT RAISE AIRPLANE IN AN OPEN AREA SUBJECT TO WIND VELOCITIES ABOVE 35 MPH.

A. Raise airplane approximately 40.00 by simultaneously lifting at wing points I and II and body point III.

CAUTION: DO NOT EXCEED ALLOWABLE JACK LOADS AS MARKED ON THE PRESSURE GAGE DIAL GLASS. SEE FIGURE 2 TO ASCERTAIN THAT GAGES ARE PROPERLY MARKED.

NOTE: The use of the hand pump is preferred to the pneumatically operated pump to achieve precise leveling.

CAUTION: DO NOT APPLY ANY LOAD ON JACK AT BODY POINT VI. FOLLOW UP MOVEMENT OF THIS POINT BY KEEPING RAM SNUG AGAINST PAD. JACK AT THIS POINT IS USED ONLY TO LONGITUDINALLY STABILIZE THE AIRPLANE.

DO NOT RAISE BODY POINT III AHEAD OF WING POINTS I AND II. THIS OPERATION WILL OVERLOAD JACKS AT BODY POINTS III AND VI.

(1) Ascertain that airplane is being raised in its level attitude by observing that plumb bob point against leveling scale is within 0.20 of zero mark in both longitudinal as well as transverse direction. (See 51-6-1, figure 10.)

(2) Ascertain that during raising operations ram lock nuts are approximately 1.00 from jack head.

(3) Allow nose landing gear oleo to extend to its fully extended position.

B. Lock all jacks if airplane is to remain supported on jacking points.

(1) Lower and hand tighten ram lock nuts against jack head on all jacks.

(2) Wrench tighten ram lock nut set screws on all jacks.

ITEM	NO. REQ'D	IDENTIFICATION	SOURCE
HYDRAULIC JACK WING POINTS I AND II [A]	2	MODEL 989R CAPACITY: 40 TONS (USA) MIN. HEIGHT: 60-78-96 INCHES RAM STROKE: 44 INCHES MAX. SCREW EXTENSION: 16 INCHES	REGENT MFG. CO., DOWNEY, CALIF. OR EQUIVALENT
HYDRAULIC JACK BODY POINT III [A]	1	MODEL B4A CAPACITY: 30 TONS (USA) MIN. HEIGHT: 55-73-91-109-127-145 IN. RAM STROKE: 40 INCHES MAX. SCREW EXTENSION: 15 INCHES	
HYDRAULIC JACK BODY POINT VI [A]	1	MODEL B4A CAPACITY: 30 TONS (USA) MIN. HEIGHT: 55-73-91-109-127-145 IN. RAM STROKE: 40 INCHES MAX. SCREW EXTENSION: 15 INCHES	
JACK PAD WING POINTS I AND II	2	PART NO. F71156	BOEING AIRPLANE COMPANY
JACK PAD BODY POINT III	1	PART NO. F71138	
JACK PAD BODY POINT VI	1	PART NO. F71139	
PLUMB BOB	1	NO. 87	THE L.S. STARRETT CO., ATHOL, MASS.
PLUMB BOB LINE	15 FT	24 LBS TEST TROLLING LINE	WESTERN MFG. CO., GLENDALE, CALIF.

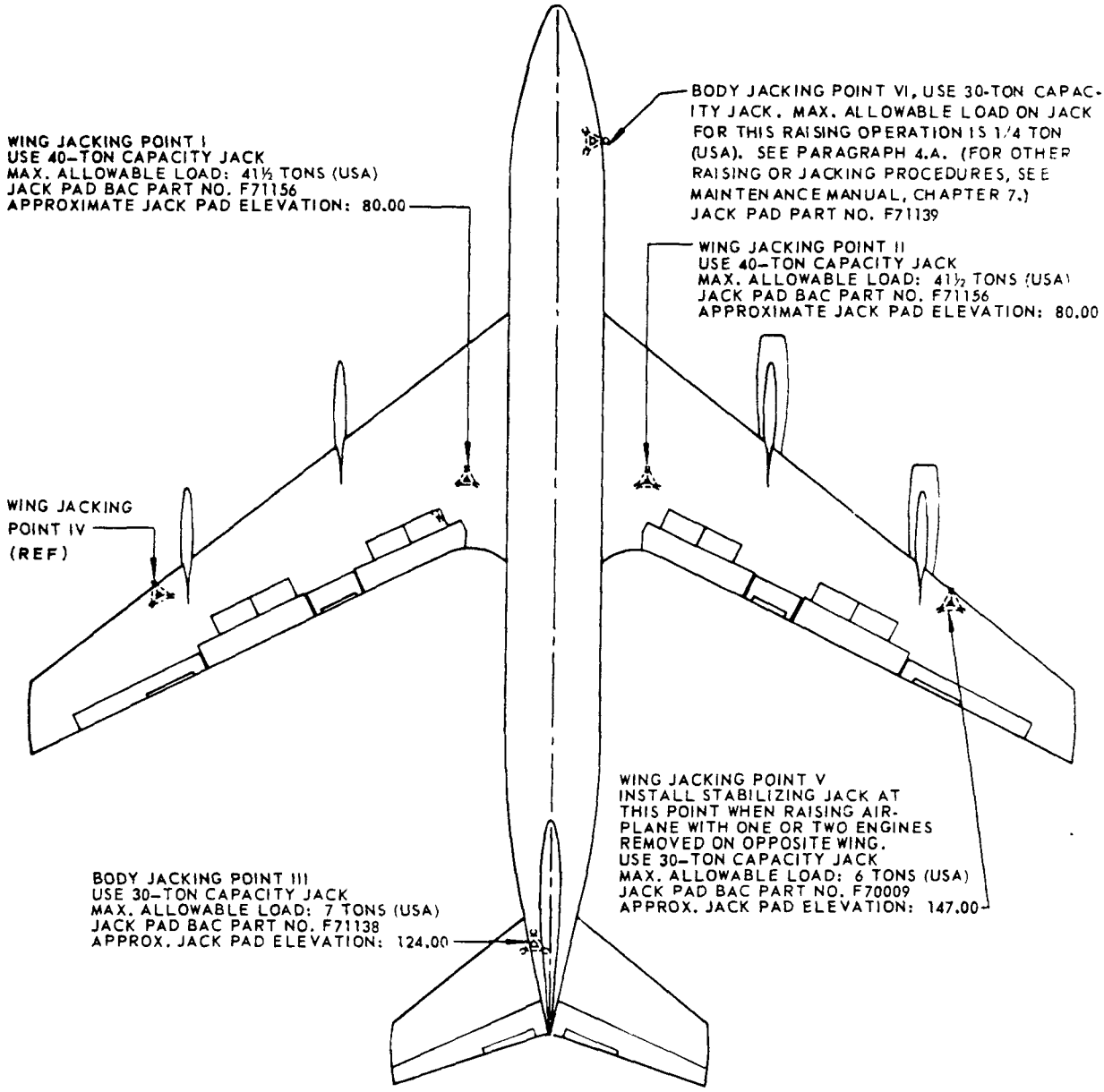
NOTE

[A] ALL HYDRAULIC JACKS MUST BE EQUIPPED WITH GAGES READING DIRECTLY IN TONS (USA). IF GAGES READ IN PSI THEN A CONVERSION CHART MUST BE AVAILABLE TO CONVERT PSI READINGS INTO TONS (USA).

Equipment for Airplane Raising
Figure 1

NOTE

MAXIMUM JACKING GROSS WEIGHT 170,000 POUNDS AT 2½ FACTORS ULTIMATE
SEE FIGURE 1 FOR JACK SPECIFICATIONS



Jacking Diagram for Airplane Raising
Figure 2

AIRPLANE LEVELING

1. Plumb Bob Level the Airplane

   A. Close release valve on all jacks.

   B. Loosen ram lock nut set screws on all jacks.

   C. Apply hydraulic pressure just enough to relieve load on ram lock nut.

   D. Turn to raise ram lock nuts approximately 1.00 from jack head on all jacks.

   E. Level airplane by using plumb bob and leveling scale mounted in main landing gear L.H. wheel well (Ref 51-6-1, Fig. 10).

   F. Level airplane transversely by operating wing jacks at points I and II.

      CAUTION: FOLLOW UP UPWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF LEVELING OPERATION CAUSES AIRPLANE TO UNDERGO A LEFT-HAND ROLL.

      FOLLOW UP DOWNWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF LEVELING OPERATION CAUSES AIRPLANE TO UNDERGO A RIGHT-HAND ROLL.

      NOTE: The use of the hand pump is preferred to the pneumatically operated pump to achieve precise leveling.

   G. Level airplane longitudinally by operating body jacks at points III and VI.

      CAUTION: FOLLOW UP UPWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF LEVELING OPERATION CAUSES AIRPLANE NOSE TO GO UP.

      FOLLOW UP DOWNWARD MOTION OF BODY POINT VI BY KEEPING RAM SNUG AGAINST PAD IF LEVELING OPERATION CAUSES AIRPLANE NOSE TO GO DOWN.

   H. Consider airplane leveled in non-jig position if plumb bob point against the leveling scale is within .10 of the zero mark (Ref 51-6-1, Fig. 10).

      CAUTION: ASCERTAIN THAT LANDING GEAR WHEELS DO NOT TOUCH FLOOR DURING LEVELING OPERATION.

      ASCERTAIN THAT DURING LEVELING OPERATIONS RAM LOCK NUTS ARE APPROXIMATELY 1.00 FROM JACK HEAD.

2. Level Airplane for Jig Position

NOTE: Do not proceed with wing support operations in jig position for at least 1 hour after airplane has been exposed to direct sun heat or after any engines have been in operation. If airplane is located in an exposed area, do not perform leveling operations when wind velocity is more than 10 mph.

A. Procure leveling equipment per Fig. 1.

B. Set up dumpy level at airplane leveling and elevation reading position as shown in 51-6-1, Fig. 3.

C. Close main landing gear LH wheel well doors.

(1) Return manual release handle to its normal position.

WARNING: STAND CLEAR OF DOOR ACTION WHEN RELEASE HANDLE IS BEING RETURNED TO ITS NORMAL POSITION.

NOTE: Landing gear control handle in control cabin must be in DOWN position (Ref 32-3-0, 707 Maintenance Manual).

D. Transversely level airplane as follows:

(1) Place the measuring assembly against LH wing point G (Ref 51-6-1, Fig. 3 and 4).

NOTE: Use ladder or aerostand as required.

(2) Sight and record reading.

(3) Place the measuring assembly against RH wing point G.

(4) Sight and record reading.

(5) Level airplane transversely per par. 1.F. until LH and RH readings are within 0.020. Calculate the average of these two readings and record.

E. Longitudinally level airplane as follows:

(1) Place the measuring assembly against leveling pad mounted on LH side of nose landing gear wheel well (Ref 51-6-1, Fig. 3, 4, and 11).

NOTE: Use ladder or aerostand as required.

(2) Sight and record reading. Subtract 6.99 from this reading.

(3) Level airplane longitudinally per par. 1.G. until reading per step E.(2) is within 0.020 reading determined at step D.(5).

NOTE: Ascertain that landing gear wheels do not touch floor during leveling operations.

Ascertain that during leveling operations ram lock nuts are approximately 1.00 from jack head.

Do not disturb transit or dumpy level set up.

F. Support airplane as shown in 51-7-1, Fig. 2.

G. Check attitude of airplane for jig position.

(1) Take final readings at the LH and RH wing points G. Calculate the average of these two readings.

(2) Take final reading at nose gear wheel well leveling pad. Subtract 6.99 from this reading.

(3) Consider airplane leveled within required tolerance if final readings taken at steps (1) and (2) are within 0.020.

H. Calculate eye-piece elevation.

(1) Use calculated average of final readings at wing points G.

(2) Subtract this average reading from 163.81 to obtain eye-piece elevation reading.

J. Take and calculate elevation readings.

(1) Take elevation readings with instrument located at airplane leveling and elevation reading position as shown on Fig. 3 and 14, Section 51-6-1, or any convenient location in order to avoid blocking line of sight by jacks or support jigs.

(2) Take readings at wing points F, V and S, using the measuring assembly (Ref 51-6-1, Fig. 4).

NOTE: Use ladder or aerostand as required.

(a) Add eye-piece elevation as calculated per par. H to elevation readings at wing points F, V and S.

(3) Take elevation readings at wing points Q, P, N and W, using a measuring assembly (Ref 51-6-1, Fig. 4).

(a) Add eye-piece elevation as calculated per par. H to elevation readings at wing points Q, P, N and W.

(4) Calculate wing point G elevation.

(a) Add eye-piece elevation (per par. H) to average point G reading as determined at step G.(1).

(5) Calculate nose landing gear leveling pad elevation.

(a) Add eye-piece elevation (per par. H) to final scale reading taken at step G.(2) but without subtracting 6.99.

(6) See Fig. 2 for jig position data.

K. Lock all jacks.

(1) Lower and hand-tighten ram lock nut against jack head.

(2) Wrench tighten ram lock nut set screw.

L. Bleed all jacks.

(1) Gradually open release valve not more than 1-1/2 turn.

(2) Check if pressure gages read zero.

M. Periodically check airplane position.

(1) Check alignment point elevation in order to ascertain that the airplane is maintaining its jig position.

(2) If necessary, operate appropriate jacks and support jigs to bring airplane into jig position.

NOTE: Factory procedures specify alignment point elevation check every 2 hours with airplane supported on a concrete floor.

ITEM	NO REQ'D	IDENTIFICATION	SOURCE
LEVEL	1	DUMPY LEVEL	KEUFFEL AND ESSER COMPANY, NEW YORK, N.Y.
FLEXIBLE MEASURING TAPE	1		ANY SOURCE
MEASURING ASSEMBLY	1	SEE FIGURE 4, 51-6-1	FABRICATE
EXTENSION LIGHT	1	100-FOOT CHORD	ANY SOURCE

Leveling Equipment
Figure 1

NOTES

[A] SEE 51-6-1, FIG. 3 FOR ALIGNMENT POINT LOCATIONS

[B] TRIM HORIZONTAL STABILIZER PER 51-6-1, PAR. 14 AND FIG. 12

[C] FOR AIRPLANES WITH JT4 ENGINES

[D] FOR AIRPLANES WITH ROLLS-ROYCE CONWAY ENGINES

[E] FOR AIRPLANES WITH JT3D TURBOFAN ENGINES

[F] RELATIVE TO ALIGNMENT POINT G, ALL DEVIATIONS FROM NOMINAL ELEVATION DIFFERENCES SHALL BE OF THE SAME MAGNITUDE AND DIRECTION AT ADJACENT FRONT AND REAR SPAR ALIGNMENT POINTS SUCH AS POINTS V AND S. DEVIATIONS FROM NOMINAL AT ADJACENT POINTS ALONG FRONT OR REAR SPARS SHALL BE IN SAME DIRECTION, SUCH AS POINTS S, P AND W OR POINTS F, V, Q, AND N

ALIGNMENT POINT [A]	ELEVATION	ELEVATION DIFFERENCE [F]
LEVELING PAD NOSE LANDING GEAR	170.80	6.99 ± 0.02
F	161.74	-2.07 ± 0.03
G	163.81	0
H [B]	261.84	98.03
J [B]	255.27	91.46
L	227.81	64.00
M	174.73	10.92
N	248.83	85.02 ± 0.30
P	225.00	61.19 ± 0.25
Q	230.82	67.01 ± 0.25
R	153.04 [C]	-10.77 [C]
	157.72 [D]	-06.09 [D]
	157.05 [E]	-6.76 [E]
S	191.44	27.63 ± 0.06
T [B]	286.80	122.99
U	125.42 [C]	-38.39 [C]
	130.10 [D]	-33.71 [D]
	129.42 [E]	-34.39 [E]
V	197.82	34.01 ± 0.06
W	245.59	81.78 ± 0.30
X	136.48	-27.33
Y	135.88	-27.93
Z	151.25	-12.56

Jig Position Data
Figure 2

AIRPLANE LOWERING

1. Lower Airplane

   A. Raise jack rams just enough to relieve pressure on support jigs.

   B. Prepare airplane for lowering per 51-6-1, paragraph 26.

   C. Lower airplane per 51-6-1, paragraph 27.

   D. Remove plumb bob per 51-6-1, paragraph 28.

   E. Remove jacks and jack pads.

   F. Close main landing doors per 51-6-1, paragraph 5B(2).

   G. Close nose landing gear doors per 51-6-1, paragraph 23.

   H. Set parking brakes.

   J. Place chocks at all landing gear wheels.

END

PROTECTIVE TREATMENT OF METAL REPAIR PARTS

1. General

A. Any repair process which breaks the surface of original structure requires a protective treatment. The treatment acts as a paint base and corrosion inhibiter when applied prior to the installation of repair parts. Unclad aluminum alloys of the original structure require subsequent alodizing in cases where repair processes expose areas to possible corrosion. Unclad aluminum alloy and chamfered edges of clad aluminum alloy repair parts require alodizing and steel parts require cadmium plating.

B. Structural components whose surfaces have not been damaged beyond the limits of allowable damage or whose surfaces have been damaged by corrosion must be refinished in accordance with the requirements of 51-2-0 of the Maintenance Manual.

C. See 51-13-1, paragraphs 5.B. and 5.D., for mechanical cleanup operations required for the elimination of burrs or sharp edges.

2. Aluminum Alloy-Brush Alodize Process

A. Alodine is the registered trade name of a proprietary process marketed by the American Chemical Paint Company. It is approved for the production of a chemical film on aluminum alloy. The film is softer than the anodic treatment but is acceptable as a protective coating and a paint base. Apply a protective coating of Alodine 1200 to all repair parts and cut or filed surfaces of original structure. Alodine 1200S may be used as an alternative. Refer to 51-2-31 of the 707 Maintenance Manual.

WARNING: HANDLE BRUSH ALODINE 1200 WITH THE USUAL PRECAUTIONS FOR CORROSIVE CHEMICALS. USE RESPIRATORS, GOGGLES, RUBBER OR NEOPRENE GLOVES, BOOTS AND APRONS WHEN HANDLING THE POWDER AND APPLYING THE SOLUTION. DO NOT ALLOW THE POWDER OR SOLUTION TO CONTACT THE SKIN. WASH OFF IMMEDIATELY. IF SOLUTION CONTACTS THE EYES, WASH WITH WATER FOLLOWED BY AN EYE WASH OR BORIC ACID. OBTAIN MEDICAL AID IMMEDIATELY. DO NOT ALLOW SWABS, PAPER, ETC., USED FOR APPLYING OR REMOVING THE ALODINE SOLUTION, TO DRY OUT. THESE CONSTITUTE A FIRE HAZARD WHEN DRIED. IMMEDIATELY AFTER USE SOAK THOROUGHLY IN WATER BEFORE DISCARDING.

B. Materials Required

(1) Alodine 1200 powder

(2) Type 3A Tycro, very fine, aluminum oxide, unitized wheels, Scotchbrite Pad, Type A, very fine aluminum oxide pads or 400 grit aluminum oxide paper

(3) Cheesecloth or new rags with less than 0.75 percent oil; Flintex-Buffalow Sanitary Wipers Co., or equivalent

(4) Methyl ethyl ketone (MEK)

C. Prepare brush Alodine 1200 solution

(1) Roll the contents of each container of Alodine 1200 powder thoroughly on clean paper prior to withdrawal of fraction to be used.

(2) Add 3 ounces of Alodine 1200 powder for each gallon of water used.

(3) Mix in stainless steel or acid-resistant container. (Do not use lead or glass.)

(4) Stir well until powder is dissolved.

NOTE: Compliance with mixing procedure is required for a satisfactory solution. A small amount of material that may settle out of solution can be disregarded.

(5) Allow the solution to stand at least 1 hour before use.

NOTE: A dirty solution is unsatisfactory. Prepare in small quantities and discard when old or dirty. If nondistilled water is used, control pH range of from 1.50 to 2.00 by addition of nitric acid. Check range by the use of pHydrion papers #60781. Add no wetting agents or other materials to this solution.

D. Prepare the surface for alodizing.

(1) Mask all surfaces likely to be affected by running, dripping, or splashing of the solution. Painted, anodized or previously alodined surfaces need not be masked.

(2) Seal or plug all holes, gaps and inlets to assemblies containing honeycomb or foam plastic with suitable sealing or caulking material or rubber plugs to prevent entry of any solution.

(3) Clean area to be alodized with a liquid solvent degreaser by using a clean brush or rags. Dry with warm air or wipe dry.

(4) Remove the existing organic and inorganic finish from the repair area. Remove the hydraulic fluid resistant finish at the same time the inorganic coating is stripped. Strip the inorganic coatings such as anodize or alodine mechanically with Tycro, Type 3A, very fine aluminum oxide unitized wheels attached to a drill motor, Scotchbrite Pad, Type A, or 400 grit aluminum oxide paper. Clean all signs of organic and inorganic coatings until a uniform, bright, shiny aluminum surface is obtained.

(5) Wipe with dry clean cheesecloth to remove loose particles and residue from the abraded area.

(6) Wipe with cheesecloth dampened (not saturated) with MEK. Repeat using clean cheesecloth until no visible residue transfers to the cheesecloth.

(7) Allow to dry for a minimum of 15 minutes.

(8) Remove any corrosion present per (1) through (7) above.

(9) See 57-2-2 for cleaning structure and repair parts prior to the installation of sealant in integral fuel tanks.

E. Apply Alodine 1200 solution.

(1) Apply Alodine 1200 evenly and liberally with a fiber or nylon brush or clean cheesecloth.

(2) Allow the solution to remain for 3 to 4 minutes to form a coating. Keep the area from drying during this period by gently blotting with cheesecloth moistened with the solution.

(3) Rinse with clean water by gently contacting the surface with wet (not saturated) clean cheesecloth. Contact for 1 to 2 minutes and repeat with clean cheesecloth.

CAUTION: EXERCISE CARE WHEN RINSING AND DRYING TO AVOID SCRATCHING OR REMOVING THE COATING, WHICH IS TENDER WHEN FRESHLY FORMED.

(4) Gently contact the surface with clean dry cheesecloth to absorb excess liquid. Repeat as required.

(5) Air dry thoroughly. Filtered hot air (160°F maximum) for 15 minutes is recommended.

(6) Apply final finish or commence adhesive bonding in accordance with 51-9-1 as soon as possible after drying. Handle parts with clean gloves and keep parts clean and dry to avoid surface contamination.

3. Magnesium Alloy-Brush Alodize Process

A. The brush alodize process for magnesium is the same as for aluminum, except for corrosion removal from the surfaces. Treat repair parts and original structure, on which the protective coating has been removed by cutting or filing, with Alodine 1200.

NOTE: Alodine 1000 is not recommended for use on magnesium or magnesium alloys.

B. Magnesium Corrosion Removal

(1) Remove most of the corrosion with aluminum wool and a stiff fiber brush.

(2) Mask off other materials and parts, especially rubber parts, bearings and pressed inserts, against contact with the treating solution or its fumes.

(3) Dissolve corrosion from pits with chrome pickle solution.

(a) Prepare chrome pickle solution containing 1.5 pounds of sodium dichromate and 1.5 pints of concentrated nitric acid per gallon of water.

(b) Brush on generous quantities of freshly prepared chrome pickle solution.

(c) Allow solution to remain in contact with surface for at least one minute.

(d) Rinse thoroughly and dry.

C. Brush Alodize with Alodine 1200 per paragraph 2.E.

4. Steel-Cadmium Plating

A. Noncorrosion resistant steel parts used in repairs must be cadmium plated for maximum corrosion protection. Refer to Overhaul Manuals 20-42-01 and 20-42-05 for cadmium plating.

B. While corrosion resistant steels are not susceptible to oxidation, they are cathodic when in contact with dissimilar metals (paragraph 5) and therefore they should be cadmium plated.

C. Apply protective coating to reworked surfaces of steel parts which have been heat-treated to less than 220,000 psi as follows:

(1) Clean by wiping with a cloth or brush which has been dipped in one of the alcoholic-phosphoric solutions Turco Pre-Paint, Kelite polycote, or in an aqueous solution containing 10% by volume phosphoric acid (85%), 10% by volume butyl cellulose, and .1% by volume Triton X-100 wetting agent. Do not allow solution to dry on work.

(2) Rinse with a water-soaked rag.

(3) Wipe dry.

(4) Apply MIL-P-8585 zinc chromate primer. (This may be obtained in aerosol spray cans under BMS 10-13 from the Fuller O'Brien Co., 450 East Grand Avenue, South San Francisco, California 94080.)

(5) Spray topcoat EC-843 (Minnesota Mining and Manufacturing Co., St. Paul, Minnesota) to obtain a total dry film thickness of 2 to 3 mils.

5. Faying Surfaces

A. Each metal and alloy has an inherent electrical potential and when placed in contact with a material of different potential, in the presence of an electrolyte, causes galvanic corrosion which results in pitting or corroding of the higher potential material.

B. Dissimilar metals are classified into four groups as shown in figure 1. Classification is determined by the surface metal i.e., the base metal of a nonplated part, or the deposited metal of a plated or coated part.

C. Figure 2 shows the protective finishes which are to be used on faying surfaces.

D. The protective finishes shown in figure 2 are suitable for the protective treatment of faying surfaces for the type of repair shown in this manual. These finishes are considered to be acceptable for field type repairs where speed and simplicity is essential. For restoration of internal and external finish, refer to Chapter 51-2-0 of the Maintenance Manual.

6. Fastener Installation

A. The requirement for protection from galvanic corrosion may be determined from Fig. 3. Fasteners requiring protective coating should be installed with wet BMS 10-11, type 1, primer with the following exceptions:

(1) Integral fuel tanks -- Ref 57-2-2.

(2) Exterior unpainted surfaces -- Install fasteners with wet, MIL-P-8585, zinc chromate primer, or in the case of removable fasteners, MIL-C-11796, class 3, corrosion preventative compound.

(3) Torqued fasteners not in close tolerance holes -- Coat hole with BMS 10-11, type 1, primer and allow to dry before installing fastener.

(4) Removable close tolerance fasteners -- Install fasteners with MIL-C-11796, class 3, corrosion preventative compound.

B. Shaved heads of aluminum rivets in unpainted anodized aluminum alloy surfaces must have a clear coating of Alodine 1000 applied manually.

7. Water Displacing Corrosion Preventive Compound

A. Corrosion inhibitors are used to supplement finish systems and as a means of preventing or retarding corrosion where the finish system has been damaged. These materials are volatile liquids which may be sprayed, swabbed or brushed on the surfaces to be treated. The liquid carrier evaporates quickly to leave a thin film of wax-like residue over the coated surface. This material has the ability to penetrate into extremely small cavities and to displace water, consequently it is able to enter between faying surfaces or between fasteners and holes, where the finish has been broken. It is a durable material, not easily removed by normal use, and where used externally will withstand a certain amount of washing, although eventually reapplication will be required.

NOTE: Each operator should evaluate his aircraft's environment, the inhibitor used, and the application schedule, to ensure adequate corrosion protection. Although Boeing has developed BMS 3-23 as a standard for organic corrosion inhibitors and recommends its use, other water displacing corrosion preventive compounds may be satisfactory, based on operator evaluation and experience.

B. Water displacing corrosion inhibiting compound has been applied during construction on certain airplanes in the locations shown in Fig. 4. Periodic reapplication in these, and other locations, is required to maintain effectiveness of this protection. Reference should be made to D6-41910, Corrosion Prevention Manual for further details.

C. There are two types of BMS 3-23 compounds as follows:

(1) Type I - A transparent colorless film which is only detectable with ultraviolet light.

(2) Type II - A colored film which is readily detected by the unaided eye.

D. Materials qualified under BMS 3-23 and the suppliers are as follows:

Material	Vendor
Boeshield T9	Oxy Metal Corporation Specialty Chemical Group 32100 Stephenson Highway Madison Heights, Michigan 48071
	Gibson Chemicals Ltd 350 Reserve Road Cheltenham Victoria, Australia 3192

8. Precautions for Use of Water-displacing, Corrosion-inhibiting Compounds

A. For personal safety the following warning must be observed when using water-displacing, corrosion-inhibiting compounds.

WARNING: THESE COMPOUNDS ARE APPROXIMATELY EQUAL TO KEROSENE OR ALIPHATIC NAPHTHA IN TOXICITY. TO PROTECT SKIN, USE SAME PRECAUTIONS AS FOR KEROSENE. WHEN SPRAYING IN AN ENCLOSED AREA, SUCH AS LOWER FUSELAGE, A VAPOR CONCENTRATION OF 500 PARTS PER MILLION IS THE MAXIMUM COMFORTABLE WORKING LIMIT. AT THIS CONCENTRATION A MAN CAN WORK AN 8-HOUR SHIFT. VAPOR LEVELS EXCEEDING 500 PPM ARE NOT DIRECTLY TOXIC, BUT FORCED VENTILATION MAY BE NECESSARY TO MAINTAIN A COMFORTABLE LEVEL. PERCHLOROETHYLENE IS PREFERRED SOLVENT AS IT IS NONFLAMMABLE. PERCHLOROETHYLENE IS TOXIC. IF USED IN EXTREMELY CONFINED AREAS, MECHANICAL VENTILATION IS MANDATORY. RESPIRATORY AND SKIN PROTECTION MAY BE NECESSARY.

WARNING: WHEN MIXED WATER-DISPLACING, CORROSION-INHIBITING COMPOUNDS AND OXYGEN ARE POTENTIALLY EXPLOSIVE. KEEP CLEAR OF OXYGEN SYSTEM COMPONENTS.

B. Being hydrocarbons these compounds are potentially dangerous when mixed with oxygen. Oxygen system components must be shielded to protect them from direct or indirect contamination.

CAUTION: AS A FIRE SAFETY PRECAUTION, THE MATERIAL SHOULD BE KEPT AWAY FROM SURFACES THAT WILL ATTAIN 300°F OR MORE IN SERVICE. THE DRY FILM FLASH POINT IS 500°F.

CAUTION: CORROSION INHIBITOR CONTAINS FLAMMABLE COMPONENTS. DO NOT EXPOSE THESE MATERIALS TO OPEN FLAME, ACTIVE CIRCUITS, OR OTHER COMPONENTS WHEREBY A POTENTIAL FIRE HAZARD WOULD EXIST. THE VOLATILE CARRIER IS ALSO FLAMMABLE. MAINTAIN SAFETY PRECAUTIONS UNTIL THE CARRIER HAS FULLY EVAPORATED.

C. Precautions must be taken when using these materials which can constitute a fire hazard when subjected to high enough temperatures.

D. Mask electrical connectors where there is a possibility of contamination of electrical contacts.

CAUTION: REMOVE EXCESS CORROSION INHIBITING COMPOUNDS FROM MECHANISMS AND MOVING PARTS WITH A CLEAN DRY RAG. THE RESULTANT THIN FILM IS ADEQUATE FOR CORROSION PROTECTION WHILE EXCESSIVE BUILD-UP COULD HARDEN AT LOW TEMPERATURES CAUSING OPERATING DIFFICULTIES.

E. Shield control cables, pulleys, teflon bearings and lubricated surfaces from direct application. The carriers used in these materials are volatile hydrocarbons which act as a solvent for lubricants. Destruction of the lubricants can result in premature and excessive wear of the components.

F. Water displacing corrosion inhibiting compounds may cause silicone rubber to swell consequently care must be exercised when making application in the vicinity of door or emergency hatch seals, grease seals in bearing assemblies or rubber-lined clamps for tubing or wiring. Skydrol seals may also be affected, so these corrosion inhibitors are not suitable for use on actuator rods.

9. Compatibility of Water Displacing Corrosion Inhibitors

A. As these materials are all usually hydrocarbons, new applications of a different compound may be applied over existing corrosion inhibitors without deleterious effects.

10. Cleaning before Application of Water Displacing Corrosion Inhibiting Compounds

A. Extreme cleanliness is not required for the application of these compounds, but better joint penetration will be achieved if the area is cleaned before application. Loose dirt or other foreign matter can be removed by vacuum or wiping. The surfaces can then be cleaned, where necessary, by using normal airplane cleaning agents or solvents.

11. Application of Water Displacing Corrosion Inhibiting Compounds

A. Statically ground the airplane, as described in 13-7-1 of the Maintenance Manual.

B. If corrosion inhibitor is to be applied near batteries, electrical contacts, electrical connectors, or other components such that a potential fire hazard would exist, remove external power and place battery switch in off position.

C. Observe the precautions given in par. 8 and mask or shield components which must not be contaminated with corrosion inhibiting compounds.

D. Ensure that all primers or enamels have been permitted to cure for a minimum of 8 hours.

E. Apply a continuous wet coat so that joint penetration will be achieved by capillary action. An application rate by spraying of 1 gallon per hour at a coverage rate of 15 to 20 square feet per minute will produce a film thickness of 0.0003 inch. Alternately these materials may be brushed or swabbed. Refer to par. 12 for further details of spraying equipment and procedures. The use of pressure equipment that applies these compounds under pressure direct to a joint or lap will improve the penetration. A soak period of 30 minutes is recommended before excess compound is removed to ensure maximum penetration.

F. Wipe up excess compound with clean gauze or rags. Excess compound will not give additional corrosion protection and is detrimental from a dirt pickup standpoint.

G. Ventilate the area until the volatile solvents have completely evaporated and remove the masking or shielding from the area treated.

12. Spray Application of Water Displacing Corrosion Inhibiting Compounds

A. Aerosol cans can be used in conjunction with plastic nozzle extensions but they are not generally recommended due to cost and the amount of overspray generated.

B. The preferred application method is with standard pressure pot equipment using an airless spray gun operated at low pressure (45 psi). Suitable spray equipment is available from the following suppliers:

(1) Nordson Corporation, Franklin and Jackson, Amherst, Ohio 44001

(2) The DeVilbiss Company, P.O. Box 913, 300 Phillips, Toledo, Ohio 43601

(3) Binks Manufacturing Company, 9201 W. Bellmont Ave., Franklin Park, Illinois 60131

(4) Graco Incorporated, 60, 11th Avenue NE, Minneapolis, Minnesota 55413

C. Greater accessibility will be provided with the use of accessories such as spray gun extension kits and swivel adapters for variable nozzle positioning.

D. Standard air atomizing equipment (siphon or pressure pot) may be used when access is sufficient to allow application of a wet coat. A spray nozzle-to-surface distance of no more than 12 inches is required for wet application. When spray is operated with a pressure pot, a suitable extension may be made as follows:

(1) Remove and retain air cap.

(2) Remove fluid tip, and solder or braze 1/8-inch annealed copper tubing of desired length on end of tip.

(3) Make nozzle at the end of the tubing by clamping tube around a 0.010-inch diameter wire.

(4) Do not connect air hose to spray gun.

(5) Use 20-30-psi pot pressure for spraying.

13. Removal of Water Displacing Compounds

A. Complete removal of corrosion inhibiting compounds is required before repainting is attempted. Solvent cleaning is also required before penetrant inspection. The following solvents have been successfully used to remove these compounds:

(1) Perchlorethylene

(2) Trichlorethylene

(3) Trichlorethane

(4) Naphtha

(5) Magnaflux Corp. Solvent

(6) Stoddart Solvent

NOTE: Methyl Ethyl Ketone (MEK) or Acetone is not recommended.

B. When using solvents for the removal of water displacing compounds ventilate the area in the same manner as described for corrosion inhibitor application in par. 5.

14. Exterior Discoloration by Corrosion Prevention Compounds

A. Liberal use of water displacing compounds on the internal surfaces of the airplane can lead to discoloration of the external surface. Because of the excellent penetrating properties of these materials, a "bleed through" can be expected at fasteners that are not fluid-tight. This is normal and does not indicate a requirement to replace or redrive the fasteners. The tiny passages should seal themselves within a short time.

B. Water displacing compounds on the exterior surface may be removed using one of the solvents listed in par. 13. They will not stain or damage the exterior of the airplane or decorative finish, but a noticeable difference in oxidation of the exterior surfaces can occur between those areas which have been coated with the compound and areas that have not. Where this difference in color is apparent it can be buffed out using the materials listed in Chapter 20 of the Maintenance Manual.

GROUP I	MAGNESIUM AND ITS ALLOYS. ALUMINUM ALLOYS 1100, 5052, 5056, 5356, 6061, 6063
GROUP II	CADMIUM, ZINC, ALUMINUM AND THEIR ALLOYS (INCLUDES GROUP I ALUMINUM ALLOYS) [A]
GROUP III	IRON, LEAD, TIN, AND THEIR ALLOYS (EXCEPT CORROSION RESISTANT STEEL)
GROUP IV	CHROMIUM, NICKEL, TITANIUM AND THEIR ALLOYS CORROSION RESISTANT STEEL
MEMBERS OF ANY ONE GROUP ARE SIMILAR MEMBERS OF DIFFERENT GROUPS ARE DISSIMILAR.	

NOTES

[A] EXCEPT FOR 5056 DRIVEN RIVETS IN 2024 ALUMINUM ALLOYS

Classification of Dissimilar Metals
Figure 1

MATERIAL	FINISH ON FAYING SURFACES OTHER THAN THOSE TO BE BONDED OR SITUATED IN INTEGRAL FUEL TANKS, INCLUDING THOSE EXPOSED TO HYDRAULIC FLUID [B] [C]		SURFACES TO BE STRUCTURALLY BONDED	SURFACES IN INTEGRAL FUEL TANKS
	SIMILAR METALS [A]	DISSIMILAR METALS [A]		
BARE ALUMINUM ALLOYS	ALODIZE (SEE PARA 2) AND APPLY ONE COAT OF BMS 10-11 PRIMER TO EACH SURFACE	ALODIZE (SEE PARA 2) AND APPLY TWO COATS OF BMS 10-11 PRIMER TO EACH SURFACE	SEE 51-9-1	SEE 57-2-2
NON-CORROSION RESISTANT STEEL	CADMIUM PLATE (SEE OVERHAUL MANUAL CHAPTER 20) AND APPLY ONE COAT OF BMS 10-11 PRIMER TO EACH SURFACE	CADMIUM PLATE (SEE OVERHAUL MANUAL CHAPTER 20) AND APPLY TWO COATS OF BMS 10-11 PRIMER TO EACH SURFACE		
CORROSION RESISTANT STEEL	NONE	CADMIUM PLATE (SEE OVERHAUL MANUAL CHAPTER 20) AND APPLY TWO COATS OF BMS 10-11 PRIMER TO EACH SURFACE		
METALS LISTED IN FIGURE 1 GROUP IV OTHER THAN CRES	NONE	APPLY TWO COATS OF BMS 10-11 PRIMER TO EACH SURFACE		
CLAD ALUMINUM ALLOY AND OTHER METALS NOT LISTED ABOVE.	APPLY ONE COAT OF BMS 10-11 PRIMER TO EACH SURFACE	APPLY TWO COATS OF BMS 10-11 PRIMER TO EACH SURFACE		

NOTE

[A] SIMILAR METALS ARE THOSE LISTED IN THE SAME GROUP IN FIGURE 1.

[B] NON-BONDED LOWER LOBE BODY SKIN FAYING SURFACES REQUIRE A FAYING SURFACE SEAL OF BMS 5-79 CLASS B OR C IN ADDITION TO PRIMER.

[C] HYDRAULIC FLUID, FIRE RESISTANT, BMS 3-11.

Faying Surfaces, Protective Finishes
Figure 2

FASTENER MATERIAL IN CONTACT WITH STRUCTURE	MATERIAL IN CONTACT WITH FASTENER			
	MAGNESIUM AND MAGNESIUM ALLOYS	ALUMINUM ALLOYS, CADMIUM AND ZINC PLATE	LEAD, TIN, BARE IRON AND CARBON OR LOW ALLOY STEELS	CORROSION RESISTANT STEELS NICKEL AND COBALT BASE ALLOYS, TITANIUM, COPPER, BRASS, CHROME PLATE AND GRAPHITE
ALUMINUM EXCEPT 5056	[A]	[B]	[A]	[A]
ALUMINUM ALLOY 5056	[B]	[B] [E]	[A]	[A]
CADMIUM OR ZINC PLATE	[A]	[C]	[A]	[D]
CHROME PLATE	[A]	[A]	[A]	[B]
UNPLATED CORROSION RESISTANT STEEL	[A]	[A]	[A]	[B]
NICKEL OR COBALT BASE ALLOYS	[A]	[A]	[A]	[B]
UNPLATED TITANIUM	[A]	[A]	[A]	[B]

NOTES

[A] PROTECTIVE TREATMENT IS NECESSARY

[B] PROTECTIVE TREATMENT IS NOT NECESSARY

[C] PROTECTIVE TREATMENT IS UNNECESSARY EXCEPT FOR CADMIUM PLATED ALLOY STEEL BOLTS THROUGH ALUMINUM ALLOYS IN CRITICAL CORROSION AREAS

[D] PROTECTIVE TREATMENT NECESSARY EXCEPT FOR CADMIUM PLATED TITANIUM AND CORROSION RESISTANT STEEL FASTENERS IN MATERIALS LISTED IN FIG. 1, GROUP IV

[E] EXCEPT FOR 5056 DRIVEN RIVETS IN 2024 ALUMINUM ALLOY

Protective Treatment for Fastener Installation
Figure 3

FUSELAGE	INTERIOR – ABOVE MAIN CABIN FLOOR 1. ALL SEAT TRACKS UNDER GALLEYS 2. UNDER ENTRY AND SERVICE DOOR SCUFF PLATES 3. UNDER TOILET COMPARTMENT PANS. INTERIOR – BELOW MAIN CABIN FLOOR 1. ALL STRUCTURES (FLOOR BEAMS, SKIN, STRINGERS, ETC.) BELOW GALLEYS, LAVATORIES AND ENTRYWAYS 2. STRUCTURE (FRAMES, SKINS, STRINGERS, ETC.) IN ALL PRESSURIZED SECTIONS BETWEEN STRINGERS S–26L AND S–26R. 3. UNDER CARGO DOOR SCUFF PLATES. 4. REAR FACE OF 960 BULKHEAD BETWEEN BUTTOCK LINES 32 LEFT AND RIGHT AND EXTENDING TO THE TEAR STRAP INTERSECTION WITH SKIN. EXTERIOR 1. STRUCTURE COVERED BY WING–TO–BODY FAIRING, INCLUDING RAM AIR INLET. 2. STATION 960 MAIN LANDING GEAR WHEEL WELL BULKHEAD IN AREA COVERED BY BULLNOSE FAIRING.
WING	1. STRUCTURE COVERED BY WING–TO–BODY FAIRING 2. EXTERIOR OF REAR SPAR IN AREA OF AILERONS 3. EXTERIOR OF WING CENTER SECTION INCLUDING BL 4Z RIB IN AREA OF RAM AIR INLET DUCT. 4. WING DRY BAY AREAS
LANDING GEAR	1. INSIDE SURFACES OF INACCESSIBLE MEMBERS OF ASSEMBLED GEAR EXPOSED TO THE ATMOSPHERE. 2. MAIN LANDING GEAR SIDE STRUT IN AREA COVERED BY STRUT FAIRING.
VERTICAL FIN	1. EXTERNAL SIDE OF REAR SPAR IN AREA FORWARD OF RUDDER.
STABILIZER	1. EXTERNAL SIDE OF REAR SPAR IN AREA FORWARD OF ELEVATOR.

Application of Water-Displacing Compound to Structure
Figure 4

CORROSION REMOVAL, GENERAL REPAIRS AND SURFACE FINISHING REQUIREMENTS

1. General

A. When active corrosion is visually apparent, a positive inspection and rework program is required to prevent any further deterioration of the structure. The following methods of assessing corrosion damage and procedures for rework of corroded areas should be used during cleanup programs. In general, any rework involves the cleaning and stripping of all finish from the corroded area, the removal of corrosion products, and the restoration of surface protective films. All cleanup should be restricted to the allowable damage rework limits of the applicable structure; but, should these limits be exceeded during rework, the affected part should be repaired or replaced. In cases of doubt, the Stress Unit of The Boeing Company should be contacted for rework limits of specific structural components when damage exceeds the allowable limits.

2. Safety Procedures

A. General safety precautions, outlined in the following paragraphs, contain rules for handling materials with hazardous physical properties and emergency procedures for the immediate treatment of personnel who have inadvertently come into contact with one of the harmful materials. Materials having hazardous physical properties are referenced to the pertinent safety precautions and emergency safety procedures. All personnel responsible for using or handling hazardous materials should be thoroughly familiar with information contained in the following paragraphs.

B. General Safety Precautions

(1) When required to use or handle any of the solvents, special cleaners, paint strippers (strong alkalies and acids), etchants (corrosion removers containing acids), or surface activation material (Alodine 1200), observe the following safety precautions:

(a) Avoid prolonged breathing of solvents or acid vapors. Solvents and acids must not be used in confined spaces without adequate ventilation or approved respiratory protection.

(b) Never add water to acid. Always add acid to water.

(c) Do not mix chemicals except as prescribed by procedure.

(d) Clean water for emergency use must be available in the immediate work area before starting work.

(e) Avoid prolonged or repeated contact of solvents, cleaners, etchants (acid), or conversion coating material (alodine solution) with skin. Rubber or plastic gloves should be worn when using solvents, cleaners, paint strippers, etchants, or conversion coating materials. Goggles or plastic face shields and suitable protective clothing must be worn when cleaning, stripping, etching, or conversion coating overhead surfaces.

(f) When mixing alkalies with water or other substance, use containers which are made to withstand heat generated by this process.

(g) Wash any paint stripper, etchant, or conversion coating material immediately from body skin or clothing.

(h) Materials splashed in the eyes must be promptly flushed out with water and medical aid obtained for the injured person.

(i) Do not eat or keep food in areas where it may absorb poisons. Always wash hands before eating or smoking.

(j) All equipment must be cleaned after work has been completed.

(k) Implement all company safety precautions.

C. Emergency Safety Procedures

WARNING: PERSONNEL MUST BE THOROUGHLY FAMILIAR WITH THE FOLLOWING EMERGENCY SAFETY PROCEDURES PRIOR TO USING ANY MATERIALS WHICH ARE REFERENCED TO AN EMERGENCY SAFETY PROCEDURE PARAGRAPH.

(1) If exposed to physical contact with any of the following materials:

Methyl alcohol	Xylene
Methyl ethyl ketone	Petroleum naphthas
Methyl isobutyl ketone	Chromates
Toluene	Dichromates
Trichloroethylene	Acetates
Epoxy resin	Cyclohexanone
Methylene chloride	Cellosolve
Brush alodine	Carbon Tetrachloride

Treat as follows:

(a) If splashed into eyes, do not rub.

(b) Flush eyes immediately with water for at least 15 minutes. Lift upper and lower eyelids frequently to ensure complete washing.

(c) If splashed on clothing or large areas of body, immediately remove contaminated clothing and wash body with plenty of soap and water. Wash clothing before rewearing.

(d) If splashed onto an easily accessible part of the body, immediately wash with soap and water.

(e) If suffering headache or other obvious symptom resulting from overexposure, move to fresh air immediately.

(f) If vapors are inhaled and breathing has slowed down or stopped, remove person from exposure and start artificial respiration at once. Call ambulance and continue this treatment until ambulance arrives.

(2) If exposed to physical contact with any of the following materials:

Hydrofluoric acid	Phenol
Nitric acid	Cresols
Phosphoric acid	Tricresyl phosphate

Treat as follows:

WARNING: IT CANNOT BE OVEREMPHASIZED THAT SPEED IS MOST IMPORTANT IN SKIN, EYE AND INHALATION TREATMENT.

(a) Eyes: If splashed into eyes, do not rub, flush immediately with water for at least 15 minutes. Lift upper and lower eyelids frequently to ensure complete washing. Call Medical immediately.

(b) Exposed Skin: If splashed on skin wash affected area with large amounts of water for at least 15 minutes. Report to Medical.

(c) Clothing: If splashed on clothing or large area of body, remove contaminated clothing and wash body under a shower for at least 15 minutes. Wash clothing before reuse. Report to Medical.

(d) Inhalation: If vapors are inhaled, remove worker to fresh air and apply artificial respiration if necessary. Call Medical.

NOTE: Tricresyl phosphate is not considered an inhalation hazard.

(e) Internally: Proceed as follows:

1) Worker unconscious: Do not give any liquid. Begin artifical respiration and have someone call Medical immediately.

2) Worker conscious:

a) Phenols and Cresols: Do not attempt to induce vomiting. Encourage him to wash out his mouth with copious amounts of water. Call Medical immediately.

b) Phosphoric Acid: Do not induce vomiting. Call Medical immediately.

c) Hydrofluoric Acid: Drink water to dilute acid, then cause vomiting by placing finger in the back of throat. Repeat. Wash out mouth repeatedly. Call Medical immediately.

d) Nitric Acid: Do not induce vomiting. Drink copious amounts of water, if possible. Call Medical immediately.

e) Tricresyl Phosphate: Cause vomiting by placing finger in the back of the worker's throat. If necessary, have him drink water, then use finger to induce vomiting. Call Medical immediately.

3. Corrosion Damage and Rework Limits

A. Corrosion evaluation will be required after initial inspection and cleaning to determine nature and extent of repair or rework. It is difficult to establish a distinct and specific dividing line between the various conditions, consequently, the first requirement for evaluation is good and sound maintenance judgement. Evaluate corrosion as follows:

(1) Light Corrosion - Characterized by discoloration or pitting to a depth of approximately 0.001 inch maximum. This type of damage will normally be removed by light hand sanding or a minimum of chemical treatment.

(2) Moderate Corrosion - Appears similar to light corrosion except there may be some blisters or evidence of scaling and flaking. Pitting depths may be as deep as 0.010 inch. This type of damage will normally be removed by extensive hand sanding or mechanical sanding.

(3) Severe Corrosion - General appearance may be similar to moderate corrosion with severe blistering exfoliation and scaling or flaking. Pitting depths will be deeper than 0.010 inch. This type of damage will normally be removed by extensive mechanical sanding or grinding.

B. Determining Degree of Corrosion Damage

(1) Determine degree of corrosion damage, as classified in paragraph 3.A. (light, moderate or severe) with a depth dial gage if accessibility permits. Before measurements are made, visually determine if corrosion is in an area which has previously been reworked. If corrosion is in the recess of a faired or blended area, measure damage to include the material which has previously been removed. The following method outlines the process for taking measurements with the depth gage.

(a) Remove loose corrosion products if present.

NOTE: The base of the depth gage must be flat against the undamaged surface on each side of the corrosion. When taking measurements on concave or convex surfaces, place the base perpendicular to the radius of the surface as shown in figure 1.

(b) Position depth gage as illustrated in figure 1 and determine the measurement reading.

(c) Take several additional depth readings.

(d) Select deepest reading as being depth of the corrosion damage.

C. Determining Rework Limits

(1) The maximum allowable amount of material removed from any damaged surface shall be determined from the criteria contained in the applicable allowable damage limits of the various chapters. If no criteria is given, contact the Stress Unit of The Boeing Company for cleanup limits.

D. Determining Material Thickness Reduction after Corrosion Cleanup

(1) The amount of material which may be removed from a part or panel during corrosion cleanup is given in Allowable Damage Limits charts in various sections of this manual. To ensure that the allowable limits are not exceeded, an accurate measurement must be made of the material removed or material thickness remaining in the reworked area after fairing. Measurement of panel thickness after rework can be made using a Vidigage (or similar) ultrasonic tester. Actual panel thickness remaining can be read from a scale on the Vidigage. Measurement of the depth of blended pits (material removed) can be made using a depth dial gage. (See figure 1.) If the area is inaccessible, clay impressions, or any other means which will give accurate results, may be used to determine material removal. In the event that material removal limits have been exceeded, the area or part must be repaired or replaced. If replacement or repair criteria is not contained in the Structural Repair Manual, contact the Service Department of The Boeing Company.

4. Corrosion Removal Techniques

A. Several standard methods are available for corrosion removal. The methods normally used to remove corrosion are chemical treatments, hand sanding with abrasive paper or metal wool, and mechanical sanding or buffing with abrasive mats, grinding wheels, or rubber mats. However, the method used depends upon the metal and the degree of corrosion. The removal method to use on each metal for each particular degree of corrosion is outlined in paragraphs 7 through 13.

B. Special Techniques

(1) In special instances, a particular or specific method may be required to remove corrosion. Depending upon rework criteria, corrosion in a hole may be removed by enlarging the hole. Abrasive blasting may be required for removing corrosion from steel fasteners, side skins, or irregularly shaped parts or surfaces. Whenever such special cases occur, the method for corrosion removal will be specified with the rework criteria in the applicable chapters.

C. Fairing or Blending Reworked Areas

(1) All depressions resulting from corrosion rework must be faired or blended with the surrounding surface. Fairing can be accomplished as follows:

(a) Remove rough edges and all corrosion from damaged area per paragraphs 7 through 13.

CAUTION: SELECT THE PROPER ABRASIVE FOR FAIRING OPERATIONS FROM FIGURE 2.

NOTE: All dish-outs are to be ellitically shaped with the major axis in the longitudinal direction.

(b) Rework depressions by forming smoothly blended dish-out (figure 3). Select appropriate abrasive paper from figure 2. In areas having closely spaced multiple pits, intervening material should be removed to minimize surface irregularity or waveiness (figure 4).

(c) Where sufficient clearance does not exist to provide an elliptical configuration as specified in figures 3 and 4, the corroded area should be blended as nearly as possible to these dimensions and the surrounding area faired gradually with no sharp or abrupt changes (figure 5).

(d) Remove all surface blemishes. Select proper abrasive to obtain desired surface finish.

5. Identification of Metals

A. A serious problem encountered in corrosion control is the identification of the metal on which corrosion occurs. The importance of this identification arises from the fact that all metals possess certain chemical characteristics that are common only to themselves; and which vary greatly from metal to metal, and from alloy to alloy of the same metal. Since these characteristics are common to all metals and their alloys, chemical cleaning solutions and chemical protective films will react differently with various metals; and in some cases, produce adverse reactions which can severely weaken or destroy the structural capabilities of the metal. Aluminum, steel, and magnesium sheet and

plate are stenciled on the back for identification. When these markings are not distinguishable or the metal is not identified in the applicable section, or when a plating material needs to be identified, positive identification can be made by chemical and/or hardness testing.

WARNING: PERSONNEL MUST BECOME THOROUGHLY FAMILIAR WITH THE SAFETY PRECAUTIONS AND EMERGENCY SAFETY PROCEDURES, PARAGRAPHS 2.B. AND 2.C. RESPECTIVELY, PRIOR TO PERFORMING ANY CHEMICAL TESTING.

CAUTION: CHEMICAL SPOT TESTING SHOULD BE USED ONLY WHEN ALL OTHER MEANS OF IDENTIFICATION HAVE BEEN EXHAUSTED.

FASTENERS MUST NOT BE IDENTIFIED BY CHEMICAL SPOT TESTS.

B. Chemical Testing

(1) The chemical identification of the various types of metals used in aircraft construction should be accomplished. Before any tests are conducted, the preliminary surface preparation and primary classification of the metal should be accomplished by the following procedure:

(a) On the surface to be tested, choose an area where there is no corrosion and remove paint (if present) from a 1-inch square. Paint may be stripped with a cloth soaked in methyl ethyl ketone or paint remover or any equivalent material.

CAUTION: ADEQUATE PRECAUTIONS MUST BE TAKEN TO PREVENT PAINT REMOVER FROM CONTACTING GLASS CLOTH PARTS. REFER TO 51-10-1.

(b) Clean area of surface to be tested.

(c) Tentatively identify the exposed metal surface by visually comparing it with samples of previously identified materials.

(d) Identify the metal as ferrous or nonferrous by placing a magnet on the exposed surface.

1) Magnetic attraction classifies the base metal as a ferrous magnetic material (iron or steel).

2) The absence of magnetic attraction classifies the base metal as either an austenitic steel or a nonferrous metal (aluminum, magnesium, etc.).

(e) Hardness test magnetic metals as detailed in 51-5-1 prior to chemical spot testing. If the metal is nonmagnetic, proceed with paragraph 5.D. following.

C. Chemical Spot Analysis of Magnetic Metals

(1) The magnetic metals usually employed in aircraft construction are ferrous alloys (low alloy steel and chromium-nickel-iron alloys sometimes called stainless steels). These magnetic alloys, when plated, are generally plated with either chromium, nickel, zinc, cadmium, silver, or with a combination of these platings. If a magnetic alloy has been plated with cadmium, zinc, or chromium, it will exert magnetic attraction. Nickel plating will show slight magnetic attraction even if the substrate or base metal is not magnetic. If positive identification of the metal plating is necessary, the identification should be made after accomplishing a hardness test as detailed in 51-5-1.

CAUTION: DO NOT PERFORM CHEMICAL SPOT TEST ON STEELS HEAT-TREATED TO 220,000 PSI AND ABOVE.

(a) Place a drop of 10% hydrochloric acid (Hl) on the prepared metal surface. Ensure that surface is dry before applying acid.

1) A rapid reaction producing a dark deposit indicates that the metal is zinc.

2) A slow or no reaction indicates that the metal may be cadmium, chromium, nickel, or steel.

WARNING: THE ADDITION OF SODIUM SULFIDE (Na2S) TO ACID PRODUCES A POISONOUS GAS. ADEQUATE VENTILATION MUST BE PROVIDED WHEN THESE TESTS ARE BEING PERFORMED. DO NOT ALLOW LARGE QUANTITIES OF SODIUM SULFIDE (Na2S) AND ACID TO BE MIXED.

(b) After 1 minute, add a drop of sodium sulfide (Na2S) to the drop of hydrochloric acid (HCl).

1) A white precipitate identifies the metal as zinc.

2) A yellow ring formed around a white precipitate identifies the metal as cadmium.

3) A black ring formed around a white precipitate identifies the metal as iron or steel.

4) A black precipitate indicates that the metal is chromium or nickel.

(c) Confirm the cadmium, zinc, iron, or steel test by placing a drop of 20% nitric acid (HNO3) on a fresh spot. After 1 minute, add a drop of sodium sulfide (Na2S) to the drop of nitric acid (HNO3).

1) A white precipitate identifies the metal as zinc.

2) A yellow precipitate identifies the metal as cadmium.

3) A black spot identifies the metal as iron or steel.

(d) Confirm the chromium test by placing a drop of 10% hydrochloric acid on a fresh spot. Add a drop of concentrated sulfuric acid (H2SO4) to the drop of hydrochloric acid.

1) A color change to green after 1 or 2 minutes identifies the metal as chromium.

(e) Confirm the nickel test by placing a drop of dimethylgloxime solution on a fresh spot. Add a drop of ammonium hydroxide (NH4OH) to the drop of dimethylgloxime solution.

1) A pink to red precipitate identifies the metal as nickel.

(f) Clean and refinish as detailed in paragraph 5.E.

D. Chemical Spot Analysis of Nonmegnetic Metals

(1) The most common nonmagnetic metals used in aircraft construction are aluminum, magnesium, and austenitic steels (generally used as 18-8 stainless steel). The positive identification of these nonmagnetic metals is accomplished by the following procedure:

(a) Place a drop of 10% hydrochloric acid (HCl) on the prepared metal surface and allow to stand for 1 minute. Ensure that surface is dry before applying acid.

NOTE: Zinc deposits on nonmegnetic metals will react with 10% hydrochloric acid but will not produce a black spot.

1) A rapid or violent reaction that produces a black spot indicates that the metal is magnesium.

2) A slow reaction indicates that the metal is aluminum.

3) No reaction indicates that the metal is an austenitic steel or a nonmagnetic plating material.

(b) If a reaction that did not produce a black spot is noted in step (a), determine if zinc is present as detailed in paragraphs 5.C.(a) through 5.C.(c).

(c) If the results of step (b) preceding are negative, confirm the magnesium and aluminum tests by placing a drop of 10% sodium hydroxide (NaOH) on a fresh spot. Check for the following:

1) No reaction which will identify the metal as magnesium.

2) A reaction that produces a colorless spot to identify the metal as a clad-aluminum alloy.

3) A reaction that produces a black spot to identify the metal as a bare-aluminum alloy.

(d) If an aluminum alloy is identified in step (c) preceding, further test to distinguish the different alloys by placing a drop of 10% cadmium chloride on a fresh spot.

1) A dark gray deposit forming within a few seconds will identify the metal as 7075 or 7178 bare-aluminum alloy.

2) A drak gray deposit forming within 2 minutes will identify the metal as 7075 or 7178 clad-aluminum alloy.

3) No deposit formation in the time specified for 7075 or 7178 clad will identify the metal as 2024 aluminum alloy (a faint deposit will form after 15 to 20 minutes).

(e) Confirm the austenitic steel test by dissolving 10 grams of cupric chloride ($CuCl2.2H20$) in 100 cubic centimeters of hydrochloric acid and placing a drop of the solution on a fresh spot. After 2 minutes, add three or four drops of distilled water to the drop of hydrochloric acid solution and dry the surface.

1) The appearance of a brown spot identifies the metal as an austenitic steel.

(f) If no reaction was noted in step (a) or (e) preceding, test for a plating material as detailed in steps (a) through (c) of paragraph 5.C.

(g) If step (f) reveals the presence of plating on the nonmagnetic metal, the plating must be removed by mechanical abrasion and the base metal identified by the visual and/or chemical methods outlined in paragraphs 4 and 5.

(h) Clean and refinish as required by paragraph 5.E.

E. Post Identification Cleaning and Refinishing

CAUTION: THE REAGENTS USED IN THE CHEMICAL SPOT TESTS ARE EXTREMELY CORROSIVE.

(1) After identification of the metal is completed, clean the area as follows:

(a) Blot any remaining chemicals with a dry cloth.

(b) Swab the area several times with a water moistened cloth.

(c) Test the surface by placing a piece of litmus paper on the moistened surface.

(d) If the litmus paper changes color, repeat steps (b) and (c) until no color change occurs.

(e) Dry surface thoroughly.

(f) Remove corrosion, if present, and refinish the surface as applicable.

6. Corrosion Rework Application

A. All corrosion products must be removed completely when corroded structures are reworked as the corroding process will continue even though the affected surface is refinished.

B. Before starting rework of corroded areas, carry out the following:

(1) Position airplane in wash rack or provide washing apparatus for rapid rinsing of all surfaces.

(2) Connect a static ground line to the airplane.

(3) Remove airplane batteries as required.

(4) Protect the pitot-static ports, louvers, airscoops, engine openings, wheels, tires, magnesium skin panels and airplane interior from moisture and chemical brightening agents.

(5) Protect the surfaces adjacent to rework areas from chemical paint strippers, corrosion removal agents and surface treatment materials.

7. Corrosion Removal Procedures for Aluminum and Aluminum Alloys

A. Aluminum and its alloys are the most widely used materials in the construction of commercial airplanes. Aluminum is characterized by an excellent strength to weight ratio, thermal and electrical conductivity, and high reflectance. In addition, this metal is nonmagnetic, nontoxic, and will not spark when struck against other metals. The formation of a tightly adhering oxide film on pure aluminum, or clad surfaces which carry a plating of pure aluminum, offer increased resistance in most corrosive conditions. Corrosive attack on aluminum surfaces is usually obvious, the corrosion products are generally white and more voluminous than the original base metal. Even in the early stages of corrosion, damage is evident as general etching, pitting, and roughness of the surface.

B. Prepare the airplane as required by paragraph 6.B. and remove corrosion products as follows:

WARNING: PERSONNEL USING THIS PROCEDURE MUST OBSERVE THE SAFETY PRECAUTIONS AND PROCEDURES OF PARAGRAPH 2.

(1) Positively identify the metal as aluminum as detailed in paragraph 5.C.

(2) Clean area to be reworked.

(3) Strip paint if required.

(4) Determine extent of corrosion damage as detailed in paragraph 3. To remove light corrosion, proceed with paragraph 7.B.(5) following. To remove moderate or severe corrosion, proceed with paragraph 7.B.(6) following.

(5) Remove light corrosion by light hand-sanding operations or by chemical means as follows:

CAUTION: DO NOT USE THE CHEMICAL REMOVAL PROCESS AT TEMPERATURES ABOVE 100°F OR BELOW 40°F.

(a) Protectively mask adjacent areas to prevent brighteners from contacting magnesium, anodized aluminum, glass, plexiglass, fabric surfaces, and all steel.

WARNING: WEAR ACID-RESISTANT GLOVES, PROTECTIVE MASK AND PROTECTIVE CLOTHING WHEN WORKING WITH CORROSION REMOVING COMPOUNDS. IF CORROSION REMOVING COMPOUND ACCIDENTALLY CONTACTS THE SKIN OR EYES, FLUSH OFF IMMEDIATELY WITH PLENTY OF CLEAR WATER. CONSULT A PHYSICIAN IF EYES ARE AFFECTED OR IF SKIN IS BURNED.

(b) Dilute corrosion removing compound, with two parts water. Mix the compound only in wood, plastic, or plastic lined containers.

NOTE: The diluted solution of corrosion removing compound may be applied to large exterior surfaces with a nonatomizing spray, starting from lower surfaces and working upwards.

(c) Apply diluted solution by brush, starting from lower surfaces and working upward to minimize runs and streaks.

(d) Leave the solution on surface from 5 to 30 minutes, depending on the temperature and the amount of corrosion present. Agitate occasionally with the brush used for application. Do not allow solution to dry on surface, as streaking will result.

NOTE: On large exterior surfaces, remove solution by high pressure water rinse.

(e) Wipe off solution with a clean, moist cloth: frequently rinsing the cloth in clear water. Wipe area several additional times with fresh cloth dampened and rinsed frequently in clear water.

(f) Dry area with clean, dry cloth and inspect for corrosion.

CAUTION: DO NOT REPEAT OPERATION MORE THAN ONCE. IF CORROSION STILL REMAINS AFTER SECOND ATTEMPT, MECHANICALLY REMOVE CORROSION AS DETAILED IN PARAGRAPH 7.B.(6).

(g) Repeat paragraphs 7.B.(5)(c) through (5)(f) if any corrosion remains.

(h) After all corrosion has been removed, proceed with paragraph 7.B.(8).

(6) Mechanically remove moderate or severe corrosion by the appropriate methods as follows:

WARNING: WEAR GOGGLES OR FACE SHIELD TO PROTECT AGAINST ANY CORROSION PARTICLES THAT BREAK LOOSE AND FLY OFF.

CAUTION: PROTECT ADJACENT AREAS TO PREVENT ADDITIONAL DAMAGE FROM CORROSION PRODUCTS REMOVED DURING MECHANICAL REMOVAL.

NOTE: On alodized surfaces, take care to avoid damage to the area adjacent to that being reworked.

(a) Remove loose corrosion products by hand scraping with a carbide-tipped scraper or fine-fluted rotary file.

NOTE: For alternate method of dry abrasive blasting, refer to paragraph 15.

(b) Remove residual corrosion by hand sanding or with approved hand-operated power tool. Select appropriate abrasive from figure 2.

(c) After removing all corrosion visible through a magnifying glass, apply corrosion removing compound as detailed in paragraph 7.B.(5) and proceed with paragraph 7.B.(7) following.

(7) Blend into surrounding surface any depressions resulting from rework and surface finish with 400-grit abrasive paper.

(8) Clean reworked area. Do not use kerosene.

(9) Determine depth of faired depressions as detailed in paragraph 3.D. to ensure that rework limits have not been exceeded.

(10) Prepare and apply alodine as follows:

(a) Determine whether rework on clad material has penetrated to the base metal as follows:

1) Clean the test area as required by 51-8-0.

2) Apply one drop of a 10% solution of sodium hydroxide (NaOH caustic soda) to the test area and allow to stand for 30 seconds. If the bottom of the reworked area turns black, the clad coating has been penetrated.

3) Thoroughly water rinse the tested area and dry with a clean cloth.

4) When rework has penetrated the clad coating, apply alodine treatment as detailed in 51-8-0.

(11) Apply original finish.

(12) Remove masking and protective covering.

8. Corrosion Removal Procedure for Magnesium Alloys

A. Magnesium is the most chemically active metal used in airplane construction and is, therefore, the most difficult to protect. By the same token, when a failure in the protective coating does occur, the prompt and complete correction of the coating failure is imperative if serious structural damage is to be avoided. Magnesium corrosion is possibly the easiest type of corrosion to detect, since even in its early stages the corrosion products occupy several times the volume of the original magnesium metal. The beginning attack shows as a lifting of the paint film and as white spots on the surface, which rapidly develop into snow like mounds or whiskers. Correction of damage involves the complete removal of corrosion, the restoration of surface coatings by chemical treatment, and a reapplication of protective coatings. Corroded magnesium parts should be removed from the aircraft, if possible, for treatment. When impossible to remove part, make preparations detailed in paragraph 6 and proceed as follows:

WARNING: PERSONNEL USING THIS PROCEDURE MUST OBSERVE THE SAFETY PRECAUTIONS AND PROCEDURES OF PARAGRAPH 2.

(1) Positively identify the metal as magnesium. Refer to paragraph 5.

(2) Clean area to be reworked.

(3) Strip paint if required.

(4) Determine extent of corrosion damage. Refer to paragraph 3. To remove light corrosion, proceed with paragraph 8.A.(5) following. To remove moderate or severe corrosion, proceed with paragraph 8.A.(6) following.

(5) Remove light corrosion by light hand sanding or chemically as follows:

CAUTION: DO NOT USE THE FOLLOWING PROCEDURE FOR ADHESIVE BONDED PARTS OR ASSEMBLIES, AREAS WHERE THE BRUSH-on solution might become lodged, or local areas bared specifically for grounding or electrical bonding purposes.

(a) Remove the loose corrosion with aluminum wool.

(b) Mask off other materials and parts, especially rubber parts, bearings, and cast or pressed inserts to prevent contact with the treating solution or its fumes.

(c) Prepare corrosion treating solution in the following proportions: 1-1/2 pounds of sodium dichromate and 1-1/2 pints of concentrated nitric acid per gallon of water. Mix as follows:

NOTE: Prepare and store the solution in clean polyethylene or glass containers.

1) Fill a suitable container with a volume of water equal to approximately one-fourth the desired total quantity of solution.

2) Add full quantity of sodium dichromate in proportions indicated above and agitate solution until the chemical is dissolved.

3) Add water until quantity of solution is equal to approximately two-thirds the desired total.

4) Slowly add total volume of nitric acid to solution and mix thoroughly.

5) Add water until total desired quantity of solution is reached and stir until entire solution concentration is equal.

a) Remove remaining corrosion by swabbing the corroded surface 1 to 2 minutes with the nitric acid solution prepared in paragraph 8.A.(5)(c) then wipe dry.

b) Rinse thoroughly with clean water while scrubbing with a mop or brush and wipe dry.

c) Repeat the preceding sequence, as necessary, until all corrosion has been removed.

d) After all corrosion has been removed, proceed with paragraph 8.A.(8) following.

(6) Mechanically remove moderate or severe corrosion by the following method:

WARNING: GOGGLES OR FACE SHIELD MUST BE USED TO PRECLUDE INJURY FROM CORROSION PARTICLES BREAKING LOOSE AND FLYING OFF.

CAUTION: DO NOT USE CARBON STEEL WIRE BRUSHES OR SILICONE CARBIDE ABRASIVES ON MAGNESIUM. PROTECT ADJACENT AREAS TO PREVENT ADDITIONAL DAMAGE FROM CORROSION PRODUCTS REMOVED WHEN USING THIS PROCESS.

(a) Remove heavy corrosion products by hand wire brushing with a stainless steel brush.

(b) Remove residual corrosion by hand sanding or with approved hand-operated power tool. Select appropriate abrasive from figure 2.

(c) After removing all corrosion visible through a magnifying glass, apply corrosion treating solution as detailed in paragraph (5)(c)5) and continue with subparagraph (7) following:

(7) Fair depressions resulting from rework as detailed in paragraph 4.C. and surface finish with 400-grit abrasive paper.

(8) Clean reworked area. Do not use kerosene.

(9) Determine depth of faired depressions as detailed in paragraph 3 to ensure that rework limits have not been exceeded.

(10) Prepare and apply magnesium conversion coating as follows:

CAUTION: DO NOT USE THE FOLLOWING PROCEDURE FOR ADHESIVE BONDED PARTS OR ASSEMBLIES, AREAS WHERE THE BRUSH-ON SOLUTION MIGHT BECOME LODGED, OR LOCAL AREAS BARED SPECIFICALLY FOR GROUNDING OR ELECTRICAL BONDING PURPOSES.

(a) Measure 1 gallon of distilled water into a clean polyethylene or glass container.

(b) Add 1.3 ounces (dry) of chromium trioxide.

(c) Add 1 ounce of calcium sulfate dehydrate.

(d) Vigorously stir for at least 15 minutes to ensure that the solution is saturated with calcium sulfate.

NOTE: Let chromate solution stand for 15 minutes prior to decanting.

(e) Prior to use, decant solution (avoid transfer of undissolved calcium sulfate) into suitable usage containers (polyethylene or glass).

(f) Apply solution by swabbing until the metal surface becomes dull golden to dark brown in color. Use caution in swabbing on the solution. Severe rubbing of the wet surface will damage the coating.

CAUTION: HIGH PRESSURE SPRAYING OR RUBBING ABRASION WILL DAMAGE THE FRESH COATING.

(g) Rinse with clean, cold water, then allow to dry at ambient temperature. Force air dry if possible.

(11) Apply original finish.

(12) Remove masking and protective covering.

9. Corrosion Removal Procedures for Carbon Steel

A. General. Carbon steel in its heat treated form is used in areas where high structural or aerodynamic loads occur on the airplane. Landing gears, flap tracks, structural splices, terminal fittings and miscellaneous brackets are some of the typical parts made from heat treated carbon steel. Red iron rust is one of the most familiar kinds of corrosion on carbon steel and generally caused from formation of ferrous oxides due to atmospheric exposure. Some surface metal oxides are purposely used to protect the underlying base metal. Red iron rust is not one of these and actually attracts moisture from the air and promotes additional corrosion. The red rust first shows on unprotected airplane hardware such as bolts, nuts and exposed fittings. Slight corrosion damage on highly stressed steel parts becomes potentially dangerous and the rust shall be removed and controlled. Corroded steel parts should be removed from the airplane for treatment if possible. The general procedures for corrosion removal are outlined in the following paragraphs.

WARNING: PERSONNEL USING THESE PROCEDURES SHALL OBSERVE THE SAFETY PRECAUTIONS AND PROCEDURES OUTLINED IN PAR. 2.

B. Corrosion Removal - Mechanical

(1) Positively identify the metal as steel and determine its heat-treat value (Ref par. 5 and 51-5-1).

(2) Protect adjacent area to prevent additional corrosion damage from corrosion products removed during mechanical removal.

(3) If grease or soil is present clean the rework area.

(4) Strip paint if applicable.

CAUTION: HAND-HELD POWER TOOLS MUST NOT BE USED ON HIGH STRENGTH STEELS HEAT-TREATED TO 220,000 PSI AND ABOVE. EXERCISE EXTREME CARE WHEN USING TOOLS ON HIGH STRENGTH STEEL NOT TO OVERHEAT THE STEEL SURFACE.

(5) Corrosion removal on steels heat-treated to 220,000 psi and above shall be accomplished by dry abrasive blasting as outlined in par. 15., with blasting pressures ranging from 40 to 70 psi or hand tools described in par. 4.

(6) Mechanically remove all corrosion from steel parts heat-treated below 220,000 psi as follows:

(a) Remove heavy corrosion products using stainless steel hand brush. Use dry abrasive blasting per par. 15., as an alternate method with blasting pressures ranging from 40 to 70 psi.

(b) Remove residual corrosion by hand sanding or with approved hand-operated power tool as outlined in 4. Select appropriate abrasives from Fig. 2.

(7) Make visual check through a 10-power magnifying glass to ensure that all corrosion is removed.

(8) Fair depressions resulting from rework per par. 4., and surface finish with 400 grit abrasive paper selected from Fig. 2.

(9) Clean reworked area.

(10) Determine depth of faired depression per par. 3., to ensure that rework depth limits have not been exceeded.

(11) Restore the protective finish immediately upon completion of rework.

C. Corrosion Removal - Chemical. Chemical rust removers are of either the acid or alkaline type. The acid type is intended for use in removing the rust or black oxide formations by either immersion or brush application of the chemical. The alkaline type is intended for use in removing red rust by immersion treatment. Procedures for the use of both types of rust removers are outlined below.

CAUTION: STEEL PARTS HEAT-TREATED ABOVE 220,000 PSI ARE SUBJECT TO HYDROGEN EMBRITTLEMENT, AND THE USE OF ACID IS PROHIBITED.

(1) Inhibited Phosphoric Acid Base Rust Remover - Brush-on Method

(a) Positively identify the metal as steel.

(b) Protect adjacent area to prevent additional damage from the chemical agents.

(c) If grease or soil is present clean the corrosion area.

(d) Remove heavy rust by chipping and/or wire brushing with stainless steel bristle brush.

(e) Dilute the concentrated acid by adding one part of acid to one part of water in acid resistant mixing container. Do not add water to acid; always add acid to water.

(f) Apply the acid mixture to corroded area with acid-resistant brush. Allow to remain long enough to loosen rust (2 to 10 minutes) and rinse with clean water completely.

(g) Examine corroded area visually with 10-power magnifying glass.

(h) If corrosion is still evident repeat application and rinse thoroughly.

(i) After removal is complete, blend or fair area affected per par. 4.

(j) Determine depth of faired depressions per par. 3., to ensure that rework limits have not been exceeded.

(k) Restore the protective finish immediately upon completion of rework.

(2) Inhibited Phosphoric Acid Base Acid Rust Remover - Immersion Method

NOTE: This method is to be used for removing heavy rust from parts removed from the airplane and where the corroded area can be completely immersed.

(a) Positively identify the metal as steel.

(b) If grease or soil is present clean the corrosion area.

(c) Remove heavy corrosion by chipping and/or wire brushing with stainless steel wire brush.

(d) Prepare the acid mixture per step (1)(e) above.

(e) Immerse the parts in acid solution only long enough to loosen the rust. The solution may be heated to a maximum of 104°F to increase the removal rate. Agitation will also help.

(f) Rinse in continuously flowing cold water rinse tank or flood with clean water.

(g) Visually examine the corrosion area with 10-power magnifying glass.

(h) If corrosion still exists, repeat immersion steps.

(i) After removal is complete fair or blend the reworked area per par. 4.

(j) Determine depth of faired depression per par. 3., to ensure that rework limits have not been exceeded.

(k) Restore the protective finish immediately upon completion of rework.

(3) Alkali Type Rust Remover

WARNING: THE ALKALI RUST REMOVER, SODIUM HYDROXIDE BASE, IS HIGHLY ALKALINE AND THEREFORE HARMFUL TO SKIN AND EYES. PERSONNEL SHOULD WEAR RUBBER GLOVES, APRONS AND GOGGLES WHEN WORKING WITH THIS MATERIAL. USE WITH ADEQUATE VENTILATION.

(a) Positively identify metal as steel.

(b) Protect adjacent components to prevent damage from the chemical agents, chips, scales, or corrosion products.

(c) Remove grease and soil from corrosion damage area.

(d) Remove heavy rust by chipping and/or wire brushing with stainless steel bristle brush.

(e) Prepare alkali base rust remover solution per manufacturer's instruction. Carbon steel or corrosion resistant steel tanks may be used.

(f) Immerse parts in rust remover solution. Temperature up to the boiling point of the solution may be used to increase the rate of removal.

(g) Rinse thoroughly in clean water.

(h) Visually inspect for complete corrosion removal with a 4- to 10-power magnifying glass.

(i) If corrosion still exists, repeat immersion procedure above.

(j) Dry thoroughly and fair or blend depressions from corrosion removal per par. 4.

(k) Determine depth of faired depressions per par. 3., to ensure that rework limits have not been exceeded.

(l) Restore protective finish immediately upon completion of rework.

9A. Corrosion Removal Procedure for Stainless Steel and Nickel-Chromium Alloys

A. General. Stainless steel and nickel-chromium alloys are used where corrosion resistance is one of the major considerations in the design of the component or system. In most applications these steels will have no other surface protection except for matching color schemes of the surrounding structure or dissimilar metal organic coatings. Stainless steel and nickel-chromium steels, however, are not free from corrosion attack. Corrosion usually appears as pits usually black in color. The existence of corrosion products prevents a passivated environment at the stainless steel surfaces and creates an active-passive corrosion cell. It is therefore necessary that the corrosion removal is complete.

CAUTION: ABRASIVE BLASTING OR GRINDING SHALL NOT BE USED ON THIN WALL TUBES OR THIN WEBS LESS THAN 0.0625 INCH THICK.

B. Corrosion Removal - Mechanical. Use the same general procedures as for carbon steel.

C. Corrosion Removal - Chemical. In severely corroded areas and where chemical agents will not be trapped in crack, crevices, lap joints, etc., the chemical removal methods described for carbon steel are applicable.

10. Corrosion Removal Procedures for Titanium Alloys

WARNING: PERSONNEL USING THIS PROCEDURE MUST OBSERVE THE SAFETY PRECAUTIONS AND PROCEDURES DETAILED IN PARAGRAPH 2.

CAUTION: PROTECTIVELY MASK ADJACENT AREAS TO PREVENT CONTAMINATION BY CHEMICALS. PREPARE THE AIRPLANE AS DETAILED IN PARAGRAPH 6.

A. Titanium is generally corrosion resistant. Periodic removal of surface deposits is required to minimize high temperature deterioration. If titanium surfaces require cleaning, hand polish with aluminum polish and a soft cloth until all traces of corrosion or surface deposits are removed. Remove the aluminum polish. Treat the cleaned surface with a solution of 13 to 26 ounces (weight) of sodium dichromate per gallon of water. Apply solution with fiber brush or cloth, keeping surface wet for 5 minutes. Wipe treated surfaces with dry cloths to remove excess solution. Do not water rinse. Remove masking and protective covering.

11. Corrosion Removal Procedures for Plated Surfaces

A. Chromium, electroless nickel, electrodeposited nickel, cadmium, and zinc are used to plate other metals. Cadmium and zinc are used for corrosion protection applications because these metals will corrode sacrificially to protect the base metal. Cadmium and zinc will continue to offer corrosion protection even though pores or other discontinuities may exist in the plating. Chromium and certain nickel platings, although having excellent resistance to corrosion, are generally used to provide a smooth, wear-resistant surface or to reclaim worn parts. Corrosion removal from plated parts is restricted because of the danger of removing the plating.

12. Corrosion Removal from Chromium and Nickel Plated Parts

A. The amount of reworking that can be performed on chromium and nickel-plated components is limited. This is due to the critical requirements to which such components are subjected. The rework should consist of light buffing to remove corrosion products and produce the required smoothness. This is permissible provided the buffing does not take the plating below the minimum allowable thickness. Whenever a chromium or nickel-plated component required buffing, coat the area with corrosion preventive compound, if possible. When buffing exceeds the minimum thickness, or the base metal has sustained corrosive attack, the component must be removed and replaced. The removed component can be restored to serviceable condition by having the old plating completely stripped and replated in accordance with acceptable methods and specifications.

13. Corrosion Removal from Cadmium and Zinc-Plated Parts

A. Due to the critical requirements of cadmium and zinc-plated components, the amount of rework that can be accomplished is limited. Check condition of the cadmium or zinc plating and accomplish the following:

CAUTION: PROTECTIVELY MASK ADJACENT AREAS TO PREVENT CONTAMINATION BY CHEMICALS. PREPARE THE AIRPLANE AS DETAILED IN PARAGRAPH 6.

(1) If corrosion has begun but has not penetrated to the base metal, continue as in subparagraph (2) following. If corrosion has begun and it has penetrated to the base metal, continue as in subparagraph (3) following.

(2) Remove corrosion that has not penetrated to the base metal as follows:

CAUTION: EXERCISE CARE WHEN REMOVING CORROSION TO CONSERVE THE PLATING MATERIAL.

(a) Remove corrosion by rubbing lightly with stainless steel wool.

(b) Swab affected area with chromic acid solution (4 ounces of chromium trioxide, type II, to 1 gallon water). Allow acid to remain on the surface 30 to 60 seconds.

(c) Rinse with water and air dry.

(d) Refinish as detailed in paragraph 13.A.(4) and (5) following, whichever is applicable.

(3) Remove corrosion that has penetrated to the base metal as follows:

(a) Determine from specific repair whether the part is to be reworked or replaced.

(b) If part is to be reworked, identify the base metal as in paragraph 5 and accomplish corrosion removal per applicable procedures in this section.

(c) Refinish as required by paragraph 13.A.(4) and (5) following, whichever is applicable.

(4) Only parts which can be removed from the airplane and reduced to the unit detail can be replated. Replate as required by paragraph 14.

(5) If part cannot be removed from the airplane, apply an approved protective finish or specific organic finish as designated in the 707 Maintenance Manual.

WARNING: PERSONNEL USING THIS PROCEDURE MUST OBSERVE THE SAFETY PRECAUTIONS AND PROCEDURES DETAILED IN PARAGRAPH 2.

14. Cadmium Plating

A. Use the following procedure for replating with cadmium:

(1) Only parts that can be removed from the airplane and reduced to a unit detail (plating of assemblies is impractical) may be cadmium plated.

(2) Aluminum parts should be reworked per the applicable procedure in this section and should not be stripped of cadmium.

(3) Steel parts having tensile strength of 220,000 psi or above must not be stripped or replated. Rework and finish as detailed in paragraph 9.

(4) Clean parts and strip paint, if present. Strip cadmium in a solution of 1 pound of technical grade ammonium nitrate per gallon of water. Strip existing plating from part for the shortest possible time required to completely remove plating. Use stripping solution at approximately room temperature of 21°C (70°F). Strip zinc plating in accordance with acceptable methods.

(5) Remove corrosion from base metal using the applicable procedure in this section.

(6) All steel parts including stainless steel heat-treated 160,000 to 220,000 psi shall be baked at 375 (± 25)°F for 3 hours prior to plating.

(7) Cadmium plate as required by the applicable repair.

(8) Bake parts as required by paragraph 14.A.(6) after plating, unless otherwise specified in specific repair.

(9) Apply surface treatment and organic finish as required by specific repair.

15. Mechanical Corrosion Removal by Blasting

A. Abrasive blasting is a process for cleaning or finishing metals, plastics, and other materials by directing a stream of abrasive particles against the surface of the parts. Abrasive blasting is used for the removal of rust and corrosion and for cleaning prior to further processing such as painting or plating. Standard blast cleaning practices should be adopted with the following requirements being met:

(1) Any form of blast cleaning equipment may be used; but in-cabinet blasting is preferred.

(2) External gun blasting may be used if adequate confinement and recovery are provided for the abrasives.

(3) Use only glass bead abrasive.

WARNING: AVOID EXCESSIVE INHALATION OF ABRASIVE DUST. PROVIDE VENTILATION AS REQUIRED.

CAUTION: MAGNESIUM CREATES A FIRE HAZARD WHEN ABRASIVE BLASTED. ADEQUATE PRECAUTIONS MUST BE TAKEN WHEN ABRASIVE BLASTING THIS METAL.

DRY ABRASIVE BLASTING OF TITANIUM ALLOYS AND HIGH TENSILE STRENGTH STEEL CREATES SPARKING. CARE MUST BE TAKEN TO ASSURE THAT THERE IS NO HAZARDOUS CONCENTRATION OF INFLAMMABLE VAPORS PRESENT.

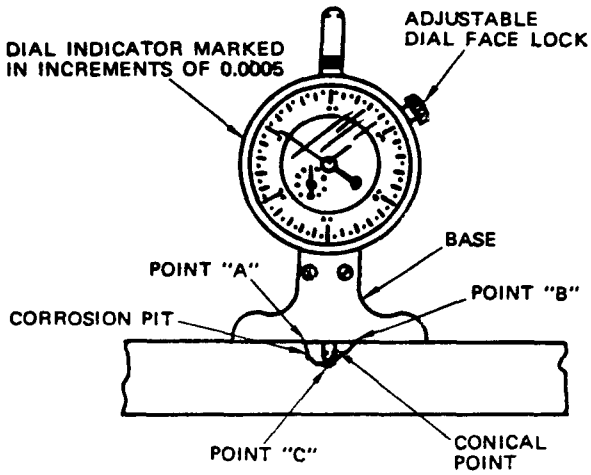
STATIC GROUND THE DRY ABRASIVE BLASTER AND THE MATERIAL TO BE BLASTED.

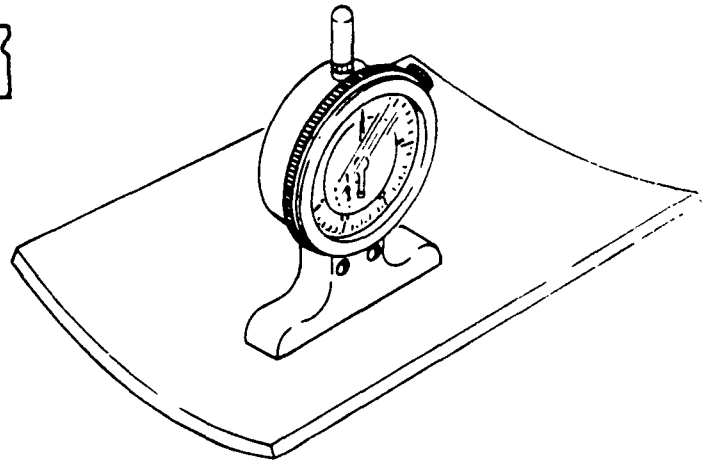
(4) Part to be blast-cleaned should be removed from component if possible; otherwise, areas adjacent to part must be masked or protected from abrasive impingement.

(5) Parts must be cleaned of oil, grease, dirt, etc., and dried prior to blast cleaning.

(6) Close-tolerance surfaces, such as bushings, bearing shaft, etc., must be masked.

(7) Blast-clean only enough to remove corrosion coating. Proceed immediately with finishing requirement using surface treatments as outlined in paragraphs 7 through 9.



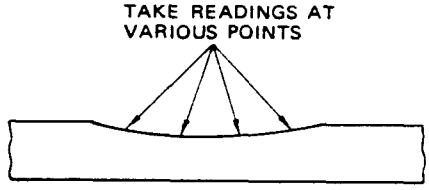


DETAIL I

NOTE

- DEPTH DIAL GAGE 0 TO 0.500 INCH RANGE.
- TAKE MEASUREMENT READINGS PERPENDICULAR TO THE RADIUS OF CONCAVE OR CONVEX SURFACES. SEE DETAIL I.
- TAKE MEASUREMENT READINGS ON EDGES ADJACENT TO CORROSION DAMAGE OR BLENDED DEPRESSION (POINTS "A" AND "B"). TAKE SEVERAL READINGS AROUND CENTER OF CORROSION DAMAGE OR BLENDED DEPRESSION (SEE DETAIL II) AND CONSIDER THE DEEPEST READING TO BE POINT "C." DETERMINE DEPTH AS FOLLOWS:

$$\text{DEPTH} = C - \frac{(A + B)}{2}$$

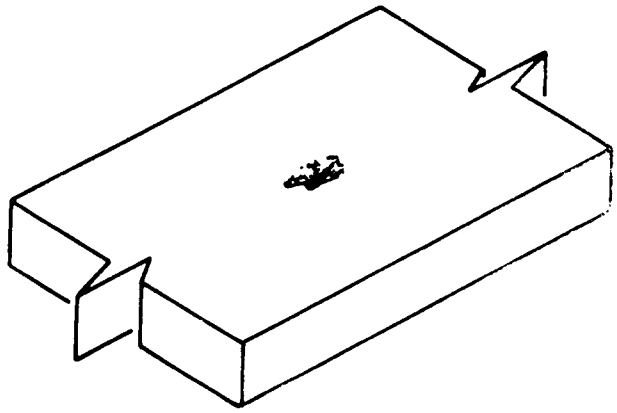


DETAIL II

Corrosion Damage and Rework Measurement Using Depth Dial Gage
Figure 1

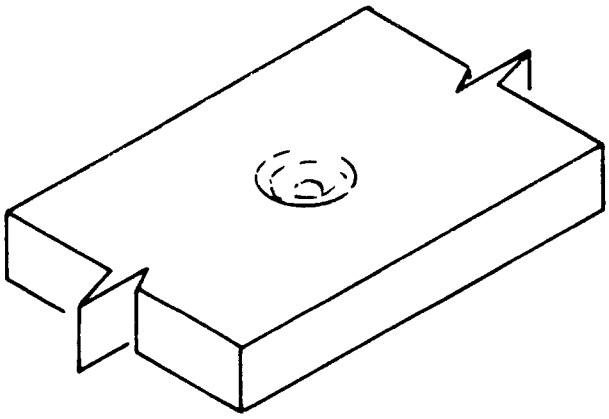
METALS OR MATERIALS TO BE PROCESSED	RESTRICTIONS	OPERATION	ABRASIVE PAPER OR CLOTH			ABRASIVE FABRIC OR PAD	WOOL		PUMICE 350 MESH OR FINER	ABRASIVE WHEEL
			ALUMINUM OXIDE	SILICON CARBIDE	GARNET		ALUMINUM	STAINLESS STEEL		
FERROUS ALLOYS HEAT TREATED TO 220,000 PSI AND ABOVE	DO NOT USE ACID BASE RUST REMOVERS. DO NOT USE HAND HELD POWER TOOLS	CORROSION REMOVAL OR FAIRING	150 FINER	150-FINER		FINE TO ULTRA-FINE	X	X	X	
		FINISHING	400				X	X	X	
FERROUS ALLOYS	DOES NOT APPLY TO STEEL HEAT TREATED TO STRENGTHS TO 220,000 PSI AND ABOVE	CORROSION REMOVAL OR FAIRING	150 FINER	180-FINER		FINE TO ULTRAFINE	X	X	X	X
		FINISHING	400				X	X	X	
ALUMINUM ALLOYS EXCEPT CLAD ALUMINUM	DO NOT USE SILICON CARBIDE ABRASIVE	CORROSION REMOVAL OR FAIRING	150 FINER		7/0 FINER	VERY FINE AND ULTRAFINE	X		X	X
		FINISHING	400				X		X	
CLAD ALUMINUM	SANDING LIMITED TO THE REMOVAL OF MINOR SCRATCHES	CORROSION REMOVAL OR FAIRING	240 FINER		7/0-FINER	VERY FINE AND ULTRAFINE			X	X
		FINISHING	400						X	
MAGNESIUM ALLOYS		CORROSION REMOVAL OR FAIRING	240-FINER			VERY FINE AND ULTRAFINE	X		X	X
		FINISHING	400				X		X	
TITANIUM		CLEANING AND FINISHING	150 FINER	180-FINER				X	X	X
PLATED OR PHOSPHATED SURFACES		REFER TO APPROPRIATE BASE METAL FOR CORROSION REMOVAL						X		

Abrasives for Corrosion Removal
Figure 2



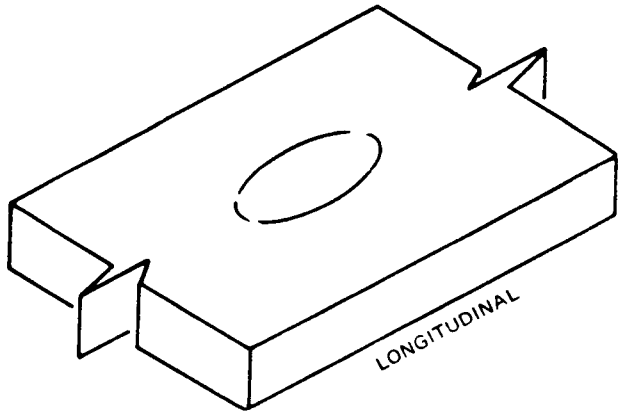
PIT HAS BEEN CLEANED UP TO THE EXTENT THAT ALL LOOSE CORROSION PRODUCTS HAVE BEEN REMOVED.

CORROSION DAMAGE BEFORE REWORK



ROUGH EDGES HAVE BEEN SMOOTHED AND ALL CORROSION HAS BEEN REMOVED. HOWEVER, DEPRESSION HAS NOT BEEN SHAPED.

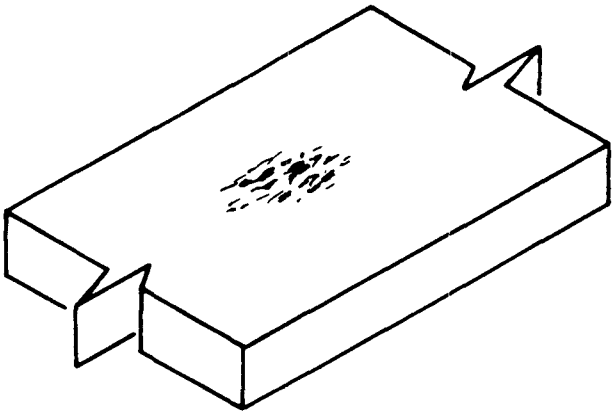
DEPRESSION AFTER CORROSION REMOVAL



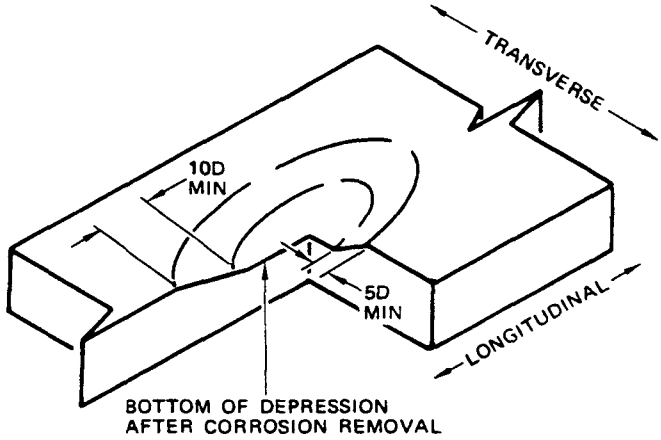
BLENDING HAS BEEN ACCOMPLISHED IN THE RATIO AND DIRECTION SHOWN IN FIGURE 4

DISH-OUT AFTER BLENDING

Blendout of Corrosion as Single Depression
Figure 3



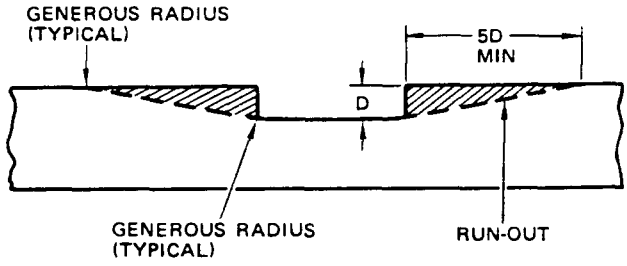
CORROSION DAMAGE
BEFORE REMOVAL



DAMAGE REMOVED AND SURFACE SMOOTHED
WITH SHALLOW ELLIPTICAL DISH-OUT

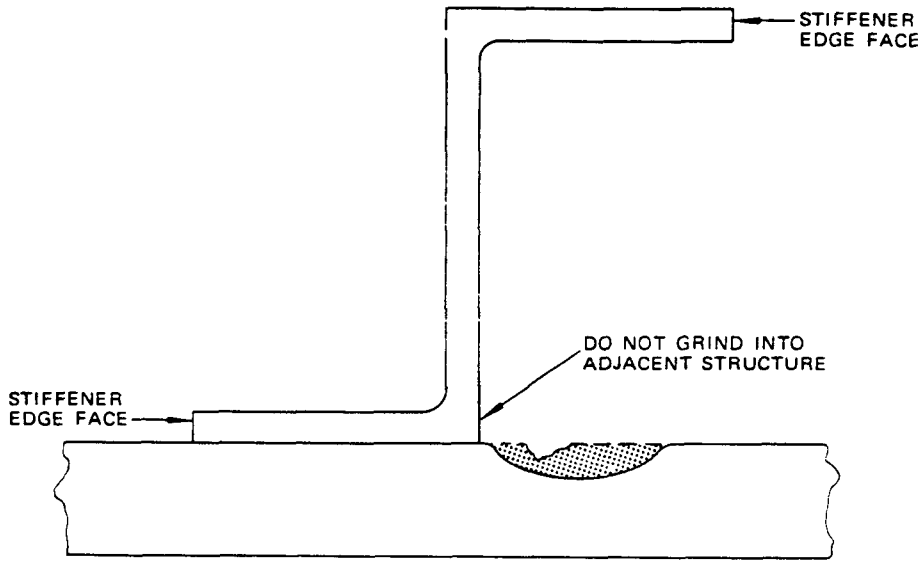
NOTE

- D = DEPTH OF DEPRESSION
- REFER TO SPECIFIC ALLOWABLE DAMAGE LIMITS FOR MAXIMUM ALLOWABLE DEPTH.
- SINCE MAXIMUM DEPTH VARIES AT DIFFERENT LOCATIONS, MAXIMUM SIZE OF DISH-OUT WILL ALSO VARY.
- THE BLENDING RATIO SHALL BE MAINTAINED AT ALL TIMES UNLESS OTHERWISE SPECIFIED IN A SPECIFIC REPAIR.
- SEE DETAIL I FOR EXAMPLE OF BLENDING.



EXAMPLE OF 1:5 BLENDING RATIO
DETAIL I

Blendout of Multiple Pits in Corroded Area
Figure 4



Profile of Reworked Corroded Areas in Regions of Limited Access
Figure 5

1. Cheesecloth or new rags

2. Cleaning brushes, fiber, nylon and wire

3. Aluminum wool and steel wool

4. Aluminum oxide paper, 220 or finer

5. Acid brighteners for aluminum

   NOTE: The following materials must be diluted with 3 parts water prior to use.

   A. Kelite L-20, Richardson Chemical Co., Allied-Kelite Products Div., 1250 N. Main St., Los Angeles, Calif. 90051

   B. Metal Glo No. 2, Turco Products Inc., Div. of Purex Corporation, Ltd., 24600 S. Main St., Wilmington, Calif. 90746

6. Phosphoric acid type corrosion removers for aluminum

   A. Kelite Process K, Richardson Chemical Co., Allied-Kelite Products Div., 1250 N. Main St., Los Angeles, Calif. 90051

      NOTE: Before use, dilute with 8 parts water.

   B. Oakite 36, Oakite Products, Inc., 558 First Ave. So., Seattle, Wash. 98104

      NOTE: Before use, dilute with 4 parts water.

   C. Turco W.O. No. 1, Turco Products, Inc., Div. of Purex Corporation, Ltd., 24600 S. Main St., Wilmington, Calif. 90746

      NOTE: Before use, dilute with 6 parts water.

7. Phosphoric acid type corrosion removers for steel

   NOTE: The following materials must be diluted with 3 parts water before use.

   A. GMC 801, Greater Mountain Chemical Co., Salt Lake City, Utah

   B. Kelite Process K, Richardson Chemical Co., Allied-Kelite Products Div., 1250 N. Main St., Los Angeles, Calif. 90051

   C. Oakite 31, Oakite Products, Inc., 558 First Ave. So., Seattle, Wash. 98104

   D. Turco Prepaint, Turco Products, Inc., Div. of Purex Corporation, Ltd., 24600 S. Main St., Wilmington, Calif. 90746

Corrosion Removal and Control - Equipment and Materials
Figure 6 (Sheet 1)

8. Nitric acid, concentrated, Federal Specification O-A-88

9. Alodine 1000 and 1200S

10. Dow 1 and 19 solutions

11. Sodium dichromate or potassium dichromate

12. Chromic acid

13. Powdered calcium sulphate

EROSION COATING

1. General

A. The leading edges of air inlets and engine nose domes may be damaged by erosion. Coatings such as Astrocoat type I applied to the affected areas will protect the metal. When the coating becomes eroded and must be replaced, it can be removed and new coating can be applied.

B. Preparation of the eroded surface for protective coating, including alodining, is described in the appropriate chapter.

2. Materials

A. Astrocoat

(1) Primer base 8200 and primer accelerator 8201

(2) Astrocoat type I base RM115P-8000 and catalyst 8100

(3) Astrocoat type II base RM115AS with catalyst 8100.

NOTE: Astrocoat materials are available from:

Sterling Lacquer Manufacturing Co., 3150 Brandon Avenue St. Louis, Missouri 63103

3. Procedure to Apply Astrocoat

WARNING: CLEANING AND COATING MATERIALS ARE TOXIC AND FLAMMABLE. USE ADEQUATE VENTILATION AND FIRE PRECAUTIONS.

A. Ensure that surfaces to receive Astrocoat have been properly prepared.

(1) If surfaces are new, they need only to be cleaned with cheesecloth moistened with Mek or tolune and wiped dry with clean cheesecloth.

(2) Repaired surfaces should be protected with Alodine 1200. Surfaces repaired by abrasive blast should be spray cleaned with MEK or water. Do not use cloth to clean the rough surfaces. Lint deposited on the blasted area when covered with Astrocoat shortens the life of Astrocoat.

B. Mask surfaces not to be coated to extend the Astrocoat one-half inch beyond the eroded area.

C. Mix Astrocoat primer base 8200 with primer accelerator 8201 per the manufacturer's instructions.

D. Apply primer by spray or brush to provide a dry film thickness of 0.0005-0.0015 inch.

E. Dry at 70-80°F for a minimum of 2 hours and not more than 18 hours before overcoating.

F. Mix Astrocoat Type I base RM115P-8000 with Astrocoat catalyst 8100 in accordance with manufacturer's instructions.

G. Apply Astrocoat Type I by spraying coats of no more than 0.001 dry film thickness to build up a total thickness of .012 ±.002 inch. Each coat should be set-to-touch before application of the next coat. This requires a drying time of approximately one hour at 70-75°F and a relative humidity of 40-50%. Time between coats should not exceed 18 hours.

H. Immediately after applying the final Astrocoat Type I coat, remove the masking. This is done to lessen the possibility of removing the Astrocoat along with the masking. If the Astrocoat is properly applied, the final surface will be smooth, as valleys are filled in during successive coats.

I. Allow at least eight hours for the final coat to cure at 70-75°F and a relative humidity of 40-50% before returning the airplane to service.

J. Should radio precipitation static be excessive, apply Astrocoat Type II anti-static finish as follows:

(1) Mix a quantity of Astrocoat Type II base RM115AS with Astrocoat catalyst 8100 per manufacturer's instructions.

(2) Apply Astrocoat Type II by spray to provide a dry film thickness of 0.0015 inch, overlapping the edges of the previously applied Astrocoat Type I by 0.20 inch. Use of masking is recommended when Astrocoat Type II is applied.

(3) After the final application, cure for at least 8 hours at 70-75°F and a relative humidity of 40-50% before returning airplane to service.

BONDED METAL STRUCTURAL REPAIR

1. General

A. This subject includes only the adhesive bonding portion of the procedure for repairs to damaged structure. See specific repairs under the applicable chapters, sections and subjects for the nonbonding portion of the repair procedures. Bonding pressure is achieved by mechanical fastening.

NOTE: Scrim cloth is not required as part of this bonding process. Repairs made to an earlier process, now removed from this subject, utilized scrim cloth and do not require replacement. When making new repairs scrim cloth should not be used even though it may be shown on the applicable repair illustration.

B. Bonding, in combination with a regular metal repair, and using proper methods, materials and precautions will increase the fatigue life of a regular metal repair.

C. The processes described in paragraphs 4 through 7 are not applicable to wing interspar structure.

D. Refer to paragraph 7 for sealing procedures at fuselage skin lap splices on in-service airplanes.

E. Refer to 51-10-1 for adhesive components.

2. Separation of Resin-Bonded Metal Structures

A. Where the configuration of the structure will permit, separate the bonded components by driving hardwood wedges between the faying surfaces of the joint. See figure 3 for wedge dimensions and method of use.

CAUTION: USE AN ADEQUATE NUMBER OF WEDGES TO PREVENT DISTORTION OF THE COMPONENTS.

B. Whenever difficulties are experienced in separating bonded components, dry ice (solid carbon dioxide) may be applied to the bond area to embrittle the resin and provide for easier separation of the faying surfaces.

C. The following precautions must be observed when using solid carbon dioxide (dry ice).

WARNING: FROSTBITE WILL RESULT IF DRY ICE CONTACTS THE SKIN OR EYES. CONSULT MEDICAL AUTHORITIES IMMEDIATELY SHOULD DRY ICE CONTACT SKIN OR EYES.

(1) Wear safety-approved insulated gloves, such as leather or neoprene-impregnated asbestos, when handling dry ice or equipment to which it has been applied.

(2) Wear eye protection equipment when breaking dry ice.

(3) Consult safety regulations before using dry ice.

3. Preparation of Faying Surfaces Before Bonding

A. Preparation of Repair Parts

(1) Prefit Repair Parts.

(a) Prefit repair parts so that only very light pressure, 1 to 2 psi, is required to give continuous contact all over the surfaces to be bonded.

(2) Clean and Finish Repair Parts in accordance with par. 3B or 3C as applicable.

B. Clean and Finish Repair Parts and Area by the Phosphoric Acid Non-Tank Anodize (PANTA) Method

(1) The phosphoric acid non-tank anodizing is to be used to prepare aluminum surfaces for metal to metal and metal to honeycomb bonding, either hot or cold, to obtain a more durable bond than the other non-tank methods of surface preparation. This processs is not to be used as a substitute, or alternative, for alodine 1200 to produce a protective finish for aluminum skins.

(2) Application of the phosphoric acid non-tank anodizing process.

WARNING: WHEN USING SOLVENTS AVOID BREATHING VAPORS. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR APPROVED GLOVES AND PROTECTIVE CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS.

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION.

(a) Cleaning of repair area and repair parts.

1) Solvent clean the repair area with MEK or BMS 11-7.

CAUTION: DO NOT ALLOW ANY STRIPPER TO ENTER THE INTERIOR OF PANEL. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

2) Remove the organic finish with solvent and mechanical means per Maintenance Manual 51-8-0 - Paint Stripping, Cleaning and Painting.

3) Solvent wipe with MEK or BMS 11-7.

4) Abrade area with nonwoven abrasive, such as nylon abrasive pad or equivalent.

5) Dry wipe with clean gauze to remove dust or debris.

(b) Prior to the start of further processing, be sure undamaged areas, crevices, and fasteners are protected from acid contamination by masking off these areas with suitable tape and plastic film. Protect working bench tops and surrounding areas by placing plastic film (e.g. mylar) between the part and the bench tops.

(c) Apply a uniform coat of gelled 12 percent phosphoric acid or PR 50 to the aluminum surfaces.

NOTE: Gelled phosphoric acid compound can be made by adding "Cab-O-Sil" to 12 percent phosphoric acid until thickened (Ref 51-10-1, Repair Materials and Equipment).

(d) Place 2 or 3 layers of gauze over top of coating; apply another coating of the gelled phosphoric acid to completely saturate and wet the gauze.

(e) Cut a piece of stainless steel screen to the size of the repair area.

(f) Place the stainless steel screen over the coating, apply another coating of the gelled phosphoric acid over the screen (Fig. 1).

NOTE: Make sure the stainless steel screen does not contact any part of the aluminum surface being anodized.

CAUTION: CHECK SETUP BEFORE PROCEEDING. SCREEEN AS CATHODE (-), ALUMINUM AS ANODE (+).

(g) Connect screen as cathode (-), aluminum as anode (+).

NOTE: Ideal temperature range for anodizing is between 65°F and 85°F.

(h) Apply a DC potential of 6 volts for 10 minutes (4 to 6 volts for 10-12 minutes are satisfactory).

NOTE: A rectifier may be used to supply the voltage during anodizing. Current density should be in the range of 1 to 7 amps/ft^2.

(i) At the end of the anodizing time, open the circuit and remove the screen and gauze.

(j) Immersion or spray rinsing should be used if possible to remove the phosphoric acid gel from the treated surface. If immersion or spray rinsing is not available, remove the acid gel by lightly wiping with gauze moistened with water. The maximum rinse delay time is 5 minutes. Do not rub the anodized surface.

(k) Air dry a minimum of 30 minutes at room temperature or force air dry at 140°F to 160°F.

(l) Check quality of anodized surface. A properly anodized surface will show an interference color when viewed through a polarizing filter, rotated 90° at a low angle of incidence to fluorescent light or daylight. An interference color is when the original color changes to complementary color when the polarizing filter is rotated 90° (Fig. 1, Detail II).

NOTE: Machined or abraded surfaces sometimes are difficult to inspect for color. Rotation of the polarizing filter is required because some pale shades of yellow or green are so close to white that without a color-change inspection, they might be considered "no-color," which would falsely indicate no anodic coating.

CAUTION: DO NOT TOUCH THE DRIED ANODIZED SURFACE. DO NOT APPLY TAPE TO THE SURFACE.

(m) If no color change is observed, repeat steps 3.B.(2)(a) thru 3.B.(2)(m).

(n) In the case of patch doublers or skin details in which both surfaces are to be anodized, both sides are coated with the phosphoric acid gel, covered with 2 layers of gauze soaked in the phosphoric acid gel, a stainless steel screen and an additional layer of phosphoric acid gel on each side. It is important, in this case, to elevate the part slightly to allow gases, formed during anodizing, to escape from the bottom surface. Trapped gases will result in smut deposits on the surface and poor surface preparation (Fig. 1, Detail III).

(o) Prime surfaces per par. 4.

(p) Apply adhesive per par. 5.

CAUTION: PROTECT SURFACES FROM CONTAMINATION AFTER ALODIZING. PRIMER MUST BE APPLIED WITHIN 48 HOURS MAX. AFTER ALODIZING. DO NOT TOUCH FINISHED SURFACES WITH BARE HANDS. WEAR CLEAN WHITE GLOVES WHEN HANDLING PARTS. REDUCTION IN QUALITY OF PRIMER MAY OCCUR.

3C. Clean and Finish Repair Parts by the Alodize Method (Alternative Method)

A. Clean and alodize faying surfaces and cut edges of repair parts according to 51-8-0.

WARNING: WHEN APPLYING PRIMER, AVOID BREATHING VAPOR OR CONTACT WITH SKIN. WEAR RUBBER GLOVES. WEAR EYE PROTECTION. WHEN WORKING IN A CONFINED SPACE, ADEQUATE VENTILATION OR RESPIRATORY PROTECTION MUST BE PROVIDED. KEEP PRIMER AWAY FROM HEAT, SPARKS AND OPEN FLAME. PERSONNEL INJURY MAY OCCUR.

CAUTION: PROTECT SURFACES FROM CONTAMINATION AFTER PRIMING. DO NOT TOUCH PRIMED SURFACES WITH BARE HANDS. WEAR CLEAN WHITE GLOVES WHEN HANDLING PARTS. DO NOT APPLY PRIMER BELOW 50°F, AND ABOVE 85% RELATIVE HUMIDITY. REDUCTION IN QUALITY OF PRIMER WILL OCCUR.

B. Prime Faying Surfaces of Repair Parts in accordance with par. 4.

4. Primer Application

A. Depending on the availability of spray equipment and the size of the repair part, corrosion inhibiting or non-corrosion inhibiting adhesive primers may be applied either by spraying or manual brush or wipe on applications. The use of primers is recommended to improve durability and prevent contamination during handling and assembly.

B. Application of BMS 5-89 Type Primer (CIAP).

(1) Condition the refrigerated primer by allowing it to come to room temperature prior to opening the container.

NOTE: Do not use primer containing lumps or indications of gellation.

(2) Agitate or stir the primer to assure a homogeneous mixture. When applying primer by a non-spray manual method, agitate prior to each application to restore suspension of solids.

(3) Spray, brush or gauze wipe a smooth uniform film of primer on the cleaned surface.

(4) Allow to air dry for 60 minutes and then air dry or bake per manufactuer's instructions.

NOTE: The thickness of the primer is essential to obtaining acceptable bond properties. Dried film thickness may vary from 0.0001 to 0.001 inch, as specified by the supplier.

C. Application of BMS 10-79 Primer (Non-CIAP)

(1) Mix 4 parts by volume of DeSoto 513-707 primer with 1 part by volume of curing solution 910-787 and 4 parts by volume of DeSoto 020-702 thinning solvent. Pot life is 8 hours at room temperature.

(2) Thoroughly mix primer immediately before application. Reagitate primer that has been allowed to stand for over 1 minute. Keep container closed when primer is not being applied.

(3) Apply a thin continuous coat of all bonding surfaces with a brush or clean cheesecloth.

(4) Air-dry at room temperature for 15 minutes minimum.

5. Adhesive Application for Structural Repairs

A. Mix Scotch-Weld Structural Adhesive EC 2216 B/A in accordance with the manufacturer's instructions. Pot life is approximately 90 minutes at 75°F for a 100-gram batch. Higher temperatures and larger batches will reduce pot life appreciably.

B. Apply a generous coat of adhesive to all bonding surfaces using a wood or nylon spatula.

C. Install all fasteners within the pot life of the adhesive.

NOTE: The mixed adhesive should be applied to the bonding surfaces as soon as possible after mixing in order to obtain the maximum work life for installation of rivets. The following time schedule should be used for rivet installation at 75°F.

Time from Mixing to Application	Time Allowable for Rivet Installation after Application of Adhesive
5 minutes	180 minutes
30 minutes	120 minutes
60 minutes	60 minutes
90 minutes	0 minutes

After riveting, wipe off excessive adhesive squeeze-out with a cheesecloth moistened with MIBK or equivalent.

D. Allow the adhesive to cure. The cure time may be accelerated by the application of heat, using the following cure times. Do not exceed temperature of 160°F.

Temperature (°F)	Time (Hours)
60	48
80	24
100	12
120	6
160	2

6. Sealing for Structural Repairs

A. Bonded metal repairs should be sealed after the adhesive has cured to a tack-free state to minimize the risk of corrosion. Use the fillet configuration data in Fig. 2 as a guide. The procedure is as follows:

(1) Clean the repair with cheesecloth dampened with MIBK or equivalent. Extend cleaning operation 5 inches beyond repair area.

(2) Mix sealant BMS 5-79 (Churchill Chemical Corp. 30414B-2 only) in accordance with the manufacturer's instructions. Pot life is approximately 2 hours at room temperature. The optional sealants listed in par. 7.A.(7) may be used to effect a faster cure.

(3) Using a plastic tool, apply fillet seals to all edges of the repair parts in the cleaned area. Fair in sealant with a fairing tool so that a continuous smooth fillet is formed. On the internal surfaces of the structure, the seals must extend a distance of 5 inches beyond ends of repair parts. On external surfaces (unless otherwise specified for a particular repair) sealant should be applied only to the perimeter of the repair parts. See Fig. 2 for fillet forming configuration. Heavy masking tape may be needed to guide the sealant forming tool.

(4) On the interior of the airplane, seal the heads of all fasteners in the repair and those within 5 inches of the repair.

(5) Allow sealant to cure to a tack-free state before restoring finish.

(6) Allow sealant to fully cure for the total times shown in par. 7.A.(9).

7. Sealing of Fuselage Skin Lap Splices to Prevent Corrosion

NOTE: Use the following procedure, as required, to provide weather sealing for skin lap joints when no metal structural repair has been made. This paragraph supplements par. 6.

A. Exterior

(1) Clean and rinse lap splice areas that are badly contaminated using an alkaline cleaner as detailed in 12-3-1 of the 707 Maintenance Manual.

(2) Clean lap splice with cheesecloth moistened with MIBK or equivalent.

(3) Dry out lap splice by heating to 150-200°F for between 2 and 2-1/2 hours.

(4) Inspect the lap joints for voids in the bondline using a high intensity light source and/or feeler gages.

(5) The sealants may either be applied in painted areas, over existing paint or after paint has been removed.

(a) If sealant is to be applied over existing decorative paint, lightly sand to remove the gloss. Use 320 grit or finer aluminum oxide paper. Reclean with MIBK or equivalent.

(b) Make a final cleaning of bare metal surfaces with BMS 11-7 cleaner.

(6) Thoroughly mix PR1436G, type I or PR1431G, type I sealant according to the instructions. Using a Semco sealant gun (or equivalent) and a suitable nozzle, inject the sealing compound into any voids.

NOTE: PR1436G, type I or PR1431G, type I sealant may be obtained from Products Research and Chemical Corporation, 2919 Empire Avenue, Burbank, California 91504.

(7) Mask the seam and seal with BMS 5-79 (Churchill Chemical Corp. 3C414B-2: pot life 2 hours) sealant. For a faster cure, the following optional materials may be used:

Areas to be painted - Pro-Seal 890 B-1/2 Pot Life: 1/2 hour

Nonpainted Areas - Pro-Seal 890 B-1/2 (almost black) or Dow Corning 93-007-1/8 (light gray), pot life 1/8 hour, over RTV 1200 primer

NOTE: Pro-Seal 890 B-1/2 may be purchased from Coast Pro-Seal and Manufacturing Company, 19451 Susana Rd., Compton, California or may be made from Pro-Seal 890 B-2 (BMS 5-26, class B) by using a base to accelerator ratio of 100:20 by weight instead of the usual 100:10.

(8) Using a plastic tool, form the sealant to the fillet configuration shown in Fig. 2. Heavy masking tape may be used to guide the tool.

(9) Allow sealant to cure for the following times: (To a 30 Durometer Hardness)

	Temperature (°F)	Time (Hours)
BMS 5-79 B-2 (Churchill 3C414B-2)	60	80
	80	35
	100	15
	120	6
	140	2.5
BMS 5-26 B-1/2 (Pro-Seal 890 B-1/2)	60	6.5
	80	3.75
	100	2.5
	120	1.5
	140	0.7

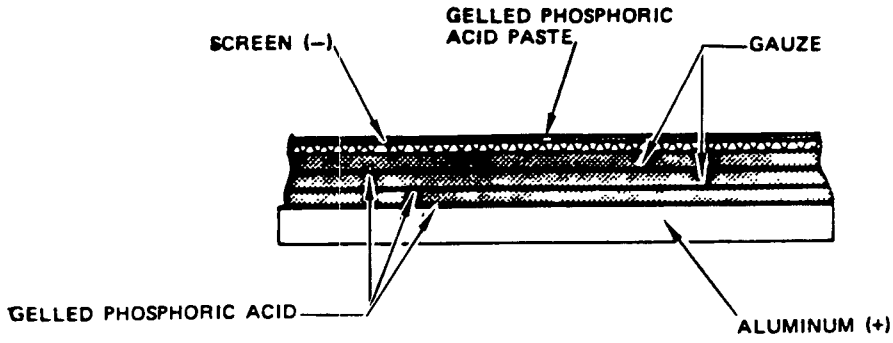
Dow Corning 93-007-1/8 will be tack-free in approximately 30 minutes and fully cured in 1 to 2 hours.

B. Interior

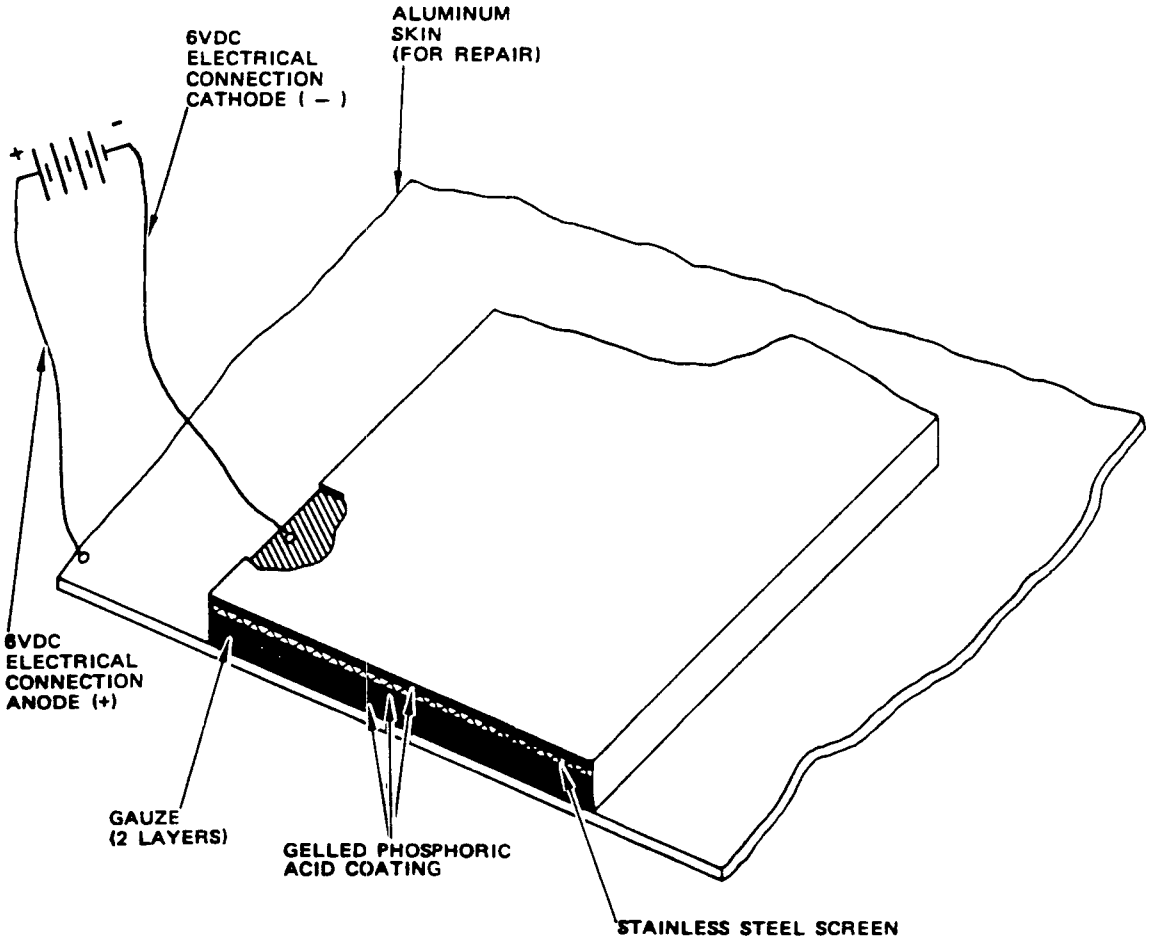
(1) Clean, dry out, inspect, and inject voids as detailed in paragraphs 7.A.(2) through (6).

(2) Make a fillet seal on all seams using the sealant specified in paragraphs 7.A.(6) through (9). See Fig. 2 for shape and dimensions.

(3) Seal fasteners which extend through the bond lap using Churchill 3C414B-2 (BMS 5-79, Class B) sealant, or brushcoat with BMS 5-26, Class A or EC 5922.

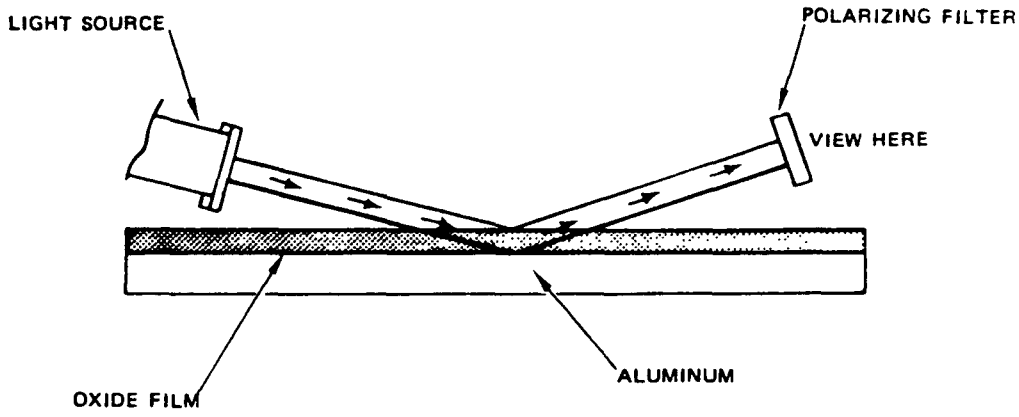


SECTION THRU ALODIZING LAYUP

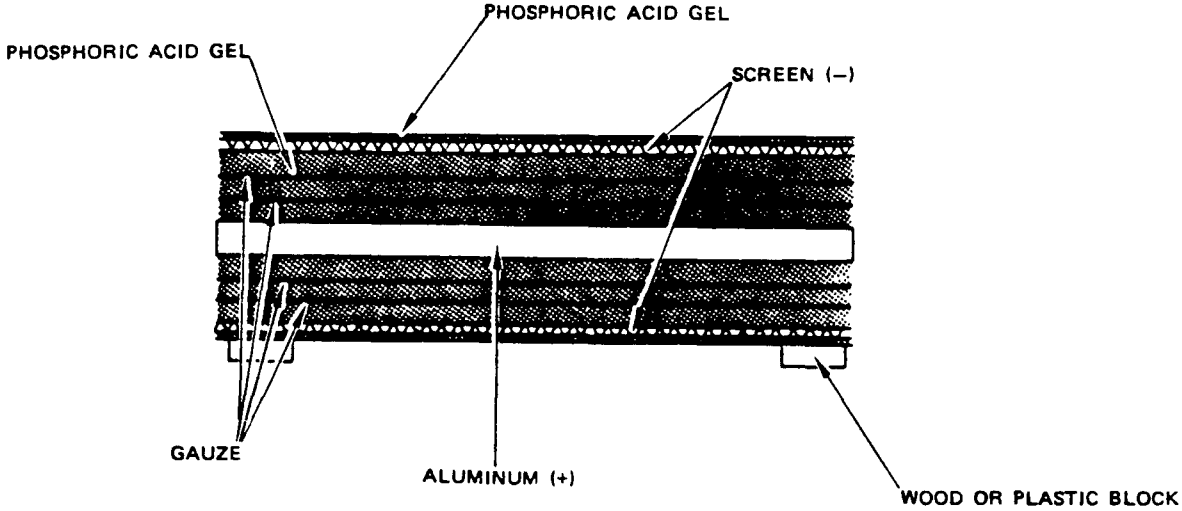


DETAIL I

Phosphoric Acid Non-Tank Anodize (PANTA) Method For Bonding Repairs Figure 1 (Sheet 1)

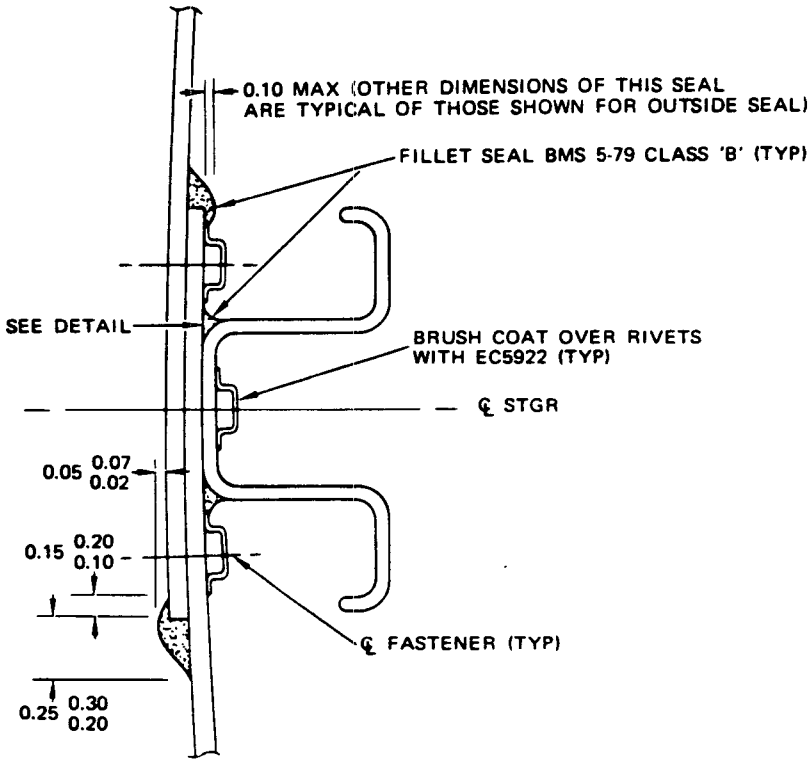


DETAIL II

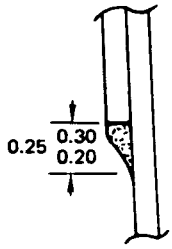


SECTION THRU SET UP FOR ANODIZING BOTH SIDES OF ALUMINUM

DETAIL III



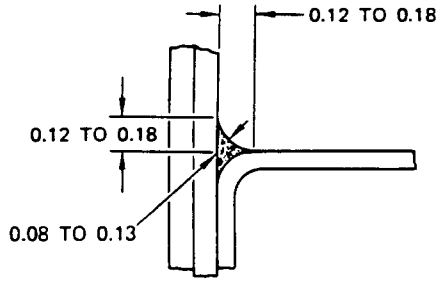
FILLET CONFIGURATION FOR SKIN THICKNESS OF 0.036–0.060



FILLET CONFIGURATION FOR SKIN THICKNESS OF 0.061 & UP

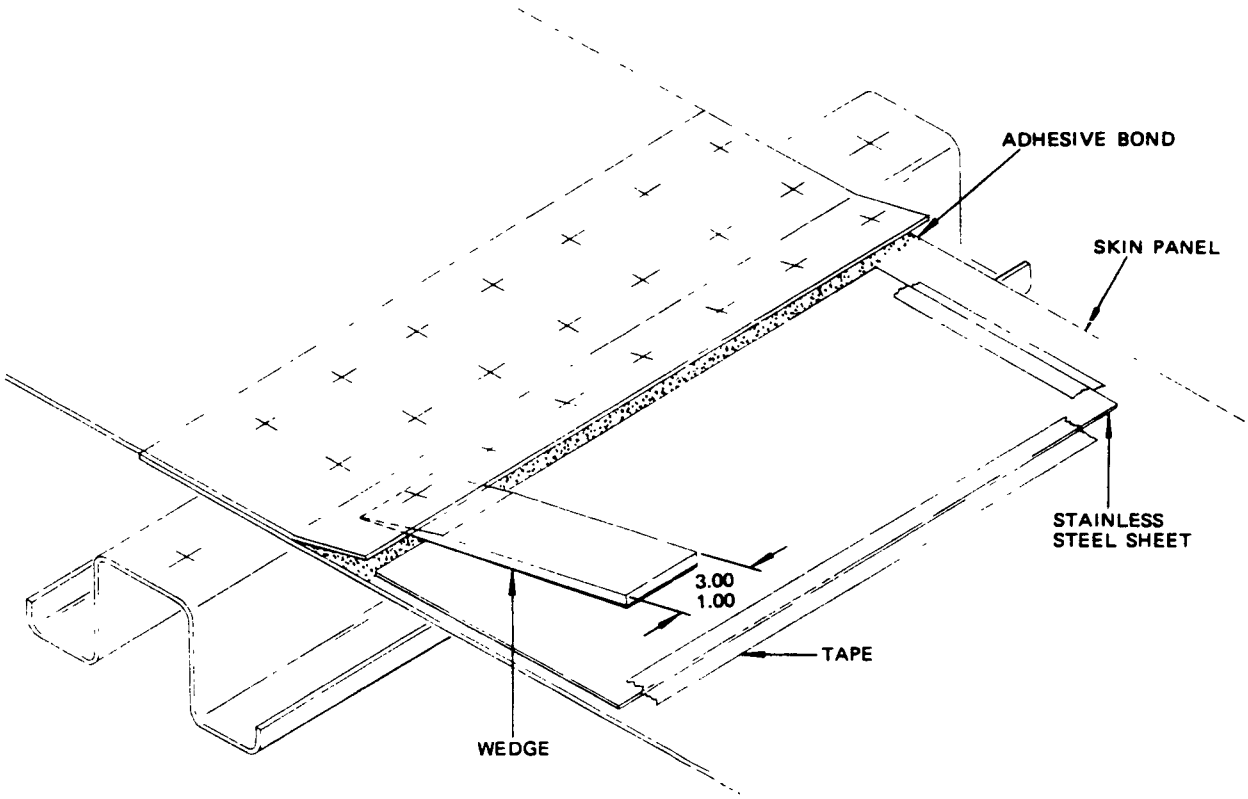
NOTE

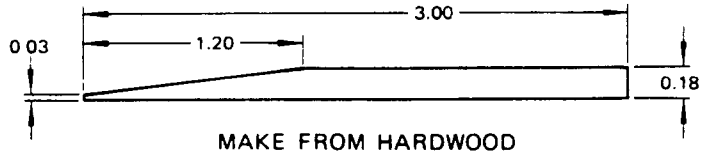
- FILLET CONFIGURATION AT FUSELAGE SKIN SPLICE SHOWN. THIS CONFIGURATION IS ALSO SUITABLE FOR OTHER BONDED REPAIRS.
- FOR GENERAL SEALING REQUIREMENTS REFER TO 51-3-0, 707 MAINTENANCE MANUAL.



DETAIL OF FILLET SEAL AT STIFFENER (TYP)

Fillet Sealing of Bonded Repairs
Figure 2





MAKE FROM HARDWOOD

WEDGE

FIBERGLAS CLOTH OVERLAY REPAIRS

1. Introduction

A. This repair method is applicable to damaged bonded panels and other metal components subject to crack damage. It does not duplicate the method specified in 51-9-1 paragraph 2. This repair method is nonstructural and is not to be used for the repair of primary structure.

B. See figure 1 for repair instructions.

C. See 51-10-1, figure 2 for supply sources of materials used for the fiberglas cloth overlay repairs.

2. Preparation of Damage Area

A. Clean damage area that will be covered by the patch.

(1) General instructions:

(a) Clean bond areas are mandatory for acceptable bonding strength.

(b) All foreign materials such as paint, oil, wax, dirt, dust, lint abrasive or abrasion particles must be removed before application of resin.

(2) Remove paint or surface coating.

(a) Apply paint stripper to bond area.

NOTE: Mask off repair area to prevent stripping of paint from a larger area than required for the patch and to prevent contact of the paint remover with cured bond in bonded skin panels.

(b) Allow paint stripper to penetrate for 5 to 10 minutes.

(c) Remove softened coating with wooden spatula or clean cheese cloth.

(3) Solvent clean

(a) Lightly apply MEK solvent with clean cloth.

(b) Wipe off MEK solvent with clean, soft, lint-free cloth.

(4) Mechanically clean

(a) Lightly sand surface of metal. Use 400 grit abrasive cloth.

(5) Solvent clean

(a) Solvent clean per par. (3) above using clean cloth for each application and wiping of the solvent. Repeat solvent cleaning until no further reduction of the soiling of the wiping cloth can be obtained.

B. Apply adhesive primer

(1) Apply a thin but continuous coat of EC776SR primer over the cleaned-up repair area with a clean, soft brush.

(2) Dry primer 1 hour at room temperature (70°F) or 30 minutes at 130°F. Use explosionproof heat source for elevated temperature cure.

CAUTION: TO PREVENT BUCKLING OF THE SKIN, DO NOT ALLOW REPAIR AREA TO REACH A TEMPERATURE THAT IS UNBEARABLE WHEN CHECKED WITH OPEN PALM OF HAND (APPROXIMATELY 150°F).

NOTE: The temperature of the repair surface can be determined with temperature indicators (e.g. Tempilstik or Tempilaq). Mark the metal approximately 0.5 inch outside the patch area with the appropriate Tempilstik. Melting of the mark from the Tempilstik indicates the temperature of the surface. Follow the manufacturer's directions for use.

CAUTION: KEEP BONDING SURFACE CLEAN. ANY CONTAMINATION REDUCES BOND STRENGTH.

3. Processing of Patches

A. Impregnate patches

(1) From style 181, 1581 or 7781 fiberglass cloth, cut two patches of equal size with at least 1.50-inch overlap around damage area.

NOTE: If Style 181, 1581 or 7781 fiberglass cloth is not available, three plies of Style 128 or 1528 cloth can be used instead of two plies of Style 181, 1581 or 7781 cloth.

(2) Cut two pieces of parting film approximately 3 inches larger all around than the fiberglass patch and tape down one piece to a smooth surface.

NOTE: Use PVA film or other parting films listed in 51-10-1, Fig. 2.

(3) Spread adhesive prepared per Fig. 2 on parting film and place one fiberglass patch over the adhesive.

NOTE: Weight of adhesive approximately equal to the weight of the dry fiberglass cloth is required to impregnate the cloth.

(4) Cover the cloth on the parting film with the second piece of parting film.

(5) Press the adhesive through the cloth by working over the parting film with a squeegee or roller, in order to impregnate the patch and to remove air bubbles.

NOTE: 51-10-1, Fig. 13 shows details of a squeegee that can be used to impregnate patches.

(6) Peel back top layer of parting film and apply an additional coat of adhesive to the surface of the patch.

(7) Place the second patch on top of the first patch.

(8) Re-cover patches with parting film and complete impregnation as in step (5).

B. Place overlay patches.

(1) Apply a coat of adhesive prepared per Fig. 2, over the cured EC-776SR primer on the repair area. Use a brush, notched putty knife or spatula.

(2) Trim the impregnated patch to the required size. The parting film on both sides of the cloth decreases fraying of the edges while cutting the cloth.

(3) Remove parting film from one side of the layup.

(4) Place exposed patch over repair area maintaining 1.50-inch overlap around damage boundary.

NOTE: In order to allow complete fabric seating around protuding rivet heads it may be necessary to carefully cut through the fabric at the rivet head with a sharp instrument such as a razor blade.

(5) Remove the existing parting film and re-cover the impregnated patch with another piece of parting film extending about 0.50 inch over edges of the patch.

NOTE: Use PVA parting film if elevated temperature will be used to cure the patch.

(6) Remove wrinkles and air bubbles with a squeegee. Work from the center of the patch towards the edges.

NOTE: Do not remove too much adhesive by excessive pressure, in order to avoid producing a patch deficient in adhesive.

(7) Sweep excess adhesive to outer edges of parting film, thereby fairing the edges of the patch to the contour of the repair surface. All loose threads shall be embedded in the tapered fairing formed by the adhesive around the periphery of the patch.

(8) Wipe off any excess adhesive that has been squeezed out at the edges of the parting film.

C. Cure impregnated patch

(1) Required curing times are listed in table in Fig. 2.

CAUTION: TO PREVENT BUCKLING OF SKIN, DO NOT ALLOW REPAIR AREA TO REACH A TEMPERATURE THAT IS UNBEARABLE WHEN CHECKED WITH OPEN PALM OF HAND (APPROXIMATELY 150°F).

NOTE: The temperature of the repair surface can be determined with temperature indicators (e.g. Tempilstik or Tempilaq). Mark the metal approximately 0.5 inch outside the patch area with the appropriate Tempilstik. Melting of the mark from the Tempilstik indicates the temperature of the surface. Follow the manufacturer's directions for use.

(2) Remove parting film after patch has cured.

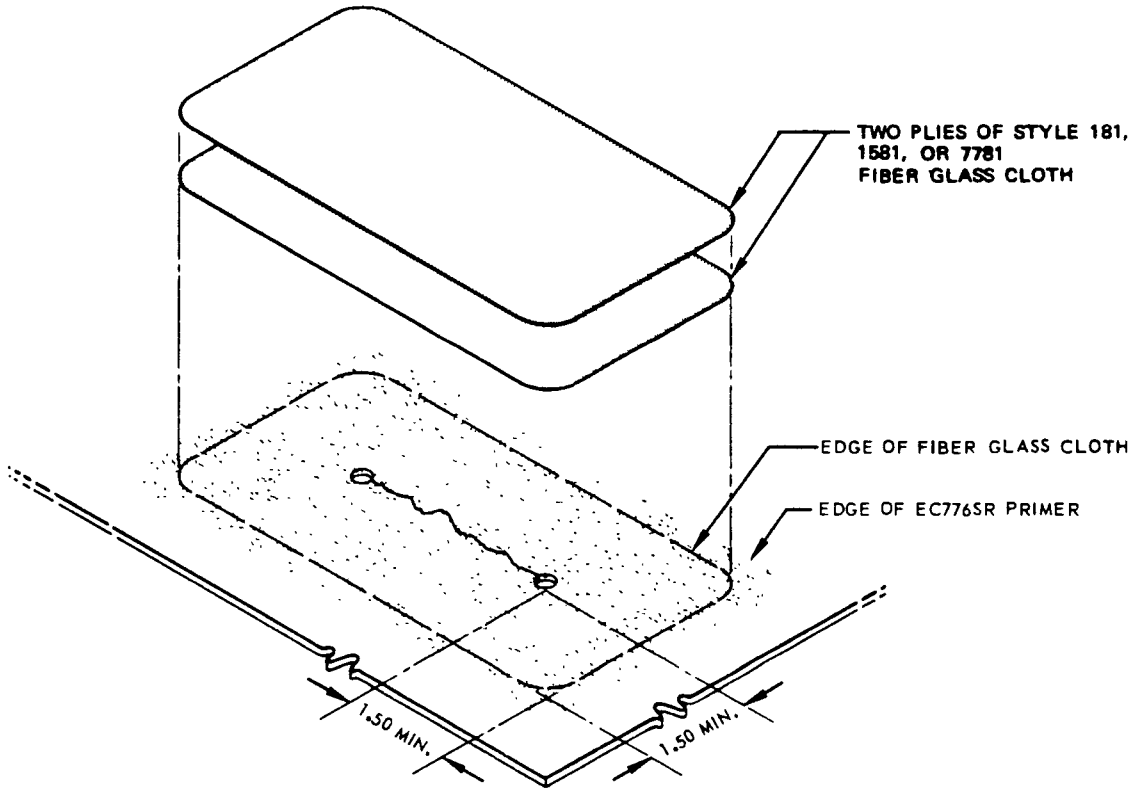
4. Finishing the Repair

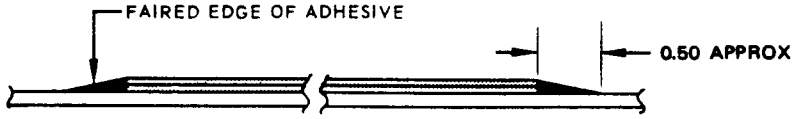
A. After removing parting film from the cured patch, apply chemical and solvent resistant finish (primer and enamel of the appropriate color) to the patch and the surrounding bare metal. See the Maintenance Manual, section 51-2-0.

NOTE: Do not apply finish directly over the EC776SR adhesive primer. Wipe off any excess adhesive primer that is not covered by the patch with a clean rag moistened with MEK solvent before painting.

REPAIR INSTRUCTIONS

1. Stop drill cracks with a 0.25 inch drill. Remove all nicks, burrs and other surface irregularities.
2. Clean the repair area and apply EC776SR primer as described in paragraph 2.
3. Impregnate and apply fiber glass cloth overlay patches as described in paragraph 3.
4. Restore the required surface finish. See paragraph 4.





SECTION THROUGH REPAIR

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS. WEAR RUBBER OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

SEE 51-10-1, FIG. 2 FOR SOURCES OF REPAIR MATERIALS AND EQUIPMENT

MIXING PROCEDURE

1. Add Epon 828 to Epon 812 and mix thoroughly.
2. Add Versamid 115 to Versamid 125 and mix thoroughly.
3. Add Epon mixture to Versamid mixture and mix thoroughly.

NOTE: Mixture pot life is approximately 2 hours at 70°F.

CURING TIMES FOR BMS 5-29	
TEMPERATURE	TIME
60°F	40 HOURS
70°F	24 HOURS
90°F	16 HOURS
100°F	13 HOURS
110°F	10 HOURS
120°F	7.5 HOURS
140°F	4 HOURS
160°F	2 HOURS
180°F	1 HOUR
200°F	30 MINUTES
220°F	15 MINUTES
240–260°F	6 MINUTES

READY-TO-USE PACKAGE

BMS 5-29 adhesive is also available in kit form under number 3147-N2X from Whitaker Corp., Narmco Materials Div., 600 Victoria Street, Costa Mesa, California 92626;.and number 80055-30 or 80055-31 from Fenwal Incorporated, 400 Main Street, Ashland, Massachusetts 01721.

The two Epons are in a plastic bag, and a separate compartment contains the two Versamids, all in correct proportions. The adhesive is ready for use after breaking the seal between the two compartments and mixing the contents thoroughly within the plastic bag by kneading.

Also a three-part package is available from Fenwal that contains fiberglass patches, in addition to the adhesive.

BMS 5-29 ADHESIVE FOR FIBERGLASS [A]	
COMPONENTS	PARTS BY WEIGHT
EPON 812	100
EPON 828	100
VERSAMID 115	100
VERSAMID 125	100

NOTES:

[A] BMS 5-126 ADHESIVE IS OPTIONAL TO BMS 5-29 ADHESIVE.

Preparation of Adhesive for Fiberglass
Figure 2 (Sheet 1)

[A] BMS 5-126 ADHESIVE (TYPE 2, CLASS 1) ADHESIVE FOR FIBERGLASS	
COMPONENTS	PARTS BY WEIGHT
A	100
B	100

BLENDING PROCEDURE:

1. Mix component A thoroughly
2. Mix component B thoroughly
3. Thoroughly blend equal parts by weight of components A and B.

NOTE: Mixture pot life is approximately 2 hours at 70°F.

CURE TIMES FOR BMS 5-126 (AT A CLAMPING PRESSURE OF 10-15 PSI)	
TEMPERATURE	TIME
70° ± 5°F	24 ± 1 HOURS
100° ± 10°F	12½ ± 1½ HOURS
150° ± 10°F	3½ ± ¼ HOURS
250 ± 10°F	20 ± 5 MINUTES

Preparation of Adhesives For Fiberglass
Figure 2 (Sheet 2)

ALUMINUM HONEYCOMB STRUCTURE REPAIRS

1. Introduction

A. This subject describes repairs to panels of sandwich construction, consisting of aluminum foil honeycomb core to which aluminum alloy skin is bonded on both sides.

B. For corroded aluminum honeycomb tab structure repair see 51-10-3.

C. Aluminum honeycomb structure is used in control surface panels and in parts of the trailing edge of the wing.

2. Repair Procedure

A. Evaluate damage per figure 1 and determine applicable repair figure.

B. Perform the repair by following instructions on the applicable repair figure.

C. Special materials and tools for honeycomb repairs are listed in figure 2.

3. Preparation of Damage Area

A. Determine extent of damage.

(1) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter. Remove water from contaminated perforated honeycomb panels as described in 51-10-2.

(2) Check for delamination of skin from the honeycomb core, particularly around cracks.

NOTE: Delamination can be detected by tapping the skin with a small metallic object, such as a half dollar coin.

B. Trim out damage.

(1) Trim damaged skin to a smooth outline, including delaminated areas. Make all cutouts with not less than 0.50 inch radius.

NOTE: See figure 9 for power router that is recommended for trimming of damage in honeycomb panels.

(2) Remove damaged honeycomb core, including areas that have been contaminated by water or other foreign matter. Remove water from contaminated perforated honeycomb panels as described in 51-10-2.

(3) Remove all burrs, nicks and sharp edges of the skin.

(4) Remove all debris from the trimmed-out hole in the honeycomb core.

C. Clean Bond Area

NOTE: The entire aluminum skin area adjacent to the damage that will be covered by the fiberglass overlay must be thoroughly cleaned in order to obtain acceptable bonding strength.

(1) Remove paint:

(a) Scrub the aluminum skin with methyl isobutyl ketone to remove paint and other surface finishes. Use no paint strippers or removers in the repair area.

NOTE: BMS 10-11 paint need not be removed. Clean it as described in steps (2) and (3) below.

(2) Mechanically clean:

(a) Lightly sand surface of aluminum skin with 400 grit abrasive cloth to remove surface oxides etc, but without penetrating the clad aluminum surface,

or

(b) Scrub the surface briskly with Dutch Household Cleanser, using clean gauze pads saturated with water. After scrubbing, wipe off cleanser and soil using dry gauze pads. Then wipe the surface with clean gauze pads slightly moistened with water. Repeat this last operation until all cleanser and soil are removed. Dry the surface with clean dry gauze.

(3) Solvent clean:

(a) After having cleaned the surface mechanically, wipe the area with a soft clean cloth moistened with methyl isobutyl ketone or trichlorethylene until no trace of foreign material remains.

NOTE: Do not allow solvent to dry on the cleaned area. Wipe it off quickly with a seperate clean dry cloth.

(b) Repeat this solvent cleaning just prior to applying the EC776SR adhesive primer.

D. Apply Primer:

(1) Apply adhesive primer EC776SR in as thin and continuous a film as possible over any unprimed area to be covered by the fiberglass overlay.

NOTE: EC776SR primer is to be used on unprimed aluminum only. If the bonding surface is coated with BMS 10-11 or BMS 5-89 primer which is abraded and cleaned per par. 3.C, EC776SR primer should not be applied. Where the repair area overlaps primed and unprimed surfaces, apply EC776SR to unprimed surfaces only.

Use a clean stiff bristle brush. Do not thin the adhesive primer.

(2) Dry primer 1 hour at room temperature (70°F) or 30 minutes at 130°F. Use explosionproof heat source for elevated temperature cure.

CAUTION: DO NOT ALLOW REPAIR AREA TO REACH A TEMPERATURE THAT IS UNBEARABLE WHEN CHECKED WITH OPEN PALM OF HAND (APPROXIMATELY 150°F).

KEEP BONDING SURFACE CLEAN. ANY CONTAMINATION REDUCES BOND STRENGTH.

4. Processing of Fiberglass Honeycomb Replacement Core

A. Fabricate core to fit snugly into cleaned out damage area flush with outside contour.

B. Apply Potting Compound 1 (Fig. 15) around contact edges of core.

C. Apply one coat of same compound on the inside of cleaned out damage area.

D. Install replacement core into damage area.

5. Processing of Patches

A. Impregnate the overlay patch

(1) Cut style 181, 1581 or 7781 fiberglass cloth for the bottom ply of the patch.

NOTE: A minimum of 1.5-inch overlap around damage area must be provided for a two-ply patch and 0.75-inch overlap per ply for patches of three or more plies, as shown in Fig. 20. If Style 181, 1581 or 7781 fiberglass cloth is not available, three plies of Style 128 or 1528 cloth can be used instead of two plies of Style 181, 1581 or 7781.

(2) Cut two pieces of parting film approximately 3 inches larger all around than the fiberglass patch and tape down one piece to a smooth surface.

NOTE: Use PVA film or other parting films listed in Fig. 2.

(3) Spread adhesive prepared per Fig. 14 on parting film and place one fiberglass ply over the adhesive.

NOTE: Weight of adhesive approximately equal to the weight of the dry fiberglass cloth is required to impregnate the cloth.

(4) Cover the cloth on the parting film with the second piece of parting film.

(5) Press the adhesive through the cloth by working over the parting film with a squeegee or roller, in order to impregnate the patch and to remove air bubbles.

NOTE: Figure 13 shows details of a squeegee that can be used to impregnate patches.

(6) Peel back top layer of parting film and apply an additional coat of adhesive to the surface of the cloth.

(7) Place fiberglass cloth for the second ply on top of the bottom ply.

(8) Recover patch with parting film and complete impregnation as in step (5).

(9) When a patch of more than two plies is required, repeat steps (6), (7) and (8) until the required number of plies have been impregnated.

NOTE: An alternate method is to impregnate the individual plies separately and then to pile up the impregnated plies.

B. Place overlay patches.

(1) Apply a coat of adhesive prepared per Fig. 14 over repair area. Use a brush, notched putty knife or spatula.

(2) Trim the impregnated patch to the required size. The parting film on both sides of the cloth decreases fraying of the edges while cutting the cloth.

(3) Remove parting film from the bottom side of the layup.

(4) Place exposed patch over repair area maintaining the required overlap around damage boundary.

(5) Remove the existing parting film and recover the impregnated patch with another piece of parting film extending about 0.50 inch over edges of the patch.

(6) Remove wrinkles and air bubbles with a squeegee. Work from the center of the patch towards the edges.

(7) Sweep excess adhesive to outer edges of parting film, thereby fairing the edges of the patch to the contour of the repair surface. All loose threads shall be embedded in resin.

(8) Wipe off any excess adhesive that has been squeezed out at the edges of the parting film.

C. Cure impregnated patch.

(1) Required curing times are listed in the table in Fig.8.

NOTE: When heat cure is used, it is necessary to constantly sweep the patch to remove air bubbles as they form.

CAUTION: USE EXPLOSIONPROOF HEAT SOURCE. APPLY HEAT UNIFORMLY OVER OVERLAY AREA.

NOTE: Temperature of the repair surface may be judged by touch. 150 to 180°F is the maximum that can be touched without experiencing pain. A more exact determination of the temperature may be made by using temperature indicators (e.g., Tempilstik or Tempilaq). Mark the metal area adjacent to the repair approximately 0.5 inch from the patch with the appropriate Tempilstik. Melting of the mark from the Tempilstik indicates the temperature of the surface. Follow the manufacturer's directions for use.

(2) Remove parting film after patch has cured.

NOTE: Heat may be used to facilitate removal of parting film. For room temperature cure, polyethylene parting film is the easiest to remove from the cured patch.

6. Hot-Bonded Metal-to-Metal Repair of Aluminum Honeycomb Structure

NOTE: These repairs are applicable for repairs requiring the recovery of full strength capabilities of the original structure.

For limitations on the use of this repair method, see Damage Evaluation (Fig. 1), 51-10-1.

A. Preliminary Cleaning of Damage Area

WARNING: WHEN USING METHYL ISOBUTYL KETONE (MIBK), AVOID BREATHING VAPORS. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR APPROVED GLOVES AND PROTECTIVE CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS.

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION.

(1) Wipe the area with a soft clean cloth moistened with methyl isobutyl ketone (MIBK) solvent until no trace of foreign materials or soil remains.

(2) Apply metallic foil tape 3 inches from the repair bond area.

CAUTION: DO NOT ALLOW ANY STRIPPER TO ENTER THE INTERIOR OF THE PANEL. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

(3) Remove finish according to 707 Maintenance Manual 51-2-21, **Paint** Stripping - Cleaning and Painting.

B. Checking for Skin Cracks

WARNING: ARC OR SPARK PRODUCING EQUIPMENT USED IN AN AREA WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS MUST BE IN AN EXPLOSIONPROOF ENCLOSURE. PERSONNEL INJURY MAY OCCUR.

CAUTION: DO NOT USE DYE PENETRANT INSPECTION AS THIS WILL PERMANENTLY CONTAMINATE BONDING SURFACES. USE EDDY CURRENT TEST ACCORDING TO D6-48023, NONDESTRUCTIVE TESTING MANUAL, PART 6.

(1) Check for skin cracks using the eddy current test.

C. Removal of Damage

WARNING: EXPLOSIONPROOF EQUIPMENT MUST BE USED WHERE THE POSSIBILITY OF VAPOR IGNITION EXISTS. PERSONNEL INJURY MAY OCCUR.

(1) Trim out damaged skin to a smooth outline including the delaminated areas. Make all cutouts with not less than 0.50-inch radius.

NOTE: An explosionproof air-powered router is recommended for cutting out damaged skins and honeycomb core (Fig. 9). The hole saw shown in Fig. 12 is used for cutting 1.00, 2.00 and 3.00 inch diameter holes.

CAUTION: USE EXTREME CARE TO AVOID CUTTING INTO THE UNDAMAGED SKIN ON THE OPPOSITE SIDE. TAKE CARE TO PREVENT OVERHEATING THE SKIN AND BOND. DAMAGE TO THE ADHESIVE RESIN SYSTEM WILL OCCUR.

(2) Remove damaged honeycomb core, including areas that have been contaminated by water or other foreign material.

CAUTION: DO NOT ABRADE THROUGH THE ADHESIVE OR DAMAGE ADJACENT CELL WALLS. REDUCTION IN QUALITY OF REPAIR BOND WILL OCCUR.

(3) Abrade the remaining core and original adhesive using a mushroom sander or hook scraper.

(4) Continue to abrade until a uniform, nonglossy surface is obtained.

(5) Remove all burrs, nicks and sharp edges of the skin.

(6) Remove all dust and debris with a vacuum cleaner.

D. Cleaning of Repair Area and Repair Parts

WARNING: WHEN USING SOLVENTS AVOID BREATHING VAPORS. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR APPROVED GLOVES AND PROTECTIVE CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS.

BREATHING VAPORS OR ALLOWING SOLVENT TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION.

(1) Clean repair area.

(a) Clean panel surfaces primed with BMS 5-89.

1) Solvent clean with soft clean cloths moistened with MEK until no trace of foreign materials remain.

(b) Clean panel surfaces nonprimed.

1) Solvent clean with MEK or BMS 11-7.

2) Abrade surfaces with Scotch-Brite, type A pads to remove all contamination.

(c) Clean core faying surface.

1) On surfaces where old core was removed abrade with Scotch-Brite, type A until all the adhesive gloss has been removed.

2) Solvent wipe with MEK until clean and allow to dry.

(d) Protect cleaned surfaces against contamination.

NOTE: Cleaned surfaces may be temporarily protected with type 344 black tape, manufactured by Minnesota Mining and Manufacturing Co., Saint Paul, Minnesota.

(2) Clean repair parts.

CAUTION: PROTECT CLEANED PARTS AND SURFACES FROM CONTAMINATION BY HANDLING PARTS WITH CLEAN, WHITE GLOVES OR SUITABLE HOOKS OR TONGS.

(a) Clean doublers preprimed with BMS 5-89, type 1.

1) Solvent clean according to par. 6.D.

(b) Clean doublers nonprimed.

1) Clean in accordance with 51-9-1, par 3. (Preferred Method)

2) Vapor degrease according to 20-30-03 of the Overhaul Manual, or solvent clean according to par. 6.D. (Alternate Method).

(c) Clean honeycomb core.

1) Vapor degrease the honeycomb core according to 20-30-03 of the Overhaul Manual.

E. Application of Primer to Repair Area and Repair Parts

(1) The preferred method of finish on parts to be bonded is the Phosphoric Acid Non-Tank Anodizing Method, applied in accordance with 51-9-1, par. 3.B. Apply primer to surfaces in accordance with par. 4.B.

WARNING: 1. WHEN APPLYING PRIMER AVOID BREATHING VAPORS. USE MECHANICAL VENTILATION OR RESPIRATORY PROTECTION WHEN WORKING IN A CONFINED SPACE OR AREA. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. WEAR APPROVED GLOVES AND PROTECTIVE CLOTHING. WEAR EYE PROTECTION. KEEP AWAY FROM SOURCES OF HEAT, FIRE, OR SPARKS.

BREATHING VAPORS OR ALLOWING PRIMER TO CONTACT SKIN OR EYES IS HAZARDOUS. HEAT, FIRE OR SPARKS CAN CAUSE AN EXPLOSION.

2. USE EXPLOSIONPROOF HEAT SOURCE FOR ELEVATED TEMPERATURE CURE. PERSONNEL INJURY MAY OCCUR.

CAUTION: PROTECT PARTS AND SURFACES FROM CONTAMINATION. HANDLE CLEANED OR FINISHED PARTS WITH CLEAN, WHITE GLOVES OR WITH SUITABLE HOOKS OR TONGS. ELEVATED TEMPERATURE CURE FOR FINISHES MUST NOT EXCEED 260°F.

NOTE: Tempilstik or Tempilak indicators may be used as described in par. 5.C. for temperature control.

F. Application of Adhesive to Repair Parts

CAUTION: TO PREVENT CONTAMINATION WEAR CLEAN WHITE GLOVES WHEN HANDLING CLEANED PRIMED PARTS. DO NOT TOUCH THE ADHESIVE WITH BARE HANDS OR OTHER PARTS OF THE BODY. DO NOT FOLD, STRETCH OR OTHERWISE THIN THE ADHESIVE FILM.

BONDING OF THE REPAIRED ASSEMBLY MUST BE COMPLETED WITHIN 48 HOURS AFTER THE ADHESIVE HAS BEEN REMOVED FROM REFRIGERATED STORAGE. QUALITY OF THE ADHESIVE WILL BE REDUCED AFTER THIS TIME LIMIT.

(1) Once every eight hours vapor degrease or thoroughly clean table tops, templates, and tools used with film adhesive. Use BMS 11-7 solvent for solvent cleaning, and **wipe dry with clean, dry** lint-free cheesecloth or gauze before solvent evaporates.

(2) Apply adhesive film BMS 5-101, type 2, grade 10 or 15 to the doubler as follows:

(a) Before opening wrapper, condition refrigerated adhesives to room temperature until moisture no longer condenses on the wrapper.

(b) During use, suspend the film roll of adhesive horizontal through its axis free from other rolls or objects.

(c) Trim the adhesive to match the repair doubler. Allow adhesive to extend 0.03 to 0.125 inch beyond periphery of doubler. When more than one piece of ahesive film is required, splice the pieces with no gap or overlap to a maximum of 0.50 inch.

(d) Apply the adhesive to bond faying surface of doubler. Leave separator sheet on the outside surface for protection prior to assembly.

(e) Press the adhesive film smoothly and firmly in place, using care not to entrap any air.

(3) Apply liquid adhesive BMS 5-51 type 3, to exposed edge of honeycomb core in square edge panel assemblies as follows:

(a) Vapor degrease the repair core in accordance with par. 6.D.(2)(c).

(b) Apply four-coat adhesive 3 to 6 cells from the perimeter of the exposed core.

(c) As soon as possible after applying pour-coat (not to exceed 3 minutes), allow the excess adhesive to drain onto a clean, absorbent, oil-free paper. After excess adhesive has drained place core on a second piece of clean, absorbent, oil-free paper.

(d) Air dry the core at ambient temperature with the cell walls horizontal for a minimum of 30 $\pm$5 minutes.

(e) Invert the core and repeat the pour-coating operation and procedures of (b), (c) and (d).

(f) After air drying, oven dry BMS 5-51, type 3 at 180 ±10°F for 30 ±5 minutes before assembly.

(g) Protect against contamination until assembly.

(4) Apply foaming adhesive BMS 5-90, type 2, class 250, grade 50 to the honeycomb core in accordance with par. 6.F.(2) and the following:

(a) Trim the adhesive to achieve a butt fit or 0.125-inch overlap. Maximum adhesive thickness is 0.20 inch.

(b) Apply the adhesive around the honeycomb core. Leave separator sheet on the outside surface for protection prior to assembly.

(c) Press the adhesive smoothly and firmly in place, using care not to entrap any air.

G. Pressure Application During Adhesive Cure

CAUTION: THE TEMPERATURES USED TO CURE THE ADHESIVES USED FOR THIS REPAIR COULD INITIATE DELAMINATION OF THE SURROUNDING AREA. TO PREVENT THIS, APPLY 3- TO 5-PSI PRESSURE AROUND THE REPAIR AREA BY SHOT BAGS OR SIMILAR MEANS.

(1) Vacuum pressure only.

(a) A vacuum bag must be sealed over the repair area (Fig. 28 and 29). Vacuum bags must be placed on both sides of the panel opposite each other.

NOTE: Because the vacuum bag method exerts only a limited amount of pressure (10-12 psi), and because 35-psi nominal is needed to adequately bond critical sections, it is restricted to the following: flat panels with less than 0.10-inch deviation in 12 inches, no compound curvatures, no local flatness irregularities (the 0.10-inch deviation should be a single rise or depression in one direction only on the panel surface) and damage size of less than 2.0 inches diameter in nondoubler areas.

(2) Pressure application devices.

(a) Pressure may be applied by using clamps, weights, sand bags or hydraulic jacks.

(b) Contoured panels require cast ceramic, plaster or plastic tools on the outer skin surface. See Fig. 29 for typical method of applying pressure to a curved panel.

NOTE: Vacuum bags may be used in conjunction with other pressure devices in order to assist in holding the heater blankets during bonding.

H. Curing of Repair

(1) Locate thermocouples as follows and as shown in Fig. 28 and 29.

(a) Four thermocouples near the exterior doubler edge.

(b) Four thermocouples on the interior doubler edge.

(c) One thermocouple on each skin surface that will be heated and pressurized.

(d) One thermocouple on each nonpressured heated skin.

(2) Apply pressure.

(a) Refer to par. 6.G.(1) for vacuum pressure only repair.

(b) For repair other than vacuum pressure only, apply 35 ±5 psi using application devices described in par. 6.G.(2).

(3) Hold vacuum differential between 20-inch mercury minimum and 24-inch mercury maximum.

CAUTION: TO PREVENT DELAMINATION, DO NOT HEAT NONPRESSURIZED AREAS OVER 200°F.

(4) Apply heat by blankets, heat lamps or heated air. Control the cure temperature by thermocouples installed as described in par. 6.H.(1).

(5) Cure at 225 to 250°F for 120 ±5 minutes. The rate of temperature rise must not exceed 5°F per minute.

(6) Heating equipment.

(a) Heating blankets must have 5 watts per square inch minimum capability and be no larger than the repair area (Fig. 28 and 29). For source of heat and vacuum units, refer to Fig. 2.

(b) Hot air and heat lamps may be used to supplement the blankets or individually to heat the bond line.

(7) Temperature control.

(a) The temperature in and around the bond area must be monitored and controlled. The unit must be capable of reading up to 300°F with an accuracy of plus or minus 5.0°F. Use 30-gage (0.0113 dia) thermocouple wires.

I. Sealing and Finishing After Repair

(1) Seal exposed vent holes, the edge of the inner skin doubler, external repair edges and exposed core splice foam with BMS 5-79 or BMS 5-95 in accordance with 51-9-1, Fig. 2.

(2) Protect sealant against hydraulic fluid contamination and complete finish in accordance with 51-00-00 of the 707 Maintenance Manual.

J. Dent Repair with External Doubler (Fig. 31)

NOTE: This repair is suitable for dents not exceeding twice the skin gage in depth and not exceeding three times the panel thickness in length or width.

(1) Preliminary clean damaged area according to par. 6.*.

(2) Check for skin cracks according to par. 6.B.

NOTE: If cracks are found, do not use this repair. Cut out dent and cracks and repair as described in par. 6.K.

(3) Fill dent with BMS 5-28, type 6.

(a) Dents within the allowable damage limits contained in the appropriate chapter of the manual may be filled to restore the component to contour, unless prohibited in the applicable allowable damage information.

(b) Potting compound BMS 5-28, Type 6 is used for filling dents.

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

(c) Apply the filling compound as follows:

1) Remove the paint from the dented area and a minimum of 1/2 inch all around.

2) Smooth out any allowable scratches, nicks or surface blemishes with aluminum wool.

3) Alodize the exposed area of skin in accordance with 51-8-0.

4) Apply filler with a spatula or trowel. Build the filler material slightly above the required contour and fair it out over the surrounding alodized area. Where necessary a plastic sheet (polyethylene or equivalent) can be secured with masking tape over the filled area to provide support during the curing period.

5) Allow the filler to cure. Curing time is 24 hours at 80 ±5°F or 5 hours at 125 ±5°F.

6) Sand the cured filler to correct contour.

CAUTION: DO NOT ALLOW ANY OF THE CLEANING SOLUTIONS TO COME IN CONTACT WITH THE POTTING COMPOUND.

(4) Clean area surrounding potting compound in dent according to par. 6.D.(1).

(5) Apply finish to the repair area according to par. 6.E.(1).

(6) Make doublers of size, thickness and material shown in Fig. 26.

(7) Remove all nicks, scratches, burrs, sharp edges and corners.

(8) Check for flushness of the cured adhesive in the potted dent.

(9) Locate doublers and check for fit and clearances.

(10) Clean doublers preprimed according to par. 6.D.(2)(a).

(11) Clean doublers nonprimed, according to par. 6.D.(2)(b).

(12) Apply adhesive primer to nonprimed doublers according to par. 6.E.(2).

(13) Apply adhesive film to doubler according to par. 6.F.(2).

(14) Hold the doublers in place with polyester tape to prevent slippage during cure.

(15) Apply polyester tape around the periphy of the doublers to prevent the adhesive film from creating excessive flash (Fig. 27).

(16) For pressure application and cure of bond, refer to par. 6.G. and 6.H.

(17) Seal and finish repair according to par. 6.I.

K. Skin and Core Repair (Fig. 30, 32, 33 and 36)

(1) Preliminary clean damaged area according to par. 6.A.

(2) Check for skin cracks according to par. 6.B.

(3) Remove damage according to par. 6.C.

(4) Make the repair core from BMS 4-4, using same size and density as original, and with honeycomb cells aligned in the same direction.

(5) Make the doublers of size, material and thickness as indicated in Fig. 26.

(6) Remove all nicks, scratches, burrs, sharp edges and corners.

(7) Prefit the doublers and core to determine the number and location of each layer of adhesive film for the bond lines. Use only light finger pressure to seat the parts and check for fits and clearances.

NOTE: A total of two layers of adhesive film may be used in areas where excessive mismatch of parts cannot be compensated for in any other manner.

(8) Clean repair area according to par. 6.D.(1).

(9) Apply finish to the repair area according to par. 6.E.(1).

(10) Clean doublers preprimed according to par. 6.D.(2)(a).

(11) Clean doublers nonprimed according to par. 6.D.(2)(b).

(12) Apply adhesive primer to nonprimed doublers according to par. 6.E.(2).

(13) Clean the core according to 6.D.(2)(c).

(14) Apply liquid adhesive to the exposed core edge of square edge panels only in accordance with par. 6.F.(4).

(15) Apply adhesive film to the doublers in accordance with par. 6.F.(2).

(16) Apply foaming adhesive to the repair core in accordance with par. 6.F.(3).

(17) Install repair parts.

(18) Hold doublers in place with polyester tape to prevent slipping during cure (Fig. 27).

(19) Apply polyester tape around the edges as shown in Fig. 27 to prevent the adhesive film from creating excessive flash.

(20) For pressure application and cure of bond, refer to par. 6.G. and 6.H.

(21) Seal and finish repair according to par. 6.I.

L. Repair of Square Edge Panels (Fig. 34, 35)

(1) Preliminary clean damaged area according to par. 6.A.

(2) Check for skin cracks according to par. 6.B.

(3) Remove damaged skin, doublers, and delaminated areas according to par. 6.C.

(4) Make doublers from same material and thickness as that of existing skin and doublers, except as noted in Fig. 35.

(5) Locate the repair doublers and check for fit and clearances.

(6) Clean the repair area in accordance with par. 6.D.(1).

(7) Apply finish to the repair area according to par. 6.E.(1).

(8) Clean doublers preprimed according to par. 6.D.(2)(a).

(9) Clean doublers nonprimed according to par. 6.D.(2)(b).

(10) Apply adhesive primer to nonprimed doublers according to par. 6.E.(2).

(11) Apply adhesive film to repair doublers in accordance with par. 6.F.(2).

NOTE: In repair shown in Fig. 35 apply adhesive BMS 5-101, type 2, grade 10 or 15.

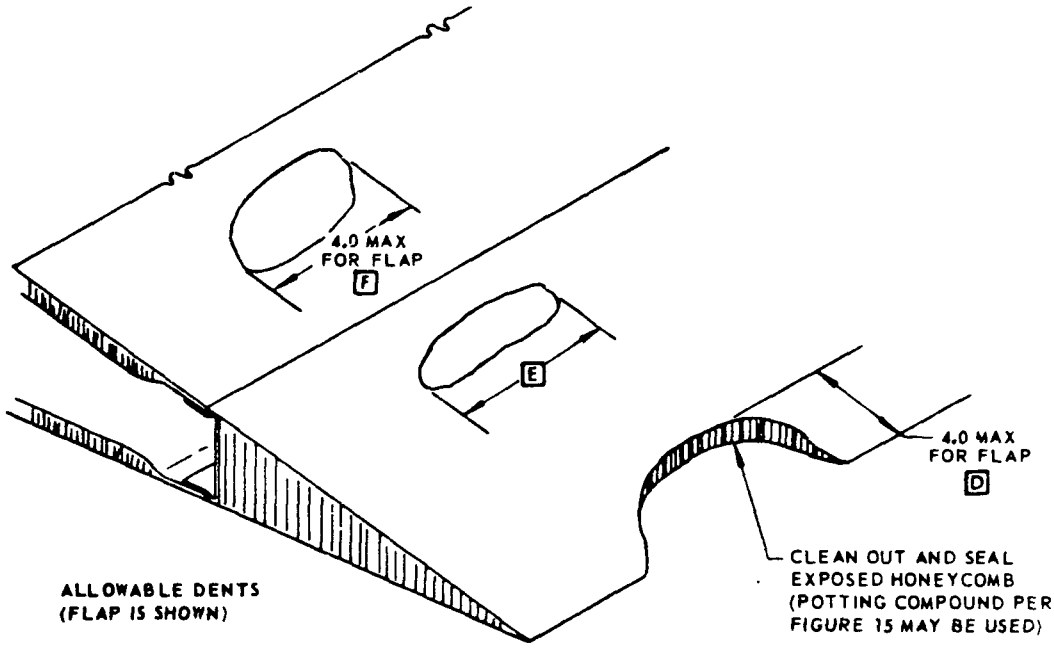
(12) Install repair parts.

(13) Hold the doublers in place with polyester tape to prevent slippage during cure (Fig. 27).

(14) Apply polyester tape around the periphery of the doublers to prevent the adhesive film from creating excessive flash (Fig. 27).

(15) For pressure application and cure of bond, refer to par. 6.G. and 6.H.

(16) Seal and finish repair according to par. 6.I.



NOTE

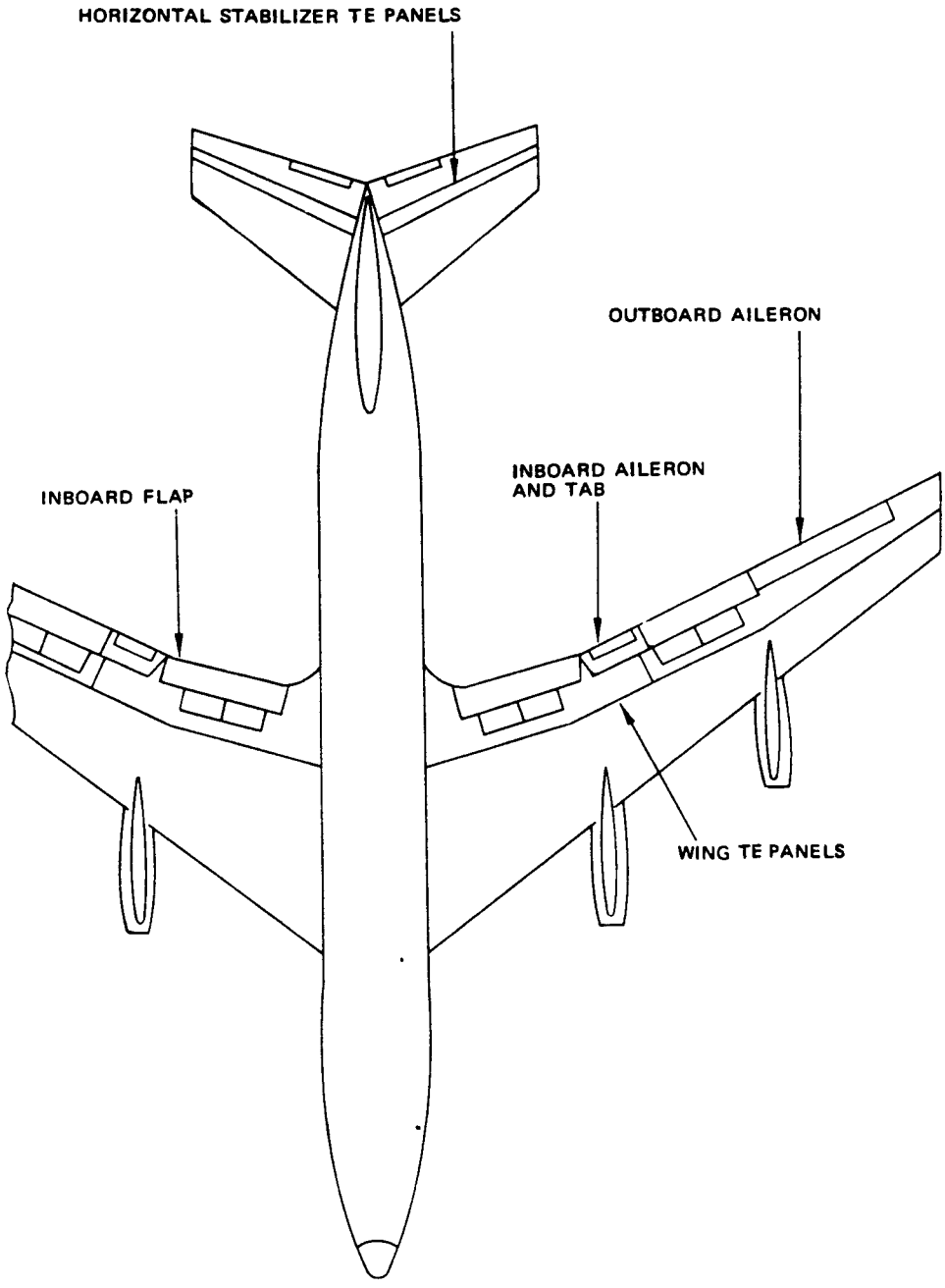
[A] THE AIRPLANE MAY BE FLOWN WITHOUT IMMEDIATE REPAIR OF DAMAGE THAT DOES NOT EXCEED THE LIMITS SHOWN IN THE TABLE. ADDITIONAL DAMAGE BEYOND THESE LIMITS CAN BE ALLOWED IN ALL AREAS EXCEPT CONTROL TABS WITHOUT AFFECTING FLIGHT SAFETY BUT DAMAGE MAY PROPAGATE TO A POINT WHERE THE STRUCTURE IS DESTROYED OR REQUIRES EXTENSIVE REPAIR. EXERCISE GOOD JUDGMENT DURING DAMAGE EVALUATION AND REPAIR TO INSURE SAFETY, MAXIMUM SERVICE LIFE AND MINIMUM MAINTENANCE COST.

[B] PROTECT UNREPAIRED ALLOWABLE DAMAGE FROM ENTRANCE OF WATER AND OTHER FOREIGN MATTER INTO THE HONEYCOMB CORE BY SEALING THE DAMAGE AREA. CHROME-COLORED PLASTIC ADHESIVE TAPE #630 SCOTCHCAL THAT CAN BE USED, FOR WEATHERPROOFING IS LISTED IN FIGURE 2.

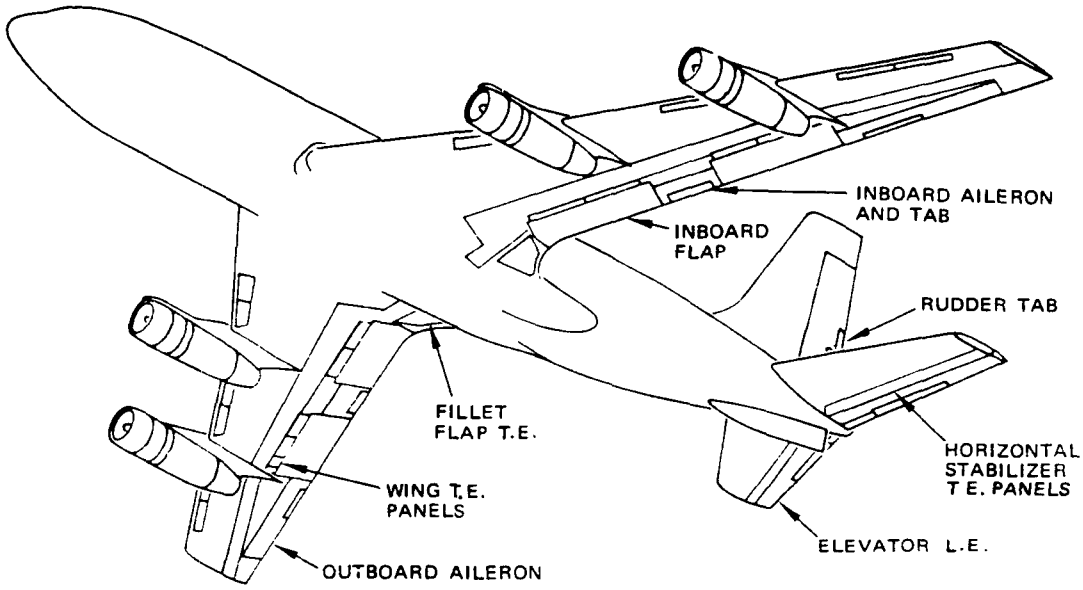
KEEP A RECORD OF THE LOCATION OF UNREPAIRED ALLOWABLE DAMAGE AND REPAIR IT AT THE EARLIEST POSSIBLE TIME.

[C] HONEYCOMB FLOOR PANELS MAY BE REPAIRED ACCORDING TO FIGURES 3, 4 AND 5.

[D][E][F] SEE ILLUSTRATION AND TABLE.



UPPER SURFACES



LOWER SURFACES

TYPE OF DAMAGE	ALLOWABLE DAMAGE WITHOUT REPAIR [A]		REPAIR INDEX [A][C]
	ALL HONEYCOMB PANELS (EXCEPT TABS, AILERON BALANCE PANELS) AND FLOOR PANELS	TABS AND AILERON BALANCE PANELS	
	CAUTION MONITOR ALLOWABLE DAMAGE FREQUENTLY FOR EVIDENCE OF PROPAGATION.	CAUTION NO DAMAGE ALLOWED IN FOAMED-IN FITTING AREA. UNREPAIRED DAMAGE EXCEEDING THE LIMITS SHOWN BELOW MAY AFFECT FLIGHT SAFETY. INSPECT FREQUENTLY TO INSURE THAT ALLOWABLE LIMITS ARE NOT EXCEEDED.	
DENTS IN EXTREME TRAILING EDGE OF TAPERED PANELS [B][D]	2 INCH DEEP DENT IN MOVABLE CONTROL SURFACES, 4 INCH DEEP DENT IN FIXED TRAILING EDGES AND FLAPS.	0.25 INCH DEEP DENT	SEE FIGURE 6; FIGURE 21 AT STATIC DISCHARGERS
DENTS IN SIDES OF TAPERED TRAILING EDGE PANELS [E]	DENTS LESS THAN 4 INCHES IN DIAMETER ARE ALLOWABLE IN MOVABLE CONTROL SURFACES, EXCEPT THE TABS, AND DENTS OF ANY SIZE ARE ALLOWABLE IN FIXED TRAILING EDGES AND FLAPS PROVIDED THEY ARE NOT ACCOMPANIED BY DELAMINATION, CUTS OR CRACKS.	DENTS LESS THAN 2 INCHES IN DIAMETER, PROVIDED THEY ARE NOT ACCOMPANIED BY DELAMINATION, CUTS OR CRACKS	SEE PUNCTURE DAMAGE
OTHER DENTS [F]	DENTS LESS THAN 4 INCHES IN DIAMETER PROVIDED THEY ARE NOT ACCOMPANIED BY A SKIN DELAMINATION, SKIN PERFORATION, OR SKIN CRACK.	DENTS LESS THAN 2 INCHES IN DIAMETER PROVIDED THEY ARE NOT ACCOMPANIED BY A SKIN DELAMINATION, SKIN PERFORATION, OR SKIN CRACK.	SEE PUNCTURE DAMAGE
SCRATCHES	SCRATCHES ARE ALLOWABLE IF NO CRACKS ARE PRESENT.	SCRATCHES ARE ALLOWABLE IF NO CRACKS ARE PRESENT	ALODIZE SCRATCHES DEEPER THAN CLADDING PER 51-8-1
CRACKS [B]	CRACK THAT CAN BE ENCOMPASSED WITHIN A CIRCLE OF 4 INCH DIAMETER PROVIDED THAT ITS EXTREMITIES ARE STOP DRILLED WITH 0.25 INCH DRILL AND THE CRACK IS SEALED FROM MOISTURE WITH WEATHERPROOF ADHESIVE TAPE.	CRACKS AND PUNCTURES ARE NOT ALLOWABLE WITHOUT REPAIR ON HONEYCOMB TABS AND AILERON BALANCE PANELS.	SEE FIGURE 3
PUNCTURES [B]	DAMAGE THAT CAN BE ENCOMPASSED WITHIN A CIRCLE OF 4 INCH DIAMETER, PROVIDED THAT THE DAMAGE IS TRIMMED TO A SMOOTH OUTLINE AND IS KEPT SEALED FROM MOISTURE.		SEE FIGURE 4, 5 AND 20.
DELAMINATIONS EDGE	REPAIR REQUIRED	REPAIR REQUIRED.	SEE FIGURE 7, 8, 16, 19, 22 AND 23
DELAMINATIONS PANEL	35 SQ IN. PROVIDED THERE ARE NO CRACKS OR DEEP SCRATCHES.	REPAIR REQUIRED	
CORRODED SKIN AND SPAR		TAB REPAIR REQUIRED	SEE 51-10-3 FIG. 3
CORRODED OR WORN CONTINUOUS HINGE		HINGE REPAIR REQUIRED	SEE 51-10-4 FIGURE 1

ITEM		USED ON 51-9-1	USED ON 51-9-2	USED ON 51-10-1	USED ON 51-11-1	IDENTIFICATION	SUPPLIER
ADHESIVE COMPONENTS	RESINS	X X	X X	X X	X X	VERSAMID 115 VERSAMID 125	GENERAL MILLS CORP. 9200 WAYZATA MINNEAPOLIS, MINNESOTA 55440
		X X	X C X	X C X X	X C X X	EPON 812 EPON 562 EPON 815 EPON 828	SHELL CHEMICAL CORP 50 W 50TH ST. NEW YORK, NEW YORK 10020
					X X X	EPOCAST 1835 EPOCAST 156 EPOCAST 1511	FURANE PLASTICS INC., 5121 SAN FERNANDO RD. W. LOS ANGELES, CALIFORNIA 90039
	CATALYSTS			X C	X C	CURING AGENT "T" CURING AGENT "U"	SHELL CHEMICAL CORP. 50 W 50TH ST. NEW YORK, NEW YORK 10020
					X X X X	EPOCAST 956 (941) EPOCAST 9816 EPOCAST 946 EPOCAST 9614	FURANE PLASTICS INC., 5121 SAN FERNANDO RD. W. LOS ANGELES, CALIF. 90039
	FILLER			X	X	PHENOLIC SPHERE (MICROBALLOONS) BJO-0930	BAKELITE CO., DIV UNION CARBIDE CORP. NEW YORK, NEW YORK 10017
	ADHESIVE	X X			X	EC-1403 EC2216 B/A PART A ACCELERATOR (GRAY) PART B BASE (WHITE)	MINNESOTA MINING AND MANUFACTURING CO., 3M CENTER STREET ST. PAUL, MINNESOTA 55101
				X X X		BMS 5-51 TYPE 3: EC-3903 BMS 5-90 TYPE 2: CLASS 250-2-5 THERMOFOAM 3050 AF-3015 CLASS 250-10-10 FM-41	MINNESOTA MINING AND MANUFACTURING CO., 3M CENTER STREET ST. PAUL, MINNESOTA 55101 AMCHEM PRODUCTS INCORPORATED SPRING GARDEN STREET AMBLER, PENNSYLVANIA 19002 MINNESOTA MINING AND MFG. CO. 3M CENTER STREET ST. PAUL, MINNESOTA 55101 OR MINNESOTA MINING AND MFG. CO. FRANCE 135 BD. SERURIER 75940 PARIS, CEDEX 19 FRANCE AMERICAN CYANAMID CO. INDUSTRAL CHEMICALS AND PLASTIC DIV., BLOOMINGDALE DEPT. OLD POST ROAD HAVRE DE GRACE, MARYLAND 21078

ITEM		USED ON A				IDENTIFICATION	SUPPLIER
		51-9-1	51-9-2	51-10-1	51-11-1		
ADHESIVE COMPONENTS (CONT)			X		X	BMS 5-126	HYSOL DIVISION THE DEXTER CORPORATION FRANKLIN STREET OLEAN, NEW YORK 14760 AMERICAN MINERAL SPIRITS CO. 2100 E. 37TH STREET WICHITA, KANSAS 67208 TECHNICAL RESEARCH COMPANY 13535 MONSTER ROAD S. SEATTLE, WASHINGTON 98178 FULLER O'BRIEN CORP. 450 E. GRAND AVENUE SOUTH SAN FRANCISCO CALIF. 94000 TRA-CON 56 NORTH STREET MEDFORD, MASSACHUSETTS 02155 M&T CHEMICALS, INC. FUNCTIONAL PLASTICS DIVISION 5121 SAN FERNANDO ROAD W. LOS ANGELES, CALIF. 90039
ADHESIVE COMPONENTS IN TWO COMPARTMENT PLASTIC BAG	ADHESIVE FOR FIBERGLASS PATCHES (SEE FIGURE 14)	X	X	X		3147-N2X 80055-30 OR -31	WHITTAKER CORP RESEARCH AND DEV., NARMCO MATERIALS DIV. 600 VICTORIA ST. COSTA MESA, CALIFORNIA 92627
	POTTING COMPOUND 1 (SEE FIGURE 15)			X	X	80055-44 OR -45	FENWAL INCORPORATED 400 MAIN STREET ASHLAND, MASSACHUSETTS 01721
ADHESIVE PRIMER PRIMER-BONDING-BMS 10-79 (ROOM TEMPERATURE CURING FLUID AND CORROSION RESISTANT)		X X	X	X		EC-776SR (EC1309) 513-707 PRIMER BASE 910-787 CURING SOLUTION 020-702 SOLVENT REDUCER	MINNESOTA MINING & MFG. CO. 3M CENTER STREET ST. PAUL, MINNESOTA 55101 DE SOTO INC. CHEMICAL COATINGS DIV. 4TH & CEDAR STREETS BERKELEY, CALIF. 94710
CORROSION INHIBITING ADHESIVE PRIMER BMS 5-89		X				BR-127 EC-3950	AMERICAN CYANAMID CO. BLOOMINGDALE DEPT. HAVRE DE GRACE, MARYLAND 21078
HONEYCOMB CORE FIBERGLASS				X C	X	HRP-3/16 -5.5 HRP-3/16 -4.0 HRP-3/16 -4.5 HRP-3/16 -6.0 HRP-3/16 -8.0	HEXCEL CORP. VALLEY INDUSTRIAL PARK CASA GRANDE, ARIZONA 85222 HEXCEL CORP. 338 NO. PENN GRAHAM TEXAS 76046
					X	HRP-3/16 -12.0	HEXCEL CORP. 338 NO. PENN GRAHAM, TEXAS 76046

Repair Material and Equipment
Figure 2 (Sheet 2)

ITEM		USED ON [A] 51-9-1	51-9-2	51-10-1	51-11-1	IDENTIFICATION	SUPPLIER
PARTING FILMS PVA (POLYVINYL ALCOHOL) PE (POLYETHYLENE) PVC (POLYVINYL CHLORIDE)		X [C] [C]	X [C] [C]	X [C] [C]	X [C] [C]	0.002 OR 0.003 THICK 0.004 THICK 0.010 TO 0.020 THICK	REYNOLDS METALS CO. 2819 FIRST AVE. SEATTLE, WASHINGTON 98121
CLOTH FIBERGLASS	WET LAYUP PROCESS	X X X [C]	X X X [C]	X X X [C]	X X X [C]	STYLE 1528 (128) STYLE 1581 (181) STYLE 7781 (181) STYLE 1582 (182) WITH VOLAN A FINISH	UNITED MERCHANTS AND MANUFACTURERS, INC. 1407 BROADWAY NEW YORK, N.Y. 10018 J.P. STEVENS CO., INC. BROADWAY AT 41ST NEW YORK, N.Y. 10036 CLARK-SCHWEBEL INTERNATIONAL S.A. BATTICE, BELGIUM BAY MILLS LTD 365 EVANS AVE TORONTO, ONTARIO CANADA MBZ TK2 HEXCEL CORP. 11711 DUBLIN BLVD. DUBLIN, CALIFORNIA 94566 BURLINGTON INDUSTRIAL FABRICS, CO. DIV OF BURLINGTON INDUSTRIES 1345 AVENUE OF THE AMERICAS NEW YORK, NEW YORK 10019
	EPOXY PREPREG PROCESS				X	MXB7701-120-Z-6040 (E715-120-CS272)	FIBERITE WEST COAST CORP. 645 No. CYPRESS ST. P.O. BOX 738 ORANGE, CALIFORNIA 92669
					X	MXB7701-1581-Z-6040 (E715-181-CS272)	
					X	MXB7701-1582-Z-6040 (E715-182-CS272)	
					X	MXB7701-1584-Z-6040 (E715-184-CS272)	
					X	MXB7701-75811-Z-6040 (E715-7581-CS272)	
					X	NARMCO 3203-1581 VOLAN A (551-181 VOLAN A)	WHITTAKER CORP. NARMCO MATERIALS DIV. 1440 N. KRAMER ANAHEIM, CALIF. 92806
					X	3203-1584 VOLAN A (551-184 VOLAN A)	WHITTAKER CORP. NARMCO MATERIALS DIV 600 VICTORIA STREET COSTA MESA, CALIF. 92626
					X	3203-7581 VOLAN A (551-7581 VOLAN A)	

Repair Material and Equipment
Figure 2 (Sheet 3)

ITEM		USED ON [A] 51-8-1	51-9-2	51-10-1	51-11-1	IDENTIFICATION	SUPPLIER
TAPES	WEATHERPROOFING TAPE			X [C]	X	NO 850 SCOTCHCAL NO. 630 SCOTCHCAL SSE 133 SCOTCHCAL	MINNESOTA MINING & MFG. CO. 3M CENTER ST. ST. PAUL, MINNESOTA 55101
	DOUBLE BACKED CLOTH TAPE	X	X	X			
	MASKING TAPE	X	X	X	X		
MATERIALS FOR SURFACE PREPARATION							
ALODIZING SOLUTION		X				ALODINE 1200	ARCHEM PRODUCTS, INC. AMBLER, PENN., 19002
PHOSPHORIC ACID		X				FED SPEC O-O-670 75 PERCENT	ANY SOURCE
PHOSPHORIC ACID GELLED		X				PR 50 10-15% BY WEIGHT	PRODUCT RESEARCH AND CHEMICAL CORP. 5454 SAN FERNANDO RD. GLENDALE, CALIFORNIA 91203
CAB-O-SIL		X					CABOT CORP. 125 HIGH ST. BOSTON, MASS 02110
PAINT STRIPPERS		X	X	X		E-Z STRIP 19-A	DELCO PRODUCTS, INC. LOS ANGELES, CALIFORNIA
		[C]	[C]	[C]		KELITE L-49	RICHARDSON CHEMICAL CO., ALLIED-KELITE PRODUCTS DIV. 1250 N. MAIN ST. LOS ANGELES, CALIFORNIA 90051
CLEANERS	SOLVENT METHYL ETHYL KETONE TOLUOL	X	X	X	X X	MEK	
	METHYL ISOBUTYL KETONE	X				MIBK	
	ABSORBENT: CHEESECLOTH	X	X	X	X	MAXIMUM OIL CONTENT 0.75%	
ABRASIVE CLOTH		X	X	X	X	ALUMINUM OXIDE 400 GRIT OR FINER	ANY SOURCE
STAINLESS STEEL SCREEN		X				# 16 MESH 0.018 DIA. CRS, TYPE 304	PACIFIC WIRE WORKS 2743-13TH S.W. SEATTLE, WA. 98124
POLARIZING FILTER		X					WILCO CO. 5519-6TH AVE SOUTH SEATTLE, WA 98108

Repair Material and Equipment
Figure 2 (Sheet 4)

ITEM		USED ON [A] 51-9-1	51-9-2	51-10-1	51-11-1	IDENTIFICATION	SUPPLIER
SAFETY ITEMS - PERSONNEL	FACE SHIELD OR MASK	X	X	X	X		
	GLOVES - COTTON	X	X	X	X	0.75% MAXIMUM OIL CONTENT	CARDINAL GLOVES NEWARK, N.J. (OR ANY OTHER SOURCE)
	GLOVES - RUBBER	X	X	X	X		
TOOLS	ABRASIVE WHEELS	X				ALUMINUM OXIDE TYPE 3A, TYCRO WHEELS, VERY FINE GRADE	MINNESOTA MINING AND MANUFACTURING CO. 3M CENTER ROAD ST. PAUL, MINNESOTA 55101
	AIR-POWERED ROUTER	X	X	X	X	ACORNAD-1	ROCKWELL MFG. CO. DAYTON DIVISION P.O. BOX 966 DAYTON, OHIO 45401
	ROUTER SUPPORT	X	X	X	X	SPECIAL	SEE FIGURE 10
	ROUTER TEMPLATE	X	X	X	X	SPECIAL	SEE FIGURE 11
	HOLE SAW	[C]	[C]	[C]	[C]	MODIFIED HSS	SEE FIGURE 12
	HOLE SAW GUIDE BUSHING	[C]	[C]	[C]	[C]	1 INCH, 2 INCH, 3 INCH	
	EXPLOSION - PROOF HEAT SOURCE	X	X	X	X		
	PLEXIGLASS SQUEEGEE	X	X	X		2.5 INCH WIDE	SEE FIGURE 13
	RUBBER ROLLER	[C]	[C]	[C]	[C]	2 INCH WIDE, 1 INCH DIA	
	VALVE STEM CUTTER			X	X		SEE FIGURE 24
	BAND SAW			X	X		SEE FIGURE 25
SEALANT MATERIAL		X				BMS 5-79 3C-414B2 ONLY	CHURCHILL CHEMICAL CORP. 3137 E. 26TH ST. LOS ANGELES, CALIF 90023
ABRASIVE PADS		X	X	X	X	ALUMINUM OXIDE SCOTCHBRITE PAD TYPE A, VERY FINE	ANY SOURCE
SEALANT		X				PR1436 CLASS C-2	PRODUCTS RESEARCH & CHEMICAL CORP. 2919 EMPIRE AVE. BURBANK, CALIF 91504
		X				PRO-SEAL 890B½	COAST PRO-SEAL & MFG CO. 19451 SUSANNA RD. COMPTON, CALIF. 90221
		X				DOW CORNING 93-007-1/8	DOW CORNING CORP. SOUTH SAGINAW ROAD MIDLAND, MICHIGAN 48641
		X				EC5922	MINNESOTA MINING & MFG. CO. 3M CENTER ROAD ST. PAUL, MINNESOTA 55101

NOTES

[A] "X" INDICATES SECTION OF THIS MANUAL WHERE ITEM IS USED FOR REPAIR.

[B] DELETED

[C] OPTIONAL TO ITEM LISTED ABOVE.

Repair Material and Equipment
Figure 2 (Sheet 5)

REPAIR INSTRUCTIONS:

NOTE: References to paragraph numbers in these repair instructions apply to the text pages at the beginning of 51-10-1.

1. Stop drill crack with 0.25-inch diameter holes at all extremities and at abrupt changes of direction. If there is skin delamination around the crack, trim out skin as described in par. 3.B.

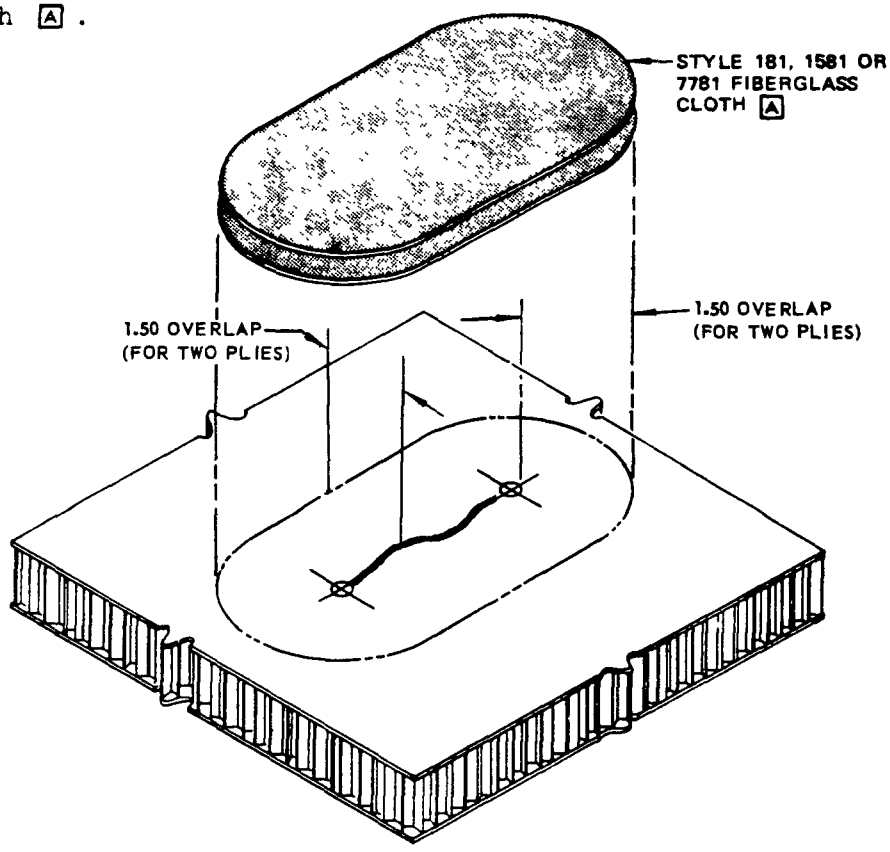
2. Prepare bond area as described in par. 3.

3. Apply overlay patches described in par. 5.

   NOTE: See Fig. 17 for the required number of plies in the patch [A].

4. Apply chemical and solvent resistant finish (BMS 10-11 primer and enamel of the appropriate color) or Scotchcal #630 tape to the patch and surrounding metal. Refer to Maintenance Manual, 51-2-0.

5. If a control surface has been repaired, rebalance it, when necessary (Ref 51-15-0 thru 51-15-13).



Skin Crack Repair - Honeycomb Structure
Figure 3

REPAIR INSTRUCTIONS

CAUTION: FOR HONEYCOMB TABS AND AILERON BALANCE PANELS THE MAXIMUM ALLOWABLE POTTED REPAIR SIZE IS ONE INCH DIAMETER.

NOTE: References to paragraph numbers in these repair instructions apply to the text pages at the beginning of Section 51-10-1.

1. Trim edges of the damaged skin to a smooth outline. Remove only that portion of the core which is damaged. Open up bent honeycomb cells.

2. Prepare skin adjacent to damage for bonding as described in paragraph 3.

3. Fill damage hole with potting compound 1 prepared according to figure 15.

NOTES

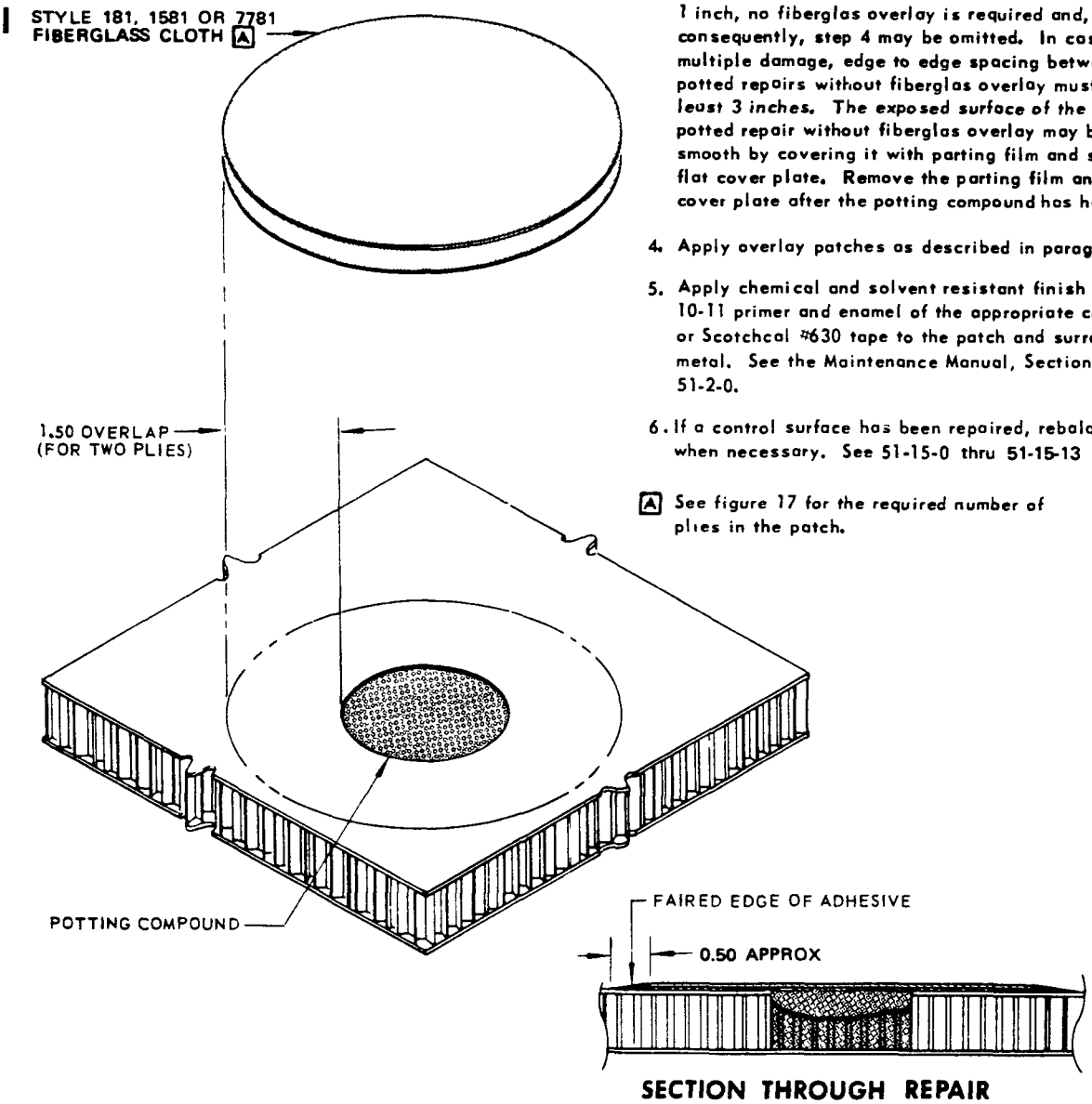
If the diameter of the potted repair does not exceed 1 inch, no fiberglas overlay is required and, consequently, step 4 may be omitted. In case of multiple damage, edge to edge spacing between potted repairs without fiberglas overlay must be at least 3 inches. The exposed surface of the potted repair without fiberglas overlay may be made smooth by covering it with parting film and smooth, flat cover plate. Remove the parting film and cover plate after the potting compound has hardened.

4. Apply overlay patches as described in paragraph 5.

5. Apply chemical and solvent resistant finish (BMS 10-11 primer and enamel of the appropriate color) or Scotchcal #630 tape to the patch and surrounding metal. See the Maintenance Manual, Section 51-2-0.

6. If a control surface has been repaired, rebalance it, when necessary. See 51-15-0 thru 51-15-13

[A] See figure 17 for the required number of plies in the patch.



SECTION THROUGH REPAIR

REPAIR INSTRUCTIONS

NOTE: References to paragraph numbers in these repair instructions apply to the text pages at the beginning of 51-10-1.

1. This repair is applicable when honeycomb core, as well as skin, have been damaged.

2. Determine extent of damage, trim out damage and prepare bond area as described in par. 3.

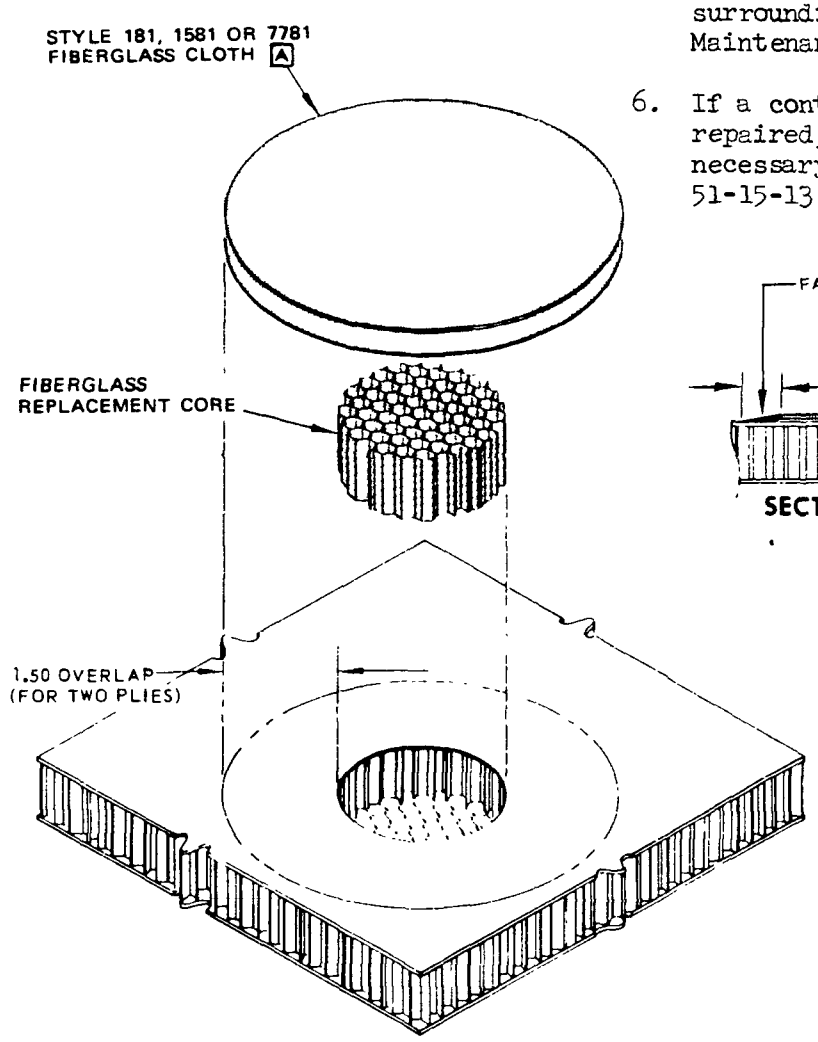
3. Install replacement core of 4.5 or 6.0 lb. fiberglass honeycomb (Fig. 2) as described in par. 4.

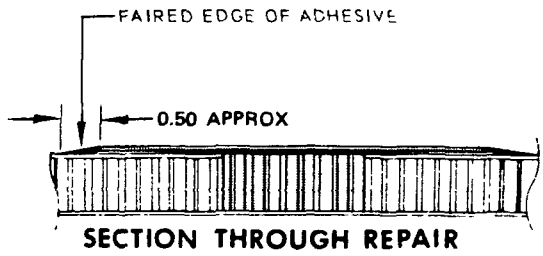
4. Apply overlay patches as described in par. 5.

   NOTE: See Fig. 17 for the required number of plies in the patch [A] .

5. Apply chemical and solvent resistant finish (BMS 10-11 primer and enamel of the appropriate color), or Scotchcal #630 tape to the patch and surrounding metal. Refer to Maintenance Manual, 51-2-0.

6. If a control surface has been repaired, rebalance it, when necessary (Ref 51-15-0 thru 51-15-13).





SECTION THROUGH REPAIR

REPAIR INSTRUCTIONS

References to paragraph numbers in these repair instructions apply to the text pages at the beginning of Section 51-10-1.

1. This repair is applicable when honeycomb core as well as skin of a trailing edge have been damaged.

2. Determine extent of damage, trim out damage and prepare bond area as described in par. 3.

3. If damage cutout extends less than 0.50 inches deep from trailing edge, use a balsa wood replacement core. Otherwise, make a replacement core of 8.0 lb. fiberglass honeycomb (Fig. 2) as shown in the figure, cutting it short by 0.20 to 0.30 inches from the trailing edge.

4. Install the replacement core as described in par. 4.

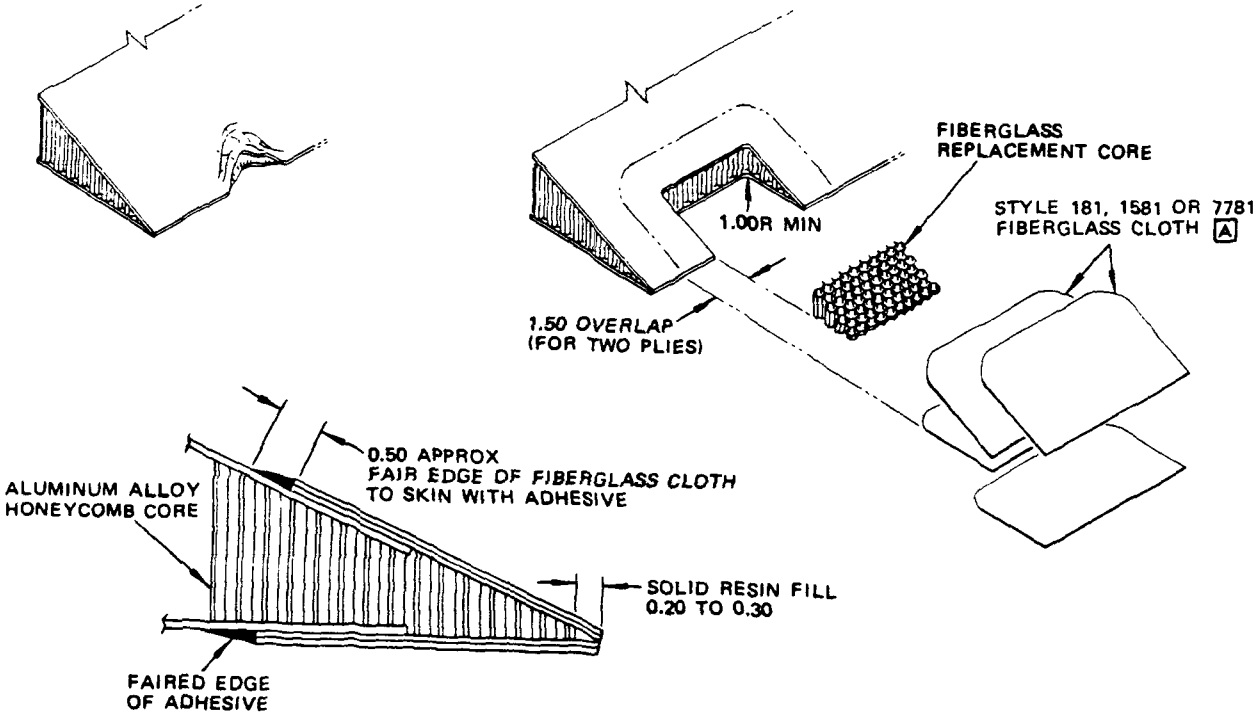
5. Apply overlay patches as described in par. 5.

6. Apply chemical and solvent resistant finish (BMS 10-11 primer and enamel of the appropriate color) or Scotchcal #630 tape to the patch and surrounding metal. See the Maintenance Manual, Chapter 51-2-0.

7. If a control surface has been repaired, rebalance it, when necessary (Ref 51-15).

NOTES

[A] SEE FIG. 17 FOR THE REQUIRED NUMBER OF PLIES IN THE PATCH

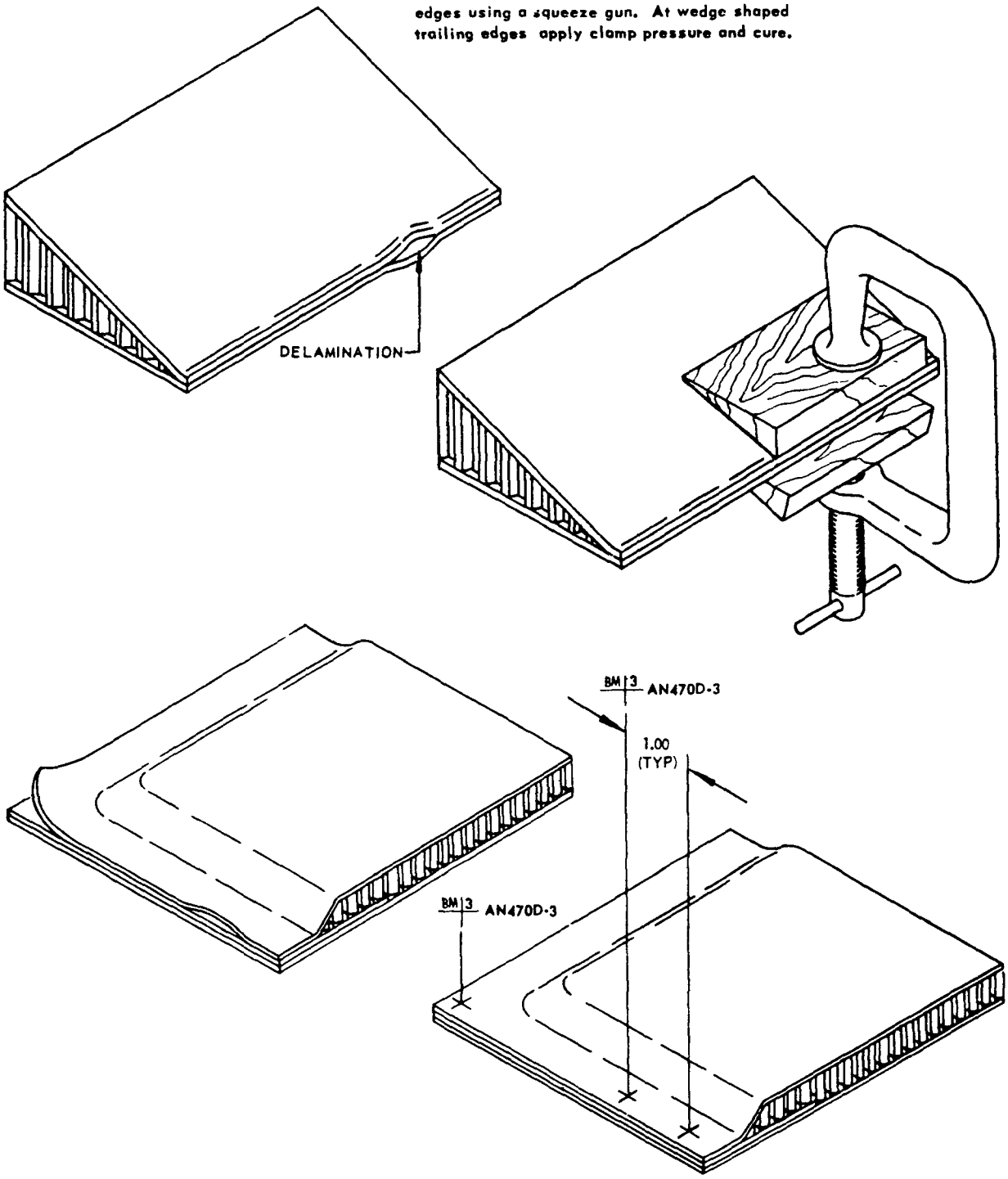


SECTION THROUGH REPAIR

REPAIR INSTRUCTIONS

1. Carefully open delaminated skin without damaging sound bond and inject adhesive prepared per figure 14.

2. Before resin is cured, install rivets at the flat edges using a squeeze gun. At wedge shaped trailing edges apply clamp pressure and cure.



Edge Delamination Repair - Honeycomb Structure
Figure 7

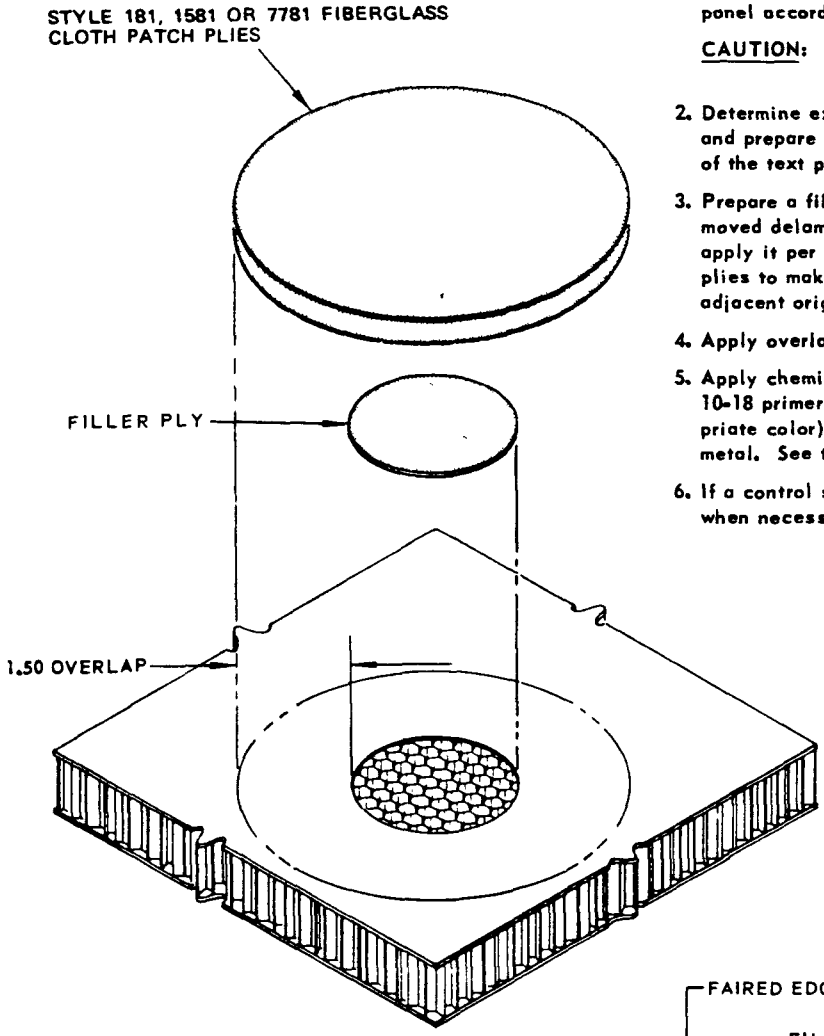
REPAIR INSTRUCTIONS

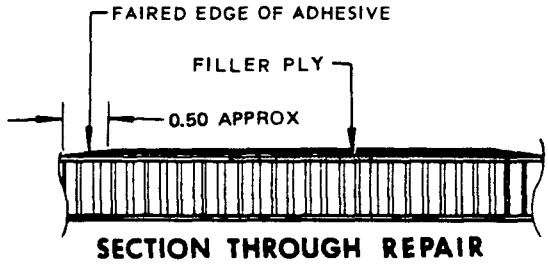
NOTE: References to paragraph numbers in these repair instructions apply to the text pages at the beginning of Section 51-10-1.

1. This repair is applicable to skin delamination from honeycomb core that is confined to the middle portion of honeycomb panels, provided the extent of the delamination can be definitely determined. Repair delamination that extends to an edge of the panel according to figure 19.

   CAUTION: DO NOT USE THIS REPAIR ON TABS AND AILERON BALANCE PANELS.

2. Determine extent of damage, trim out damaged skin and prepare bond area as described in paragraph 3 of the text pages.
3. Prepare a fiberglas cloth filler to replace the removed delaminated metal skin. Impregnate and apply it per paragraph 5. Use one or two filler plies to make the delaminated area level with the adjacent original metal skin.
4. Apply overlay patches as described in paragraph 5.
5. Apply chemical and solvent resistant finish (BMS 10-18 primer and BMS 10-11 enamel of the appropriate color) to the patch and the surrounding bare metal. See the Maintenance Manual, Section 51-2-0.
6. If a control surface has been repaired, rebalance it, when necessary. See 51-15-0 thru 51-15-13





SECTION THROUGH REPAIR

INSTRUCTIONS

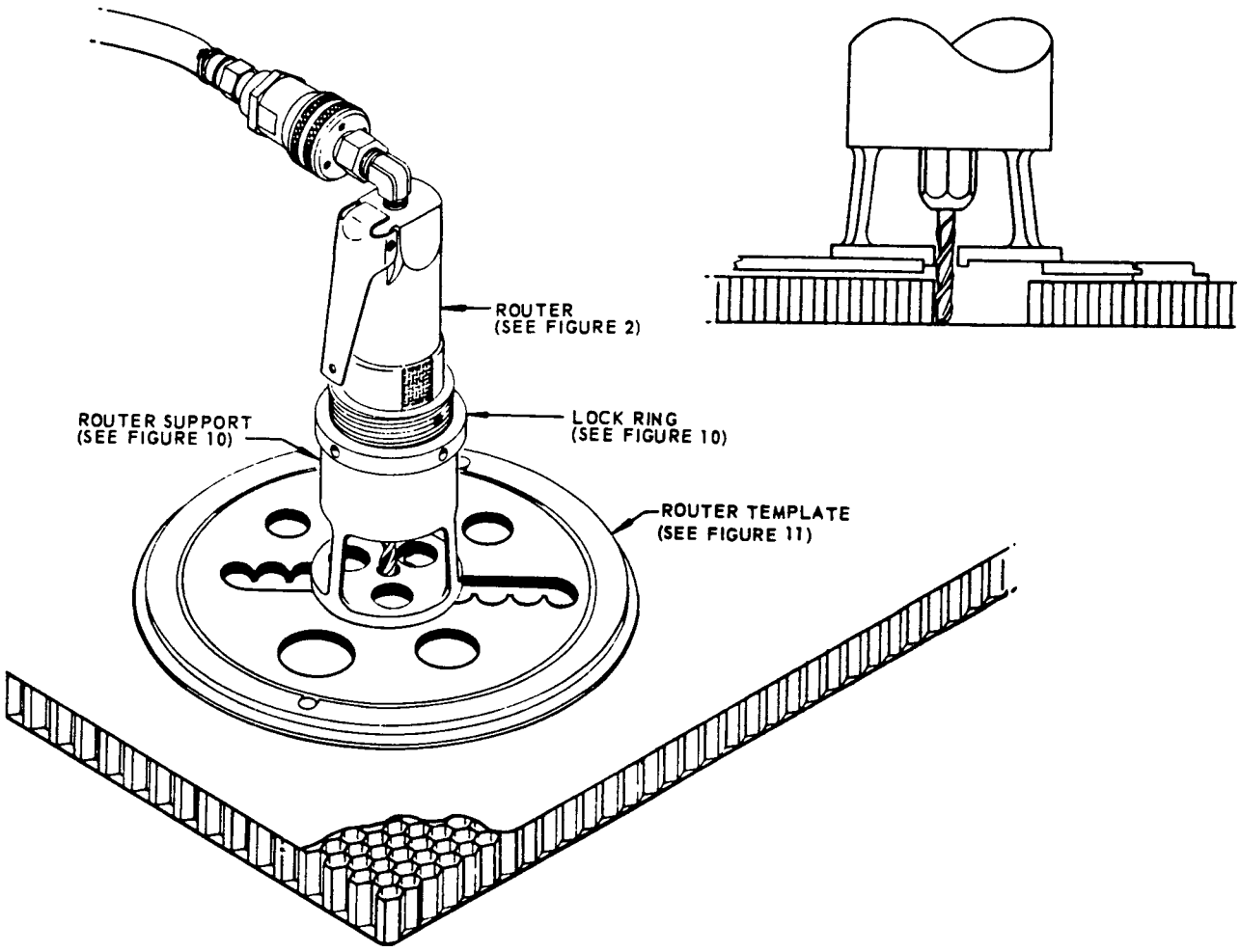
This router assembly is used to remove damaged core and skin in flat honeycomb panels.

The power router must be explosion proof. The suggested ACORNAD–1 router is air-powered.

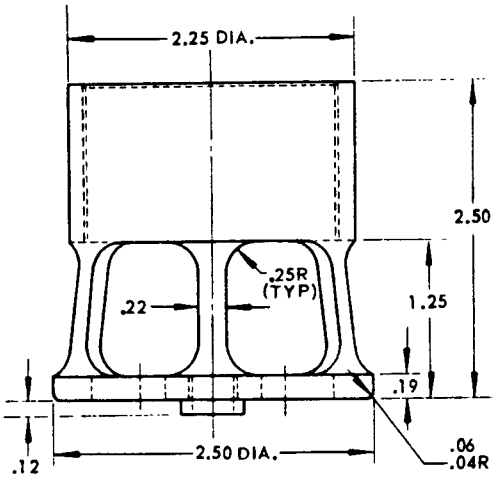
The router is kept perpendicular to the repair surface by a router support which can be adjusted to give the desired depth of cut.

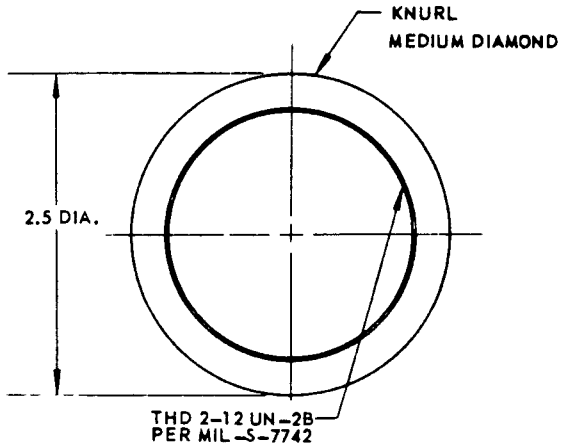
A suitable template has to be used in order to trim the damage to a smooth outline. Plywood templates with rounded holes of the desired size and shape may be made for this purpose. A metal template for cutting circular holes of various sizes is detailed in figure 11, designed for use with a ¼ inch router bit in the power router.

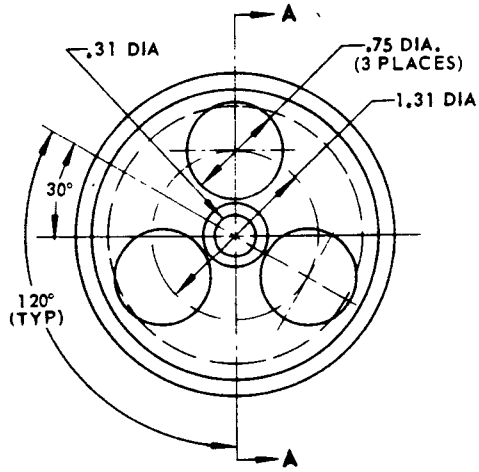
WARNING: USE FACE SHIELD OR GOGGLES WHEN WORKING WITH ROUTER.

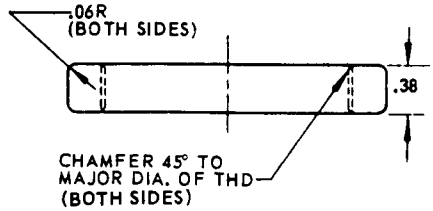


Router and Template
Figure 9

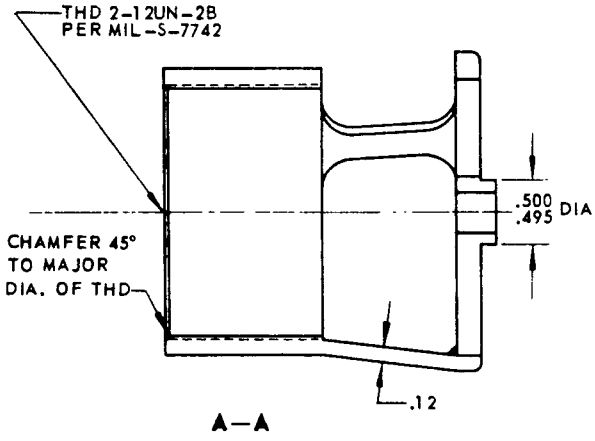








LOCK RING



SUPPORT BASE ASSEMBLY

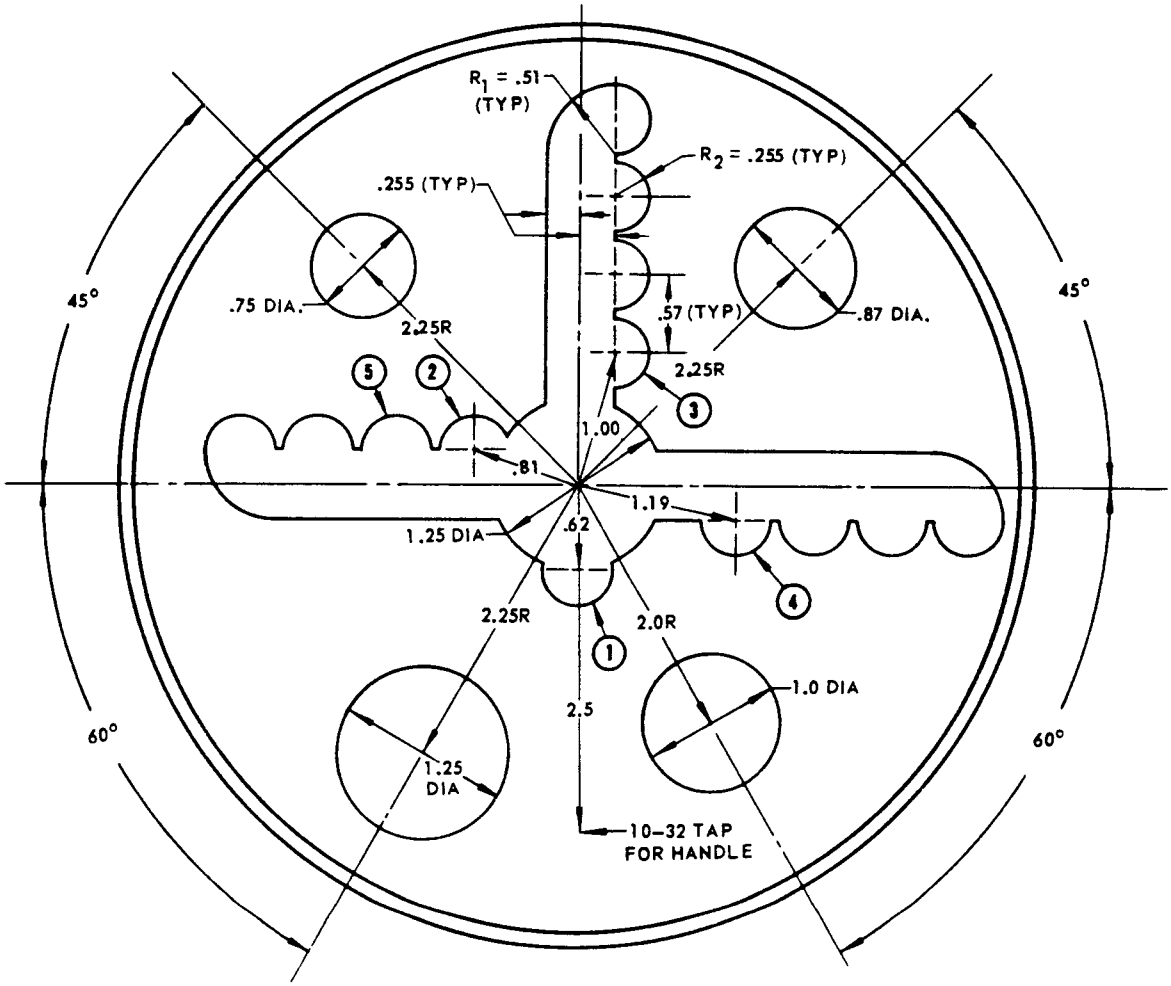
NOTE

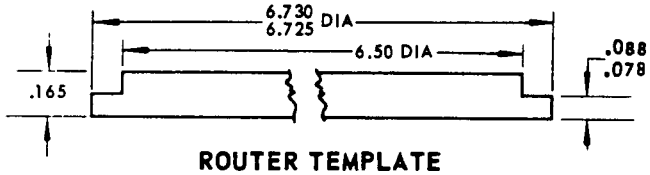
THIS ROUTER BASE AND LOCK RING IS FOR USE WITH THE ROUTER SHOWN IN FIGURE 9 THAT IS FITTED WITH SPECIAL 2-12UN-2A THREADED SLEEVE.

MATERIAL: SAE 1010 STEEL (SAE 1015, 1020, ASTM A7-50 OR AISI-C-1018 OPTIONAL).

AISI CORROSION RESISTANT STEEL CASTING OPTIONAL

Router Support Assembly
Figure 10





ROUTER TEMPLATE

INSTRUCTIONS

This template is designed to guide the power router assembly illustrated in Figure 9 while cutting out damage to a circular outline with a ¼ inch router bit.

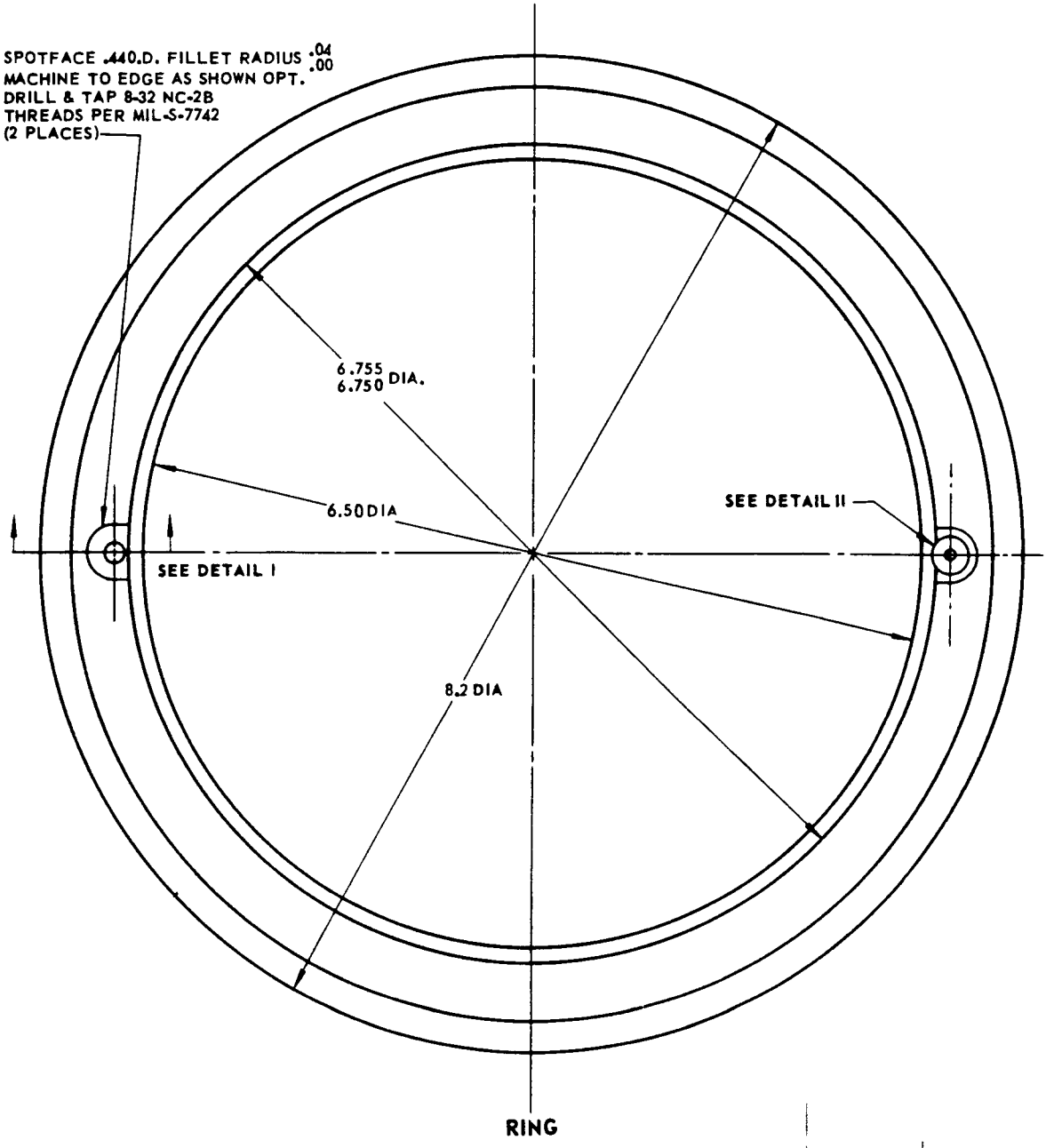
Both the template and ring can be fabricated of SAE 1010 steel (SAE 1015, 1020, ASTM A7-50, or AISI-C-1018 optional).

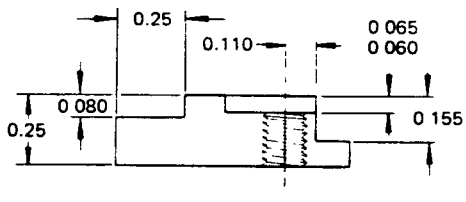
The 4 circular holes in the template can be used to rout holes up to one inch diameter.

To rout out larger damage, center the template ring over the damage and tape it to the honeycomb panel with masking tape. The template turns freely within the ring. The head of the 2 screws prevents the template from coming out of its seat.

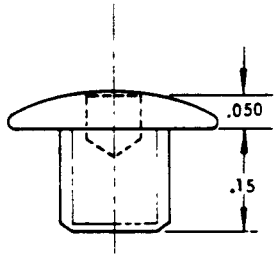
Start routing from the center. Place the guide of the router base in slot 1, start the router and rotate the template clockwise while routing. A handle may be inserted in the tap hole to facilitate rotation of the template within its seat. After completing a circle with router in slot 1 proceed to slot 2, 3 and so on in the indicated sequence until all damage has been routed out.

Router Template Assembly
Figure 11 (Sheet 1 of 2)





DETAIL I



DETAIL II

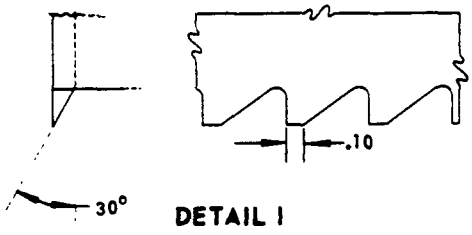
INSTRUCTIONS

This hole saw is used for trimming damaged alluminum skin of honeycomb panels to a circular outline. Recommended sizes of this tool are 1 inch, 2 inch and 3 inch diameter. For these sizes it is an alternate tool to the power router shown in figure 9.

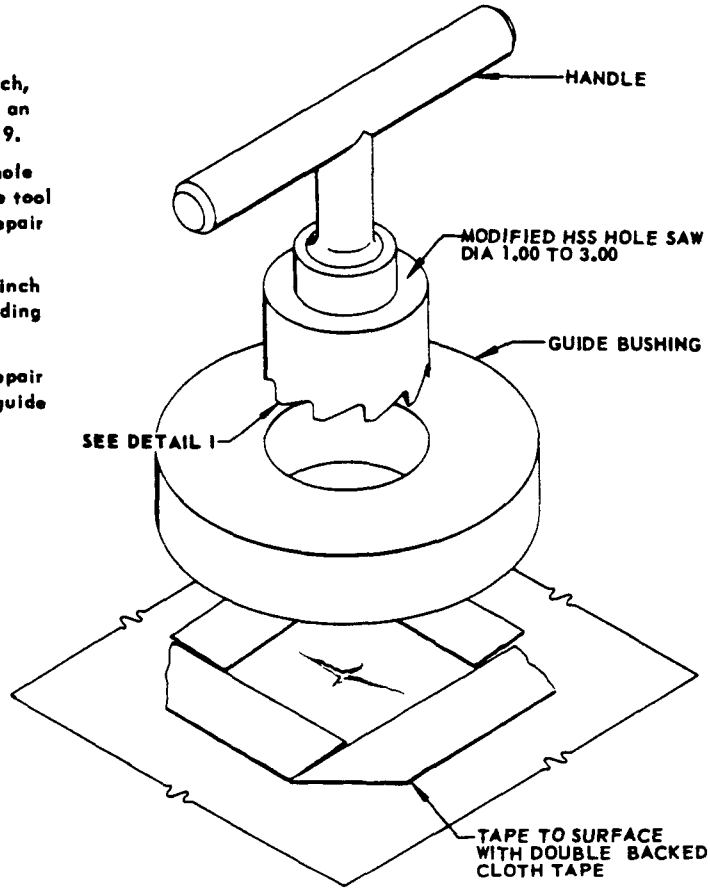
This hand tool is a modified high speed steel hole saw with a handle. The hole is cut by turning the tool within a guide bushing which is attached to the repair surface with double-backed tape.

The guide bushing can be fabricated from 0.75 inch thick aluminum alloy stock with a hole corresponding to the diameter of the hole saw.

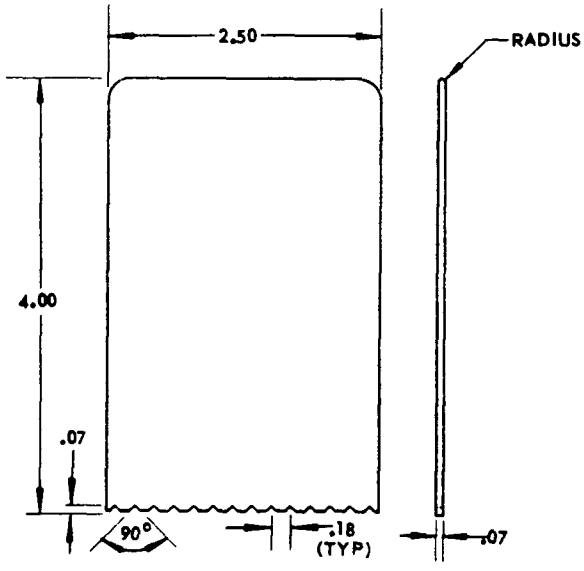
NOTE: Keep the hole saw perpendicular to the repair surface. Lateral pressure will shift the guide bushing.



DETAIL I



Hole Saw
Figure 12



INSTRUCTIONS

Make this squeegee from 0.07 inch plexiglas or equivalent material.

The notched edge of the squeegee can be used for spreading adhesive and the smooth edges for impregnation of fiberglas cloth patches.

Squeegee
Figure 13

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS. WEAR RUBBER OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

SEE 51-10-1, FIG. 2 FOR SOURCES OF REPAIR MATERIALS AND EQUIPMENT

MIXING PROCEDURE

1. Add Epon 828 to Epon 812 and mix thoroughly.
2. Add Versamid 115 to Versamid 125 and mix thoroughly.
3. Add Epon mixture to Versamid mixture and mix thoroughly.

NOTE: Mixture pot life is approximately 2 hours at 70°F.

CURING TIMES FOR BMS 5-29	
TEMPERATURE	TIME
60°F	40 HOURS
70°F	24 HOURS
90°F	16 HOURS
100°F	13 HOURS
110°F	10 HOURS
120°F	7.5 HOURS
140°F	4 HOURS
160°F	2 HOURS
180°F	1 HOUR
200°F	30 MINUTES
220°F	15 MINUTES
240–260°F	6 MINUTES

READY-TO-USE PACKAGE

BMS 5-29 adhesive is also available in kit form under number 3147-N2X from Whitaker Corp., Narmco Materials Div., 600 Victoria Street, Costa Mesa, California 92626; and number 80055-30 or 80055-31 from Fenwal Incorporated, 400 Main Street, Ashland, Massachusetts 01721.

The two Epons are in a plastic bag, and a separate compartment contains the two Versamids, all in correct proportions. The adhesive is ready for use after breaking the seal between the two compartments and mixing the contents thoroughly within the plastic bag by kneading.

Also a three-part package is available from Fenwal that contains fiberglass patches, in addition to the adhesive.

BMS 5-29 [A] ADHESIVE FOR FIBERGLASS	
COMPONENTS	PARTS BY WEIGHT
EPON 812	100
EPON 828	100
VERSAMID 115	100
VERSAMID 125	100

NOTES:
[A] BMS 5-126 ADHESIVE IS OPTIONAL TO BMS 5-29 ADHESIVE.

Preparation of Adhesive for Fiberglass
Figure 14 (Sheet 1)

Ⓐ BMS 5-126 ADHESIVE (TYPE 2, CLASS 1) ADHESIVE FOR FIBERGLASS	
COMPONENTS	PARTS BY WEIGHT
A	100
B	100

BLENDING PROCEDURE:

1. Mix component A thoroughly
2. Mix component B thoroughly
3. Thoroughly blend equal parts by weight of components A and B.

NOTE: Mixture pot life is approximately 2 hours at 70°F.

CURE TIMES FOR BMS 5-126 (AT A CLAMPING PRESSURE OF 10-15 PSI)	
TEMPERATURE	TIME
70° ± 5°F	24 ± 1 HOURS
100° ± 10°F	12½ ± 1¼ HOURS
150° ± 10°F	3½ ± ¼ HOURS
250 ± 10°F	20 ± 5 MINUTES

Preparation of Adhesives for Fiberglass
Figure 14 (Sheet 2)

POTTING COMPOUND 1	
COMPONENTS	PARTS BY WEIGHT
EPON 815	100
MICROBALLOONS	24
CURING AGENT "T"	22

Amount of microballoons may be varied from 16 to 25 parts by weight in order to obtain a mixture of the desired consistency. Also the amount of curing agent "T" may be varied from 16 to 25 parts by weight. Increased amount of curing agent decreases the required curing time. Use only 16 parts of curing agent when making potted repairs larger than 1.50 inch diameter to prevent foaming of the potting compound.

MIXING PROCEDURE

1. Add microballoons to Epon 815 and mix thoroughly
2. Add curing agent and mix thoroughly.

NOTE: Pot life of mixture after adding curing agent is approximately 30 minutes. Cure time is approximately 4 hours at 70° F. or 1 hour at 130° F.

NOTE

COMPONENTS OF POTTING COMPOUND 1 ARE AVAILABLE IN A PLASTIC BAG NO. 80055-44 OR 80055-45 FROM FENWAL INCORPORATED, 400 MAIN STREET, ASHLAND, MASS. 01721. BEFURE USE, ALLOW CURING AGENT TO ENTER THE PLASTIC BAG CONTAINING THE EPON 815 – MICROBALLOON MIXTURE FROM AN ADJACENT COMPARTMENT AND MIX THE CONTENTS THROUGHLY WITHIN THE PLASTIC BAG BY KNEADING.

WARNING:

THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

Preparation of Potting Compounds
Figure 15

NOTE

[A] OPTIONAL PART. SEE REPAIR INSTRUCTIONS STEP 8.

[B] THALCO GLASS CLOTH FIBER PRODUCTS, LOS ANGELES, CALIFORNIA

REPAIR FASTENER LOCATIONS

REPAIR MATERIAL			
PART		QTY.	MATERIAL
1	PLATE [A]	1	.016 CLAD 2024-T3
2			

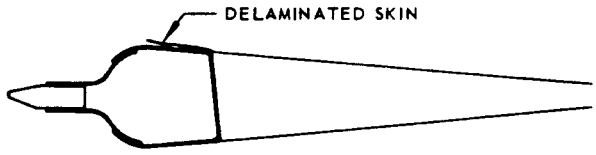
REPAIR INSTRUCTIONS

1. This repair is applicable to skin delaminations from cap-type spar of honeycomb tabs and tapered trailing edge panels.
2. Use narrow parting tool, approx 0.02 inches thick, inserted under delaminated skin and determine extent of delamination by sawing motion. Check also per paragraph 3.A.

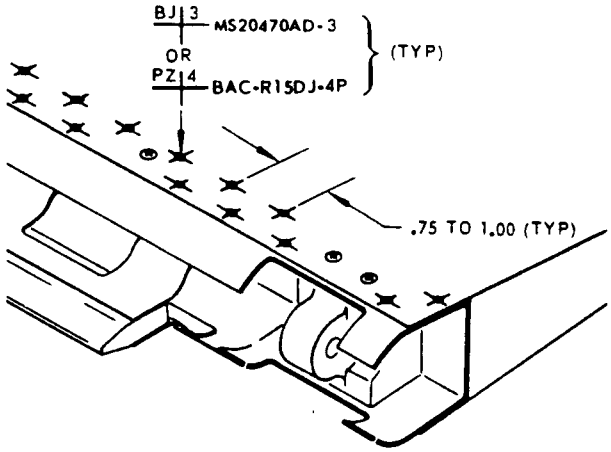
   NOTE: Use care to avoid crimping skin when checking extent of delamination. Do not damage the skin or good bond area by excessive forcing. Remove hinge support screws of tabs when checking for delamination in those areas.
3. Lay out rivet pattern as shown, extending pattern three rivet spaces beyond end of delamination. For repair of tab, aft row of rivets should be as close to spar web as good riveting practice will allow. Drill holes for rivets to be installed in step 6.
4. Clean and dry faying surfaces.
5. Mix Potting Compound 1 per figure 15 and spoon into delaminated area.
6. Rivet skin with MS20470AD3 rivets. Blind rivets may be substituted if necessary.
7. Finish per 51-2-0 of the Maintenance Manual.
8. For flaps, the following additional and optional procedure is recommended.

   (a) Locate the rivet pattern as shown, extending pattern three rivet spaces beyond end of delamination.

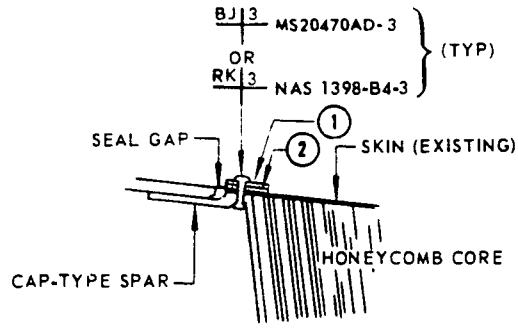
   (b) Prepare the outside surface skin of the delamination area and add optional part 1 per 51-9-1 Provide suitable pressure on part 1, aft of the rivet line during bonding cure.



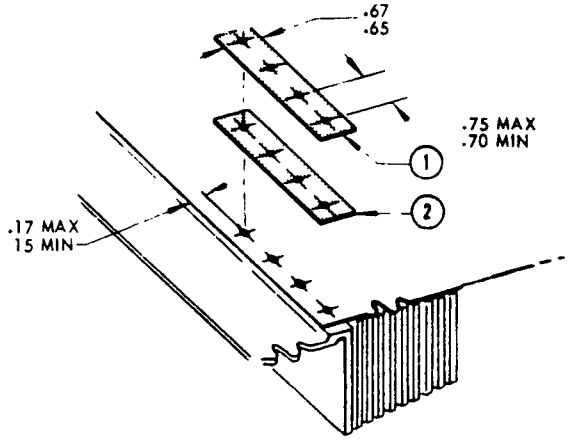
SECTION THROUGH DAMAGE



REPAIR OF RUDDER CONTROL TAB



SECTION THROUGH REPAIR



REPAIR OF FLAP

NOTES

THERE ARE NO LIMITATIONS ON THE SIZE OF REPAIRABLE DAMAGE FOR ALUMINUM HONEYCOMB STRUCTURE, PROVIDED ACCEPTABLE REPAIRS CAN BE MADE USING THE MATERIALS AND PROCESSES OUTLINED IN THIS MANUAL. HONEYCOMB TABS WITH FOAMED-IN FITTINGS CAN BE REPAIRED ONLY IF THERE IS NO DAMAGE IN THE FOAMED-IN AREA WITHIN 1 INCH OF THE FITTING.

[A] TWO PLIES OF STYLE 181, 1581 OR 7781 GLASS FABRIC ARE ADEQUATE TO REPAIR DAMAGE OF LESS THAN 30 SQUARE INCHES IN FIXED TRAILING EDGE HONEYCOMB PANELS OF THE WING. THE TABLE BELOW IS APPLICABLE TO REPAIRS LARGER THAN 30 SQUARE INCHES IN WING FIXED TRAILING EDGE AND TO REPAIRS OF ANY SIZE IN ALL OTHER HONEYCOMB STRUCTURE, INCLUDING TABS.

REQUIRED OVERLAP PER PLY IS 0.75 INCHES. FIGURES 3 THRU 6 ILLUSTRATE TWO-PLY REPAIRS. FIGURES 19 AND 20 ILLUSTRATE REPAIRS WITH MORE THAN TWO PLIES.

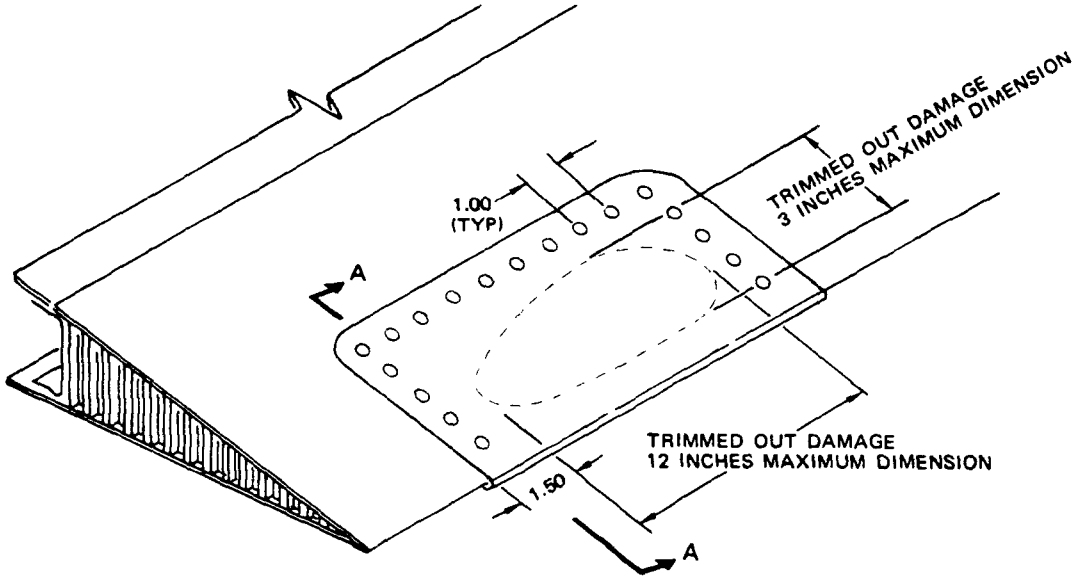
REPAIR PLIES REQUIRED	
GAGE OR ORIGINAL ALIMINUM SKIN	NUMBER OF STYLE 181, 1581 OR 7781 GLASS FABRIC REPAIR PLIES [A]
0.010 OR LESS	2
0.012	3
0.016 0.018 0.020	4
0.022 0.025	5

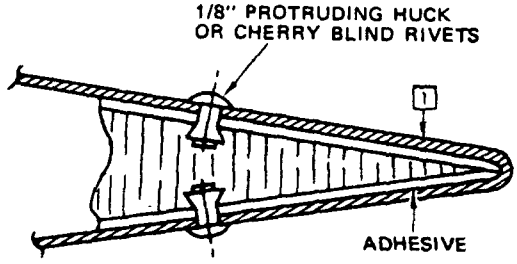
Allowable Repairs - Honeycomb Structure
Figure 17

REPAIR INSTRUCTIONS

1. Replace this repair within 150 hours with a permanent overlap repair per figure 6 when performing the permanent repair, cut out the damage, including the rivet holes, to the boundary of the time limited metal patch.
2. Trim out the damaged skin to a regular outline.
3. Make the metal patch. [1]
4. Clean faying surfaces and apply adhesive (Potting Compound 1) prepared as described in figure 15.
5. Assemble repair and rivet with blind rivets. Application of adhesive and riveting should be completed before adhesive starts to cure within 30 minutes after addition of curing agent.

REPAIR MATERIAL			
PART		QTY	MATERIAL
[1]	PATCH	1	0.032 2024-0





SECTION A-A

Flap Trailing Edge - Time Limited Repair
Figure 18

REPAIR INSTRUCTIONS

1. This repair is applicable to skin delaminations from aluminum honeycomb core in tapered panels, as well as uniform thickness pan type panels.

2. Determine extent of damage, trim out damaged skin and prepare bond area as described in par. 3 of the text.

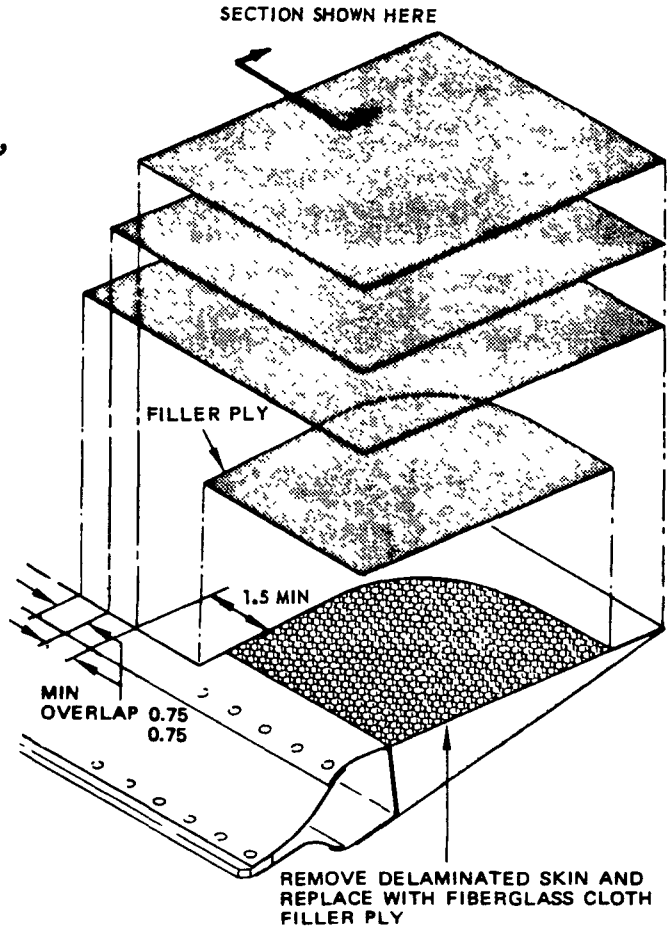
3. Prepare a fiberglass cloth filler to replace the removed delaminated metal skin. Impregnate and apply it per par. 5 of the text. Use one or two filler plies to make the delaminated area level with the adjacent original metal skin.

4. Prepare plies of Style 181, 1581 or 7781 fiberglass cloth for a patch with overlaps in the spanwise direction as shown in the figure. Impregnate and apply the patch as described in par. 5 of the text.

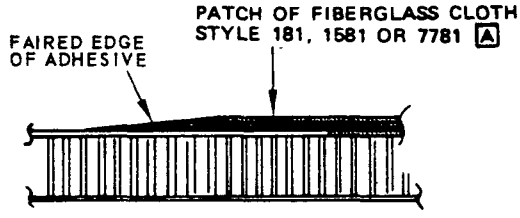
   NOTE: See Fig. 17 for the required number of plies in the patch [A].

5. Apply chemical and solvent resistant finish (BMS 10-11 primer and enamel of the appropriate color) or Scotchcal #630 tape to the patch and surrounding metal. Refer to the Maintenance Manual, 51-2-0.

6. If a control surface has been repaired, rebalance it, when necessary (Ref 51-15-0 thru 51-15-13).



REPAIR OF TAB IS SHOWN



SECTION THROUGH REPAIR

Skin Delamination Repair - Honeycomb Tapered Panel
Figure 19

REPAIR INSTRUCTIONS

NOTE: References to paragraph numbers in these repair instructions apply to the text pages at the beginning of Section 51-10-1.

1. This repair is applicable to damage over 30 square inches in one skin and core of honeycomb panels in the fixed trailing edge of the wing.

NOTE: The size of the patch and the number of repair plies is determined by the gage of the original skin of the honeycomb panel, as shown in Table 1. The two-ply patch repairs shown elsewhere in this section of the manual are adequate to repair skins up to 0.01 inches thick, and thicker skins if the damage is less than 30 square inches.

2. Remove damaged skin and honeycomb core, and prepare bond area as described in par. 3.

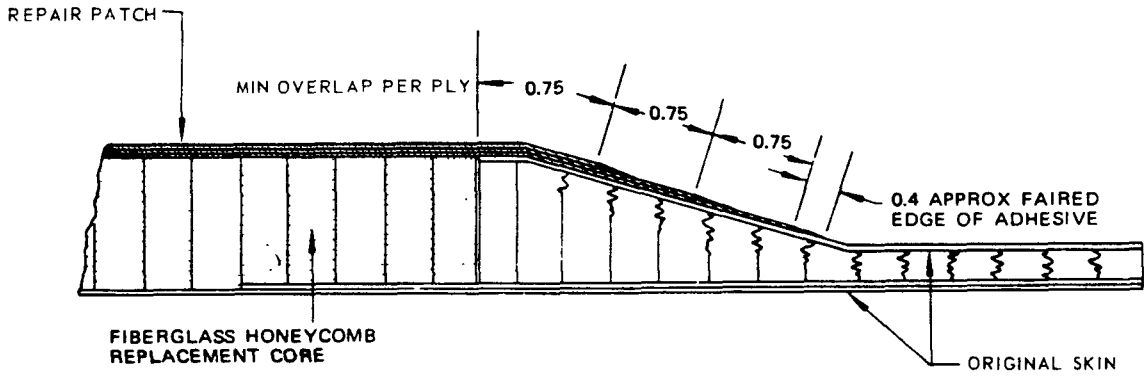
3. Install replacement core of 4.5 lb or 6.0 lb fiberglass honeycomb (Fig. 2) as described in par. 4.

4. Determine required number of plies for the patch from Table 1. Apply overlay patches as described in par. 5.

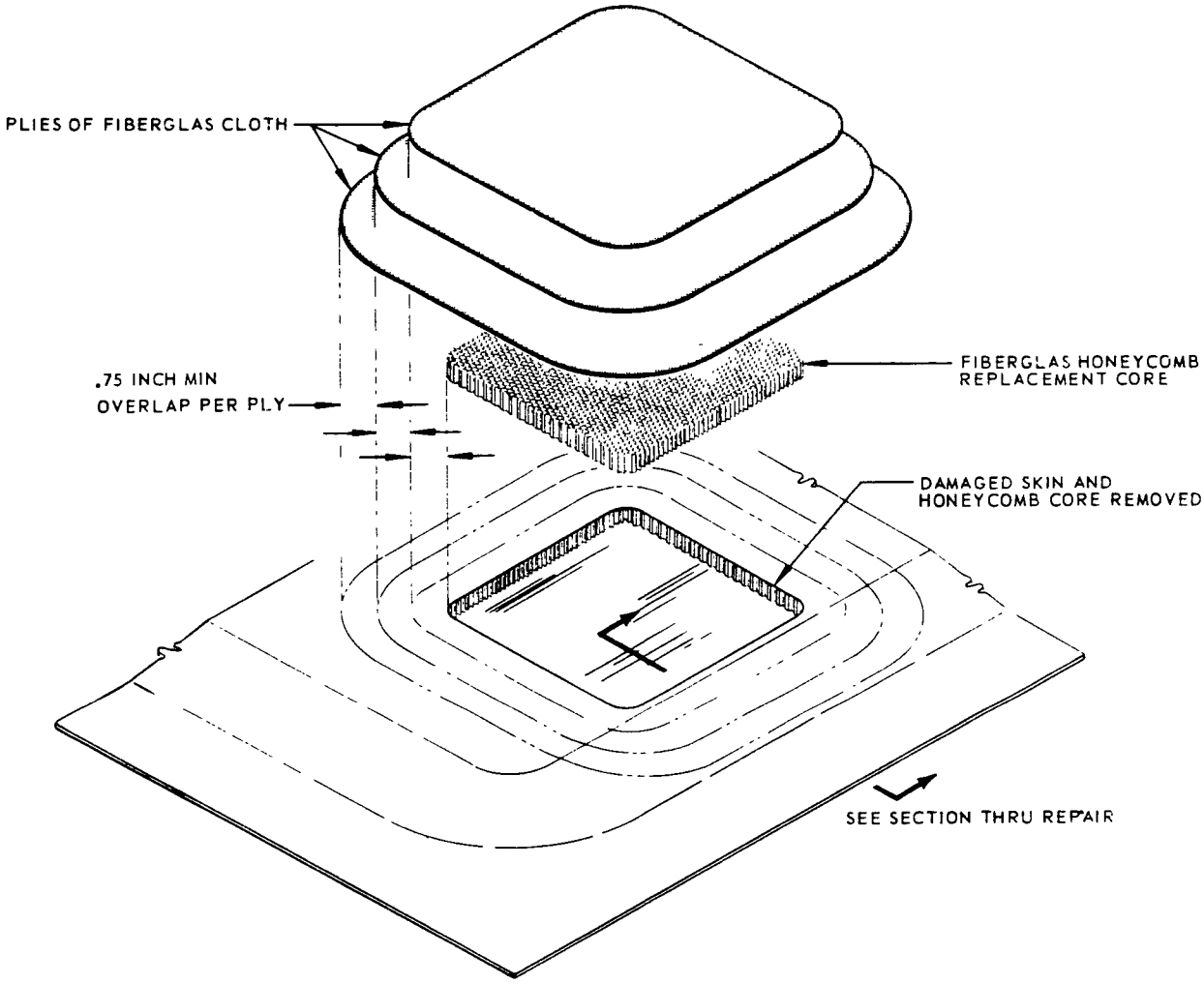
5. Apply chemical and solvent resistant finish (BMS 10-11 primer and enamel of the appropriate color) or Scotchcal 630 tape to the patch and surrounding metal. Refer to Maintenance Manual, Section 51-2-0.

REPAIR PLIES REQUIRED	
GAGE OF ORIGINAL ALUMINUM SKIN	NUMBER OF STYLE 181, 1581 OR 7781 FIBERGLASS CLOTH REPAIR PLIES
0.010 OR LESS	2
0.012	3
0.016 0.018 0.020	4
0.022 0.025	5
0.032	6
0.040	7

TABLE I



SECTION THROUGH REPAIR



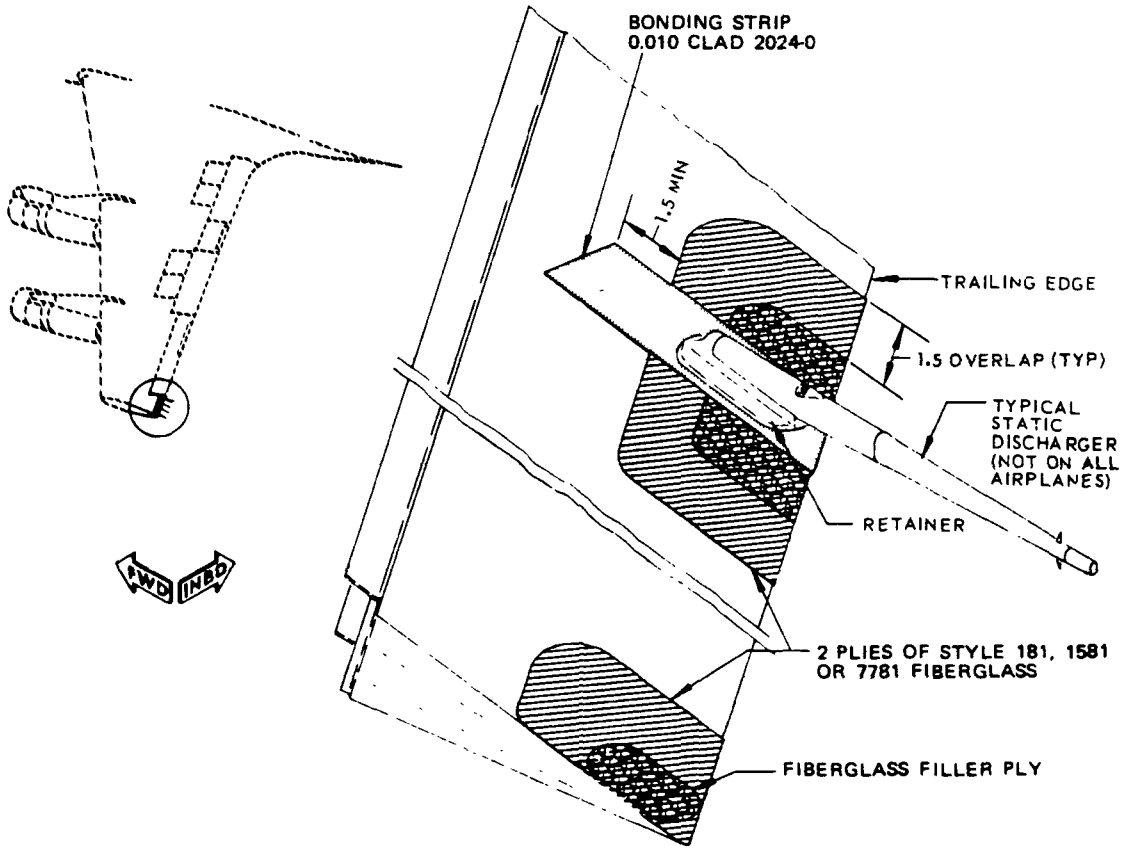
Honeycomb Structure Repair - Wing Fixed Trailing Edge
Figure 20 (Sheet 2 of 2)

REPAIR INSTRUCTIONS

NOTE: References to paragraph numbers in these repair instructions apply to the text pages at the beginning of Section 51-10-1.

1. Honeycomb repairs at locations where static dischargers are attached must provide for electrical continuity from the metal skin to the static discharger retainer by an aluminum strip on top of the fiberglas overlay bonded to the original aluminum skin with conductive adhesive.
2. The repair shown at the tip applies to damage to one skin only, such as a lightning strike that has melted away the skin below the static discharger retainer base without damaging the honeycomb core.
   A. Prepare bond area as described in Paragraph 3 and apply overlay patches per Paragraph 5. Use an impregnated fiberglas filler ply below the patch in the damage area.
   B. Attach bonding strip and static discharger retainer over the patch as described in Steps 4 and 5 below.
3. Repair the trailing edge per figure 6 if the honeycomb core, as well as both skins have been damaged.
4. After the fiberglas overlay has cured, bond an 0.010 aluminum strip, 0.25 inch wider than the electrical discharger retainer base, over the repair. Wrap the strip around the trailing edge and bond one end to original metal skin. Use bonding procedure as described for installation of static discharger retainers in Maintenance Manual, Section 23-12-0.

   NOTE: Make sure that the bonding surface is flat. Provide pressure during curing using a clamping arrangement as shown in figure 7.
5. Install the static discharger retainer on the bonding strip and check the static discharger as described in Maintenance Manual, Section 23-12-0.
6. If a control surface has been repaired, rebalance it when necessary. See 51-15-0 thru 51-15-13.



Honeycomb Structure Repair at Static Dischargers
Figure 21

REPAIR INSTRUCTIONS

1. Drill a $\begin{smallmatrix}.541\\.529\end{smallmatrix}$ inch diameter hole through spar and into honeycomb 1-1/4 inch deep.
2. Clean with MEK, face of spar around area of hole.
3. *Prepare bolt, washer, and nut per* [C]
4. Prepare potting compound per figure 15, and fill hole. The assembly must be in the vertical position, trailing edge down, when filling hole with potting compound.
5. *Agitate potting compound* in hole with spatula or similar instrument to break up air pockets, allow to settle, refill as necessary.
6. Insert bolt into hole, head first until washer contacts spar. Clean bolt and washer with MEK before inserting into hole.
7. Apply pressure to the nut while resin is curing. Lead shot bags, lead weights or any other suitable weights can be applied directly.
8. Cure time for resin is 24 hours at a minimum temperature of 70 °. Heat, not exceeding 200 °F, may be applied to one or both skins to speed up cure time. If heat is used to cure resin, some expansion of resin in the hole may occur. Make sure that washer is pressed firm against the spar before resin hardens.
9. *Tighten nut* to a torque of 30 to 40 pound-inches after resin has cured.
10. Apply protective finish of one coat of alodine 1000 and one coat zinc chromate primer per 51-2-0 of the Maintenance Manual over reworked area.

NOTE

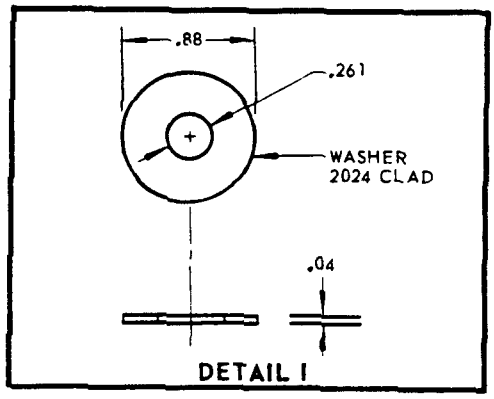
THIS REPAIR IS FOR A BREAK IN THE BOND BETWEEN SPAR WEB AND HONEYCOMB.

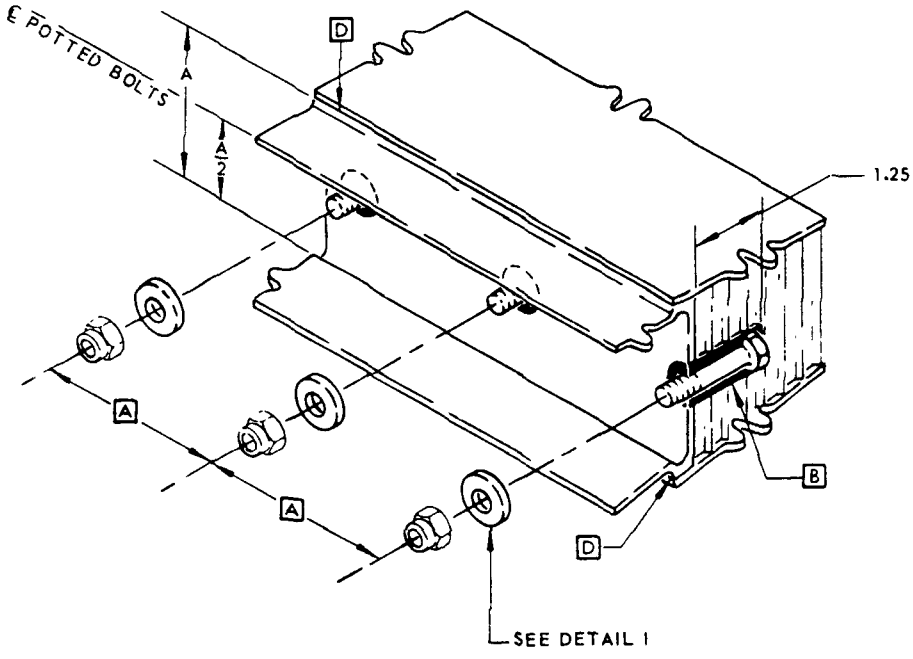
[A] SPACE BOLTS EQUALLY BETWEEN RIBS AT 3.00 APPROX. WHEN CLIPS ARE SPACED AT 6 INCHES OR MORE. USE ONLY 2 BOLTS WHEN CLIPS ARE SPACED BETWEEN 4.5 AND 6.0 INCHES. INSTALL BOLT AT 1/2 CLIP SPACING WHEN CLIPS ARE SPACED LESS THAN 4.5 INCHES.

[B] POTTING COMPOUND PER FIGURE 15

[C] BOLT – AN4-12A
NUT – NAS679A4W
WASHER – SEE DETAIL I
} OR EQUIVALENT
PLACE WASHER ON BOLT AND SCREW NUT ON UNTIL FLUSH WITH END OF BOLT BEFORE INSERTING INTO HOLE.

[D] FOR REPAIR OF DELAMINATION BETWEEN SKIN AND SPAR SEE FIGURE 16.





Flap Trailing Edge Spar to Honeycomb Delamination - Potted Bolt Repair
Figure 22

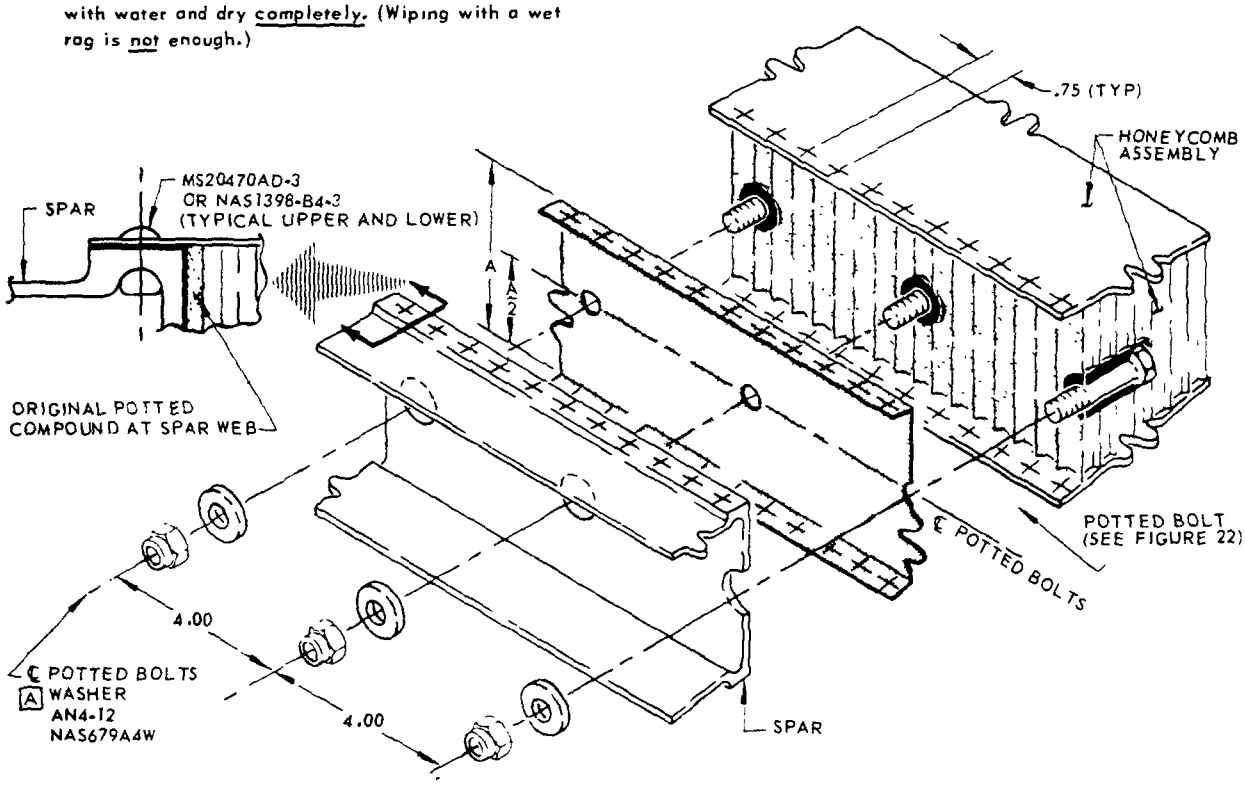
NOTE
REPAIR IS APPLICABLE TO A COMPLETELY DELAMINATED HONEYCOMB TRAILING EDGE ASSEMBLY (INBOARD AND OUTBOARD) OF THE WING TRAILING EDGE FLAPS.

[A] SEE FIGURE 22 DETAIL I.

REPAIR INSTRUCTIONS

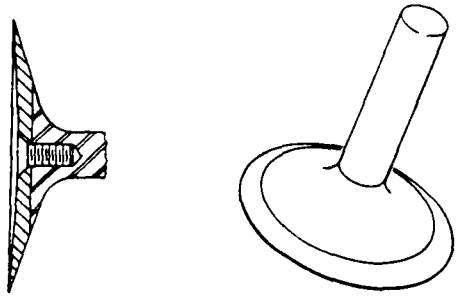
1. Remove the entire trailing edge assembly from the flap assembly.
2. Do not damage the skins (upper or lower) of the honeycomb assembly when separating them at the faying surfaces of the spar chords.
3. Construct some type of holding repair fixture that will rigidly support and maintain the original shape or contour of the honeycomb assembly.
4. Place the honeycomb assembly in the repair fixture so that the tapered end is pointed vertically downward.
5. The skin section will probably have the old adhesive still firmly bonded to it. Thoroughly clean the surfaces with MEK solvent then follow with a wash using a mild soap detergent and dry. Abrade the surfaces with sandpaper prior to bonding. Use sandpaper number 280-320. Do not allow water to enter any cell of the honeycomb assembly.
6. The spar is probably heavily coated with hard greases. Soften and remove these greases with MEK solvent and thoroughly wash the spar with soap (Tide, White King, etc.). Rinse thoroughly with water and dry completely. (Wiping with a wet rag is not enough.)
7. Prepare adhesive per 51-9-1
8. Apply adhesive per 51-9-1 to the inside skins and to the potted compound which seals the honeycomb at the spar web.
9. Apply an even coating of adhesive resin to the faying surfaces of the spar member.
10. Press the spar member to the faying surface and locate it properly with respect to the honeycomb assembly. Use clamps and suitable weights to provide pressure for bonding at the spar web.

    NOTE: Do not rivet the skins to the spar at this stage of repair.
11. Locate holes per 51-10-1 Fig. 22 through spar web at 4.00 inch spacings and at the midpoint between spar chords.
12. Complete the repair instructions 1. through 9. of 51-10-1 Fig. 22.
13. Rivet the skins at the lap areas of the spar chords. Use MS20470AD-3 or NAS1398-B4-3 at a pitch distance of 0.75 inch. Be sure to rivet the skins while the adhesive (51-9-1, Paragraph 4) is still wet. An alternative method is to apply some form of pressure, i.e., clamped bars along the entire skin-bond area, during the adhesive cure period. Rivet after completion of the cure period.
14. Finish in accordance with 51-2-0 of the Maintenance Manual.



Trailing Edge Flap Spar to Honeycomb Delamination, Potted Bolts and Bonded-Riveted Repair
Figure 23

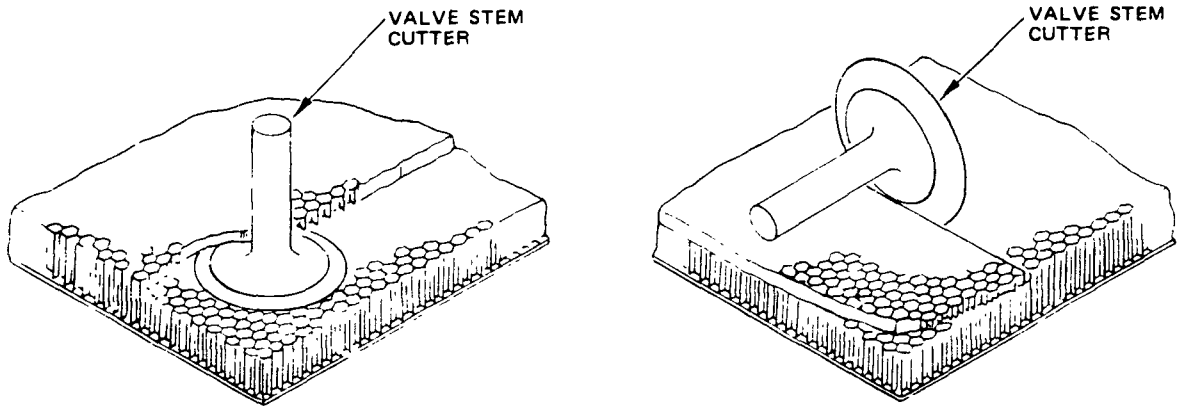
CUTTERS AVAILABLE IN VARIETY OF SIZES THAT ATTACH TO POWER SOURCE SUCH AS ROUTER SHOWN IN FIG. 3.



TWO-PIECE CUTTER

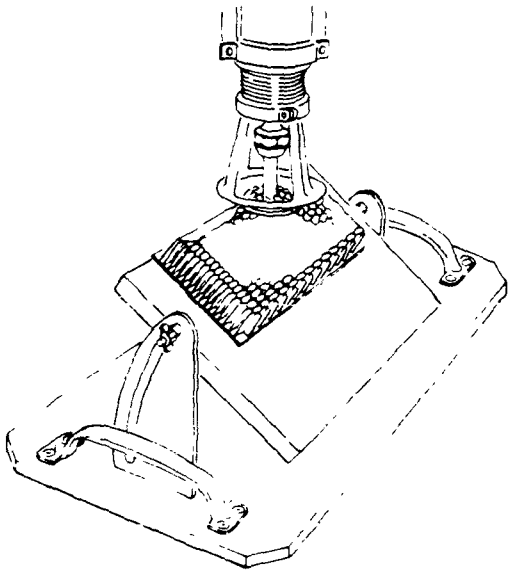
ONE-PIECE CUTTER

VALVE STEM CUTTERS



FLAT CUTTING FOR DOUBLER RECESSES, EDGE STEPS OR OVERALL THICKNESS REDUCTION

Machining With Valve Stem Cutter
Figure 24 (Sheet 1)



Machine with sine plate for making tapered cuts or wedge shape details. Aluminum honeycomb may be stabilized by:

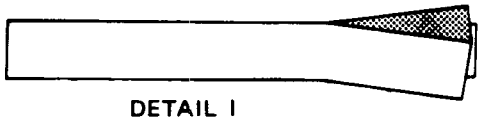
1. Use of double backed tape
2. Bonding nylon cloth on one surface
3. Bonding skin on one surface
4. Freezing the cells with water or ethylene glycol

Nonmetallic honeycomb may be stabilized by:

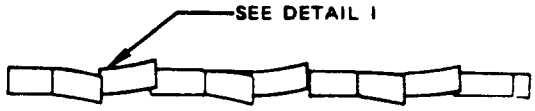
1. Use of double backed tape
2. Bonding a layer of adhesive film to surface of honeycomb
3. Bonding a layer of adhesive film and a layer or prepregnated fiberglass cloth

Stabilized honeycomb details may be held for machining by use of vacuum, mechanical clamping using large area pads, double backed tape or shot bags.

Machining With Valve Stem Cutter
Figure 24 (Sheet 2)



DETAIL I



RAKER TOOTH FORM BAND SAW BLADE

WORKPIECE MATERIAL	WORKPIECE THICKNESS (IN.)	BAND TYPE	TOOTH FORM	PITCH	BAND SPEED (FT/MIN)	CUTTING RATE (SQ IN./MIN)	CUTTING FLUID
ALUMINUM HONEYCOMB (CUT PARALLEL TO CELL WALLS)	6	WELD EDGE	RAKER	14	4000	100+	NONE
FIBERGLASS HONEYCOMB	12	DIAMOND EDGE (CONTINUOUS)	60 TO 80 GRIT		6000	100+	NONE -- VACUUM EXTRACTION OF DUST
NOMEX HONEYCOMB (CUT PARALLEL TO CELL WALLS)		REMINGTON TUNGSTEN CARBIDE (CONTINUOUS)	70 TO 100 GRIT		4000	60+	

RECOMMENDED CONDITIONS FOR BAND SAWING HONEYCOMB MATERIALS

Band Sawing Honeycomb Materials
Figure 25

ORIGINAL SKIN THICKNESS	PART NUMBER		
	1	2	3
0.012 TO 0.020	SAME THICKNESS AS ORIGINAL SKIN	NOT REQD	SAME THICKNESS AS ORIGINAL SKIN
0.025	0.016	0.016	
0.032	0.016	0.020	
0.040	0.020	0.025	
0.044	0.025	0.025	
0.050	0.025	0.032	
0.052	0.025	0.032	

REPAIR MATERIAL GAGES FOR VACUUM BONDED REPAIRS

TABLE I

ORIGINAL SKIN THICKNESS	PART NUMBER		
	1	2	3
0.012 TO 0.020	SAME THICKNESS AS ORIGINAL SKIN	NOT REQD	SAME THICKNESS AS ORIGINAL SKIN
0.025	0.012	0.016	
0.032	0.012	0.020	
0.040	0.016	0.025	
0.044	0.020	0.025	
0.050	0.020	0.032	
0.052	0.020	0.032	

REPAIR MATERIAL GAGES WHERE VACUUM BONDING IS NOT BEING USED

TABLE II

EXAMPLE VACUUM BONDED REPAIR

(a) ORIGINAL OUTER SKIN 0.032 GAGE WITH 2.0 MD (HOLE). FROM CHART, SIZE OF PART 3 = 5.0 DIA

(b) FROM TABLE I, GAGE OF PART 2 = 0.02. FROM CHART, SIZE OF PART 2 = 8.0 X 8.0

(c) FROM TABLE 1, GAGE OF PART 1 = 0.016. SIZE OF PART 1 = (8.0 + 2.0) X (8.0 + 2.0) = 10 X 10.

NOTES

- THIS FIGURE IS FOR USE IN DETERMINING DOUBLER SIZE AND GAGE ONLY. SEE PARAGRAPH 3 OF THE TEXT FOR REPAIR INSTRUCTIONS.
- WHERE VACUUM BONDING IS UTILIZED THE HEAVIER DOUBLERS SPECIFIED IN TABLE I MUST BE USED.
- THE VENT HOLES IN THE REPAIR DOUBLER PART 2 ARE PROVIDED TO ELIMINATE AIR ENTRAPMENT, AND ARE ONLY REQUIRED WHEN VACUUM BONDING IS BEING USED.
- MATERIAL FOR REPAIR PARTS SHOULD BE TO THE SAME SPECIFICATION AND HEAT TREAT AS THE SKIN BEING REPAIRED.
- PREPRIMED SHEET MATERIAL MAY BE USED FOR THE MANUFACTURE OF DOUBLERS WHERE IT IS AVAILABLE.

MD = MAXIMUM DIMENSION OF HOLE OR DENT

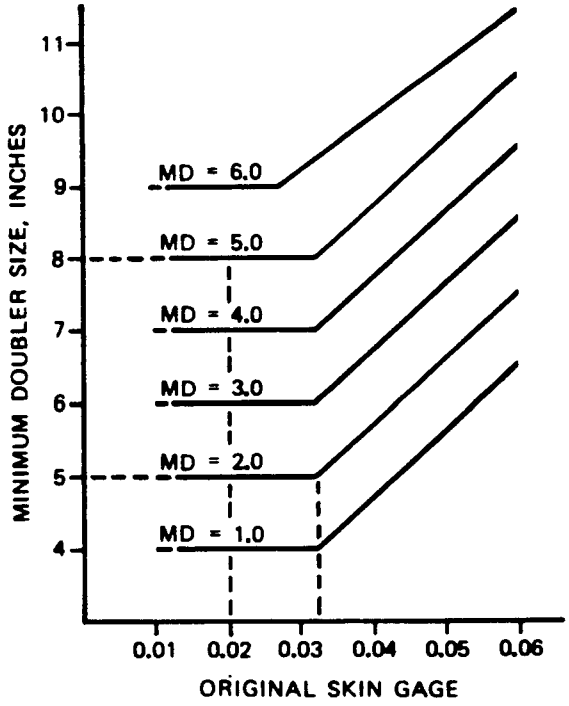
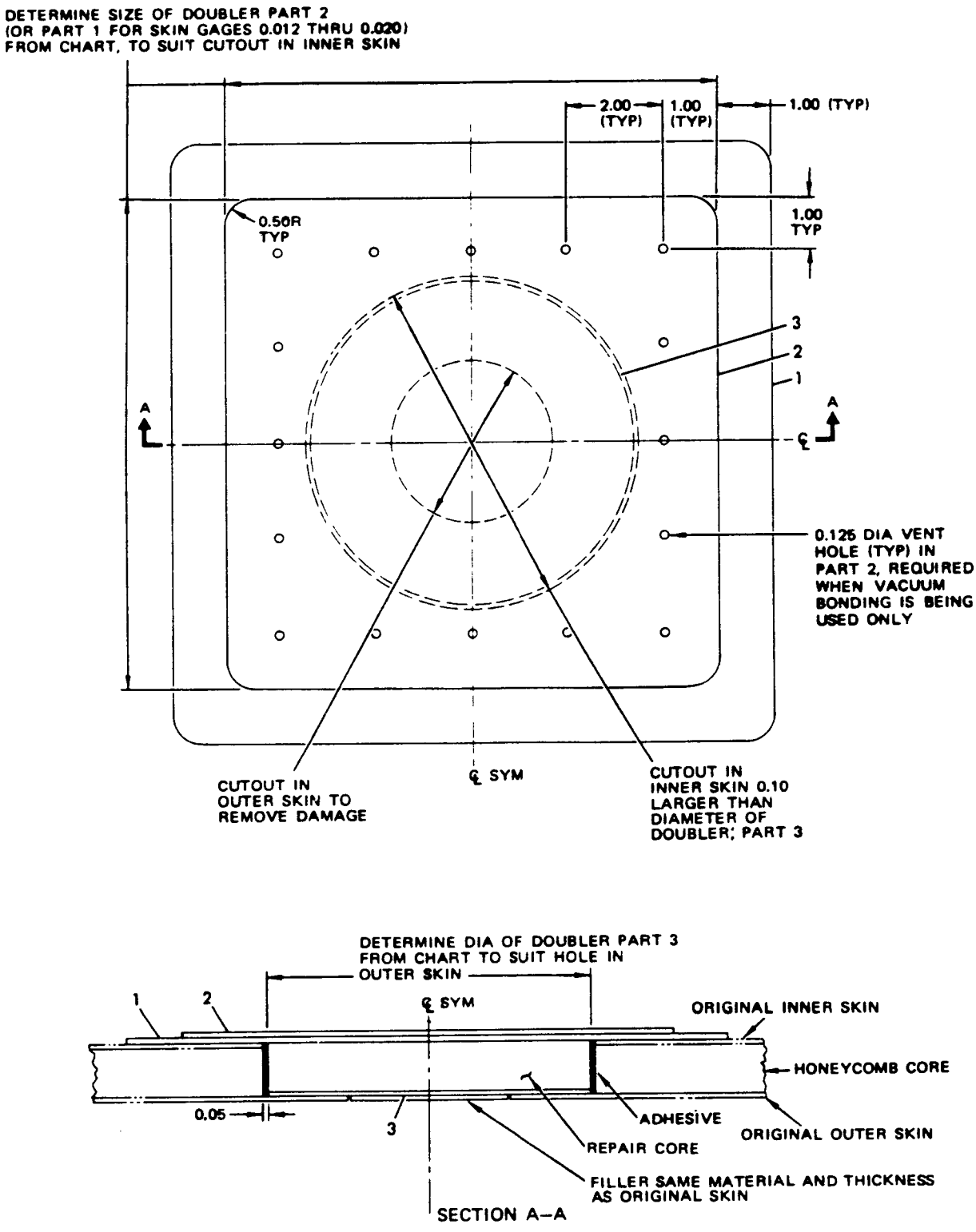
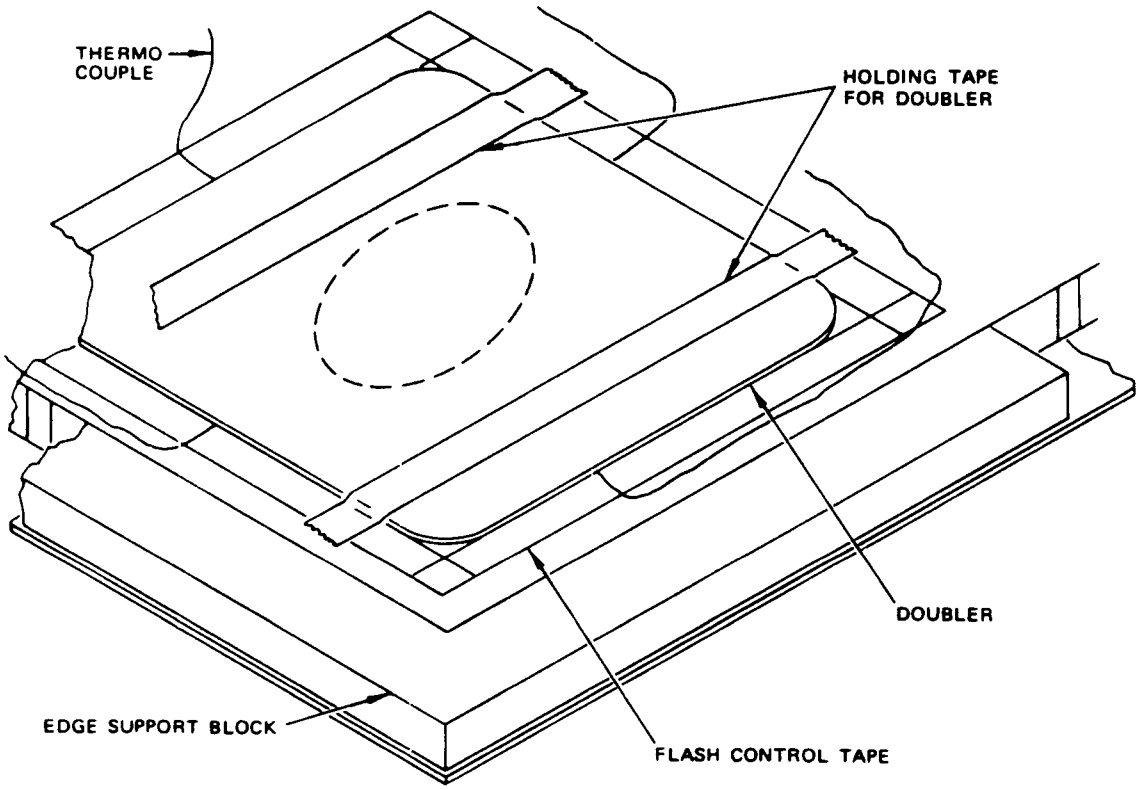


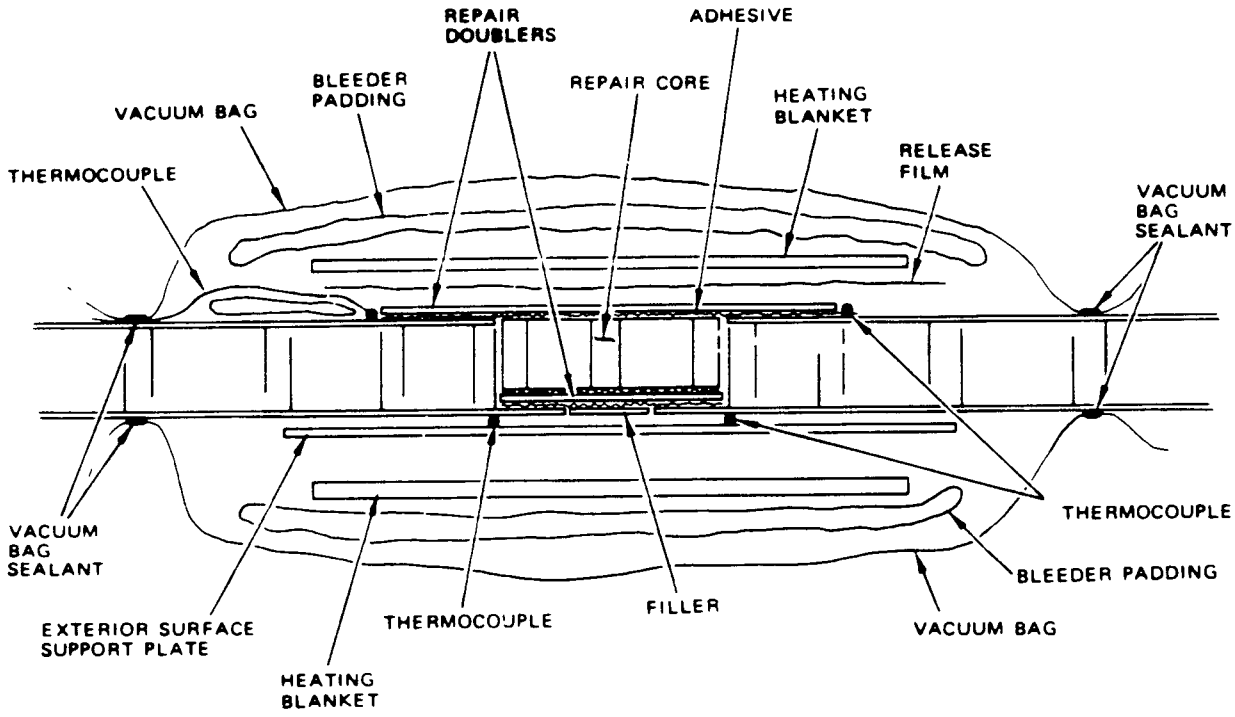
CHART SHOWING DOUBLER SIZE REQUIRED DETERMINED FROM HOLE OR DENT SIZE AND SKIN GAGE



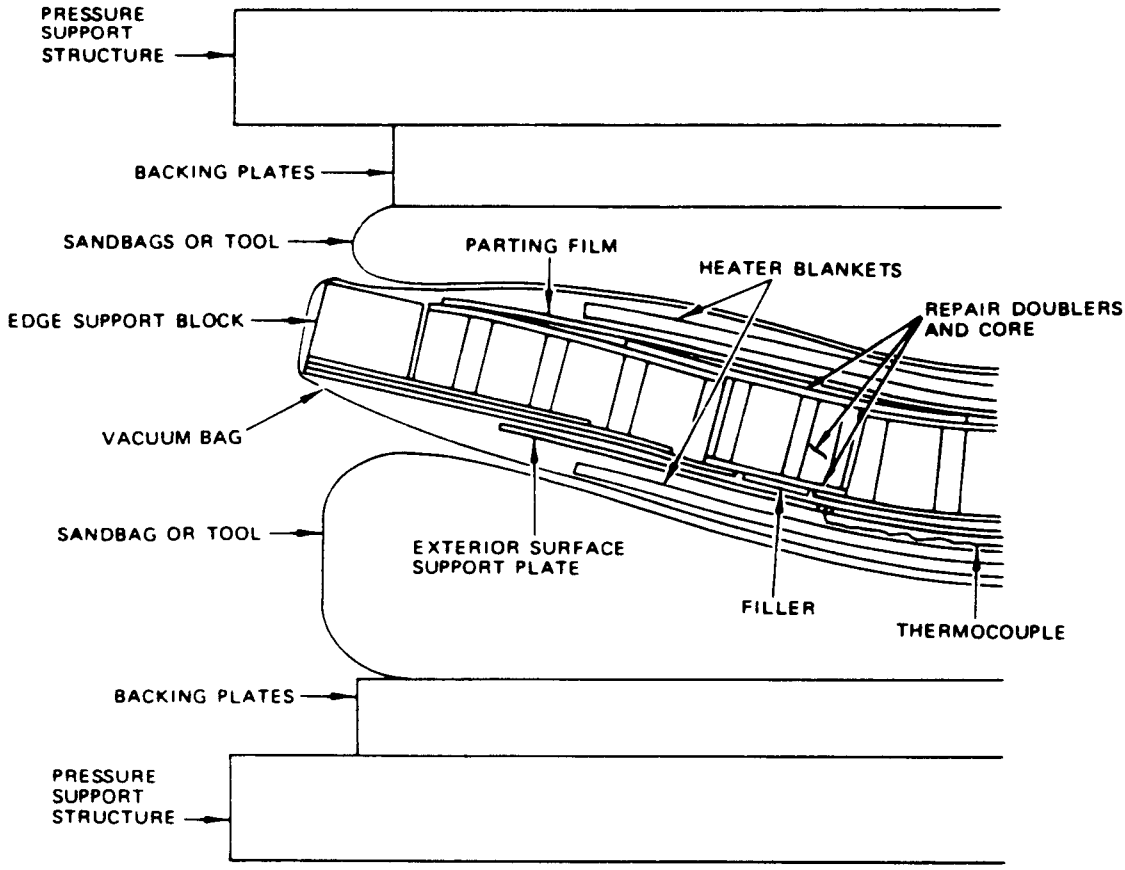
Repair Doubler Requirements
Figure 26 (Sheet 2)



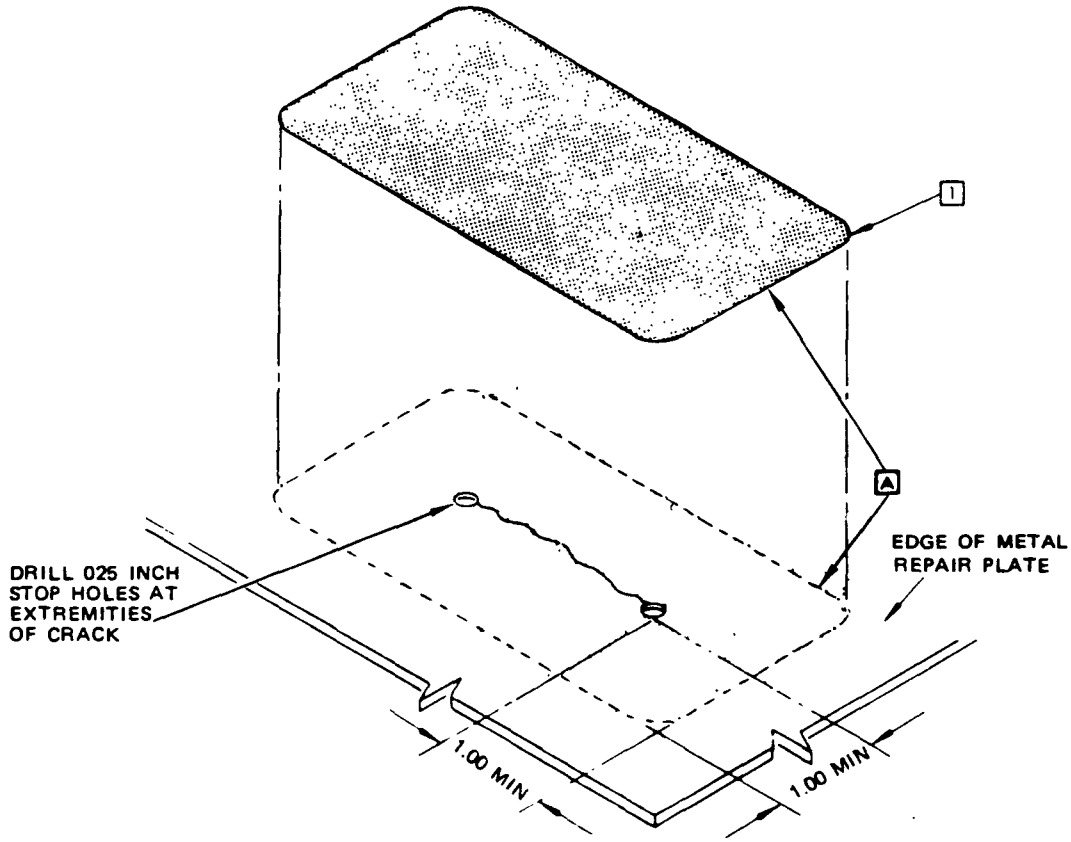
Doubler Installation
Figure 27

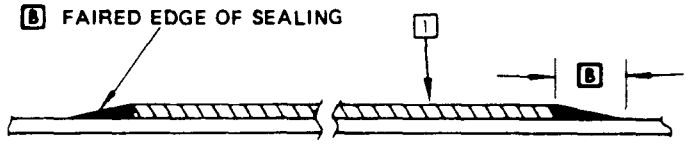


Application of Pressure During Cure For Flat Panels
Figure 28



Application of Pressure During Cure For Curved Panels
Figure 29





SECTION THROUGHT REPAIR

NOTES

- THIS REPAIR METHOD IS APPLICABLE TO DAMAGED BONDED PANELS AND OTHER METAL COMPONENTS SUBJECT TO CRACK DAMAGE. THIS REPAIR METHOD IS NONSTRUCTURAL AND IS NOT TO BE USED FOR THE REPAIR OF PRIMARY OR SECONDARY STRUCTURE. REFER TO 51-0 FOR LOCATION OF PRIMARY AND SECONDARY STRUCTURE
- REFER TO PAR 6K FOR INSTRUCTIONS FOR REPAIR.

[A] FAYING SURFACE AREA TREAT ACCORDING TO 51-9-1. *PHOSPHORIC ANODIZING* NON-TANK ANODIZING (PANTA) METHOD

[B] SEAL EDGES PER 51-9-1

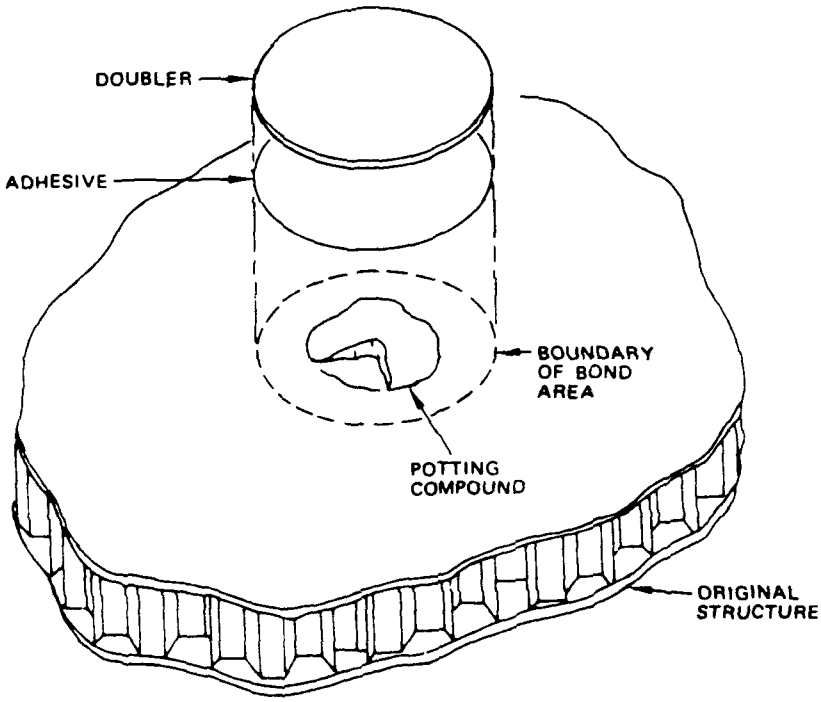
[C] UNCLAD MATERIAL MAY BE USED. DO NOT USE 7075 CLAD AS ANY REPLACEMENT.

REPAIR MATERIAL	
PART	MATERIAL
1	REPAIR PLATE SAME GAGE AND MATERIAL AS SKIN [C]

TABLE I

CURE TIMES (AT PRESSURE OF 10-15 PSI)	
TEMPERATURE	TIME
225°F - 250°F	60-90 MINUTES
200° F	120 MINUTES

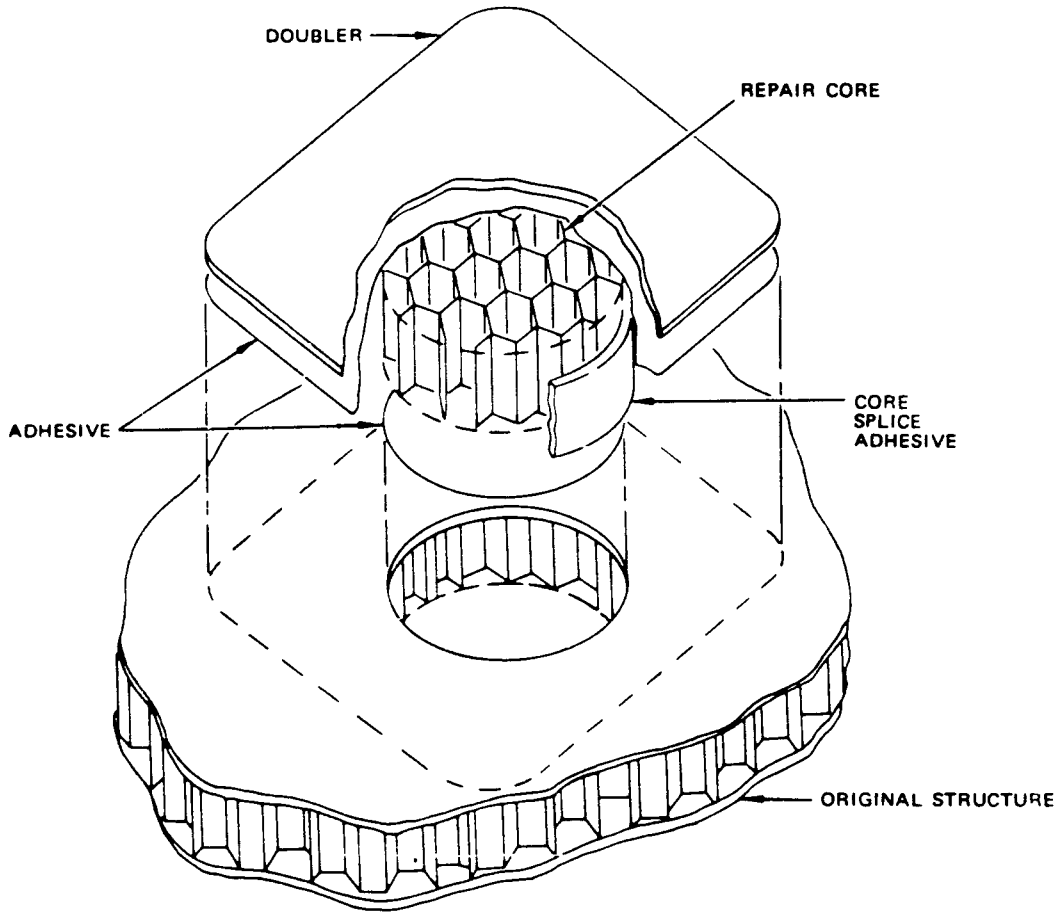
Bonded Metal Skin Repair - Typical
Figure 30



NOTE

- REFER TO PAR 6J FOR REPAIR PROCEDURE

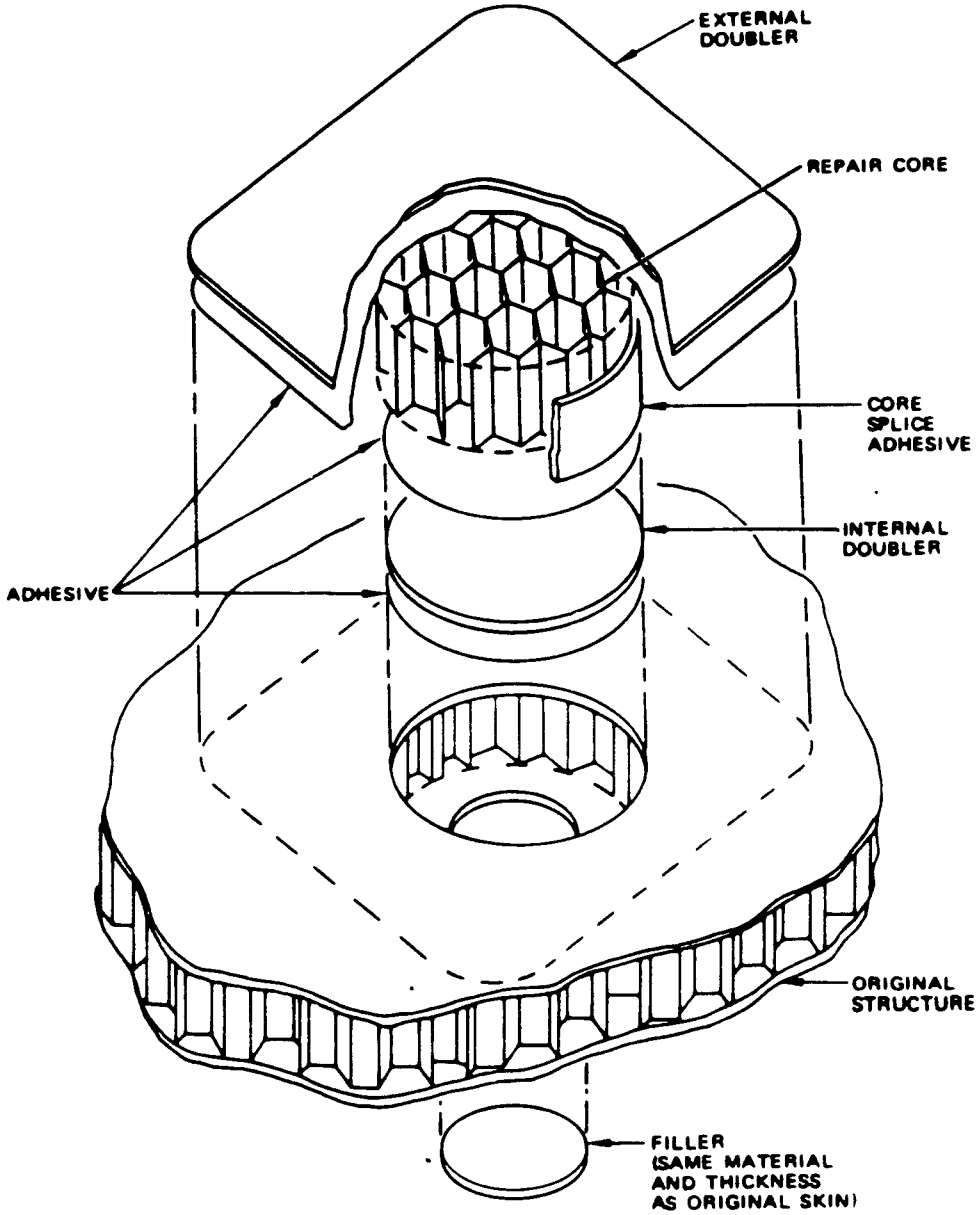
Dent Repair With External Doubler
Figure 31



NOTE

- REFER TO PAR 6K FOR REPAIR PROCEDURE

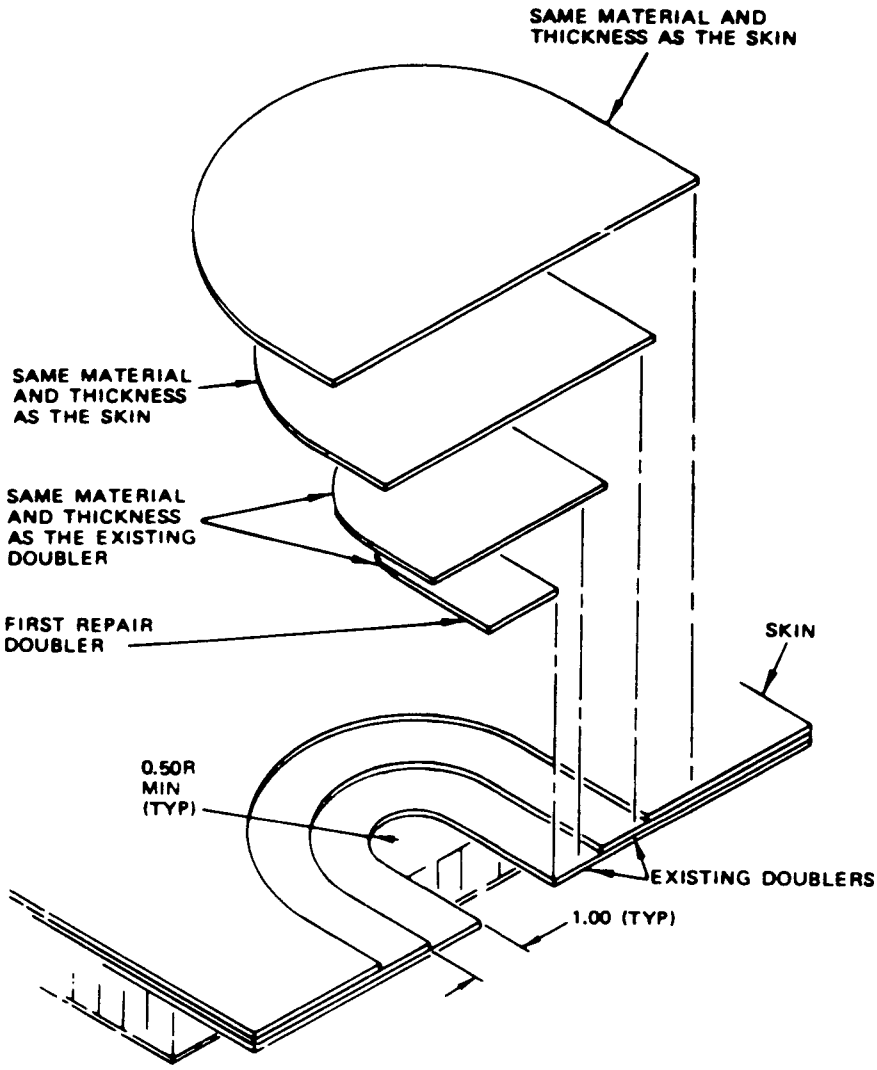
Skin and Core External Repair
Figure 32



NOTE

- REFER TO PAR 6K FOR REPAIR PROCEDURE

Skin and Core Flush Repair
Figure 33



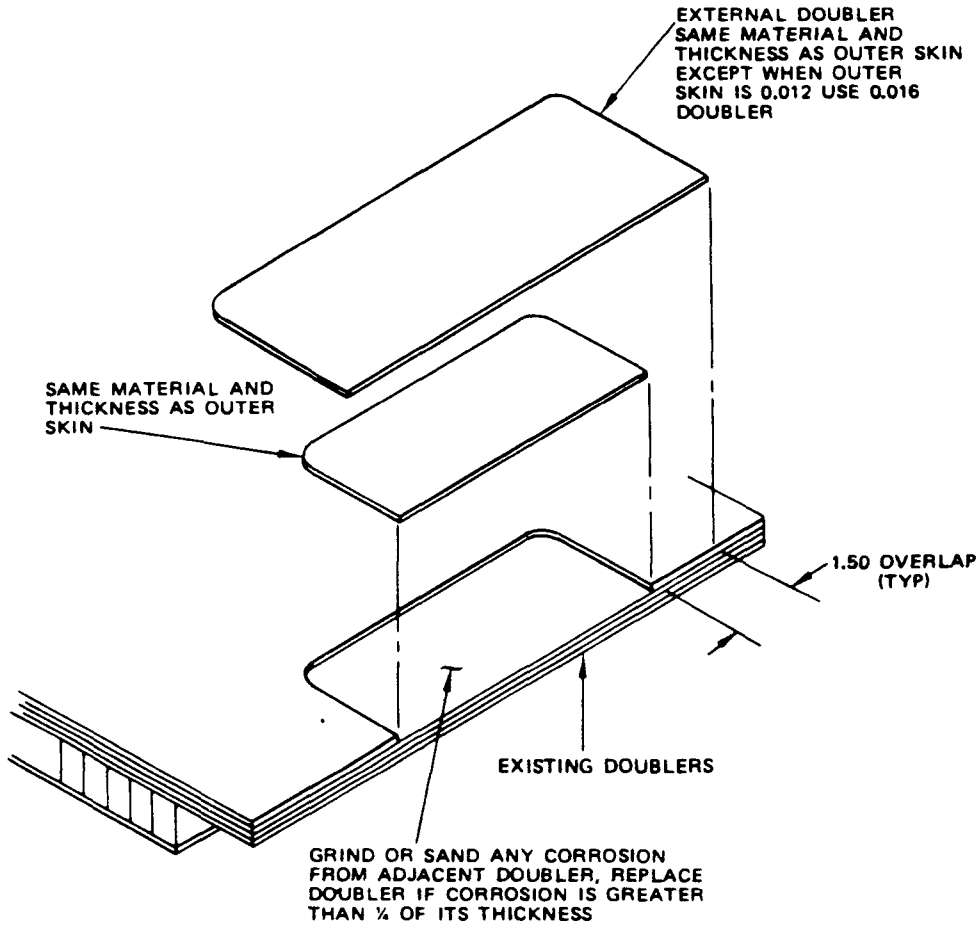
NOTES

- REFER TO PAR 6L FOR REPAIR PROCEDURE
- WHERE AERODYNAMIC SMOOTHNESS IS REQUIRED, APPLY AERODYNAMIC SMOOTHER TO EDGES OF OUTER REPAIR DOUBLERS. REFER TO 51–4–1.

Square Edge Panel Repair Puncture Damage
Figure 34

NOTES

- REPAIRS TO OUTBOARD WING PANELS WILL REQUIRE AERODYNAMIC SMOOTHER TO THE EDGES OF THE EXTERNAL DOUBLER WHICH ARE PERPENDICULAR TO THE AIRSTREAM.
- REFER TO PAR 6L FOR REPAIR PROCEDURE



Square Edge Panel Repair - Corrosion and/or Delamination Damage
Figure 35

NOTES

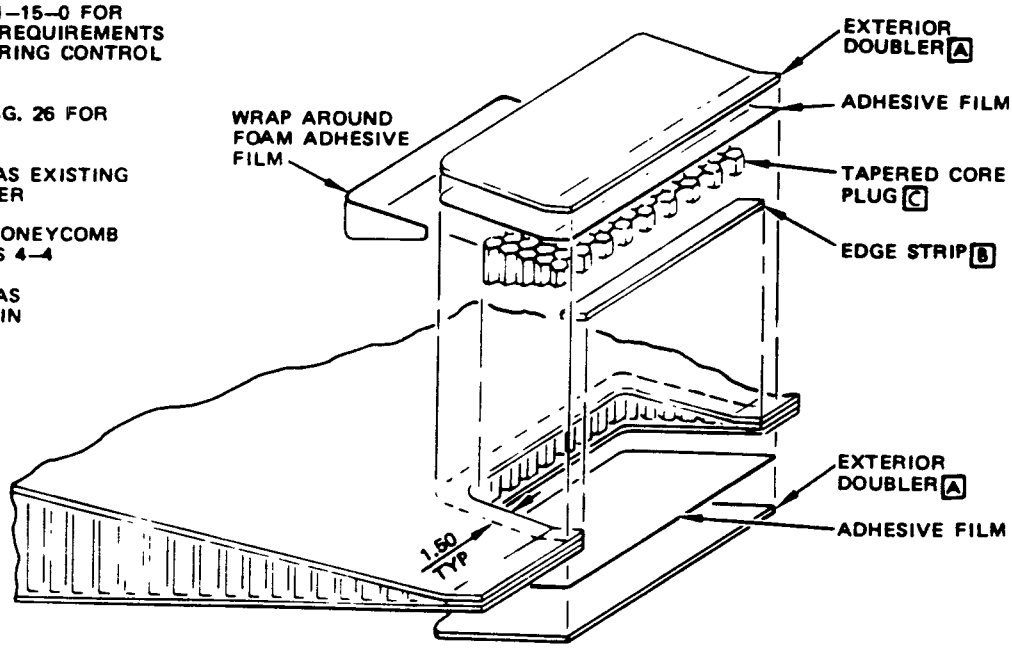
- REFER TO PAR 6K FOR REPAIR PROCEDURE
- REFER TO 51–15–0 FOR BALANCING REQUIREMENTS WHEN REPAIRING CONTROL SURFACES

[A] REFER TO FIG. 26 FOR GAGE

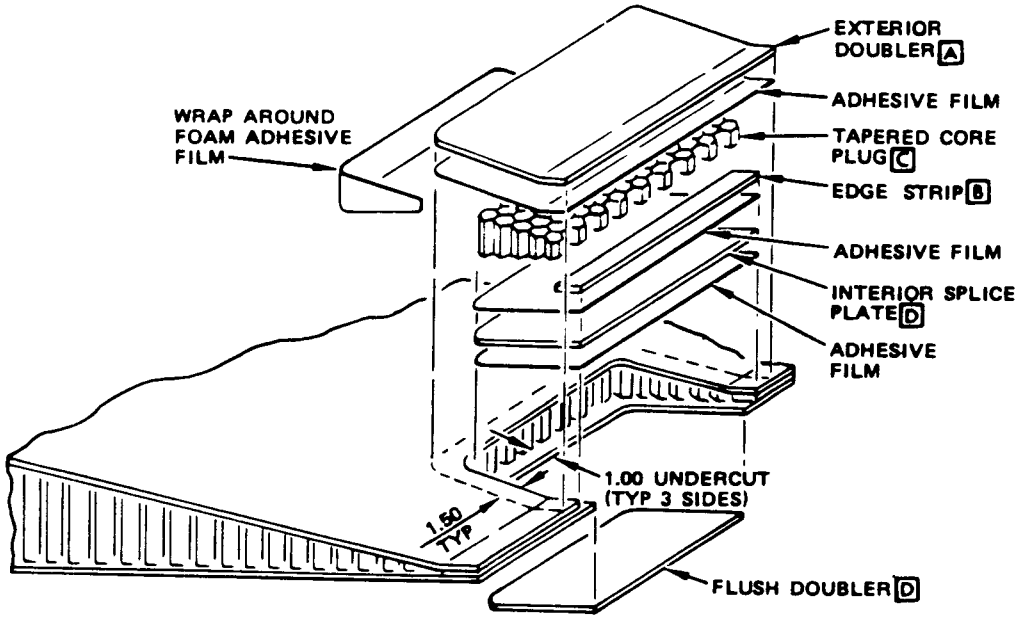
[B] SAME GAGE AS EXISTING EDGE DOUBLER

[C] ALUMINUM HONEYCOMB CORE TO BMS 4–4

[D] SAME GAGE AS ORIGINAL SKIN



DETAIL I
REPAIR WITH TWO NON–FLUSH DOUBLERS



DETAIL II
REPAIR WITH ONE FLUSH DOUBLER

Trailing Edge Repair - Honeycomb
Figure 36

MOISTURE REMOVAL FROM PERFORATED ALUMINUM HONEYCOMB ASSEMBLIES

1. Introduction

A. This moisture removal procedure applies only to those panels which have a perforated aluminum honeycomb core - a core which has been manufactured with a number of very small holes in its cell walls.

B. The existence of water in a perforated honeycomb assembly may be due to failure of the seals at the ends of the assembly or due to damaged skin; its presence in the honeycomb may be suspected by cracked or damaged seals or skin, but can only be positively located by x-ray. When water is discovered in an assembly, remove it as indicated in the paragraphs which follow.

2. Preparing the Assembly

A. The affected assembly may have the water removed while attached to the airplane (figure 2) or taken off and worked on a bench or trestle, or in special cases, (indicated in paragraph 4) put into a heated vacuum platen.

B. End seals on honeycomb assemblies are of a thin layer (.10 to .30 thick) of aerodynamic smoother. This rubbery material may be cut out with a sharp, pointed knife. Remove the sealant, one row of the metal honeycomb core, and adhesive flash down to the plane of the tape adhesive on the skins, do not attempt to remove the tape adhesive itself, unless already detached from the skin. On large assemblies where it is impossible to get at the ends, or where water concentration shows up in the middle, cut a 1/2 inch diameter hole in one skin only at least 1 inch from assembly end, and 2 inches from the extreme trailing edge (figure 3).

CAUTION: CARE MUST BE TAKEN TO PREVENT THE GOUGING OF THE FRAGILE CELL WALLS WITH THE KNIFE.

NOTE: Occasionally, an end seal will consist of BMS5-28 sealant. This sealant is a very hard epoxy, and it is not practical to remove it by hand. The seal must be removed with a powered router.

C. Place strips of double backed masking tape along the skin surface, over and under the area cut out, and also on the end seal in front of the area cut out. In the area thus enclosed pack several layers of absorbent cloth against the open cell walls. Leave a small opening, approximately 2-1/2 inches from the trailing edge for insertion of the vacuum tube. Enclose these layers of cloth with a piece of PVA, PVC or polyethylene film, which has been cut to a suitable size, and stick to double backed tape, making a bag loose enough to allow for flexing under vacuum. Any leaky corners in bag may be sealed with masking tape or duxseal. Cut opening in the bag to allow entrance of vacuum line. Core should be cut back, at this point only, about 1/2 inch.

D. The vacuum line hook up to assembly (see figure 2) consists of transparent vinyl tubing 1/2" O/D x 1/4" I/D which goes from inside the assembly to

the air aspirator, about a foot away from the honeycomb assembly a tee fitting is fitted into the line and a small length of tubing attached to allow release of vacuum. While vacuum is being drawn this outlet must be plugged with any suitable removable plug. The bag may be tested at this stage for leaks, plug any leaks found with Presstite Fit line through bag into honeycomb core, make airtight seal around bag with Presstite

E. Above area that has the greatest concentration of water drill a 1/2 inch diameter hole in skin and insert tubing that is connected to vacuum gage. Tube can be of any convenient length. Seal around tube with Presstite. Below area that has the greatest concentration of water bring hose attached to portable heater. Heat lamps or heating blocks may also be used as a source of heat. Use thermocouple temperature indicator if heating blocks are used.

3. Removing the Moisture

A. Heat the area containing water for about 15 minutes or until a temperature of 180°F is reached. Templestiks or Templaks may be used to indicate temperature.

B. Turn on vacuum source and draw a steady vacuum to a maximum of 20 inches Hg. If gage reading will not exceed 10", check vacuum bag for excessive leakage.

CAUTION: ON THE HORIZONTAL STABILIZER TRAILING EDGE DO NOT EXCEED A VACUUM OF 15 INCHES Hg.

C. Leave heat and vacuum on assembly for one hour. Water being extracted from assembly will be evidenced by the appearance of water droplets appearing in the transparent vinyl tubing. When water appears to have ceased coming out of the assembly a rocking type action shall be given to the air flow by removing the plug on the Tee section and alternately opening and closing the line with the finger until no more water appears to be drawn out.

D. Take an x-ray picture at this time to determine the amount of water left in the assembly. When the x-ray shows that about 90% of the water is removed, and no dense pockets that could cause damage by freezing are left, the operation may be considered completed.

NOTE: A dense pocket is defined as 5 or more adjacent cells with water in. The actual rate of water removal, depending upon heat and vacuum applied, will be four-tenth pound approximately, in 90 minutes.

E. Remove the vacuum apparatus, and allow the assembly to cool for at least 30 minutes.

F. Repair holes in the skin as per 51-10-1.

G. Control tabs after repair must be weighed and rebalanced per section 51-15-1.

4. Water Removal from Control Tabs

A. Remove water from the control tabs in the following manner:

(1) Remove tab from the airplane.

(2) Remove end seals or drill holes in tab. (See figures 5 to 8.)

(3) Place tab on heated vacuum platen and pack with Osnaburg cloth, or other suitable material, to insure that the vacuum shall reach all of the openings. Place a vacuum blanket over the tab and seal. (See figure 4.)

NOTE: If a heated vacuum platen is not available place the tab in an oven capable of having a vacuum drawn in it, or construct an airtight box or bag large enough to take the tab. Any suitable source of external heat, capable of heating the tab to 225°F to 260°F, may be used.

(4) Bring the tab up to a temperature of 225°F to 260°F at a rate of rise of 12° per minute than pull a full vacuum of 28 inches of mercury and hold for 5 minutes. After 5 minutes of full vacuum release pressure for 10 minutes. Continue this cycle of 5 minutes vacuum, 10 minutes release pressure for 60 to 90 minutes.

NOTE: The actual rate of water removal, depending upon heat and vacuum applied, will be four-tenth pound approximately, in 90 minutes.

(5) Allow part to cool. When cooled, x-ray to determine if any water is left in; if so, the above heat cycling procedure shall be repeated, and an additional x-ray taken to show results.

(6) Reseal holes per 51-10-1.

(7) Rebalance tabs per 51-15-3, 51-15-4, 51-15-9 or 51-15-13.

5. Repair of End Seals

A. End seals on the honeycomb assemblies are either a BMS5-79 sealant or a BMS5-28 sealant. After water removal, repair these end seals as follows:

6. BMS5-79 Sealant

A. BMS5-79 sealant, known as "Aerodynamic Smoother" is a soft, putty-like compound, and is easily applied on a clean surface with a spatula or flow gun and cures in about 24 hours.

B. Prepare the required amount of sealant with the correct activator (the batch number of the base compound and the activator must be identical) using exact proportions called for on the containers.

C. Mix thoroughly until mixture is of a uniform color. Do not entrap air bubbles while mixing.

7. Application

A. Clean end with aliphatic naphtha and clean cheesecloth.

B. Apply compound with a flow gun or spatula. Make certain that no air is trapped in the recess during the filling procedure. Overfill to allow for smoothing and leveling. Because of compound shrinkage two fillings may be required approximately 8 hours apart to bring compound up to level.

C. Use spatula to smooth level.

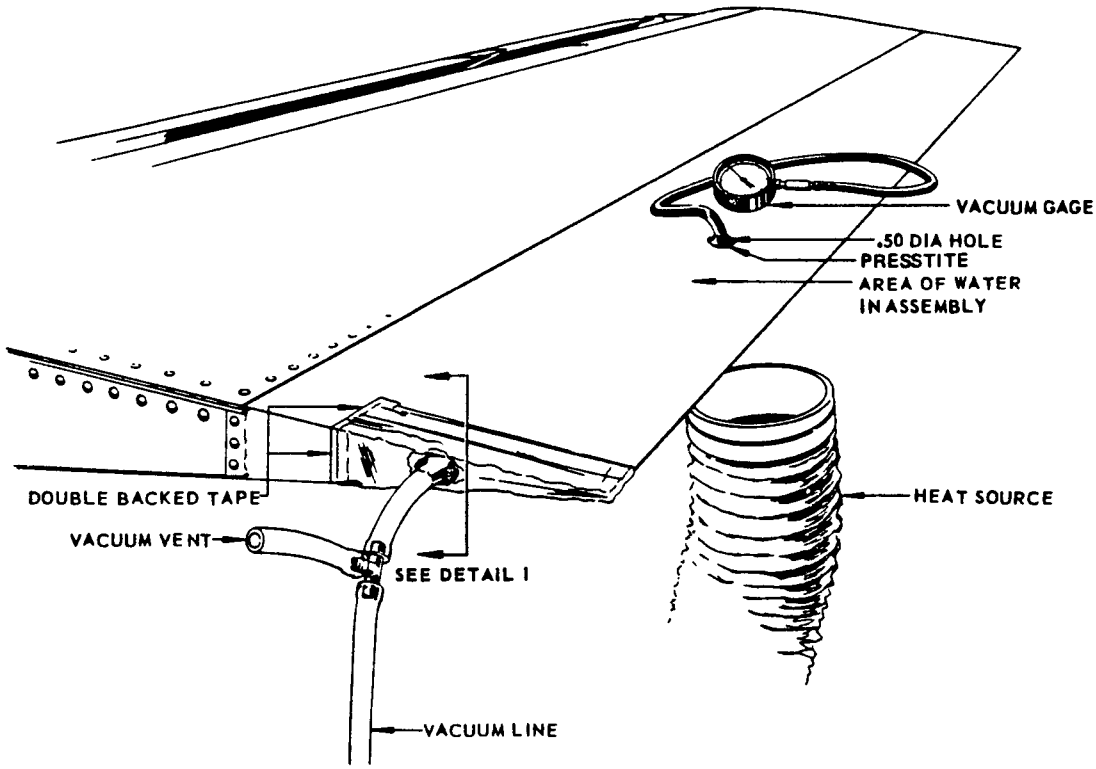
D. After compound has been allowed to cure (at least 24 hours) paint end with BMS10-11 paint, per 51-2-0 of the 707 Maintenance Manual.

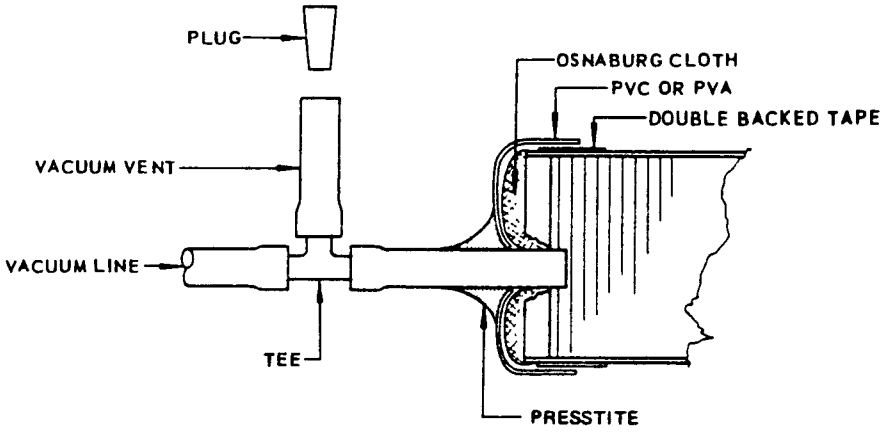
8. BMS5-28 Sealant

A. BMS5-28 sealant is a hard epoxy sealant. A repair to the end seals of this material, which may be greater than one inch diameter, shall be carried out using potting compound 1 mixed as indicated in figure 15, 51-10-1.

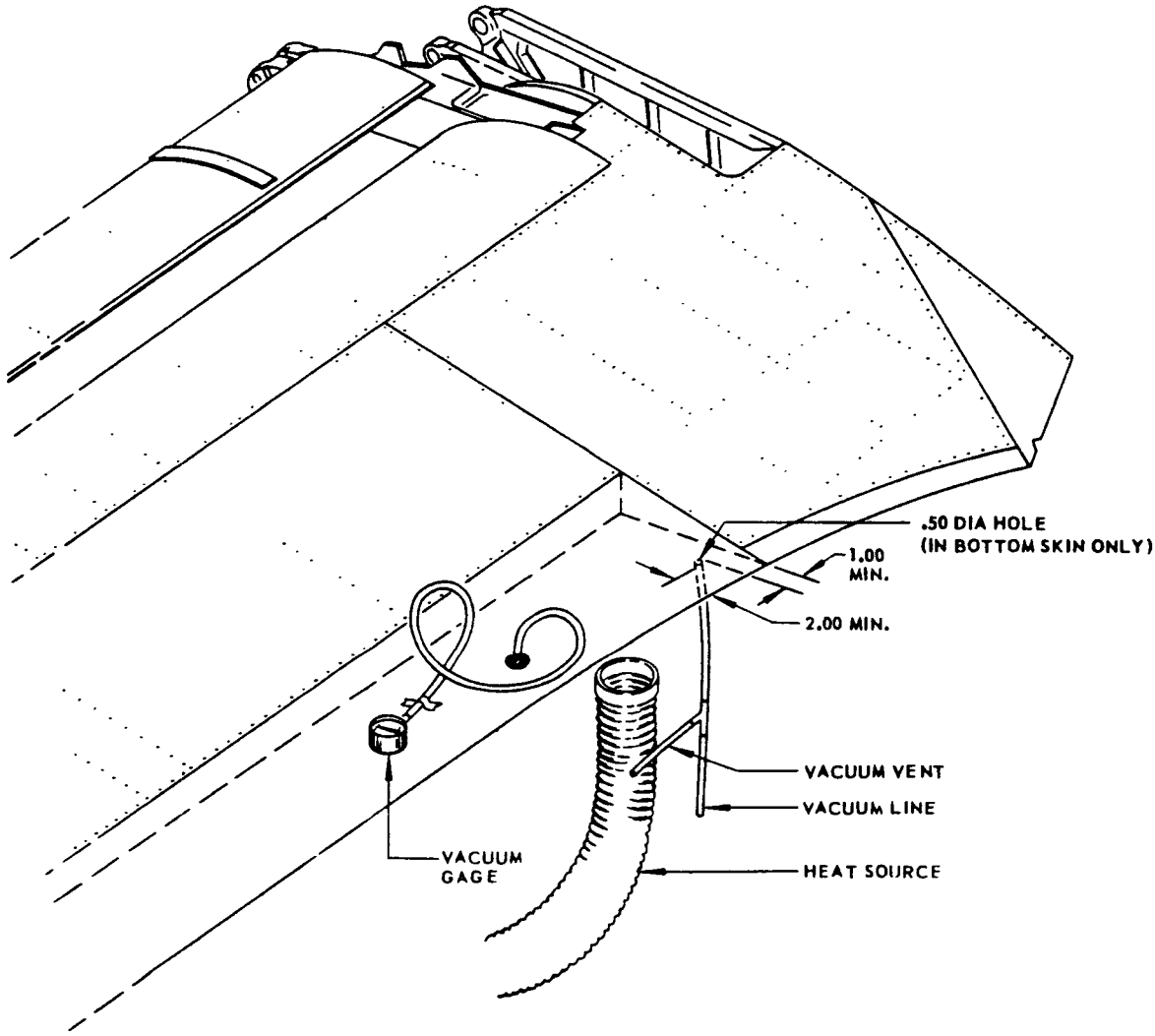
ITEM	IDENTIFICATION	SUPPLIER
AIR ASPIRATOR	PENDRITHY NO. 21 XL-96 3/8 DIA.	STEAM SUPPLY AND RUBBER CO. 123 JACKSON ST. SEATTLE, WASH. 98104
HOT AIR BLOWER		HERMAN NELSON DIVISION OF AMERICAN AIR FILTER CO. INC., MOLINE, ILLINOIS 61265
TEE FITTING	TO FIT VINYL TUBI NG	ANY SOURCE
VINYL TUBING	TRANSPARENT ½ O/D x ¼ I/D	ANY SOURCE
ABSORBENT CLOTH	OSNABURG	ANY SOURCE OR BEMIS COMPANY INC., 55 SO. ATLANTIC ST. SEATTLE, WASH 98134
SEALANT (VACUUBAG)	PRESSTITE (587.9)	ENMAR CORPORATION 39TH AND CHOUTEAU STS. ST' LOUIS, MO. 93110
BULK SEALING PUTTY	POLYVINYL CHLORIDE (PVC) POLYVINYL ALCOHOL (PVA) OR POLYETHYLENE FILM	ANY SOURCE OR REYNOLDS METAL CO 2819 FIRST AVE. SEATTLE, WASH. 98121
DOUBLE BACKED MASKING TAPE MASKING TAPE		ANY SOURCE OR MINNESOTA MINING AND MFG CO 3M CENTER ST ST PAUL MINNESOTA 55101
½" DRILL		ANY SOURCE
SCISSORS		ANY SOURCE
TEMPLSTIK OR TEMPLAK	175°F TO 200°F	TEMPILSTIK CORPORATION 132 W 22ND ST. NEW YORK, N.Y. 10011

Repair Materials and Equipment
Figure 1

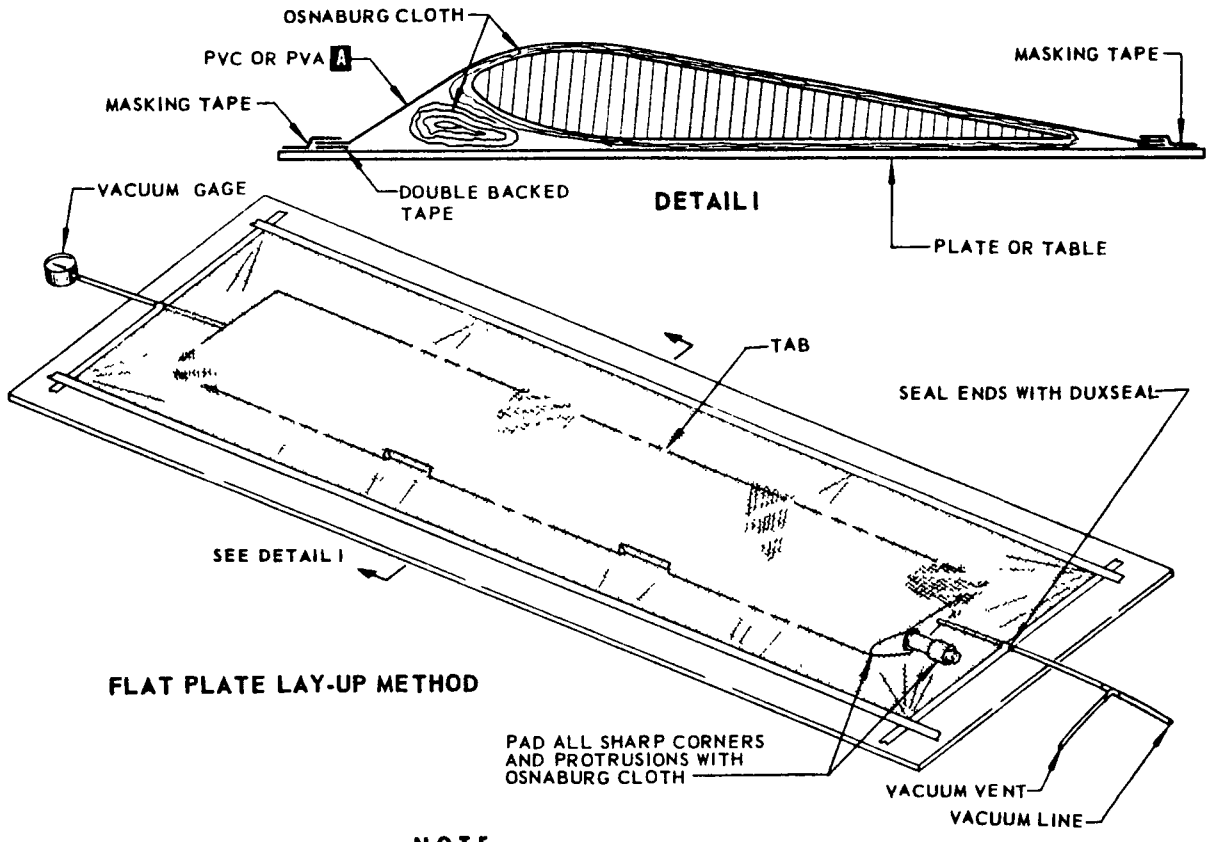

VACUUM GAGE
.50 DIA HOLE
PRESSTITE
AREA OF WATER IN ASSEMBLY
DOUBLE BACKED TAPE
VACUUM VENT
SEE DETAIL 1
HEAT SOURCE
VACUUM LINE


PLUG
OSNABURG CLOTH
PVC OR PVA
DOUBLE BACKED TAPE
VACUUM VENT
VACUUM LINE
TEE
PRESSTITE

DETAIL 1



Location of Holes In Skin
Figure 3



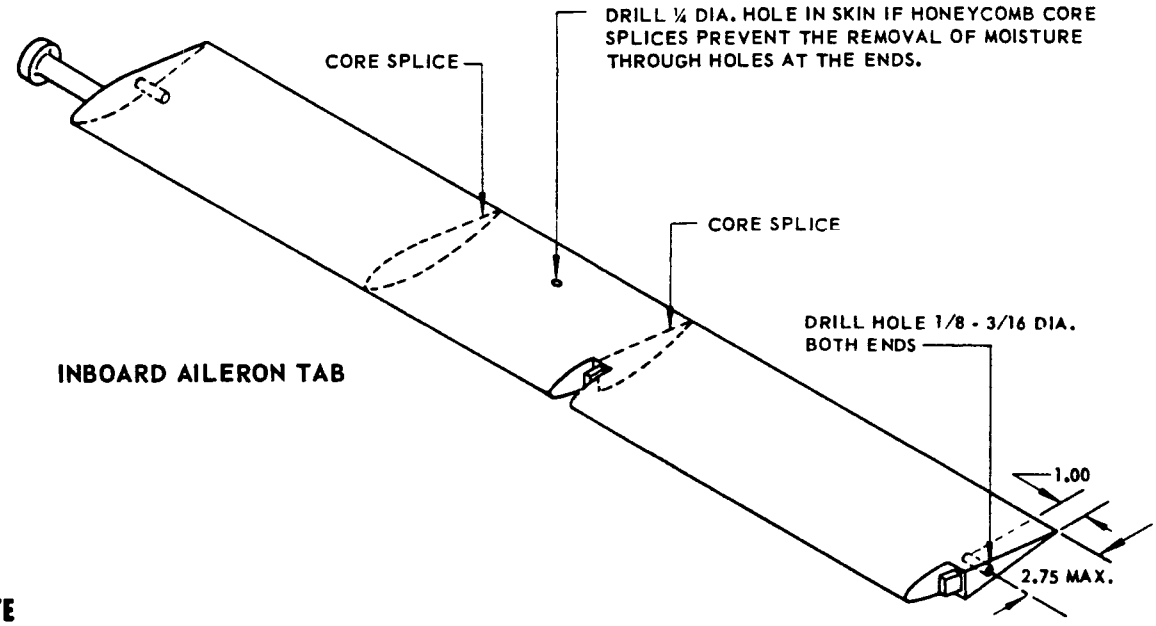
FLAT PLATE LAY-UP METHOD

NOTE

ANY SUITABLE HEAT SOURCE CAPABLE OF BRINGING TAB UP TO 225°F TO 260°F MAY BE USED

A OR ANY SUITABLE VACUUM BLANKET CAPABLE OF WITHSTANDING 260° F

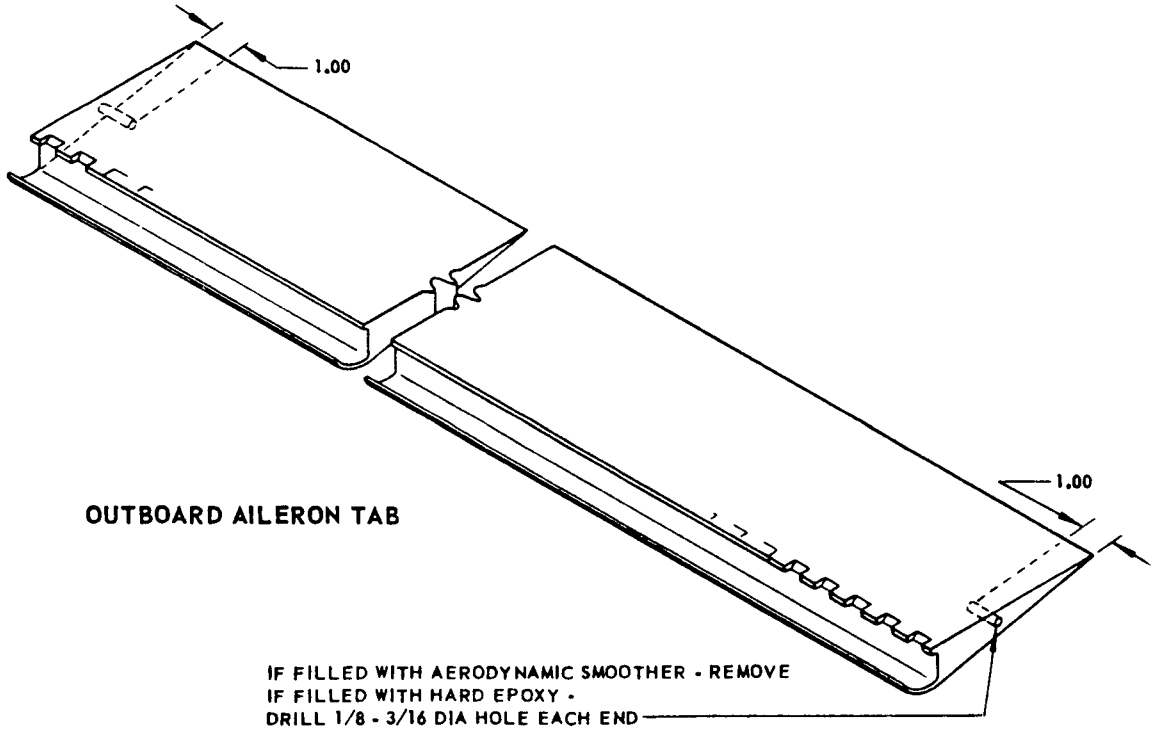
Water Removal From Tabs - Alternate to Heated Vacuum Platen
Figure 4



INBOARD AILERON TAB

NOTE

THE LOCATION OF HOLES FOR WATER REMOVAL AS ILLUSTRATED FOR THE AILERON TABS IS TYPICAL FOR ALL TABS CONTAINING PERFORATED ALUMINUM HONEYCOMB CORE.



OUTBOARD AILERON TAB

Location of Holes for Water Removal from Tabs
Figure 5

CORRODED ALUMINUM HONEYCOMB TAB REPAIR

1. Introduction

A. This section outlines repair procedures for corrosion damage on aluminum honeycomb tab structures.

B. See repair procedures as outlined in 51-10-1 for other damage.

2. Prepare Tab for Examination

A. Remove all hinge blocks, actuator fittings, etc.

B. Clean Tab Surface

(1) Wipe off excess oil, grease or other contamination.

(2) Apply solvent per BMS 11-7 from safety cans with oil-free absorbent materials.

(3) Scrub surface with a clean fiber brush to loosen soils.

(4) Wipe off solvent before it has evaporated with a clean oil and lint-free, absorbent disposable material such as finetex, new cheese cloth, or new rags with less than .75 per cent oil. Laundered, returnable rags or towels are not satisfactory.

(5) Repeat applications of clean solvent as necessary to remove oils.

C. Application of Paint Strippers

NOTE: The surface must be thoroughly dry and at a temperature of 50°F to 100°F.

(1) Mask bonded skin edges with Permacel P112 aluminum foil tape or equivalent before applying the stripper.

(2) Make a brush application to the unmasked surfaces with any one of the following recommended strippers;

(a) Nuvite Take-off 631-3A

(b) Turco 4669 (thick) preferred for removal of epoxy finishes

(c) Del Chem E-Z Strip 19AC

(d) Del Chem E-Z Strip 19A Type I

(3) Completely mix the stripper in the container before withdrawing any for use.

(4) Brush liberal amounts of well mixed stripper on the painted surface. Brush apply in one direction only. Do not brush back and forth.

(5) Apply the stripper to an area no larger than can be reasonably worked. The surface must remain moist.

(6) Allow the stripper to set undisturbed until the paint is completely loosened as indicated by wrinkling. This will require fifteen minutes to two hours.

(7) If finish is not completely stripped remove old stripper and re-apply stripper to the entire area keeping the surface moist.

(8) Scrub stubborn areas with a stiff bristle brush applying stripper when required to keep surfaces moist with stripper.

D. Removal of Stripper

(1) Remove excess stripper and loosened paint with squeegee or rags.

(2) Clean the surface in accordance with the applicable parts of 51-10-3, paragraph 2B.

E. Visual Examination of Tab

(1) Visually examine cleaned tab for skin delamination, loose fasteners or any structural defect.

(2) Carefully examine the tab by using a 8-power or higher magnifying glass and probe with a sharp tool to determine if corrosion exists at these typical locations.

(a) Spar forward face

(b) Spar flanges

(c) Spar flange radii

(d) Spar flange fasteners

(e) Balance weight fasteners

(f) Balance weight brackets

(g) Skin edges along spar.

(3) See 51-10-3, figure 1 for illustration of possible corrosion areas.

(4) Examine skin and spar bond line. Probe with a knife blade or equivalent at moderate force to locate any areas of skin and spar separation.

(5) If a separation area is found, insert a piece of suitably shaped shimstock into the gap and using a sawing motion, attempt to enlarge the separation and establish the limits of the unsound bond.

NOTE: Unsound bond area may extend into the honeycomb structure.

(6) Examine the extent of all corrosion damage on the tab and then determine the repair limits as outlined in 51-10-3, paragraph 3.

3. Repair Limits

A. Dimensional Limits

(1) Max full length span repairs with the corresponding chord width dimensions are as shown in 51-10-3, figure 2, Table I.

(2) Max full chord width repair with the corresponding span length dimensions are as shown in 51-10-3, figure 2, Table I.

B. Rebalancing Limits

(1) Rebalance requirements of the repaired tab are as outlined in 51-15-0.

C. Weight Limits

(1) The weight of the repaired and rebalanced tab with the corresponding adjust weight requirement of the control surface system are as shown in 51-15-0 of the Structural Repair Manual or 27-15 of the Overhaul Manual.

D. Tab Weight and Balance Calculation

(1) If any tab requires a full span length repair or a full chord width repair as shown in 51-10-3, figure 2, calculate the weight and balance effect of the repair and determine if the required nose weight and the required adjust weight can be installed in the available weight space before beginning the actual repair. Refer to 51-15-0 of the Structural Repair Manual for rebalancing procedures.

(2) Weight Data for Weight and Balance Calculations

(a) Aluminum alloy 0.101 pounds/cubic inch

(b) 4130 steel 0.283 pounds/cubic inch

(c) Sintered tungsten alloy 0.600 pounds/cubic inch

(d) Fiberglas EC 181 plus requisite BMS 5-29 (one layer cured thickness = .015 inch nominal) .050 pound/cubic inch

4. Repair Procedures

A. See 51-10-3, Figure 3, for typical corroded tab repair.

B. See 51-10-1, Figure 2, for special materials and tools required for honeycomb structure repair.

C. Locate the delaminated skin removal edge cut at approximately 0.5 inch outside the limits of the established boundary line of solid bond as outlined in 51-10-3, paragraph 2, and shown in 51-10-3, Figure 1. Detail I.

D. Preparation of Damaged Area

(1) Remove balance weight brackets and attachments.

(2) Cut and remove the corroded portion of the spar flange as required.

(3) Trim and remove delaminated skin in accordance with 51-10-1 to the boundaries established in 51-10-3, paragraph 4C. Additional skin may be removed if examination reveals that corrosion has penetrated beyond the initial removal boundaries.

(4) Check repair limits and determine if the tab repair should be completed or abandoned.

(5) Remove Corrosion from Spar

(a) Mechanically remove the corrosion by using 2024-T3 alloy knives, rotary files, or 180 grit or finer aluminum oxide paper. Typical tools are suggested on 51-13-1, figure 1.

NOTE: Do not reduce flange thickness below the minimum dimensions given in 51-10-3, Figure 2. Table I.

(b) Blend local deep corroded areas into surrounding surface. Ratio blend length to measured depth at least 100 to 1.

(c) Finish surface to 63 RHR (RMS).

CAUTION: DO NOT USE "WET OR DRY" TYPE PAPER OR "WINDOW SCREEN" TYPE ABRASIVE SHEET

(6) Break sharp edges .03 on all repair parts, and trimmed original parts.

(7) Remove all burrs, nicks, scratches and sharp edges on all repair parts and trimmed original parts.

(8) Clean tab and remove all dirt, water, shavings, etc.

(9) Check spar flanges to determine if the thickness values of 51-10-3, Figure 2, Table I are not less than minimum requirements, and examine with a magnifying glass all refinished areas for any remaining corrosion.

(10) Immediately following examination of the work on the spar, brush alodize per 51-8-0.

E. Fiberglass Layup

(1) Apply fiberglass layup as outlined in 51-10-1, Figure 19.

NOTE

A MAKE CAREFUL EXAMINATION AT ALL FASTENER LOCATIONS TO DETECT ANY EVIDENCE OF LOOSENING OR CORROSION.

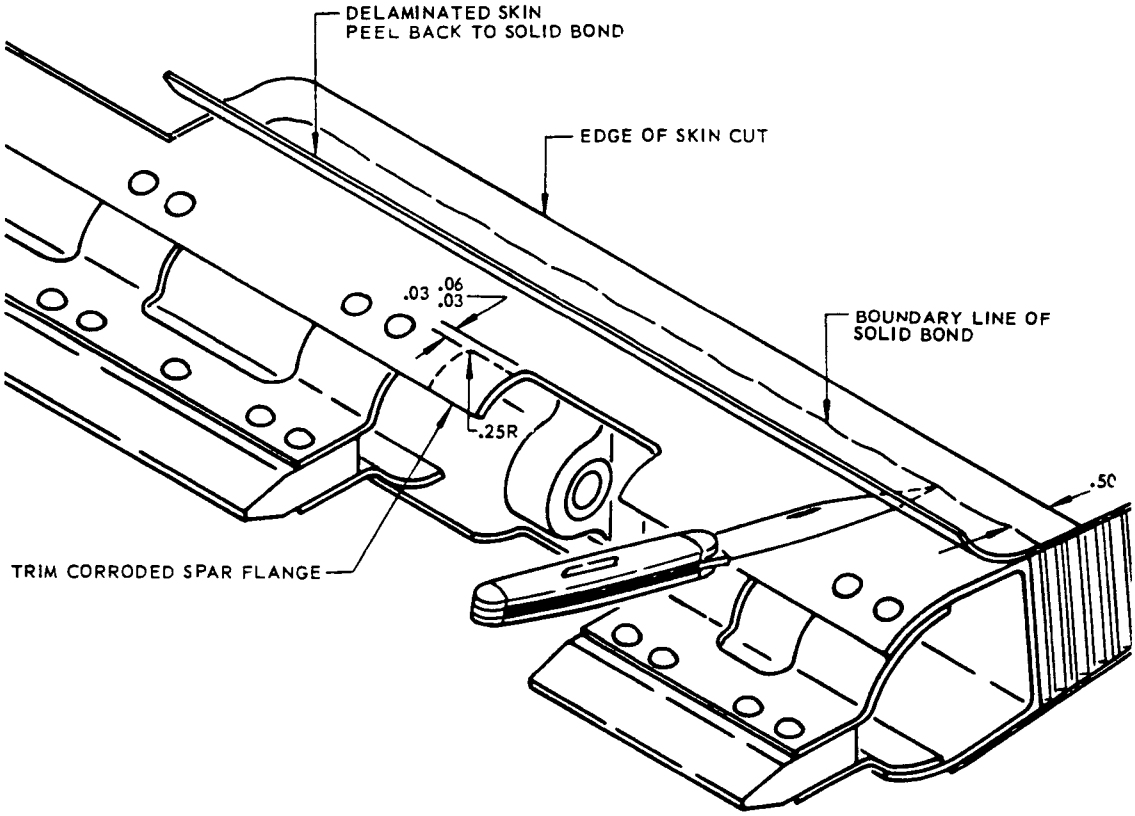
B MAKE CAREFUL EXAMINATION ALONG SKIN AND SPAR BOND LINE TO DETECT ANY INDICATION OF DELAMINATION OR CORROSION.

C MAKE CAREFUL EXAMINATION OF SPAR FLANGES, SPAR FORWARD FACE AND BALANCE WEIGHT INSTALLATION PARTS FOR ANY INDICATION OF CORROSION PITS OR DAMAGE.

D MAKE CAREFUL EXAMINATION ALONG SKIN BOND LINE TO DETECT ANY INDICATION OF DELAMINATION OR CORROSION.

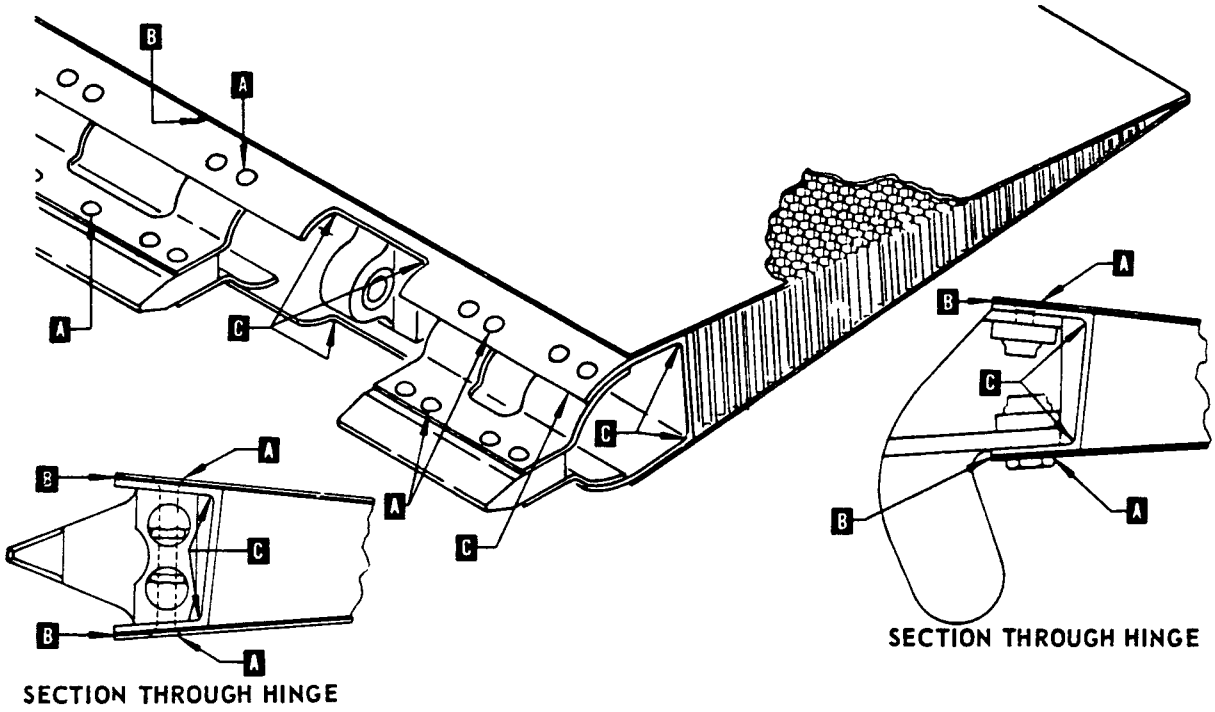
E MAKE CAREFUL EXAMINATION OF HINGE FITTINGS FOR ANY INDICATION OF CORROSION DAMAGE.

F MAXIMUM SURFACE DEPTH ALLOWED AFTER CORROSION CLEANUP IS AS NOTED.



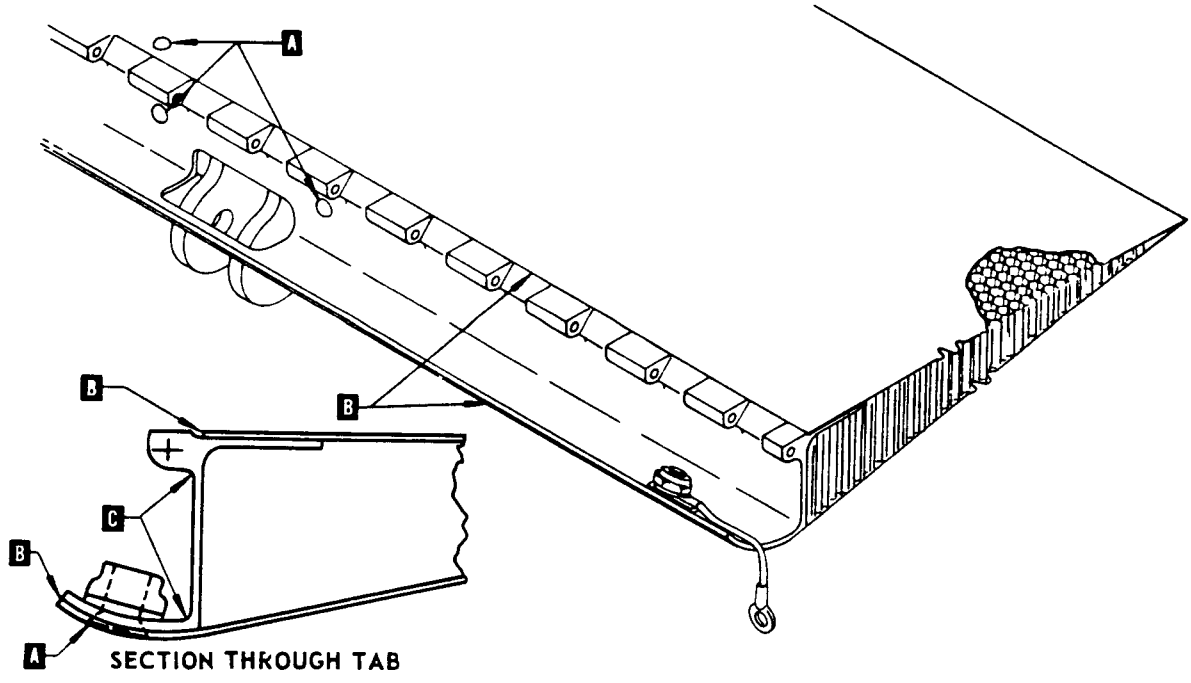
METHOD FOR DETERMINING BOUNDRY LINE OF SOLID BOND

Honeycomb Tab Examination
Figure 1 (Sheet 1 of 4)



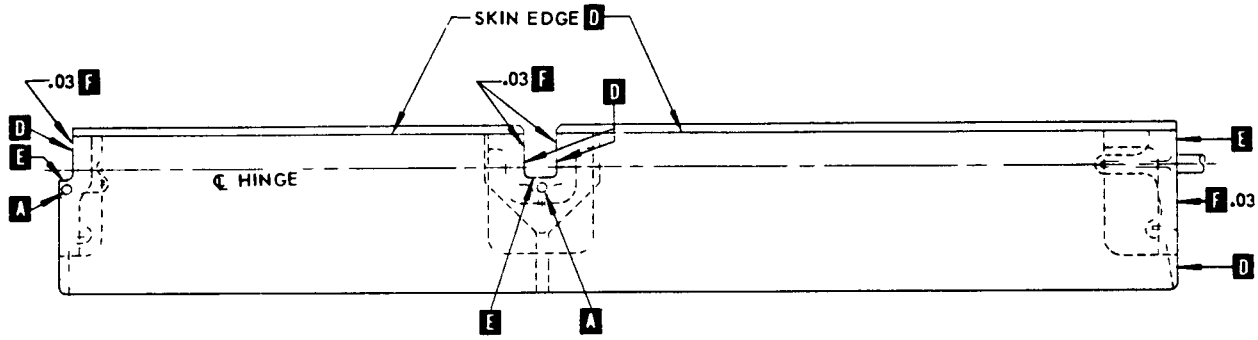
RUDDER CONTROL TAB

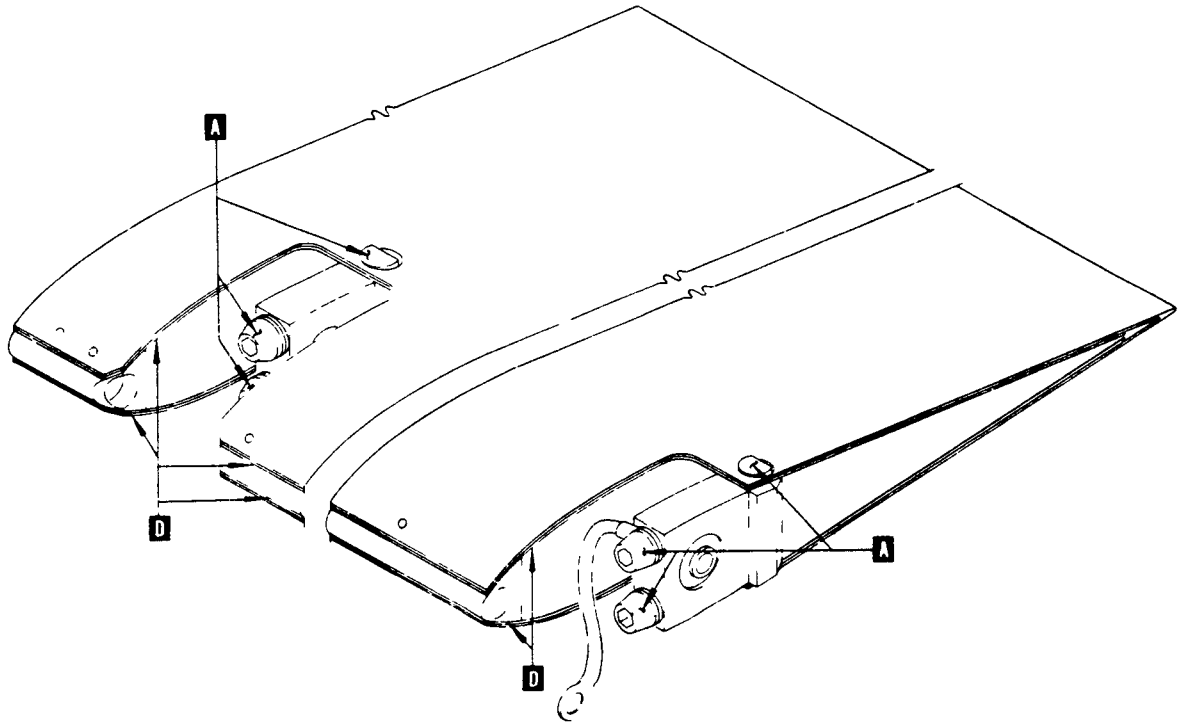
RUDDER CONTROL TAB AS SHOWN ELEVATOR CONTROL AND STABILIZER ACTUATED TABS SIMILAR



OUTBOARD AILERON TAB

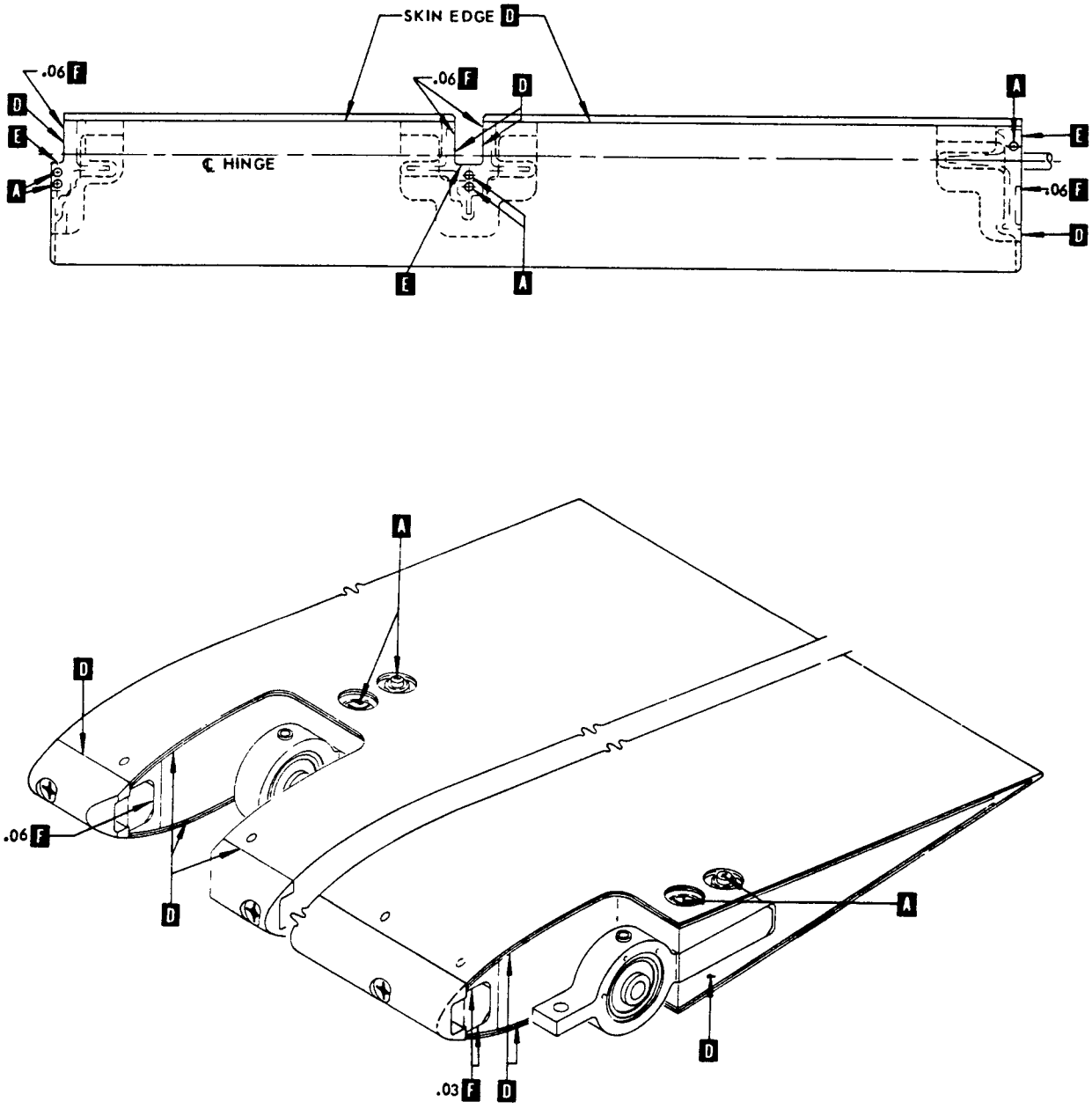
Honeycomb Tab Examination
Figure 1 (Sheet 2 of 4)



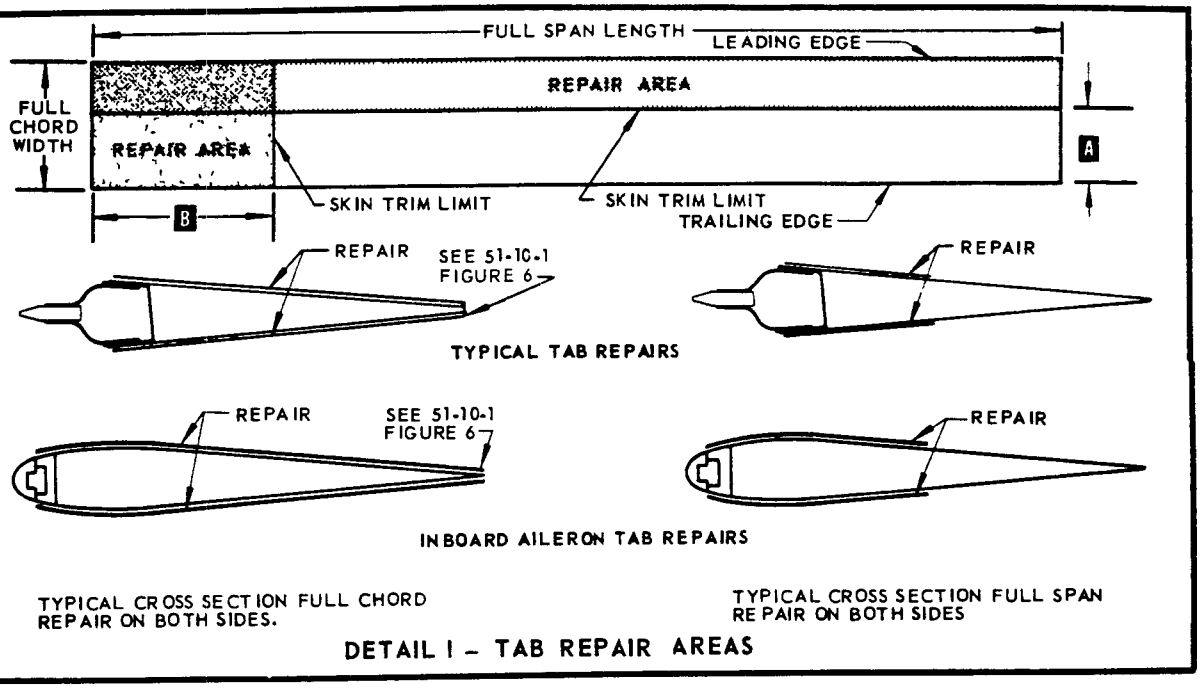


INBOARD AILERON TAB
(EARLY AIRPLANES)

Honeycomb Tab Examination
Figure 1 (Sheet 3 of 4)



INBOARD AILERON TAB
(LATER AIRPLANES)



DETAIL I – TAB REPAIR AREAS

TAB	SKIN TRIM DIMENSIONS						TRAILING EDGE TO ℄ HINGE	SPAR FLANGE MINIMUM THICKNESS
	FULL CHORD WIDTH REPAIR		FULL SPAN LENGTH REPAIR					
	ONE SIDE ONLY B C	BOTH SIDES AT SAME TIME B D	ONE SIDE ONLY A E		BOTH SIDES AT SAME TIME A F			
	REPAIR LENGTH	REPAIR LENGTH	MIN	MAX	MIN	MAX		
RUDDER CONTROL	20	15	5.80	7.80	7.50	8.50	10.0	HINGE AND ACTUATOR BLOCK MOUNTING PAD .070 OTHER AREAS .030
ELEVATOR STABILIZER ACTUATED	12	7	4.20	6.60	6.60	7.25	8.70	HINGE AND ACTUATOR BLOCK MOUNTING PAD .070 OTHER AREAS .030
ELEVATOR CONTROL	20	20	5.00	6.60	6.60	7.25	8.70	HINGE AND ACTUATOR BLOCK MOUNTING PAD .070 OTHER AREAS .030
OUTBOARD AILERON	24	12	2.30	4.50	3.00	4.75	5.00	UPPER FLANGE .030 SEE DETAIL II LOWER FLANGE .030
INBOARD AILERON	18 G	9 G	4.80 G	7.00 G	5.00 G	7.00 G	7.00	SEE FIG. 1 FOR AILERON CORROSION DEPTH LIMITS

TABLE I

NOTE

MAXIMUM ALLOWED REPAIRS AS FOLLOWS ARE NOT TO BE USED SIMULTANEOUSLY ON THE SAME TAB.

C ONLY ONE REPAIR ON ONE SIDE OF THE TAB AT THE INDICATED DIMENSIONS AND AT ANY PLACE THROUGHOUT THE SPAN LENGTH.

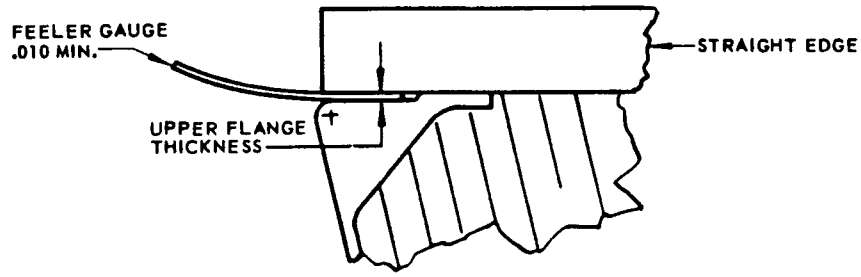
D ONLY ONE REPAIR ON BOTH SIDES OF THE TAB AT THE INDICATED DIMENSIONS AND AT ANY PLACE THROUGHOUT THE SPAN LENGTH.

E ONLY ONE REPAIR ON ONE SIDE OF THE TAB AT THE INDICATED DIMENSIONS.

F ONLY ONE REPAIR ON BOTH SIDES OF THE TAB AT THE INDICATED DIMENSIONS.

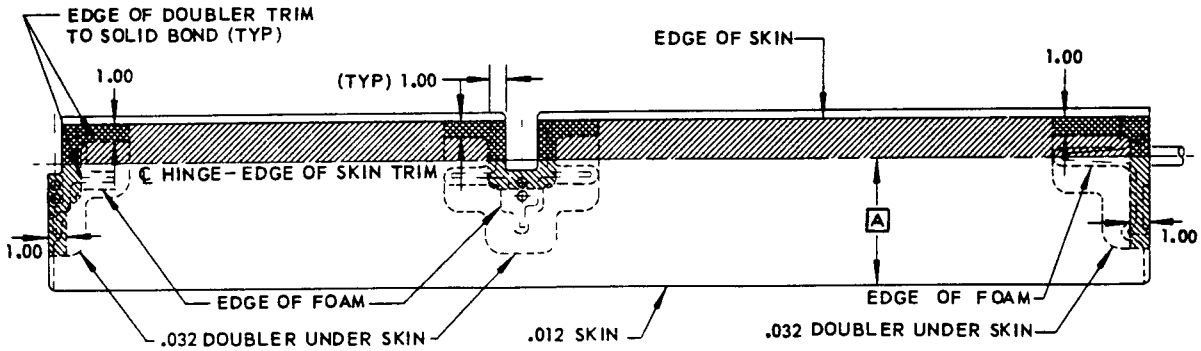
G SEE DETAILS III AND IV FOR MAXIMUM DOUBLER EDGE TRIM.

Honeycomb Tab Repair Limits
Figure 2 (Sheet 1 of 2)



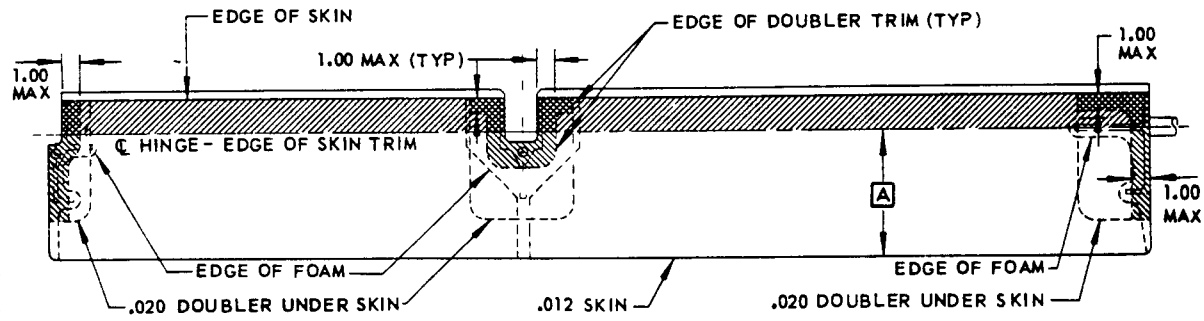
OUTBOARD AILERON TAB

DETAIL II – MEASURE FLANGE THICKNESS AS SHOWN



TRIM DOUBLER EDGES TO SOLID BOND AS REQUIRED BUT DO NOT EXCEED THE SHADED AREA DIMENSIONS. IF IT IS REQUIRED THAT THE DOUBLER EDGES ARE FURTHER TRIMMED OR THAT THE DOUBLER BE REPLACED, CONSULT THE BOEING SERVICE UNIT FOR SPECIAL REPAIR.

DETAIL III – INBOARD AILERON



TRIM DOUBLER EDGES TO SOLID BOND AS REQUIRED BUT DO NOT EXCEED THE SHADED AREA DIMENSIONS. IF IT IS REQUIRED THAT THE DOUBLER EDGES ARE FURTHER TRIMMED OR THAT THE DOUBLER BE REPLACED, CONSULT THE BOEING SERVICE UNIT FOR SPECIAL REPAIR

DETAIL IV – INBOARD AILERON

REPAIR INSTRUCTION

1. This repair is applicable to corroded skin and spar repairs on aluminum honeycomb tab structure. See Fig. 4 for Inboard Aileron Tab repair instructions.

2. Remove tab from airplane in accordance with Maintenance Manual, Chapter 27.

3. Clean tab and examine for corrosion as outlined in 51-10-3, par. 2.

4. Determine the repair limits and the solid bond boundaries as outlined in 51-10-3, par. 3.

5. If balance weight brackets are required to be replaced determine dimension A and B at each end of the tab and record before disassembly. See applicable detail IV, X or XII for method of determining dimensions.

6. Cut out damaged skin and corroded spar flange as outlined in 51-10-3, par. 4. Ref 51-10-3, Fig. 2, Table II for minimum spar flange thickness allowed.

7. Cut out, remove and replace damaged honecomb in accordance with 51-10-1.

8. Clean tab after cutting and trimming and remove all dirt, shavings, oil, water, etc.

9. Brush alodize per 51-8-0 all bare metal parts and areas.

10. Fabricate new balance weight brackets similar to detail parts (1), (2), (3) and (4) as required.

11. Add additional balance weight material in the areas indicated if required by fabricating new parts or by silver brazing additional material onto the original balance weight.

12. Install balance weights and brackets and locate by using dimensions A and B previously determined in step 5.

13. Determine the number of fiberglass plies as required for the applicable tab in Table I and install the filler and overlay plies similar to instructions in 51-10-1, Fig. 19.

14. Cover all fastener holes with fiberglass layup.

15. Clean reinforcing washers at actuating arm fastener holes and insert into wet overlay as shown in Detail V. Center washer over the hole in the spar and press into the layup until the upper surface of the washer is flush with the fiberglass surface. Clamp washer in position until cured. When the fiberglass is fully cured drill fastener holes through layup at the hinge, actuator fitting and bonding jumper attachment points.

16. Counterbore hinge and bonding jumper fastener holes as shown in Detail VI.

Honeycomb Tab Repair
Figure 3 (Sheet 1)

REPAIR INSTRUCTIONS (Cont)

17. Add a single fiberglass overlay along the uncut or unrepaired metal skin edges as shown in Detail VII.

18. Restore original finish to tab per finish requirement of 51-2-0 of the Maintenance Manual.

19. Install hinge blocks, actuator fittings and bonding jumpers. Check the contact area of the bonding jumper to determine if the bonding area is bare before installation.

20. Check balance of tab as outlined in applicable subject. See Table I.

21. Increase balance weight moment if required by installing new balance weights or modify existing weights as described in step 11.

NOTES

- CORRODED RUDDER TAB REPAIR AS SHOWN OTHER TAB REPAIRS SIMILAR
- SEE 51-8-8 FOR METAL PROTECTIVE TREATMENT
- SEE 51-2-0 FOR FASTENER CODE, REMOVAL AND INSTALLATION, HOLE SIZES AND EDGE MARGIN
- BREAK SHARP EDGES 0.03 ALL REPAIR PARTS AND TRIMMED ORIGINAL PARTS. ADD NEW BALANCE

[A] ADD ADDITIONAL BALANCE WEIGHT MATERIAL IN THE INDICATED AREA

[B] TRIM CORRODED SPAR FLANGE AS REQUIRED

[C] SEE FIG. 2 FOR SKIN TRIM DIMENSION LIMITS.

[D] SEE TABLE I OF FIG. 2 FOR MINIMUM FLANGE THICKNESS.

[E] DO NOT REPLACE DOUBLER. SEE FIG. 2 FOR DOUBLER TRIM LIMITS ON INBOARD AILERON TAB

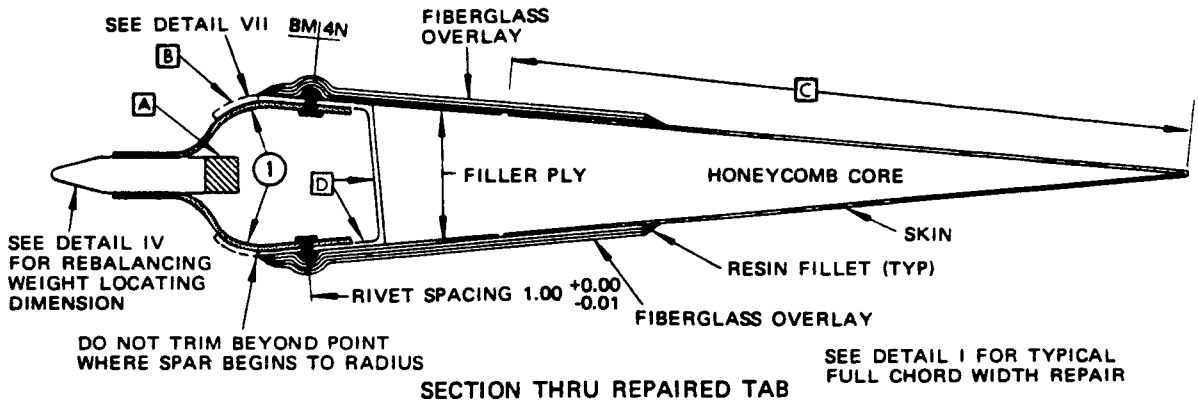
[F] CORROSION DAMAGE TO DOUBLER MUST BE CLEANED UP AND BLENDED TO SMOOTH CONTOUR. REMOVAL OF DOUBLER IS NOT REQUIRED

Honeycomb Tab Repair
Figure 3 (Sheet 2)

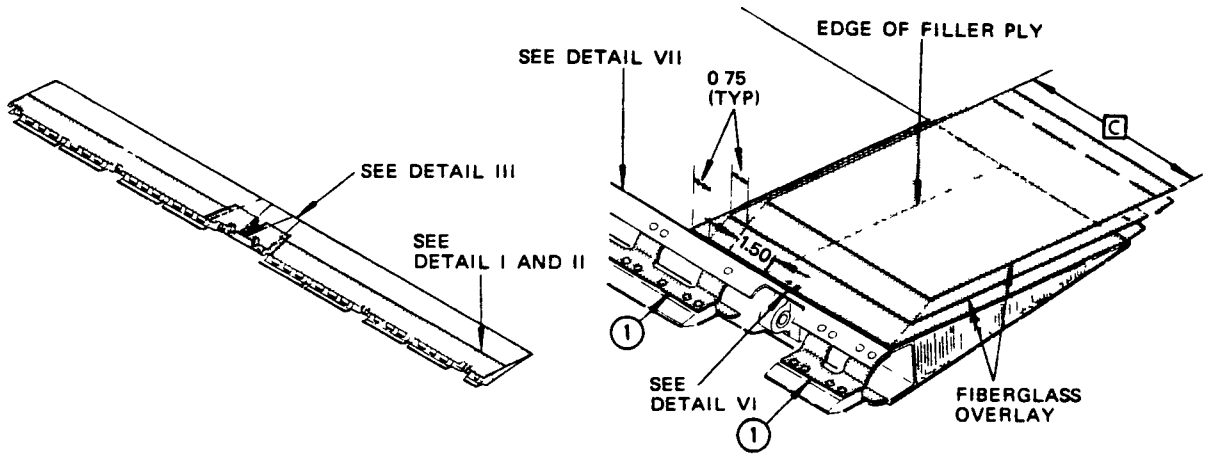
TAB	THICKNESS OF ORIGINAL ALUMINUM SKIN AND DOUBLER		REPAIR MATERIAL		
			NUMBER OF STYLE 181 OR 1581 FIBERGLASS CLOTH PLIES		
	SKIN	DOUBLER	SKIN REPLACEMENT ONLY	SKIN AND DOUBLER REPLACEMENT	DOUBLER REPAIR ONLY [E]
RUDDER CONTROL 51 15-13	0 010	0.025	1 FILLER PLY 3 PLY OVERLAY PATCH	2 FILLER PLIES 5 PLY OVERLAY PATCH	5 PLY OVERLAY PATCH
ELEVATOR STA BILIZER ACT UATED 51 15-9	0 010	0 025	1 FILLER PLY 3 PLY OVERLAY PATCH	1 FILLER PLY 5 PLY OVERLAY PATCH	5 PLY OVERLAY PATCH
ELEVATOR CONTROL 51 15-10	0 010	0 025	1 FILLER PLY 3 PLY OVERLAY PATCH	1 FILLER PLY 5 PLY OVERLAY PATCH	5 PLY OVERLAY PATCH
OUTBOARD AILERON 51 15-6	0 008	0 008	1 FILLER PLY 2 PLY OVERLAY PATCH	3 FILLER PLIES 2 PLY OVERLAY PATCH	2 PLY OVERLAY PATCH
INBOARD AILERON 51 15-3	0 012	0 032	1 FILLER PLY 3 PLY OVERLAY PATCH	[E] 3 FILLER PLIES 6 PLY OVERLAY PATCH	6 PLY OVERLAY PATCH
	0 012	0 020	1 FILLER PLY 3 PLY OVERLAY PATCH	[E] 2 FILLER PLIES 5 PLY OVERLAY PATCH	4 PLY OVERLAY PATCH

TABLE I

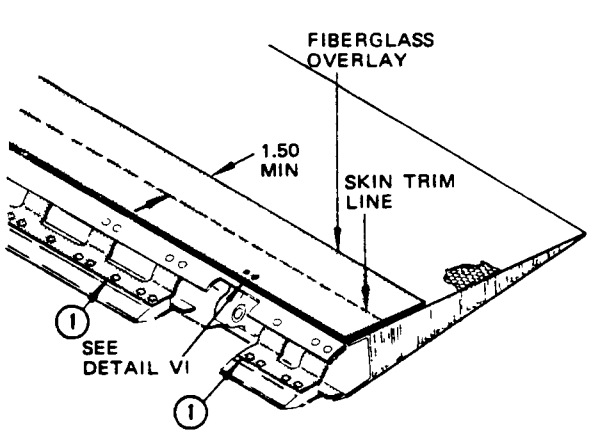
Honeycomb Tab Repair
Figure 3 (Sheet 3)



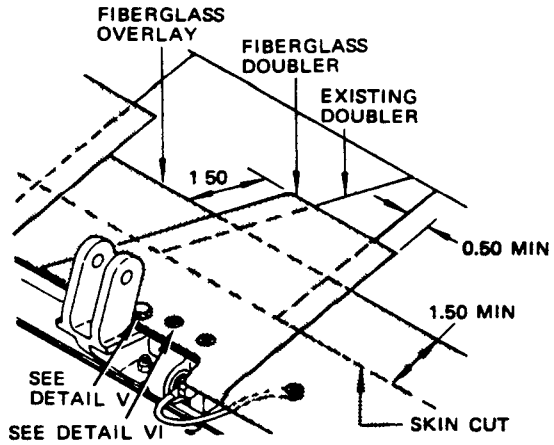
SECTION THRU REPAIRED TAB
FULL SPAN LENGTH REPAIR



TYPICAL FULL CHORD WIDTH REPAIR
DETAIL I

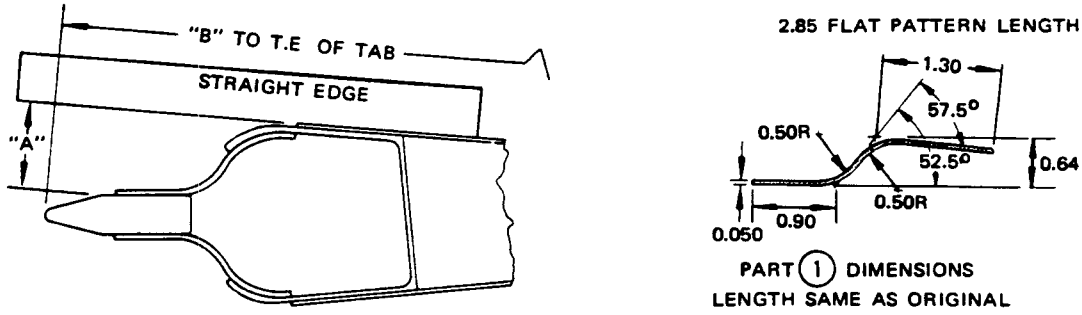


TYPICAL SPAN LENGTH REPAIR
DETAIL II

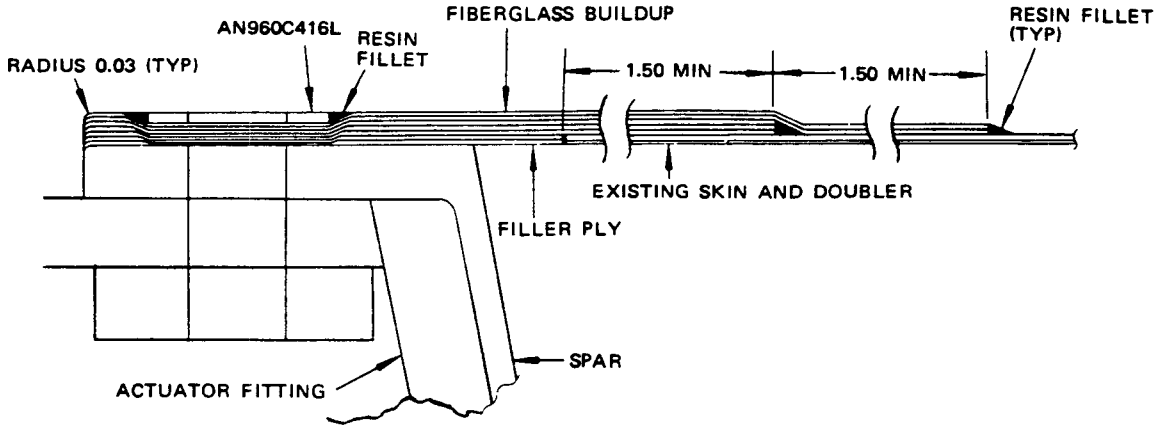


DETAIL III

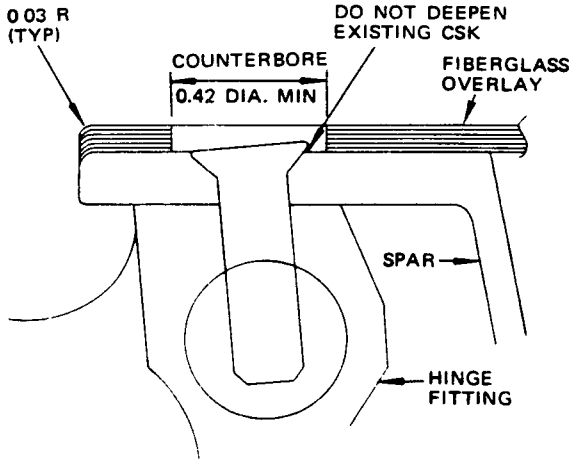
Honeycomb Tab Repair
Figure 3 (Sheet 4)



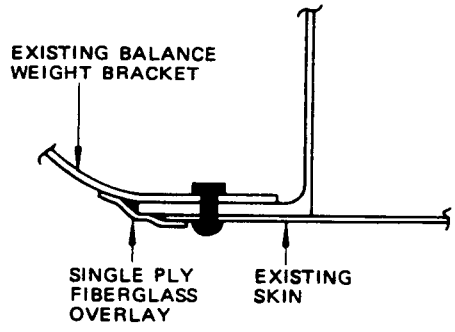
BALANCE WEIGHT LOCATING DIMENSIONS "A" AND "B"
DETAIL IV



SECTION THRU ACTUATOR
DETAIL V

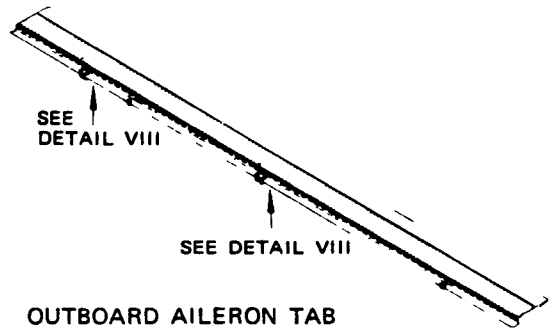


SECTION THROUGH HINGE
DETAIL VI

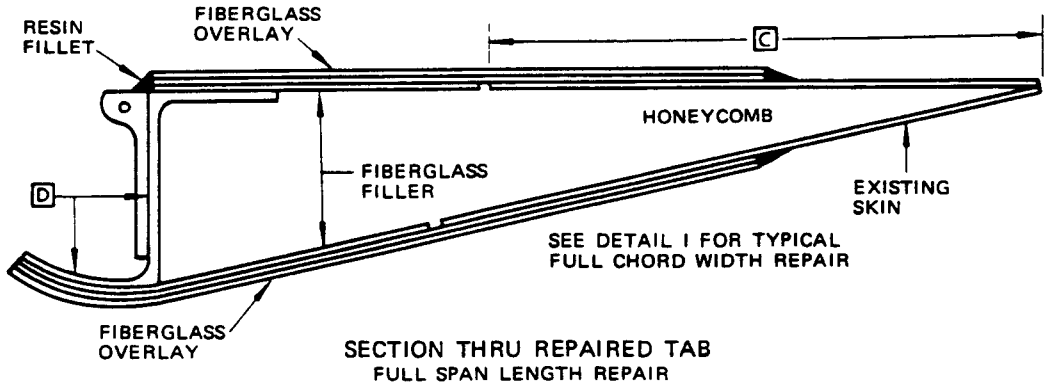


FIBERGLASS LAYUP
(WHEN SKIN IS NOT CUT BACK)
DETAIL VII

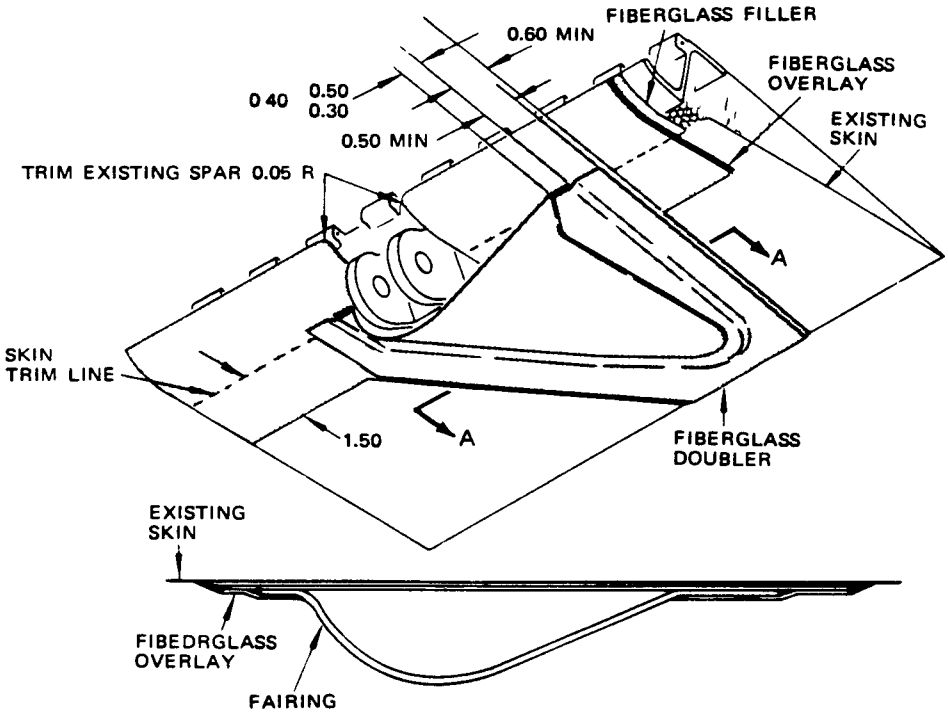
Honeycomb Tab Repair
Figure 3 (Sheet 5)



OUTBOARD AILERON TAB



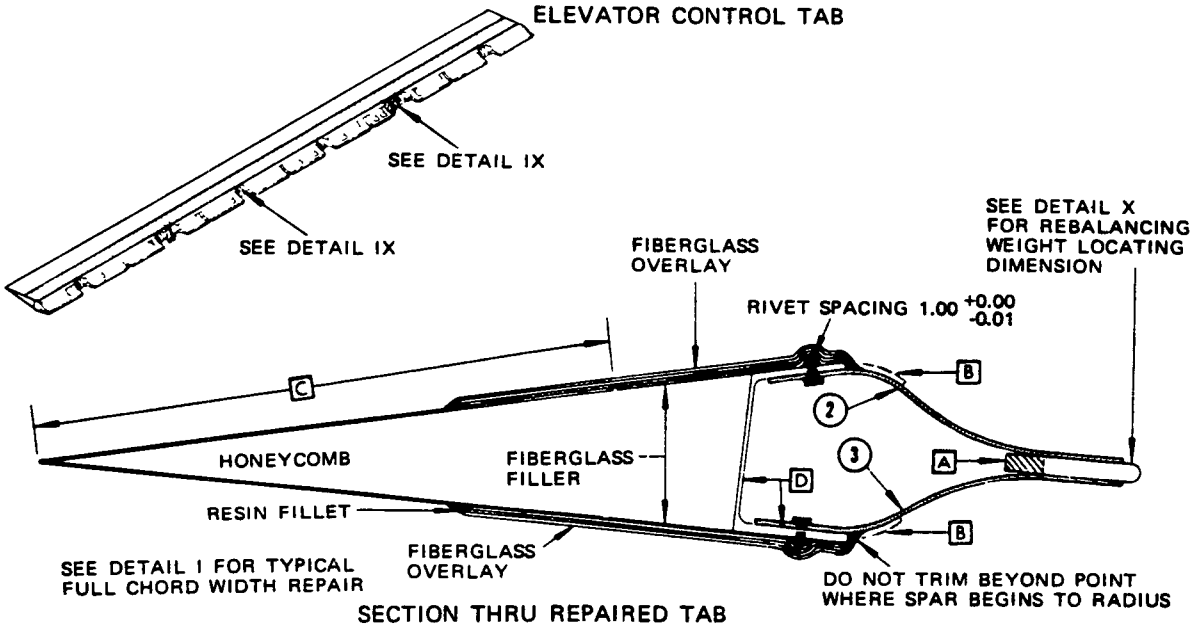
SECTION THRU REPAIRED TAB
FULL SPAN LENGTH REPAIR



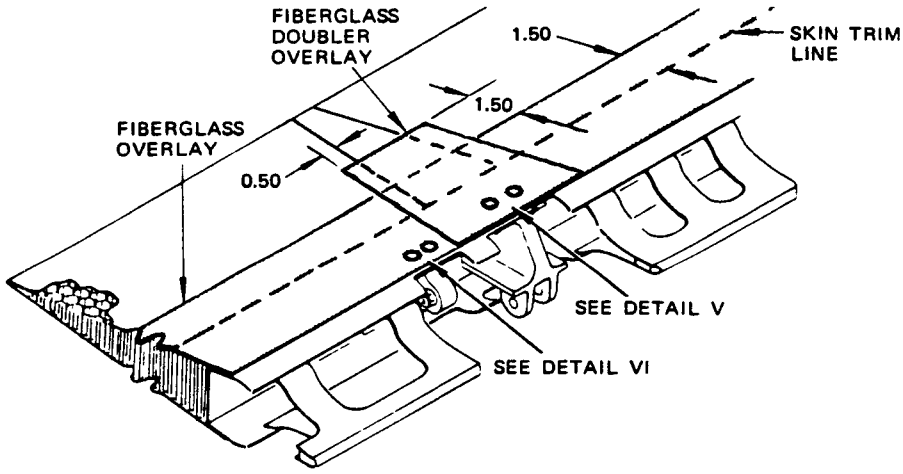
SECTION A–A

DETAIL VIII

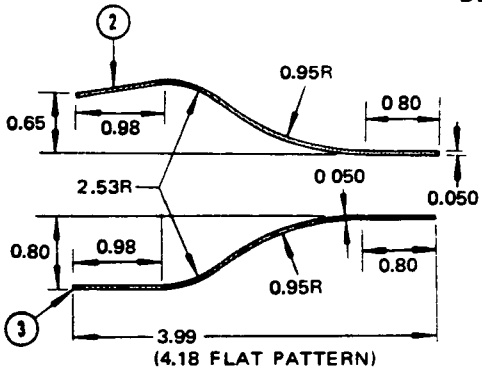
Honeycomb Tab Repair
Figure 3 (Sheet 6)



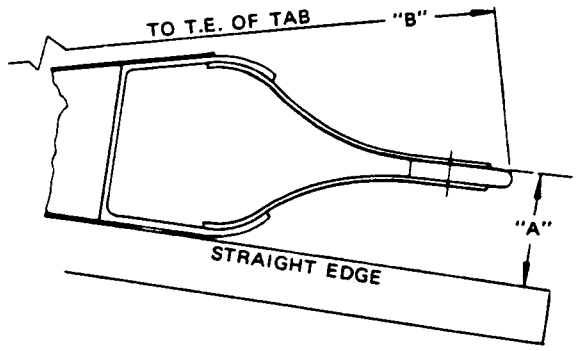
SECTION THRU REPAIRED TAB
FULL SPAN LENGTH REPAIR



DETAIL IX



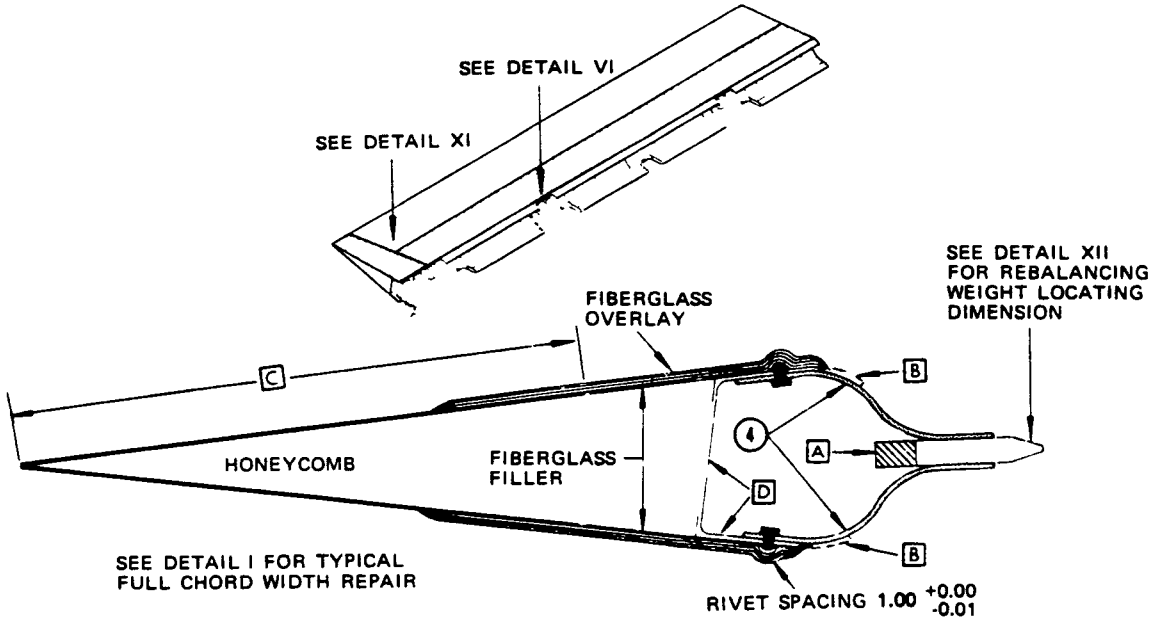
PART (2) AND (3) DIMENSIONS LENGTH SAME AS ORIGINAL



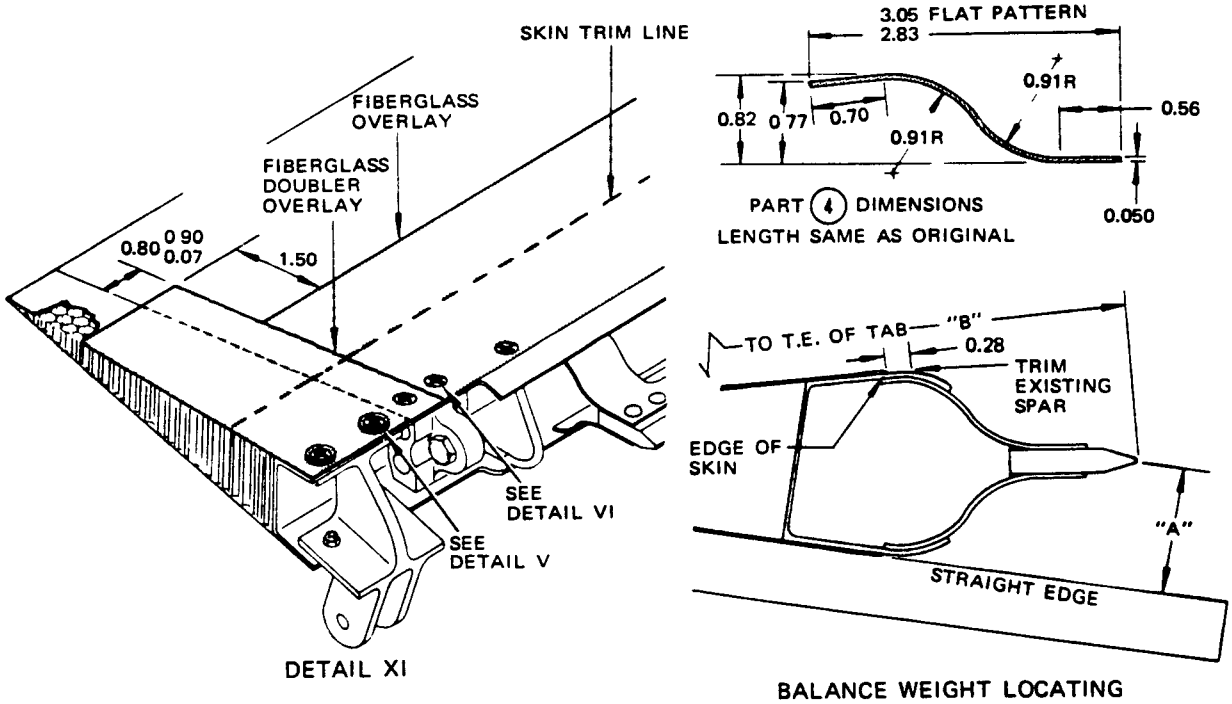
BALANCE WEIGHT LOCATING DIMENSIONS "A" AND "B"
DETAIL X

Honeycomb Tab Repair
Figure 3 (Sheet 7)

ELEVATOR STABILIZER ACTUATED TAB



SECTION THRU REPAIRED TAB
FULL SPAN LENGTH REPAIR



DETAIL XI

BALANCE WEIGHT LOCATING DIMENSIONS "A" AND "B"
DETAIL XII

Honeycomb Tab Repair
Figure 3 (Sheet 8)

REPAIR INSTRUCTIONS

1. Remove inboard aileron tab from the airplane in accordance with Maintenance Manual, Chapter 27.
2. Remove hinge fittings and fasteners.
3. Remove leading edge nose and balance weights:
   a. If the tab nose is as shown in detail I, emove the nose and the balance weights.
   b. If the tab nose is as shown in detail II, remove the nose weight only.

   CAUTION: IF THE BALANCE WEIGHT OF DETAIL II HAS BEEN INSTALLED WITH ADHESIVE, CARE MUST BE TAKEN TO DRIVE THE BALANCE WEIGHT OUT WITHOUT DAMAGING THE TAB.
4. Clean the tab and examine for corrosion as outlined in 51-10-3, paragraph 2.
5. Determine the repair limits and the solid bond boundaries as outlined in 51-10-3, paragraph 3.
6. Cut out damaged skin, trim doubler edge if required and remove corrosion as outlined in 51-10-3, paragraph 4. See 51-10-3, figure 2 for allowable corrosion depth after cleanup.
7. Hinge fitting examination.
   a. Examine the foamed-in-place hinge fittings for evidence of looseness or damage. If the hinge fitting is loose or damaged, discard the tab.
   b. If the hinge fitting is firmly in place and there is no evidence of other damage proceed with the repairs as outlined.
8. Cut out, remove and replace damaged honeycomb in accordance with 51-10-1.
9. Chamfer or radius on all indicated edges.
10. Clean tab after cutting and trimming and remove all dirt, shavings, oil, water etc.
11. Brush alodize per 51-8-0 all bare metal parts and areas. Prime faying surfaces with BM10-11, Type I.
12. Determine the number of fiberglass plies as required for the aileron tab in figure 3, table I and install the filler and overlay plies similar to instructions given in 51-10-1, figure 19.
13. Cover all fastener holes with fiberglass layup as shown.
14. Drill and counterbore fastener holes through the fiberglass layup after cure.
15. Overlay the edges previously chamfered in paragraph 9. and indicated by note [A] with a single faberglass overlay. Fiberglass overlay on edges must not interfer with the installation of the hinge fitting.
16. Restore original finish to tab per finish requirement of 51-2-0 of Maintenance Manual.
17. Install hinge fittings and fasteners and bonding jumpers. Check that the contact area of the bonding jumper is clean and bare before installing.
18. Balance tab as outlined in 51-15-3.

NOTE

SEE 51-8-0 FOR METAL PROTECTIVE TREATMENT.

SEE 51-2-0 FOR FASTENER CODE, REMOVAL AND INSTALLATION, HOLE SIZES AND EDGE MARGIN.

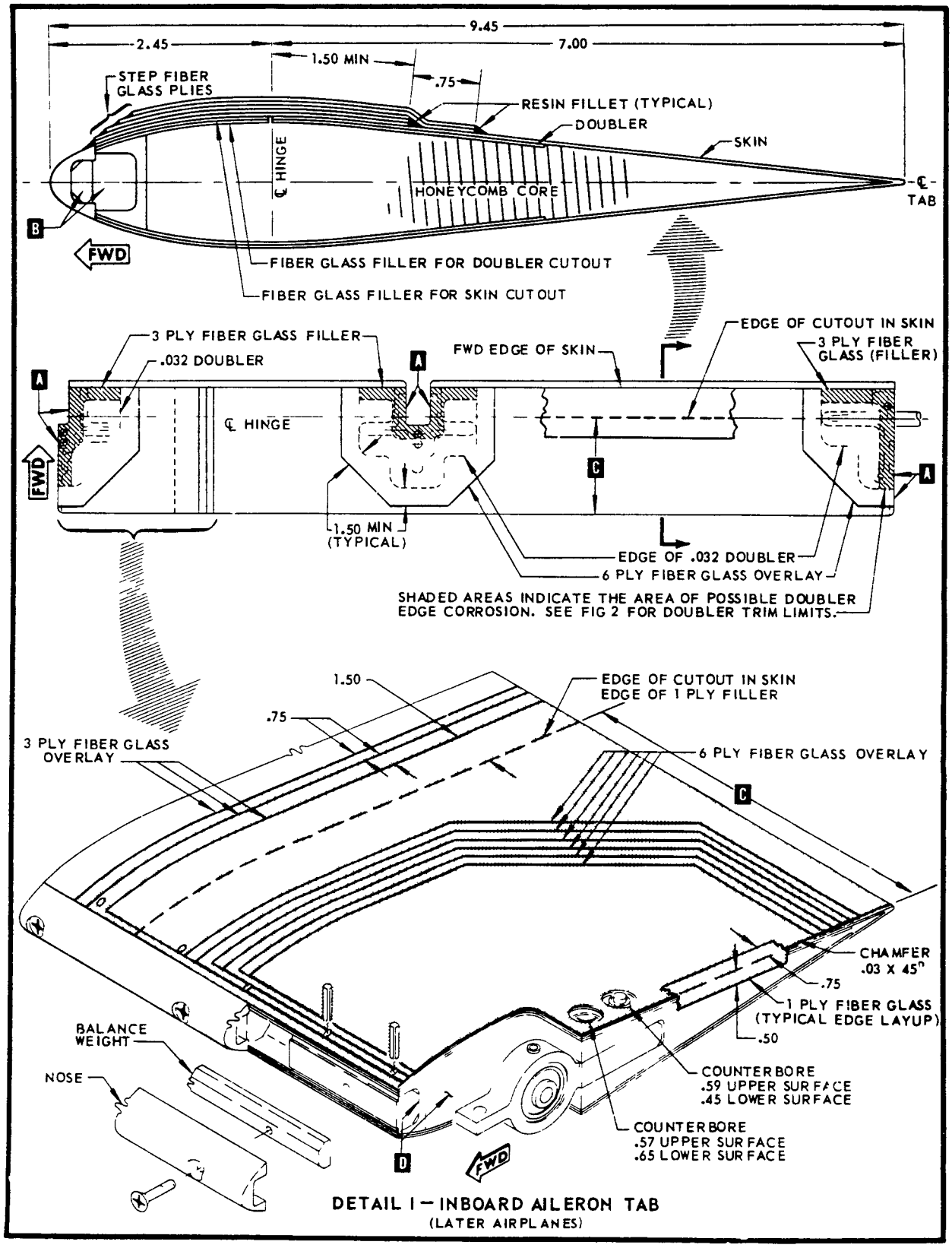
[A] CHAMFER OR RADIUS .03 ON INDICATED AREAS.

[B] ADD ADDITIONAL BALANCE WEIGHTS IN THE INDICATED AREAS WHEN REQUIRED.

[C] SEE FIGURE 2 TABLE 1 FOR DIMENSIONS.

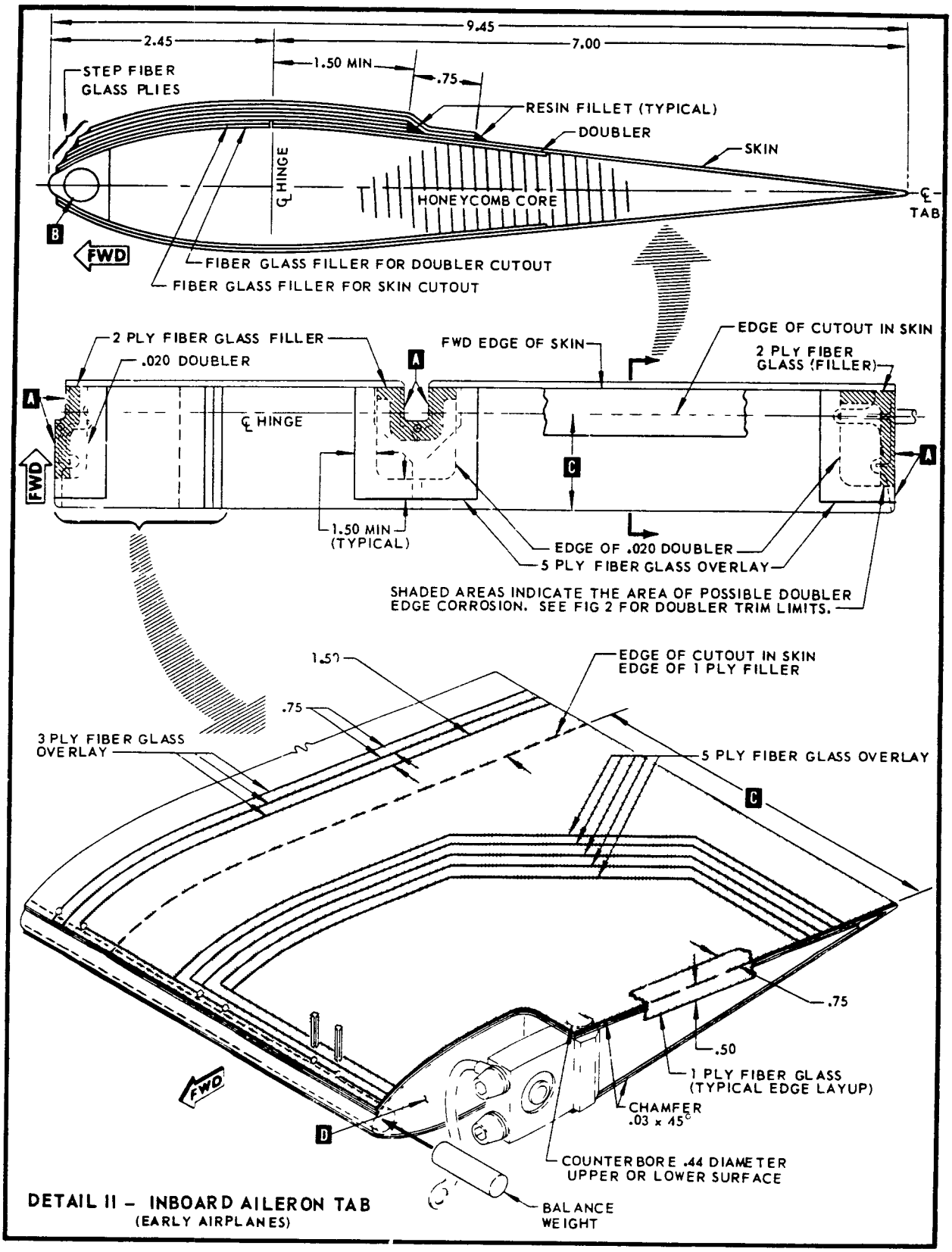
[D] SEE 51-10-3 FIG 1 FOR MAXIMUM ALLOWED CORROSION DEPTH AFTER CLEANUP.

Inboard Aileron Honeycomb Tab Repair
Figure 4 (Sheet 1 of 3)



DETAIL I — INBOARD AILERON TAB
(LATER AIRPLANES)

Inboard Aileron Honeycomb Tab Repair
Figure 4 (Sheet 2 of 3)



Inboard Aileron Honeycomb Tab Repair
Figure 4 (Sheet 3 of 3)

CONTINUOUS HINGE REPAIR

1. Introduction

A. This subject outlines repair procedures for damaged, worn or corroded continuous unbushed production hinges of outboard aileron tabs, inboard aileron balance panels and their mating parts in paragraph 4. Repair coverage for bushed hinges of inboard aileron balance panels and their mating parts is indicated in paragraph 5.

B. See 51-10-1 for aluminum honeycomb tab structure repairs. See 51-10-3 for corroded aluminum honeycomb tab repairs.

C. See 51-10-4, Figure 1, for hinge rework repair.

D. See 51-15-0 for rebalance requirements.

2. Prepare Hinge for Examination

A. Remove the hinge pin from the hinge and separate the hinge halves as outlined in Maintenance Manual Chapter 27.

B. Clean hinge halves similar to 51-10-3, paragraph 2.B.

3. Hinge Examination

A. Examine carefully the cleaned hinge halves and determine if the hinge loops show evidence of corrosion damage, out of round or enlarged holes, or holes with cracks.

B. Determine the minimum wall thickness at each hinge loop. See detail I, Figure 1.

4. Repair Procedures for Unbushed Hinges

A. The repair of a damaged hinge loop by a bonding installation of a bushing, see Figure 2, for the surfaces per paragraph 1.A. assumes that service wear limits (per Maintenance Manual 27-14-0) have been reached and requires consideration of the following:

(1) The location of the damage to determine whether it is in the 12-1/2 per cent of length at either end or in the middle 75% of the hinge length.

NOTE: Do not rebush hinges of an Outboard Aileron Tab.

(2) The minimum measured wall thickness available before hinge loop hole enlargement.

(a) This value must be at least .072 in the 12-1/2 per cent of length at either end for the Inboard Aileron Balance Panel Hinges.

(b) This value must be at least .072 in the middle 75 per cent of length for the Inboard Aileron Balance Panel Hinges.

(3) The minimum measured wall thickness available after hinge loop enlargement by reaming a standard sized hole .1552 dia minimum to .1572 dia maximum. See paragraph 3.B.

(a) This value must be at least .04 for the entire length of the Inboard Aileron Balance Panel Hinges.

(4) The fabrication of a bushing is shown in Figure 2. Notes D and E relative to outside diameter apply.

(5) The bonding of a bushing into a reworked hinge loop by use of adhesives (BMS 5-25 GRADE I or BMS 5-29D TYPE 2 CLASS I) and cure at room temperature is required. See 51-10-1, Figure 14, or 51-1-2.

B. An alternative method of repair by a bonded bushing installation, where service wear limits (per Maintenance Manual 27-14-0) have not been reached, requires consideration of the following:

(1) The minimum measured wall thickness available after hinge loop enlargement to any size hole must be at least .04. See paragraph 3.B.

(2) The fabrication of a bushing is shown in Figure 2. Note F relative to outside diameter applies.

(3) The bonding of a bushing into a reworked hinge is done in the same manner as per paragraph 4.A.(5) above.

C. An additional recommended alternative method of repair is the replacement of segments (worn beyond the values indicated in paragraphs A. and B. above) as shown in Figure 1.

5. Repair Procedure for Bushed Hinges

A. It is assumed that service wear limits per Maintenance Manual 27-14-0 have been reached.

B. Press out the worn bushing without damaging the existing hole in the hinge loop.

C. Check the hinge loop for the presence of cracks and for wall thickness requirement per detail I, Figure 1.

(1) If cracks are present or walls are less than .04 inch, repair per Figure 1.

D. Use the existing .1562 inch minimum to .1567 inch maximum diameter hole.

E. Use bushing per Figure 2.

F. Bond the bushing in the hole by an adhesive, BMS 5-25 GRADE I or BMS 5-29D TYPE 2 CLASS I, and cure at room temperature. See 51-10-1, Figure 14, or 51-1-2 for vendor information.

REPAIR INSTRUCTIONS

1. This repair is applicable to corroded or worn continuous hinges used on aileron and tab surfaces.

2. Remove surface, separate hinge halves, clean and examine as outlined in 51-10-4 and then determine the loop wall thickness (detail I).

3. If the wall thickness determined in step 2 is 0.040 or more, install bushings as outlined in 51-10-4. If the wall thickness is less than 0.040, cut out hinge segment and install repair parts as shown.

4. Remove fasteners as required.

5. Machine allowance for cut edges 0.00 (+0.01/-0.00) as shown.

6. Fabricate repair hinges and repair parts as required.

7. Locate fasteners in repair parts to match new holes or existing holes as required.

8. Anodize or brush alodize all cut and trimmed edges on original parts per 51-8-0.

9. Finish repair parts 1, 2, 3 and 4 with electroless nickel plating per 13-6-8 of the Overhaul Manual.

10. Install repair hinge halves and adjust with shims as required to align hinge pins.

11. Install hinge halves, hinge pin, and retainers per Maintenance Manual, Chapter 27.

12. Operate hinge to determine if the installing parts operate freely without binding or interference during full travel of the surface.

13. Rebalance per 51-15-0 after repair.

14. Modification of this repair can be used for other continuous hinge repairs.

15. If repair parts 1, 2, 3 and 4 become worn and damaged, remove fasteners and drill out blind fasteners as required to replace the worn hinge parts with new repair parts as outlined in 1 thru 14. Remove, replace, and install 1 with 2, or 3 with 4 at the same time on a tab and its related surface.

NOTES

- REFER TO THE FOLLOWING WHEN MAKING THIS REPAIR

  51-8-0 FOR PROTECTIVE TREATMENT OF METALS

  51-2-0 FOR FASTENER CODE, REMOVAL AND INSTALLATION, HOLE SIZES AND EDGE MARGIN

- BREAK SHARP EDGES 0.03 ON ALL REPAIR PARTS AND TRIMMED ORIGINAL PARTS

- REFER TO 51-10-4, PAR. 1 THRU 4 FOR CONTINUOUS HINGE REPAIR WITH BUSHINGS

[A] SHIM AS REQUIRED TO ALIGN HINGE PIN

[B] SIMILAR PARTS, DRAWING NUMBER 69-6177-1 OR -2 OPPOSITE CAN BE OBTAINED FROM THE BOEING COMPANY SPARE PARTS DEPARTMENT

Continuous Hinge Repair
Figure 1 (Sheet 1)

NOTES (CONT)

[C] SIMILAR PARTS, DRAWING NUMBER 69-8420-1 OR -2 OPPOSITE, CAN BE OBTAINED FROM THE BOEING COMPANY SPARE PARTS DEPARTMENT

[D] 0.0937 (+0.0053/-0.0000) DIA HOLE, FINISH 125 MICROINCHES. CHAMFER 0.015 (+0.016/-0.000) X 45° EDGES OF HOLES. 0.093 (+0.005/-0.000) DIA HOLE AFTER ELECTROLESS NICKEL PLATING

[E] FINISH 250 MICROINCHES EXCEPT AS NOTED IN [D]

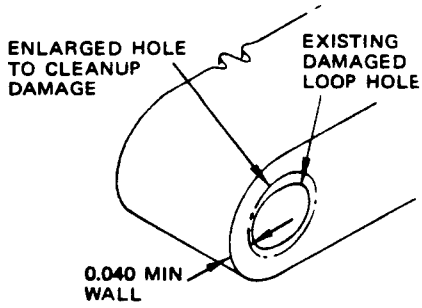
[F] DIMENSIONS NOT TO BE ACCUMULATIVE ON 1.00 PITCH

SYMBOLS

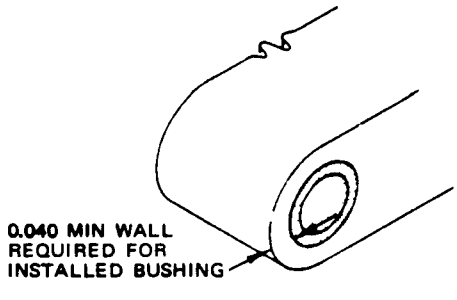
✦ REPAIR FASTENER LOCATIONS

+ ORIGINAL FASTENER LOCATIONS

REPAIR MATERIAL			
PART		QTY	MATERIAL
(1)	HINGE HALF [B]	4	4130 STEEL BAR HT 175,000-185,000
(2)	HINGE HALF [B]	1	4130 STEEL BAR HT 175,000-185,000
(3)	HINGE HALF [C]	4	4130 STEEL BAR HT 175,000-185,000
(4)	HINGE HALF [C]	1	4130 STEEL BAR HT 175,000-185,000

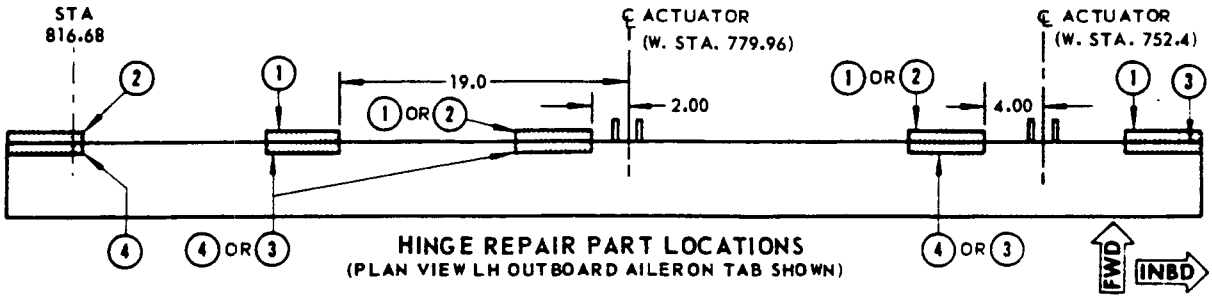


DAMAGED HOLE



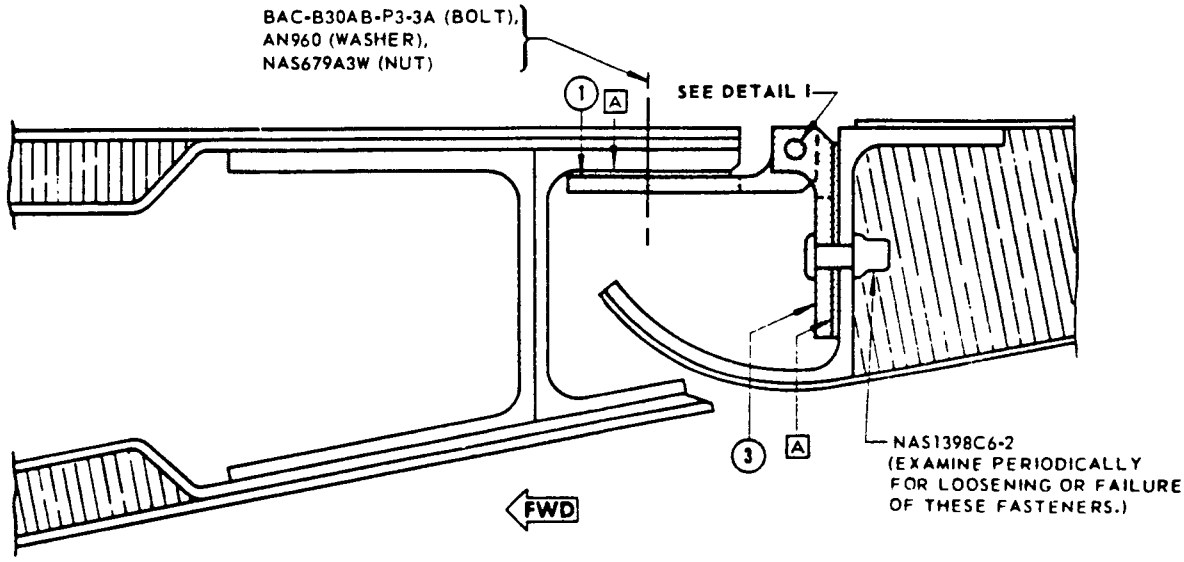
REPAIRED HOLE WITH BUSHING

DETAIL 1
DAMAGED HINGE PIN HOLE REPAIR

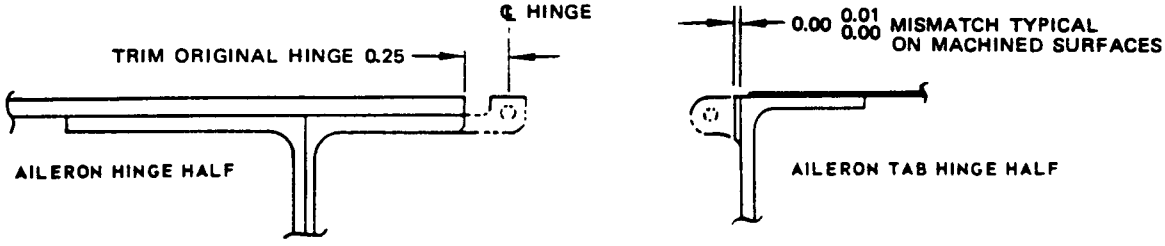


HINGE REPAIR PART LOCATIONS
(PLAN VIEW LH OUTBOARD AILERON TAB SHOWN)

NOTE: REPLACEMENT OF THESE SECTIONS OF HINGE USING THE 5 SHORT STEEL HINGES SHOWN IN THIS FIGURE IS CONSIDERED A SATISFACTORY REPAIR FOR A CONTINUOUS HINGE WORN OVER ITS ENTIRE LENGTH.

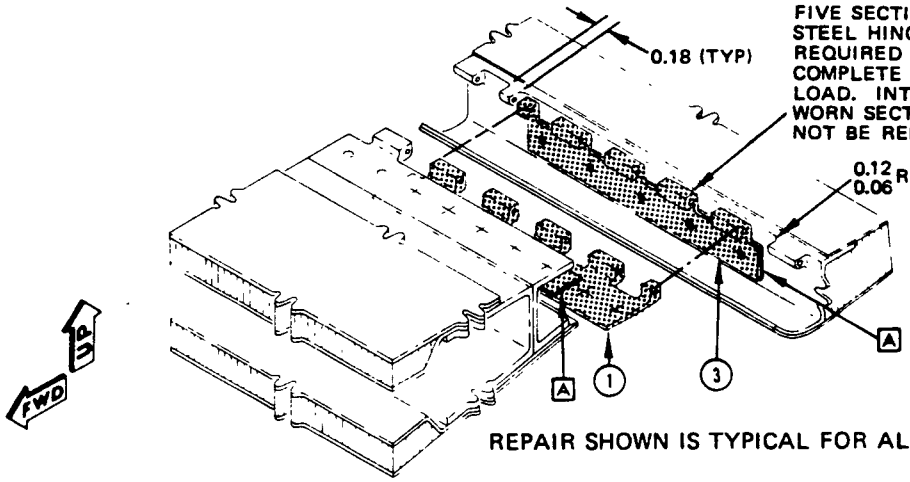


SECTION THROUGH DAMAGE

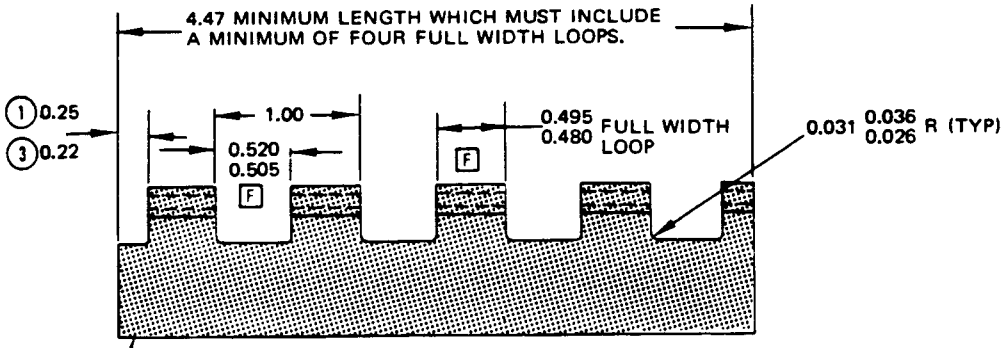


TRIM DIMENSIONS FOR EXISTING HINGE HALVES

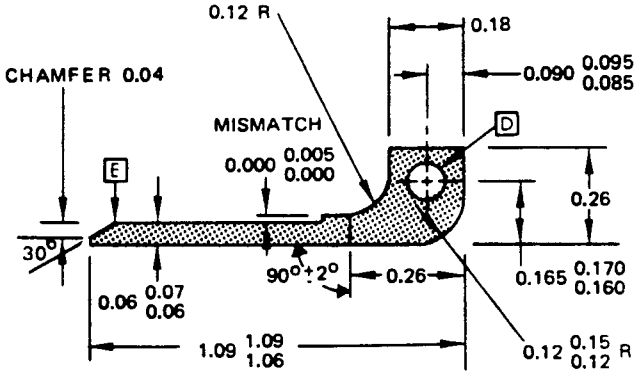
Continuous Hinge Repair
Figure 1 (Sheet 3)



REPAIR SHOWN IS TYPICAL FOR ALL LOCATIONS

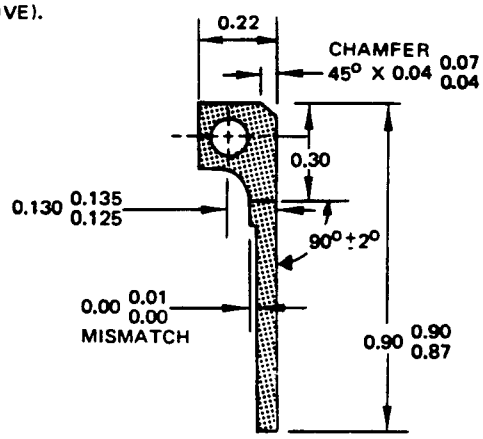


ALL DIMENSIONS SHOWN IN THIS VIEW ARE APPLICABLE TO BOTH PARTS 1 AND 3 EXCEPT AS SHOWN. (END CONFIGURATIONS ARE REVERSED AS SHOWN ABOVE).



ALL DIMENSIONS GIVEN ARE BEFORE PLATING EXCEPT AS NOTED IN D

DIMENSIONS FOR PART 1

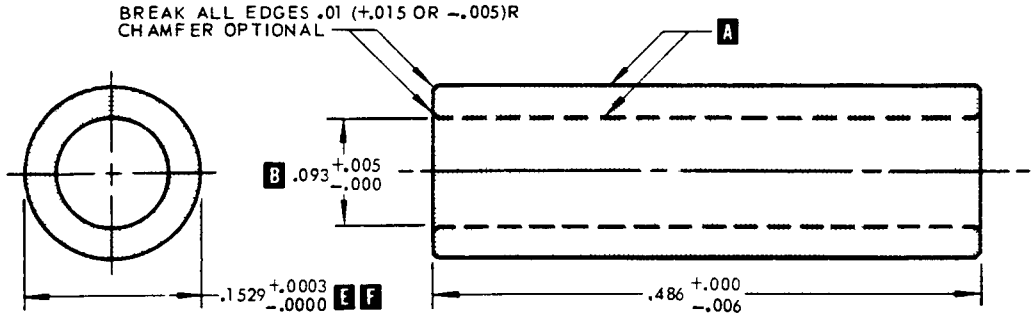


ALL DIMENSIONS GIVEN ARE BEFORE PLATING EXCEPT AS NOTED IN D

(PART 3 SAME AS PART 1 EXCEPT AS SHOWN)

DIMENSIONS FOR PART 3

Continuous Hinge Repair
Figure 1 (Sheet 4)



END VIEW OF BUSHING

PLAN VIEW OF BUSHING C D

NOTE

A FINISH ALL MACHINE SURFACES TO 63

B O. D. AND I. D. OF BUSHING SHALL BE CONCENTRIC WITHIN + OR -.003 .

C MAKE FROM CORROSION RESISTANT STEEL BAR AISI 303, CLASS 303 OR 303E. CONDITION A OR AISI 303 BAR PER MIL-S-7720, TYPE B. CADMIUM PLATE O.D. PER QQ-0-416 TYPE I CLASS B. (MINIMUM THICKNESS .0002) NO FINISH REQUIRED ON I.D.

D ALTERNATIVE PART - MAKE FROM BOEING PART 66-11221 AVAILABLE FROM BOEING SPARE PARTS DEPARTMENT. SEE PARAGRAPH 4.A. OF TEXT.

E O. D. AFTER PLATING TO BE .1533 (+.0005 OR -.0000 DIA). SEE PARAGRAPH 4.A. OF TEXT.

F THIS DIAMETER, AFTER PLATING, IS TO ASSURE .0014 TO .0039 DIAMETRICAL CLEARANCE WITH RESPECT TO ANY MATING HOLE. SEE PARAGRAPH 4.B. OF TEXT.

Bushing Fabrication - Continuous Hinge
Figure 2

FIBERGLASS CLOTH REINFORCED PLASTICS REPAIR

1. Introduction

A. This subject describes repairs to laminates manufactured of resinous plastic and several layers of fiberglass cloth reinforcement and repairs to sandwich construction that consists of face plies of these laminates bonded to a fiberglass honeycomb core. Fiberglass cloth is also called glass fabric.

B. Figure 1 shows location of the major plastics parts on the outside of the airplane and includes allowable damage and repair limitations.

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

C. Refer to par. 3 thru 13 for repair procedures which use resin systems with normal curing rates. These paragraphs are applicable to components concerned with both electronic and nonelectronic functions.

D. Refer to par. 14 for repair procedures which use a resin system with a normal curing rate. This paragraph is applicable only to the Doppler Radome.

E. Refer to par. 15 for repair procedures, with accelerated curing rates, applicable only to the Doppler Radome.

F. Refer to par. 16 for a rapid repair procedure which uses resin systems with accelerated curing rates. This paragraph is applicable to components concerned mainly with nonelectronic functions only. A repair accomplished by this method has a limited life and should be examined periodically for evidence of deterioration. Replace this type of repair with a permanent type repair as indicated in par. C below, at the first opportunity where facilities are available.

G. Refer to par. 17 for a permanent repair procedure which uses resin systems with fast curing rates. This paragraph is applicable to components concerned mainly with nonelectronic functions only. The repair in this paragraph is considered permanent and may be used as an alternative repair to the nonelectronic components referred to in par. C above, and as a replacement for the repair method in par. F above.

H. Refer to par. 18 for a permanent repair procedure which uses a resin system, equivalent to that of original production, for certain C-Band Nose Radomes as identified by manufacturing part numbers. Refer to par. 20 for information relative to a method for the measurement of repair thickness requirements.

J. Refer to par. 19 for a permanent repair procedure which uses a resin system equivalent to that of original production, for certain C-Band and X-Band Nose Radomes as identified by manufacturing part numbers. Refer to par. 20 for information relative to a method for the measurement of repair thickness requirements.

2. How to Use this Section of the Manual

A. Find the applicable repair figure and repair limitations, in Fig. 1.

B. Perform the repair by following the repair instruction steps and those portions of the text referred to in the applicable repair figure.

C. Special repair materials are listed in 51-10-1, Fig. 2.

3. Preparation of Damage Area - Radome

A. Remove erosion shoe (where applicable).

(1) The rubber erosion shoe that protects the nose radome must be removed before damage to the forward portion of the radome can be repaired.

(2) Starting at the edge of the erosion shoe, apply Toluol or MEK solvent to the seam line and peel the shoe back from the radome. If the shoe is to be reused, remove it carefully, allowing the solvent to soften the adhesive.

B. Determine extent of damage.

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

(1) Check panel in vicinity of damage for entry of water, oil, fuel, dirt or other foreign matter.

NOTE: Moisture and oil within the radome structure greatly reduce its electromagnetic transparency.

(2) Check for delamination around the damage.

NOTE: Delamination can be detected by tapping the skin with a small metallic object, such as a half dollar coin.

C. Trim out damage.

(1) If honeycomb core has been damaged, remove the damaged portion of the core to a smooth outline including areas contaminated by water that cannot be dehydrated by heating.

NOTE: The sanding can be done with a flexible disk sander, a belt sander, a rotating pad sander or by hand. Use No. 180 sandpaper, or equivalent.

4. Honeycomb Core Repair

A. Honeycomb Core Plug

(1) Fabricate core plug of HRH 10/F50-5.0 (NOMEX) or HRP 3/16-5.5 fiberglass honeycomb to fit snugly into cleaned out damage area, flush with original core and with honeycomb cells aligned in the same direction. Replacement core must overlap and make intimate contact with the cell walls of surrounding core material. See 51-10-1 Fig. 24 and 25 for methods of cutting core material.

NOTE: HRH 10/F50-5.0 (NOMEX) honeycomb material is more flexible than HRP 3/16-5.5 honeycomb material, and facilitates the shaping to contour of the repair part.

(2) Apply Epon 828 adhesive mixture prepared per Fig. 5 around contact edges of the core plug and the inside of cleaned out damage area.

(3) Install core plug into damage area.

B. Potted Core Repair

(1) Potting can be used as an alternative to the core plug repair described above, especially for core damage of small size.

NOTE: Observe size limits for resin filled holes in electrically critical area: one square inch for nose radome, doppler radome and antenna doors.

(2) Fill cleaned out damage in honeycomb core with Potting Compound 1 prepared per Fig. 5. Removal of damaged core is not required when accomplishing this potted core repair.

5. Processing of Patches - Radome Repair

A. Impregnate Patches

(1) From Style 181, 1581 or 7781 fiberglass cloth, cut a piece that is large enough, so that the required number of plies for the patch can be cut from it.

NOTE: Use one ply of Style 181, 1581 or 7781 fiberglass cloth in the patch for each damaged ply of the original laminate, except use one additional repair ply when required in the repair index of Fig. 1. If Style 181, 1581 or 7781 fiberglass cloth is not available, three plies of Style 128 or 1528 cloth can be used for each two plies of Style 181, 1581 or 7781 cloth required.

5. Processing of Patches - Radome Repair

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NOTE: Use one ply of Style 181, 1581 or 7781 fiberglass cloth in the patch for each damaged ply of the original laminate, except use one additional repair ply when required in the repair index of Fig. 1. If Style 181, 1581 or 7781 fiberglass cloth is not available, three plies of Style 128 or 1528 cloth can be used for each two plies of Style 181, 1581 or 7781 cloth required.

(2) Cut two pieces of parting film approximately 3 inches larger all around than the fiberglass cloth and tape down one piece to a smooth surface.

NOTE: Use PVA film or other parting films listed in 51-10-1, Fig. 2.

(3) Spread Epon 828 adhesive mixture prepared per Fig. 5 over parting film and place the fiberglass cloth over the adhesive.

NOTE: Weight of adhesive approximately equal to the weight of the dry fiberglass cloth is required to impregnate the cloth.

(4) Cover the cloth on the parting film with the second piece of parting film.

(5) Press the adhesive through the cloth by working over the parting film with a squeegee or roller, in order to impregnate the patch and to remove entrapped air.

NOTE: 51-10-1, Fig. 13 shows details of a squeegee that can be used to impregnate patches.

(6) Cut the impregnated cloth to the required sizes for each individual patch layer. The parting film on both sides of the cloth decreases fraying of the edges while cutting the cloth. Direction of fibers in patch should be in the same direction as fibers of base material. For the nose radome patch, the fibers should run parallel to the station planes of the airplane.

NOTE: Cut the largest ply of cloth to the shape of the outside of the scarfed area. Cut each succeeding ply so that it is at least 0.80 inch smaller all around than the preceding ply, the total number of Style 181, 1581 or 7781 cloth plies being equal to the number of damaged plies in the original laminate to be repaired, except use one additional repair ply when required in the repair index of Fig. 1.

B. Place Patches

(1) Clean out repair area with oil-free air. Wipe the surfaces with a clean cloth moistened with MEK (methyl ethyl ketone).

(2) Apply a coat of Epon 828 adhesive mixture prepared per Fig. 5, over the repair area.

(3) Remove parting film from one side of the smallest ply of the patch and place its exposed face against the repair area, with direction of fibers in the same direction as fibers of base material. For the nose radome patch, the fibers should run parallel to the station planes of the airplane.

(4) Use a squeegee over the parting film that covers the patch to remove wrinkles and entrapped air. Do not remove too much adhesive by excessive pressure in order to avoid producing a patch deficient in adhesive.

(5) After removing parting film from the contact faces, place the next larger size ply of the impregnated patch over the ply on the repair area with at least 0.80-inch overlap all around.

(6) Place succeeding plies of the patch as described in steps (4) and (5) above.

(7) After placing the last ply, recover the entire lay-up with a piece of parting film extending about 0.50 inches over edges of the patch.

(8) Sweep excess adhesive to outer edges of parting film thereby fairing the edges of the patch to the contour of the repair surface. All loose threads shall be embedded in resin.

(9) Wipe off any excess adhesive that has been squeezed out at the edges of the parting film.

C. Cure impregnated patch.

(1) Required curing time for Epon 828 adhesive mixture is about 12 hours at 70°F or 35 minutes at 200°F. A cured patch is hard and resounds when tapped lightly with a coin or other light metallic object.

NOTE: When heat is used to cure a patch over honeycomb core, it is necessary to constantly sweep the area with a squeegee to remove air bubbles as they form.

(2) Remove parting film from the patch after curing.

(3) The patch should be free from pits, blisters, starved areas and excess resin deposit.

6. Replacement of Erosion Shoe (where applicable)

A. Refer to 13-3-1, Maintenance Manual.

7. Repair of Radome Damage Cause by Electrical Discharge

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

A. Clean inner and outer surfaces thoroughly. Radome must be entirely free from moisture and dirt.

NOTE: If the damage is in the nose area, remove the rubber erosion shoe.

B. Locate the defects in the inner skin, and directly opposite on the outer skin, remove the paint from an area not less than 4 inches in diameter.

C. The performance of a leakage test with positive air pressure may help to locate outer skin defects which are not readily apparent.

(1) Coat the outer skin defect area with an uncatalyzed resin film.

(2) By using a flexible type funnel which encompasses the inner skin defect, apply a positive air pressure not to exceed 3 psi to this area.

(3) The bubbling in the resin film will pinpoint the outer skin defect.

NOTE: Maximum repairable size of a single damage caused by electrical discharge is 1 square inch, including punctures in both the inner and outer skins and the delaminated area. Minimum allowable spacing between adjacent repairs is 3 inches, edge to edge.

D. Drill a 1/16-inch hole in the center of the defect, then insert a hypodermic needle through the skin and fill this core cell with Epon 815 mixture prepared per Fig. 5. Insert the needle between the delaminated plies of the skin and inject this adhesive.

E. Coat the defects with a thin film of this resin and cover with PVA or other parting film.

F. When adhesive has gelled, remove the parting film. Replace the rubber errosion shoe, if removed, and repaint outside surfaces.

8. Repair of Antenna Doors

A. General

(1) Most of the belly antenna doors contain an antenna element of wire mesh embedded behind the outside ply of the fiberglass skin.

B. Repair

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

(1) Repair the antenna doors according to Fig. 6, except that the damaged portion of the antenna element must be replaced as described below when the damage to the antenna element is larger than 2 square inches. The total unrepaired damaged area of the antenna element shall not exceed 5 square inches for several repairs in the same door.

NOTE: Use one more ply in the repair patch than the number of the damaged plies of the skin.

C. Repair Antenna Element

(1) Expose the antenna element by removing the outside ply around the damage for 0.125 to 0.25 inch.

(2) Place a piece of 60 mesh 0.0075 diameter copper wire screen or aluminum screen over the damage so that is overlaps and contacts the exposed edges of the original antenna element. Solder or bond the repair screen to the antenna element with a conductive adhesive to assure good electrical contact.

(3) Complete the repair by covering the repaired antenna element with two plies of fiberglass per par. 5, with a minimum of 0.80-inch overlap per ply.

9. Processing of Patches

A. Impregnate the Patch

(1) Cut the Style 181, 1581 or 7781 fiberglass cloth slightly larger than required for the repair.

NOTE: If Style 181, 1581 or 7781 fiberglass cloth is not available, three plies of Style 128 or 1528 cloth can be used instead of two plies of Style 181, 1581 or 7781.

(2) Mix the adhesive called out in the applicable repair figure as described in figure 5.

(3) Spread the adhesive onto a piece of clean PVA parting film approximately 3 inches larger all around than the fiberglas cloth to be impregnated and that has been taped down to a smooth surface.

NOTE: Weight of adhesive approximately equal to the weight of the dry fiberglas cloth is required to impregnate the cloth.

(4) Place the fiberglas cloth to be impregnated over the adhesive on the parting film and cover it with another piece of parting film.

(5) Press the adhesive through the cloth by working over the parting film with a squeegee or roller, in order to impregnate the patch and to remove air bubbles.

NOTE: Do not sweep dry. 51-10-1, figure 13 shows details of a squeegee that can be used to impregnate patches.

(6) To impregnate the second ply, peel back top layer of parting film, apply an additional coat of adhesive over the surface of the impregnated first layer of fiberglas, place cloth for the second ply on it, recover with the parting film, and impregnate the second layer as described in step (5) above.

NOTE: When a patch of more than two plies is required, repeat step (6) until the required number of plies have been impregnated. An alternate method is to impregnate the individual plies separately and then to pile up the impregnated plies.

(7) Trim the impregnated patch to the exact required size without removing the parting film. The parting film on both sides of the cloth decreases fraying of the edges while cutting the cloth.

B. Apply the Patch

(1) Apply the adhesive called out in the applicable repair figure, mixed per figure 5, to the repair area that will be covered by the patch.

(2) Remove parting film from the patch impregnated per paragraph 9.A and place the patch over the repair area maintaining a uniform overlap around damage boundary.

(3) Then recover the patch with a PVA parting film extending about 0.50 inches over the edges of the patch.

NOTE: If vacuum is available, bag the area with Osnaberg cloth at about 2 inches all around the layup, cover it with PVA film, seal and apply vacuum.

(4) Remove wrinkles and bubbles by sweeping with a squeegee over the PVA film. Work from the center of the patch towards the edges.

NOTE: Use a light touch when sweeping the patch, especially when removing bubbles that may form during elevated temperature cure. Do not remove too much adhesive by excessive pressure in order to avoid producing a patch that is deficient in adhesive.

(5) Sweep excess adhesive to the edges of PVA film, thereby fairing the edges of the patch to the contour of the repair surface. All loose threads shall be embedded in the tapered fairing formed by the adhesive around the periphery of the patch.

(6) Wipe off any excess adhesive that has been squeezed out at the edges of the parting film.

C. Cure the Patch

(1) Cure the BMS 5-29 impregnated patch according to time listed on table in Fig. 5.

NOTE: For curing of Epon 828 impregnated patches, see paragraph 5.C.

CAUTION: DO NOT ALLOW THE REPAIR AREA TEMPERATURE TO EXCEED 210°F.

D. Apply Finish

(1) After removing parting film from the cured patch, apply chemical and solvent resistant finish (BMS 10-11 primer and BMS 10-11 enamel of the appropriate color) to the repair. See the Maintenance Manual section 51-2-51.

10. Preparation of Damage Area

A. Trim out Damage

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

DO NOT DAMAGE THE ORIGINAL ADHESIVE BOND OR THE SURFACE OF THE BASE MATERIAL.

(1) When the damage is more than a skin scratch, trim out the damaged area to a smooth outline and file or sand the edges smooth.

NOTE: Fraying or delamination around trimmed edges of the hole shall not exceed 1/16 inch from the trimmed edge. Delamination is characterized by an area of whiteness.

B. Clean Damage Area

(1) Clean damage area that will be covered by the repair, as well as faying surfaces of the plastic repair parts.

(2) Wipe the surfaces with a clean cloth moistened with MEK (methyl ethyl ketone).

(3) Abrade the surface with #400 grit silicone carbide cloth, or equivalent until the surface gloss has been removed. Abrade surfaces covered with BMS 10-11 paint until the surface film has been removed.

(4) Wipe the abraded area with a clean cloth moistened with MEK. Do not allow the MEK to dry on the repair surface but wipe it off the repair surface immediately with another piece of clean, dry, soft, lint-free cloth or gauze.

11. Repair of Stiffeners (Fig. 2)

A. Cut a repair cap from a BAC1529 hat section of 5-ply fiberglass cloth reinforced plastic fabricated per BMS 8-52 that conforms to the contour of the damaged stiffener and overlaps the damage 2 to 2.5 inches in the longitudinal direction. Use either the entire cross-section of the repair cap or use part of it, cutting it so that it overlaps the damage at least 0.5 inch in the transverse direction.

NOTE: Applicable repair caps are as follows:

Repair Cap	For Stiffener
BAC1529-6	BAC1529-2
-7	-3
-8	-4
-9	-5

B. File or sand the stiffener cap edges smooth. Clean the inner surface of the repair cap as described in par. 10.B.

C. Place the repair cap over the stiffener and examine to determine that all surfaces are in contact with stiffener. When there are gaps greater than 0.01 inch between the mating sections, use one or more buildup plies of impregnated fiberglass cloth to obtain a continuous bond line.

D. Impregnate one ply of fiberglass cloth with BMS 5-29 adhesive per Fig. 5 as described in par. 9 to be placed between the contact surfaces of the damaged stiffener and the repair cap so that it extends 0.125 to 0.25 inch outside all edges of the repair cap. Impregnate buildup plies when required in step C above.

E. Apply BMS 5-29 adhesive mixed per Fig. 5 to the contact surfaces of the damaged stiffener and the repair cap, and place between them the fiberglass cloth prepared in step D above.

F. Place a PVA parting film over the repair area and cure the repair under 8- to 12-psi pressure. Required curing time is 30 hours at 70°F, or 45 minutes at 175°F, or 30 minutes at 200°F.

CAUTION: DO NOT ALLOW THE REPAIR AREA TEMPERATURE TO EXCEED 210°F.

G. After removing parting film from the cured repair, apply two coats of BMS 10-11, type 1 primer to the repair (Ref 51-2-0, Maintenance Manual).

12. Repair of Skin (Fig. 3)

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

A. Cut a plug from BMS 8-52 5-ply plastic about 1/8 inch greater all around than the cut-out in the skin per par. 10.A. Scarf the edges of the plug and the hole to mate and provide a flush fit.

NOTE: For skin damaged by a scratch only, no trimming of the skin and no plug is required.

B. Clean the edges of the plug and hole by wiping with clean gauze moistened with MEK (methyl ethyl ketone). Wipe with clean dry gauze before the MEK dries.

C. Apply Epon 815 adhesive mixed per Fig. 5 to the edges of the plug and the hole, and bond the plug into the hole flush with the skin surface.

D. Cut the required number of plies for the patch from Style 181, 1581 or 7781 fiberglass cloth.

NOTE: If Style 181, 1581 or 7781 fiberglass cloth is not available, three plies of Style 128 or 1528 cloth can be used instead of two plies of Style 181, 1581 or 7781.

E. Reclean the repair area as described in par. 10.B.

F. Impregnate the patch with BMS 5-29 adhesive, apply it to the repair area, cure it and finish as described in par. 9.

13. Sealing

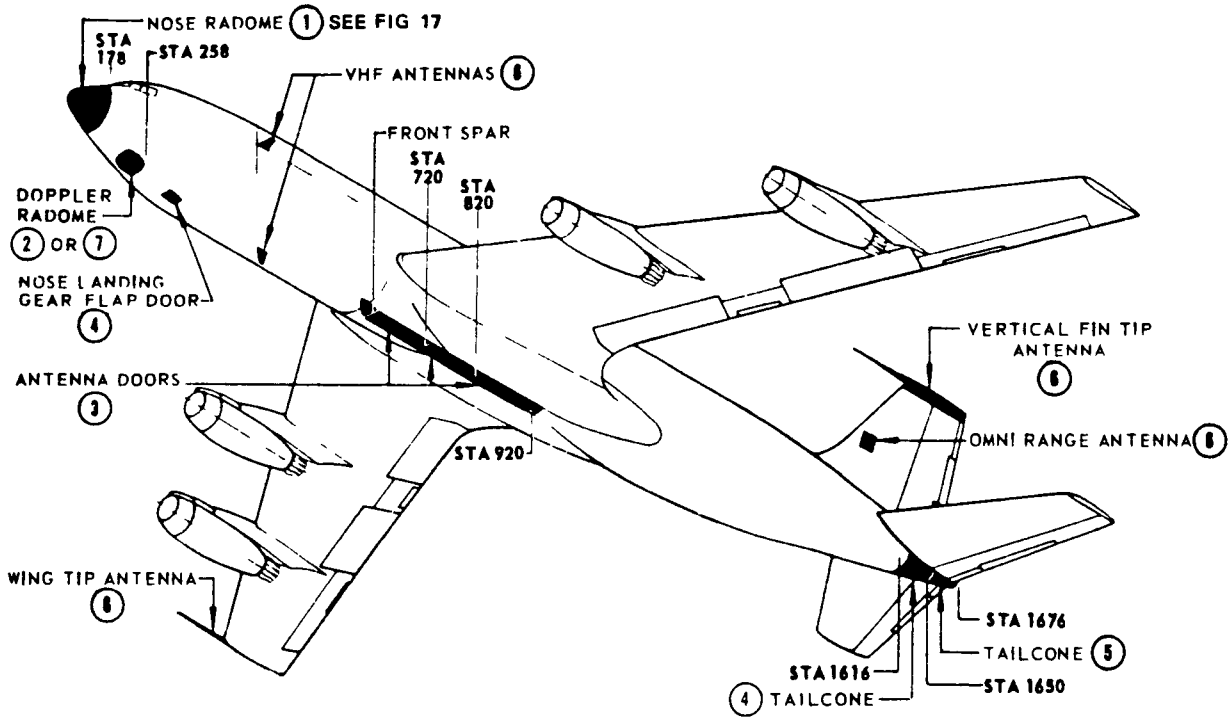
A. Sand the skin surface, or a repaired area, lightly with 2/0 Garnet paper and wipe the particles off with lint-free cloth.

B. Prepare the sealer material indicated as Resin Mix 3 (Sealer Resin) per the directions of Fig. 5.

C. Apply the sealer material to skin surface, or to a repaired area and to all machined surfaces of laminates except drilled or countersunk holes. Apply the sealer material immediately after mixing.

D. Remove all excess sealer by scraping over the surface vigorously with a flexible rubber sponge or squeegee. Properly applied sealer appears as a thin film which is barely visible.

E. Allow the sealer to gel at room temperature.


NOSE RADOME (1) SEE FIG 17
STA 178
STA 258
VHF ANTENNAS (8)
FRONT SPAR
STA 720
STA 820
DOPPLER RADOME (2) OR (7)
NOSE LANDING GEAR FLAP DOOR (4)
ANTENNA DOORS (3)
STA 920
VERTICAL FIN TIP ANTENNA (6)
OMNI RANGE ANTENNA (8)
WING TIP ANTENNA (6)
STA 1676
TAILCONE (5)
STA 1616
(4) TAILCONE
STA 1650

NOTE

[A] THE FOLLOWING ARE REPAIR LIMITS THAT MAY BE ALLOWED ON THE DOPPLER RADOME WITHOUT ELECTRICAL TESTING: 2 INCH DIAMETER MAXIMUM FOR EACH INDIVIDUAL DAMAGE, IF REPAIRED PLY FOR PLY, AND 10% MAX. TOTAL ACCUMULATED AREA OF REPAIR.

REPAIRS WHICH EXCEED THE ABOVE LIMITS ARE REPAIRS WHICH PROVIDE MORE REPAIR PLIES THAN THE NUMBER OF ORIGINAL PLIES WILL REQUIRE ELECTRICAL TESTING.

2 INCH DIAMETER IS THE MAXIMUM DAMAGE THAT MAY BE REPAIRED PER FIGURE 6 WITH A PATCH THAT REPLACES DAMAGED DOPPLER RADOME SKIN PLY FOR PLY.

REFER TO THE DOPPLER RADOME MANUFACTURER OR TO A QUALIFIED ELECTRONICS LABORATORY FOR SUCH SERVICE. TESTS SHALL BE MADE IN ACCORDANCE WITH THE TECHNIQUES AND PROCEDURES OF AIRCRAFT TECHNICAL COMMITTEE REPORT NO. ARTC-4 PARAGRAPH 4.1, DATED JULY 30, 1960 AND SHALL DETERMINE THAT ONE WAY POWER TRANSMISSION EFFICENCY OF A REPAIRED AREA OF A DOPPLER RADOME SHALL BE NOT LESS THAN 85%. SEE NOTE FOR ARTC-4 AVAILABILITY.

[B] AFTER COMPLETION OF THE REPAIR AFFECTING THE ANTENNA SCREEN AND PRIOR TO CONNECTING THE ANTENNA, TEST AS FOLLOWS: MEASURE CAPACITANCE BETWEEN ANTENNA AND AIRPLANE STRUCTURE USING A CAPACITANCE BRIDGE; CAPACITANCE READINGS MUST BE 195 (± 5) PICOFARADS WITH ANTENNA DOOR CLOSED. ACCESS TO MEASUREMENT POINT IS POSSIBLE THROUGH AN ADJACENT DOOR.

[C] THIS REPAIR IS PROHIBITED FOR USE ON ROUTE SEGMENTS WHEN THE DOPPLER RADAR IS DEPENDENT NAVIGATIONAL SYSTEM.

[D] INDICATE EXTEND OF DAMAGE AND REPAIR AREA ON INSIDE OF RADOME, TO KEEP RECORD OF REPAIRS.

MATERIAL	PART NAME	MAXIMUM SINGLE DAMAGE ALLOWABLE WITHOUT REPAIR	MAXIMUM SINGLE REPAIRABLE DAMAGE	MIN. ALLOWABLE SPACING BETWEEN ADJACENT REPAIRABLE DAMAGES - EDGE TO EDGE
HONEYCOMB SANDWICH WITH LAMINATED FACE PLIES	(1) NOSE RADOME SEE Fig. 17			
	(2) DOPPLER RADOME	1 SQUARE INCH DAMAGE ALLOWED PROVIDED THE DAMAGE IS SEALED FROM MOISTURE (E.G. WITH SCOTCH BRAND NO. 850 OR 853 OR PERMACEL P95 TAPE) RECORD THE LOCATION OF DAMAGE AND REPAIR AT THE FIRST AVAILABLE OPPOR TUNITY.	[C] 2.50 INCH DIAMETER HOLE AFTER CLEANUP	
			[A] 4 INCH DIA. WITH ONE ADDITIONAL REPAIR PLY. 2 INCH DIA. IF REPAIRED PLY FOR PLY	[D] 12 INCHES
	(3) ANTENNA DOORS		NO LIMIT	
	(4) NOSE LANDING GEAR FLAP DOOR AND TAILCONE		NO LIMIT	
SOLID LAMINATE FIBER GLASS	(5) TAILCONE		NO LIMIT	
	(6) ANTENNA COVERS		4 INCH DIAMETER	12 INCHES
	(7) DOPPLER RADOME		[A] SEE PARA-GRAPH 14.D.	

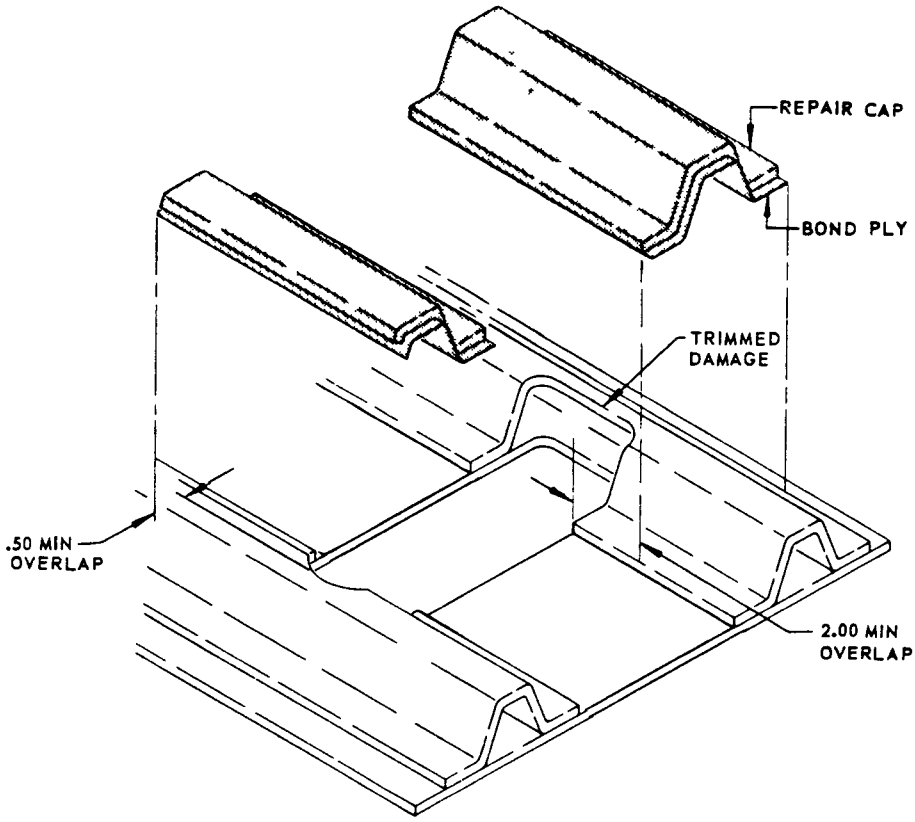
Fiberglass and Cotton Cloth Reinforced Plastics Repair Index
Figure 1 (Sheet 3)

REPAIR INDEX				
ELECTRONIC OMPONENTS				
		DOPPLER RADOME (2)		DOPPLER RADOME (7)
		TEMP REPAIP	PERM REPAIR	PERM REPAIR
		RE PAIR PER PARAGRAPH 15		
			REPAIR PER FIGURE 6	
				REPAIR PER PARAGRAPH 14 AND FIG. 8

Fiberglass Reinforced Plastic Repair Index
Figure 1 (Sheet 4 of 5)

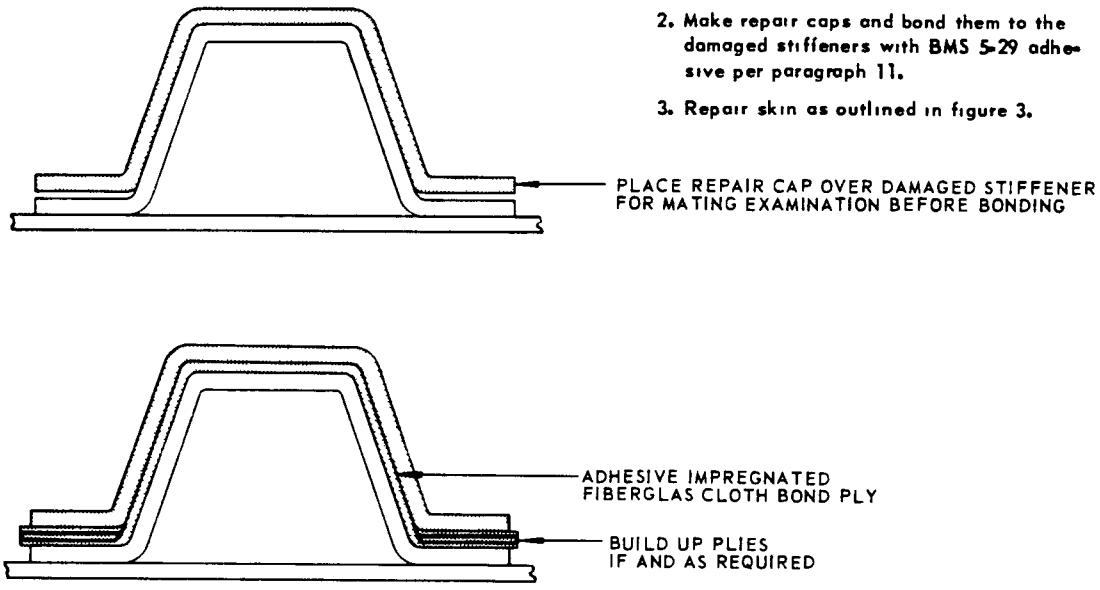
REPAIR INDEX			
NONCRITICAL ELECTRONIC COMPONENTS AND STRUCTURAL COMPONENTS (3) (4) (5) (6)			
TEMPORARY REPAIR		PERMANENT REPAIR	
RESIN SYSTEM WITH ACCELERATED CURING RATE		RESIN SYSTEM WITH FAST CURING RATE (PREFERRED METHOD)	RESIN SYSTEM WITH NORMAL CURING RATE (OPTIONAL METHOD)
[3]	REPAIR PER PARAGRAPH 16.A. THRU 16.E.	REPAIR PER PARAGRAPH 17.A. THRU 17.C.	[B] REPAIR PER PARAGRAPH 8. PROVIDE ONE ADDITIONAL PLY
[4]	REPAIR PER PARAGRAPH 16	REPAIR PER PARAGRAPH 17	REPAIR PER FIGURE 7. PROVIDE ONE ADDITIONAL PLY
[5]			REPAIR CRACKED TAIL CONE PER FIGURE 4. REPAIR OTHER DAMAGE PER FIGURE 3
[6]	REPAIR PER PARAGRAPH 16.A. THRU 16.E.	REPAIR PER PARAGRAPH 17.A. THRU 17.C.	REPAIR PLY FOR PLY. SEE FIGURE 6 FOR PLY APPLICATION METHOD

Fiberglass Reinforced Plastic Repair Index
Figure 1 (Sheet 5 of 5)



REPAIR INSTRUCTIONS

1. Trim out damage and clean repair area as described in paragraph 10.
2. Make repair caps and bond them to the damaged stiffeners with BMS 5-29 adhesive per paragraph 11.
3. Repair skin as outlined in figure 3.



SECTION THROUGH TYPICAL STIFFENER REPAIR

Stiffener Repair - Plastic Hat Sections
Figure 2

REPAIR INSTRUCTIONS

1. Repair any damaged stiffeners as outlined in figure 2 before repairing the skin.

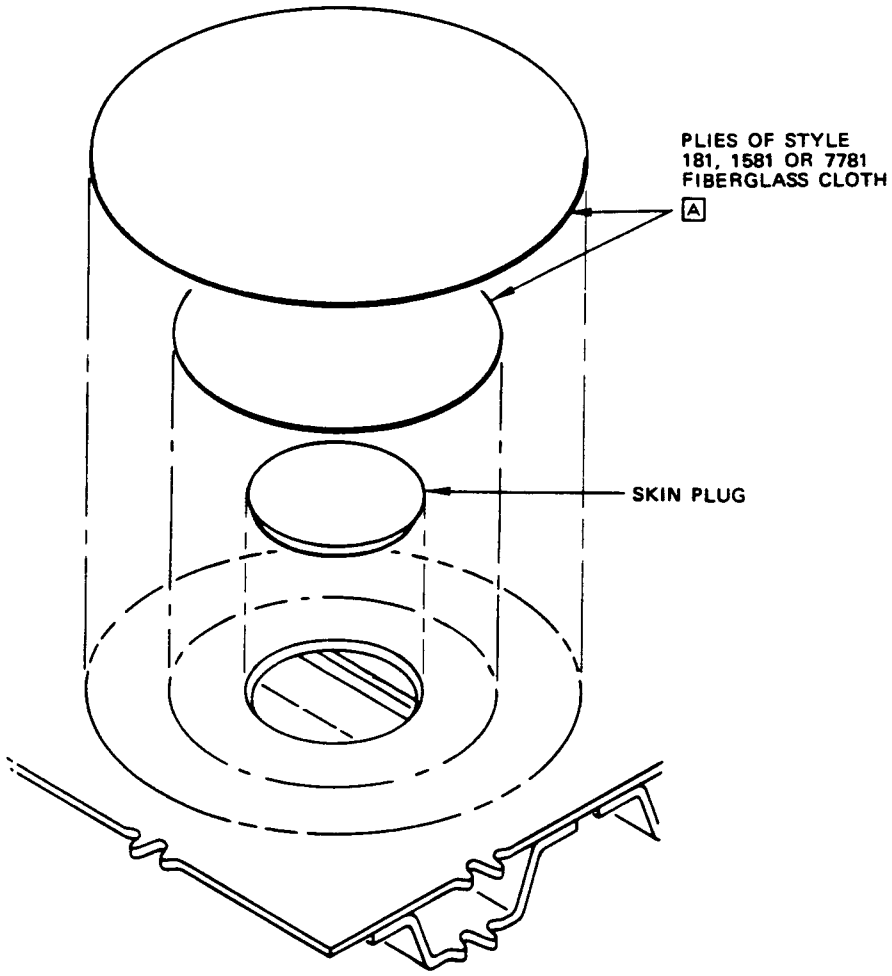
2. Trim out damage and clean repair area as described in paragraph 10.

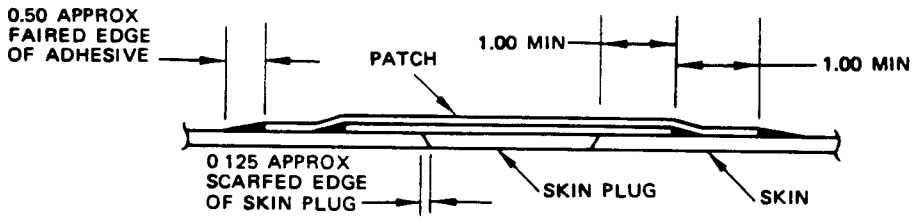
3. Close the hole in the skin with a plug and apply a fiberglass cloth patch impregnated with BMS 5-29 adhesive as described in paragraph 12.

NOTE

1. ONLY TWO REPAIR PLIES ARE SHOWN HERE, BUT FOR REPAIR OF THE SOLID LAMINATE PORTION OF THE TAIL CONE, USE AS MANY REPAIR PLIES AS THERE ARE DAMAGED PLIES IN THE ORIGINAL TAIL CONE SKIN. MAKE THE SMALLEST PLY AT LEAST 2 INCHES LARGER IN DIAMETER THAN THE HOLE IN THE SKIN; MAKE EACH ADDITIONAL PLY 2 INCHES LARGER THAN THE PRECEDING PLY, WITH THE SMALLEST PLY NEXT TO THE DAMAGED SKIN. WHEN REPAIRING SKIN BETWEEN HAT-SECTION STIFFENERS IN THE TAIL CONE, APPLY HALF OF THE REQUIRED NUMBER OF REPAIR PLIES ON THE INSIDE AND HALF ON THE OUTSIDE OF THE TAIL CONE. APPLY THE ODD PLY ON THE INSIDE OF THE TAIL CONE WHEN AN ODD NUMBER OF PLIES ARE REQUIRED.

Fiberglass Skin Repair
Figure 3 (Sheet 1)





SECTION THROUGH REPAIR

Fiberglass Skin Repair
Figure 3 (Sheet 2)

REPAIR INSTRUCTIONS

1. Stop drill the crack with a 0.25-inch diameter drill.

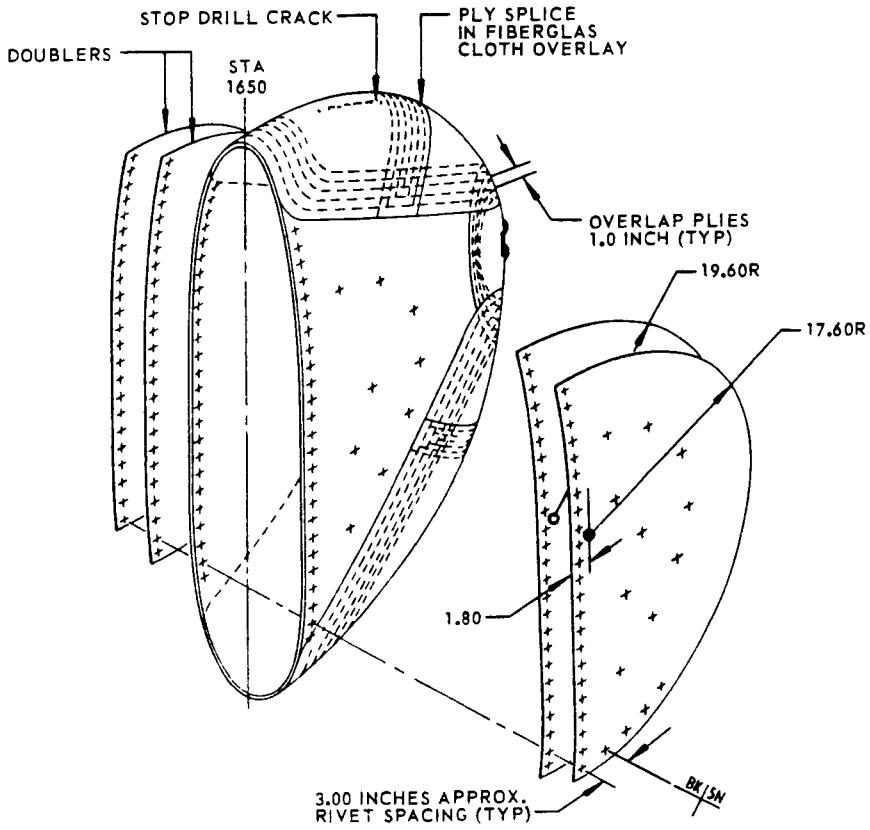
2. Cut the four doublers shown from a 0.050-inch thick 5-ply fiberglass cloth laminate fabricated per BAC5449 or per BMS 8-52.

3. Clean the entire outer surface of the solid laminate tail cone and the doublers as described in par. 10.B.

4. Prepare and apply an overlay of 6 plies of Style 181, 1581 or 7781 fiberglass cloth around the periphery of the tail cone as shown in the illustration, with BMS 5-29 adhesive by the process described in par. 9.

5. Immediately after bonding the two doublers to each other and bonding one pair of doublers to each side of the tail cone with BMS 5-29 adhesive mixed per Fig. 5, rivet the doublers to the tail cone with rivets at approx 3.0-inch spacing along the entire edge of the doubler and with rivets in the center as required. Use AN470B5 rivets (or preferably AN456B5 brazier head rivets) with an aluminum washer under the driven head on the inside of the tail cone.

6. Cure and finish the repair per par. 9.C. and D.



Cracked Fiberglass Tail Cone Repair
Figure 4

POTTING COMPOUND 1	
COMPONENTS	PARTS BY WEIGHT
EPON 815	100
MICROBALLOONS	24
CURING AGENT "T"	22

Amount of microballoons may be varied from 16 to 25 parts by weight in order to obtain a mixture of the desired consistency. Also the amount of Curing Agent "T" may be varied from 16 to 25 parts by weight. Increased amount of curing agent shortens the required curing time. Use only 16 parts of curing agent when making potted repairs larger than 1.50 inch diameter to prevent foaming of the potting compound.

MIXING PROCEDURE

1. Add microballoons to Epon 815 and mix thoroughly.
2. Add curing agent and mix thoroughly.

NOTE: Pot life of mixture after adding curing agent is approximately 30 minutes. Cure time is approximately 4 hours at 70° F. or 1 hour at 130° F.

READY-TO-USE PACKAGE

COMPONENTS OF POTTING COMPOUND 1 ARE AVAILABLE IN A PLASTIC BAG NO 80055-44 OR 80055-45 FROM FENWAL INCORPORATED, 400 MAIN STREET, ASHLAND MASS 01721 BEFORE USE, ALLOW CURING AGENT TO ENTER THE PLASTIC BAG CONTAINING THE EPON 815-MICROBALLOON MIXTURE FROM AN ADJACENT COMPARTMENT AND MIX THE CONTENTS THROUGHLY WITHIN THE PLASTIC BAG BY KNEADING

WARNING:

THESE CHEMICALS CONTAIN TOXIC INGREDIENTS, PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

EPON 828 MIXTURE	
COMPONENTS	PARTS BY WEIGHT
EPON 828	100
CURING AGENT "T"	15 TO 25

Amount of curing agent may be varied from 15 to 25 parts by weight. For fast cure use maximum amount of curing agent that still permits enough working time for application of the patch.

MIXING PROCEDURE

Add curing agent to Epon 828 and mix thoroughly.

NOTE: Mixture pot life is approximately 20 minutes at 70° F. after addition of curing agent

EPON 815 MIXTURE	
COMPONENTS	PARTS BY WEIGHT
EPON 815	100
CURING AGENT "T"	25

NOTE: Pot life of mixture is approximately 30 minutes.

RESIN MIXTURE	
COMPONENTS	PARTS BY WEIGHT
PART A EPOCAST 1511	100
PART B EPOCAST 9614	15

MIXING PROCEDURE

1 Add Part B to Part A and mix thoroughly

NOTE: Pot life of mixture after adding curing agent is approximately 15 to 25 minutes for a one pound mixture.

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS. WEAR RUBBER OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

SEE 51-10-1, FIG. 2 FOR SOURCES OF REPAIR MATERIALS AND EQUIPMENT

MIXING PROCEDURE

1. Add Epon 828 to Epon 812 and mix thoroughly.
2. Add Versamid 115 to Versamid 125 and mix thoroughly.
3. Add Epon mixture to Versamid mixture and mix thoroughly.

NOTE: Mixture pot life is approximately 2 hours at 70°F.

CURING TIMES FOR BMS 5-29	
TEMPERATURE	TIME
60°F	40 HOURS
70°F	24 HOURS
90°F	16 HOURS
100°F	13 HOURS
110°F	10 HOURS
120°F	7.5 HOURS
140°F	4 HOURS
160°F	2 HOURS
180°F	1 HOUR
200°F	30 MINUTES
220°F	15 MINUTES
240–260°F	6 MINUTES

READY-TO-USE PACKAGE

BMS 5-29 adhesive is also available in kit form under number 3147-N2X from Whitaker Corp., Narmco Materials Div., 600 Victoria Street, Costa Mesa, California 92626; and number 80055-30 or 80055-31 from Fenwal Incorporated, 400 Main Street, Ashland, Massachusetts 01721.

The two Epons are in a plastic bag, and a separate compartment contains the two Versamids, all in correct proportions. The adhesive is ready for use after breaking the seal between the two compartments and mixing the contents thoroughly within the plastic bag by kneading.

Also a three-part package is available from Fenwal that contains fiberglass patches, in addition to the adhesive.

BMS 5-29 ADHESIVE FOR FIBER GLASS [A]	
COMPONENTS	PARTS BY WEIGHT
EPON 812	100
EPON 828	100
VERSAMID 115	100
VERSAMID 125	100

NOTES:
[A] BMS 5-126 ADHESIVE IS OPTIONAL TO BMS 5-29 ADHESIVE.

Preparation of Adhesive for Fiberglass
Figure 5 (Sheet 2)

Ⓐ BMS 5-126 ADHESIVE (TYPE 2, CLASS 1) ADHESIVE FOR FIBERGLASS	
COMPONENTS	PARTS BY WEIGHT
A	100
B	100

BLENDING PROCEDURE:

1. Mix component A thoroughly
2. Mix component B thoroughly
3. Thoroughly blend equal parts by weight of components A and B.

NOTE: Mixture pot life is approximately 2 hours at 70°F.

CURE TIMES FOR BMS 5-126 (AT A CLAMPING PRESSURE OF 10-15 PSI)	
TEMPERATURE	TIME
70° ± 5°F	24 ± 1 HOURS
100° ± 10°F	12½ ± 1½ HOURS
150° ± 10°F	3½ ± ¼ HOURS
250 ± 10°F	20 ± 5 MINUTES

RESIN MIX 3 (SEALER RESIN)	
COMPONENTS	PARTS BY WEIGHT
EPOCAST 991A	100
EPOCAST 941	12

MIXING PROCEDURE

1. Weigh the Resin into a container.
2. Weigh the Hardener into the same container.
3. Mix thoroughly by hand.

NOTE: The potlife of this mix is approximately 15 minutes at 77°F.

POTTING RESIN FOR PUNCTURE NOT EXCEEDING 3/16 INCH	
COMPONENTS	PARTS BY WEIGHT
RESIN MIX 1	100
MILLED GLASS FIBERS 1/32" LENGTH CATIONIC BINDER	SEE STEP 1. BELOW

MIXING PROCEDURE

1. Add milled glass fibers to Resin Mix 1 to provide a consistency similar to putty.

NOTE: Pot life is approximately the same as Resin Mix 1.

RESIN MIX 1 (LAMINATING RESIN)	
COMPONENTS	PARTS BY WEIGHT
EPOCAST 1835	100
EPOCAST 9816	15

MIXING PROCEDURE

1. Add Furane 9816 to Furane HT 1835 and mix thoroughly.

NOTE: Mixture pot life is approximately 45-60 minutes at 75°F.

Preparation of Adhesives For Fiberglass
Figure 5 (Sheet 2)

REPAIR INSTRUCTIONS

1. Trim out damaged area and prepare for repair as detailed in paragraph 3.

2. Repair honeycomb core as detailed in paragrap 4.

3. Apply patch plies as detailed in paragraph 5.

4. Refinish using chemical and solvent-resistant finish as detailed in 51-2-51 of the 707 Maintenance Manual.

NOTE

- WHEN MORE THAN 10 SQUARE INCHES OF CONDUCTIVE COATING IS REMOVED BY A SINGLE REPAIR, OR, WHEN A TOTAL OF 25 SQUARE INCHES OF COATING IS REMOVED BY SUBSEQUENT REPAIRS, REPLACE AS DESCRIBED IN 51-2-71 OF THE 707 MAINTENANCE MANUAL.

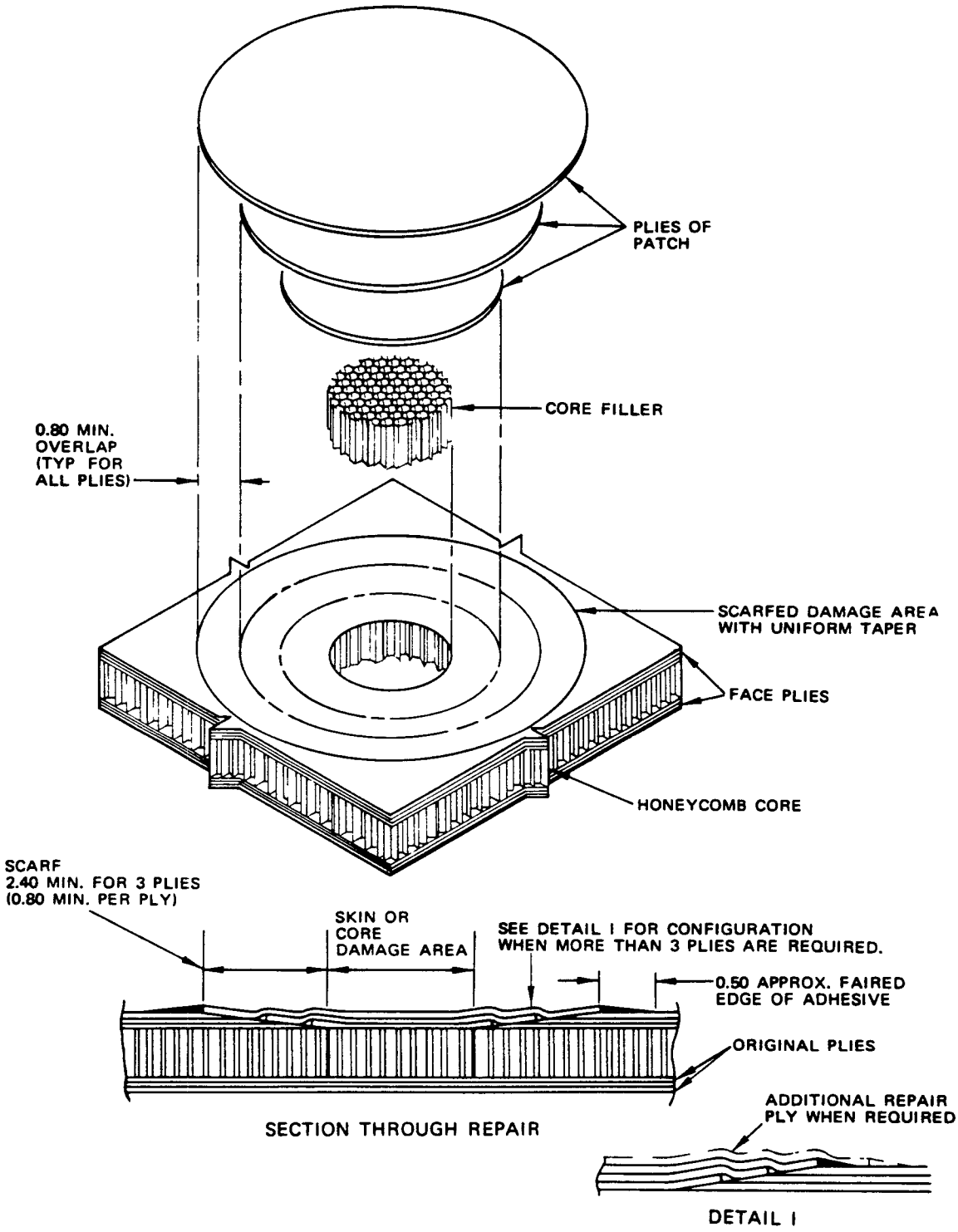
- INSTALL CONDUCTIVE STRIPS, WHEN REQUIRED, AS DESCRIBED IN 53-2-51 OF THE 707 MAINTENANCE MANUAL.

- AFTER REPAIR OF FORWARD PORTION OF THE NOSE RADOME, REPLACE THE EROSION SHOE AS DESCRIBED IN 13-3-1 OF THE MAINTENANCE MANUAL.

- THIS REPAIR IS DESIGNED FOR A NOSE RADOME WITH 3-PLY SKIN. REFER TO 51-11-1, FIGURE 1, TABLE 1, FOR THE NUMBER OF PLIES REQUIRED FOR THE REPAIR OF OTHER ELECTRICALLY CRITICAL COMPONENTS.

- REPAIR RADOMES DAMAGED BY ELECTRICAL DISCHARGE AS DETAILED IN PARAGRAPH 7.

Radome Repair
Figure 6 (Sheet 1)



Radome Repair
Figure 6 (Sheet 2)

REPAIR INSTRUCTIONS

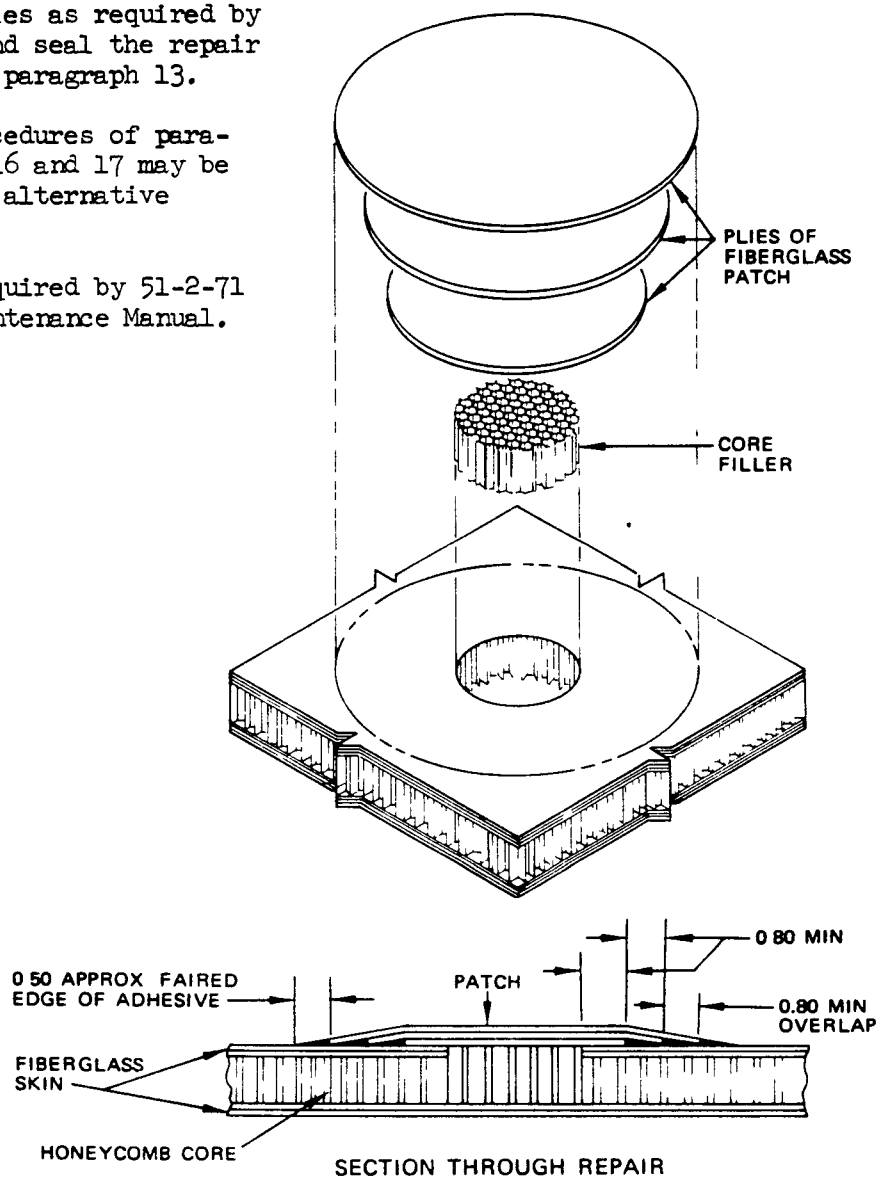
1. Trim out damaged skin and prepare for repair as detailed in paragraph 10.

2. Repair damaged honeycomb core as detailed in paragraph 4, but with core plug flush with the outer skin.

3. Apply patch plies as required by paragraph 9, and seal the repair as detailed in paragraph 13.

   NOTE: The procedures of paragraphs 16 and 17 may be used as alternative repairs.

4. Refinish as required by 51-2-71 of the 707 Maintenance Manual.



External Repair with Accelerated Cure for Glass Fabric Reinforced Honeycomb Components
Figure 7

14. Repair for Doppler Radome Laminated Fiberglas Cloth Wall

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

A. Remove the Doppler radome and fasteners from the airplane.

B. Clean all dust, dirt, oil and other contamination from the damaged area with clean oil free cloths soaked in MEK (methyl ethyl ketone).

C. Check for delamination of fiberglass cloth plies.

(1) Delamination is evident when the plies have become unbonded and a gap has resulted or when a whitish area is observed. Tapping on the surface near the damage with a coin gives off a dull sound.

(2) Keep accurate records of the repair area and location, so that future repairs will not exceed the requirements of par. D.

(3) Determine the type of damage defined as follows:

(a) Surface scratches that do not extend into the first fiberglass cloth ply.

(b) Gouges that extend into one or more fiberglass cloth plies.

(c) Punctures that extend completely through all the fiberglass cloth plies.

(d) Delaminated fiberglass cloth plies.

D. Radome repair thickness limits.

(1) See Fig. 8 for location of "A," "B," and "C" areas.

(2) In area "A" the required wall thickness must be 0.315 ±0.006, except no more than 10% of any of all possible 4-1/2 x 5 inch rectangles may have a thickness of 0.315 ±0.010.

(3) In area "B" the required thickness must be 0.315 ±0.010.

(4) In area "C" the required thickness must be 0.315 ±0.015.

(5) Aerodynamic Smoothness

(a) The contour waviness of the convex face of the radome must not exceed 1/4% of the wave length. $\frac{\text{depth}}{\text{length}} = 0.0025$

NOTE: If damage occurs between area "A" and "B" or "C" the required wall thickness for "A" will apply. If the damage occurs between "B" and "C" the required wall thickness for "B" will apply.

(6) A maximum of 15% of the area may be repaired provided the original contour and the requirements of par. D are met.

E. Cleaning and Sanding

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

(1) Clean damaged area with clean oil free cloths soaked with MEK.

(2) Remove decorative paint if applicable.

WARNING: THE SANDING GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJUROUS. OBSERVE PRECAUTION AS TO SKIN AND RESPIRATION PROTECTION.

(3) Sand damaged area with 180-grit or finer sandpaper.

(4) Use a flexible disk sander, belt sander, rotating pad sander or manual sander.

(5) Clean off sanding dust with clean oil free cloths soaked with MEK.

F. Repair of surface scratches.

(1) Clean damaged area per par. E.

(2) Remove scratches by sanding with 180-grit or finer sandpaper. Do not sand into the surface of the first fiberglass cloth ply.

(3) Coat the sanded area with resin mix 1 or resin mix 3 and after curing lightly sand to produce a smooth surface. Prepare resin mixes per Fig. 5.

(4) Restore original finish.

G. Repair of a gouge extending through one or more fiberglass cloth plies.

(1) Clean damaged area per par. E.

(2) Sand out a circular or oval dish shaped area with a uniform taper around the damage for a distance of 0.50 inch for each damaged ply to be replaced (Fig. 8).

(3) Repair in accordance with the instructions in par. J and K.

H. Repair of a puncture that extends completely through the laminated fiberglass wall.

(1) Clean damaged area per par. E.

(2) If the puncture diameter is three-sixteenths of an inch or less repair by filling with milled glass fibers mixed with resin mix 1 to form a potting resin, the consistency of putty. Prepare resin mixes per Fig. 5. Allow material to cure then sand to fair with the surrounding surface.

(3) If the puncture diameter is three-sixteenths of an inch or more, repair by cutting out the damage and install patches as shown in Fig. 8.

(4) Repair according to the instructions in par. J and K.

I. Repair of delaminated fiberglass cloth plies.

(1) Clean damaged area per par. E.

(2) If the outer two plies are slightly delaminated, repair by injecting resin mix 1 into the delaminated ply to rebond.

(3) If three or more of the plies are delaminated, trim and sand out the damage. Sand out a circular or oval dish shaped area with a uniform taper around the damage for a distance of 0.50 inch for each damaged ply to be replaced (Fig. 8).

(4) Repair according to the instructions in par. J and K.

J. Cutting and impregnating of cloth patches

(1) Cut off a piece of Style 184 or 1584 fiberglass cloth large enough to include all the patches needed for the patch buildup.

(2) Cut off a piece of Style 116 fiberglass cloth large enough to include the patch needed for the final overlay.

(3) Cut two pieces of PVA (Polyvinyl Alcohol) film approximately three inches larger all around than the cloth cut out in par. (1).

(4) Cut two pieces of PVA film approximately three inches larger all around than the cloth cut out in par. (2).

(5) Tape down one sheet of PVA film on a smooth surface.

(6) Spread the resin mix 1 over the PVA film and place the cloth over the resin.

NOTE: The required weight of resin is approximately equal to the weight of dry fiberglass cloth.

(7) Cover the cloth on the PVA film with a second piece of PVA film.

(8) Press down on the second piece of PVA film with a squeegee or roller to force the adhesive through the cloth and remove all air bubbles.

NOTE: 51-10-1, Fig. 13 shows details of a squeegee that can be used to impregnate patches.

(9) Cut through the PVA films and the impregnated cloth at the same time. The direction of the fibers in the patch must be in the same direction as the fibers in the original surface.

(10) Cut the largest cloth patch to match the size of the repair area and then cut each succeeding cloth patch 0.50 inch smaller all the way around than the preceding patch. The total number of replacement patches must equal the number of damaged plies in the original wall except that one additional Style 116 ply will be used as shown in Fig. 8.

K. Install Patches

(1) Clean out repair area with oil free air. Wipe the surface with clean cloths moistened with MEK.

(2) Apply a coat of resin mix 1 to the repair area. Prepare the resin according to Fig. 5.

(3) Remove the PVA film from one side of the smallest cloth patch and place its exposed face against the repair area with direction of fibers in the same direction as the fibers of the original wall.

(4) With a squeegee carefully apply pressure on top of the PVA film to remove wrinkles and air bubbles.

CAUTION: EXCESSIVE WORKING WILL CAUSE VOIDS OR DRY SPOTS RESULTING IN AN INCOMPLETE BOND.

(5) After removing the PVA film from the contact faces place the next larger impregnated patch over the smaller one and allow for 0.50-inch overlap all around.

(6) Place the succeeding impregnated patches and allow for 0.50 overlap as outlined in par. (4) and (5).

(7) After placing the last patch, recover the entire layup with a piece of perforated PVA film. Use PVA film with 1/32 diameter holes spaced at 1/2 inch.

(8) Place one ply of Osnaberg cloth over the perforated PVA film. Extend the perforated PVA film two inches beyond the repair and the Osnaberg 3 to 4 inches beyond the PVA film.

(9) Stretch a piece of PVA film over the entire area and seal with the use of double-backed tape.

(10) Evacuate the space under the PVA film with a minimum vacuum of 20 inches gage pressure. Check to be certain that there are no leaks. Continue pressure until the cure time and temperature requirement of paragraph (11) have been met.

(11) Allow for adequate curing time.

(a) Select the desired curing time from the table.

Curing Time	Temperature
12 hours	75°F
4 hours	125°F
1.5 to 2 hours	150°F

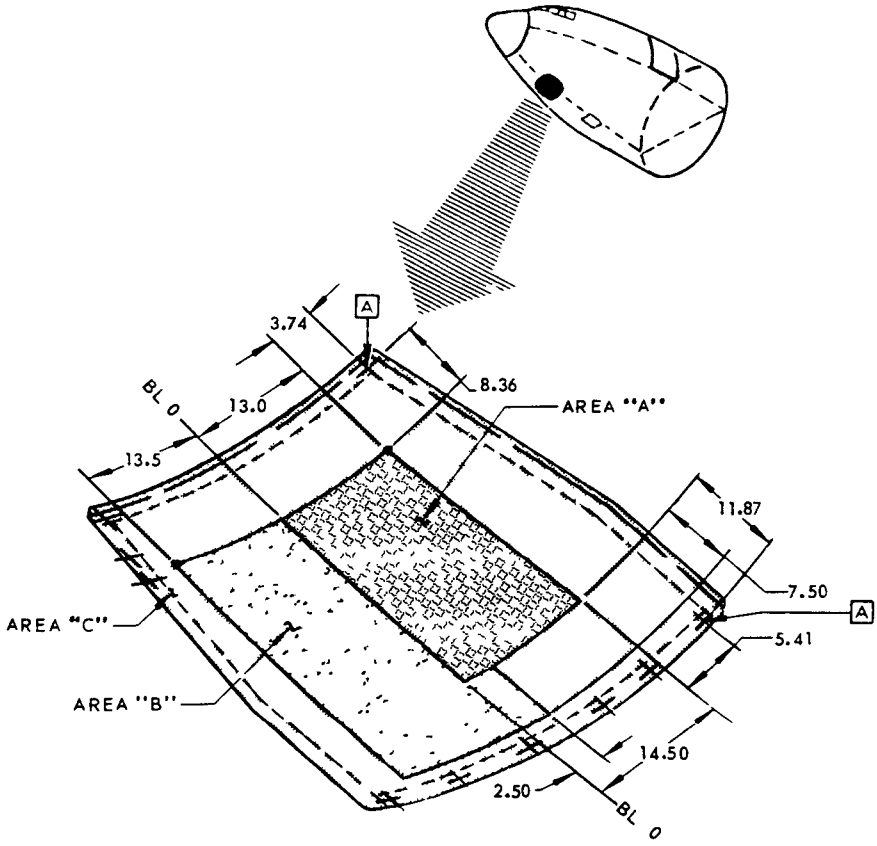
(12) After cure remove the PVA film and Osnaburg cloth.

(13) Lightly hand sand the patch to produce a smooth feather edge.

L. Check that the thickness limits of paragraph D. have been met.

M. Restore original finish. See the Maintenance Manual section 51-2.

N. Reinstall the Doppler radome and all the original fasteners.

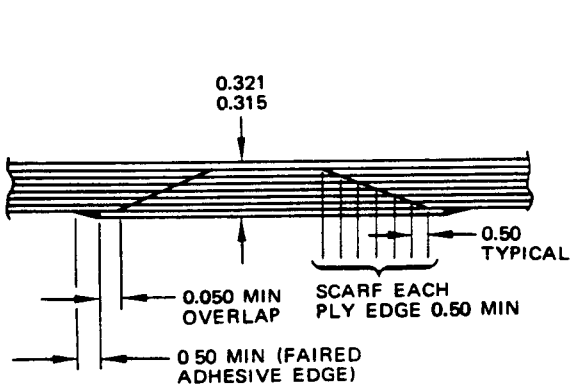


NOTE

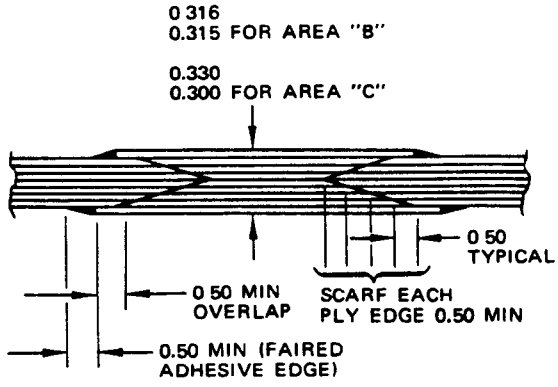
REPAIR METHODS AS DESCRIBED IN PARAGRAPH 14.

DIMENSIONS INDICATED ARE PARALLEL TO CONTOUR.

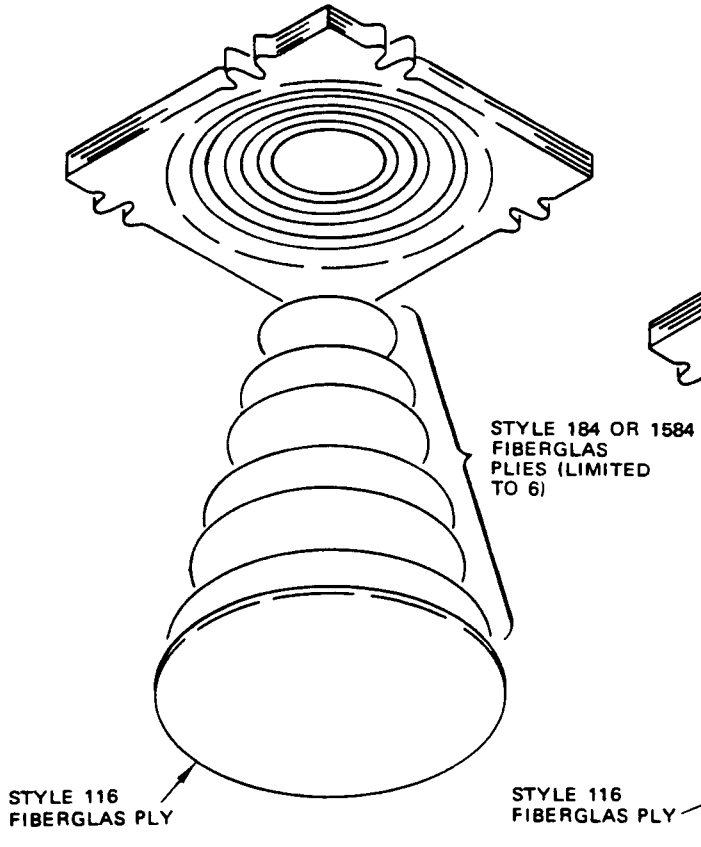
[A] USE EXISTING FASTENER HOLE FOR DIMENSION INDEX.



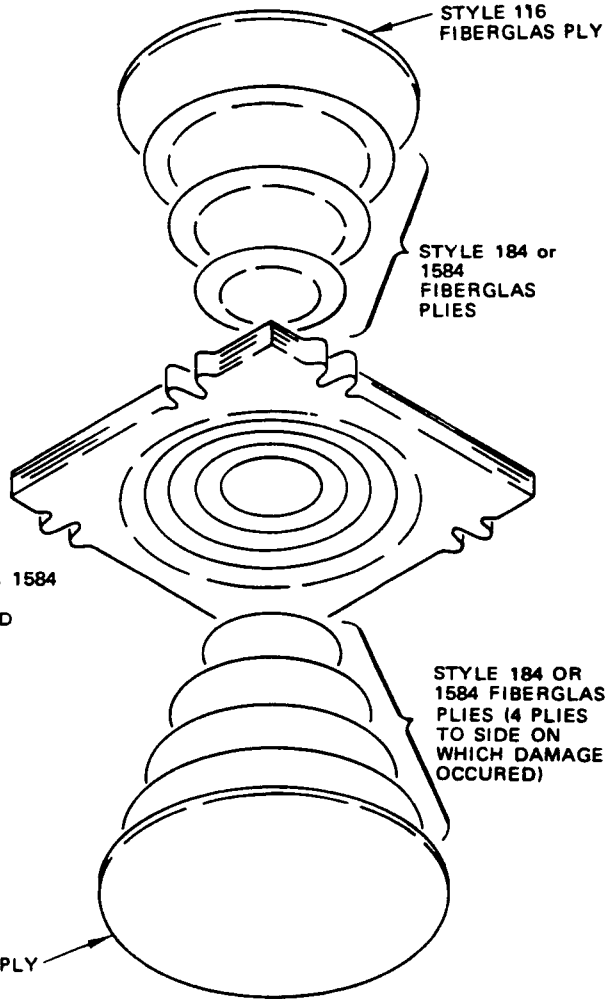
SECTION THROUGH DAMAGED AREA "A"



SECTION THROUGH DAMAGED AREAS "B" AND "C"



REPAIR FOR AREA "A"



REPAIR FOR AREAS "B" AND "C"

Repair of Solid Laminate Doppler Radome Door
Figure 8 (Sheet 2)

15. Quick Repair for Doppler Radome per Kit 65-99466

A. Limitations of the Repair Method

(1) The repair, when allowed by size requirements and per note [C] of Fig. 1, is acceptable for a one-time flight (not to exceed 24 hours flight time) to a main repair base for repair per 51-11-1, Fig. 1.

(2) The repair is usually limited to those areas of a radome where the contour is relatively flat to enable the precured patch (Fig. 11) to adhere satisfactorily.

(3) The foam resin system has a very short pot life (20 seconds) (Fig. 12).

(4) Environmental humidity conditions during the repair affect the time of foam resin curing. Resin cure time at a low relative humidity (e.g. 20%) is much slower than at a higher value such as 50% or greater.

(5) The adhesive and foam resin systems as a kit require close control of temperature during shipment and storage prior to use. The recommended total storage life of the kit is 6 months (Fig. 10).

B. Items for consideration prior to any of the Repair Procedures which are listed below.

(1) The adhesive and foam systems cure quickly without exterior heat.

(2) Do not mix the foam batch parts (3) and (4) until all other mechanical operations, such as trimming, cutting, etc., have been completed. Then and only then should they be combined and mixed as directed in Fig. 10.

(3) Chemical paint strippers may attack resin systems, therefore, should not be used for removing paint.

C. Repair of Damage to Outer Skin Only

(1) Cut away all skin plies that have been separated from the honeycomb core. Make the skin removal as nearly circular as possible without cutting an excessive amount of "sound skin." If the damage area is elongated, radius the ends of the skin removal slot.

(2) Abrade the outer skin surface in an area about 6 inches in diameter around the cut out area.

(3) Remove any water which may be present in the honeycomb core. Use clean, dry compressed air to accelerate the drying process. Do not proceed further in the repair process unless the affected cells are absolutely dry.

(4) Prepare a batch of foam mix per figure 10.

(5) Use a clean tongue depressor to apply the foam to the exposed core. Be sure to apply enough foam to the honeycomb, so that, when expanded, excess foam will protrude beyond the outer skin surface.

(6) Let the foam harden and remove the excess foam by sanding.

(7) Clean away sanding dust and fingerprints from the foam and adjacent skin surface with MEK or acetone.

(8) Brush the entire sanded area and the formed foam block with a very thin film of adhesive, part (2), of figure 10.

(9) Remove the protective cover from part (5) and place the patch so that the rubbery side is against the adhesive. Hold the patch firmly in place until the adhesive is cured. See figure 10 for modification of part (5) in doubly curved regions.

D. Repair of Damage to Outer Skin and Honeycomb Core

(1) Remove all outer skin that has been separated from the honeycomb core. Make the skin removal as nearly circular as possible without cutting an excessive amount of "sound" skin. If the area is elongated, radius the ends of the removal slot. Cut out the honeycomb core, down to the inner skin.

(2) See paragraph C.(2) above.

(3) See paragraph C.(3) above.

(4) Trim part (1) of figure 10 (foam block) and form into a plug which will fit into the prepared cavity. Lay the plug in a convenient place ready for a quick insertion into the cavity.

(5) See paragraph C.(4).

(6) Use a clean tongue depressor to assist in pouring the foam batch onto the foam plug.

(7) Insert the plug into the cavity and press hard enough to squeeze the excess resin out around the sides of the plug. Hold the plug in place until the resin has foamed and hardened.

(8) Cut away the excess foam and sand flush with the outer skin surface.

(9) See paragraph C.(7).

(10) See paragraph C.(8).

(11) See paragraph C.(9).

E. Repair of Damage through the Entire Sandwich Structure

(1) Remove all delaminated inner and outer skins. If one skin damage is greater, remove the honeycomb core even with the edge of larger hole in the skin. Make the skin removal as nearly circular as possible without cutting an excessive amount of sound skin. If the damage area is elongated, radius the ends of the skin removal slot.

(2) Abrade the inner and the outer skin in the area about 6 inches in diameter around the rupture.

(3) Clean the surfaces with MEK, acetone or ethyl alcohol.

(4) See paragraph C.(3).

(5) Brush the entire area of the inner skin with a very thin film of adhesive, part (2) of figure 10.

(6) Remove the protective cover from part (5) skin patch, and place it so that the rubbery side is against the adhesive. Hold the patch firmly in place until the adhesive is cured.

(7) See paragraph D.(4).

(8) See paragraph C.(4).

(9) Use a clean tongue depressor to assist in pouring the foam batch onto the plug.

(10) Insert the plug into the cavity, pressing hard enough to squeeze excess resin out around the sides of the foam plug.

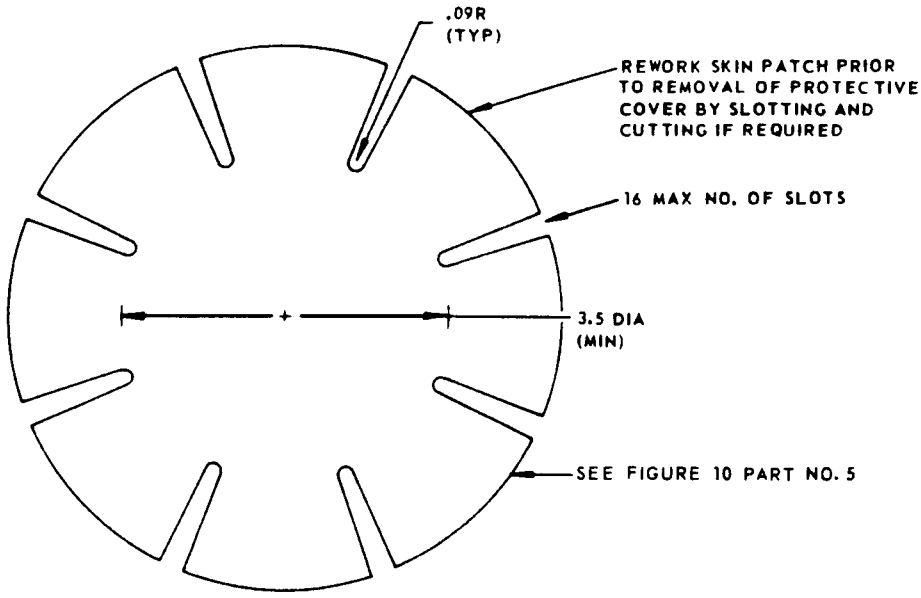
(11) Hold the plug in place until the resin has formed and hardened.

(12) Remove the excess foam by sanding it flush with the skin surface.

(13) See paragraph C.(7).

(14) See paragraph C.(8).

(15) See paragraph C.(9).



Skin Patch
Figure 9

WARNING

THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

NOTE

[A] MAINTAIN TEMPERATURE OF THIS KIT COMPONENT BETWEEN 50° - 70° F. DURING ANY SHIPMENT OR STORAGE PRIOR TO ITS USE. STORAGE LIFE OF THE KIT IS 6 MONTHS.

[B] AVOID CONTACT WITH SKIN.

FOAM MIX PROCEDURE

1. POUR PART (4) INTO PART (3) CONTAINER.
2. USING A TONGUE DEPRESSOR, STIR THE CONTENTS TOGETHER QUICKLY. BE SURE TO MIX THE RESIN IN FROM THE SIDES OF THE CONTAINER.
3. MIX THE BATCH THOROUGHLY.

KIT CONTENTS 65-99466			
PART		QTY	REMARKS
(1)	FOAM BLOCK	1	CURED POLYURETHANE (20 TO 25 PER CU FT
(2)	ADHESIVE [A]	1	BOTTLE / 16154, 1/4 OZ
(3)	FOAM, PART F-1 [A]	1	BOTTLE / SA111, 4 OZ
(4)	FOAM, PART F-2 [A] [B]	1	BOTTLE SA112, 2 OZ
(5)	SKIN PATCH	2	6 INCH DIAMETER

Kit 65-99466
Figure 10

16. Quick, Temporary Repair Procedures for Nonelectronic Components

A. Limitations

(1) Examine these repairs periodically for possible deterioration.

(2) Replace such deteriorated repairs by the method described in par. 17 at the first opportunity.

B. Materials Required

(1)	Concresive #1204 Parts A and B	Adhesive Engineering Company 1411 Industrial Road San Carlos, California 94070
(2)	Glass Fabric Cloth Style 181, 1581 or 7781 Volan A Finish	United Merchants and Manufacturers Inc. 1407 Broadway New York, New York 10018 J.P. Stevens and Co., Inc. Broadway at 41st New York, New York 10036 Clark-Schwebel International S.A. Battice, Belgium Bay Mills, Ltd. 365 Evans Avenue Toronto, Ontario, Canada MBZ TK2 Hexcel Corp 11711 Dublin Blvd. Dublin, California 94566 Burlington Industrial Fabrics Co. Div. of Burlington Industries 1345 Avenue of the Americas New York, New York 10019
(3)	Acetone, Methyl Ethyl Ketone Solvent Cleaner	Any Source
(4)	Parting Film: 0.002 Mylar or Equivalent	Reynolds Metal Co. 2819 First Ave. Seattle, Washington 98121
(5)	Metal Patch	The Boeing Company per 65-99801

C. Repair by Placement of Patch Plies

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

(1) Preparation of damaged area.

(a) If honeycomb core has been damaged or is contaminated with water, remove the damaged portion of the skin and core (Ref par. 3.C.).

(b) Check panel in vicinity of damage for presence of water, oil, fuel, dirt or other foreign matter and wash with methyl ethyl ketone or acetone to remove the foreign material.

D. Preparation of Patch Plies

(1) Cut a piece of Style 181, 1581 or 7781 fiberglass cloth, Volan A finish, that is large enough so that two plies for the patch can be cut from it.

NOTE: If Style 181, 1581 or 7781 fiberglass cloth is not available, three plies of Style 128 or 1528 cloth can be used instead of two plies of Style 181, 1581 or 7781.

(2) Cut the fiberglass cloth to the required sizes for each individual patch ply.

NOTE: Cut the smallest circular ply of cloth with a diameter 1 inch larger than the damaged area. Cut the largest circular ply of cloth with a diameter 2 inches larger than the damaged area.

E. Placement of Patch Plies

(1) Fill the damaged honeycomb area with the paste resin mixture prepared per Fig. 11 and with a stiff brush or squeegee spread a film of resin mixture over the repair area extending approximately 1/4 inch beyond the periphery of the largest patch ply.

(2) Place the smallest fiberglass cloth patch ply against the repair area and coat with the resin mixture using a stiff brush.

(3) Place the largest patch ply against the preceding patch ply and coat with the resin mixture.

(4) Cover the entire lay-up with a piece of parting film extending one inch over the edges of the patch.

(5) Sweep entrapped air and excess resin to the edge of the parting film, thereby fairing the edge of the patch to the contour of the repair surface. All loose threads shall be embedded in the resin.

(6) Allow patch to cure before removing the film.

WARNING

THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

RESIN MIXTURE	
COMPONENTS	PARTS BY WEIGHT
CONCRESIVE #1204	
PART A	100
PART B	73

MIXING PROCEDURE

ADD PART B TO A AND MIX THOROUGHLY.

NOTE POT LIFE OF MIXTURE AFTER ADDING CURING AGENT IS APPROXIMATELY 10 MINUTES

Preparation of Adhesive
Figure 11

17. Rapid, Permanent Repair Procedures at Room Temperature for Nonelectronic Components

A. Materials Required

(1) Refcoa Epoxy Resin 87-3 (Part A); Refcoa Hardener QX-2648-T (Part B)	King Fiberglass Corporation 366 W. Nickerson St. Seattle, Washington 98119
(2) Phenolic Microballoons BJO-0930	Union Carbide Corporation Chemicals and Plastics Div. River Road Bound Brook, New Jersey 08805
(3) Acetone, Methyl Ethyl Ketone Solvent Cleaner	Any Source
(4) Glass Fabric Cloth Style 181, 1581 or 7781 Volan A Finish	United Merchants and Manufacturers Inc. 1407 Broadway New York, New York 10018 J.P. Stevens and Co., Inc. Broadway at 41st New York, New York 10036 Clark-Schwebel International S.A. Battice, Belgium Bay Mills, Ltd. 365 Evans Avenue Toronto, Ontario, Canada MBZ TK2 Hexcel Corp 11711 Dublin Blvd. Dublin, California 94566 Burlington Industrial Fabrics Co. Div. of Burlington Industries 1345 Avenue of the Americas New York, New York 10019
(5) Parting Film: 0.002 Mylar or Equivalent	Reynolds Metal Co. 2819 First Ave. Seattle, Washington 98121

B. Repair by Placement of Patch Plies to Sandwich Face Laminates

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

(1) Examine the damaged area of a honeycomb assembly.

(a) Determine extent of damage.

1) Check panel in vicinity of damage for presence of water, oil, fuel, dirt or other foreign matter.

2) Check for delamination around periphery of the damaged area.

NOTE: Delamination can be detected by tapping the skin with a small metallic object, such as a half dollar coin. There is a hollow sound from the delaminated area compared to a ringing-solid sound from nondamaged area.

(2) Trim out the damage.

(a) If honeycomb core has been damaged or is contaminated with water, remove the damaged portion of the skin and core as shown in Fig. 12.

WARNING: THE SANDING OPERATION GIVES OFF A FINE DUST THAT MAY CAUSE SKIN IRRITATIONS. BREATHING OF AN EXCESSIVE AMOUNT OF THIS DUST MAY BE INJURIOUS. OBSERVE PRECAUTIONS AS TO SKIN AND RESPIRATION PROTECTION.

(b) Sand out a circular or oval dish-shaped area of the face laminate with uniform taper around the damage for a distance of at least 0.50 inch for each damaged ply (Fig. 12).

(3) Make a repair to honeycomb core by potting.

(a) Wash out any dirt, sanding dust or foreign material with methyl ethyl ketone or acetone.

(b) After wash solvent has evaporated, fill the cleaned out area in the honeycomb core with potting compound prepared per Fig. 13.

(c) After 25 minutes, sand excess potting material flush with the previously sanded tapered area.

(4) Apply patch plies per par. C below.

C. Repair by Placement of Patch Plies to Laminates and to Face Laminates of Honeycomb Sandwich Assemblies

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

(1) Examine the damaged area of laminate assembly.

(a) Refer to par. B.(1)(a) above.

(2) Trim out the damage.

(a) Sand out a circular or oval dish-shaped area with uniform taper around the damage for a distance of at least 0.50 inch for each damaged ply (Detail II, Fig. 12).

(3) Impregnate the patch plies.

(a) Cut a piece of Style 181, 1581 or 7781 fiberglass cloth finish that is large enough so that the required number of plies for the patch can be cut from it.

NOTE: Use one ply of 181, 1581 or 7781 fiberglass cloth in the patch for each damaged ply of the original laminate.

If Style 181, 1581 or 7781 fiberglass cloth is not available, three plies of Style 128 or 1528 cloth can be used instead of two plies of Style 181, 1581 or 7781.

(b) Cut two pieces of 0.002 Mylar parting film, or equivalent approximately 3 inches larger all around than the fiberglass cloth.

(c) Spread the resin mixture prepared per Fig. 14 over the parting film and place the fiberglass cloth over the resin.

(d) Cover the cloth on the parting film with the second piece of parting film.

(e) Press the resin mixture through the cloth by working over the parting film with a squeegee or roller, in order to impregnate the cloth and to remove entrapped air.

(f) Cut the impregnated cloth to the required sizes for each individual patch ply. The parting film on both sides of the cloth decreased fraying of the edges while cutting the cloth.

NOTE: Cut the largest ply of cloth to the shape of the outside of the scarfed area. Cut each succeeding ply so that it is at least 0.50 inch smaller all around than the preceding ply.

(4) Place the patch plies.

(a) Wipe the surfaces of the repair area with a clean cloth moistened with methyl ethyl ketone or acetone.

(b) With a stiff brush or squeegee, spread a thin film of resin mixture over the repair area (0.003-0.009") extend approximately 1/8 inch beyond the periphery of the scarfed area.

(c) Remove the parting film from one side of the smallest patch ply of the patch and place its exposed face against the repair area.

(d) After removing the parting film from the contact face of the preceding patch ply, place the next larger size ply of the impregnated cloth over the ply on the repair area with at least 0.50-inch overlap all around.

(e) Place succeeding plies of the impregnated cloth as described in step (d) above.

(f) After placing the last ply and removing the outer parting film, cover the entire lay-up with a piece of parting film extending about 4-6 inches beyond the scarf area over the edges of the patch.

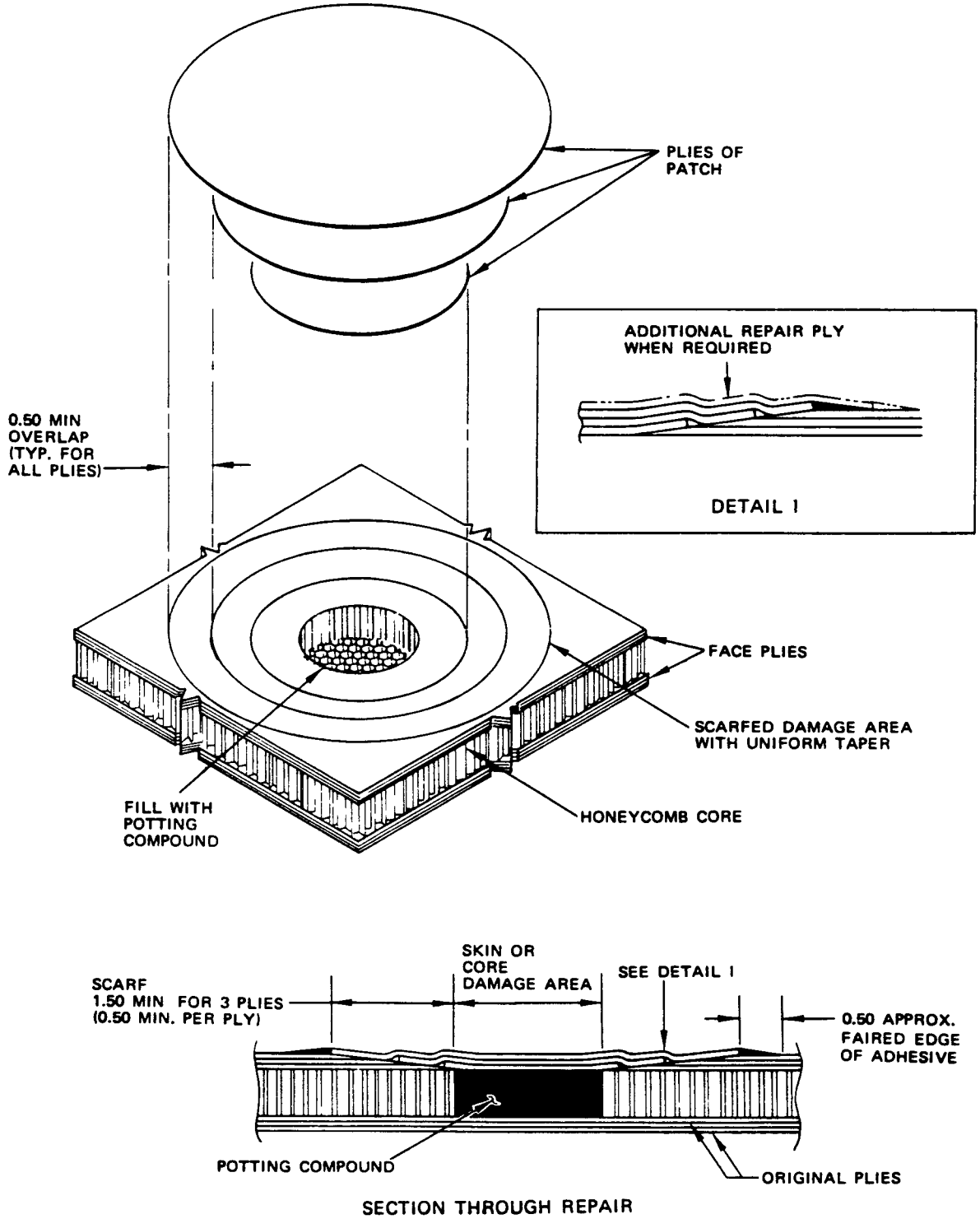
(g) Sweep entrapped air and excess resin to the edge of the parting film, thereby fairing the edge of the patch to the contour of the repair surface. All loose threads shall be embedded in the resin.

(h) Wipe off any excess resin that has been squeezed out at the edge of the parting film.

(i) Allow approximately 1 hour 45 minutes for cure before removing the film.

(j) The gel and cure times of the potting and laminating resins are based on ambient temperature (70 to 80°F); elevated temperatures will advance the reactions and lower temperatures will retard the reactions. An infrared heat lamp, 250 watts, 115 to 125 volts or equivalent, heat source may be used to speed up the cure. The graph per Fig. 17 indicates the temperature obtained on the patch surface when the heat lamp is a certain height. A height of 12 to 15 inches is recommended, which gives approximately a 10-minute cure.

D. Refer to par. 21 for repair of aluminum flame-sprayed coating full conductivity and par. 22 for conductive coating repairs.



SECTION THROUGH REPAIR

Potted Core Repair
Figure 12

WARNING

THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

RESIN MIXTURE

COMPONENTS	PARTS BY WEIGHT
REFCOA EPOXY RESIN 87-3 (PART A)	100
MICROBALLOONS	15 - 25
REFCOA HARDENER QX-2648-T (PART B)	28

AMOUNT OF MICROBALLOONS MAY BE VARIED FROM 15 - 25 PARTS BY WEIGHT IN ORDER TO OBTAIN A MIXTURE OF THE DESIRED CONSISTENCY

MIXING PROCEDURE

1 ADD MICROBALLOONS TO 87-3 AND MIX THOROUGHLY.

2. ADD HARDENER AND MIX THOROUGHLY

NOTE POT LIFE OF MIXTURE AFTER ADDING HARDENER IS APPROXIMATELY 5 MINUTES. CURE TIME IS 20 MINUTES

DUE TO HIGH EXOTHERM, THE POTTED AREA MAY BLOW ANY HOLES IN THE POTTING WILL FILL WITH EXCESS RESIN FROM THE PATCHING

Preparation of Potting Compound
Figure 13

WARNING

THESE CHEMICALS CONTAIN TOXIC INGREDIENTS. PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

RESIN MIXTURE

COMPONENTS	PARTS BY WEIGHT
REFCOA EPOXY RESIN 87-3 (PART A)	100
REFCOA HARDENER QX-2648-T (PART B)	28

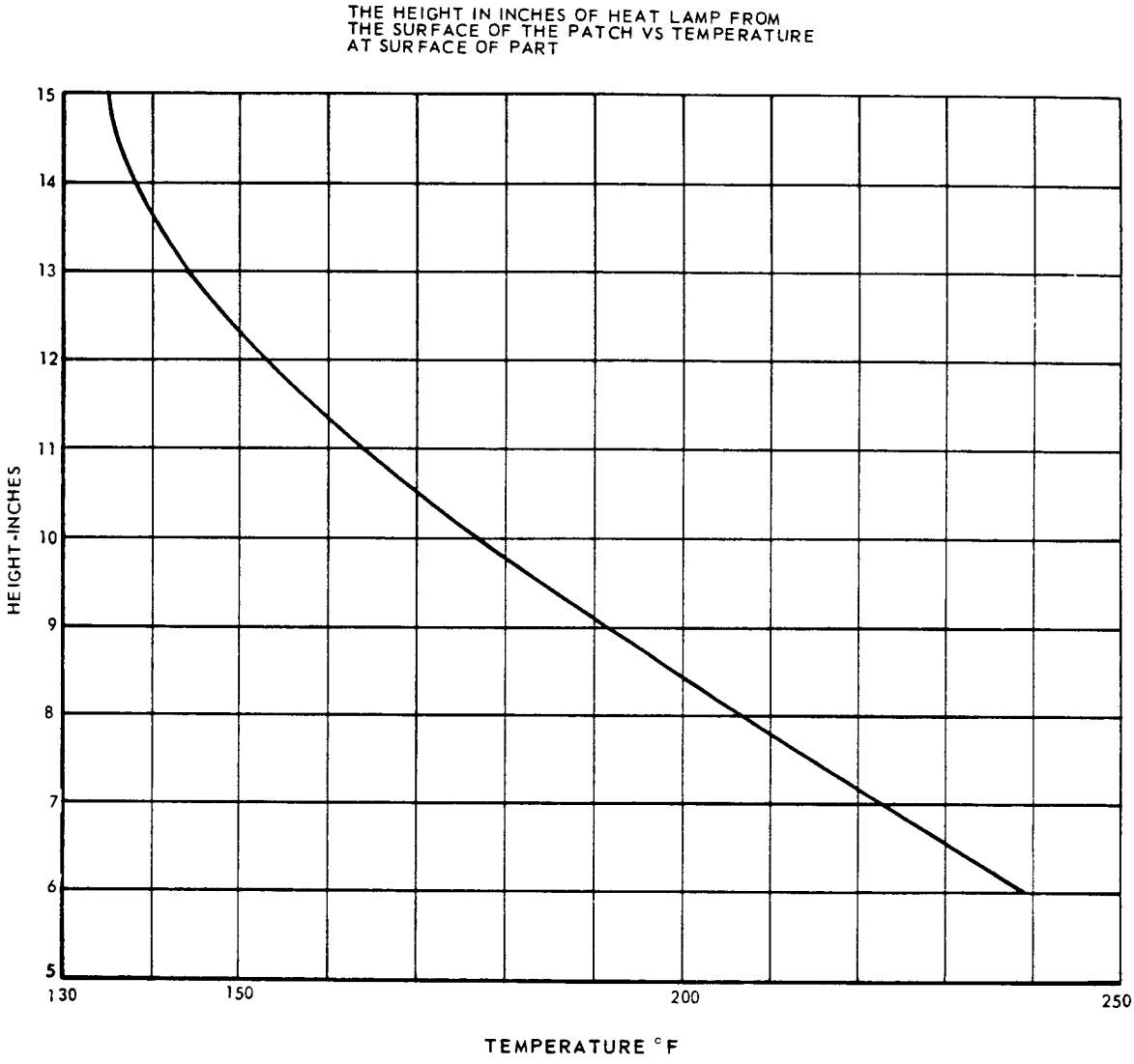
MIXING PROCEDURE

ADD HARDENER (PART B) TO RESIN (PART A) AND MIX THOROUGHLY

NOTE POT LIFE OF MIXTURE AFTER ADDING CURING AGENT IS APPROXIMATELY 10 MINUTES CURE TIME IS 2 HOURS AT 70 - 75° F

NOTE WEIGHT OF THE RESIN MIXTURE IS APPROXIMATELY 1-1/2 TIMES THE WEIGHT OF THE DRY FIBERGLASS CLOTH

Preparation of Resin Mixture
Figure 14



Potting and Laminating Resin Cure Temperatures
Figure 15

18. Preferred Repair - Nose Radome (C-Band) (Manufacturing Part Numbers: 65-2040, 65-2040-6, 65-2040-8, 65-54464-1, and 65-54464-3)

A. General Requirements

(1) The magnitude of repair which may be accomplished is dependent upon the ability of maintaining the original contour and cross section of the structure and satisfactorily meeting the necessary structural thickness and electrical requirements.

(2) Repairs requiring removal and replacement of the honeycomb core shall retain orientation requirements as specified in Fig. 16.

(3) Radomes which are repaired per the procedures which follow, and which meet thickness tolerances in the repaired area will not require electrical test before use (par. C, page 50).

(4) When additional repairs are made to a previously repaired radome, the accumulative areas must not exceed the limitations as outlined below (par. C, page 50).

(5) Figure 18 illustrates a typical repair configuration.

(6) Repairs made to the single-stage C-band radome (mfg drawing No. 65-54464) require 0.535-inch thick HRP core material.

(7) Repairs made to the C-band radomes (mfg drawing No. 65-2040) require 0.570-inch thick NP core material.

B. Materials Required

(1) Resin

(a) Epocast 1835	Furane Plastics, Inc. 5121 San Fernando Rd. W. Los Angeles, California 90039
(b) Presto Polyester Patch Paste No. 49X2	Presto Chemicals, Inc. 9346 Glenoaks Blvd. Sun Valley, California 91352

(2) Hardeners

(a) Epocast 9816	Furane Plastics, Inc. 5121 San Fernando Rd. W. Los Angeles, California 90039
(b) MEK Peroxide	Any source
(c) Epocast 946	Furane Plastics, Inc. 5121 San Fernando Rd. W. Los Angeles, California 90039

(3) Glass Fabrics

(a) BMS 9-3, Type D, H, or H-2, Class 7	Milliken Industrials Exeter Division Chestnut St. Exeter, New Hampshire 03833 J.P. Stevens and Co., Inc. 1460 Broadway New York, New York 10036 United Merchants and Manufacturers Inc. 1407 Broadway New York, New York 10018 Clark-Schwebel International S.A. Battice, Belgium Bay Mills, Ltd. 365 Evans Avenue Toronto, Ontario, Canada MBZ TK2 Hexcel Corp 11711 Dublin Blvd. Dublin, California 94566 Burlington Industrial Fabrics Co. Div. of Burlington Industries 1345 Avenue of the Americas New York, New York 10019

(4) Honeycomb

(a) HRP 3/16-5.5 (Use HRP 3/16-5.5 for repairing 65-2040 radomes. Repair core thickness is 0.570 ±0.006 inch for C-band. Ref A.(7).)	Hexcel Corporation Valley Industrial Park Casa Grande, Arizona 85222 Hexcel Corporation 338 No. Pennsylvania Graham, Texas 76046
(b) HRP 3/16-4.00 (Use HRP 3/16-4.00 for repairing 65-54464 radomes. Repair thickness is 0.535 ±0.006 inch for C-band. Ref A.(6).)	Hexcel Corporation Valley Industrial Park Casa Grande, Arizona 85222 Hexcel Corporation 338 No. Pennsylvania Graham, Texas 76046

(5)	Polyvinyl Fluoride Film Bondable Both Sides, Thickness 1 Mil.	Collins and Aikman 210 Madison Ave. New York City, N.Y. 10016
	(a) Tedlar - 100 BG 30TR	E.I. DuPont de Nemours & Co. 5500 Union Pacific Ave. Los Angeles, California 90022
(6)	Polyvinyl Alcohol (PVA) Vacuum Bag or Parting Film	Reynolds Metal Co. 2819 First Ave. Seattle, Washington 98121
(7)	Acetone	Any Source
(8)	Methyl Ethyl Ketone (MEK)	Any Source
(9)	Vacuum Bag Sealer - Zinc Chromate Tape or Equivalent	Any Source
(10)	Garan 225 Mold Release	Ram Chemicals, Inc. 210 E. Alondra Blvd. Gardena, California 90247
(11)	Quartz Heat Lamps	Any Source
(12)	Adhesive	
	(a) AF-126 wt 0.03 psf	Minnesota Mining & Manufacturing Co. 3M Center Road Saint Paul, Minnesota 55101
	(b) 3M-3002 Core Splicing Foam Adhesive (AF-126 wt 0.085 psf or three layers of AF-126 wt 0.03 psf may be used as an alternate to 3M-3002.)	Minnesota Mining & Manufacturing Co. 3M Center Road Saint Paul, Minnesota 55101
(13)	Osnaberg Cloth	Any Source or Bemis Company Inc. 55 So. Atlantic St. Seattle, Washington 98134
(14)	Milled Glass Fibers	Owens-Corning Fiberglas Corporation 608 Madison Ave. Toledo, Ohio 43604
(15)	Thermocouple Wire, Iron-Constantan 1268T, 24 gage or finer	Any Source

C. Limitations

(1) A radome with a repaired area which does not exceed the thickness requirements as listed below, does not require electrical testing per Fig. 17 note [B] and Details I or II.

(a) Single-stage C-band radome (mfg drawing no. 65-54464).

A repair at a region of double overlaps, shall be 0.600 inch minimum to 0.625 inch maximum in thickness.

A repair at a region of single overlaps, shall be 0.590 inch minimum to 0.615 inch maximum in thickness.

A repair at a region of no overlaps, shall be 0.580 inch minimum to 0.605 inch maximum in thickness.

(b) C-band radome (mfg drawing no. 65-2040).

A repair at a region of no production overlaps shall be 0.625 inch minimum to 0.655 inch maximum in thickness.

A repair at a region of production overlaps shall be 0.615 inch minimum to 0.655 inch maximum in thickness.

(2) A repaired area which has excess resin (or a similar construction defect) amounting to more than 2% area at the center cells or more than 10% area of the periphery cells, requires electrical testing per ARINC requirements prior to acceptance for use.

D. Repair Area Preparation

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

(1) Determine extent of damaged area by visual examination.

(a) Remove decorative coating as required by sanding with 180-grit or finer sandpaper. The sanding must not extend into the surface ply of glass.

(b) Wipe dust from the surface with a clean cloth moistened with solvent per B.(7) or B.(8), page 49.

(2) Remove damaged section.

(a) Surface scratches.

1) Remove scratches by sanding with 180-grit or finer sandpaper. The sanding must not extend into the surface ply of glass.

2) Wipe dust from the surface per D.(1)(b) and repair per F thru I, pages 55 thru 58.

(b) Punctures.

1) Remove damaged area around puncture and clean debris from hole and surrounding area.

2) Clean area per D.(1)(b) (this page) and repair per F thru I, pages 55 thru 58.

(c) Delaminations

1) Skin delaminations not exceeding one percent of any six inch by six inch area may be repaired by resin injection.

a) Inject resin per B.(1)(a), page 48, catalyzed with 15%, by weight of B.(2)(c), page 48 into the delaminated area. Cure per H.(1)(a), page 57.

b) Apply pressure, cure, and finish per G. through I., pages 57 through 58.

c) Delaminations which cannot be repaired satisfactorily by resin injection due to skin distortion or which exceed size limitation, shall be repaired by removal and replacement of plies per D.(2)(d), page 52.

2) Skin to core delaminations

a) Delaminations from the core shall be repaired by removal and replacement of plies per D.(2)(d), page 52.

(d) Damaged plies

(Cut away the damaged area with a sharp knife. Be careful to avoid damaging surrounding material.)

1) Damage extending down to but not through the ply of skin adjacent to the core.

a) Scarf the area adjacent to the damaged portion using 180 grit or finer sandpaper. The sanding should extend a minimum of one inch from damaged area for each ply except 1-1/2 inches for the first replacement ply. See figure 18. The sanding should produce a bevelled edge with a very shallow taper and with a circular or oval shaped periphery. Sufficient material must be removed so that the replacement plies will bring patched area back to original contour. Replacement is on a ply for ply basis.

b) Wipe dust from the surface with a clean cloth moistened with acetone or MEK.

c) Patch, cure and finish per F. through I., pages 55 through 58.

2) Damaged plies extending down to the core.

   a) Protect exposed core with masking tape, metal plate or equivalent.

   b) Scarf the area adjacent to the damaged portion using 180 grit or finer sandpaper. The sanding should extend a minimum of one inch from damaged area for each ply except 1-1/2 inches for the first replacement ply. See figure 18. The sanding should produce a bevelled edge with a very shallow taper and with a circular or oval shaped periphery. Sufficient material must be removed so that the replacement plies will return patched area to original contour. Replacement is on a ply for ply basis.

   c) Remove core protection and lightly sand core to remove resin fillets where possible without reducing core thickness.

   d) Patch, cure, and finish per F. through I., pages 55 through 58.

3) Damage extending into or through core but not into the inner skin.

   a) Trim and remove all damaged core to a smooth oval or circular outline.

   b) Scarf the area adjacent to the damaged portion using 180 grit or finer sandpaper. The sanding should extend a minimum of one inch from damaged area for each ply except 1-1/2 inches for the first replacement ply. See figure 16. The sanding should produce a bevelled edge with a very shallow taper and with a circular or oval shaped periphery. Sufficient material must be removed so that the replacement plies will return patched area to original contour. Replacement is on a ply for ply basis.

   c) Sand the inner skin bonding surface to remove resin fillets to allow seating of the replacement core.

      CAUTION: BACK UP INNER SKIN TO PREVENT DELAMINATION DURING SANDING OPERATIONS.

d) Trim replacement core to fit repair hole allowing a maximum of 1/16 inch gap between original and replacement core when 3M-3002 core splicing tape is used and a maximum of zero gap when AF-126 is used. An interference fit of 1/32 inch is most desirable with AF-126. See 51-10-1 Fig. 24 and 25 for methods of cutting material.

e) Use AF-126 wt 0.03 psf adhesive per B.(12)(a) on the bottom face of the core and 3M-3002 core splicing foam adhesive (or AF-126 wt 0.085 psf per B.(12)(b)), (page 54) tape around the edge of the core. Position the core in place and proceed with F.(4), page 60 immediately.

f) Patch, cure and finish per F. thru I., pages 59 thru 62.

4) Damage extending through both skins

a) Proceed with steps a) thru d) of D.(2)(d)3), pages 57 thru 58.

b) Smooth down the inner skin and plug the hole with masking tape, retaining the proper contour. Place a PVC parting film over the area to be repaired on the interior side of the radome. Dam the area and pour a water plaster mixture directly over the area to form a backup. Plaster should be a minimum of one inch thick. When plaster has hardened, remove it from the radome and dry it in an air circulating oven at 120°F for approximately 24 hours. Remove and replace the PVA film with clean PVA film and remove masking tape. Clamp, prop or lash backup mold into place. Proceed with step d) of D.(2)(d)3), page 58, then position core and adhesive in place. If an interference fit exists, the oversized core may be compressed by hand and allowed to expand in the repair area. Patch, cure, and finish outer skin per F. thru I. Remove backup, clean inner surface and repair inner skin per D.(2)(d)2), page 57.

c) For damages where retention of the contour is impossible by the above methods, use a plaster backup cast from an equivalent area on the radome or from the same area on a similar undamaged structure.

d) For damage where contour can be retained just by replacement of the core, proceed by steps a) through e) of D.(2)(d)3), page 53. Position the core and splice in place. Patch, cure, and finish outer skin per F. through I. Use a vacuum bag and/or plate on inner surface if required to maintain contour. Remove inner skin per D.(2)(d)2), page 53.

NOTE: Stagger the overlap of the inner and outer skins so they do not fall one on top of the other. See figure 16.

E. Preparation of Surrounding Area

(1) Wipe dust from repair area and surrounding surface with a clean cloth moistened with acetone or MEK.

(2) Cover sanded area with masking tape and apply mold release per B.(10) to the surrounding surface that will be in contact with bleeder material. Remove the masking tape and reclean patch area with acetone or MEK.

(3) Surround the repaired area with Osnaburg cloth. Lay cloth approximately 1 inch away from the repaired area and tape to hold in place.

(4) Clean any mold release from areas outside the bleeder cloth to assure adherence of sealing tape. Place extruded sealing tape around entire area and tie in a vacuum sniffer tube and thermocouple wire.

(5) Proceed with applicable lay-up.

F. Patch Procedure

(1) Surface scratches

(a) Coat sanded area with mixture of 100 parts resin per B.(1)(a) and 15 parts hardener per B.(2)(c) or 100 parts resin per B.(1)(b) and 2 parts hardener per B.(2)(b). See page 48.

(b) Sweep area to fair in resin and to remove any trapped air.

(c) Gel and cure per H. Finish surface per I. See pages 57 and 58.

(2) Punctures

(a) Punctures which are 3/16 inch or less in diameter shall be repaired as follows:

1) Method 1 - Add milled glass fibers to resin per B.(1)(a) and 15% by weight of hardener per B.(2)(c) to obtain a material with the consistency of putty. Work this mixture into hole. See page 48.

2) Method 2 - Catalyze resin per B.(1)(b) with 2% by weight of B.(2)(b) and work into the hole. See page 48.

(b) Process per G., H. and I., pages 57 through 58.

(c) Punctures which exceed 3/16 inch diameter shall be repaired by replacement of plies per D.(2)(d), page 52.

CAUTION: WORK LIFE OF RESIN PER B.(1)(b) AFTER BEING CATALIZED IS 15 MINUTES AT 70°F. (SEE PAGE 48.)

(3) Replacement of plies not involving exposed core.

(a) Determine cloth requirements. Cut and weigh cloth.

(b) Mix an equal weight of resin per B.(1)(a) catalyzed with 10% by weight of B.(2)(a) and vacuum impregnate cloth. See page 48.

CAUTION: WORK LIFE OF RESIN PER B.(1)(a) AFTER BEING CATALYZED IS 90 MINUTES AT 70°F. PATCHES MUST BE LAID UP AND GELLED BEFORE THE WORK LIFE HAS EXPIRED. (SEE PAGE 48.

(c) Cut required patches allowing excess as desired to permit trimming after positioning to assure a close fit per figure 18. All replacement plies shall be cut to match the warp and fill directions of the original material.

(d) Position and trim plies, apply pressure per G. Cure and finish per H. and I. See pages 57 through 58.

(4) Replacement of plies over exposed core.

(a) Proceed per steps (a) and (b) of F.(3), page 56.

(b) Presweep each ply between two sheets of parting film to reduce the resin content to approximately 35-40% by weight. Cut the repair plies to the desired size, remove the parting film and position repair plies in place. Excess resin buildup in the cells will cause electrical interference, necessitating electrical testing. See C.(2), page 51.

(c) Complete repair per F.(3), steps (c) and (d), page 56.

G. Application of Pressure

(1) Stretch a piece of PVA film over the entire area and seal to the extruded tape.

(2) Attach vacuum hose to sniffer and evacuate space under film. Maintain a minimum of 20 inches of mercury vacuum during sweeping and cure.

(3) Apply a light film of vaseline or oil on top of the PVA film to aid in sweeping.

(4) Sweep areas as required per applicable repair using squeegees or rollers. The motion of the sweep must be slow enough so that air in the part will move to the front of the wave of excess resin and thus be swept out of the part. Sweeping must be done carefully so there is no displacement of the fabric, and must be continued until all visible air bubbles and all excess resin have been removed. On exposed core repairs per F.(4), page 56, make all sweep passes away from the exposed core area to keep excess resin out of core cells. Do not sweep the exposed core area. The patch area may be heated by oven, heat lamps, or heat guns to aid in sweeping.

(5) Care must be taken not to puncture the PVA film. If any holes develop, immediately wipe area with acetone-moistened rag to remove lubricant, then seal hole with transparent adhesive tape. Resweep to remove air.

(6) Cure and finish per H. and I., pages 57 and 58.

H. Curing

(1) Accelerated cure

(a) Cure at 250°F for a minimum of 2 hours under vacuum pressure. Heat-up rate shall be a maximum of 7°F per minute. Heating may be done by oven, quartz lamps, etc. Sweep out all air bubbles that may arise during the gel period.

(2) Cure for steps not requiring adhesive cure

(a) Cure cycle is two hours at 190°F or 24 hours at 70°F.

(3) Clean-up

(a) When part has cooled to room temperature, remove all bagging material, hoses and Osnaburg bleeder. Clean area with cloth moistened with acetone or MEK. Finish per I., page 58.

I. Finishing of Surfaces

Smooth edges of repair and remove resin ridges by sanding lightly with 180 grit or finer sandpaper. Clean dust from area with acetone-moistened rag and check for defects. Repair area must be free of pits, blisters, starved areas or excess resin deposits.

(1) Exterior surfaces

(a) Seal any exposed fibers with a thin coating of resin per B.(1)(a) catalyzed with 10% by weight of B.(2)(a). Cure per H.(2)(a). See page 58.

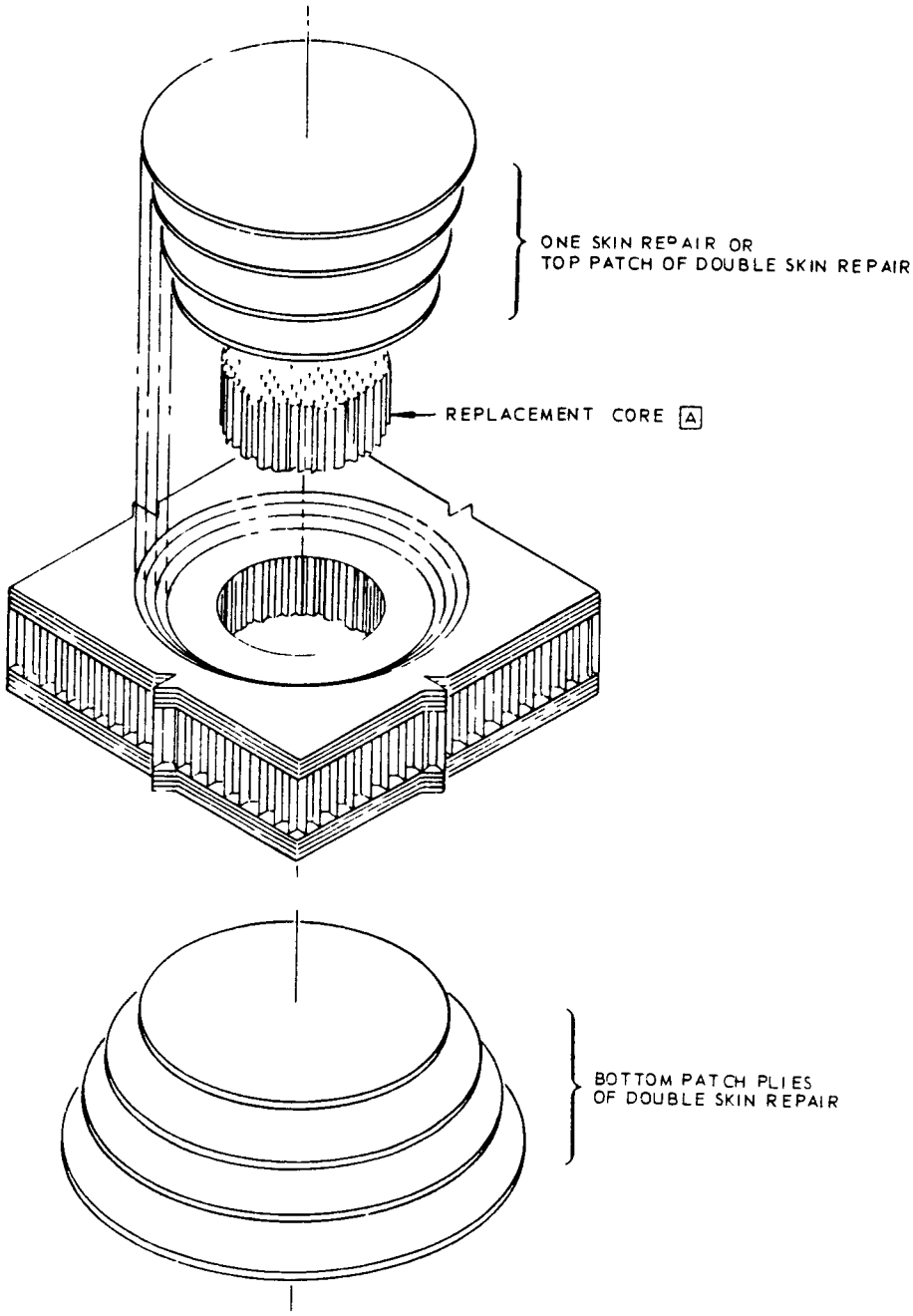
(b) Refinish the repaired surface area as indicated in Maintenance Manual 51-2-0.

(2) Interior surfaces

(a) Seal any exposed surface as follows:

Apply a thin coating of resin per B.(1)(a) catalyzed with 10% by weight of B.(2)(a) over the surface. Cure per H.(2)(a). Place a sheet of bondable Tedlar film per B.(5) over the resin mix and smooth out all wrinkles. Trim the Tedlar beyond the patch area so that it overlaps the Tedlar film on the inner surface by 1/4 inch minimum. Vacuum bag the area and sweep patch area, being careful not to dislodge or wrinkle the Tedlar film. See page 49.

(b) Cure per H.(2)(a). Remove all bagging, clean up excess resin, and remove all unbonded Tedlar film. See page 58.



Repair of Single Stage Epoxy H/C Sandwich
Details Used on Electrical Applications
Figure 16 (Sheet 1 of 2)

NOTE

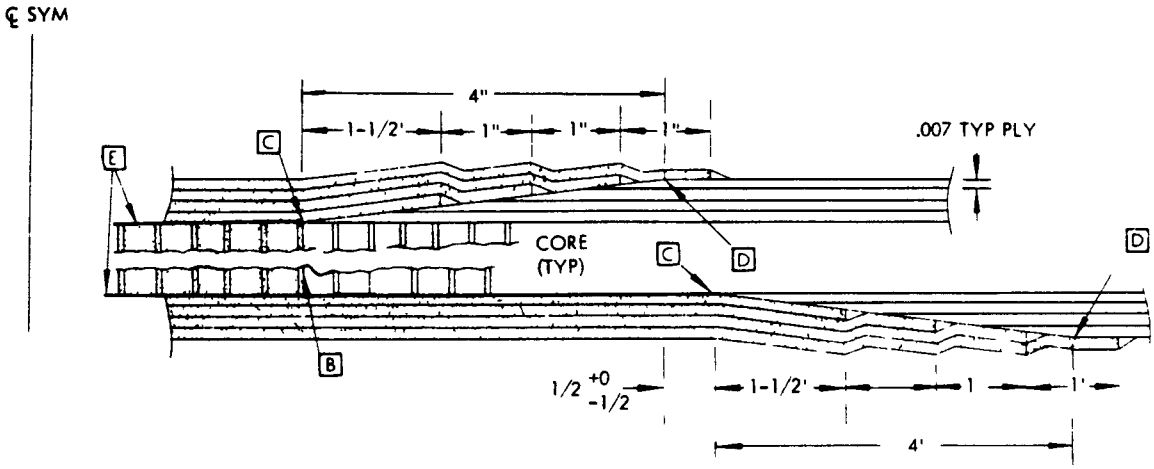
[A] CELL WALLS MUST BE ALIGNED IN THE SAME DIRECTION AS THE ORIGINAL HONEYCOMB.

[B] EDGE OF REPLACEMENT CORE

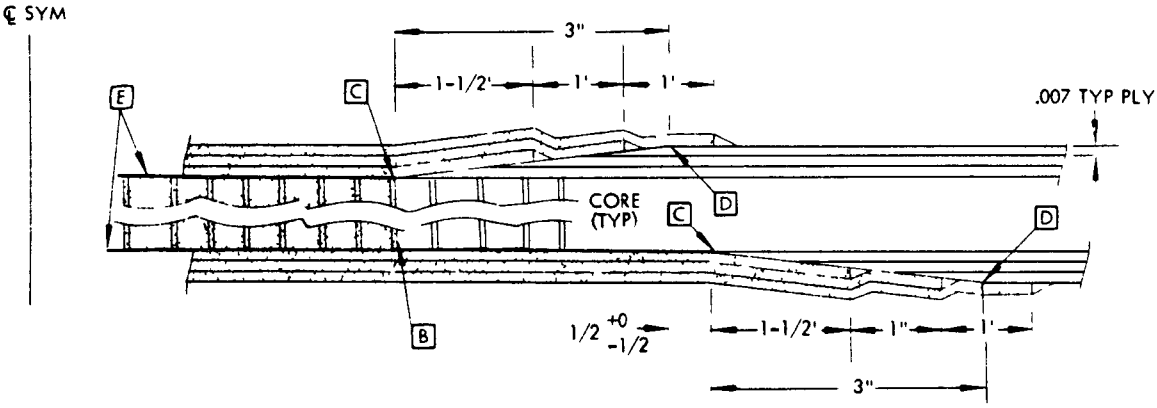
[C] START OF BEVEL IN ORIGINAL FACE PLIES

[D] END OF BEVEL IN ORIGINAL FACE PLIES

[E] ADHESIVES PER PARAGRAPH 18.B.(12)



4 FACE PLIES EACH SIDE OF CORE



VERTICAL SCALE EXAGGERATED

3 FACE PLIES EACH SIDE OF CORE

Repair of Single Stage Epoxy H/C Sandwich
Details Used on Electrical Applications
Figure 16 (Sheet 2 of 2)

19. Preferred Repair - Nose Radome (C-Band and X-Band)* (*Mfg Drawing No. 65-73294, 65-73295 and 65-54463)

A. General Requirements

(1) The magnitude of repair which may be accomplished is dependent upon the ability of maintaining the original contour and cross section of the structure and satisfactorily meeting the necessary structural thickness and electrical requirements.

(2) Repairs requiring removal and replacement of the honeycomb core shall retain orientation requirements as specified in Fig. 16.

(3) C-Band radomes which are repaired per the procedures which follow, and which meet thickness tolerances of ± 0.01 inch in the repaired area will not require electrical test before use. Refer to par. C below.

(4) X-Band radomes which are repaired per the procedures which follow, and which, while meeting the thickness tolerances in the repaired area, will require electrical test before use (Ref par. C).

(5) When additional repairs are made to a previously repaired radome, the accumulative areas must not exceed the limitations as outlined below. Refer to par. C below.

(6) Figure 16 illustrates a typical repair configuration.

(7) Repairs made to the X-Band radome (mfg drawing No. 65-54463) require 0.237-inch thick HRP core material.

(8) Repairs made to the X-Band radome (mfg drawing No. 65-73294) aft of Station 145.0 require 0.237-inch thick HRP core material.

(9) Repairs made to the C-Band radome (mfg drawing No. 65-73295) aft of Station 141.6 require 0.548-inch thick HRP core material.

(10) Repairs made to the X-Band radome (mfg drawing No. 65-73294) forward of Station 141.60 require 0.237-inch thick HRH 10/F50-5.0 core material or alternatively, 0.237-inch thick HRP core material.

(11) Repairs made to the C-Band radome (mfg drawing No. 65-73295) forward of Station 137.4 require 0.548-inch thick HRH 10/F50-5.0 core material or alternatively, 0.548-inch thick HRP core material.

(12) Repairs made to the X-Band radome (mfg drawing No. 65-73294) at the splice, between Station 141.6 to 145.0 require 0.207-inch thick HRP core material.

(13) Repairs made to the C-Band radome (mfg drawing No. 65-73295) at the splice between Station 137.4 to 141.6 require 0.548-inch thick HRH 10/F50-5.0 core material or alternatively, 0.548-inch thick HRP core material.

B. Materials Required

(1) EPOCAST 1835 Resin Mix Systems — Furane Plastics, Inc., 5121 San Fernando Rd. W., Los Angeles, California 90039

(a) System No. 1

EPOCAST 1835 Resin:	100 parts by weight
EPOCAST 951 Hardener:	9 parts by weight

(b) System No. 2

EPOCAST 1835 Resin:	100 parts by weight
EPOCAST 9816 Hardener:	15 parts by weight

(c) System No. 3

EPOCAST 1835 Resin:	100 parts by weight
EPOCAST 146 Hardener:	15 parts by weight

Alternately use:

Epon 815 or Epon 828 — 100 parts resin to 20-25 parts curing agent T. See Fig. 2.

(2) Presto Polyester Patch Paste No. 49X2 — Presto Chemicals, Inc., 9346 Glenoaks Blvd., Sun Valley, California 91352

(3) Glass Fabrics (See 16)

(4) Honeycomb

(a) HRP 3/16-4.00 (Use HRP 3/16-4.00 for repairing 65-73294 radomes aft of Station 145.0. Repair core thickness is 0.237 ±0.006 inch for X-Band.)	Hexcel Corporation Valley Industrial Park Casa Grande, Arizona 85222 Hexcel Corporation 338 No. Pennsylvania Graham, Texas 76046
(b) HRP 3/16-4.00 (Use HRP 3/16-4.00 for repairing 65-73295 radomes aft of Station 141.6. Repair core thickness is 0.538 ±0.006 inch for C-Band.)	Hexcel Corporation Valley Industrial Park Casa Grande, Arizona 85222 Hexcel Corporation 338 No. Pennsylvania Graham, Texas 76046
(c) HRH 10/F50-5.0 or HRP 3/16-4.00 (Use HRH 10/F50-5.0 or HRP 3/16-4.00, for repairing 65-73294 radomes forward of Station 141.6. Repair core thickness is 0.237 ±0.006 inch for X-Band.)	Hexcel Corporation Valley Industrial Park Casa Grande, Arizona 85222 Hexcel Corporation 338 No. Pennsylvania Graham, Texas 76046
(d) HRH 10/F50-5.0 or HRP 3/16-4.00 (Use HRH 10/F50-5.0 or HRP 3/16-4.00, for repairing 65-73295 radomes forward of Station 137.4. Repair core thickness is 0.538 ±0.006 inch for C-Band.)	Hexcel Corporation Valley Industrial Park Casa Grande, Arizona 85222 Hexcel Corporation 338 No. Pennsylvania Graham, Texas 76046
(e) HRP 3/16-4.00 (Use HRP 3/16-4.00 for repairing 65-54463 radomes. Repair core thickness is 0.237 ±0.006 inch for X-Band.)	Hexcel Corporation Valley Industrial Park Casa Grande, Arizona 85222 Hexcel Corporation 338 No. Pennsylvania Graham, Texas 76046

(f)	HRP 3/16-4.00 (Use HRP 3/16-4.00 for repairing 65-73294 radomes at splice. Repair core thickness is 0.207 ±0.006 inch for X-Band.)	Hexcel Corporation Valley Industrial Park Casa Grande, Arizona 85222 Hexcel Corporation 338 No. Pennsylvania Graham, Texas 76046
(g)	HRH 10/F50-5.0 or HRP 3/16-4.00 (Use HRH 10/F50-5.0 or HRP 3/16-4.00, for repairing 65-73295 at splice. Repair core thickness is 0.538 ±0.006 inch for C-Band.)	Hexcel Corporation Valley Industrial Park Casa Grande, Arizona 85222 Hexcel Corporation 338 No. Pennsylvania Graham, Texas 76046
(5)	Polyvinyl Fluoride Film Bondable Both Sides, Thickness 1 Mil.	Collins and Aikman 210 Madison Ave. New York City, N.Y. 10016
(a)	Tedlar - 100 BG 30TR	E.I. DuPont de Nemours & Co., Inc. 5500 Union Pacific Ave. Los Angeles, California 90022
(6)	Polyvinyl Alcohol (PVA) Vacuum Bag or Parting Film or equivalent	Reynolds Metal Co. 2819 First Ave. Seattle, Washington 98121
(7)	Acetone	Any Source
(8)	Methyl Ethyl Ketone (MEK)	Any Source
(9)	Vacuum Bag Sealer - Zinc Chromate Tape or Equivalent	Any Source
(10)	Garan 225 Mold Release	Ram Chemicals, Inc. 210 E. Alondra Blvd. Gardena, California 90247
(11)	Quartz Heat Lamps	Any Source

(12) Structural Adhesives

(a) BMS 5-51, Type II, Class I

1) AF-126	Minnesota Mining and Mfg. Co. 3M Center Street St. Paul, Minnesota 55101

(b) BMS 5-28, Type 5

1) Magnobond 79-4 Part A and Part B	Magnolia Plastics Inc. 5547 Peachtree Industrial Blvd. Chamblee, Georgia 30006
2) Epocast 8219 Mod II-A Hardener 8219-III-B	Furane Plastics Inc. 5121 San Fernando Rd. W. Los Angeles, California 90039

(13) Osnaburg Cloth, Unbleached any class, per CCC-C-429	Any Source or Bemis Company, Inc. 55 So. Atlantic St. Seattle, Washington 98134
(14) Milled Glass Fibers, 1/32-inch length (cationic) binder, or equivalent	Owens-Corning Fiberglass Division 608 Madison Ave. Toledo, Ohio 43604
(15) Thermocouple Wire, Iron-Constantan 1268T, 30 gage or finer	Any Source

(16) Glass Fabrics

(a) BMS 8-79H, Class II * (Epoxy prepreg)

1) MXB 7701-120-Z-6040 (E-715-120-CS272) MXB 7701-1581-Z-6040 (E-715-181-CS272)	Fiberite West Coast Corporation 645 N. Cypress Street P.O. Box 738 Orange, California 92669

* Glass Fabric Preimpregnated Epoxy Resin, Low Temperature Curing.

2)	Narmco 3203-1582 Volan A (551-182 Volan A) Narmco 3203-1584 Volan A (551-184 Volan A) Narmco 3203-7581 Volan A (551-7581 Volan A)	Whittaker Corporation Narmco Materials Division 1440 N. Kramer Anaheim, California 92806 Whittaker Corporation Narmco Materials Division 600 Victoria Street Costa Mesa, California 92626
3)	MXB 7701-1582-Z-6040 (E-715-182-CS272) MX 7701-1584-Z-6040 (E-715-184-CS272) MX 7701-75811-Z-6040 (E-715-7581-CS272)	Fiberite West Coast Corporation 645 N. Cypress Street P.O. Box 738 Orange, California 92669
(17)	Polyvinyl Fluoride Film Tedlar - 100 BG, 30 TR	E.I. DuPont de Nemours and Co., Inc. 5500 Union Pacific Ave. Los Angeles, California 90022
(18)	Sealer Resin	Fiber Resin Corporation 170 W. Providencia Burbank, California 91502
(a)	Epox-O-Weld (Follow manufacturer's instructions furnished with each kit.)	
(b)	Epocast 4-991A 100 parts by weight	Furane Plastics, Inc. 5121 San Fernando Rd. W. Los Angeles, California 90039
	Epocast 941 10 parts by weight	Furane Plastics, Inc. 5121 San Fernando Rd. W. Los Angeles, California 90039
(c)	Fiber Resin 5518S 100 parts by weight	Fiber Resin Corporation 170 W. Providencia Burbank, California 91502
	Fiber Resin 8318C 50 parts by weight	Fiber Resin Corporation 170 W. Providencia Burbank, California 91502

C. Limitations

(1) A C-Band radome with a repaired area which does not exceed the thickness requirements as listed below does not require electrical testing per Fig. 17, note [C]. (See also Fig. 17, Detail IV.)

(a) C-Band radome (mfg drawing No. 65-73295)

1) A repair at a region of no overlaps, shall be 0.580 inch minimum to 0.605 inch maximum in thickness.

2) A repair at a region of single overlaps shall be 0.590 inch minimum to 0.615 inch maximum in thickness.

3) A repair at a region of double overlaps shall be 0.600 inch minimum to 0.625 inch maximum in thickness.

(2) An X-Band radome must be repaired to the following thickness requirements and, in addition, must be electrically tested as detailed in Fig. 17, note [P].

(a) X-Band radome (mfg drawing No. 65-73294)

1) A repair at a region of no overlaps, shall be 0.304 inch minimum to 0.322 inch maximum in thickness.

2) A repair at a region of single overlaps shall be 0.292 inch minimum to 0.310 inch maximum in thickness.

3) A repair at a region of double overlaps shall be 0.308 inch minimum to 0.328 inch maximum in thickness.

(b) X-Band radome (mfg drawing No. 65-54463)

1) A repair at a region of no overlaps shall be 0.304 inch minimum to 0.332 inch maximum in thickness.

2) A repair at a region of single overlaps shall be 0.292 inch minimum to 0.310 inch maximum in thickness.

3) A repair at a region of double overlaps shall be 0.308 inch minimum to 0.328 inch maximum in thickness.

(3) A repaired area of a C-Band radome which has excess resin (or a similar construction defect) amounting to more than 2% area at the center cells area or more than 10% area of the periphery cells, requires electrical testing per ARTC-4 requirements prior to acceptance for use (Fig. 17, Note [C]).

D. Repair Area Preparation

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

(1) Determine extent of damaged area by visual examination.

(a) Remove decorative coating as required by sanding with 180-grit or finer sandpaper. The sanding must not extend into the surface ply of glass.

(b) Wipe dust from the surface with a clean cloth moistened with solvent per B.(7) or B.(8).

(2) Remove damaged section.

(a) Surface scratches.

1) Remove scratches by sanding with 180-grit or finer sandpaper. The sanding must not extend into the surface ply of glass. If scratch has penetrated into fibers, replace plies per D.2.(d).

2) Wipe dust from surface per D.(1)(b) and repair per F.(1), H, and I.

(b) Punctures.

1) Remove damaged area around puncture and clean debris from hole and surrounding area.

2) Clean area per D.(1)(b), and repair per F.(2). Punctures less than 3/16 inch in diameter may be resin filled per F.(2)(a). Punctures under 3/16 inch in diameter may be resin filled per F.(2)(a). Larger punctures require removal and replacement of plies per D.(2)(d). See also F.(2).

(c) Delaminations

1) Skin delaminations not exceeding one per cent of any six inch area may be repaired by resin injection.

a) Inject resin per B.(1)c), system No. 3 into the delaminated area.

b) Apply pressure cure and finish per G., H., and I.

c) Delaminations which cannot be repaired satisfactorily by resin injection, due to skin distortion, or which exceed size limitation shall be repaired by removal and replacement of plies per D.(2)(d).

2) Skin-to-Core Delaminations

Repair delaminations from the core by removal and replacement of plies per D.(2)(d).

(d) Damaged plies

(Cut away the damaged area with a sharp knife. Be careful to avoid damaging surrounding material.)

1) Damage extending down to but not through the ply of skin adjacent to the core.

a) Scarf the area adjacent to the damaged portion using 180 grit or finer sandpaper. The sanding should extend a minimum of one inch from damaged area for each ply except 1-1/2 inches for the first replacement ply. See figure 16. The sanding should produce a bevelled edge with a very shallow taper and with a circular or oval shaped periphery. Sufficient material must be removed so that the replacement plies will bring patched area back to original contour. Replacement is on a ply for ply basis.

b) Wipe dust from the surface with a clean cloth moistened with acetone or MEK.

c) Patch, cure and finish per F. through I.

2) Damaged plies extending down to the core.

   a) Protect exposed core with masking tape, metal plate or equivalent.

   b) Scarf the area adjacent to the damaged portion using 180 grit or finer sandpaper. The sanding should extend a minimum of one inch from damaged area for each ply except 1-1/2 inches for the first replacement ply. See figure 16. The sanding should produce a bevelled edge with a very shallow taper and with a circular or oval shaped periphery. Sufficient material must be removed so that the replacement plies will return patched area to original contour. Replacement is on a ply for ply basis.

   c) Remove core protection and lightly sand core to remove resin fillets where possible without reducing core thickness.

   d) Patch, cure, and finish per F. through I.

3) Damage extending into or through core but not into the inner skin.

   a) Trim and remove all damaged core to a smooth oval or circular outline.

   b) Scarf the area adjacent to the damaged portion using 180 grit or finer sandpaper. The sanding should extend a minimum of one inch from damaged area for each ply except 1-1/2 inches for the first replacement ply. See figure 16. The sanding should produce a bevelled edge with a very shallow taper and with a circular or oval shaped periphery. Sufficient material must be removed so that the replacement plies will return patched area to original contour. Replacement is on a ply for ply basis.

   c) Sand the inner skin bonding surface to remove resin fillets to allow seating of the replacement core. The sanding must not extend into the glass fibers.

      CAUTION: BACK UP INNER SKIN TO PREVENT DELAMINATION DURING SANDING OPERATIONS.

   d) Wipe dust from the area with a clean cloth moistened with acetone or MEK.

e) Trim a piece of adhesive per D.(12)(a) to fit repair hole and position in place on the inner skin or place on bottom face of replacement core.

f) Trim replacement core to fit repair hole, allowing a maximum of 1/16-inch gap between original and replacement core. Use HRP 3/16-4.00 core material for fabrication of the replacement core. Use core 0.01 inch thinner for C-Band and 0.015 inch thinner for X-Band radomes. See 51-10-1 Fig. 24 and 25 for methods of cutting core material.

g) Butter the edge of the original core plug with B.(12)(b) adhesive or wrap the plug with a 30 mil thick layer of B.(12)(a) adhesive. Position plug in place.

h) Patch core and finish per F thru I.

4) Damaged extending through both skins.

a) Proceed with steps a) thru d) of D.(2)(d)3).

b) Smooth down the inner skin and plug the hole with masking tape, retaining the proper contour. Place a PVC parting film over the area to be repaired on the interior side of the radome.

NOTE: The outer skin may be backed up with plaster and the inner skin repaired first if the nature of the damage makes this procedure more desirable.

c) Dam the area and pour a water plaster mixture directly over the area to form a backup. Plaster should be a minimum of 1 inch thick. When plaster has hardened, remove it from the radome ad dry it in an air circulating oven at 120°F for approximately 24 hours. Remove and replace the PVA film with clean PVA film and remove masking tape. Clamp, prop or lash backup mold into place. Proceed with steps f) and g) of D.(2)(d) then patch, cure and finish outer skin per F.(4) thru I. Remove backup, clean inner surface, and repair inner skin per D.(2)(d)2).

d) For damages where retention of the contour is impossible by the above methods, use a plaster backup cast from an equivalent area on the radome or from the same area on a similar undamaged structure.

e) For damage where contour can be retained just by core replacement, proceed through steps a) through g) of D.(2)(d)3). Patch, cure and finish outer skin per F.(4) through I. Use a vacuum bag and/or plate on inner surface if required to maintain contour. Repair inner skin per D.(2)(d)2).

NOTE: Stagger the overlap of the inner and outer skins so they do not fall one on top of the other. (See figure 16.)

E. Preparation of Surrounding Area

(1) Wipe dust from repair area and surrounding surface with a clean cloth moistened with acetone or MEK.

(2) Cover sanded area with masking tape and apply mold release per B.(10) to the surrounding surface that will be in contact with bleeder material but keeping well back from the patch bonding area. Remove the masking tape and reclean patch area with acetone or MEK.

CAUTION: USE EXTREME CARE TO PREVENT CONTAMINATION OF BONDING AREA WITH MOLD RELEASE AGENT.

(3) Surround the repaired area with Osnaburg cloth. Lay cloth approximately 1 inch away from the repaired area and tape to hold in place.

(4) Clean any mold release from areas outside the bleeder cloth to assure adherence of sealing tape. Place extruded sealing tape around entire area and tie in a vacuum sniffer tube and thermocouple wire.

(5) Proceed with the applicable layup.

F. Patch Procedure

NOTE: Prepare the area per E. prior to patch procedure when using room temperature resin systems to enable completion of processing before gellation of the resin.

(1) Surface scratches

(a) Coat sanded areas with resin per B.(1)a), b) or c).

(b) Sweep area to fair in resin and to remove any trapped air.

(c) Gel and cure per H.; finish surface per I.

(2) Punctures

(a) Punctures which are 3/16 inch or less in diameter shall be repaired per Method No. 1 or No. 2 as follows:

1) Method No. 1

Add milled glass fibers per B.(14) to resin per B.(1)a), b) or c) to obtain a material with the consistency of putty. Work this mixture into hole.

CAUTION: WORK LIFE OF RESIN PER B.(1)(a)c) IS 15 MINUTES AT 70°F.

2) Method No. 2

Catalyze patch paste per B.(2) and work mixture into hole.

3) Allow material to cure at room temperature (70°F or higher for 24 hours then sand to fair with surrounding surface. Finish surface per I.

(b) Punctures which exceed 3/16 inch diameter shall be repaired per D.(2)(d)3).

(3) Replacement of plies not involving exposed core.

(a) Prepreg per B.(16).

1) Cut required patches allowing excess as desired to permit trimming after positioning to assure a close fit per figure 16. Cut all replacement plies to match the warp direction of the original material.

2) Position and trim plies, apply pressure per G. Cure and finish per H. and I.

(b) Wet layup per B.(1).

1) Determine cloth requirements. Cut and weigh cloth.

2) Mix an equal weight of resin per B.(1), systems No. 1, 2 or 3 and vacuum impregnate cloth.

CAUTION: WORK LIFE OF SYSTEM NO. 1 IS 90 MINUTES, SYSTEM NO. 2 IS 90 MINUTES, AND SYSTEM NO. 3 IS 45 MINUTES AT 70°F. PATCHES MUST BE LAID UP AND SWEPT BEFORE THE WORK LIFE HAS EXPIRED.

3) Cut required patches allowing excess as desired to permit trimming after positioning to assure a close fit per figure 16. All replacement plies shall be cut to match the warp direction of the original material.

4) Position and trim plies, apply pressure per G. Cure and finish per H. and I.

(4) Replacement of plies over exposed core.

(a) Prepreg per B.(16).

1) Cut a piece of adhesive per B.(12)(a). Position it over core and trim as required. The adhesive must completely cover the core but need not extend up the taper.

2) Proceed per items 1) and 2) of F.(3)(a).

(b) Wet layup per B.(1).

1) Proceed per items 1) and 2) of F.(3)(b).

2) Presweep that portion of each ply that will be positioned over the exposed core area to reduce resin content by approximately one third. This excess resin must not be allowed to flow into core cells. Excess resin buildup in the cells will cause electrical interference, requiring electrical testing.

3) Cut a piece of adhesive per B.(12)(a). Position it over the core and trim as required. The adhesive must completely cover the core but need not extend up the taper.

4) Complete repair per F.(3)(b)3) and 4).

G. Application of Pressure

(1) Prepreg per B.(1).

(a) Stretch a piece of PVA film over the entire area and seal to the extruded tape.

(b) Attach vacuum hose to sniffer and evacuate space under film. Maintain a minimum of 20 inches of Mercury vacuum during cure.

(c) Cure and finish per H. and I.

(2) Wet layup per B.(1).

(a) Stretch a piece of PVA film over entire area and seal to the extruded tape.

(b) Attach vacuum hose to sniffer and evacuate space under film. Maintain a minimum of 20 inches of Mercury vacuum during sweeping and cure.

(c) Apply a light film of vaseline or oil on top of PVA film to aid in sweeping and cure.

(d) Sweep areas as required per applicable repair using squeegees or rollers. The motion of the sweep must be slow enough so that air in the part will move to the front of the wave of excess resin and thus be swept out of the part. Sweeping must be done carefully so that there is no displacement of the fabric, and must be continued until all visible air bubbles and all excess resin have been removed. On exposed core repairs per F.(4) make all sweep passes away from the exposed core area to keep excess resin out of core cells. Do not sweep the exposed core area. The patch area may be heated by oven, heat lamps, or heat guns to aid in sweeping.

(e) Care must be taken not to puncture the PVA film. If any holes develop, immediately wipe area with acetone moistened rag to remove lubricant, then seal hole with transparent adhesive tape. Resweep to remove air.

(f) Cure and finish per H. and I.

H. Curing

(Repaired areas containing adhesive per B.(12)(a) must be cured a minimum of 90 minutes at temperatures between 225° and 250°F.

(1) Prepreg per B.(16).

(Cure time does not include the time required for the mold and part to heat up to temperature. Cure time is the period after the part has reached that temperature.)

(a) Place the assembly, while under vacuum pressure, into an autoclave and apply 40 +10/-5 pounds per square inch positive pressure to the autoclave cavity. Maintain a minimum of 20 inches of Mercury vacuum on the part during the entire cycle.

(b) Heat to 200 (± 10)°F at a rate not to exceed 5°F per minute, and hold for 30 minutes minimum.

(c) Heat from 200° to 260°F (+5°/-10°F) at a rate not to exceed 7°F per minute. Cure for a minimum of 60 minutes.

(d) Cool under pressure until the part temperature is 160°F or less.

(2) Wet layup per B.(1).

(a) Room temperature cure

1) Gel and cure resin under vacuum for a minimum of 24 hours at 70°F or higher.

(b) Accelerated Cure

1) Heat patch area to 190°F (± 10)°F and hold one hour to gel. Cure an additional hour minimum at 200°-250°F. Heating, which may be by oven quartz lamps etc. must have a gradual heat up rate. Start oven cure with a cold oven.

(3) Clean-up

(a) When part has cooled to room temperature, remove all bagging, hoses and Osnaburg bleeder. Clean area with cloth moistened with acetone or MEK. Finish per I.

I. Finishing of Surfaces

(1) Smooth edges of repair and remove resin ridges by sanding lightly with 180 grit or finer sandpaper.

(2) Clean dust from area with acetone moistened rag and check for defects. Repair area must be free of pits, blisters, starved areas or excess resin deposits.

(3) Exterior surfaces

(a) Seal any exposed fibers with a thin coating of resin per B.(1). Cure per H.

(4) Interior surfaces

(a) Seal any exposed surface per Methods 1 or 2 as follows:

1) Method No. 1

Apply a thin coating of resin per B.(1) over the surface. Place a sheet of bondable Tedlar film per B.(17) over the resin mix and smooth out all wrinkles. Trim the Tedlar beyond the patch area so that it overlaps the Tedlar film on the inner surface by a 1/4 inch minimum. Vacuum bag the area and sweep patch area, being careful not to dislodge or wrinkle the Tedlar film. Cure per H. Remove all bagging, clean up excess resin, and remove all unbonded Tedlar film.

2) Method No. 2

Seal area with a thin coating of sealer resin per B.(18) item (a), (b) or (c). Scrape off all excess sealer before it has gelled. Let sealer resin cure a minimum of 24 hours at 70°F before use.

NOTES

[A] INDICATE EXTENT OF DAMAGE AND REPAIR AREA ON INSIDE OF RADOME, TO KEEP A RECORD OF REPAIRS

[B] THE FOLLOWING ARE REPAIR LIMITS THAT MAY BE ALLOWED ON THE NOSE RADOME WITHOUT ELECTRICAL TESTING

FOR THE ELECTRICALLY MOST CRITICAL AREA FORWARD OF STA 153: MAXIMUM OF 3-INCH DIAMETER INDIVIDUAL DAMAGE, 10% MAXIMUM TOTAL ACCUMULATED AREA OF REPAIRS

FOR THE ELECTRICALLY CRITICAL AREA BETWEEN STA 153 AND 175: 4-INCH MAXIMUM INDIVIDUAL DAMAGE 15% MAXIMUM TOTAL ACCUMULATED AREA OF REPAIRS EXCLUDING UPPER AND LOWER NON-CRITICAL AREAS

REPAIRS WHICH EXCEED THE ABOVE LIMITS OR REPAIRS WHICH PROVIDE MORE REPAIR PLIES THAN THE NUMBER OF ORIGINAL PLIES WILL REQUIRE ELECTRICAL TESTING

4-INCH DIAMETER IS THE MAXIMUM DAMAGE THAT MAY BE REPAIRED PER FIG. 6 WITH A PATCH THAT REPLACES DAMAGED NOSE RADOME SKIN PLY FOR PLY

REFER TO THE NOSE RADOME MANUFACTURER OR TO A QUALIFIED ELECTRONIC LABORATORY FOR TESTING SERVICE. THE MANUFACTURER'S NAME IS LOCATED ON THE INSIDE SURFACE OF THE RADOME NEAR THE LEFT-HAND REAR EDGE. TESTS SHALL BE MADE IN ACCORDANCE WITH THE TECHNIQUES AND PROCEDURES OF AIRPLANE TECHNICAL COMMITTEE REPORT NO. ARTC-4, PAR. 4.1, DATED JULY 30, 1960 AND SHALL DETERMINE THAT ONE-WAY POWER TRANSMISSION EFFICIENCY OF A REPAIRED AREA OF A NOSE RADOME SHALL BE NOT LESS THAN 87% FOR C-BAND RADOMES AND NOT LESS THAN 85% FOR X-BAND RADOMES MANUFACTURED WITH PREPREG OR 78% FOR THOSE MANUFACTURED BY THE WET LAY-UP PROCESS. COPIES OF ARTC-4 DATED JULY 30, 1960 ARE AVAILABLE FROM:

NATIONAL STANDARDS ASSOC.
1321 14TH ST N.W.
WASHINGTON D.C. 20005

[C] DAMAGE TO NOSE RADOME, WHICH IS GREATER THAN THAT INDICATED BY [B] REQUIRES REPAIR AND ELECTRICAL TESTING TO MEET STANDARDS AS NOTED IN [B] . A LISTING OF REPAIR FACILITIES, QUALIFIED PER BOEING DOCUMENT D-16538-6 APPEARS BELOW:

1. HEATH TECHNA-PLASTICS INC.
   19819 84TH SOUTH
   KENT, WASHINGTON
   98031

2. THE BRUNSWICK CORPORATION
   325 BRUNSWICK LANE
   MARION, MARYLAND
   24354

3. GOODYEAR AEROSPACE CORPORATION
   P.O. BOX 85
   LICHFIELD PARK, ARIZONA
   85340

[D] REPAIR AT A REGION OF DOUBLE OVERLAPS. THICKNESS OF REPAIR SHALL BE 0.600 INCH MINIMUM TO 0.625 INCH MAXIMUM

[E] REPAIR AT A REGION OF SINGLE OVERLAPS. THICKNESS OF REPAIR SHALL BE 0.590 INCH MINIMUM TO 0.615 INCH MAXIMUM

Fiberglass and Cotton Cloth Reinforced Plastic Repair Index "Nose" Radome
Figure 17 (Sheet 1)

NOTES (CONTINUED)

[F] REPAIR AT A REGION OF NO OVERLAPS. THICKNESS OF THE REPAIR SHALL BE 0.580-INCH MINIMUM TO 0.605-INCH MAXIMUM

[G] SLASHING OF CORE WHEN MAKING A REPAIR IS NOT PERMITTED

[H] NO LONGITUDINAL CORE SPLICES ARE PERMITTED IN THIS REGION

[J] RADOMES WITHOUT NOMEX "FLEX CORE"

[K] RADOMES WITH NOMEX "FLEX CORE" FORWARD OF BODY STATION 141.60

[L] TOTAL THICKNESS IN DOUBLE OVERLAY SHALL BE 0.308-INCH MINIMUM TO 0.328-INCH MAXIMUM

[M] TOTAL THICKNESS IN SINGLE OVERLAP SHALL BE 0.292-INCH MINIMUM TO 0.310-INCH MAXIMUM

[N] TOTAL THICKNESS IN NO OVERLAP SHALL BE 0.304-INCH MINIMUM TO 0.322-INCH MAXIMUM.

[P] TESTS SHALL BE MADE IN ACCORDANCE WITH AIRCRAFT TECHNICAL COMMITTEE REPORT NO. ARTC-4, PAR. 4.1, DATED JULY 30, 1960

[Q] AREAS OF DAMAGE, EACH NOT EXCEEDING ONE SQUARE INCH, DUE TO DETERIORATION, DELAMINATION, EROSION, DENTS, GOUGES, SCRATCHES AND PUNCTURES ARE ALLOWED PROVIDED THAT:

(1) THEY ARE NOT WITHIN 2 INCHES OF AN EDGE OR EDGE ATTACHMENT FASTENERS

(2) MINIMUM SPACING BETWEEN UNREPAIRED AREAS OF DAMAGE IS 10 INCHES

(3) DAMAGE IS COVERED WITH NONMETALIZED SCOTCH BRAND 850 OR 853, OR PERMACEL P95 POLYESTER TAPE (TAPE REPAIR IS SATISFACTORY IF GROUND OPERATION OF RADAR APPEARS SATISFACTORY)

(4) LOCATION OF DAMAGE IS RECORDED AND REPAIRED AT THE FIRST AVAILABLE OPPORTUNITY

Fiberglass and Cotton Cloth Reinforced Plastic Repair Index "Nose" Radome
Figure 17 (Sheet 2)

MATERIAL	PART NAME	MAXIMUM SINGLE DAMAGE ALLOWABLE WITHOUT REPAIR	MAXIMUM SINGLE REPAIRABLE DAMAGE	MIN ALLOWABLE SPACING BETWEEN ADJACENT REPAIRABLE DAMAGES EDGE TO EDGE
HONEYCOMB SANDWICH WITH LAMINATED FACE PLIES	NOSE RADOME (1)	[C]	(ENTIRE SURFACE) NO LIMIT [J]	
			1 SQUARE INCH FOR DAMAGE CAUSED BY ELECTRICAL DISCHARGE	[A] 3 INCHES
			[B][C] 4-INCH DIAMETER	[A] 12 INCHES
			(SURFACE AFT OF STA 141.6) NO LIMIT (C-BAND) [K]	
			1 SQUARE INCH FOR DAMAGE CAUSED BY ELECTRICAL DISCHARGE	[A] 3 INCHES
			[B][C] 4-INCH DIAMETER	[A] 12 INCHES
			(SURFACE AFT OF STA 145 0) NO LIMIT (X-BAND) [K]	
			1 SQUARE INCH FOR DAMAGE CAUSED BY ELECTRICAL DISCHARGE	[A] 3 INCHES
			[B][C] 4-INCH DIAMETER	[A] 12 INCHES
			(SURFACE FROM STA 130 0 TO STA 137 4) (C-BAND) NO LIMIT [K]	
			1 SQUARE INCH FOR DAMAGE CAUSED BY ELECTRICAL DISCHARGE	[A] 3 INCHES
			[B][C] 4 INCH DIAMETER	A MAX OF 1 REPAIR IN THIS REGION
			(SURFACE FROM STA 130.0 TO STA 141 6) (X-BAND) NO LIMIT [K]	
			1 SQUARE INCH FOR DAMAGE CAUSED BY ELECTRICAL DISCHARGE	[A] 3 INCHES
			[B][C] 4 INCHES DIAMETER	A MAX OF 1 REPAIR IN THIS REGION
			SURFACE AT SPLICE 137.4 TO STA 141.6 (C BAND) [K]	
			1 SQUARE INCH FOR DAMAGE CAUSED BY ELECTRICAL DISCHARGE	[A] 3 INCHES
			4-INCH DIAMETER	A MAX OF 1 REPAIR IN THIS REGION
			SURFACE AT SPLICE STA 141 6 TO STA 145.0) (X-BAND) [K]	
			1 SQUARE INCH FOR DAMAGE CAUSED BY ELECTRICAL DISCHARGE	[A] 3 INCHES
			3-INCH DIAMETER	A MAX OF 1 REPAIR IN THIS REGION

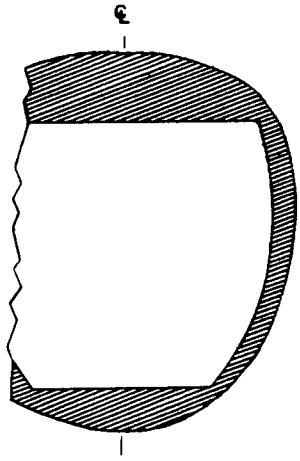
Fiberglass and Cotton Cloth Reinforced Plastic Repair Index "Nose" Radome
Figure 17 (Sheet 3)

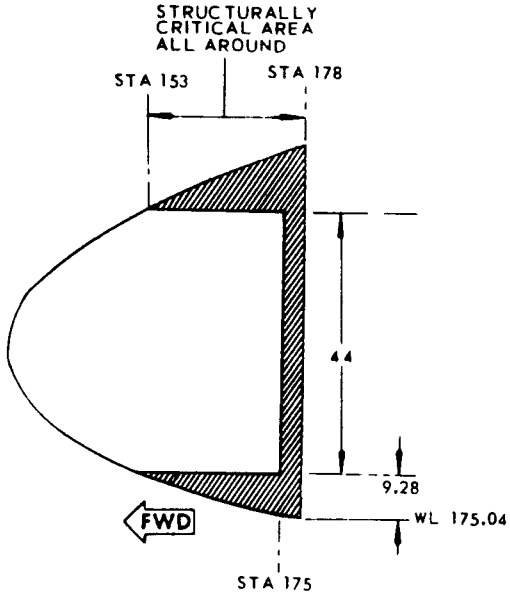
REPAIR INDEX			
ELECTRONIC COMPONENTS			
NOSE RADOME (C-BAND) (1) [J]		NOSE RADOME (X-BAND) (1) [J]	
PERMANENT REPAIR		PERMANENT REPAIR	
PREFERRED METHOD (RESIN SYSTEM EQUIV-ALENT TO PRODUCTION)	OPTIONAL METHOD (RESIN SYSTEM WITH NORMAL CURING RATE)	PREFERRED METHOD (RESIN SYSTEM EQUIV-ALENT TO PRODUCTION)	OPTIONAL METHOD (RESIN SYSTEM WITH NORMAL CURING RATE)
REPAIR PER PARA 18 AND FIG 16 SEE DETAIL I OR II OF FIG. 17		REPAIR PER PARA 19 AND FIG 16 SEE DETAIL III OF FIG 17	
	INJECT ADHESIVE PER PARA 7		INJECT ADHESIVE PER PARA 7
	REPAIR DAMAGED SKIN PLY FOR PLY PER FIG 6		REPAIR DAMAGED SKIN PLY FOR PLY PER FIG 6

Fiberglass and Cotton Cloth Reinforced Plastic Repair Index "Nose" Radome
Figure 17 (Sheet 4 of 8)

REPAIR INDEX (CONT)			
ELECTRONIC COMPONENTS (CONT)			
NOSE RADOME (C-BAND) (1) [K]		NOSE RADOME (X-BAND) (1) [K]	
PERMANENT REPAIR		PERMANENT REPAIR	
PREFERRED METHOD (RESIN SYSTEM EQUIV-ALENT TO PRODUCTION)	OPTIONAL METHOD (RESIN SYSTEM WITH NORMAL CURING RATE)	PREFERRED METHOD (RESIN SYSTEM EQUIV-ALENT TO PRODUCTION)	OPTIONAL METHOD (RESIN SYSTEM WITH NORMAL CURING RATE)
REPAIR PER PARA 19 AND FIG. 16 SEE DETAIL IV OF FIG. 17			
	INJECT ADHESIVE PER PARA 7		
	REPAIR DAMAGED SKIN PLY FOR PLY PER FIG. 6		
		REPAIR PER PARA 19 AND FIG. 16 SEE DETAIL V OF FIG 17	
			INJECT ADHESIVE PER PARA 7
			REPAIR DAMAGED SKIN PLY FOR PLY PER FIG. 6
REPAIR PER PARA 19 AND FIG. 16. SEE DETAIL IV OF FIG 17			
	INJECT ADHESIVE PER PARA 7		
	REPAIR DAMAGED SKIN PLY FOR PLY PER FIG 6		
		REPAIR PER PARA 19 AND FIG 16 SEE DETAIL V OF FIG 17	
			INJECT ADHESIVE PER PARA 7
			REPAIR DAMAGED SKIN PLY FOR PLY PER FIG 6
	INJECT ADHESIVE PER PARA 7		
REPAIR PER PARA 19 AND FIG. 16 SEE DETAIL IV OF FIG 17			
			INJECT ADHESIVE PER PARA 7
		REPAIR PER PARA 19 AND FIG 16 SEE DETAIL V OF FIG. 17	

	ELECTRICALLY NON-CRITICAL AREA
	ELECTRICALLY CRITICAL AREA
	NO LONGITUDINAL CORE SPLICES





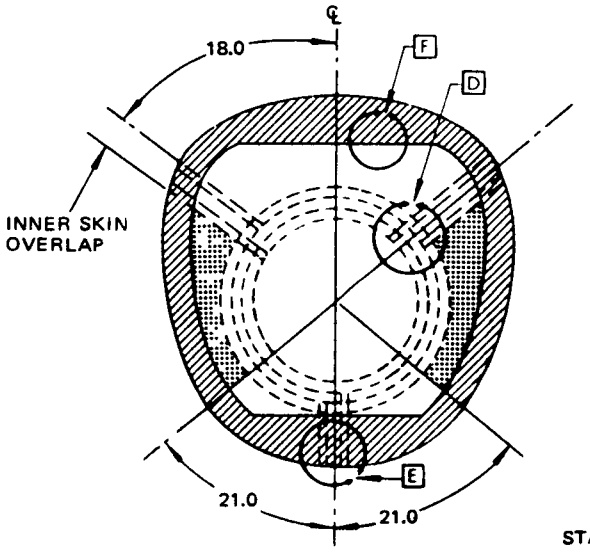
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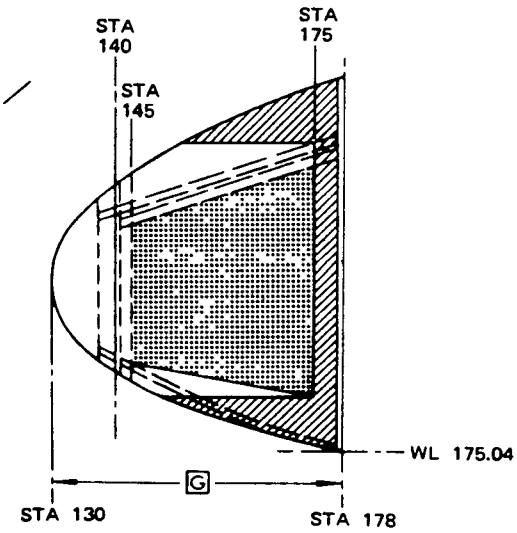
REPAIR IN A REGION OF NO PRODUCTION OVER LAPS TOTAL THICKNESS OF REPAIR SHALL BE 0 625 INCH MINIMUM TO 0 655 INCH MAXIMUM

REPAIR IN A REGION OF PRODUCTION OVERLAPS TOTAL THICKNESS OF REPAIR SHALL BE 0 615 INCH MINIMUM TO 0 665 INCH MAXIMUM

MANUFACTURING PART NUMBERS
C-BAND [J] 65-2040-6, 65-2040-8
X-BAND [J] 65-2040-5

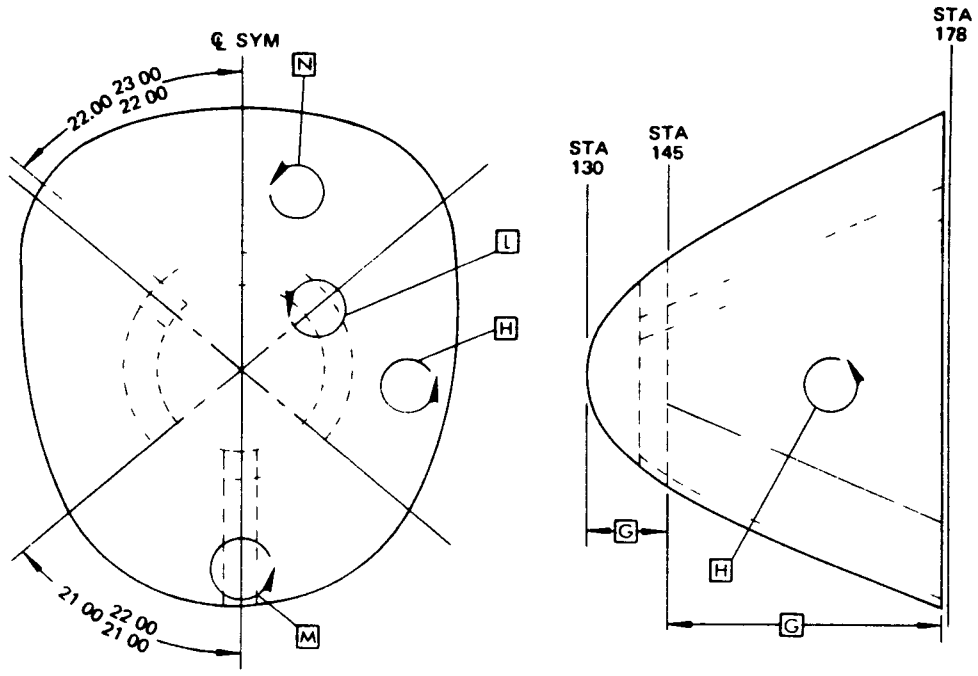
DETAIL I





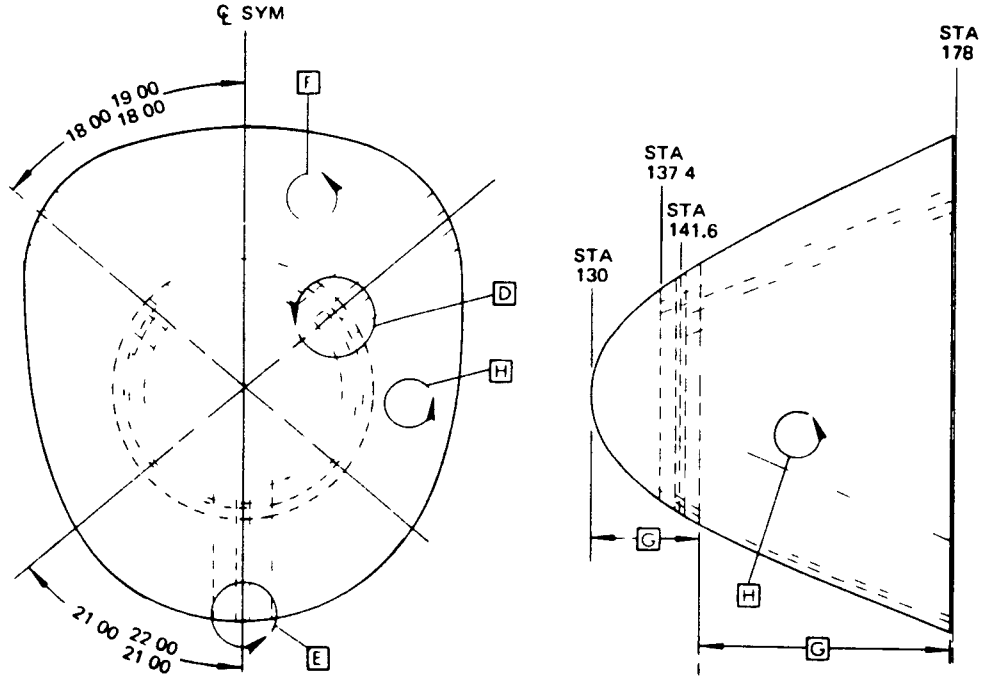
C-BAND [J]
MANUFACTURING PART NUMBERS
65-54464-1, & 65-54464 3

DETAIL II



X-BAND [J] MANUFACTURING
PART NUMBER 65 54463 1

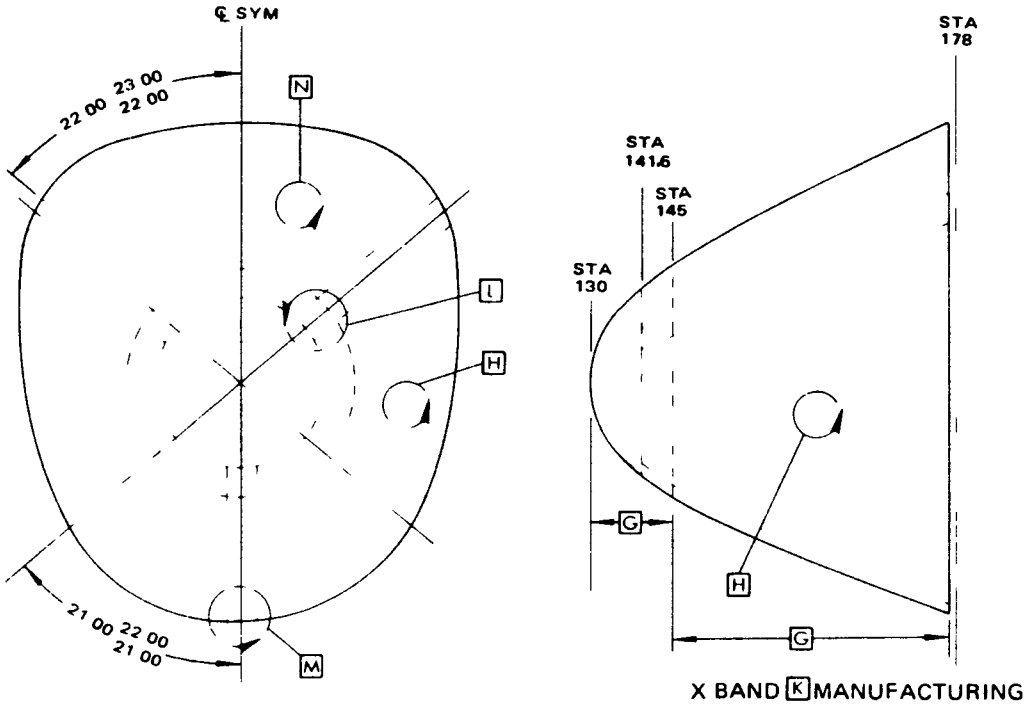
DETAIL III



C BAND [K] MANUFACTURING
PART NUMBERS 65 73295 1,
65-73295 2

DETAIL IV

Fiberglass and Cotton Cloth Reinforced Plastic Repair Index "Nose" Radome
Figure 17 (Sheet 7 of 8)



X BAND [K] MANUFACTURING PART NUMBERS 65 73294 1, 65 73294 2

DETAIL V

20. Procedure for Radome Repair Thickness Measurements

(1) Radome thickness after repair may be measured as described in the NON-DESTRUCTIVE TEST MANUAL D6-48023, PART 6.

21. Repair of Aluminum Flame-Sprayed Coating - Full Conductivity, Wing Tip Leading Edge

NOTE: Where a metal spraying capability exists, aluminum flame-sprayed coatings can be repaired to restore full electrical conductivity and continuity. Coatings must be restored by the metal overspray process when it is mandatory that electrical conductivity and other electrical properties be restored.

A. Repair damaged aluminum flame-sprayed coatings as follows:

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

(1) Mask off the area surrounding the damaged coating.

(2) Lightly grit-blast the damaged area using 180-grit (or finer) abrasive.

CAUTION: DO NOT ALLOW THE ABRASIVE TO PENETRATE THE GLASS FABRIC.

(3) Bevel the flame-sprayed coating for a minimum of 1 inch around the damaged area.

(4) Clean with MEK or acetone to remove sanding dust and any other contamination.

CAUTION: DO NOT ALLOW PART TEMPERATURE TO EXCEED 120°F. APPLY FLAME-SPRAYED COATING IN SEVERAL STAGES AND ALLOW PART TO COOL AFTER EACH SPRAYING STAGE.

(5) Overspray the damaged area with aluminum as detailed in Process Specification BAC5056, Section 6.3.

(6) Thoroughly mix together Epon 815 resin and Shell Curing Agent "T" in the following amounts:

EPON 815	100 parts by weight
Curing Agent "T"	20 to 25 parts by weight

(7) Carefully apply the resin mix evenly over the entire oversprayed area.

(8) Cure the resin sealed surface for a minimum of 24 hours at 75 ±10°F, or for a minimum of 8 hours at 125 ±15°F.

(9) Sand the oversprayed area to produce a smooth surface that is flush with the surrounding area. Use 240-grit wet or dry abrasive paper.

(10) Apply alodine to the repaired area as detailed in 51-8-0.

22. Repair Procedures - Electrically Noncritical, Wing Tip Leading Edge

CAUTION: CHEMICAL PAINT STRIPPERS MAY ATTACK RESIN SYSTEMS, THEREFORE, SHOULD NOT BE USED FOR REMOVING PAINT.

A. Lightly sand the area with 320-grit abrasive paper.

B. Clean the area with MEK or acetone to remove any sanding dust or other contamination.

C. If necessary, apply pinhole filler (Ref Maintenance Manual, 51-2-22).

D. Apply BMS 10-11, type 1 primer overlapping the undamaged flame-sprayed surface around the damaged area by approximately 0.75 inch.

E. Mask the outer 0.25-inch perimeter of the primed area so that the subsequent conductive coating will only overlap the flame-sprayed surface by 0.50 inch. Apply conductive coating as described in Maintenance Manual, 51-2-71.

CAUTION: CONDUCTIVE COATING MUST NOT BE PERMITTED TO COME INTO DIRECT CONTACT WITH THE FLAME-SPRAYED SURFACE DUE TO THE POSSIBILITY OF ELECTROLYTIC CORROSION.

F. Measure the electrical resistance as described in the Maintenance Manual, 51-2-71, ensuring that readings are taken between the original flame-sprayed coating and the conductive coating.

G. Restore the finish according to the Maintenance Manual, 51-2-51.

ALUMINUM-FACED PAPER HONEYCOMB STRUCTURE REPAIR FOR GALLEYS

1. General

A. Airplane galleys are installed in airplanes to the operator's requirements. In some instances these galleys are furnished by the operator and other instances by The Boeing Company. It is not practicable, therefore, for this document to identify the materials used in galley construction. However, aluminum-faced paper honeycomb panels were commonly used until it was found that they were susceptible to moisture damage. Because of this possible deterioration, operators should make themselves aware from vendor's drawings where paper honeycomb has been used in galley construction and establish inspection intervals based on their experience with this material.

B. To ensure the structural integrity of the galley structure, the paper honeycomb panels should be inspected for physical damage, delamination, and damage by moisture which can cause corrosion and deterioration of the core. Delamination can be detected visually, by coin tap, or by the use of the NDT methods described in the Nondestructive Test Manual (D6-7170), Part 1, 51-04-00. Water contained in the honeycomb core can be detected by X-Ray if necessary.

C. For allowable damage data and repair index see Fig. 1. Due to the variations in galley design, the limitations and repairs given in the subject are typical. The most severe limitations are imposed in the vicinity of the attachments to the basic airplane structure and at panel edges and panel joints.

2. Removal of Moisture

A. Moisture can only be removed effectively from the honeycomb core by removing the portion of one of the skins over the affected area. Frequently, deterioration of the core will necessitate removal. If the core is structurally satisfactory, the wetted area may still be removed or alternatively be dried by means of a flow of warm air.

3. Repair of Dents

A. Dents exceeding the allowable damage limitations given in Fig. 1 will probably have damaged the core necessitating a repair to the skin and core as described in par. 4.

B. Dents not exceeding the allowable damage limits do not require repair, but where appearance necessitates it, they may be filled as follows:

(1) Remove the paint or decorative finish.

(2) Clean the area as described in par. 9.

(3) Apply potting compound mixed as described in par. 11 to the depressed area.

(4) Allow the potting compound to cure. This may be accelerated by the application of heat which must not exceed 125°F. Refer to par. 10 for cure times.

(5) Sand the potting compound to provide a smooth surface.

(6) Refinish the repair as described in par. 8.

4. Repair of Delaminated Areas

A. If there is evidence of moisture in the honeycomb core, removal of the delaminated portion of skin to permit moisture removal, and repair in accordance with par. 5, is the only practical solution.

B. Delaminated areas of panels which are not adjacent to a panel edge may be repaired as follows:

(1) Drill a hole 0.125-inch diameter at each extremity of the delaminated area.

(2) Inject adhesive, mixed as described in par. 10, into one hole until it comes out of the other hole.

(3) Fill the 0.125-inch diameter holes with the adhesive.

(4) Apply pressure up to 10 psi and allow the adhesive to cure. Accelerated curing may be achieved by the application of heat not exceeding 125°F. Refer to par. 10 for cure times.

(5) Restore the finish as described in par. 8.

C. Delaminated areas of panels which extend to a free edge may be repaired as follows:

(1) Inject adhesive, mixed as described in par. 10, between the delaminated skin and honeycomb core. If necessary, utilize the method described in par. 4.B.

(2) Apply pressure up to 10 psi and allow the adhesive to cure. Accelerated curing may be achieved using heat not exceeding 125°F. Refer to par. 10 for cure times.

(3) Make the corrosion resistant steel capping channel shown in Fig. 2.

(4) Clean the mating surfaces of the panel and capping channel as described in par. 9.

(5) Install the capping channel with a faying surface seal of the sealant described in par. 7. Form a fillet of sealant at the edges of the channel.

(6) Restore the finish as described in par. 8.

5. Repair to Skin and Core

A. The procedure described in this paragraph may be adapted to repair either one or both skins and the honeycomb core. Refer to Fig. 3 and proceed as follows:

(1) Remove the damaged skin with a hole saw or router. If an undamaged skin is being cut to provide access for a core repair or moisture removal, it is preferable to remove the inner skin.

(2) Remove the damage portion of core.

(3) Make the replacement portion of core from Nomex honeycomb of the same cell size and density as the existing core.

(4) Make the filler and doubler shown in Fig. 3. Use the same material and thickness as the original skin for the filler, but one gage heavier for the doubler.

(5) Remove the finish from the panel over the area to be covered by the doubler.

(6) Clean the mating surfaces of all repair parts and the existing panel as described in par. 9.

(7) Install the repair parts with adhesive, mixed as described in par. 10. It will be necessary to apply adhesive to both the existing core and the replacement portion to ensure a good butt splice.

(8) Form a fillet at the edge of the doubler using the adhesive squeezed out.

(9) Apply pressure up to 10 psi and cure the adhesive. Accelerated curing may be achieved by using heat not exceeding 125°F. Refer to par. 10 for cure times.

(10) Restore the finish as described in par. 8.

6. Panel Replacement

A. When a panel is damaged beyond repair it should be replaced by a panel with similar physical characteristics as the original. The core material need not be paper honeycomb provided that the cell size and core density are comparable to the original. Refer to Fig. 4 and proceed as follows:

(1) Remove the damaged panel with its attaching extrusion and fasteners.

(2) Make a new panel from comparable material.

(3) Make the extruded attachment angles shown in Fig. 4.

(4) Clean the attachment angles and the mating surfaces of the new panel as described in par. 9.

(5) Attach the angles to the new panel, making a faying surface seal with the sealant described in par. 7.

(6) Drill the matching holes in the attachment angles and the existing panel.

(7) Install the inserts in the existing panel as follows:

(a) Drill the appropriate size hole down to, but not contacting the opposite face.

(b) Remove the debris.

(c) Place the insert in position with the axis perpendicular to the panel face and the head flush using the pressure-sensitive, adhesive-coated alignment tab.

(d) Prepare a quantity of the potting compound described in par. 12 and inject it through one hole in the alignment tab. Leave slight excess on the tab to allow for shrinkage.

NOTE: For inserts without alignment tabs, the potting compound should be inserted in the hole before positioning the insert.

(e) Cure the potting compound. Do not place any load on the inserts for 24 hours after curing. Refer to par. 12 for cure times.

(8) Solvent clean the mating faces of the attachment angles and the existing panel.

(9) Install the new panel making a faying surface seal between the angles and the existing panel.

(10) Install a corrosion resistant steel capping channel on any free edges of the new panel as described in par. 4.C.

(11) Seal as described in par. 7.

(12) Refinish the panel as described in par. 8.

7. Sealing

A. Sealing of all fastener holes and edges of panels, doublers, capping channels etc., is essential to exclude moisture which will cause deterioration of the honeycomb core and adhesive. This sealing should be repaired if at any time it will not ensure satisfactory exclusion of moisture.

B. The sealant recommended for use is PR1436G which is a two part, dichromate cured polysulphide material, which should be thoroughly mixed before use as follows:

(1) Measure out the correct amount of base compound and accelerator into separate containers.

(2) Stir each material in its own container until they reach even consistency.

(3) Stir the accelerator into the base compound and mix thoroughly for 5 to 7 minutes. Scrape sides of container and paddle to ensure thorough mixing of all of the compound. If a mechanical mixer is used, do not exceed 80 RPM.

NOTE: Correct proportions of base compound and accelerator and thorough mixing are extremely important.

C. Before sealant application clean the appropriate surfaces as described in par. 9.

D. Apply the sealant with a spatula or extrusion gun. If a gun is used, hold it almost perpendicular to the work surface. Avoid air bubbles and voids in the sealant. See Fig. 5 for typical examples of sealant application.

8. Finish

A. After completion of repairs the finish should be restored. Normally the interior surfaces are painted with white epoxy, while the exterior surfaces are covered with a decorative sheet of plastic material.

B. Painted surfaces may be restored as follows:

(1) Remove the original finish.

(2) Fill all dents, scratches, edges of doublers, faces of inserts and fastener heads in the manner described in par. 3.

(3) After the potting compound has cured, sand the surfaces to give a smooth finish.

(4) Clean the area as described in par. 9.

(5) Apply BMS 10-11 type 1 or BMS 10-79 epoxy primer.

(6) Apply BMS 10-60 type 1 polyurethane enamel.

C. Surfaces covered with decorative plastic may be restored as follows:

(1) Remove the old adhesive from the panel surface.

(2) Fill all dents, scratches, edges of doublers, faces of inserts and fastener heads in the manner described in par. 3.

(3) After the potting compound has cured, sand the surfaces to give a smooth finish.

(4) Clean the surface as described in par. 9.

(5) Apply the decorative plastic sheet using an adhesive compatible with the type of plastic being used.

9. Cleaning

A. To ensure good adhesion of the sealant or adhesive used in these procedures, clean surfaces are important. To ensure a high degree of cleanliness, proceed as follows:

(1) Clean the surface with clean lint-free cloth moistened with acetone, methyl ethyl ketone or naphtha. Pour the solvent into the cloth because the liquid will become contaminated if the cleaning cloth is dipped into it. Always use clean solvent, not reclaimed material.

(2) Dry the solvent with a clean piece of cloth before it evaporates.

(3) Repeat the cleaning process until soil does not appear on the cloth.

10. Adhesive

A. The recommended adhesive is Scotchweld Structural Adhesive EC2216B/A, Type I which is a two-part adhesive which must be mixed to the manufacturer's instructions. Pot life after mixing is approximately 90 minutes for a 100-gram batch at 75°F. Higher temperatures or larger batches will result in a reduction of pot life.

B. All fasteners should be installed within the pot life of the adhesive.

C. Curing times for the adhesive at varying temperatures are:

Temperature (°F)	Time (Hours)
60	48
80	24
100	12
120	6

11. Potting Compound

A. The recommended potting compound is the adhesive described in par. 10 with 30 parts by weight of phenolic microballoons added.

12. Potting Compound for the Installation of Inserts

A. The following potting compounds are recommended for the wet installation of inserts:

(1) Epocast 8623A/B, Mod. 1, Type 3 which has a work life of 30 minutes at room temperature when mixed as follows:

Epocast 8623A	100 parts by weight
Epocast 8623B	25 parts by weight

(2) Magnabond 79-6, Mod. 2 which has a work life of 35 minutes at room temperature when mixed as follows:

Magnabond 79-6A	100 parts by weight
Magnabond 79-6B	32 parts by weight

(3) Epocast 8623A, Mod. 1, Type 3 with Epocast Hardener #946 which has a work life of 20 minutes at room temperature when mixed as follows:

Epocast 8623A	100 parts by weight
Epocast Hardener #946	14 parts by weight

B. Cure times for the potting compounds are as follows:

(1) Epocast 8623A/B and Magnabond 79-6, 24 hours at 80°F or 5 hours at 110°F

(2) Epocast 8623A with #946 hardener, 3 hours at 75°F

13. Equipment and Materials

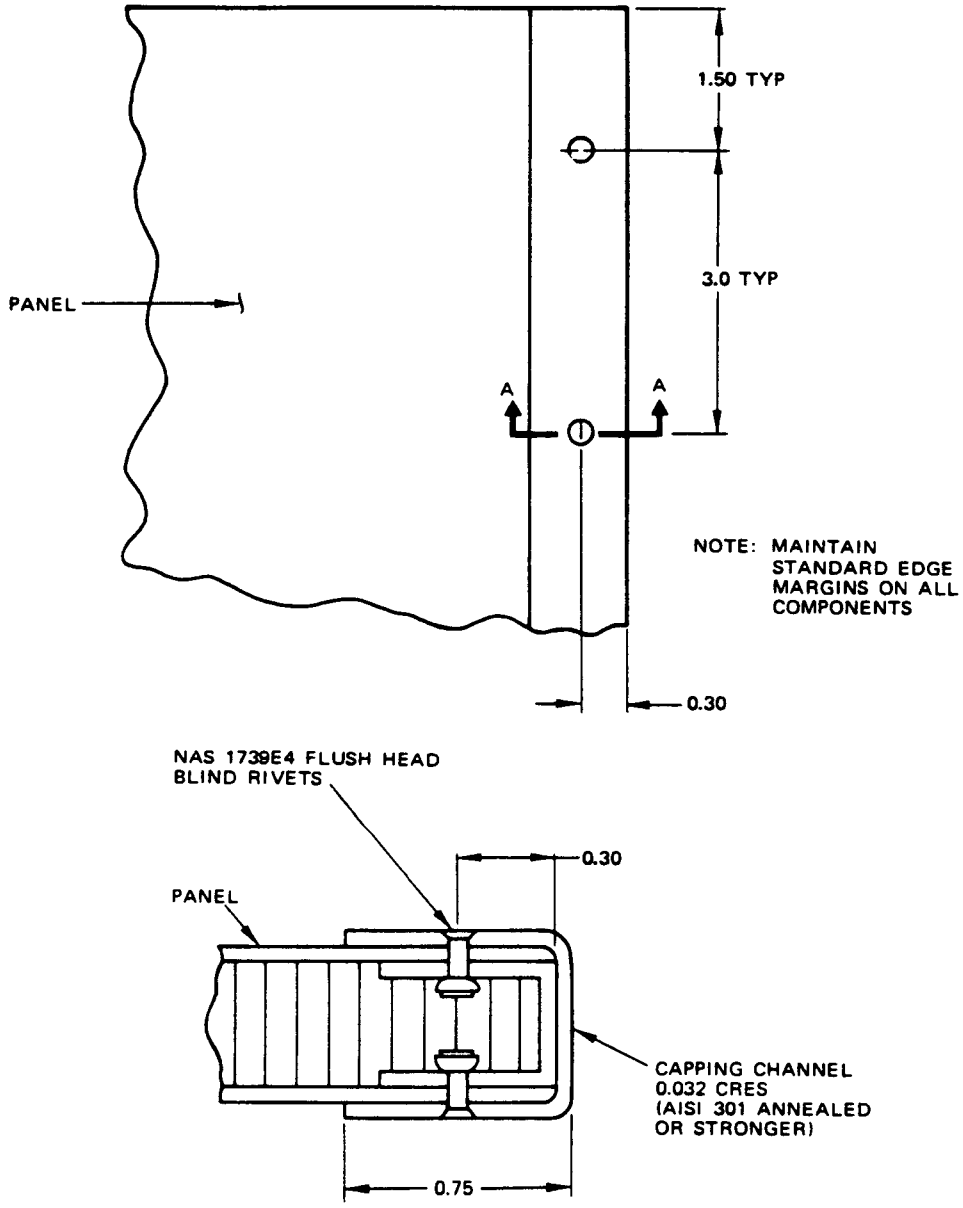
A. A recommended unit to provide heat and vacuum for use in making bonded repairs can be obtained from Airline Systems, 6361 First Ave. So., Seattle, Washington 98108. These are the VHB-1000 series vacuum heater blankets and Porta Bonda.

B. Suppliers of material referred to in these procedures are as follows:

Material	Source
BMS 8-124 nonmetallic honeycomb core (various cell sizes and densities)	Hexcel Corporation Coast Manufacturing Div. P.O. Box 668 815 Lawrence Street Lancaster, Ohio 43130 or Hexcel Corporation Coast Manufacturing Div. 11711 Dublin Boulevard Dublin, California 94566
Scotchweld EC2216B/A, Type I structural adhesive	Minnesota Mining and Manufacturing Co. St. Paul, Minnesota 55101
PR1436 sealant	Products Research and Chemical Corp. 2919 Empire Avenue Burbank, California 91504
Phenolic Microballoons BJO-0939	Union Carbide Corporation Chemicals and Plastics Division Bound Brook Plant River Road Bound Brook, New Jersey 08805
Magnabond 79-6, Mod. 2 potting compound	Magnolia Plastics, Inc. 5547 Peachtree Industrial Blvd. Chamblee, Georgia 30005
Epocast 8623A/B, Mod. 1, Type 3 potting compound and Epocast Hardener #946	Furane Plastics, Inc. 5121 San Fernando Road W. Los Angeles, California 90039
Acetone, methyl ethyl ketone or nahptha	Any source

TYPE OF DAMAGE	ALLOWABLE DAMAGE WITHOUT REPAIR		REPAIR INDEX
	AREAS OF PANELS EXCLUDING THE BASE, AREA OF UPPER ATTACHMENTS AND AREAS WITHIN 2 INCHES OF EDGE, JOINTS, INTERSECTIONS OR FASTENERS	BASE, AREA OF UPPER ATTACHMENTS, PANELS WITHIN 2 INCHES OF EDGE, JOINTS, INTERSECTIONS OR FASTENERS	
SCRATCHES	ALLOWED IF THERE ARE NO CRACKS. BLEND OUT AND ALODIZE SCRATCHES WHICH PENETRATE THE CLADDING		
DENTS	ALLOWED PROVIDED THAT THEY ARE NOT MORE THAN 3 INCHES ACROSS THE MAJOR AXIS, NOT DEEPER THAN 10% OF THE PANEL THICKNESS AND THE WIDTH TO DEPTH RATIO IS NOT LESS THAN 20:1	NOT ALLOWED	REFER TO PAR. 3 [A]
PUNCTURES	PUNCTURES WHICH MAY BE DRILLED OUT TO 0.50 INCH DIA ARE PERMITTED PROVIDED THEY ARE FILLED WITH POTTING COMPOUND. REFER TO PAR. 11.	NOT ALLOWED	REFER TO PAR. 5 [A]
DELAMINATION	NOT ALLOWED EXCEPT FOR HORIZONTAL INTERIOR SHELVES WHERE DELAMINATED AREA DOES NOT EXCEED 20% OF SHELF AREA	NOT ALLOWED	REFER TO PAR. 4 [A]
CRACKS	NOT ALLOWED WITHIN 10 INCHES OF BASE, OTHERWISE ALLOWED PROVIDED THEY DO NOT EXCEED 3.0 INCHES IN LENGTH, ARE STOPPED WITH 0.25 INCH DIA HOLES AT THE EXTREMITIES AND FILLED WITH POTTING COMPOUND. REFER TO PAR. 11.	NOT ALLOWED	REPAIR AS FOR PUNCTURE. REFER TO PAR. 5 [A]
EXTENSIVE DAMAGE	NOT ALLOWED	NOT ALLOWED	REFER TO PAR. 6 [A]

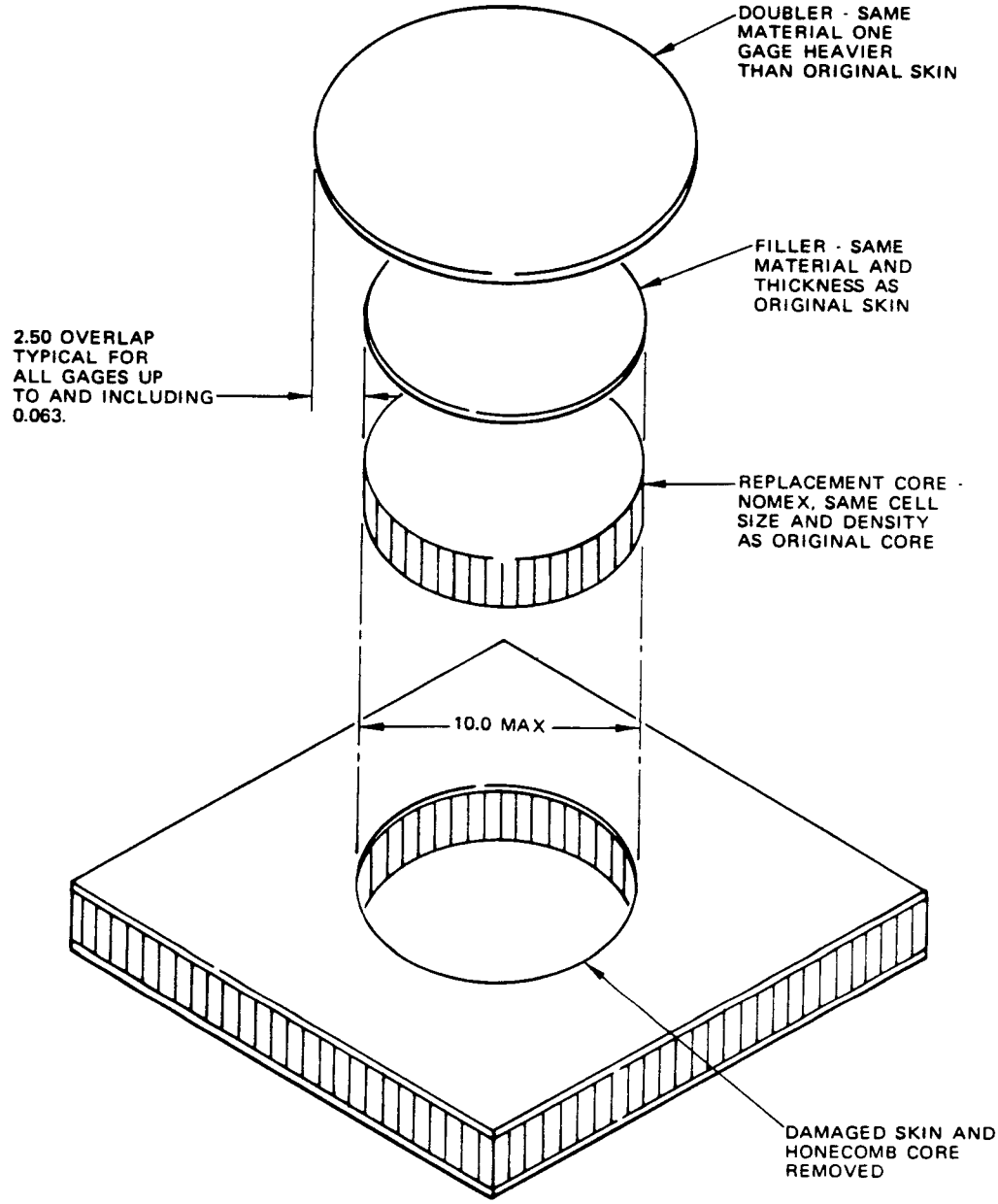
[A] FOR ALL REPAIRS TO BASE, AREA OF UPPER ATTACHMENTS, PANELS WITHIN 2 INCHES OF JOINTS, INTERSECTIONS OR FASTENERS, REFER TO THE BOEING COMPANY FOR DISPOSITION.



SECTION A–A

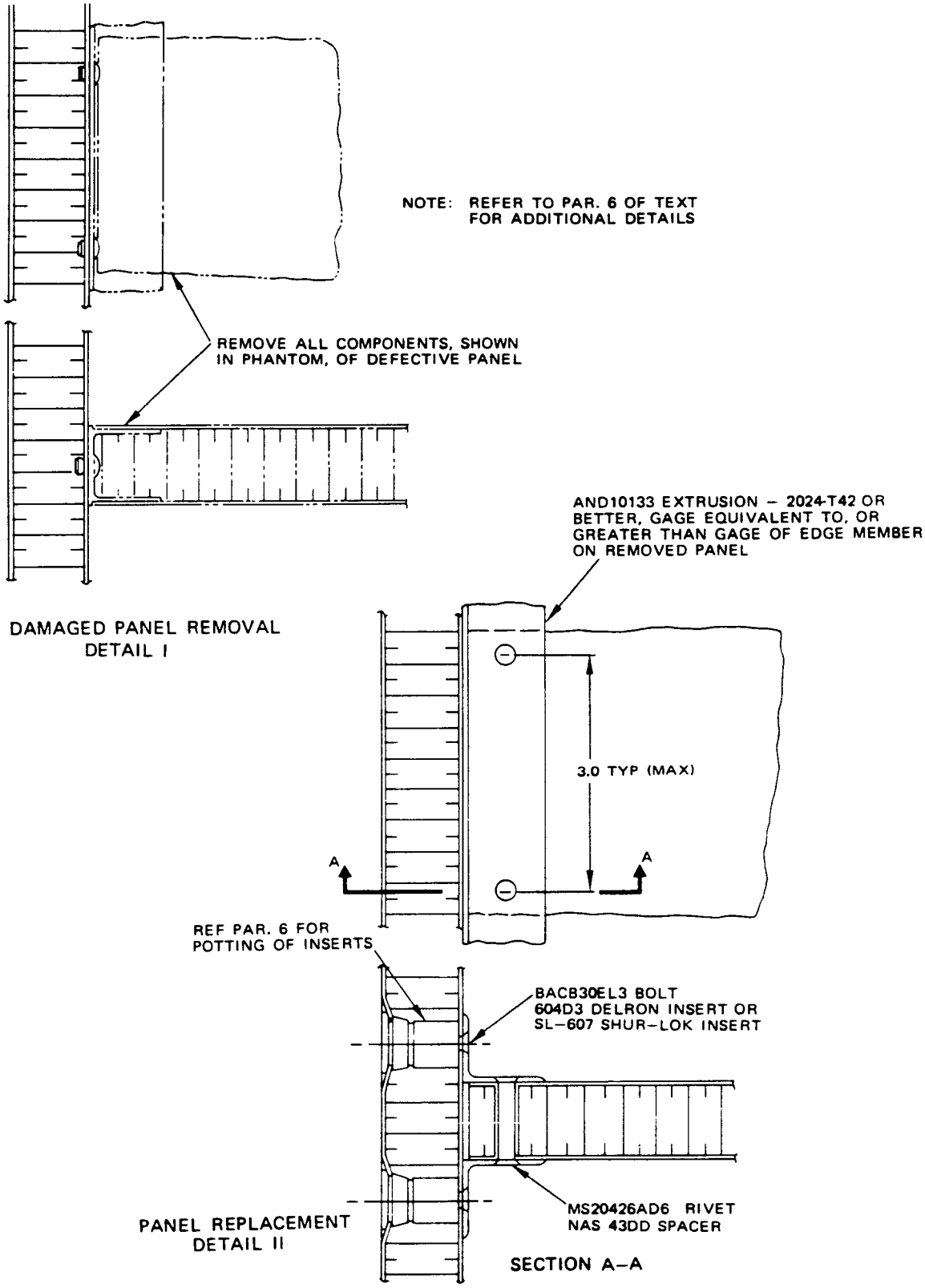
NOTE: REFER TO PAR. 4 FOR TEXT FOR ADDITIONAL DETAILS

Repair to Delaminated Free Edge of Panel
Figure 2

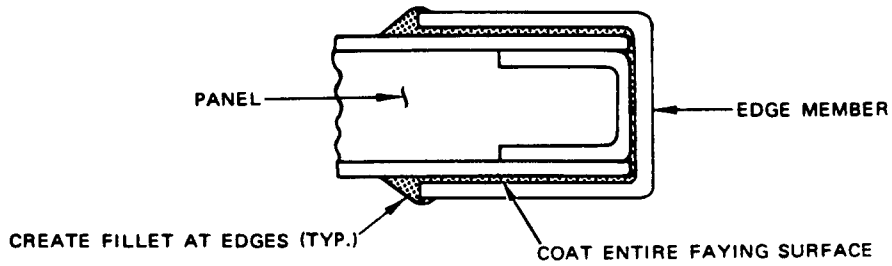


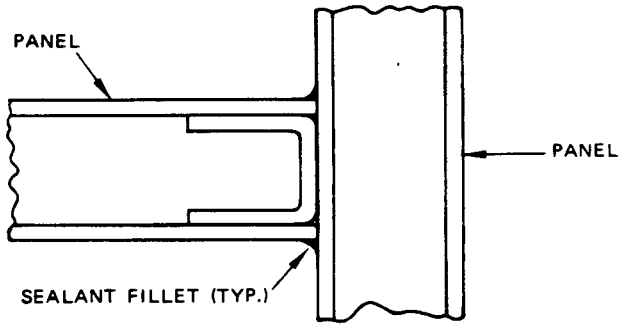
NOTE: REFER TO PAR. 5 OF TEXT FOR ADDITIONAL DETAILS

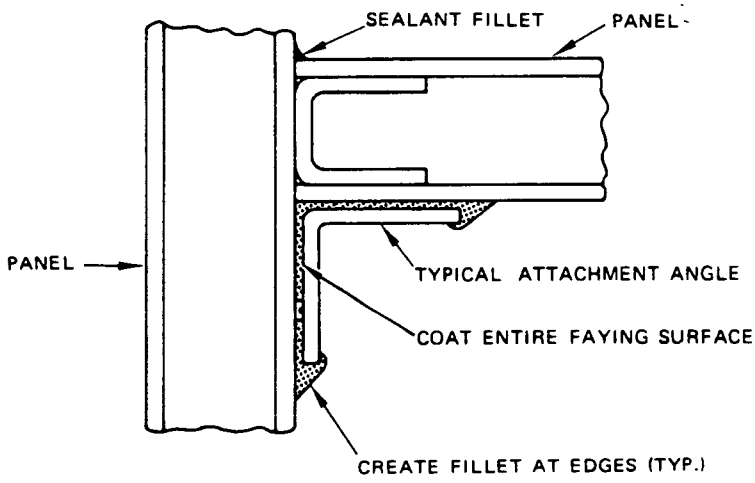
Repair to Skin and Core
Figure 3



Replacement of Damaged Panel
Figure 4







NOTE: REFER TO PAR. 7 OF TEXT FOR ADDITIONAL DETAILS.

Typical Sealant Applications
Figure 5

MAT MOLDED FIBERGLAS REPAIR

1. Introduction

A. This section of the manual describes repairs to fiberglas mat reinforced plastic. Repairs to fiberglas cloth reinforced plastic are described in 51-11-1.

B. Mat molded fiberglas is used in applications involving electrical equipment on the airplanes. In general, mat molded fiberglas is used in non-structural applications such as relay shields and junction boxes. Typical items made of mat molded fiberglas in most airplanes are the main A.C. power shield and pilot's light shield in the control cabin. Preloaded cargo containers used by AA and WAL are also made of mat molded plastic.

2. Evaluate damage per figure 1 below.

Type of Damage	Minor Damage	Major Damage
Holes	Up to 0.38 dia.	Over 0.38 dia.
Edge Cracks	Up to 0.75 long	Over 0.75 long
Inboard Cracks	Up to 2.00 long	Over 2.00 long

Damage Evaluation
Figure 1.

3. Select applicable resin mixture from figure 2.

4. Procure repair materials and equipment per figure 3.

5. Prepare damage area. See figure 4.

A. Stop drill 1/16 to 3/16 dia. at ends of cracks.

B. Bevel area around cracks or holes at 15° to 45°.

C. Sand entire damage area and approximately 0.50 beyond bevel edges.

D. Solvent clean damage areas.

(1) Apply solvent with clean absorbent cleaner.

(2) Scrub with clean fiber brush, if necessary.

(3) Wipe off solvent before it evaporates with clean absorbent cleaner.

WARNING: ACETONE AND METHYL-ETHYL-KETONE SOLVENTS ARE TOXIC AND AN EXTREME FIRE HAZARD. DO NOT USE THIS MATERIAL IN CONFINED AREAS WITHOUT VENTILATION. WEAR NEOPRENE GLOVES FOR PROTECTION OF HANDS.

NOTE: Keep prepared area clean; contamination by paint, oil, grease, wax, dirt or dust reduces repair strength.

6. **Mix selected resin mixture per figure 2.**

7. Repair Damage. See figure 4.

A. Fill damage area with applicable resin mixture with a putty knife or wooden spatula.

B. Cover repair area with parting film extending 1.00 to 2.00 over bevel edges.

NOTE: Use PE (polyethylene) parting film only when room temperature cure resin mixtures are used. PVA (polyvynil alcohol) parting film is water soluble and easier to remove after curing high temperature cure resin mixtures.

C. Remove excess resin with a wooden spatula or squeegee.

D. Cure repair area.

(1) Cure for approximately 4 hours at 75° or until tack free if room temperature cure resin mixture is used.

(2) Cure for 30 minutes at 225°F or 15 minutes at 275°F if high temperature cure resin mixture is used.

NOTE: Explosion-proof device delivering hot air is the preferred heat source.

NOTE: Use Tempilsticks for controlling repair area temperature if high temperature cure resin mixture is used.

E. Remove parting film.

(1) Peel off parting film if polyethylene (PE) material is used.

(2) Sponge off with warm water at approximately 110°F to dissolve parting film if polyvinyl alcohol (PVA) material is used.

MIXTURES FOR MINOR DAMAGE REPAIR				
TYPE	INGREDIENTS	PARTS BY WEIGHT	POT LIFE	CURE TIME
ROOM TEMP. CURE RESIN	RESIN	100	30 TO 60 MINUTES	4 HRS AT 75° F OR UNTIL TACK FREE
	FIRE INHIBITOR	5		
	LIQUID CATALYST	2		
	DRIER CATALYST	½		
HIGH TEMP. CURE RESIN	RESIN	100	8 TO 10 HOURS	60 MINUTES AT 225° F 15 MINUTES AT 275° F
	FIRE INHIBITOR	5		
	LIQUID CATALYST	2		
	PASTE CATALYST	½		

MIXING PROCEDURE:

1. Add fire inhibitor to resin and stir until fully dispersed.

   WARNING: Fire inhibitor dust or fumes are very toxic. Do not use this material in confined areas without ventilation. Wear neoprene gloves for protection of hands. Flush inside of upper and lower eyelids with clean water for at least 15 minutes to remove contamination from eyes.

   NOTE: Omit fire inhibitor if pigments are used to color resin mixture.

2. Add liquid catalyst and stir until fully dispersed.

3. Add drier catalyst or paste catalyst and stir until fully dispersed.

   WARNING: Do not directly mix liquid catalyst with drier catalyst. This mixture is violently explosive.

NOTE

USE EITHER ROOM OR HIGH TEMPERATURE CURE RESIN MIXTURE. USE OF HIGH TEMPERATURE CURE RESIN SAVES TIME PROVIDED EXPLOSION – PROOF HEAT SOURCE IS AVAILABLE

MIXTURES FOR MAJOR DAMAGE REPAIR				
TYPE	INGREDIENTS	PARTS BY WEIGHT	POT LIFE	CURE TIME
ROOM TEMP. CURE RESIN	RESIN	67	30 TO 60 MINUTES	4 HRS AT 75° F OR UNTIL TACK FREE
	FIRE INHIBITOR	5		
	LIQUID CATALYST	2		
	DRIER CATALYST	½		
	FIBER GLASS MAT (0.50 SQUARES)	33		
HIGH TEMP. CURE RESIN	RESIN	67	8 TO 10 HOURS	60 MINUTES AT 225° F 15 MINUTES AT 275° F
	FIRE INHIBITOR	5		
	LIQUID CATALYST	2		
	PASTE CATALYST	½		
	FIBER GLASS MAT (0.50 SQUARES)	33		

MIXING PROCEDURE:

1. Add fire inhibitor to resin and stir until fully dispersed.

   WARNING: Fire inhibitor dust or fumes are very toxic. Do not use this material in confined areas without ventilation. Wear neoprene gloves for protection of hands. Flush inside of upper and lower eye lids with clean water for at least 15 minutes to remove contamination from eyes.

   NOTE: Omit fire inhibitor if pigments are used to color resin mixture.

2. Add liquid catalyst and stir until fully dispersed.

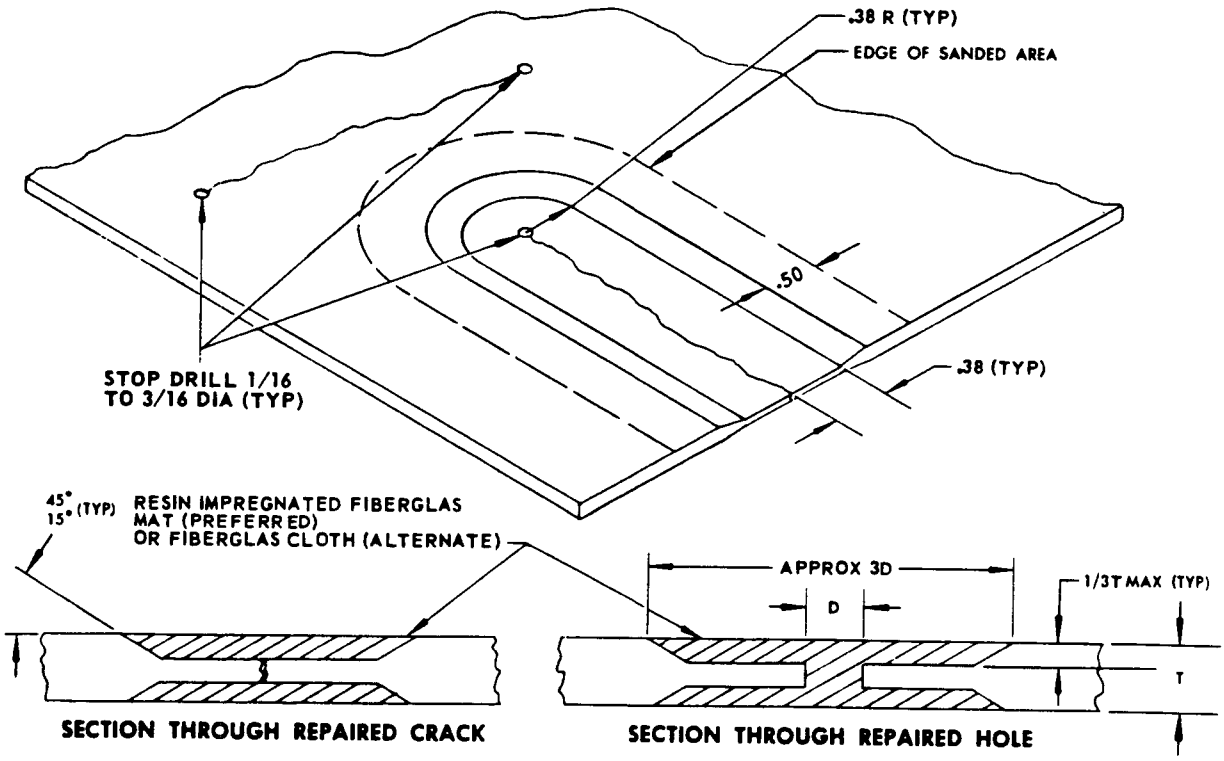
3. Add drier catalyst or paste catalyst and stir until fully dispersed.

   WARNING: Do not directly mix liquid catalyst with drier catalyst. This mixture is violently explosive.

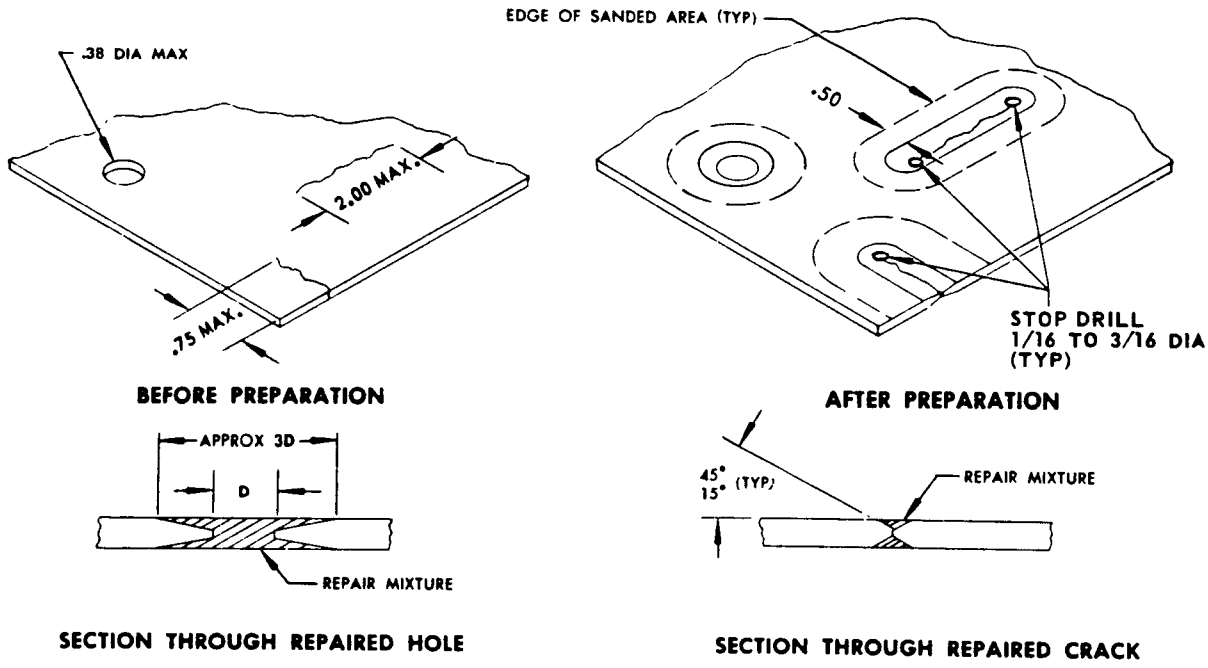
4. Add fiber glass mat and stir until fully dispersed.

ITEM	IDENTIFICATION	SUPPLIER
RESIN, FIRE RESISTANT POLYESTER	LAMINAC 4146 MEDIUM VISCOSITY OR LAMINAC 4147 LOW VISCOSITY OR PLASKON 951 LOW VISCOSITY	AMERICAN CYANAMID CO., INDUSTRIAL CHEMICALS AND PLASTICS DIV. BERDAN AVE., WAYNE, NEW JERSEY 07470 AMERICAN CYANAMID CO., INDUSTRIAL CHECMICALS AND PLASTICS DIV. BERDAN AVE., WAYNE, NEW JERSEY 07470 BARRETT DIV., ALLIED CHEMICAL CORPORATION P.O. BOX 4000R MORRISTOWN, N.J. 07960
INHIBITOR, FIRE	ANTIMONY TRI-OXIDE	HARSHAW CHEMICAL CO. 1945 E. 97TH ST. CLEVELAND, OHIO 44106 OR J.T. BAKER CHEMICAL CO. 600 BROAD ST. N. PHILLIPSBURG, N.J. 08865
CATALYSTS, POLYESTER RESIN PASTE	LUPERCO ATC OR GAROX BZP	WALLACE & TIERNAN INC., LUCIDOL DIV., BUFFALO, N.Y. RAM CHEMICALS, INC 210 E. ALONDRA BLVD. GARDENA, CALIF. 90247
LIQUID	LUPERSOL DDM OR GAROX MEK	WALLACE & TIERNAN INC., LUCIDOL DIV., BUFFALO, N.Y. RAM CHEMICALS, INC., 210 E. ALONDRA BLVD. GARDENA, CALIF. 90247
DRIER	COBALT NAPHTHALENE 6% COBALT SOLUTION	ANY CHEMICAL SUPPLIER
FIBER GLASS MAT	BINDER TYPE #216	OWENS-CORNING FIBERGLAS CORP. 608 MADISON AVE. TOLEDO, OHIO 43604
CLOTH	# 182 8-HARNESS SATIN WITH FINISH VOLAN "A" OR GARAN	UNITED MERCHANTS AND MANUFACTURERS, INC. 1407 BROADWAY NEW YORK, N.Y. 10018
PARTING FILM PE (POLYETHYLENE) OR PVA (POLYVINYL ALCOHOL)	0.002 TO 0.004 THICK REYNOLON 4201 OR 4203	ANY SOURCE REYNOLDS METAL CO., 2819 FIRST AVENUE SEATTLE, WASH. 98121
MASKING TAPE	1.0 TO 2.0 WIDE	ANY SOURCE
CLEANERS-SOLVENT ACETONE OR METHYL ETHYL KETONE	INDUSTRIAL GRADE INDUSTRIAL GRADE	ANY SOURCE
CLEANERS-ABSORBENT CHEESE CLOTH OR PAPER TOWELS	INDUSTRIAL GRADE OIL CONTENT-.75% MAX	ANY SOURCE
ABRASIVES SANDPAPER OR EMERY CLOTH OR EMERY WHEEL	# 180 GRIT # 600 GRIT # 180 GRIT	ANY SOURCE
SAFETY ITEMS - PERSONNEL FACE SHIELD OR MASK GLOVES-NEOPRENE GLOVES-COTTON	INDUSTRIAL GRADE INDUSTRIAL GRADE INDUSTRIAL GRADE	ANY SOURCE
CONTAINERS BREAD PAN CANS-SOLVENT-SAFETY	APPROX. 3.0 x 8.0 INDUSTRIAL GRADE	ANY SOURCE
TEMPILSTICKS	225°F 275°F	TEMPILSTIK CORPORATION 132 W 22nd STREET NEW YORK, N.Y. 10011

ITEM	IDENTIFICATION	SUPPLIER
TOOLS SPATULA, WOODEN PUTTY KNIFE ROTARY FILE OR DRUM OR DISK SANDER OR HAND SANDING BLOCK SCISSORS C-CLAMPS SCRIBER COMPASS FUNNEL SQUEEGEE	INDUSTRIAL GRADE	ANY SOURCE
	SYNTHETIC RUBBER (ROYALITE) OR PHENOLIC LAMINATE	ANY SOURCE



MAJOR DAMAGE



MINOR DAMAGE

GENERAL REPAIR PROCEDURES

1. Classification of Damage to Airplane Structural Members

A. Damage as considered in this manual, is any cross-sectional change or permanent distortion of a structural member. It is classified in the following three categories: allowable damage, repairable damage and damage necessitating replacement of damaged parts.

B. Use good judgement in determining the type of significant damage to flat stock structural material. The terms "dent," "crease,", abrasion," "gouge," "nick," "scratch," "crack" and "corrosion" referred to elsewhere in the manual, are defined below as a guide for this determination, particularly with respect to the external skin of the airplane in panel areas:

(1) Dent - A dent is normally a damage area which is depressed with respect to its normal contour. There is no cross-sectional area change in the material. Area boundaries are smooth. Its form is generally the result of contact with a relatively smoothly contoured object.

NOTE: A dent-like form of damage to skin in nonpanel areas (or thick skin in panel area) may be the result of the peening action of a smoothly contoured object contacting it. Consider that such damage results in a local cross-sectional area change, if the inner surface of skin shows no contour change.

(2) Crease - A damage area which is depressed or folded back upon itself in such a manner that its boundaries are sharp or well defined lines or ridges. Consider it to be the equivalent of a crack.

(3) Abrasion - An abrasion is a damage area of any size which results in a cross-sectional area change due to scuffing, rubbing, scraping, or other surface erosion. It is usually rough and irregular.

(4) Gouge - A gouge is a damage area of any size, which results in a cross-sectional area change. It is usually caused by contact with a relatively sharp object which produces a continuous, sharp or smooth channel-like groove in the material.

(5) Nick - A nick is a local gouge with sharp edges. Consider a series of nicks, in a line pattern to be the equivalent of a gouge.

(6) Scratch - A scratch is a line of damage of any depth in the material and results in a cross-sectional area change. It is usually caused by contact with a very sharp object.

(7) Crack - A crack is a partial fracture or complete break in the material with the most significant cross-sectional area change. In appearance, it is usually an irregular line and is normally the result of fatigue failure.

(8) Corrosion - Corrosion, due to a complex chemical action, is a damage area of any size and depth which results in a cross-sectional area change. Depth of such pitting damage must be determined by a cleanup operation. Damage of this type may occur on surfaces of structural elements of wing integral fuel tanks. Refer to paragraph 2.B.

C. Use good judgement in the determination of significant cross-sectional area changes by proper visual measurement of both depth, per par. 2, and length of any type (or combinations) of damage mentioned above.

2. Allowable Damage

A. Damage or distortion which can be permitted to exist as it is or which may be corrected by a simple procedure, such as stop drilling cracks or smoothing out nicks is classified as allowable damage. The extent of allowable damage for the major assemblies and component parts is defined at the beginning of each chapter. An Optical Micrometer tripod base type of tool is recommended for depth determination of such damage. This tool is manufactured by:

Monogram Industries Inc
Air Cargo Division
8525 Stetlar Drive
Culver City, California 90230

Clean up the nicks, scratches or gouges in the following manner:

(1) Sand down any paint film in the damage areas as required to a smooth base surface and polish out the damage with aluminum wool. Treat the bare metal exposed per 51-8-0 and finish per 51-2-0 of the Maintenance Manual.

(2) Scratches which have not penetrated the clad surface may be reworked by burnishing. A suitable nondestructive test procedure must be used after rework to ensure that the material is free from cracks.

NOTE: If scratches or skin defects completely penetrate the clad surface, or if the scratches or skin defects are on an unclad surface, refer to the appropriate chapter for instructions.

(3) For minor scratches or isolated skin defects where the clad surface has not been completely penetrated, hand burnishing is satisfactory. Treat the bare metal exposed per 51-8-0 and finish per 51-2-0 of the Maintenance Manual.

NOTE: During burnishing if cladded surface is completely penetrated, damaged area must be rounded out within the allowable damage limits of the appropriate chapter and the finish restored.

(4) For more extensive scratches or for areas containing multiple small defects which do not penetrate the clad material, power burnishing is recommended. Four different shaped rotary burnishing heads, designated ST 917 A-B-C-D are recommended for skin repair. The Titan 2 air motor manufactured by Star Dental Mfg. Co., is recommended to drive the rotary heads. Burnish the scratch and defect as follows:

(a) Remove the paint from the damaged area and a minimum 1/2 inch all around.

(b) Burnish out any scratches or small defects from the skin using the recommended tools. Refer to the appropriate chapter for allowable damage and damage limitations.

NOTE: During burnishing if cladded surface is completely penetrated, damaged area must be rounded out within the allowable damage limits of the appropriate chapter.

(c) Alodize the exposed area of the skin in accordance with 51-8-0.

(d) Restore the finish in accordance with 51-2-0 of the Maintenance Manual.

B. Damage due to corrosion requires a rework operation to determine its penetration depth into a structural member prior to establishing its classification as allowable damage or damage requiring repair. Remove this type of damage within integral fuel tank areas by the procedure which follows.

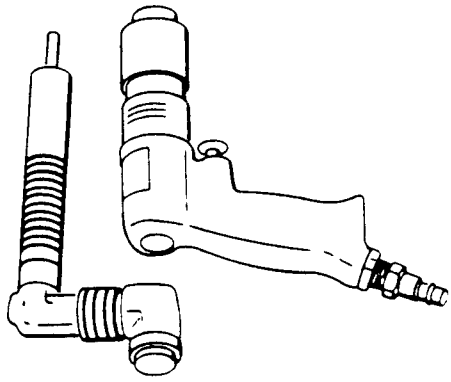
(1) Remove all sludge or powdery deposits which may be present on structural elements as outlined in 28-2-0 of the Maintenance Manual.

(2) Mechanically remove the corrosion by using rotary files, rubber backed disk sanders, carbide tipped scrapers, aluminum wool, aluminum oxide abrasive paper, etc. Use air motors for all power operated tools. Figure 1 lists and illustrates acceptable tools.

CAUTION: EXERCISE CARE WHEN OPERATING POWER TOOLS TO PREVENT DAMAGE TO STRUCTURAL SURFACES BY OVERHEATING OR SCUFFING.

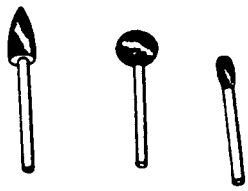


90° AIR VANE. ARIDEST NO. 1, 1850 RPM. MANUFACTURED BY ROCKWELL MFG. CO., DAYTON DIVISION, DAYTON, OHIO, OPTIONAL MODEL D, 2000 RPM. MANUFACTURED BY CHICAGO PNEUMATIC TOOL CO., 6 E 44TH ST., NEW YORK 27, N.Y.

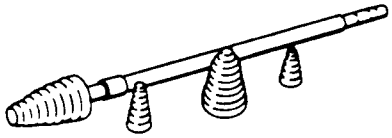


1/4 INCH DRIVE AIR MOTOR, 3500 TO 4750 RPM MODEL LINKFUL NO. 2. MANUFACTURED BY ROCKWELL MFG CO., DAYTON DIVISION, DAYTON, OHIO.

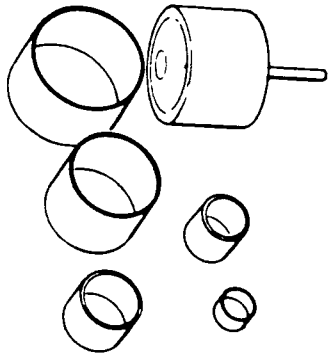
360° ADAPTER, MODEL AT337. MANUFACTURED BY AIRCRAFT TOOLS, INC., 9930 BELLANCA AVE., LOS ANGELES 45, CALIFORNIA.



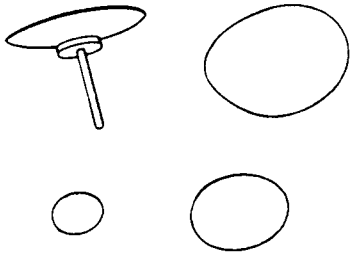
ROTARY FILES. BALL AND CONICAL SHAPES MANUFACTURED BY INDUSTRIAL SUPPLIERS.



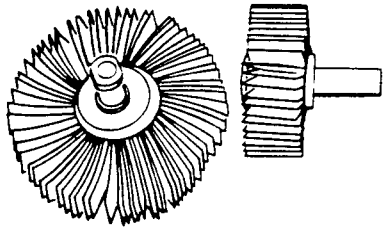
SPIRAPOINT CONES WITH 1/2 INCH DIAMETER ADAPTER CONE. SIZES 3/4 BY 1-1/2 INCHES, 1/2 BY 3/4 INCH AND 5/8 BY 1-1/2 INCHES MANUFACTURED BY BEHR-MANNING CO., TROY, NEW YORK



DRUM SANDER. 1/4 INCH DIAMETER DRIVE DRUM 3/4 INCH AND 1 BY 1 INCH SLEEVE ALUMINUM OXIDE ABRASIVE MANUFACTURED BY INDUSTRIAL SUPPLIERS



MUSHROOM SANDING PAD WITH 1, 2, AND 3 INCH DIAMETER ALUMINUM OXIDE ABRASIVE DISCS 1/4 INCH DIAMETER SHANK FOR AIR MOTOR 1/4-28 SIZE THREADED SHANK FOR AIR VANE MANUFACTURED BY BEHR-MANNING CO., 6116 HOWE ST., TROY, NEW YORK



FLEXIBLE SANDING WHEEL. "GRIND-O-FLEX." 1/2 BY 2 INCHES AND 1 BY 3 INCHES 80 GRIT, ALUMINUM OXIDE ABRASIVE MANUFACTURED BY MERIT PRODUCTS INC., 3691 LEANWEE AVE., LOS ANGELES, CALIFORNIA

(3) Final dress-out and radiusing of pits to be 0.125 inch minimum in the walls of the integral water tank. In the integral fuel tanks, rework the corroded area to a saucer-shaped surface as shown in 57-2-1, figure 1, detail VII. Make the rework surface equivalent to 63 RHR or better.

(4) Consider the reworked depression to be the equivalent of a gouge and evaluate it in terms of area out. Allowable damage for interspar wing is defined in 57-2-1, figure 1, detail VII; for integral water tank: 53-2-1, figure 1, detail XI. If allowable limits are not exceeded consider the reworked surface "gouge" to be allowable and apply finish per Maintenance Manual. Damage exceeding allowable limits must be repaired.

3. Repairable Damage

A. Make a repair to repairable external surface damage by an external type repair or by a "flush" type repair as in paragraphs B and C below. Make a repair to repairable internal region damage by application of 51-14-2, 51-14-3, 51-14-4 or by such repairs as are called out in specific subjects within the manual.

B. An "EXTERNAL" repair as presently defined in this manual is a type of repair which can be quickly applied. It is used to minimize down time of an airplane. It is generally a field-oriented type repair rather than a shop-type. In form, it protrudes with respect to a damaged aerodynamic surface. It may be replaced for appearance or for aerodynamic c considerations but replacement is not required. (See paragraph D below.) Airplane performance (51-4-1) may be affected by numerous external type repairs in critical areas.

C. A "FLUSH" repair as presently defined in this manual is a type of repair that may be used to replace an "EXTERNAL" repair as defined in paragraph B above for aerodynamic or appearance reasons. It is generally a shop-oriented rather than a field-type repair. In form it is flush with respect to a damaged aerodynamic surface.

D. The repair types mentioned in paragraphs B and C above are structurally equivalent for static strength. The operator has the option of using either type to effect a structurally airworthy, FAA approved repair. Several external type repairs in this manual have been designed in such a manner that fastener holes made during a field repair, may be used for the subsequent flush type repair at the same location during a depot or shop oriented repair.

E. All other repairs called out in the manual which involve internal metal structural components are structurally airworthy, FAA approved repairs for the service life of the airplane. They may be of "flush" type or "EXTERNAL" type repairs in form.

4. Replacement of the Part

A. Replacement of the entire part is suggested when repair of the part is not practical or economical. In some cases damage may necessitate replacement of the part. These are specifically noted in other chapters of the manual. Replacement is often advisable when damage to a complicated part is extensive or the damaged part is less than 30 inches long.

B. Identification sections of Chapters 52 through 57 indicate approved repairs for many of the tabulated structural items. Those items which have no repair entries are considered to be repairable by replacement.

5. Operations Concerned with Repairs for Damage Beyond Allowable Damage Limits

A. Remove finish of original structure where required for sealing or surface treatment.

B. Break sharp edges equivalent to .03 radius and deburr edges of repair fastener holes where possible, in original damaged components.

C. Treat the surface or edges of damaged components to preclude possible corrosion when mechanical repair operations have exposed unprotected metal as described in 51-8-0.

D. Break sharp edges from 0.015 to 0.03 radius and deburr all edges of repair fastener holes in repair parts and original parts.

E. Treat surfaces or edges of repair parts as described in 51-8-0 prior to installation.

F. Determine sealing level and type of sealing method required.

(1) Use faying surface sealant applications for repairs on external surfaces when access is limited. Make faying surface sealant applications for the following:

(a) Pressure requirements BMS 5-79

(b) High temperature requirements BMS 5-63

(c) Moisture requirements BMS 5-79

(2) Use filleted and fastener sealant applications for flush repairs on external surfaces when access is available on the pressurized side. Use faying surface sealant applications for flush repairs when access is limited or unavailable. Make filleted and fastener sealant applications for the following:

(a) Integral tank requirements BMS 5-26. Refer to 57-2-2.

(b) Pressure requirements BMS 5-79

(c) High temperature requirements BMS 5-63

(d) Moisture requirements BMS 5-79

G. Prepare surfaces for repair parts installation.

(1) External repairs.

(a) Clean the faying surfaces.

(b) Apply proper sealant material outlined in F, on faying surface seal area of repair part.

(c) Apply any required finish per 51-2-0 of the Maintenance Manual to nonfaying surface of repair part, by masking methods prior to installation.

(d) Install repair parts with required fasteners.

(2) Flush repairs.

(a) Clean the faying surfaces.

(b) Apply adhesive per 51-9-1 to faying surfaces. The squeegee shown in 51-10-1, figure 13 may be used for adhesive application.

(c) Install repair parts with required fasteners.

(d) Apply proper sealant material as filleted and fastener seals.

(e) Apply aerodynamic smoother BMS 5-79 in gaps exposed when repair is in an aerodynamically critical area.

(f) Apply proper finish per 51-2-0 of the Maintenance Manual.

H. Complete additional processes or checks which may be required.

(1) Rebalance control surfaces per 51-15.

TYPICAL REPAIRS - GENERAL

1. Introduction

Many sections of the airframe structure are similar in design and fabrication. Examples of such items are sheet metal webs and formed structural shapes. Typical repairs to these and other items have been compiled in this section to eliminate the duplication of repairs under each applicable component. Repairs in this section apply to the member shown regardless of location on the aircraft structure and will include only those parts or members necessary to show the typical situation.

2. Usage

Typical repairs may be accomplished individually, or combined with other repairs for a major repair. Technique and material variation is permissible only so far as to facilitate fabrication and insure the original strength and usefulness of the affected component. In a case, except interspar wing skins, where a typical repair is not applicable or a specific repair is not called out in the manual, make a repair in a manner which is structurally equivalent and similar in fastener pattern configuration to the nearest existing splice. Make due consideration for both longitudinal and transverse fastener patterns which, for example in fuselage skin panels, are different from each other.

1. Typical Repair for Minor Dents

A. Introduction

(1) This section covers repair of dents in leading edges of metal construction. For aerodynamic smoothness requirements in these areas see 51-4-1. For dents in aluminum honeycomb see 51-10-1, figure 1.

(2) Dents in the leading edges of the wing, struts, nacelle nose cowls and stabilizers where access inside these structures is not readily available, may be repaired with a filling compound. Dents in some areas as described below cannot be filled and must be reworked to original contour.

(3) Preparation of a filler material, potting compound per BMS5-28A Type III, is described in paragraph C. These repairs can be considered permanent provided the limitations listed in paragraph B below are not exceeded.

B. Dent Repair Limitations

(1) Maximum size of permissible dents which when filled will not adversely affect anti-icing functions or which will not affect structural integrity are as follows:

(a) Wing leading edge at rib bays. See figure 1, detail I.

1) Dents which do not break, crack or tear the skin may be filled.

2) Dents with gouges or abrasions which do not exceed 20% of the skin gage may be filled.

3) Dents in the "D" duct nose section whose maximum depths do not contact the distribution duct may be filled.

(b) Stabilizers leading edges at rib bays. See figure 1, detail II.

1) Dents which do not break, crack or tear the skin aft of the deicing boot may be filled.

2) Dents with gouges or abrasions which do not exceed 20% of the skin gage aft of the deicing boot may be filled.

3) Dents in the deicing boot may be reworked providing the skin and deicing boot cladding is not cracked and the deformed area does not extend within 1.25 inches of the rib rivet centerline.

NOTE: Do not fill deicing boot dents with filler compound. Repair these dents by removing the leading edge and reworking the skin to contour from the interior as described in paragraph D below. See the 707 Maintenance Manual, Section 30-1-61 for removal and installation instructions.

(c) Nose cowl leading edges. See figure 2.

1) Dents in size up to and including .125 inch depth by 2 inches width, located at the inner surfaces of the inlet ducts for the turbocompressor, engine compressor and oil cooler, or to those areas of a nose cowl outer skin within .50 inch of the extreme leading edges of these ducts, will not adversely affect anti-icing performance but may affect engine performance.

CAUTION: DO NOT FILL. REPAIR DENTS WHICH EXCEED THE VALUES GIVEN, BY REWORK OR REPLACEMENT OF THE DAMAGED DUCT SURFACE.

2) Dents up to .25 inch depth in the external surface, .50 inch aft of the extreme leading edge, in which the skin is not cracked or broken or in which gouges do not exceed 25% of the skin gage may be filled.

3) Dents in the nose dome will not adversely affect anti-icing performance.

CAUTION: DO NOT FILL DENTS. REWORK OR REPLACE THE NOSE DOME.

(2) There must be no signs of sheared rivets or loose fasteners within the area of a dent.

(3) There must be no abrupt changes in dent contour.

C. Application of Filling Compound

(1) Smooth out all allowable gouges of the dent with aluminum wool.

(2) Brush alodize per 51-8-0 the dent area in such a manner that the surface so treated, overlaps the dent periphery by not less than .50 inch.

NOTE: Do not apply a paint finish to the dent area.

(3) The dent filling compound consists of 100 parts by weight of Epon 815 (Shell Chemical Corp., New York, N.Y.), 200 parts of Atomized Aluminum, Grade 123 (Aluminum Company of America, Pittsburgh, Pennsylvania), and 20 parts of Curing Agent "T" (Shell Chemical Corp.). Add the Atomized Aluminum to Epon 815 and mix thoroughly. Then add curing agent and mix thoroughly.

WARNING: THESE CHEMICALS CONTAIN TOXIC INGREDIENTS, PROVIDE ADEQUATE VENTILATION AND PROTECT SKIN AND EYES FROM CONTACT WITH UNCURED RESINS OR CURING AGENT. WEAR RUBBER GLOVES OVER COTTON GLOVES FOR PROTECTION OF HANDS. IF SKIN IS EXPOSED TO DIRECT CONTACT WITH UNCURED RESINS OR CURING AGENT, WASH WITH WARM WATER AND SOAP. AVOID THE USE OF SOLVENTS FOR CLEANING SKIN.

(4) Apply filler with a spatula or trowel. Build the filler material slightly higher than the intended finished surface and fair it out over the surrounding alodized area. See figure 1. Use a plastic sheet (polyethylene or equivalent) secured with masking tape to give support to the filler compound during cure, if necessary.

(5) Allow the filler to cure until completely hardened. Cure time is one hour at 130°F.

(6) When thoroughly cured, sand and feather to the original contour and smooth with a disc or "jitterbug" sander. Prime or paint per finish requirements of section 51-2-0 of the 707 Maintenance Manual.

NOTE: Exercise care to prevent sanding through cladding or the removal of structural material around the repair area.

D. Removal of Deicing Boot Dents

(1) Fabricate a 3/4 inch by 1-1/2 inch by 16 inch hardwood block and a 1/2 inch diameter by 16 inch steel rod each having one end rounded.

(2) Restore the general outside contour using the hardwood block to transmit the hammer blows. Use the steel rod to remove any remaining low spots.

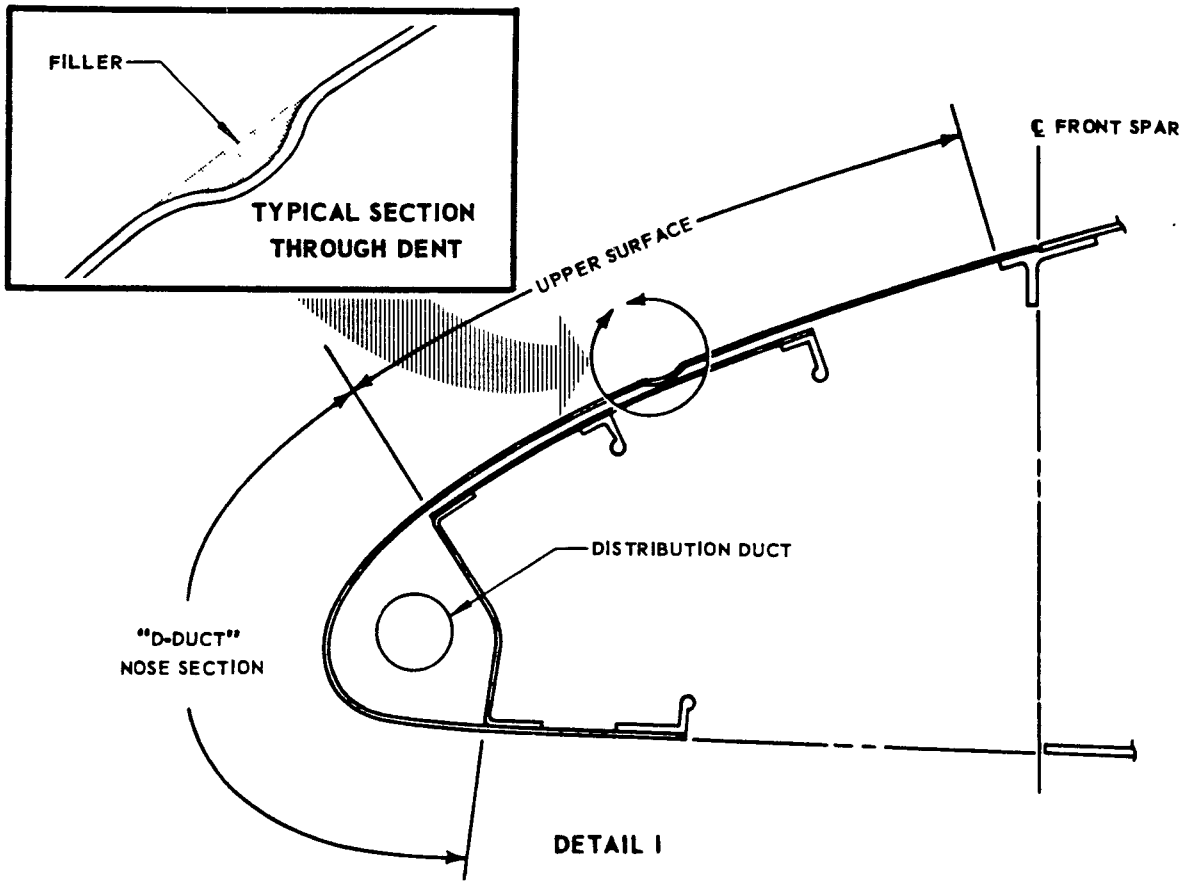
NOTE: Exercise care to avoid bulging beyond the original contour as reworking from the exterior mars the cladding. Use the hardwood block for the majority of the reforming process to minimize scuffing to the skin caused by the steel rod. A back-up block is not required for the reforming process.

(3) Perform a dye check on the cladding after repair to assure that it is free from cracks.

(4) Replace deicing boot per 30-1-61 of the 707 Maintenance Manual if crack is detected in cladding.

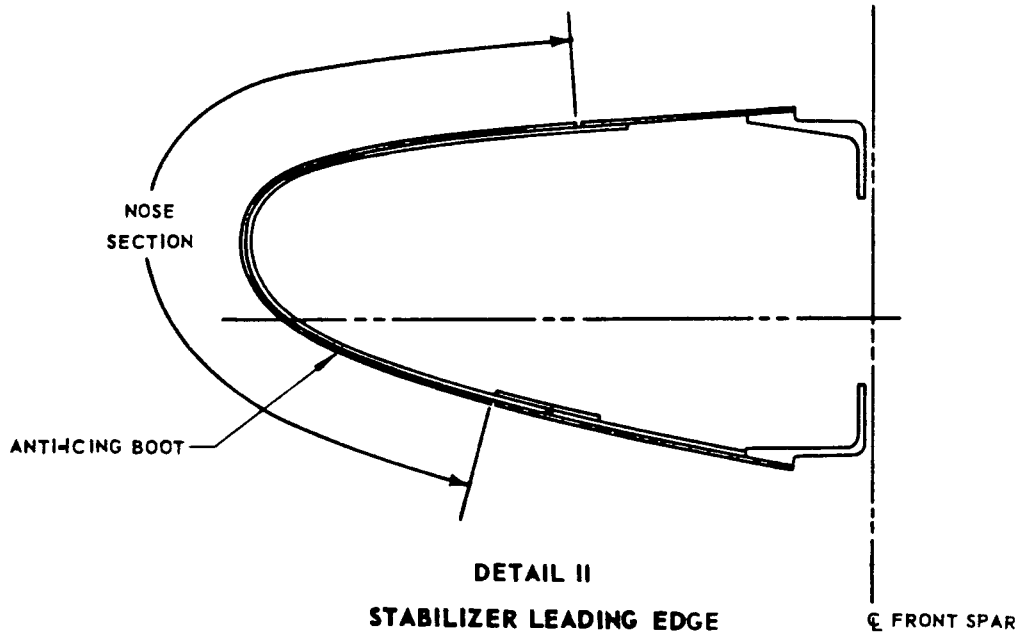
(5) Apply finish if required per 51-2-0 of the 707 Maintenance Manual.

(6) Functionally test boot after the reforming process per 30-1-0 of the 707 Maintenance Manual.



DETAIL I

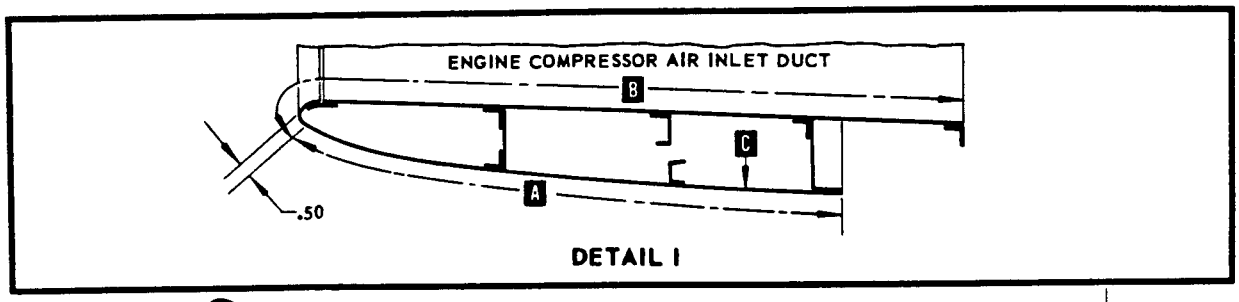
WING LEADING EDGE



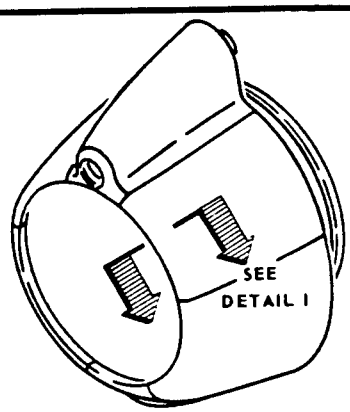
DETAIL II

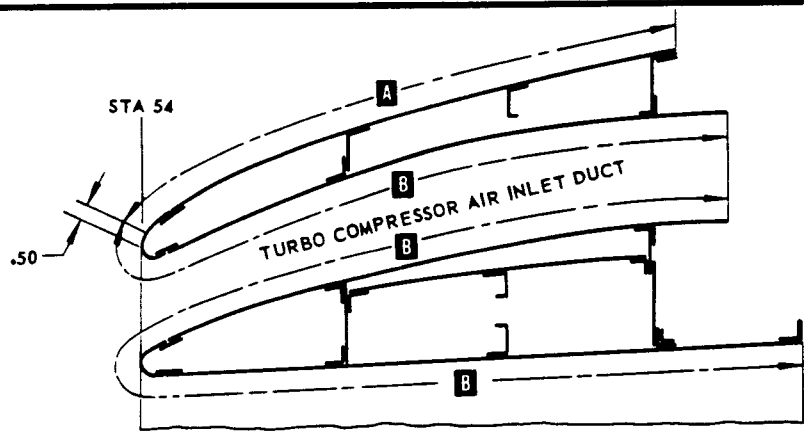
STABILIZER LEADING EDGE

Minor Dent Repair - Wing and Stabilizers Leading Edges
Figure 1



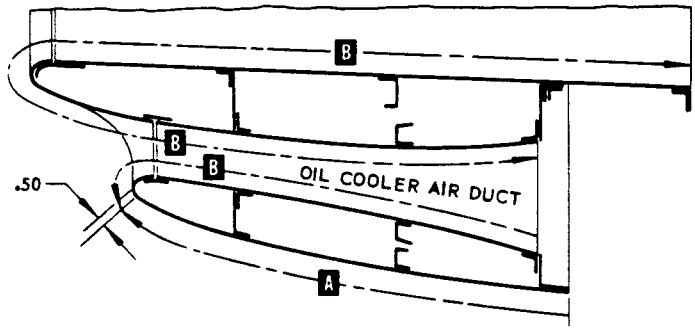
DETAIL I





ENGINE COMPRESSOR AIR INLET DUCT

EFFECTIVITY
JT4 ENGINE



VERTICAL SECTION THROUGH JT4 ENGINE NOSE COWL

NOTE

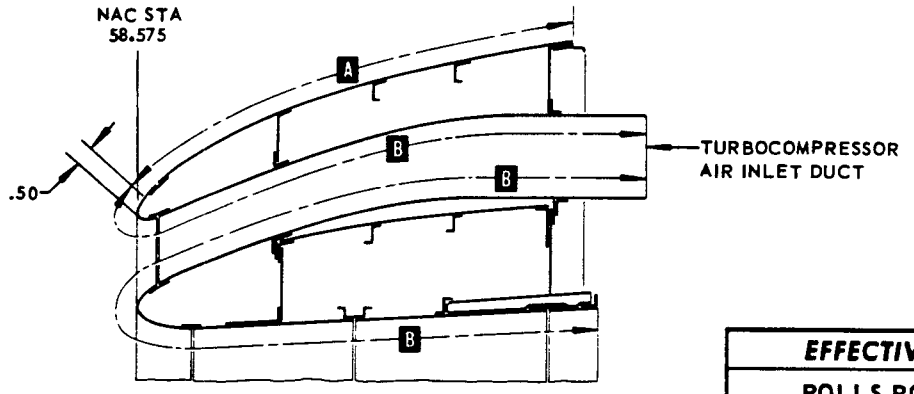
THESE NOTES APPLICABLE TO ALL ENGINES

A REPAIR OF MINOR DENTS BY THE FILLER METHOD IS PERMISSIBLE IN THIS AREA

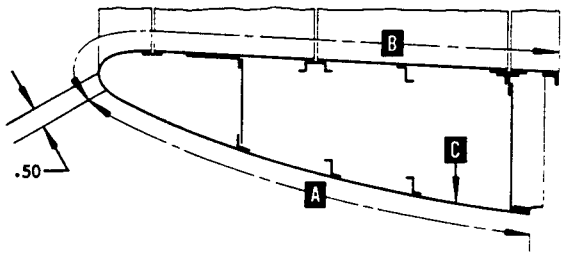
B REPAIR OF MINOR DENTS BY THE FILLER METHOD IS NOT PERMISSIBLE IN THIS AREA

C NOSE COWL OUTER SKIN

Minor Dent Repair - Nacelle Nose Cowl
Figure 2 (Sheet 1 of 2)

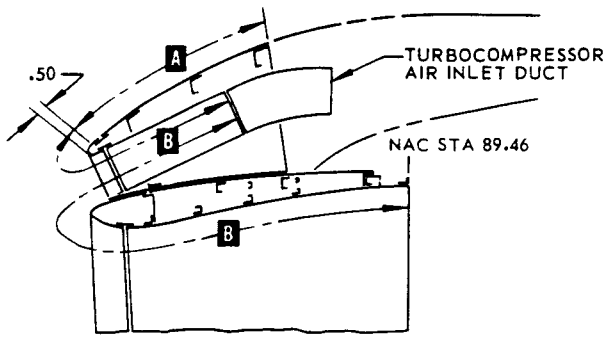


ENGINE COMPRESSOR AIR INLET DUCT



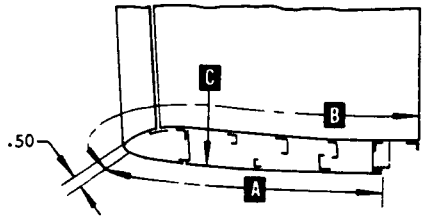
VERTICAL SECTION THROUGH ROLLS-ROYCE
ENGINE NOSE COWL

EFFECTIVITY
ROLLS-ROYCE CONWAY ENGINE



ENGINE COMPRESSOR AIR INLET DUCT

EFFECTIVITY
JT3D (FAN ENGINE)



VERTICAL SECTION THROUGH
FAN ENGINE NOSE COWL

Minor Dent Repair - Nacelle Nose Cowl
Figure 2 (Sheet 2 of 2)

2. Unfilled Dents

A. Unfilled dents will be reflected in reduced performance of an airplane and may tend to raise buffeting or stalling speeds, if located in areas affecting stall characteristics. It is impractical to define dents with respect to sizes, depths, locations, quantities or other criteria in terms of buffeting or stalling speeds. It is more practical to identify the effect of such dents in terms of increased drag by monitoring the performance level of the airplane.

END

NOTES

- THESE WEB REPAIRS ARE NOT APPLICABLE TO WING SPAR WEBS, BEADED PRESSURE WEBS, OR BODY STA 1440 BULKHEAD.
- RESTORE REQUIRED SURFACE FINISH PER 51-2-0 OF THE MAINTENANCE MANUAL.
- BREAK SHARP EDGES 0.03 ALL REPAIR PARTS AND TRIMMED ORIGINAL PARTS.
- APPLY SKYDROL RESISTANCE FINISH PER 51-2-0 OF THE MAINTENANCE MANUAL.
- APPLY SEALANT PER 51-3-0 OF THE MAINTENANCE MANUAL.
- THE USE OF STEEL FASTENERS WITHIN 3.00 FEET OF ANY FLUX GATE COMPASS REQUIRES COMPENSATION TO THE FLUX VALVE PER THE MAINTENANCE MANUAL COMPASS SWING.
- SEE 51-8-0 FOR METAL PROTECTIVE TREATMENT.
- SEE 51-2-0 FOR FASTENER CODE, REMOVAL AND INSTALLATION, HOLE SIZES AND EDGE MARGINS.
- SEE 51-15-0 WHEN THE REPAIR INVOLVES CONTROL SURFACES.

[A] SEE TABLE II FOR ROWS OF RIVETS REQUIRED.

[B] SEE TABLE II FOR RIVET SPACING.

WHEN ORIGINAL MATERIAL IS 7075-T6 USE CLAD 7075-T6 IN NEXT THICKER GAGE.

WHEN ORIGINAL MATERIAL IS 2024-T3 USE CLAD 2024-T3 IN NEXT THICKER GAGE.

WHEN DAMAGE OCCURS IN THE ORIGINAL WEB SPLICE USE NEXT THICKER GAGE.

[C] USE WHEN ORIGINAL WEB IS 0.071 AND GREATER.

[D] TO PREVENT FASTENER DEFLECTION AND CONSEQUENT OVERLOADING OF ADJACENT STRUCTURE, ATTACH FILLER PART [2] TO PART [3] INDEPENDENTLY WITH A SINGLE ROW OF RIVETS WHEN IT EXCEEDS THAT IN TABLE I.

[E] BONDING, IN COMBINATION WITH A REGULAR METAL REPAIR, IS PREFERRED BUT OPTIONAL. BONDED REPAIRS WILL INCREASE THE FATIGUE LIFE OF A REGULAR METAL REPAIR. BOND PER 51-9-1.

[F] DELETED

[G] DELETED

[H] DELETED

SYMBOLS

+ ORIGINAL FASTENER LOCATIONS.

✦ REPAIR FASTENER LOCATIONS.

REPAIR MATERIAL			
PART		QTY	MATERIAL
[1]	PLATE	1	SAME AS ORIGINAL [B]
[2]	FILLER	2	SAME AS ORIGINAL [C]
[3]	PLATE	1	SAME AS ORIGINAL [B]

FASTENER	MAX. GAGE OF PART [2] WITHOUT INDEPENDENT ATTACHMENT
MS20470D4	0.025
MS20470D5	0.032
BACB30FM5	0.040
MS20470D6	0.036
BACB30FM6	0.045
MS20470D8	0.050
BACB30FM8	0.063
MS20470D10	0.063
BACB30FM10	0.080

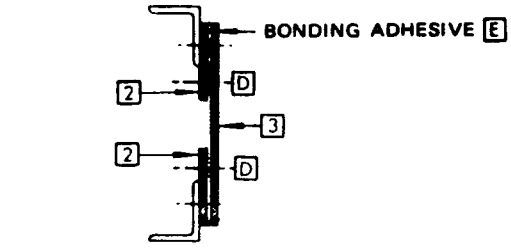
TABLE I

Typical Web Repair
Figure 1 (Sheet 1)

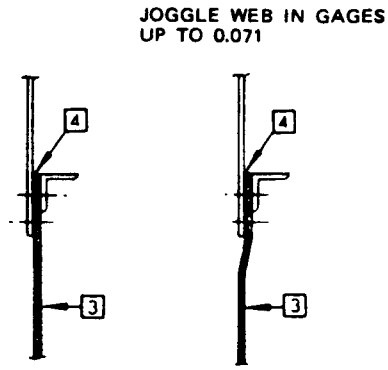
GAGE OF ORIGINAL WEB		RIVETED MATERIAL																
		2024-T3								7075-T6								
		TYPE OF FASTENERS								TYPE OF FASTENERS								
		AN470-D					HS52P			AN470-D					HS52P			
		1/8	5/32	3/16	1/4	5/16	3/16	1/4	5/16	1/8	5/32	3/16	1/4	5/16	3/16	1/4	5/16
.020	A REQD ROWS									1	1						
	B MIN									.41	.51						
	B MAX									.59	.74						
.027	A REQ'D ROWS									1	1						
	B MIN									.41	.51						
	B MAX									.57	.72						
.025	A REQ'D ROWS	1								1	1						
	B MIN	.43								.41	.51						
	B MAX	.58								.56	.70						
.028	A REQ'D ROWS	1								1	1						
	B MIN	.43								.41	.51						
	B MAX	.54								.55	.67						
.032	A REQ'D ROWS	1	1							1	1	1					
	B MIN	.43	.54							.41	.51	.62					
	B MAX	.51	.66							.53	.66	.80					
.036	A REQ'D ROWS	1	1							1	1	1					
	B MIN	.43	.54							.41	.51	.62					
	B MAX	.51	.63							.45	.63	.77					
.040	A REQ'D ROWS	1	1	1						2	1	1	1				
	B MIN	.43	.54	.65						.41	.51	.62	.82				
	B MAX	.46	.61	.74						.80	.62	.75	1.00				
.045	A REQ'D ROWS	2	1	1						2	1	1	1				
	B MIN	.43	.54	.65						.41	.51	.62	.62				
	B MAX	.80	.60	.72						.68	.52	.72	1.00				
.050	A REQ'D ROWS	2	1	1	1					2	2	1	1				
	B MIN	.43	.54	.65	.86					.41	.51	.62	.82				
	B MAX	.70	.55	.70	94					.58	.92	.66	.89				
.056	A REQ'D ROWS	2	2	1	1							2	1		1	1	
	B MIN	.43	.54	.65	.86							.62	.82		.62	.82	
	B MAX	.60	.74	.67	.90							1.14	.89		.67	.90	
.063	A REQ'D ROWS	2	2	2	1	1						2	1	1	1	1	
	B MIN	.43	.54	.65	.86	1.07						.62	.82	1.02	.62	.82	
	B MAX	.52	.80	1.15	.88	1.09						.94	.84	1.05	.64	.90	
.071	A REQ'D ROWS		2	2	2	1	2					2	2	1	2	1	
	B MIN		.54	.65	.86	1.07	.65					.62	.82	1.02	.62	.82	
	B MAX		.70	1.00	1.70	1.07	1.28					.82	1.48	1.04	1.24	90	
.080	A REQ'D ROWS		2	2	2	2	2	2				2	2	2	2	1	
	B MIN		.54	.65	.86	1.07	.65	.86				.62	.82	1.02	.62	.82	
	B MAX		.60	.86	1.50	2.04	1.22	1.62				.70	1.27	1.96	1.20	.90	
.090	A REQ'D ROWS			2	2	2	2	2				2	2	2	2	1	
	B MIN			.65	.86	1.07	.65	.86				.62	.82	1.02	.62	.82	
	B MAX			.72	1.30	1.98	1.18	1.58				.62	1.10	1.70	1.17	.90	
.100	A REQ'D ROWS			3	2	2	2	2	2				3	3	2	2	2
	B MIN			.89	1.17	1.47	.89	1.17	1.47				1.34	1.68	1.02	1.34	1.68
	B MAX			1.05	1.25	1.92	1.25	1.68	2.08				1.47	2.30	1.04	1.36	1.82
.112	A REQ'D ROWS			3	3	2	2	2	2				3	3	3	2	2
	B MIN			.89	1.17	1.47	.89	1.17	1.47				1.34	1.68	1.02	1.34	1.68
	B MAX			.94	1.67	1.74	1.25	1.67	2.08				1.34	2.05	1.46	1.34	1.82
.125	A REQ'D ROWS				3	2	2	2	2					3	3	2	2
	B MIN				1.17	1.47	.89	1.17	1.47					1.68	1.02	1.34	1.68
	B MAX				1.50	1.56	1.22	1.67	2.08					1.84	1.69	1.34	1.70
.140	A REQ'D ROWS				3	3	2	2	2						3	2	2
	B MIN				1.17	1.47	.89	1.17	1.47						1.02	1.34	1.68
	B MAX				1.34	2.08	1.13	1.67	2.08						1.60	1.37	1.70
.160	A REQ'D ROWS				3	3	2	2	2						3	2	2
	B MIN				1.17	1.47	.89	1.17	1.47						1.02	1.34	1.68
	B MAX				1.17	1.82	1.00	1.66	2.08						1.40	1.46	1.75
.180	A REQ'D ROWS					3	2	2	2						3	2	2
	B MIN					1.47	.89	1.17	1.47						1.02	1.34	1.68
	B MAX					1.62	.92	1.50	2.08						1.25	1.47	1.75
.190	A REQ'D ROWS					3	2	2	2						3	2	2
	B MIN					1.47	.89	1.17	1.47						1.02	1.34	1.68
	B MAX					1.54	.89	1.46	2.08						1.18	1.40	1.78
.200	A REQ'D ROWS						3	2	2						3	2	2
	B MIN						.89	1.17	1.47						1.02	1.34	1.68
	B MAX						1.29	1.40	2.08						1.12	1.34	1.82
.224	A REQ'D ROWS						3	2	2							3	2
	B MIN						.89	1.17	1.47							1.34	1.68
	B MAX						1.20	1.29	1.90							1.78	1.68
.250	A REQ'D ROWS						3	2	2							3	3
	B MIN						.89	1.17	1.47							1.34	1.68
	B MAX						1.10	1.20	1.75							1.60	2.25

TABLE II

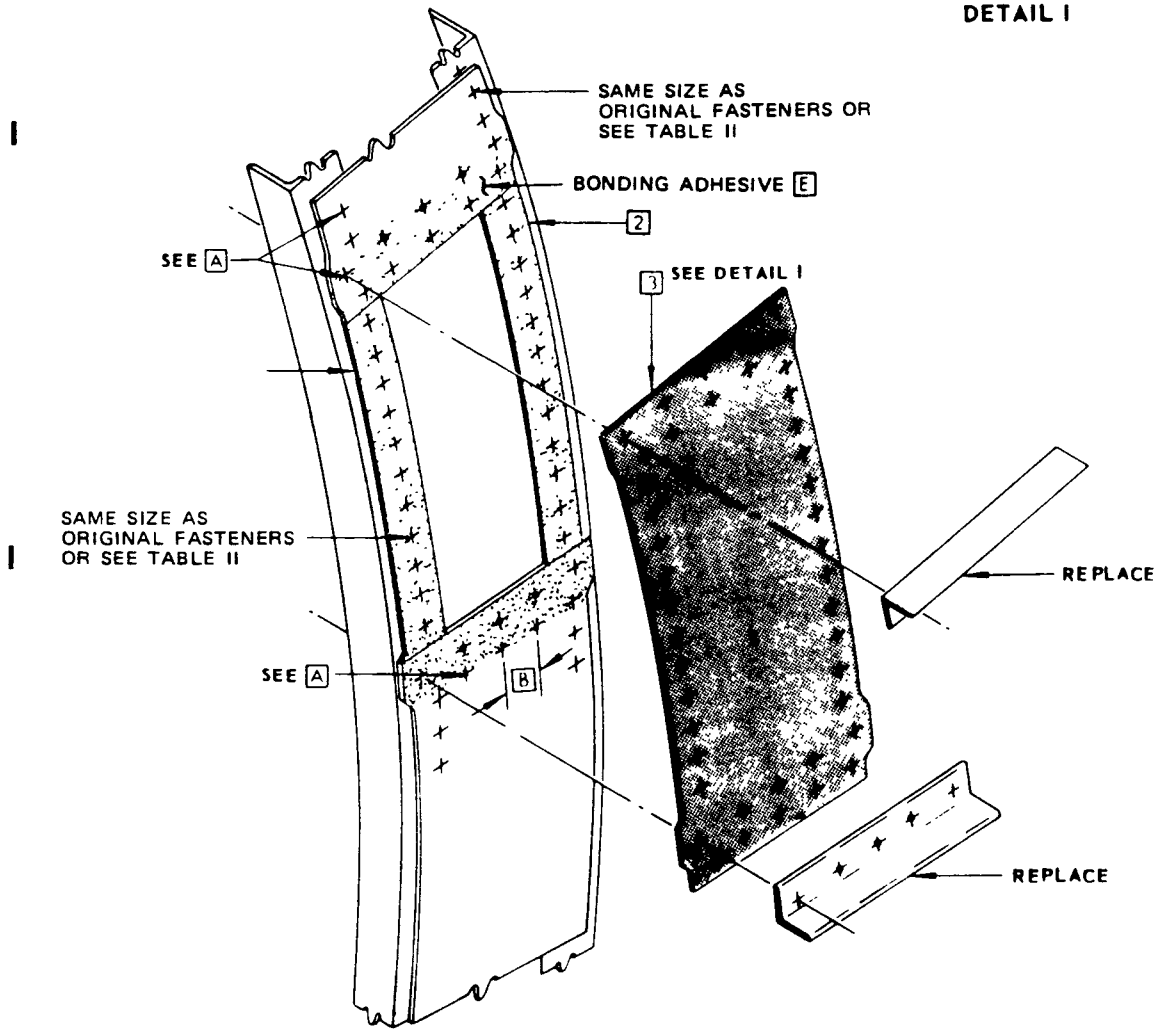
Typical Web Repair
Figure 1 (Sheet 2)



SECTION THROUGH REPAIR
FOR GAGES 0.071 AND GREATER

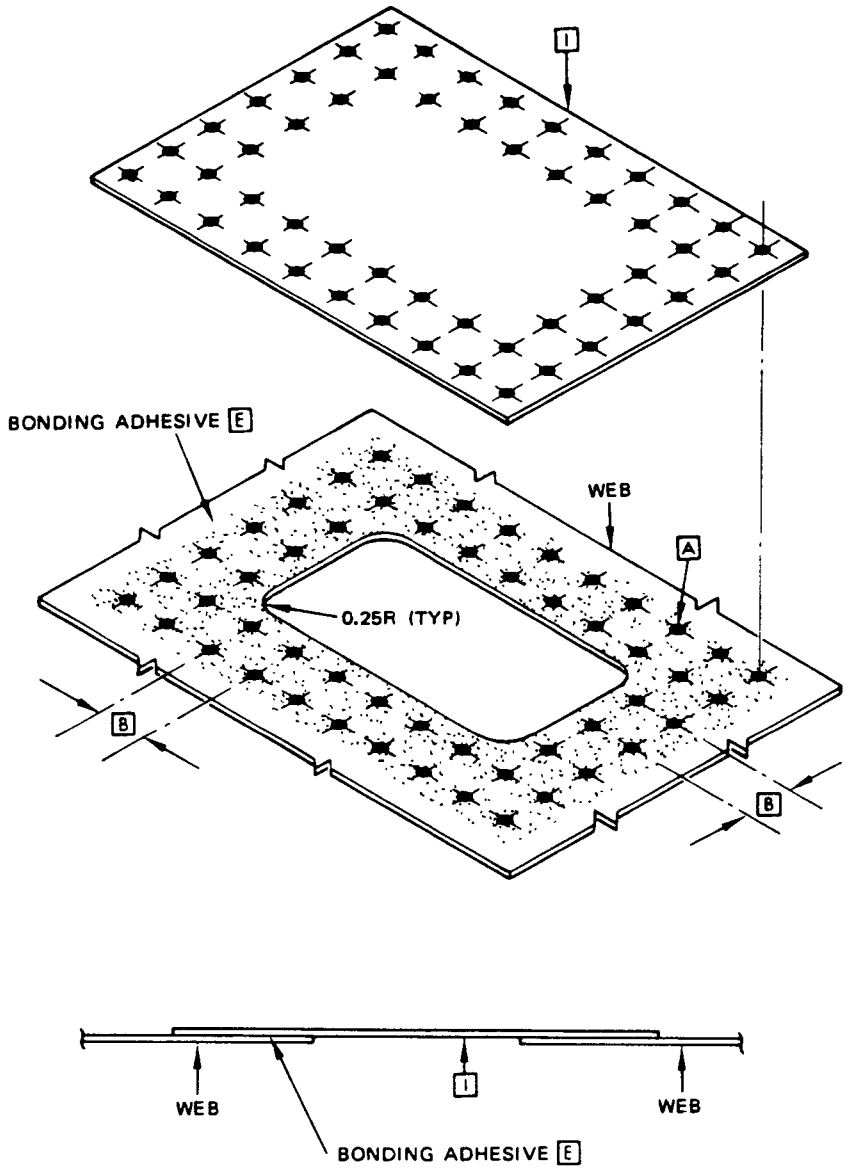


DETAIL I



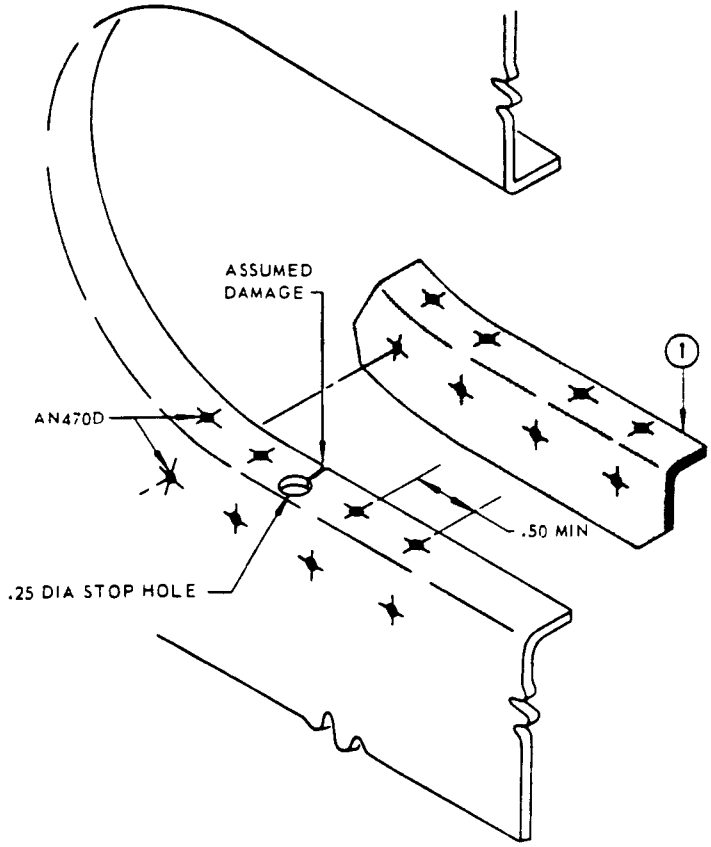
REPAIR OF WEB BY LAP SPLICE

Typical Web Repair
Figure 1 (Sheet 3)



SECTION THROUGH REPAIR

Typical Web Repair
Figure 1 (Sheet 4)



REPAIR INSTRUCTIONS:

1. This repair is limited to materials up to .064 thick. Damage is assumed as a crack in the flange of the lightening hole only. This repair is not applicable if the crack extends beyond the flange tangent point into the bend radius.
2. Stop drill 1 4 Dia. at end of crack.
3. Prepare repair angle and predrill angle and web.
4. Repair angle material and gage to be same as web.
5. Protective treat parts per 51-8-0.
6. Install repair plate using AN470D rivets. Use 5/32 Dia. rivets in material up to .040 gage, 3/16 from .040 to .064. Minimum spacing between rivets .50.
7. Restore original finish in repair area per 51-2-0 of the Maintenance Manual.

REPAIR MATERIAL			
PART		QTY.	MATERIAL
1	ANGLE	1	SAME AS ORIGINAL

NOTE

BREAK SHARP EDGES 0.03 ALL REPAIR PARTS AND TRIMMED ORIGINAL PARTS

SEE 51-2-0 FOR FASTENER CODE, REMOVAL AND INSTALLATION, HOLE SIZES AND EDGE MARGINS

SEE 51-15-0 WHEN THE REPAIR INVOLVES CONTROL SURFACES.

⊕ REPAIR FASTENER LOCATIONS

Cracked Lightening Hole Flange Repair
Figure 2

NOTE

- USE SAME MATERIAL AS ORIGINAL
- USE SAME GAGE AS ORIGINAL IF REPAIR IS APPLIED TO OUTSIDE
- WHEN THE REPAIR IS APPLIED TO THE INSIDE OF THE SECTION, USE ONE GAGE HEAVIER IF THE FLANGE IS EQUAL TO OR GREATER THAN DIMENSION "F"
- USE TWO GAGES HEAVIER IF FLANGE IS LESS THAN DIMENSION "F"
- DO NOT USE LESS THAN THREE RIVETS IN A ROW
- "D" DENOTES DIAMETER OF FASTENER HOLES
- SEE 51-2-0 FOR FASTENER CODE, REMOVAL AND INSTALLATION, HOLE SIZES AND EDGE MARGINS
- SEE 51-8-0 FOR METAL PROTECTIVE TREATMENT. RESTORE REQUIRED SURFACE FINISH PER 51-2-0 OF THE MAINTENANCE MANUAL
- SEE 51-15-0 WHEN THE REPAIR INVOLVES CONTROL SURFACES
- THE USE OF STEEL FASTENERS WITHIN 3.00 FEET OF ANY FLUX GATE COMPASS REQUIRES COMPENSATION TO THE FLUX VALVE PER THE MAINTENANCE MANUAL COMPASS SWING

✦ REPAIR FASTENER LOCATIONS

[A] DAMAGE MUST NOT PENETRATE INTO RADIUS

[B] USE ORIGINAL RIVET LOCATIONS WHERE FLANGES WERE ATTACHED, OTHERWISE USE SPACING IN TABLE

[C] SEE TABLE

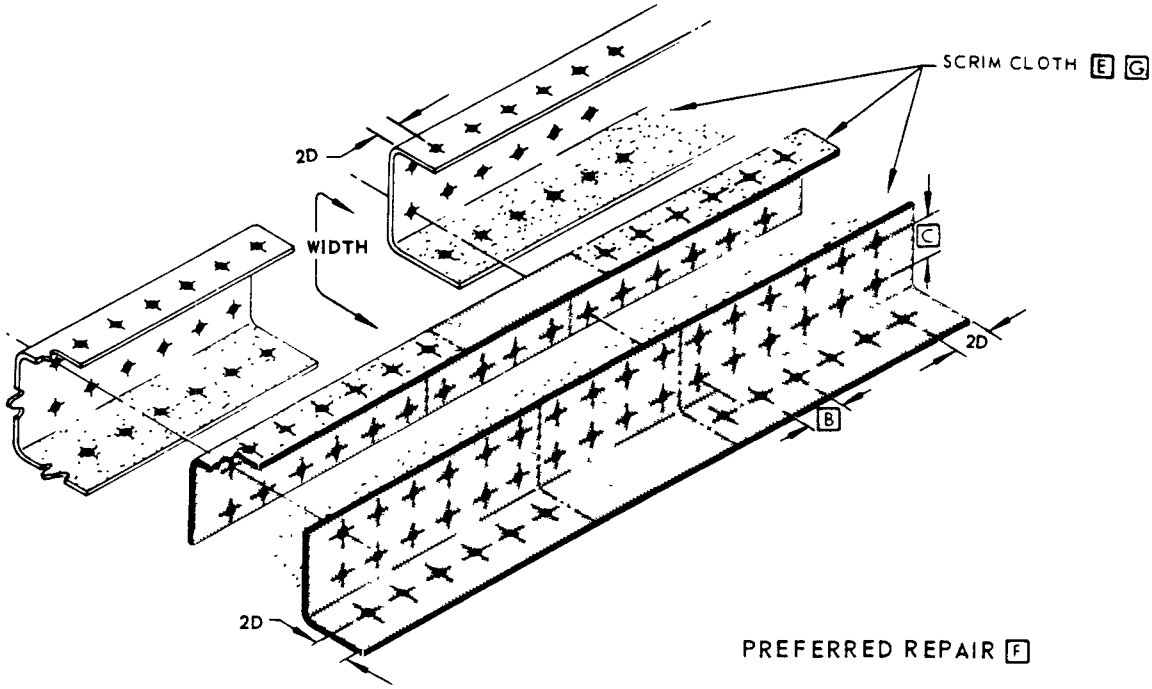
[D] SEE PREFERRED REPAIR

[E] THALCO NO. 196
THALCO GLASS CLOTH FIBER PRODUCTS
LOS ANGELES, CALIFORNIA

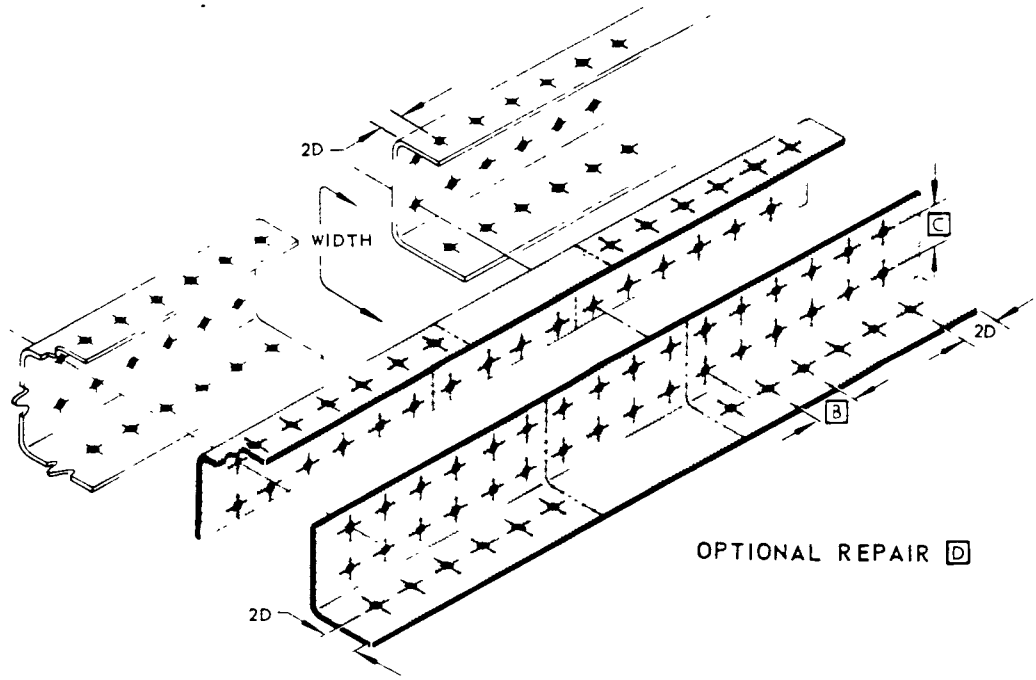
[F] BOND PER 51-9-1

[G] SCRIM CLOTH IS NOT REQUIRED WHEN BONDING PER 51-9-1 DATED MAY 5/70 IS EMPLOYED. EXISTING BONDED REPAIRS WHICH UTILIZED SCRIM CLOTH ARE SATISFACTORY AND NEED NOT BE REWORKED

GAGE	DIM. "F"
.025	.30
.028	.30
.032	.35
036	.45
.040	45
.045	.55
.050	.65
.056	.65
.063	.70
071	.85
.080	.95
090	1.15
100	1.25
112	1.30
125	1.60
140	1.65



PREFERRED REPAIR F



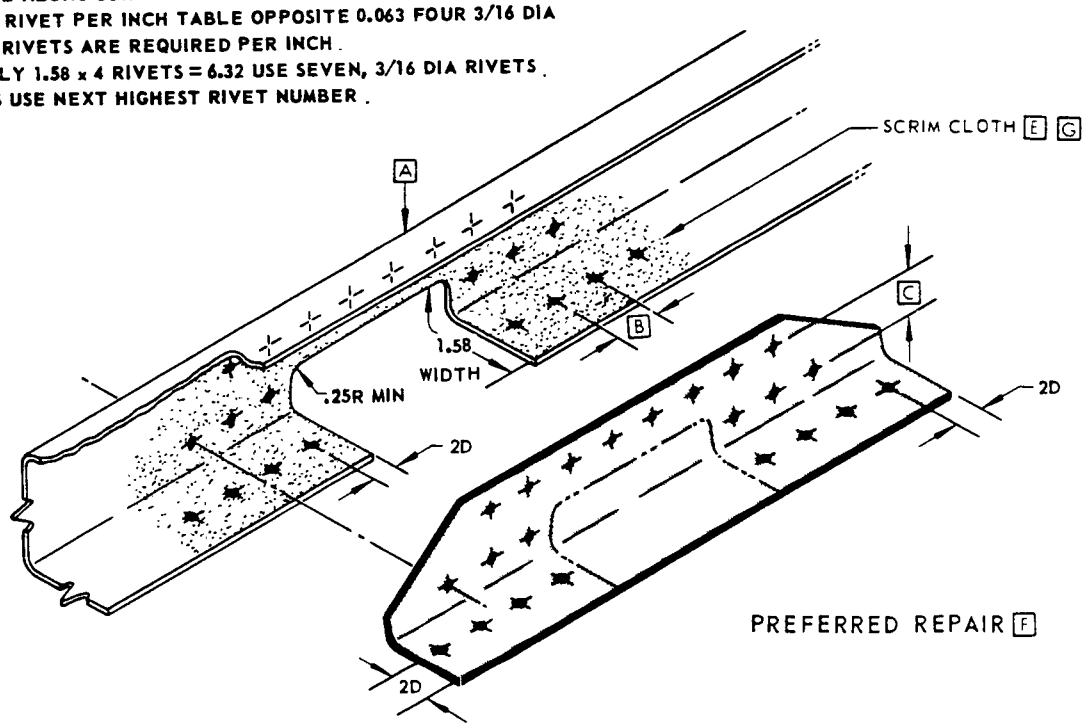
OPTIONAL REPAIR D

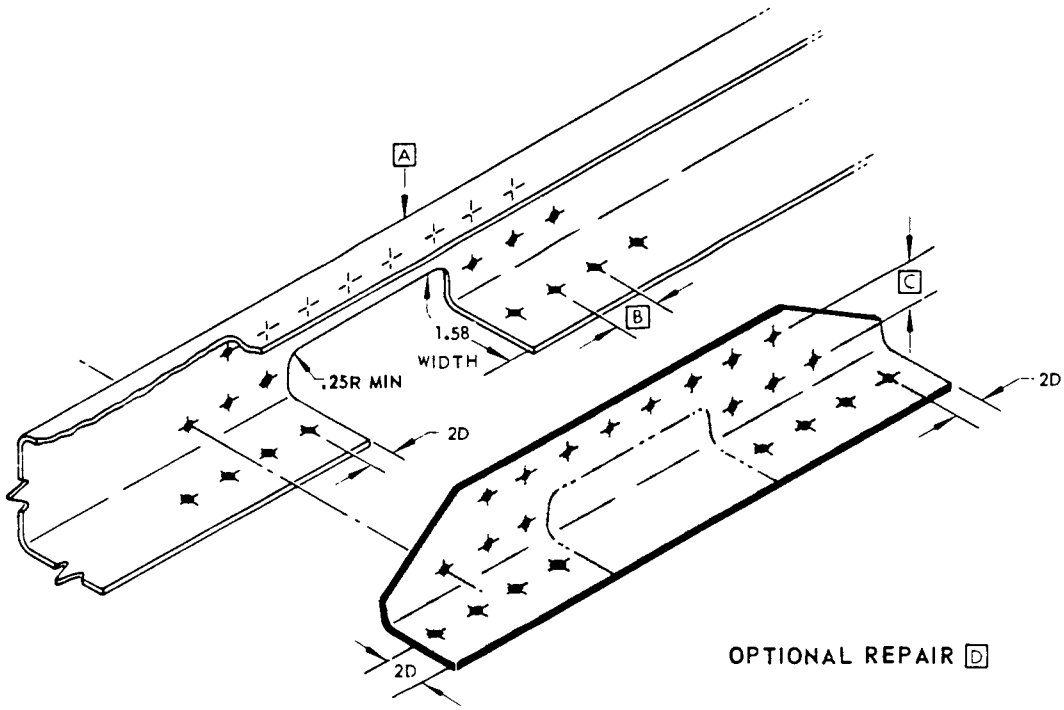
REPAIR OF COMPLETELY SEVERED MEMBER

Typical Formed Section Repair
Figure 1 (Sheet 2 of 6)

EXAMPLE

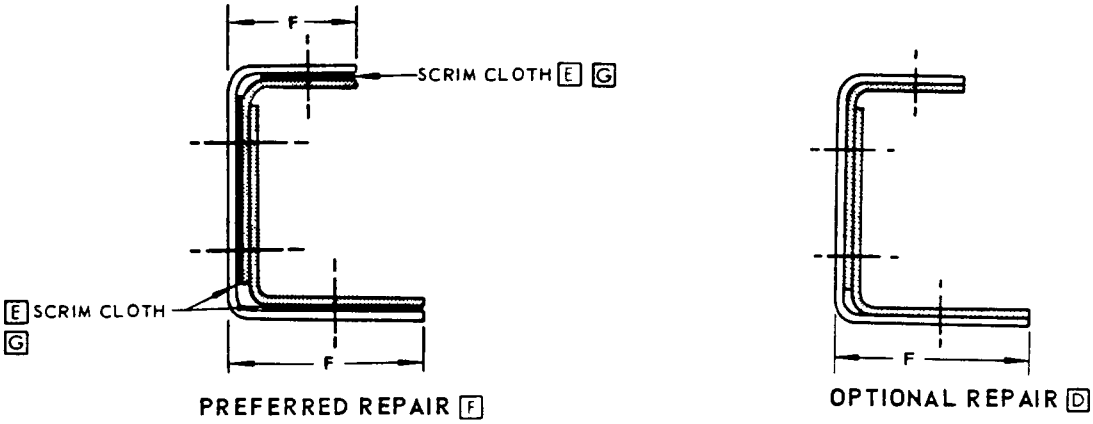
ASSUME DAMAGE IN 0.063 CHANNEL, 7075-T6 MATERIAL.
MEASURE ALONG SURFACE AND FIND WIDTH OF DAMAGE 1.58.
FIND IN RIVET PER INCH TABLE OPPOSITE 0.063 FOUR 3/16 DIA AN470D RIVETS ARE REQUIRED PER INCH.
MULTIPLY 1.58 x 4 RIVETS = 6.32 USE SEVEN, 3/16 DIA RIVETS.
ALWAYS USE NEXT HIGHEST RIVET NUMBER.





REPAIR OF DAMAGED MEMBER

Typical Formed Section Repair
Figure 1 (Sheet 3 of 6)



PREFERRED REPAIR F

OPTIONAL REPAIR D

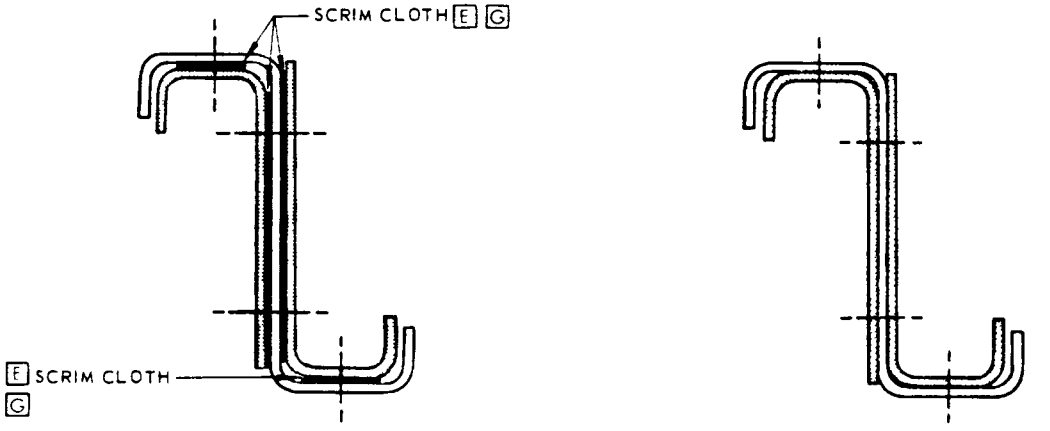
CHANNEL REPAIR



PREFERRED REPAIR F

OPTIONAL REPAIR D

ANGLE REPAIR



PREFERRED REPAIR F

OPTIONAL REPAIR D

ZEE SECTION REPAIR

Typical Formed Section Repair
Figure 1 (Sheet 4 of 6)

RIVET PER INCH WIDTH TABLE -7075-T6 RIVETED MATERIAL

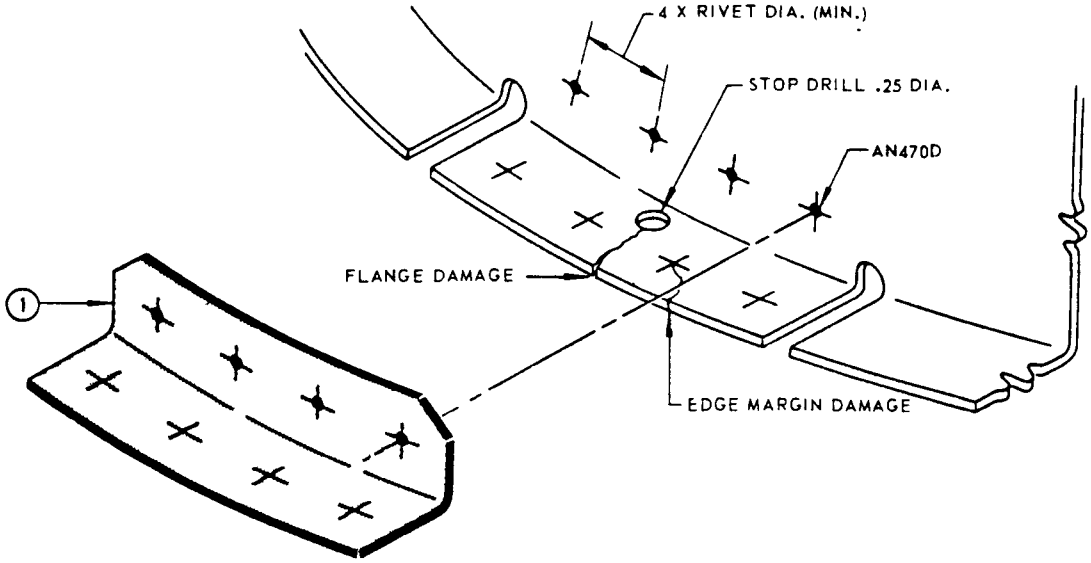
SHEET GAGE	UNIVERSAL HEAD						PROTRUDING HEAD			100° COUNTERSUNK HEAD							
	AN470D - RIVET 2017 - T3						STEEL FASTENER 160,000 HT			AN426D OR BAC-R15CE					STEEL FASTENER 160,000 HT		
		1/8	5/32	3/16	1/4	5/16	3/16	1/4	5/16			3/16	1/4	5/16	3/16	1/4	5/16
.016		5	4														
.018		5	4														
.020		5	4														
.022		5	4														
.025		5	4														
.028		5	4														
.032		5	4	3													
.036		5	4	3													
.040			4	3								4					
.045			4	3								5					
.050			5	3	3		3	3				5	4		3	3	
.056			5	4	3		3	3				5	4		3	3	
.063				4	3	2	3	3	2			5	4	3	3	3	2
.071				5	3	2	3	3	2			5	4	3	3	3	2
.080				5	3	2	3	3	2				4	3	4	3	2
.090					3	2	3	3	2				4	3	4	3	2
.100					4	3	3	3	2				4	3	4	3	2
.112					4	3	3	3	2				4	3	4	3	2
.125					5	3	3	3	2				5	3	4	3	2
.140					5	3	4	3	2				5	3	4	3	2
.160						4	4	3	2					4	4	3	2
.180						4	4	3	2					4	4	3	2

RIVET PER INCH WIDTH TABLE- 2024-T4, 2024-T3 RIVETED MATERIAL

SHEET GAGE	UNIVERSAL HEAD						PROTRUDING HEAD			100° COUNTERSUNK HEAD							
	AN470D-RIVET 2017 - T3						STEEL FASTENER 160,000 HT			AN426D OR BAC-R15CE					STEEL FASTENER 160,000 HT		
		1/8	5/32	3/16	1/4	5/16	3/16	1/4	5/16	1/8	5/32	3/16	1/4	5/16	3/16	1/4	5/16
.020																	
.022																	
.025		4															
.028		4															
.032		5	4														
.036		5	4														
.040		5	4	3			3				5	4					
.045		5	4	3			3				5	4					
.050			4	3	3		3	3			5	4	4		3	3	
.056			4	3	3		3	3			5	4	4		3	3	
.063			5	3	3	2	3	3	2		5	4	4	2	3	3	2
.071			5	4	3	2	3	3	2		5	5	4	2	3	3	2
.080				4	3	2	3	3	2		6	5	4	2	3	3	2
.090				5	3	2	3	3	2			5	4	3	3	3	2
.100				5	3	2	3	3	2			5	4	2	3	3	2
.112					3	2	3	3	2				4	3	3	3	2
.125					4	3	3	3	2				4	3	3	3	2
.140					4	3	3	3	2				4	3	3	3	2
.160					5	3	3	3	2				5	3	3	3	3
.180					5	4	4	3	2				5	4	4	3	3

RIVET AND BOLT SPACING																		
SHEET	3/32			1/8			5/32			3/16			1/4			5/16		
	B		C	B		C	B		C	B		C	B		C	B		C
GAGE	MIN	MAX	MIN	MIN	MAX	MIN	MIN	MAX	MIN	MIN	MAX	MIN	MIN	MAX	MIN	MIN	MAX	MIN
.016	.50	.50	.56	.50	.50	.75												
.018	.50	.50	.56	.50	.50	.75												
.020	.50	.50	.56	.50	.50	75												
.022	.50	.50	.56	.50	.50	.75												
.025	.50	.50	.56	.50	.50	.75												
.028	.50	.50	.56	.50	.50	.75												
.032	.50	.55	.56	.50	.55	75	.50	.55	.93	.60	.60	1.12	.75	.75	1.50			
.036				.50	.55	.75	.50	.55	.93	.60	.60	1.12	.75	.75	1.50			
.040				.50	.65	.75	.50	.65	.93	.60	.65	1.12	.75	.75	1.50			
.045				.50	.75	.75	.50	.75	.93	.60	.75	1.12	.75	.75	1.50			
.050				.50	.85	.75	.50	.85	.93	.60	.85	1.12	.75	.85	1.50	.93	.93	1.87
.056				.50	.95	.75	.50	95	.93	.60	.95	1.12	.75	.95	1.50	.93	.95	1.87
.063				.50	1.05	.75	.50	1.05	.93	.60	1.05	1.12	.75	1.05	1.50	.93	1.05	1.87
.071							.50	1.20	.93	.60	1.20	1.12	.75	1.20	1.50	.93	1.20	1.87
.080							.50	1.35	.93	.60	1.35	1.12	.75	1.35	1.50	.93	1.35	1.87
.090							.50	1.50	.93	.60	1.50	1.12	.75	1.50	1.50	.93	1.50	1.87
.100										.60	1.70	1.12	.75	1.70	1.50	.93	1.70	1.87
.112										.60	1.90	1.12	.75	1.90	1.50	.93	1.90	1.87
.125										.60	2.15	1.12	.75	2.15	1.50	.93	2.15	1.87
.140										.60	2.37	1.12	.75	2.37	1.50	.93	2.37	1.87
.160										.60	2.60	1.12	.75	2.60	1.50	.93	2.60	1.87
.180										.60	2.96	1.12	.75	2.96	1.50	.93	2.96	1.87

Typical Formed Section Repair
Figure 1 (Sheet 6 of 6)



REPAIR MATERIAL			
PART		QTY.	MATERIAL
1	ANGLE	1	SAME AS ORIGINAL

REPAIR INSTRUCTIONS:

1. This repair is limited to material of .081 thickness or less.
2. Damage is assumed as a crack in the tab flange.
3. Stop drill crack 1/4 Dia. if crack does not terminate in a rivet hole.
4. Repair angle is to be same material and gage as existing material.
5. Prepare repair part and drill. Fasteners in the web are to be spaced minimum of 4 times rivet diameter. Diameter of repair fastener is to be one size larger than those in the tab flange, and the same number of fasteners shall be used in the web as in the tab flange, with a minimum of three fasteners.
6. Protective treat parts per 51-8-0.
7. Install parts using AN470D rivets in web. Replace original fasteners in tab flange.
8. Restore original finish in repair area per 51-2-0 of the 707 Maintenance Manual.

NOTE

SEE 51-2-0 FOR FASTENER CODE, REMOVAL AND INSTALLATION, HOLE SIZES AND EDGE MARGINS.

+ ORIGINAL FASTENER LOCATIONS

+ REPAIR FASTENER LOCATIONS

BREAK SHARP EDGES 0.03 ALL REPAIR PARTS AND TRIMMED ORIGINAL PARTS

Tab Flange Repair
Figure 2

REPAIR INSTRUCTIONS

1. Cut out damaged portion of extrusion in such a manner that fastener edge margin is maintained.
2. Break all sharp edges and corners of cleaned out damage area and remove all scratches.
3. Select repair parts and fasteners in the manner shown in preferred or alternate repair examples. Repair fasteners should be the smallest dia. possible consistent with the structure involved, and no more than 1/32" dia. larger than existing fasteners in the comparable flange. Fastener holes should remove no more than 20% of the cross sectional area.

REPAIR MATERIAL

ORIGINAL EXTRUSION MATERIAL							
		2024-T4		7075-T6		7178-T6	
PART		QTY	MATERIAL	QTY	MATERIAL	QTY	MATERIAL
(1)	EXTRUDED SECTION		MAKE FROM "AND" EXTRUSION 2024-T4, 7075-T6 OR 7178-T6				
(2)	FILLER OR PLATE		2024-T3 CLAD OR BARE		7075-T6		7178-T6
(3)	FORMED SECTION		2024-0 HT-T4		7075-6 HT-T6		7178-0 HT-T6

NOTE

- SEE 51-15-0 WHEN THE REPAIR INVOLVES CONTROL SURFACES.
- EXTRUSION REPAIRS MADE WITH "AND" EXTRUDED SECTIONS ARE PREFERRED.
- REPAIRS SHOWN ARE FOR CONSTANT SECTION EXTRUSIONS.
- THESE REPAIRS DO NOT APPLY TO THE WING INTERSPAR STRINGERS.
- SEE 51-2-0 FOR FASTENER CODE, REMOVAL AND INSTALLATION, HOLE SIZES AND EDGE MARGINS.
- SEE 51-8-0 FOR METAL PROTECTIVE TREATMENT.
- FINISH PER 51-2-0 OF THE MAINTENANCE MANUAL.
- IT IS MANDATORY THAT REPAIR PARTS USED FOR SPANWISE BEAM STIFFENERS OR F.S. STIFFENERS IN THE WING CENTER SECTION, HAVE ROUNDED CORNERS AND EDGES (RADIUS EQUAL TO GAGE, MINIMUM) IF THEY CONTACT A FUEL CELL.
- THE USE OF STEEL FASTENERS WITHIN 3.00 FEET OF ANY FLUX GATE COMPASS REQUIRES COMPENSATION TO THE FLUX VALVE PER THE MAINTENANCE MANUAL COMPASS SWING.

[A] FASTENER SPACING ON FIXED LEG TO BE SAME AS ORIGINAL.

[B] FASTENER SPACING AS SHOWN IN TABLE IV OR SAME AS [A]

[C] FASTENER SPACING AS SHOWN IN TABLE IV. IF THIS MINIMUM CANNOT BE HELD, STAGGER FASTENERS AS SHOWN PICTORIALLY ON SHEET 2.

[D] EQUAL TO OR NEXT GAGE GREATER.

[E] RADIUS TO SUIT.

[F] FOR FASTENER SIZE AND NUMBER SEE TABLES I, II, AND III.

[K] CHAMFER TO SUIT RADIUS.

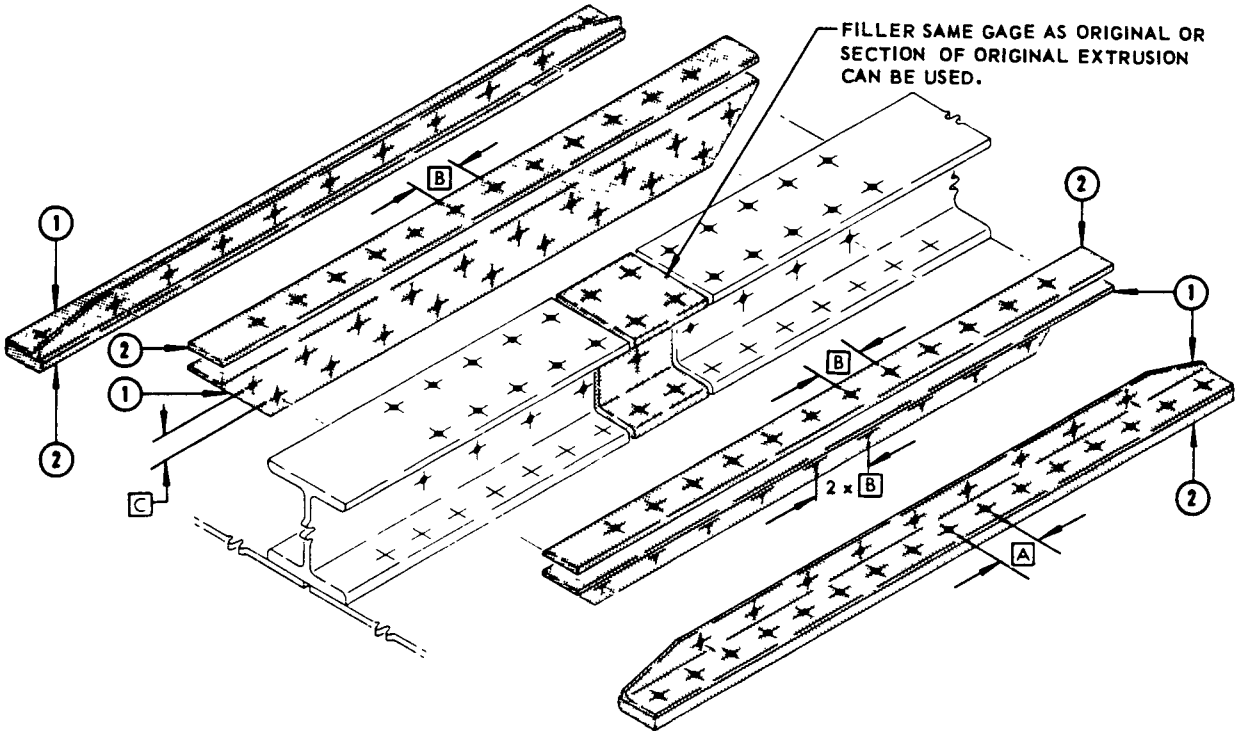
[L] RADIUS AND/OR TAPER TO SUIT EXTRUSION.

[M] IF ANGLE RADIUS INTERFERES WITH RIVETING, INSTALL RADIUS FILLERS AS IN "ZEE" REPAIR.

[N] MINIMUM THICKNESS AT CHAMFER SHOULD NOT BE LESS THAN THICKNESS OF EXTRUSION.

Typical Extruded Section Repair
Figure 1 (Sheet 1 of 6)

PREFERRED REPAIR EXAMPLE



ASSUME A DAMAGED 7075-T6 EXTRUDED "I" SECTION

1. Determine gage of 7075-T6 repair angles for T = 0.130, 1/2 T = 0.065. Select "AND" section having thickness equal to or next gage greater than 1/2 T. AND 10138-1303 section with 0.078 thick flanges can be trimmed to suit.

2. Determine gage of 7075-T6 radius filler for H = 0.188. Select plate equal to or next gage greater than H. Next greater gage is 0.190.

3. Determine gage of 7075-T6 radius filler for G = 0.250. Gage equal to or next greater is 0.250.

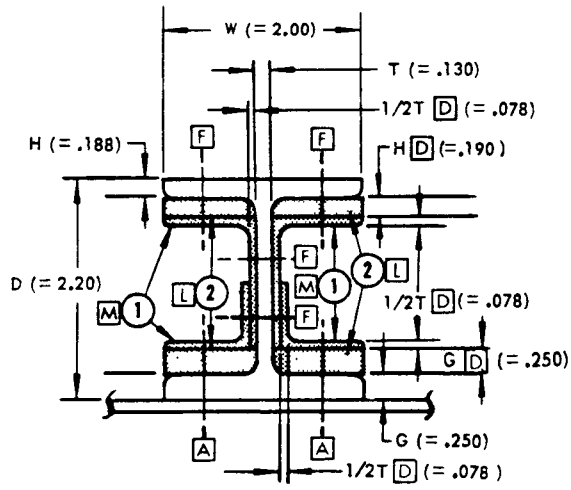
4. To determine number of fasteners required for 7075-T6 extrusion refer to table II. For 0.188 thick flange find opposite 0.190 (next higher gage) five 3/16 diameter steel fasteners per inch width.

   5 x 2.00 flange width = 10 fasteners each side of damaged area (min).

   For 0.130 thick web find opposite 0.140 (next higher gage) four 3/16 diameter steel fasteners.

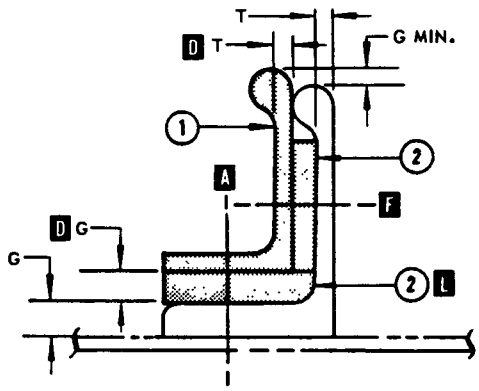
   4 x (2.20 - 0.188 - 0.250) = 4 x 1.76 = 7.04. Use eight fasteners each side of damaged area (min).

   For 0.250 thick flange find opposite 0.250. Seven 3/16 diameter steel fasteners. 7 x 2.00 flange width = 14 fasteners. (or use 4 x 2.00 = 8 1/4 diameter steel fasteners) each side of damaged area (min).

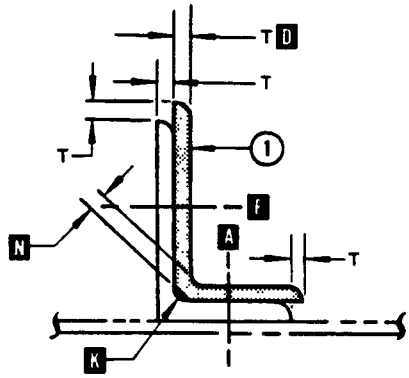


SECTION ADJACENT TO DAMAGE

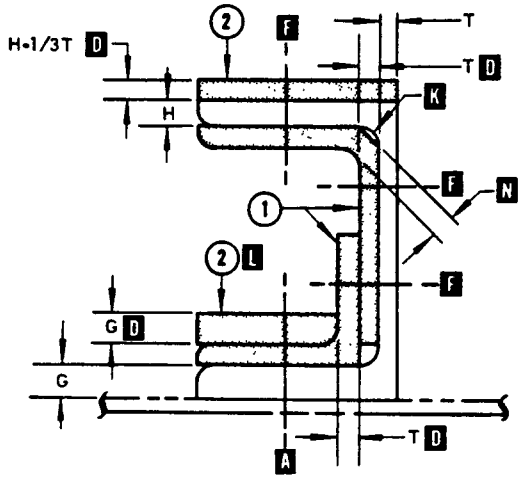
Typical Extruded Section Repair
Figure 1 (Sheet 2 of 6)



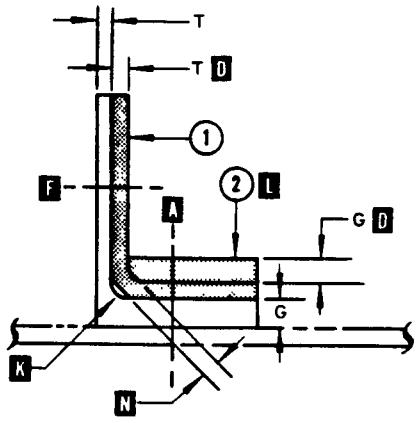
BULB ANGLE



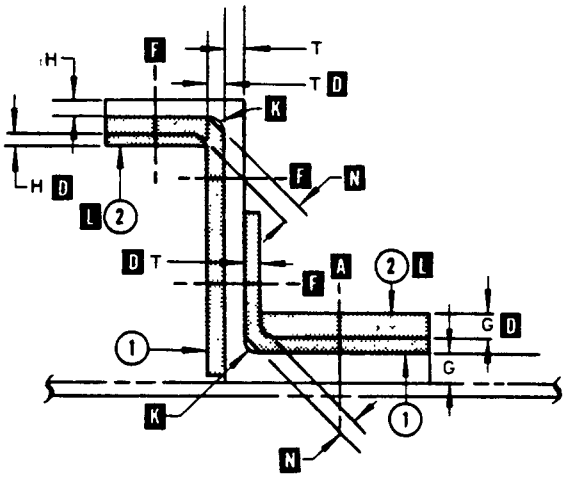
ANGLE-EQUAL LEG THICKNESS



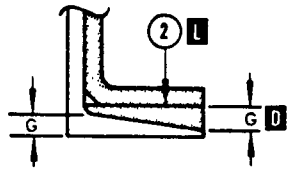
CHANNEL



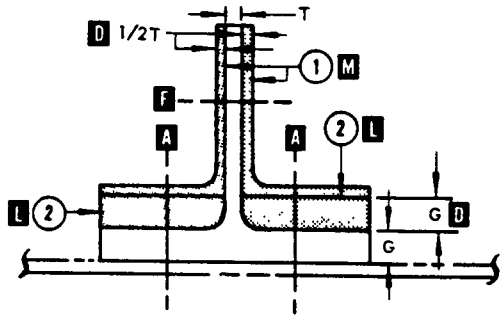
ANGLE



ZEE SECTION



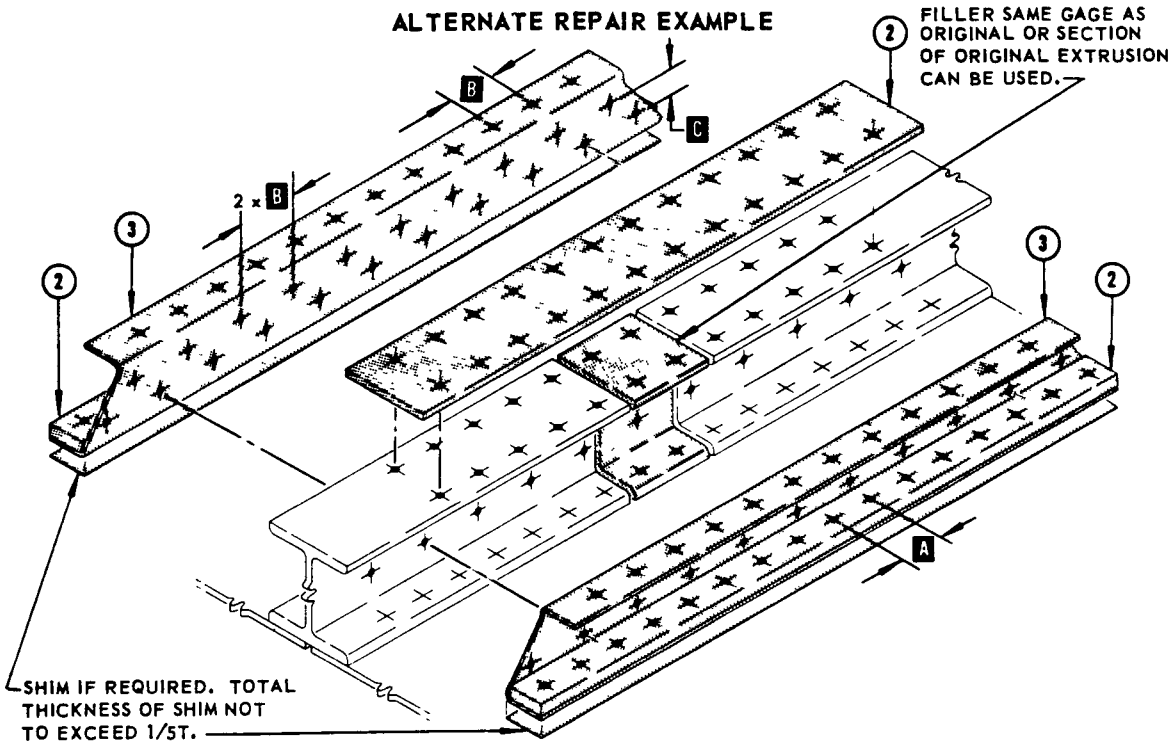
TAPERED FLANGE



TEE SECTION

Typical Extruded Section Repair
Figure 1 (Sheet 3 of 6)

ALTERNATE REPAIR EXAMPLE



ASSUME A DAMAGED 7075-T6 EXTRUDED "I" SECTION

1. Determine gage of 7075-0 HT-T6 repair channels for T = 0.130. 1/2 T = 0.065. Select sheet metal gage equal to 1/2 T or next greater gage. Next greater gage is 0.071. Shim as shown if required.

2. Determine gage of 7075-T6 radius filler for G = 0.250. Gage equal to or next greater is 0.250.

3. Determine gage of 7075-T6 splice plate for upper flange H = .188.
   .188 - (.130 x 1/3) = .145. Gage equal to or next greater is .160.

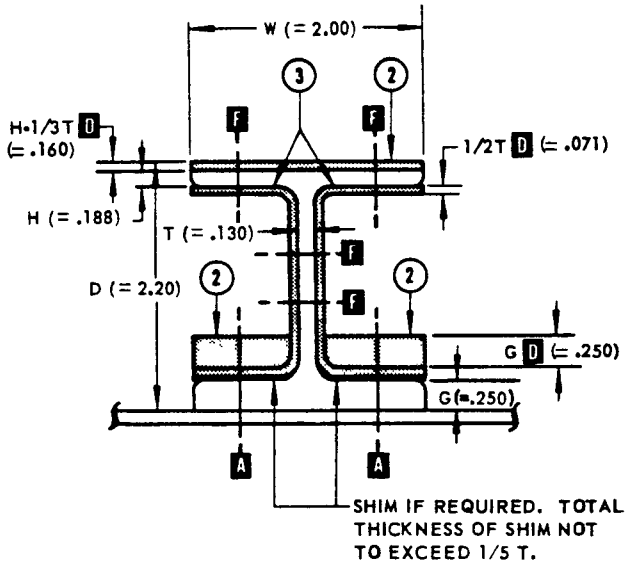
4. To determine number of fasteners required for 7075-T6 extrusion refer to table II. For 0.188 thick flange find opposite 0.190 (next higher gage) five 3/16 diameter steel fasteners per inch width.

   5 x 2.00 flange width = 10 fasteners each side of damaged area (min).

   For 0.130 thick web find opposite 0.140 (next higher gage) four 3/16 diameter steel fasteners.

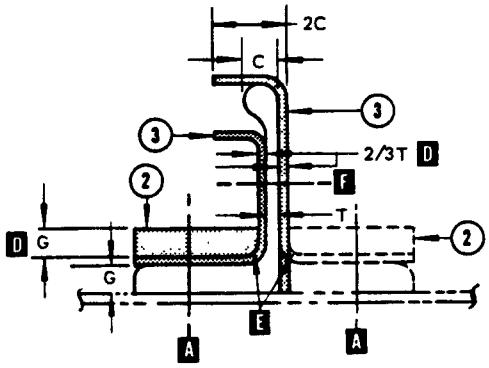
   4 x (2.20 - 0.188 - 0.250) = 4 x 1.76 = 7.04. Use eight fasteners each side of damaged area (min).

   For 0.250 thick flange find opposite 0.250. Seven 3/16 diameter steel fasteners. 7 x 2.00 flange width = 14 fasteners. (or use 4 x 2.00 = 8 1/4 diameter steel fasteners) each side of damaged area (min).

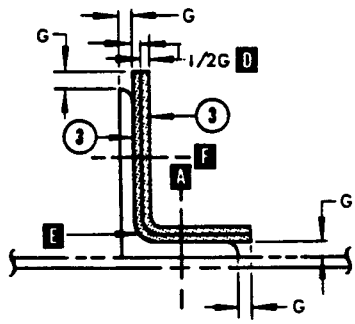


SECTION ADJACENT TO DAMAGE

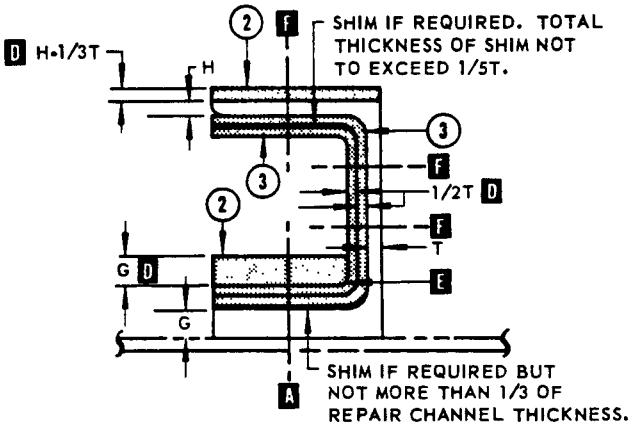
Typical Extruded Section Repair
Figure 1 (Sheet 4 of 6)



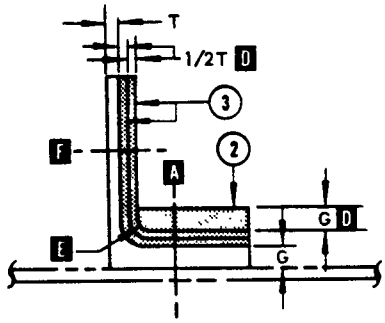
BULB ANGLE OR TEE



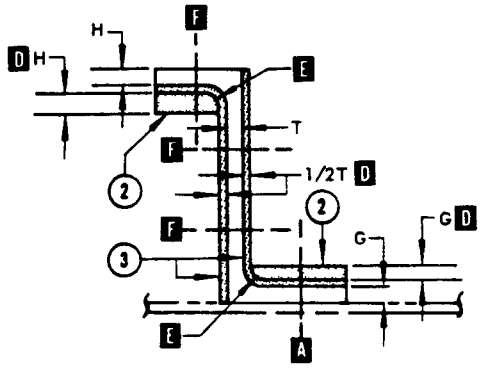
ANGLE-EQUAL LEG THICKNESS



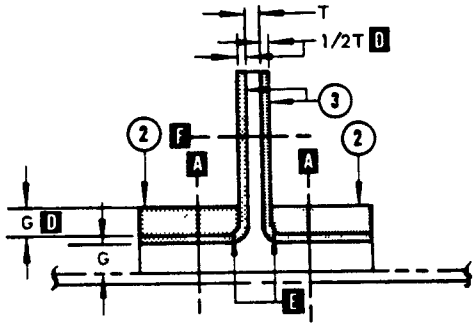
CHANNEL



ANGLE



ZEE SECTION



TEE SECTION

Typical Extruded Section Repair
Figure 1 (Sheet 5 of 6)

TABLE I. 2024-T4 EXTRUSIONS NUMBER OF FASTENERS PER INCH WIDTH

	AN470D RIVET					STEEL FASTENER 160,000 HT			
GAGE	5/32	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8
.050	4	3	2			3	2		
.056	5	3	2			3	2		
.063	5	4	2	2		3	2	2	
.071	6	4	2	2	2	3	2	2	
.080	6	5	3	2	2	3	2	2	
.090	7	5	3	2	2	3	2	2	
.100	8	6	3	2	2	3	2	2	2
.112	9	6	3	2	2	3	2	2	2
.125		7	4	3	2	3	2	2	2
.140		8	4	3	2	4	2	2	2
.160		9	5	3	2	4	3	2	2
.180			5	4	3	4	3	2	2
.190			5	4	3	5	3	2	2
.200			6	4	3	5	3	2	2
.224			6	4	3	5	3	2	2
.250			7	5	3	5	3	2	2
.313				6	4		4	3	2
.375				7	5			3	2
.500					6				3

TABLE II. 7075-T6 EXTRUSIONS NUMBER OF FASTENERS PER INCH WIDTH

	AN470D RIVET					STEEL FASTENER 160,000 HT			
GAGE	5/32	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8
.050	5	4	3			4	3		
.056	6	4	3			4	3		
.063	7	5	3	2		4	3	2	
.071	8	5	3	2	2	4	3	2	2
.080	9	6	3	2	2	4	3	2	2
.090	9	7	4	3	2	4	3	2	2
.100		7	4	3	2	4	3	2	2
.112		8	5	3	2	4	3	2	2
.125		9	5	3	2	4	3	2	2
.140		10	6	4	3	4	3	2	2
.160			6	4	3	4	3	2	2
.180			7	5	3	5	3	2	2
.190			7	5	4	5	3	2	2
.200			8	5	4	5	3	2	2
.224			9	6	4	6	3	3	2
.250			9	6	4	7	4	3	2
.313				8	5			3	3
.375					6				3
.500					8				

TABLE III. X7178-T6 EXTRUSIONS NUMBER OF FASTENERS PER INCH WIDTH

	AN470D RIVET					STEEL FASTENER 160,000 HT			
GAGE	5/32	3/16	1/4	5/16	3/8	3/16	1/4	5/16	3/8
.050	6	4	3			4	3		
.056	7	5	3			4	3		
.063	7	5	3	2		4	3	2	
.071	8	6	3	2	2	4	3	2	
.080	9	6	4	2	2	4	3	2	2
.090	10	7	4	3	2	4	3	2	2
.100		8	4	3	2	4	3	2	2
.112		9	5	3	2	4	3	2	2
.125			5	4	3	4	3	2	2
.140			6	4	3	4	3	2	2
.160			7	4	3	5	3	2	2
.180				5	4	5	3	2	2
.190				5	4	5	3	2	2
.200				5	4	5	3	3	2
.224				6	4	6	4	3	2
.250				7	5		4	3	2
.313				8	6		5	4	3
.375					7		6	4	3
.500					9			5	4

TABLE IV. FASTENER SPACING

FASTENER DIA.	B		C
	MIN.	MAX.	MIN.
5/32	.50	1.10	.93
3/16	.60	1.30	1.12
1/4	.75	1.75	1.50
5/16	.93	2.18	1.87
3/8	1.17	2.62	2.25

Typical Extruded Section Repair
Figure 1 (Sheet 6 of 6)

REPAIR INSTRUCTIONS

1. Cut and remove damaged portion of extrusion for preferred or optional repair.
2. Calculate the length and gages of the repair parts and make them accordingly.
3. Drill and ream holes as required.
4. Install the repair parts, using a bonded repair according to 51-40-5.
5. Replace the finish as described in 51-20-0 of the 727 Maintenance Manual.

NOTES

- THIS REPAIR PROCEDURE IS A SUPPLEMENT TO THE EXISTING REPAIR PROCEDURE IN 51-40-4, FIG. 1.
- EXISTING REPAIRS MADE ACCORDING TO 51-40-4, FIG. 1, ARE SATISFACTORY AND ARE NOT AFFECTED BY THIS REVISION.
- REFER TO THE FOLLOWING WHEN MAKING THIS REPAIR:
- 51-30, FASTENER REMOVAL, INSTALLATION, HOLE SIZES AND EDGE MARGINS.
- 51-10-2, PROTECTIVE TREATMENT OF METALS.
- BREAK SHARP EDGES OF ORIGINAL AND REPAIR PARTS 0.03.
- THESE REPAIRS DO NOT APPLY TO THE WING INTERSPAR STIFFENERS.

+ ORIGINAL FASTENER LOCATIONS

⊕ REPAIR FASTENER LOCATIONS

[A] THIS REPAIR IS LIMITED TO THOSE LOCATIONS WHERE SPACE AND ADJACENT STRUCTURE PERMITS THE DEVELOPMENT OF THE REPAIRS.

[B] SELECTION OF GAGE TO BE DETERMINED BY THE FASTENER SPACING AS SHOWN IN TABLE I AND THE REQUIREMENT TO GIVE THE COMBINED CROSS SECTIONAL AREA OF JOINT PLATES 1.25 TIMES GREATER THAN THE ORIGINAL EXTRUSION.

[C] DIAMETER OF FASTENERS TO BE DETERMINED BY THE AVAILABILITY OF ADEQUATE EDGE MARGINS (WHICH SHOULD NOT BE LESS THAN 2D) AND IN THE CASE OF FLUSH FASTENERS IN EXTERNAL SURFACES, THE SKIN THICKNESS AVAILABLE FOR COUNTERSINKING THE FASTENER HEAD. RECOMMENDED SPACING FOR REPAIR FASTENERS IS 4D. FOR FASTENER REQUIREMENTS SEE TABLES II THROUGH V.

[D] USE SAME TYPE FASTENER AS ORIGINAL FASTENERS.

[E] USE SAME MATERIAL AS PART BEING REPAIRED.

Typical Repair of Thin Extrusions Up To 0.08 Gage
Figure 2 (Sheet 1)

MINIMUM THICKNESS OF REPAIR PART [2]	
FASTENER SPACING	REPAIR PLATE GAGE
UP TO 0.75	0.050
OVER 0.75 TO 0.84	0.056
OVER 0.84 TO 0.94	0.063
OVER 0.94 TO 1.06	0.071
OVER 1.06 TO 1.75	0.080

TABLE I

RIVET PER INCH WIDTH TABLE FOR 2024-T4 EXTRUSIONS							
GAGE	MS20470D RIVET				STEEL FASTENER 160,000 HT		
	5/32	3/16	1/4		3/16	1/4	
0.040	4	3	2		3	2	
0.045	4	3	2		3	2	
0.050	4	3	2		3	2	
0.056	5	3	2		3	2	
0.063	5	4	2		3	2	
0.071	6	4	2		3	2	
0.080	6	5	3		3	2	

TABLE II

RIVET PER INCH WIDTH TABLE FOR 7075-T6 EXTRUSIONS							
GAGE	MS20470D RIVET				STEEL FASTENER 160,000 HT		
	5/32	3/16	1/4		3/16	1/4	
0.040	4	4	3		4	3	
0.045	4	4	3		4	3	
0.050	5	4	3		4	3	
0.056	6	4	3		4	3	
0.063	7	5	3		4	3	
0.071	8	6	3		4	3	
0.080	9	6	3		4	3	

TABLE III

RIVET PER INCH WIDTH TABLE FOR 7178-T6 EXTRUSIONS							
GAGE	MS20470D RIVET				STEEL FASTENER 160,000 HT		
	5/32	3/16	1/4		3/16	1/4	
0.040	4	4	3		4	3	
0.045	5	4	3		4	3	
0.050	6	4	3		4	3	
0.056	7	5	3		4	3	
0.063	7	5	3		4	3	
0.071	8	6	3		4	3	
0.080	9	6	4		4	3	

TABLE IV

FASTENER SPACING		
FASTENER DIA	MIN	MAX
5/32	0.50	1.10
3/16	0.60	1.30
1/4	0.75	1.75

TABLE V

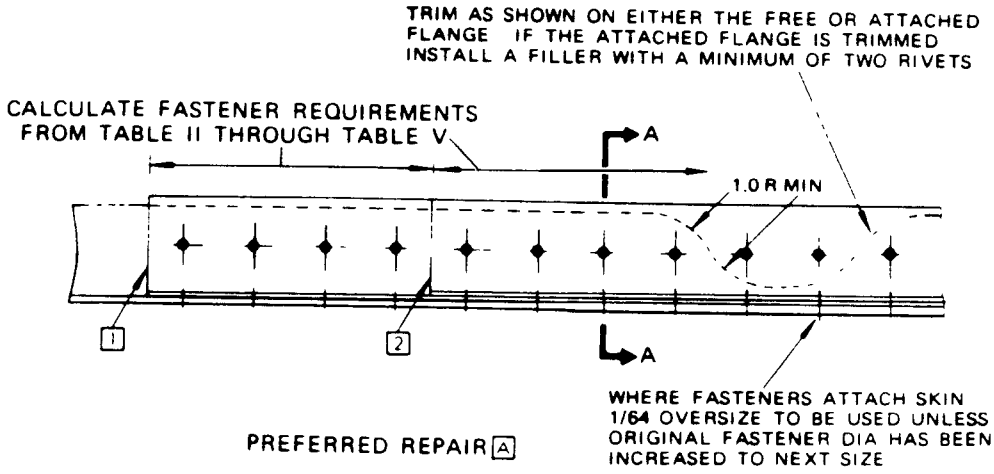
Typical Repair Thin Extrusion up to 0.08 Gage
Figure 2 (Sheet 2)

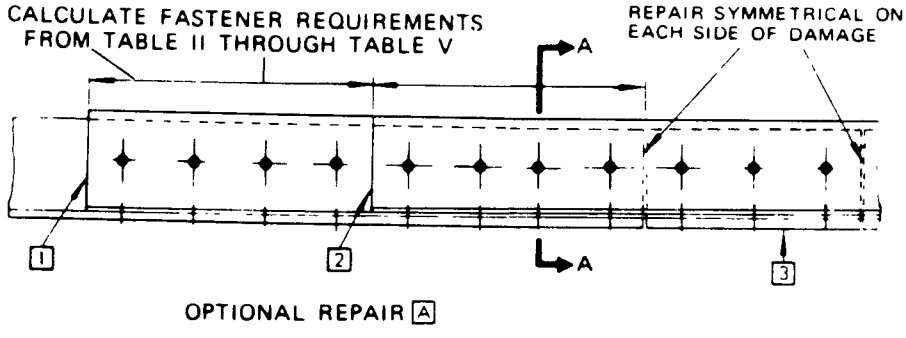
REPAIR MATERIAL			
PART		QTY	MATERIAL
1	JOINT PLATE	1	0.040 E
2	JOINT PLATE	1	0.040 TO 0.08 E B
3	FILLER	1	SAME SECTION AS ORIGINAL EXTRUSION

SUITABLE FASTENERS C D

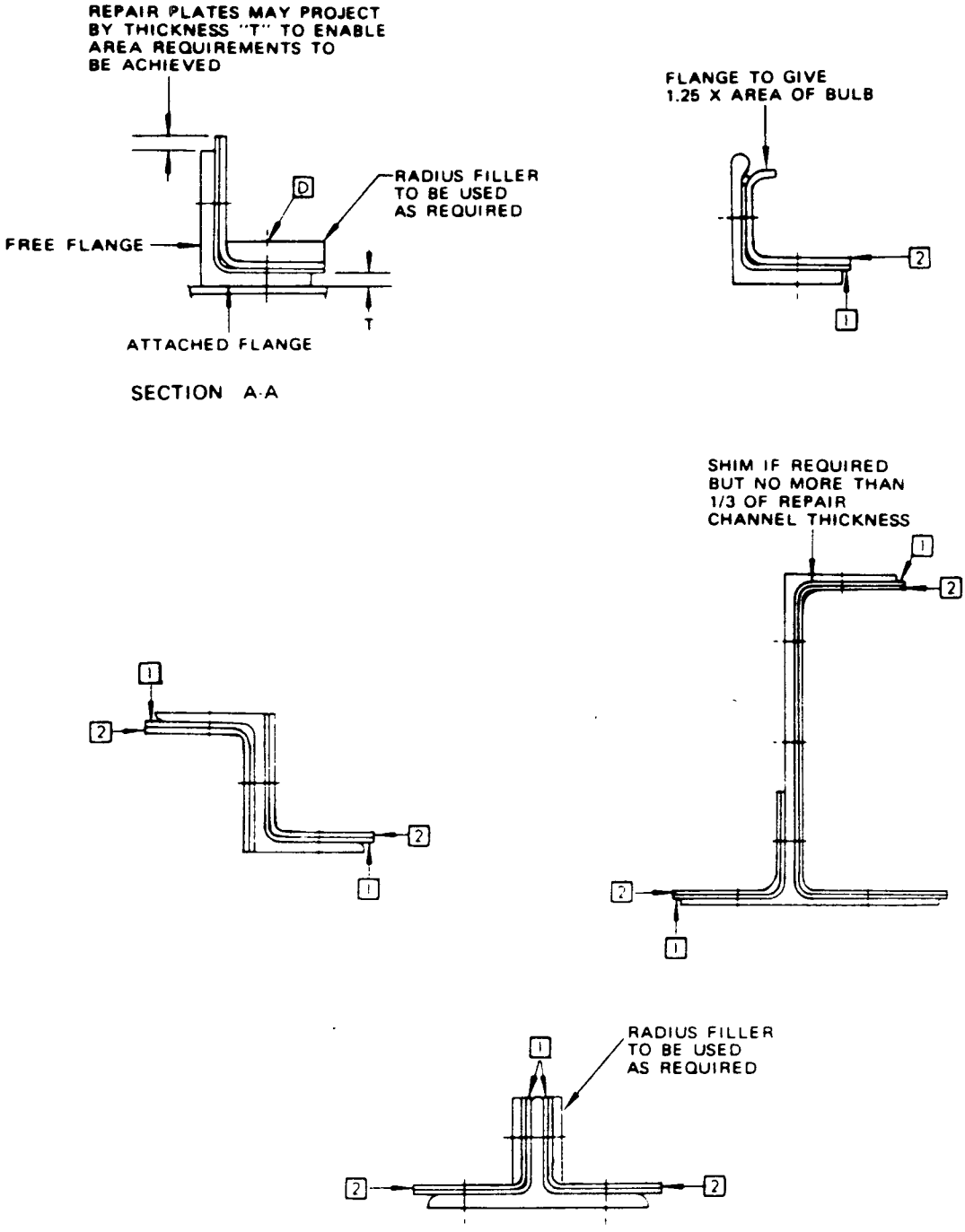
PROTRUDING HEAD
- MS20470D ALUMINUM RIVET
- BACR15BB-D ALUMINUM RIVET
- BACB30FM HI-LOK
- BACB30FP HI-LOK, 1/64 OVERSIZE

COUNTERSUNK HEAD
- BACR15CE-D ALUMINUM RIVET
- BACB30FN HI-LOK
- BACB30FQ HI-LOK, 1/64 OVERSIZE
- BACB30LU BOLT, STANDARD AND 1/64 OVERSIZE





Typical Repair Thin Extrusions up to 0.08 Gage
Figure 2 (Sheet 3)



TYPICAL SECTIONS THROUGH EXTRUSION REPAIRS

Typical Repair Thin Extrusion up to 0.08 Gage
Figure 2 (Sheet 4)

REPAIR INSTRUCTIONS

1. Remove fasteners and sealant over the area to be repaired.

2. Cut out the damaged portion of the extrusion in such a manner that fastener edge margins are maintained.

3. Calculate the gages of repair parts. Refer to sample calculation.

4. Calculate the number of fasteners to develop the strength of the repair parts. Refer to sample calculation.

5. Make the repair parts. Do not machine repair parts from large sections with strength properties reduced from those of the part being repaired.

6. Assemble the repair parts and drill and ream the fastener holes in existing and new locations.

7. Remove all burrs, nicks, sharp edges, and corners from the cut original parts and the repair parts. Chamfer or radius 0.015 to 0.030 on all cut edges.

8. Alodize the repair parts and the cut edges of existing parts.

9. Install prepack seals between the original extrusions and the repair parts, making BMS 5-95 faying surface seals between mating faces. Fasteners must be installed wet with BMS 5-95 sealant. Install BMS 5-95 injection sealant in gap between original and filler extrusion.

   NOTE: Use BMS 5-26 sealant instead of BMS 5-95 sealant in wing center section and all fuel tanks.

10. Restore finish after completion of repair.

NOTES

- THIS REPAIR MAY BE USED TO PARTIALLY REPLACE AN EXTRUSION OR TO SPLICE AN EXTRUSION WITH A CROSS SECTION CRACK INCLUDING A COMPLETE BREAK
- REPAIR IS SYMMETRICAL ON EACH SIDE OF JOINT
- REFER TO 51-15 WHEN THE REPAIR INVOLVES CONTROL SURFACES
- EXTRUSION REPAIRS MADE WITH "AND" EXTRUDED SECTIONS ARE PREFERRED
- REPAIRS SHOWN ARE FOR CONSTANT SECTION EXTRUSIONS
- THESE REPAIRS DO NOT APPLY TO WING INSPAR STIFFENERS

Extruded Section Repair - Machine Tapered
Figure 3 (Sheet 1)

NOTES (CONT)

- IT IS MANDATORY THAT REPAIR PARTS USED FOR SPANWISE BEAM STIFFENERS OR FRONT SPAR STIFFENERS IN THE WING CENTER SECTION HAVE ROUNDED CORNERS AND EDGES (RADIUS EQUAL TO GAGE MINIMUM) IF THEY CONTACT A FUEL CELL.

- REFER TO THE FOLLOWING WHEN USING THIS REPAIR.

  51-8-0 FOR PROTECTIVE TREATMENT OF METAL REPAIR PARTS.

  51-2 FOR FASTENER CODE, REMOVAL AND INSTALLATION, HOLE SIZES, EDGE MARGINS AND FASTENER STRENGTH.

  51-30 OF THE MAINTENANCE MANUAL FOR SEALS AND SEALING.

  51-20 OF THE MAINTENANCE MANUAL FOR FINISHES.

[A] FASTENERS IN ROW X AND Y MAY BE STAGGERED TO SUIT DEPTH OF EXTRUSION AND TO SUIT 4D DIMENSION. THE TOTAL NUMBER OF FASTENERS THRU WEB INCLUDE ROWS X AND Y.

[B] MACHINE TAPER AT 20 TO 1 SLOPE AND TO 0.040 MINIMUM THICKNESS OR TO MAXIMUM THICKNESS EQUAL TO 1/3 THE THICKNESS OF THE FLANGE BEING SPLICED.

[C] RADIUS OR CHAMFER TO SUIT RADIUS OF ORIGINAL EXTRUSION AND INSTALL PREPACK SEAL - TYPICAL.

[D] DETERMINE DIAMETER FROM TABLE I AND FOLLOWING CRITERIA:
(a) WHERE FLUSH HEAD FASTENERS ARE REQUIRED, INSTALL BACB30FN HI-LOKS AND WHERE PROTRUDING HEAD FASTENERS ARE REQUIRED, INSTALL BACB30FM HI-LOKS.
(b) FASTENER DIAMETER SHOULD NOT EXCEED 1/16 INCH GREATER THAN THE ORIGINAL FASTENER UNLESS ADEQUATE EDGE MARGINS CAN BE MAINTAINED AND KNIFE EDGES AVOIDED.

[E] STEEL FASTENERS MUST NOT BE INSTALLED WITHIN 3.0 FEET OF THE FLUX VALVE. REFER TO THE MAINTENANCE MANUAL FOR COMPASS SYSTEM MAINTENANCE PRACTICES.

[F] INSTALL SHIMS TO MAXIMUM GAP EQUAL TO 0.005 INCHES.

SYMBOLS

G	=	ORIGINAL THICKNESS OF UPPER FLANGE
G_1	=	THICKNESS OF UPPER FLANGE OF REPAIR MEMBER
H	=	ORIGINAL THICKNESS OF LOWER FLANGE
H_1	=	THICKNESS OF LOWER FLANGE OF REPAIR MEMBER
T	=	ORIGINAL THICKNESS OF VERTICAL LEG
T_1	=	THICKNESS OF VERTICAL LEG OF REPAIR MEMBER WHERE ONE REPAIR MEMBER IS USED

T_2 = THICKNESS OF VERTICAL LEG OF REPAIR MEMBER WHERE TWO REPAIR MEMBERS ARE USED

A_{FG} = UPPER REPAIR FLANGE AREA IF REPAIR FLANGE DOES NOT PROJECT PAST END OF FLANGE OF ORIGINAL MEMBER

A_{FH} = LOWER REPAIR FLANGE AREA IF REPAIR FLANGE DOES NOT PROJECT PAST END OF FLANGE OF ORIGINAL MEMBER

A_W = REPAIR MEMBER WEB AREA

D = ONE FASTENER DIAMETER

F_{TU} = ULTIMATE TENSILE STRENGTH

F_{BRU} = ULTIMATE BEARING STRENGTH

PSI = POUNDS PER SQUARE INCH

+ ORIGINAL FASTENER LOCATIONS [D]

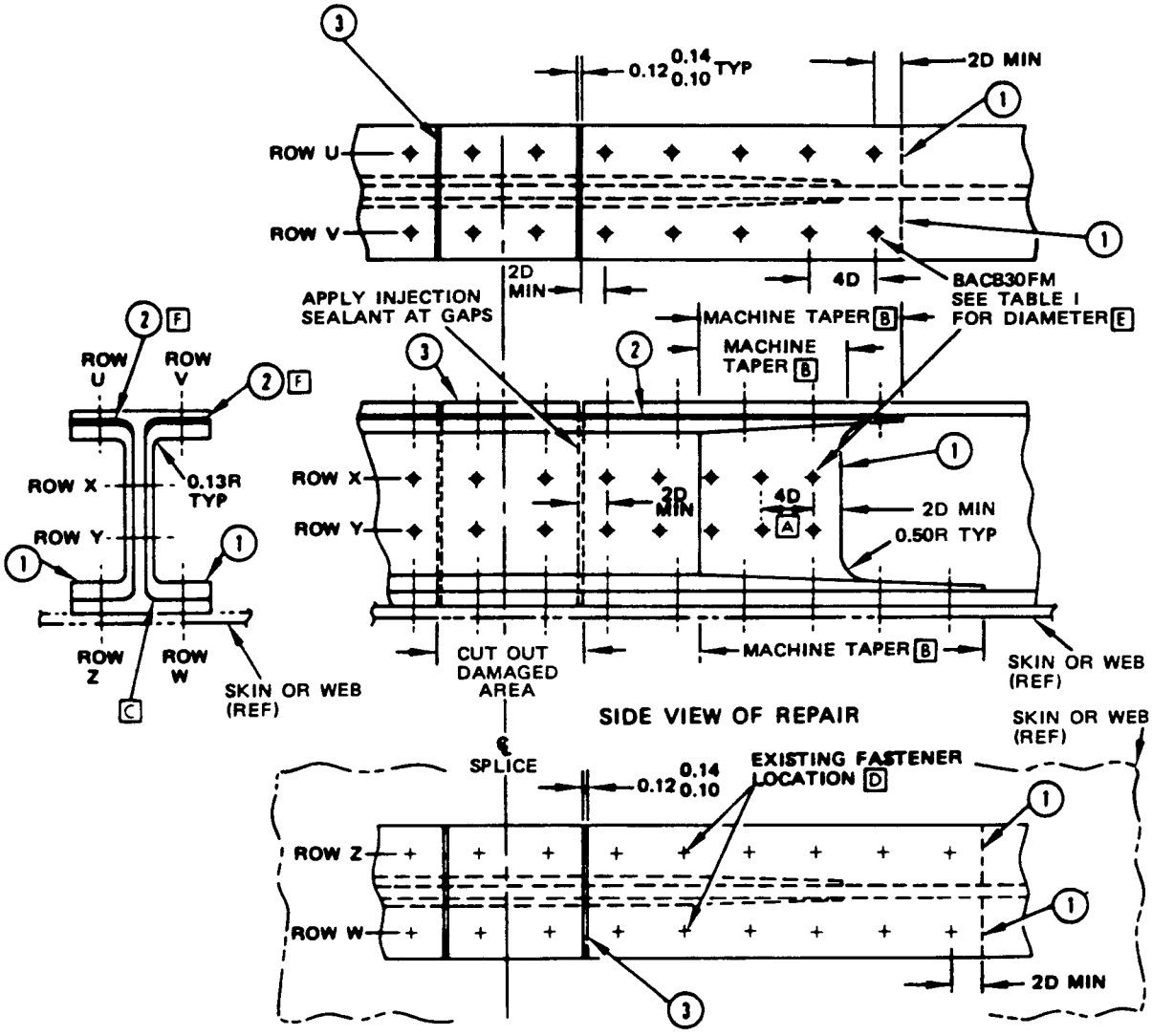
✦ REPAIR FASTENER LOCATION. INSTALL BACB30FM HI-LOKS. SEE TABLE I FOR DIAMETER

TOTAL MATERIAL THICKNESS (INCHES)	FASTENER DIAMETER (INCHES)
UNDER 0.50	3/16 or 1/4
0.50 to 0.65	1/4 or 5/16
0.66 to 0.80	5/16 or 3/8
0.81 AND OVER	3/8

TABLE I

REPAIR MATERIAL			
PART		QTY.	MATERIAL
(1)	REPAIR SECTION	1 or 2	SAME AS MEMBER BEING REPAIRED OR EQUIVALENT. SEE REPAIR INSTRUCTIONS, STEP 5.
(2)	SHIM	1 or 2	
(3)	FILLER	1	
(4)	REPAIR SECTION	1	

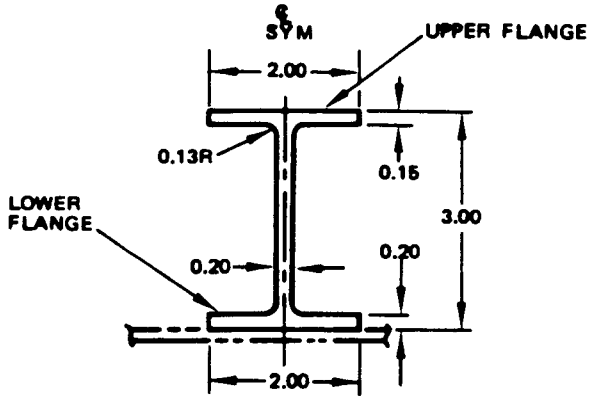
Extruded Section Repair - Machine Tapered
Figure 3 (Sheet 3)



Extruded Section Repair - Machine Tapered
Figure 3 (Sheet 4)

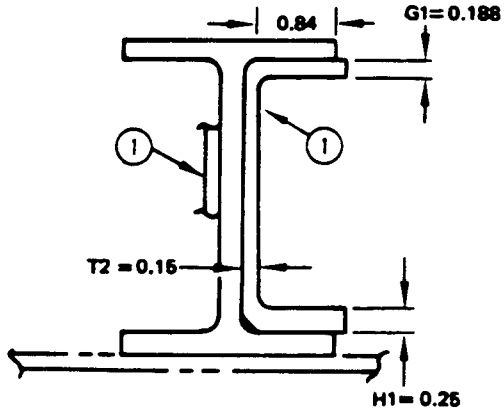
SAMPLE CALCULATION FOR AREA AND GAGE

The following example shows the calculation required to repair an extrusion of the following dimensions:



Material: 2024-T4 extrusion
Thickness of repair part flanges (at constant section) shall be at least 1.25 x thickness of original extrusion and area shall be at least 1.25 x area of original (see symbols in notes).

REPAIR PART (1)



UPPER FLANGE THICKNESS - G1

1.25 x FLANGE GAGE = 1.25 x 0.15
= 0.188

1.25 x ORIGINAL AREA = 1.25 x $2.00/_2$ x 0.15
= 0.1875

NOTE: Radius area of original section ignored.

A_{FG} = Repair flange area if gage = 0.188 and if repair flange does not project past end of flange of original member

A_{FG} = 0.84 x 0.188 = 0.158, which is less than the area requirement

So project end of repair flange to make area equal to 0.1875. Flange may project by thickness of repair flange.
0.188(0.188) = additional area = 0.035

A_{FG} + 0.035 = 0.158 + 0.035 = 0.193, which is greater than 0.1875 and therefore meets the area requirement.

LOWER FLANGE THICKNESS

1.25 x flange gage = 1.25 x 0.20 = 0.25

1.25 x original area = 1.25 x $2.00/_2$ x 0.20 = 0.25

A_{FH} = Repair flange area if gage = 0.25 and if repair flange does not project past end of flange of original member.

A_{FH} = 0.84 x 0.25 = 0.21, which is less than the area requirement.

So project end of repair flange to make area equal to 0.25. Flange may project by thickness of repair flange.

0.25(0.25) = additional area = 0.0625
A_{FH} + 0.0625 = 0.21 + 0.0625 = 0.2725, which is greater than 0.25 and therefore meets the area requirement.

WEB THICKNESS - T2

1.25 x web gage x 1/2 = 1.25 x 0.20 x 1/2 = 0.125

1.25 x original area = 1.25 x 0.20 (3.00-0.15-0.20)
= 0.663

A_W = repair web area

If repair gage = 0.125,
then A_W = 0.125 [3.00-0.15-0.188-0.25-0.20]
A_W = 0.2765
$2A_W$ = 0.553, which is less than area requirement.
So set $2A_W$ = 0.663 to determine larger repair gage
0.663 = T2 [3.00-0.15-0.188-0.25-0.20] x 2
T2 = 0.15

SAMPLE CLACULATION - FASTENER REQUIREMENTS

NOTE: Fastener requirements are calculated to develop the strength of repair parts. This sample calculation is to determine the number of fasteners required for the repair section identified in the previous calculation. Strengths of fasteners are obtained from 51-2-9.

The following conditions shall be used to determine the minimum fastener requirements:

1. Conservatively install sufficient fasteners in the constant section to develop the repair, using a minimum of two fasteners.

2. Fastener requirements in tapered section shall be based on length of tapered section, with 2D edge margin at end of part and about 4D spacing (3D to 5D variation).

   NOTE: The thickness of tapered section is to be per note [B].

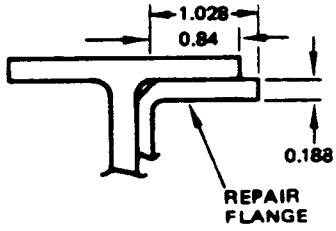
3. Length of repair part is to be determined by length of longest section (flange or web) of repair part.

UPPER FLANGE

Required capability (using 3/16 diameter Hi-Loks) $= [(0.84 + 0.188) \times 0.188 - 0.19(0.188)]F_{tu}$

$= [(1.028) \times 0.188 - 0.19(0.188)] \times 61{,}000$

Area Calculation of Repair Flange; Hole Size; Repair Flange Thickness; Ultimate Tensile Strength of 2024-T4 Extrusion



Required capability = 9,610 lbs.

CONSTANT SECTION:

For 3/16 diameter hi-lok, the shear allowable of fastener is 2,690 pounds and the thickness of 2024-T4 extrusion required to develop the shear strength of the fastener (using F_{bru} = 100,000 PSI) is $\frac{2{,}690}{100{,}000\ (0.1875)} = 0.143$

Thus, the fasteners are shear critical for both the 0.150 original flange and the 0.188 repair flange, and the number of fasteners required in constant section is 9,610/2,690 = 3.57. Use 4 fasteners and space at about 4D.

TAPERED SECTION:

Thickness at end of part = 1/3 (0.15) = 0.05 per note [B]. Then length of tapered section for 20 to 1 taper ratio = (0.188 - 0.05)20 = 2.76 inches. Using 2D edge margin for end fastener and 2D from start of taper to first fastener in tapered section, distance remaining is 2.76 - 4D = 2.76 - 4(0.1875) = 2.01 inches. Install additional fasteners in tapered section at 3 to 5 diameter spacing. Two additional would give $\frac{2.01}{3(0.1875)} = 3.6D$ spacing

WEB

Required capability (using 3/16 diameter Hi-Loks) $= [0.15(3.00-0.15-0.188-0.25-0.20) - 0.19(0.15)2]\ F_{tu}$

$= [0.15(2.212) - 0.19(0.15)2] \times 61{,}000$

Area Calculation of Repair Web; Hole Size; Repair Web Thickness; Ultimate Tensile Strength of 2024-T4 Extrusion

$= 16{,}763$ lbs. for each repair web

Required capability $= 2(16{,}763)$

$= 33{,}526$ lbs. for both repair webs

CONSTANT SECTION:

For 3/16 diameter hi-loks, the fasteners are shear critical in the repair web (from previous calculations, a thickness of 0.143 or greater is required to develop the shear strength).

P = Allowable load per fastener transferred to original web (double shear)

F_{bru} = Ultimate bearing strength of web
= 100,000 PSI

$$\frac{LBS}{IN^2} = \frac{P}{(0.1875)(0.20)} = 100{,}000$$

P = 3,750 lbs. per fastener, which is less than 2 x 2,690 = 5,380 (double shear capability of each fastener).

Thus, fasteners are bearing critical in original web (0.20 thick). The number of fasteners required in constant section is 33,526/3,750 = 8.94. Use 10 fasteners (for even load distribution) and space at about 4D.

TAPERED SECTION:

Thickness at end of part = 1/3(0.20) = 0.067 per note [B]. Then length of tapered section for 20 to 1 taper ratio = (0.15 - 0.067)20 = 1.66 inches. Using 2D edge margin for end fastener and 2D from start of taper to first fastener in tapered section, distance remaining is 1.66 - 4D =1.66 - 4(0.1875) = 0.91 inch. One additional fastener would give $\frac{0.91}{2(0.1875)}$ = 2.43D spacing (too close).
So do not install the additional fastener. Then spacing = $\frac{0.91}{0.1875}$ = 4.85D, which meets the 3 to 5 diameter spacing requirement.

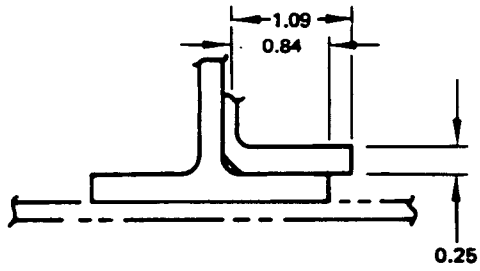
Extruded Section Repair - Machined Tapered
Figure 3 (Sheet 8)

LOWER FLANGE

Required capability = $[(0.84 + 0.25) \times 0.25 - 0.19(0.25)] F_{tu}$
(using 1/4 diameter Hi-Loks)

$= [(1.09) \times 0.25 - 0.25(0.25)] \times 61{,}000$

- $(1.09) \times 0.25$: Area Calculation of Repair Flange
- $0.25(0.25)$: Hole Size
- 0.25: Repair Flange Thickness
- $61{,}000$: Ultimate Tensile Strength of 2024-T4 Extrusion



Required capability = 12,810 lbs.

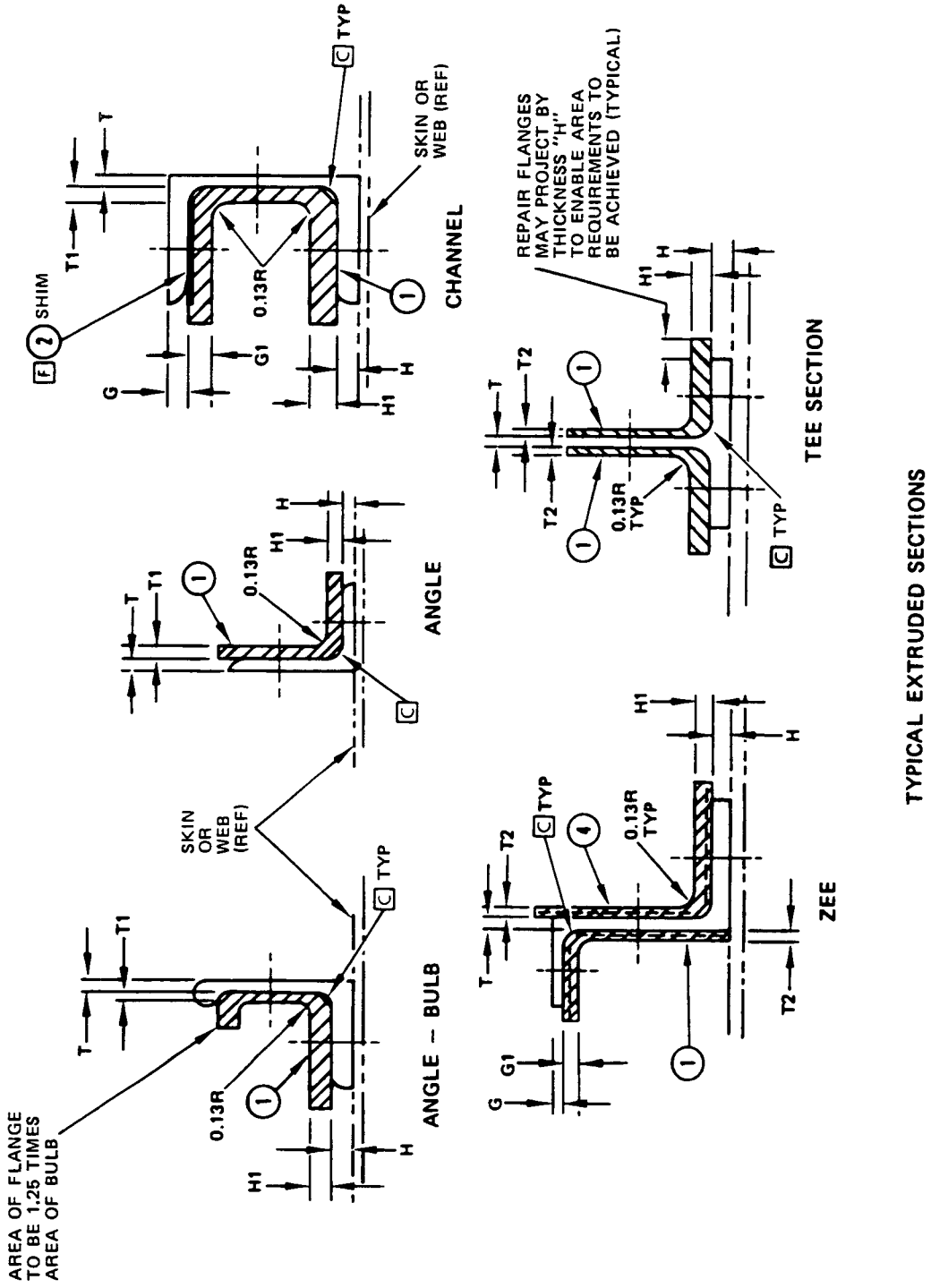
CONSTANT SECTION:

For 1/4 diameter hi-lok, the shear allowable of fastener is 4,650 pounds and the thickness of 2024-T4 extrusion required to develop the shear strength of the fastener (using F_{bru} = 100,000 PSI) is $\frac{4{,}650}{100{,}000(0.25)} = 0.186.$
Thus, the fasteners are shear critical for both the 0.20 original flange and the 0.25 repair flange, and the number of fasteners required in constant section is 13,725/4,650 = 2.76. Use 3 fasteners and space at about 4D. If there are existing 1/4 diameter fasteners, pick up 3. If fastener diameter differs, recalculate requirement.

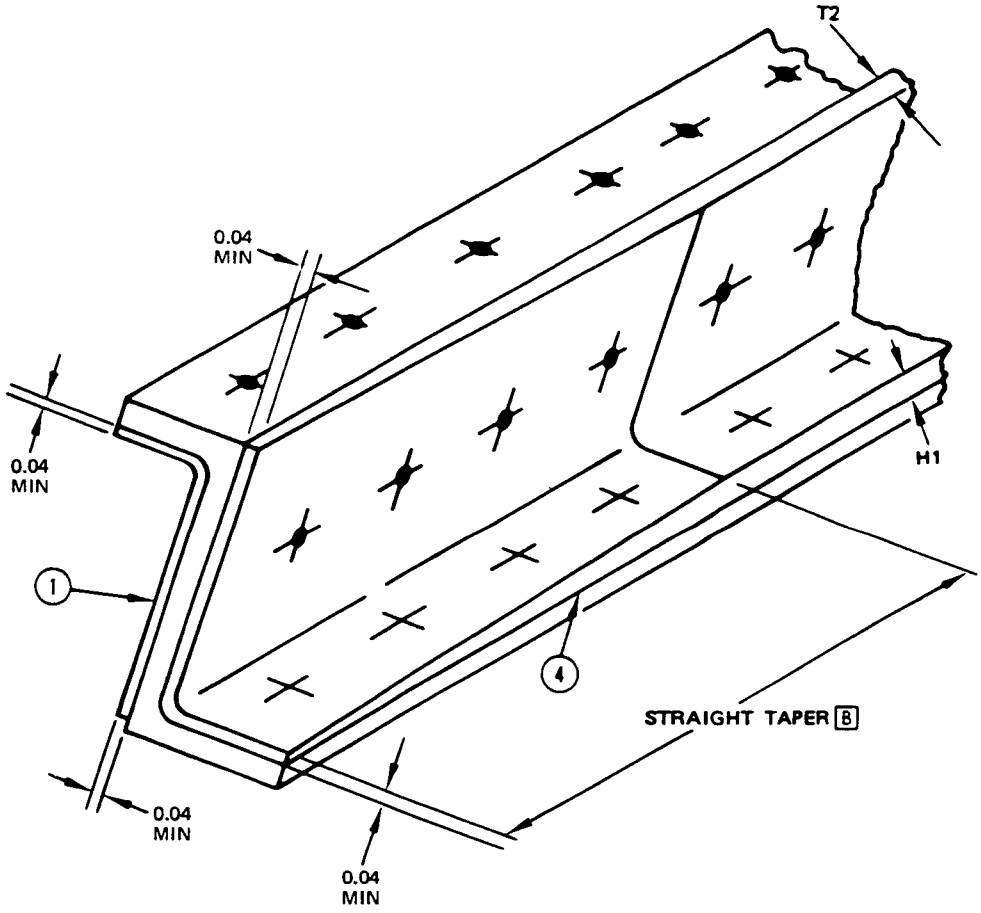
TAPERED SECTION:

Thickness at end of part = 1/3(0.20) = 0.067 per note [B]. Then length of tapered section for 20 to 1 taper ratio = (0.25 - 0.067)20 = 3.66 inches. Using 2D edge margin for end fastener and 2D from start of taper to first fastener in tapered section, distance remaining is 3.66 - 4D = 3.66 - 4(0.25) = 2.66 inches. Install additional fasteners in tapered section at 3 to 5 diameter spacing. Two additional would give
$\frac{2.66}{3(0.25)}$ = 3.55D spacing. If there are existing fasteners, make adjustments to end up with approximately same end thickness and taper ratio.

Extruded Section Repair - Machine Tapered
Figure 3 (Sheet 9)



Extruded Section Repair - Machine Tapered
Figure 3 (Sheet 10)



ISOMETRIC VIEW
OF REPAIR ANGLES
(TYPICAL FOR ALL SECTIONS)

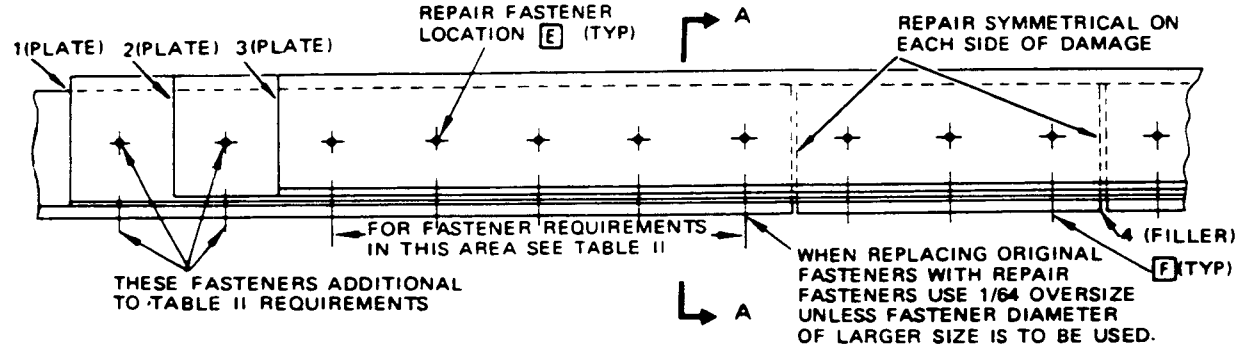
Extruded Section Repair - Machine Tapered
Figure 3 (Sheet 11)

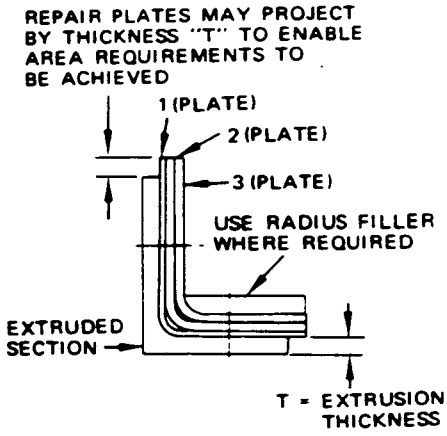
BOEING 707

INTERCONTINENTAL
STRUCTURAL REPAIR

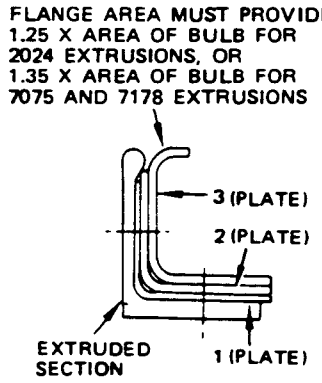
APPLICABILITY

THIS REPAIR DOES NOT APPLY TO WING INTERSPAR STIFFENERS, SPAR CHORDS, SPANWISE BEAM CHORDS, STRUCTURE IN FUEL TANKS, OR SECTION 44 SEAT TRACKS

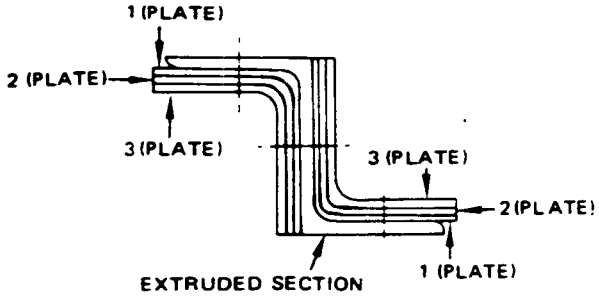




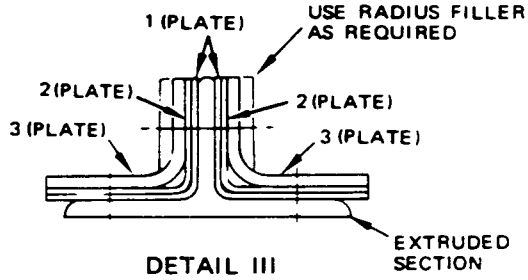
SECTION A–
SEE DETAILS I, II, III & IV FOR TYPICAL REPAIRS OF OTHER SECTIONS



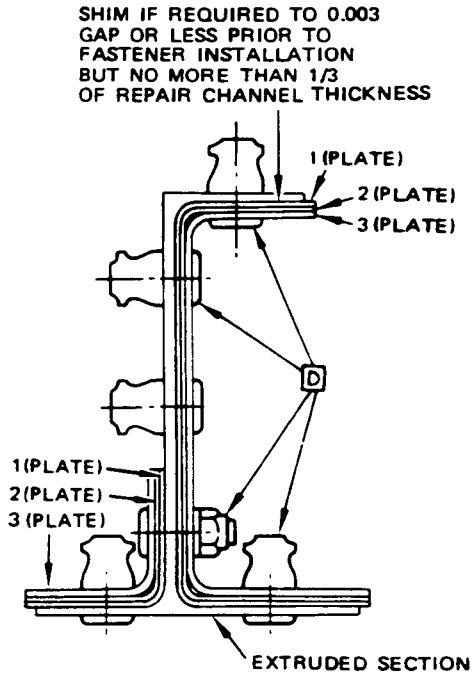
DETAIL I



DETAIL II



DETAIL III



DETAIL IV

Typical Extruded Section Repair
Figure 4 (Sheet 1)

REPAIR MATERIAL							
		2024 EXTRUSIONS		7075 EXTRUSIONS		7178 EXTRUSIONS [G]	
PART		QTY	MATERIAL	QTY	MATERIAL	QTY	MATERIAL
1	PLATE	AS REQ	0.040 2024-T3 CLAD OR BARE	AS REQ	0.040 7075-T6 CLAD OR BARE	AS REQ	0.040 CLAD OR BARE 7178-T6 OR BARE 7075-T6
2	PLATE	AS REQ	0.040 TO 0.063 2024-T3 [A] CLAD OR BARE	AS REQ	0.040 TO 0.063 7075-T6 [A] CLAD OR BARE	AS REQ	0.040 TO 0.063 CLAD OR BARE 7178-T6 [A] OR BARE 7075-T6
3	PLATE	AS REQ	0.050 TO 0.125 2024-T3 [B] CLAD OR BARE	AS REQ	0.050 TO 0.125 7075-T6 [B] CLAD OR BARE	AS REQ	0.050 TO 0.125 CLAD OR BARE 7178-T6 [B] OR BARE 7075-T6
4	PLATE	AS REQ	SAME AS ORIGINAL EXTRUSION				

MINIMUM THICKNESS OF REPAIR PART 3	
FASTENER SPACING	REPAIR PLATE GAGE
UP TO 0.75	0.050
OVER 0.75 TO 0.84	0.056
OVER 0.84 TO 0.94	0.063
OVER 0.94 TO 1.06	0.071
OVER 1.06 TO 1.20	0.080
OVER 1.20 TO 1.35	0.090
OVER 1.35 TO 1.50	0.100
OVER 1.50 TO 1.68	0.112
OVER 1.68 TO 1.77	0.125

TABLE I

FASTENER DIAMETER	FASTENERS PER INCH WIDTH OF FLANGE OR WEB OF ORIGINAL EXTRUSION [C]	
	2024 EXTRUSION	7075 EXTRUSION
5/32	5.0	5.3
3/16	4.2	4.4
1/4	3.1	3.3

TABLE II

REPAIR INSTRUCTIONS

1. Cut and remove damaged portion of extrusion.
2. Calculate the gages and lengths of the repair parts and make them accordingly.
3. Break edges of original and repair parts 0.015 to 0.030.
4. Assemble the repair parts and drill and ream the fastener holes.
5. Remove the repair parts and prepare them for bonding in accordance with 51-9-1.
6. Install the repair parts bonding in accordance with 51-9-1.
7. Apply sealant according to 51-3-0 of the 707 Maintenance Manual.
8. Restore the finish in accordance with 51-2-0 of the 707 Maintenance Manual.

Typical Extruded Section Repair
Figure 4 (Sheet 2)

NOTES

- SEE 51-2-0 FOR FASTENER REMOVAL, INSTALLATION, HOLE SIZES AND EDGE MARGINS
- SEE 51-1-1 FOR MIN BEND RADII 51-8-0
- SEE 51-8-0 FOR PROTECTIVE TREATMENT OF METALS
- SEE 51-15-0 FOR BALANCING REQUIREMENTS WHEN REPAIRING CONTROL SURFACES
- THIS REPAIR PROCEDURE IS A SUPPLEMENT TO THE EXISTING REPAIR PROCEDURE IN 51-14-4, FIGURE 1
- EXISTING REPAIRS MADE ACCORDING TO 51-14-4, FIGURE 1, ARE SATISFACTORY AND ARE NOT AFFECTED BY THIS FIGURE
- THIS REPAIR IS LIMITED TO THOSE LOCATIONS WHERE SPACE AND ADJACENT STRUCTURE PERMIT THE DEVELOPMENT OF THE REPAIRS

[A] SELECTION OF GAGE DETERMINED IN CONJUNCTION WITH PART 3 TO GIVE A COMBINED CROSS-SECTIONAL AREA OF ALL PLATES 1.25 TIMES GREATER THAN THE ORIGINAL 2024 EXTRUSION OR 1.35 TIMES GREATER THAN THE ORIGINAL 7075 EXTRUSION OR 7178 EXTRUSION. EACH LEG OF THE EXTRUSION MUST BE JOINED BY MATERIAL PROPORTIONATELY GREATER THAN THE ORIGINAL AREA

[B] SELECTION OF GAGE DETERMINED BY FASTENER SPACING FROM TABLE I AND AREA REQUIREMENTS IN CONJUNCTION WITH OTHER REPAIR PARTS AS SHOWN IN NOTE [A] . IF NECESSARY FOR AREA REQUIREMENTS, ADDITIONAL PLATES MAY BE FITTED USING TABLE I AS A GUIDE TO MINIMUM GAGE

[C] ALL FASTENERS IN REPAIR TO BE OF SAME NOMINAL DIAMETER, WHICH IS TO BE DETERMINED BY AVAILABLE EDGE MARGINS AND SKIN THICKNESS AVAILABLE FOR COUNTERSINKING. EDGE MARGINS MUST NOT BE LESS THAN 2D. RECOMMENDED FASTENER SPACING 4D. (D = DIAMETER OF FASTENER)

[D] INSTALL IN SUCH A SEQUENCE, OR COMBINATION OF SUITABLE FASTENERS AND NUTS, THAT WILL PREVENT INTERFERENCE OF NUTS. INTERFERENCE MAY BE PREVENTED BY DIMENSIONAL CONTROL, PROVIDED THAT MINIMUM EDGE MARGIN AND SPACING IS MAINTAINED

[E] SUITABLE PROTRUDING HEAD FASTENERS

BOLT:
BACB30FM HI-LOK
BACB30FP HI-LOK, 1/64 OVERSIZE

NUT:
BACC30M HI-LOK COLLAR

Typical Extruded Section Repair
Figure 4 (Sheet 3)

[F] SUITABLE FLUSH HEAD FASTENERS

BOLT:
BACB30FN HI-LOK
BACB30FQ HI-LOK, 1/64 OVERSIZE
BACB30LU STANDARD AND OVERSIZE [H]

NUTS:
BACC30M HI-LOK COLLAR
BACCN10JC LOCKNUT (INSTALL WITH 0.062 THICK STANDARD WASHER)

[G] BARE 7075-T6 CAN BE SUBSTITUTED PROVIDED THE COMBINED CROSS SECTIONAL AREA AND THICKNESS OF THE REPAIR PARTS IS 1.35 TIMES GREATER THAN THE ORIGINAL PART

[H] DO NOT INSTALL THESE TENSION FASTENERS WHERE SHEAR HEAD FASTENERS WERE INSTALLED IF TENSION HEAD WILL RESULT IN KNIFE EDGE CONDITION

Typical Extruded Section Repair
Figure 4 (Sheet 4)

CONTROL SURFACE REBALANCING

1. General

A. All flight control surfaces must be balanced to within certain limitations to prevent flutter with its effect on flight safety. Flutter is a form of dynamic instability, in which the amplitude of the self-induced vibration may increase until the surface suffers structural damage or is actually destroyed. One method of flutter prevention is to have a proper mass distribution of the control surface about the hinge line.

B. Control surface balance is achieved by balancing each component within specified limits so that, when assembled, the components will constitute a properly balanced installation. This method of control surface balancing is called the component method. Secondary requirements are specified for the components to ensure that the location of the center of gravity (CG) of the complete installation will lie within the limits specified by the static balance requirements. Components from control surface installations balanced by this method are, therefore, directly interchangeable.

C. This subject contains general information applicable to the balancing of all control surfaces. For specific balancing procedures for each control surface, refer to the appropriate subject within 51-15-1 through 51-15-13.

D. The effect on control surface balance must be considered every time one of the system components covered in this subject is repaired or repainted.

WARNING: ANY COMPONENTS OF THE FLIGHT CONTROL SURFACES WHICH ARE NOT BALANCED AS REQUIRED BY THE PROCEDURES AND LIMITATIONS OF 51-15-1 THROUGH 51-15-13 COULD AFTER REPAIR OR MODIFICATION, PRODUCE UNDESIRABLE FLUTTER CHARACTERISTICS AND AFFECT FLIGHT SAFETY.

E. The cumulative effect of repairs and repeated painting without removal of the existing painted finish could lead to the use of all the available balance adjust weight positions. Should this situation arise, consideration should be given to removal of existing painted finishes as a means of regaining an adjustment capability.

F. The control surface must be removed from the airplane for repair and rebalancing when it is not practical to maintain the accuracy and tolerance requirements.

G. When a control surface is removed for repair, it should be rebalanced in a jig, using the procedures in the applicable section before reinstallation on the airplane. Do not install the surface before rebalancing.

H. A control surface should be rebalanced to the center of the allowable moment range to reduce the need for balance adjustment for a subsequent repair.

2. Special Tools and Equipment

A. The special tools and equipment required during rebalancing operations are identified and illustrated in Fig. 3.

3. Repair Categories

A. Repairs to flight control surfaces are defined as minor and major repairs as follows:

(1) Minor repairs to the main control surfaces (ailerons, elevators, and rudder) are those which, after computing the effect of the repair, do not require rebalancing or the addition of balance weights, or repairs to damaged skins and the trailing edge which add no more than 0.50 pound to the surface (weight of repair materials less the weight of the removed damaged material).

(2) Minor repairs to balance panels are those which entail the replacement of parts with new equivalent parts, such as seals, weights, hinge pins, fasteners, etc., with no appreciable change in weight and moment requirements (Fig. 1).

(3) Minor repairs to control surface tabs are those which, after computing the effect of the repair, are within the range of the available repair moment of Fig. 2 and do not require rebalancing.

(4) Major repairs to the main control surfaces (ailerons, elevators, and rudder) comprise the following:

(a) Repairs to or replacement of major structural components such as fittings, spars, ribs, or complete skin panels.

(b) Repairs which would add extra structural members to the basic design.

(c) Complete repainting of a main control surface (ailerons, elevators, and rudder), except that the rudder does not need rebalancing after repainting as defined in Chapter 27 of the 707-320 Maintenance Manual.

(d) Any repair(s) which would add to any known previously unbalanced moments so that the limits of paragraph 3.A. are exceeded.

NOTE: The total number of repairs which may be made to a control surface, before complete rebuild becomes necessary, must be determined by a structural engineer. When the cumulative effect of repairs is such that rebalancing within the specified limits is no longer possible, the surface must be rebuilt to the as-manufactured configuration.

(5) Major repairs to balance panels are those made to the panel or continuous hinges which would exceed the weight or repair moment of figure 1.

(6) Major repairs to control surface tabs comprise the following:

(a) Repairs to or replacement of major structural components such as fittings, spars, or skins.

(b) Repairs which would add extra structural members to the basic design.

(c) Complete repainting of surfaces.

(d) Any repair(s) which would exceed the available repair moment as defined in figure 2.

B. Minor repairs are those which can be made with the component installed on the airplane.

C. Major repairs require the removal of the component from the airplane.

4. Estimation of Repair Weight of Honeycomb Structures

A. Refer to 51-10-1, 51-10-3, and 51-11-1 for repairs for control surfaces of aluminum honeycomb and nonmetallic honeycomb construction.

B. When calculating the effect of a repair to a control surface of honeycomb construction (which has not been removed from the airplane), see figures 4 and 5 for the approximate weights of completed repairs and location of center of gravity for trailing edge repairs.

C. When substitute materials are used for replacement parts, e.g., fiberglass core instead of aluminum core, allow for the difference in weight when calculating the effect of the repair.

5. Rebalance Requirements after Repairs

A. A check of the balance condition can be made after minor repairs with the component installed on the airplane. Removal from the airplane and complete rebalancing will, however, be necessary if there is insufficient space for additional balance weights.

B. Complete rebalancing, with the component mounted on a balancing jig stand, is required after each major repair.

C. Refer to 51-15-1 through 51-15-13 for applicable balancing procedures.

D. When rebalancing it is advisable to use manufacturing tolerances in establishing the new center of gravity in order to introduce a further rework capability into the component without exceeding the operational limits.

6. Sign Convention

A. During balancing operations, distances are considered positive (+) if measured aft from the hinge centerline and negative (-) if measured forward of the hinge centerline. Weight reactions are considered positive (+) if the trailing edge of the surface exerts a downward load on the support and negative (-) if the load is in an upward direction.

7. Tab Adjust Weight System

A. The effective moment of a tab about the hinge line of the major control surface is determined by multiplying the weight of the tab (W) (in pounds) by the distance (I) (in inches) from the CG location of the tab to the hinge line of the control surface.

Effective moment of tab = (W) (I)

B. Since (I) is relatively large, small variations in the tab weight can cause large changes in the effective moment about the control surface hinge line. Replacing a tab with a tab of different weight could move the CG location of the entire installation outside the specified limits. A complete rebalancing of the surface assembly and tab would thus be necessary for each tab replacement.

C. A tab adjust weight system has been incorporated in the balance weight design for the control surfaces to avoid this difficulty. These tab adjust weights, mounted on the balance panels, balance out variations in the tab weight. For a given increment of tab weight, there is specified a particular adjust weight. A heavier tab requires a heavier adjust weight. Tables showing the tab weight range and the associated adjust weights appear on the tab assembly or installation drawings, and are given in this document for easy reference.

NOTE: These adjust weights do not balance out the entire weight of the tab, but only that portion above a certain base weight.

D. Although the adjust weight is mounted on the balance panel, it is considered part of the tab, and must never be separated from it. At time of tab installation on the surface, the adjust weight must be mounted in its correct location on the balance panel.

NOTE: Due to the importance of the tab weight, upon completion of the static balance test the actual weight of the balanced tab will be stamped on the tab per drawing.

If the tab is reworked, repaired, or painted, it must be rebalanced, stamped with the new actual weight, and provided with the correct adjust weight.

INSTALLATION	WEIGHT IN POUNDS	MOMENT POUNDS-INCHES
INBOARD AILERON CONFIGURATION	NO REQUIREMENT	
SINGLE TAB CONTROL ROD NOT INSTALLED		-210 (± 5) [A] [B]
DOUBLE TAB CONTROL ROD NOT INSTALLED		-236 (± 5) [A] [B]
SINGLE OR DOUBLE TAB CONTROL ROD INSTALLED		-200 (± 5) [A] [B]
BALANCE PANELS		
BAY 1	NO REQUIREMENT	-71 (± 2 1/2) [A] [B]
BAY 2	NO REQUIREMENT	-66 (± 2 1/2) [A] [B]
OUTBOARD AILERON	NO REQUIREMENT	+193 (± 9) [A] +189 (± 5) [B]
BALANCE PANELS		
BAY 2	NO REQUIREMENT	+500 (± 6) [A] [B]
BAY 3	NO REQUIREMENT	+250 (± 5) [A] [B]
BAY 4	NO REQUIREMENT	+120 (± 4) [A] [B]
BAY 5	NO REQUIREMENT	+ 75 (± 3) [A] [B]
ELEVATOR	NO REQUIREMENT	+1025 (+63/-43) [A] +1025 (± 13) [B]
BALANCE PANELS		
BAY 0	19.5 TO 20.0	NO REQUIREMENT
BAY 1	23.6 TO 24.1	NO REQUIREMENT
BAY 2	22.1 TO 22.6	NO REQUIREMENT
BAY 3	20.9 TO 21.4	NO REQUIREMENT
BAY 4	19.4 TO 19.9	NO REQUIREMENT
BAY 5	33.4 TO 33.9	NO REQUIREMENT
RUDDER		
STANDARD		1495 (+65/-70) [A] 1495 (+5/-70) [B] [D]
HIGH SPEED [C]		1435 (+65/-185) [A] 1435 (+5/-185) [B] [D]
BALANCE PANELS		
BAY 1	29.4 TO 30	
BAY 2	40.5 TO 41.1	
BAY 3	36.7 TO 37.3	
BALANCE PANEL EXTENSIONS		
BAY 1	22.1 TO 22.4	
BAY 2	20.0 TO 20.3	
BAY 3	57.3 TO 58.0	

NOTE

[A] OPERATIONAL LIMITS

[B] MANUFACTURING LIMITS

[C] 60 POUND-INCHES MOMENT OVERBALANCE IN BAY 5 IS ADDED TO STANDARD RUDDER BY INCREASE IN BALANCE WEIGHTS.

[D] PAINTED SURFACE WITH REPAINTING CAPABILITIES IS PROVIDED BY 60 POUND-INCH MOMENT OVERBALANCE IN BAY 2 OR BAY 3 ADJUST WEIGHTS

Control Surface Weight and Moment Requirements
Figure 1

NOTE: The following information is applicable only to tabs balanced within manufacturing limits. Tabs are within these limits as delivered from the factory and when balanced to the requirements of the tab balancing procedures in this subject.

1. Determine whether a repair can be made without rebalancing, as follows:

   A. Determine available repair moment as follows:

      (1) If actual weight of tab to be repaired is known, the available repair moment is determined by multiplying this known weight by 0.04. or by interpolating between the values in Table 1

      (2) If actual weight of the tab is not known, the smallest moment from the applicable portion of Table 1 must be used.

   B. A repair can be made without rebalancing if the moment added by the repair is less than the available repair moment of the tab.

2. Record the weight change and calculated moment change due to complete repair.

   CAUTION: AN ACCURATE AND PERMANENT RECORD OF ALL UNBALANCED REPAIRS MUST BE MAINTAINED TO ENSURE THAT OPERATIONAL LIMITS ARE NOT EXCEEDED.

3. When a repair adds a moment in excess of the available repair moment, or when it is not known whether the tab is balanced within manufacturing limits before making a repair, the tab must be removed from the airplane and rebalanced as described in 51-15-3, 51-15-6, 51-15-9, 51-15-10 and 51-15-13.

Tab Balancing Requirements
Figure 2 (Sheet 1)

TAB	BALANCING LIMITS		WEIGHT OF TAB (POUNDS)	AVAILABLE REPAIR MOMENT (POUND-INCHES)
	C.G. LOCATION FORWARD OF HINGE ℄ (INCHES)			
	MANUFACTURING	OPERATIONAL		
INBOARD AILERON	0 18 – 0.29	0.14 – 0.29	10 – 20.25	0.40 – 0.81
ELEVATOR CONTROL				
	0 22 – 0.35	0.10 – 0.35	22 – 27.5	0.88 – 1.10
	0.22 – 0.34	0.10 – 0.34	28.5	1.14
	0.22 – 0.33	0.10 – 0.33	29.5	1 18
	0.22 – 0.32	0.10 – 0.32	30.0	1.20
ELEVATOR STABILIZER ACTUATED	0.22 – 0.35	0.18 – 0.35	7.5 – 25 0	0.30 – 1.00
RUDDER CONTROL	0.24 – 0.40	0.20 – 0.40	27 – 37	1.08 – 1.48
OUTBOARD AILERON		NOT BALANCED		

TABLE I

Tab Balancing Requirements
Figure 2 (Sheet 2)

SPECIAL TOOLS AND EQUIPMENT			
ITEM	QUANTITY REQUIRED	DETAIL	SOURCE
BALANCE JIG STAND	1	I	BOEING FME5-71799 OR EQUIVALENT
TOOL STAND	1	II	MAKE PART (STEEL)
PLATFORM SCALE	1	II	FAIRBANKS MORSE & CO. [A]
OUTBOARD AILERON STATIC BALANCE TEST JIG	2	III	BOEING TSJ5-88190-1 OR EQUIVALENT
INBOARD AILERON STATIC BALANCE TEST JIG	2	III	BOEING TSJ5-86072-1
ELEVATOR AND RUDDER STATIC BALANCE TEST JIG	2	IV	BOEING 3ME5-96190 OR EQUIVALENT
INBOARD AND OUTBOARD AILERON BALANCE PANEL STATIC BALANCE TEST JIG	2	V	MAKE PART
ELEVATOR AND RUDDER BALANCE PANEL STATIC BALANCE TEST JIG	2	VI	BOEING 2ME5-97214 OR EQUIVALENT
ELEVATOR CONTROL TAB, STABILIZER ACTUATED TAB AND RUDDER TAB STATIC BALANCE TEST JIG	2	VII	MAKE PART
INBOARD AILERON TAB STATIC BALANCE TEST JIG	1	VII AND VIII	MAKE PART
SLIDING WEIGHT - ELEVATOR CONTROL TAB	1	IX	MAKE PART
SLIDING WEIGHT	1	X	MAKE PART
CONTROL SURFACES AFT SUPPORT	1	XI	MAKE PART
BEAM ASSEMBLY	1	XII	BOEING F70330-16 OR EQUIVALENT [D]
PROTRACTOR LEVEL	1		ANY SOURCE
C-CLAMPS	2		ANY SOURCE

NOTE

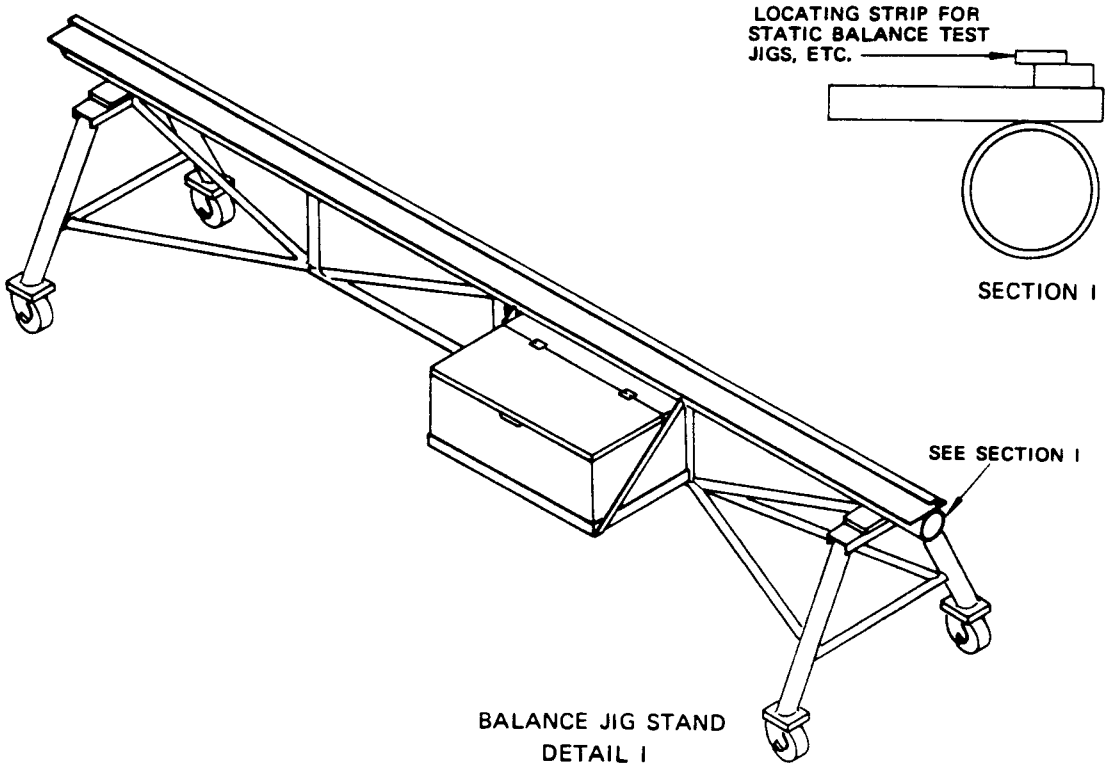
[A] ANY SUITABLE SCALES OF EQUIVALENT CAPACITY AND ACCURACY, WITH BEAM GRADUATION IN 1/100 POUNDS AND 300-POUND CAPACITY. PLATFORM 13.5 X 19.5

[B] MACHINE OFF EXCESS LENGTH TO OBTAIN WEIGHT WITHIN SPECIFIED TOLERANCE.

[C] USE THIS HOLE FOR MOUNTING ELEVATOR ACTUATED TAB WITH PIANO HINGE.

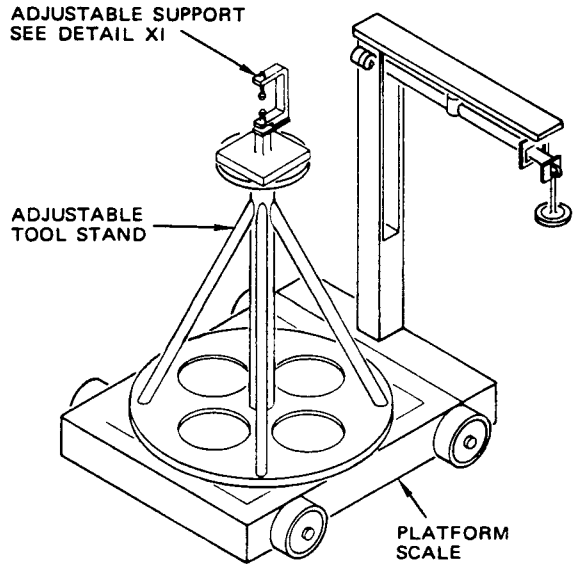
[D] THE -16 BEAM ASSEMBLY MAY BE ORDERED AS A PART OF THE -1 AND -4 ASSEMBLIES WHICH REPLACE THE CORRESPONDING ITEMS ABOVE FOR FUTURE PROCUREMENT

Special Tools and Equipment for Balancing Control Surfaces
Figure 3 (Sheet 1)



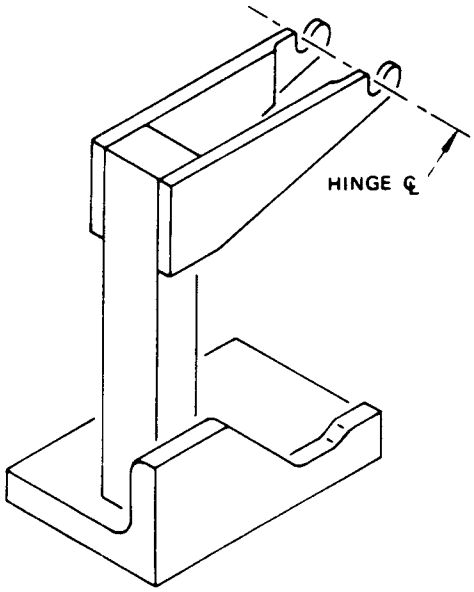
BALANCE JIG STAND
DETAIL I

WEIGHT RANGE (POUNDS)	REQUIRED ACCURACY OF PLATFORM SCALE
6 TO 9	± 0.01
10 TO 34	± 0.1 OF 1% OF THE MEASURED WEIGHT
35 TO 299	± 0.2 OF 1% OF THE MEASURED WEIGHT
300 AND ABOVE	± 0.25 OF 1% OF THE MEASURED WEIGHT



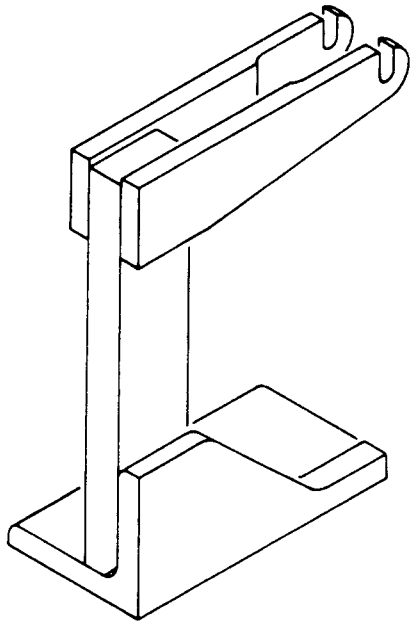
ADJUSTABLE TOOL STAND AND PLATFORM SCALE
DETAIL II

Special Tools and Equipment for Balancing Control Surfaces
Figure 3 (Sheet 2)



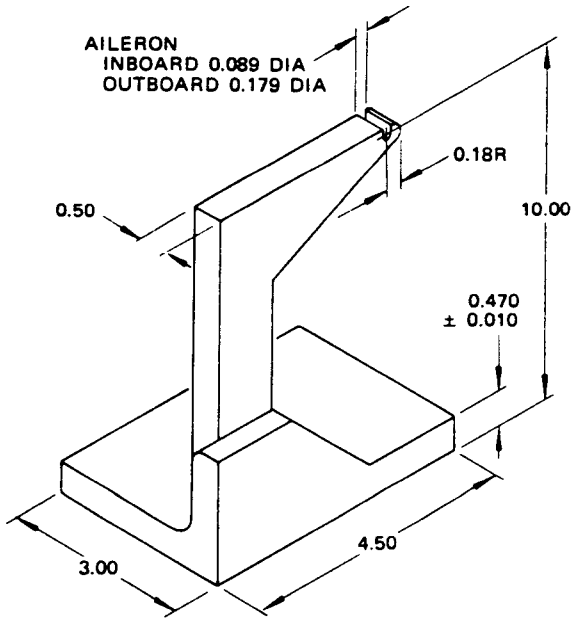
INBOARD AND OUTBOARD AILERON FORWARD HINGE

DETAIL III



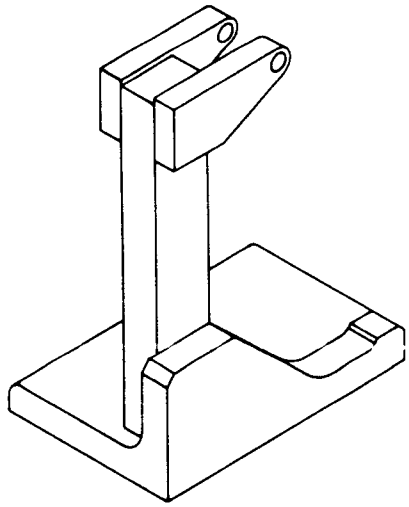
RUDDER AND ELEVATOR FORWARD HINGE

DETAIL IV



INBOARD AND OUTBOARD AILERON BALANCE PANEL

DETAIL V

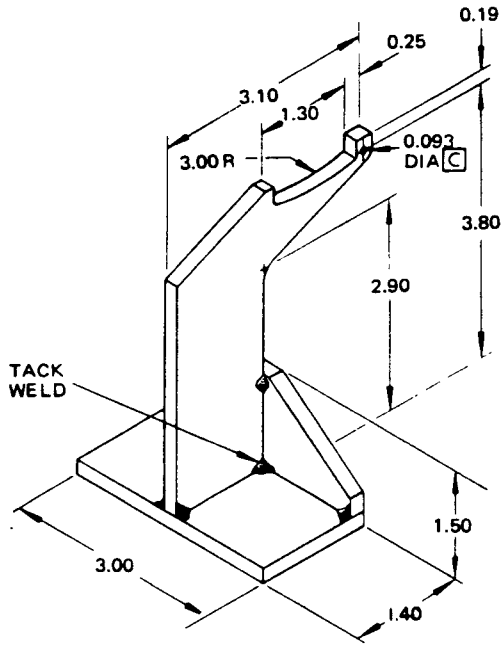


ELEVATOR AND RUDDER BALANCE PANEL

DETAIL VI

STATIC BALANCE TEST JIGS

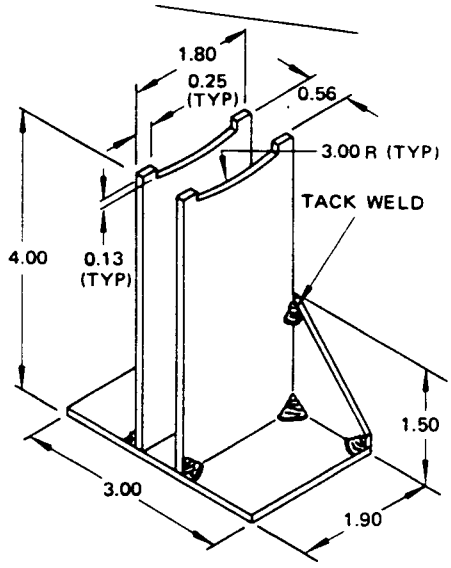
Special Tools and Equipment for Balancing Control Surfaces
Figure 3 (Sheet 3)



MATERIAL: 0.20 STEEL

ELEVATOR CONTROL TAB, STABILIZER ACTUATED TAB AND RUDDER TAB

DETAIL VII



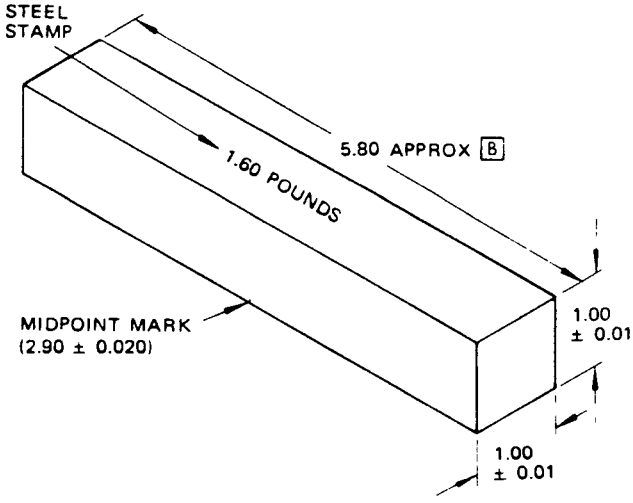
MATERIAL: 0.10 STEEL

INBOARD AILERON TAB

USE THIS FIXTURE AT THE OUTBOARD HINGE BEARING OF INBOARD AILERON TAB.

DETAIL VIII

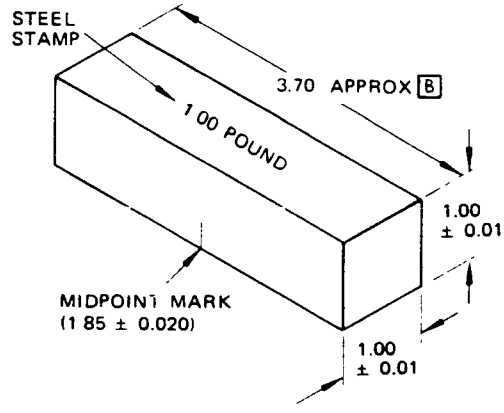
STATIC BALANCE TEST JIGS



WEIGHT 1.60 ± 0.01 POUNDS
MATERIAL STEEL

ELEVATOR CONTROL TAB SLIDING WEIGHT

DETAIL IX

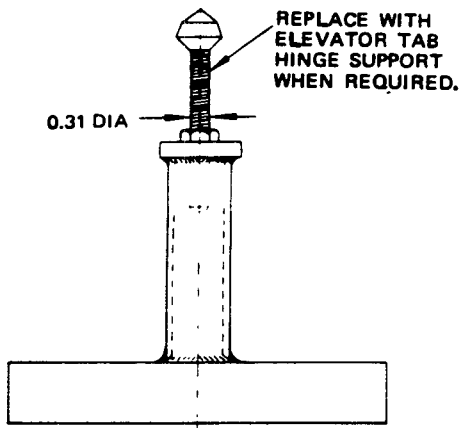


WEIGHT 1.00 ± 0.01 POUNDS
MATERIAL. STEEL

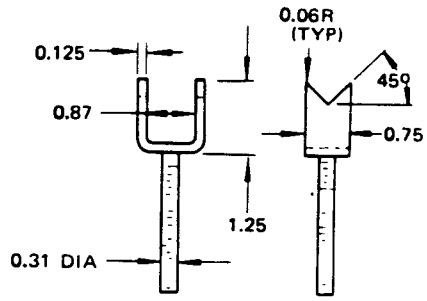
SLIDING WEIGHT

DETAIL X

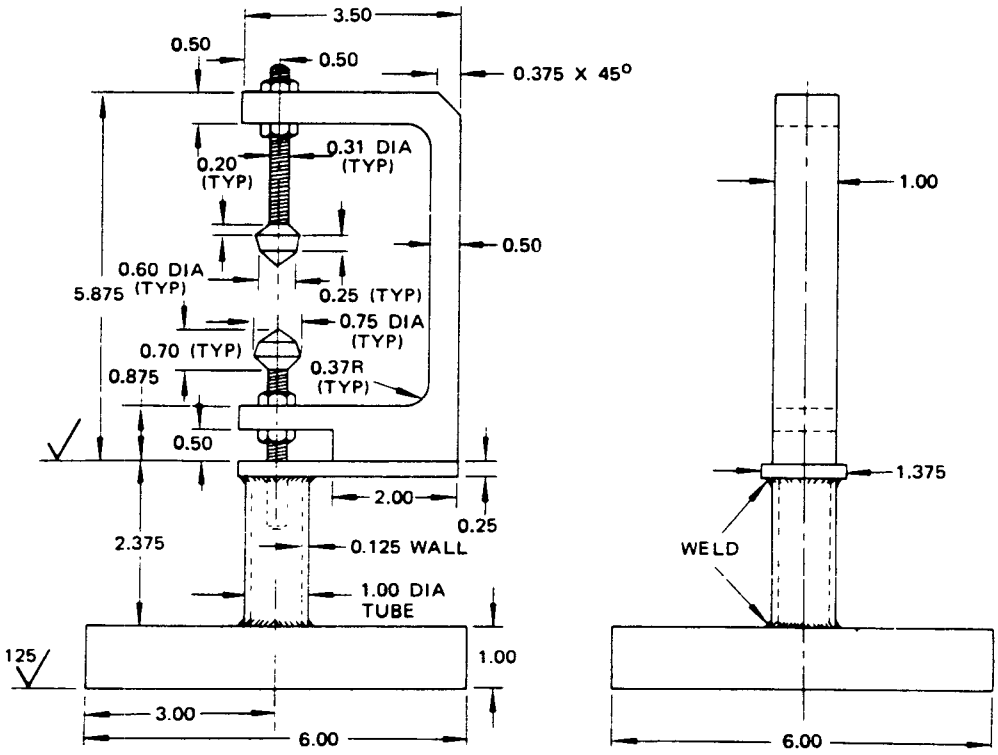
Special Tools and Equipment for Balancing Control Surfaces
Figure 3 (Sheet 4)



FORWARD AND AFT SUPPORT



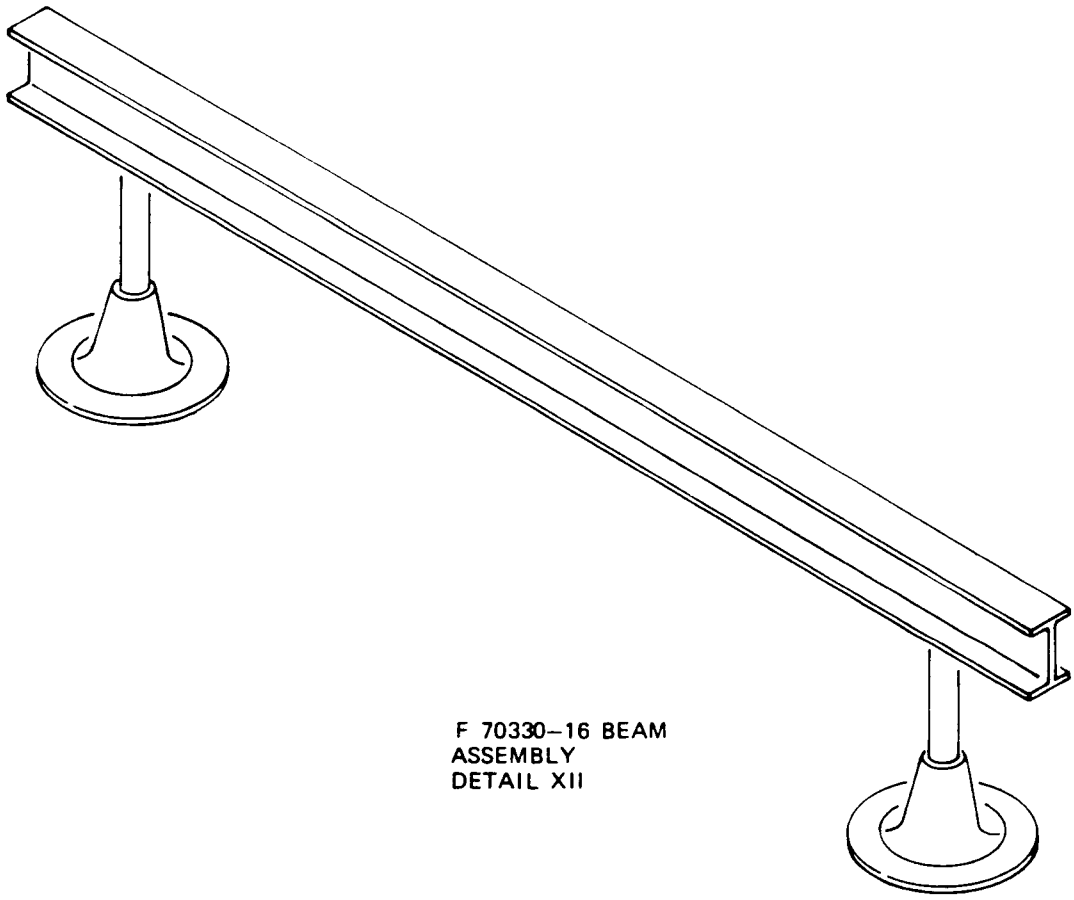
ELEVATOR TAB
HINGE SUPPORT



AFT SUPPORT (OPTIONAL)

CONTROL SURFACE SUPPORTS FOR ADJUSTMENT TO BALANCED ATTITUDE
DETAIL XI

Special Tools and Equipment for Balancing Control Surfaces
Figure 3 (Sheet 5)



F 70330-16 BEAM
ASSEMBLY
DETAIL XII

Special Tools and Equipment for Balancing Control Surfaces
Figure 3 (Sheet 6)

NOTES

- CALCULATE WEIGHT ADDED BY REPAIRS TO CONTROL SURFACES OF HONEYCOMB CONSTRUCTION BY REFERENCE TO TABLES I, II AND III.
- WHERE SUBSTITUTE MATERIALS ARE USED TO REPLACE ORIGINAL PARTS THE DIFFERENCE IN WEIGHT MUST BE CALCULATED.
- ASSUMING GOOD WORKMANSHIP AND CALCULATION THE DEGREE OF ACCURACY ACHIEVED IN CALCULATING WEIGHTS WILL BE WITHIN ± 10% FOR FIBERGLASS ASSEMBLIES AND WITHIN ± 5% FOR METAL ASSEMBLIES.

[A] DENSITY FOR MIX DESCRIBED IN 51-10-1 AND 51-11-1 ONLY.

SAMPLE CALCULATION

1. ASSUME 4-INCH DIAMETER HOLE IN ONE SKIN AND CORE OF ALUMINUM HONEYCOMB PANEL TO BE REPAIRED AS SHOWN IN 51-10-1, FIG. 5. ORIGINAL CORE - BMS 4-4, TYPE 3-10, 1 INCH THICK. ORIGINAL SKIN 0.020 2024 ALUMINUM ALLOY.

2. AS FIBERGLASS IS TO BE SUBSTITUTED FOR THE ORIGINAL ALUMINUM SKIN AND CORE IT IS NECESSARY TO CALCULATE THE WEIGHT OF THE PARTS REMOVED:

   SKIN -- $3.142 \times 2^2 \times 0.002 = 0.0251$ LB
   CORE -- $3.142 \times 2^2 \times 1 \times 0.0018 = 0.0226$ LB

   TOTAL MATERIAL REMOVED 0.0477 LB

3. CALCULATE WEIGHT OF REPAIR MATERIALS:

   NP3/16 - 112 - 4.5 CORE -- $3.142 \times 2^2 \times 1 \times 0.0026 = 0.0327$ LB
   2 PLIES OF 181 FIBERGLASS CLOTH
   $2 \times 3.142 \times 3.5^2 \times 0.00067 = 0.0516$ LB
   CORE SPLICE ADHESIVE (PERIMETER = 3.142×4) = 0.098 LB

   TOTAL WEIGHT OF REPAIR MATERIAL 0.1823 LB

4. SUBTRACT TOTAL IN 2 FROM TOTAL IN 3 TO FIND THE WEIGHT ADDED BY REPAIR:

   $0.1823 - 0.0477 = 0.1346$ LB.

5. REFER TO 51-15-1 THROUGH 51-15-13 FOR REBALANCING INSTRUCTIONS.

Estimated Weight of Honeycomb Repairs
Figure 4 (Sheet 1)

CORE MATERIAL		WEIGHT (LB PER CU. IN.)
POTTED REPAIR	EPOXY RESIN WITH MICROBALLOONS	0.0312 [A]
ALUMINUM	BMS 4-4 TYPE 4-07	0.0009
	BMS 4-4 TYPE 3-07	0.0012
	BMS 4-4 TYPE 4-10	0.0013
	BMS 4-4 TYPE 3-10	0.0018
	BMS 4-4 TYPE 4-15	0.0020
	BMS 4-4 TYPE 3-15	0.0025
	BMS 4-4 TYPE 4-20	0.0025
	BMS 4-4 TYPE 4-25	0.0030
	BMS 4-4 TYPE 3-20	0.0033
	BMS 4-4 TYPE 4-30	0.0035
	BMS 4-4 TYPE 3-25	0.0040
	BMS 4-4 TYPE 4-40	0.0046
	BMS 4-4 TYPE 3-30	0.0047
NONMETALLIC	HRP 3/16-4.0	0.0023
	BMS 8-124, CLASS I, TYPE I, GRADE 4.0	0.0023
	NP 3/16-112-4.5	0.0026
	HRH F/50-10-5.0	0.0029
	EC776-112-6.0	0.0036
	NP 3/16-112-9.0	0.0062

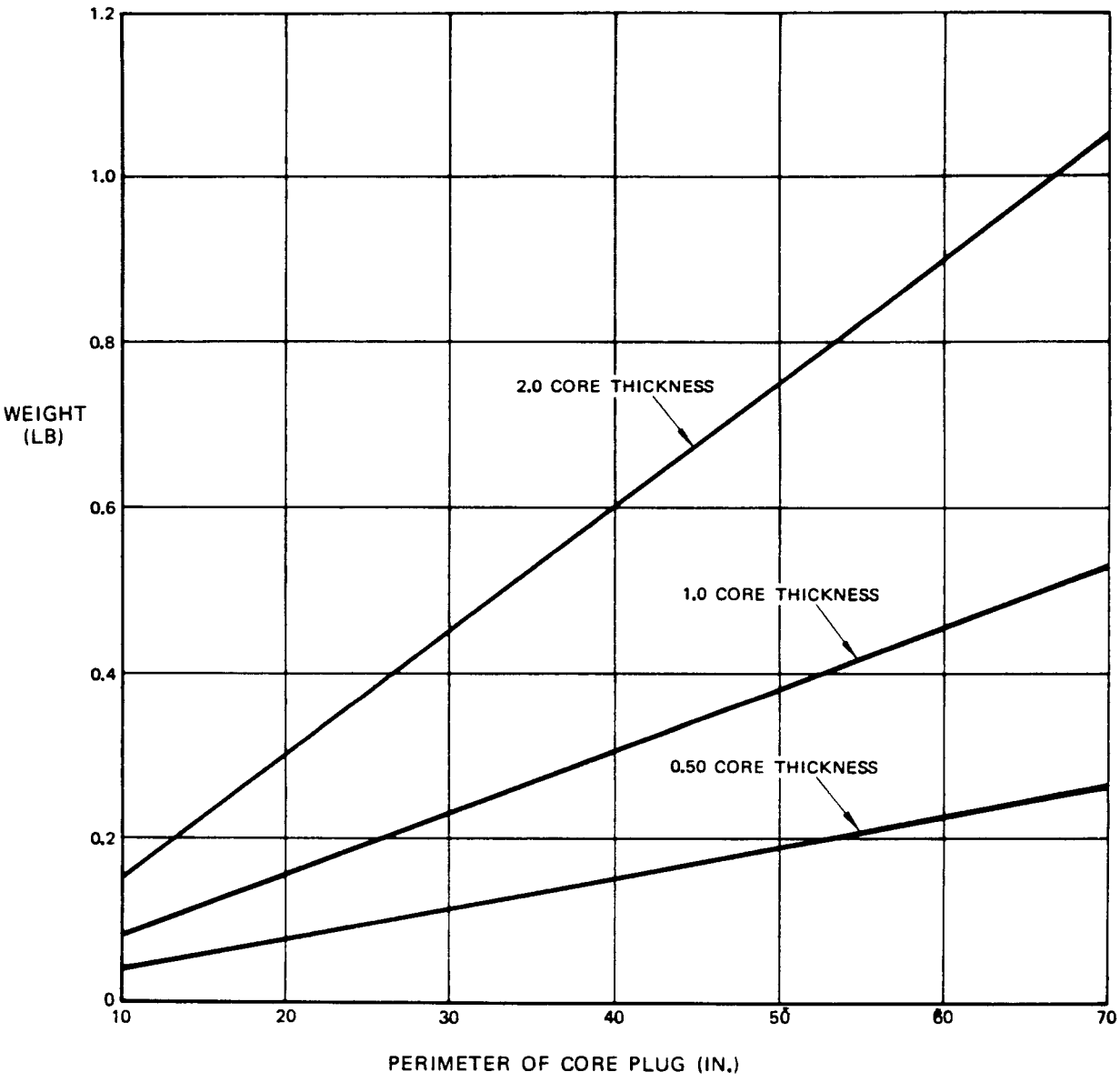
APPROXIMATE WEIGHT OF CORE MATERIALS
TABLE I

SKIN MATERIAL		WEIGHT (LB PER SQ IN.)
FIBERGLASS	NO. 120 CLOTH, RESIN IMPREGNATED AND CURED	0.00030
	NO. 181 CLOTH, RESIN IMPREGNATED AND CURED	0.00067
ALUMINUM ALLOY	0.010 2024 SHEET	0.0010
	0.012 2024 SHEET	0.0012
	0.016 2024 SHEET	0.0016
	0.018 2024 SHEET	0.0018
	0.020 2024 SHEET	0.0020
	0.022 2024 SHEET	0.0022
	0.025 2024 SHEET	0.0025

FIBERGLASS LAY-UP = 0.067 LB PER CU. IN.

APPROXIMATE WEIGHT OF SKIN MATERIALS
TABLE II

Estimated Weight of Honeycomb Repairs
Figure 4 (Sheet 2)



WEIGHT OF ADHESIVE FOR SPLICING CORE
TABLE III

Estimated Weight of Honeycomb Repairs
Figure 4 (Sheet 3)

FINISH	WEIGHT PER SQ FT (POUNDS)
BMS 10-11 EPOXY PRIMER, PER 0.001 INCH OF THICKNESS	0.010
BMS 10-60 OR 10-72 ENAMEL, PER 0.001 INCH OF THICKNESS	0.008
ALUMINUM FLAME SPRAY	0.085
STATIC CONDITIONER + PIN HOLE FILLER + CONDUCTIVE COATING	0.020

WEIGHT OF FINISHING MATERIAL
TABLE I

NOTES

- THE WEIGHT OF NORMAL APPLICATION OF PAINT (BOEING) IS:

  WASH PRIMER (0.0004 THICK) = 0.004 LB PER SQ FT
  INTERMEDIATE PRIMER (0.0008 THICK) = 0.008 LB PER SQ FT
  ENAMEL (0.002 THICK) = 0.016 LB PER SQ FT

  TOTAL 0.028 LB PER SQ FT

- THE VARIATION OF PAINT THICKNESS IS NORMALLY WITHIN THE TOLERANCE ± 0.001 INCH.

Estimated Weight of Finish
Figure 5

INBOARD AILERON REBALANCING

1. General

A. Accurate rebalancing of the inboard aileron can only be achieved when the surface is balanced in a specific configuration. Two configurations have been established for rebalancing, one with the tab control rods and linkage installed and the second with the control rods and linkage removed (Fig. 1). Excess or missing parts will produce erroneous results and, consequently, a configuration check must be made before rebalancing. It should be noted that the inboard aileron may have either a single or double tab control rod installation.

B. The control tab and balance panels are removed from the inboard aileron and are balanced as separate assemblies (Ref 51-15-2 and 51-15-3). However, for the rebalancing operation, the attaching hardware and grounding jumpers for the control tab must be installed in the correct locations on the aileron.

C. Any decorative paint and protective finish must be applied to the surface prior to rebalancing operation.

D. The permanent weights listed in Fig. 1, which also serve as retainers for any additional weights required by rebalancing, must be installed in the correct locations on the inboard aileron with all attaching bolts.

2. Special Tools and Equipment

A. The equipment required during rebalancing is illustrated in Fig. 2. (See also 51-15-0, Fig. 3.)

3. Balancing Procedures with Inboard Aileron Removed from Airplane

A. Prepare the aileron as described in Fig. 1 and locate on the balance jig stand using static balance test jigs at WS 466.360 and WS 535.140 (Fig. 2).

NOTE: Aileron must be free to rotate about the hinge line.

B. Locate a weighing scale and a control surface support tool under the horn as shown in Fig. 2. This will ensure that a download is applied to the weighing scale.

C. Adjust the support tool until the aileron is in a balanced attitude (when the chord line is horizontal) and record to the nearest tenth of a pound the weight reaction (WR) at the centerline of the balance panel hinge (Fig. 2).

NOTE: Before rebalancing, insert wood dowels through rigging pinholes in tab control rod linkages to hold rod assemblies in fixed positions.

D. Determine the trial moment by multiplying the weight reaction (WR) (pounds) by the -14.00 inch moment arm.

Trial moment = (WR) (-14.00) LB-IN

NOTE: Since (B) is measured forward of the hinge line it will be negative and, therefore, the actual moment will be negative.

E. Using the trial moment obtained in par. 3.D., determine the number and location of balance weights to be added to the aileron from the table related to the type of balance configuration (Fig. 4).

F. Install the weights in the locations required by Fig. 6 and carry out a second trial moment as detailed in par. 3.B. thru 3.D. The second trial moment is designated the check balance moment.

G. Install the required number of balance weights in the designated locations. (See Fig. 6 for mounting locations.)

NOTE: When manufacturer's balance weights are not available, additional weights may be fabricated per Fig. 5.

H. The inboard aileron is now balanced within the required moment limits (51-15-0, Fig. 1).

4. Sample Calculation for Balancing an Inboard Aileron Configuration II- with Single Tab Control Rod Removed

A. The following is a summation of the steps of par. 3.A. thru 3.C. (all values are assumed).

(1) Mount the aileron and measure the weight reaction and moment arm (par. 3.A. thru 3.C.).

Weight reaction (WR) = 12.57 pounds
Moment arm (B) = -14.00 inches

(2) Determine trial moment (par. 3.D.).

(WR)(B) = (12.57 pounds)(-14.00 inches)
= -175.98 pound-inches

(3) From table 1, Fig. 4 determines that this moment requires the addition of one balance weight, P/N 69-18086, on the upper surface. See Fig. 6 for mounting location of weight.

(4) Determine the check balance moment (par. 3.F.).

(WR) = 13.67 pounds
(B) = -14.00 inches
Check balance moment = (WR)(B)
= (13.67 pounds)(-14 inches)
= -191.38 pound-inches

(5) This moment, from Table II of Fig. 4 requires the addition of four balance weights P/N 65-1091-16 on the lower surface of the aileron See Fig. 6 for mounting locations.

5. Adjustment of Balance after Minor Repair with Inboard Aileron Installed

A. The effect of minor repairs on the inboard aileron must be calculated and, if necessary, the balance condition adjusted before putting the airplane back in service, provided there is space for the installation of the required balance weights. Where there is not sufficient space for the addition of the required balance weights, rebalance as described in par. 3 and 4. Adjust the aileron balance condition as follows:

(1) Determine the net weight of the repair (within 0.03 pound) by subtracting the weight of the removed damaged material from the approximated weight of the repair (Ref 51-15-0).

(2) Measure the distance (Y) from the centerline of the aileron hinge to the center of gravity of the repair (Fig. 3).

(3) The distance from the CG of the balance weights to the centerline of the aileron hinge is 11.00 inches.

(4) Multiply the net weight of the repair by distance (Y) to obtain the repair moment.

(5) Divide the repair moment by 11.00 inches to calculate the number of weights required to restore the balance of the aileron.

NOTE: When the required balance weight is less than 0.33 pound, additional balance weights need not be installed; however, the resulting balance weight requirement must be accounted for during subsequent repair and rebalancing calculations.

(6) Install the balance weights in the sequence and locations shown in Fig. 6.

6. Sample Calculation for Rebalancing after Minor Repair with Aileron Installed (Ref par. 5)

A. Calculate the effect of a repair to an aileron as follows: (All values are assumed.)

(1) Weigh the material removed from damage area. 0.10 pound

(2) Weigh all material used to make the repair. 0.60 pound

(3) Subtract 0.10 from 0.60 to obtain net weight. 0.50 pound

(4) Measure distance (Y). 21.02 inches

(5) Distance from CG of balance weights to centerline of hinge = 11.00 inches

(6) Calculate repair moment:

Distance (Y) x net weight

21.02 X 0.50 10.51 pound-inches

(7) Determine the amount of weight to be added.

(Repair moment divided by 11.00 inches)

$\frac{10.51}{11}$ = 0.96 pound

(8) Calculate the number of balance weights required, as follows:

(a) USE BALANCE WEIGHTS P/N 65-1091-16.

$$\text{No. of weights} = \frac{\text{extra weight required}}{\text{weight of one balance weight}}$$

$$= \frac{0.96}{0.35} = 2.74$$

3 balance weights are required.

INBOARD AILERON - BALANCING CONFIGURATION

CONFIGURATION I - With the control rods and linkage installed.

(a) Remove the following parts:

[1] Aileron control tab

[2] Balance panel

[3] Balance panel hinge pins

[4] End seal assemblies

(b) Install the following components:

[5] Fabric hinge seals and retaining pins

[6] The following permanent balance weights, which serve as adjust weight retainers, must be attached to the required surface with all attaching bolts installed. (See Fig. 6 for mounting diagram.)

QUANTITY	PART NUMBER	LOCATION
1	69-12022-15	UPPER SURFACE - INBOARD HORN
1	69-12022-16	UPPER SURFACE - OUTBOARD HORN
4	65-1091-1, -2 OPP	LOWER SURFACE - INBOARD HORN
1	65-1091-3, -4 OPP	LOWER SURFACE - OUTBOARD HORN
3	65-1091-1, -2 OPP	LOWER SURFACE - OUTBOARD HORN

[7] Aileron control tab hinge bolts and nuts. Bonding jumpers, spacers and hardware

[8] Aft half of balance panel aft hinge

NOTE: Before rebalancing inboard aileron with control rods and linkages installed (Configuration I) insert wood dowels through rigging pin hole in control rod linkages to hold rod assemblies in fixed position.

Inboard Aileron - Preparation for Balancing
Figure 1 (Sheet 1)

CONFIGURATION II - With the control rods and linkage removed.

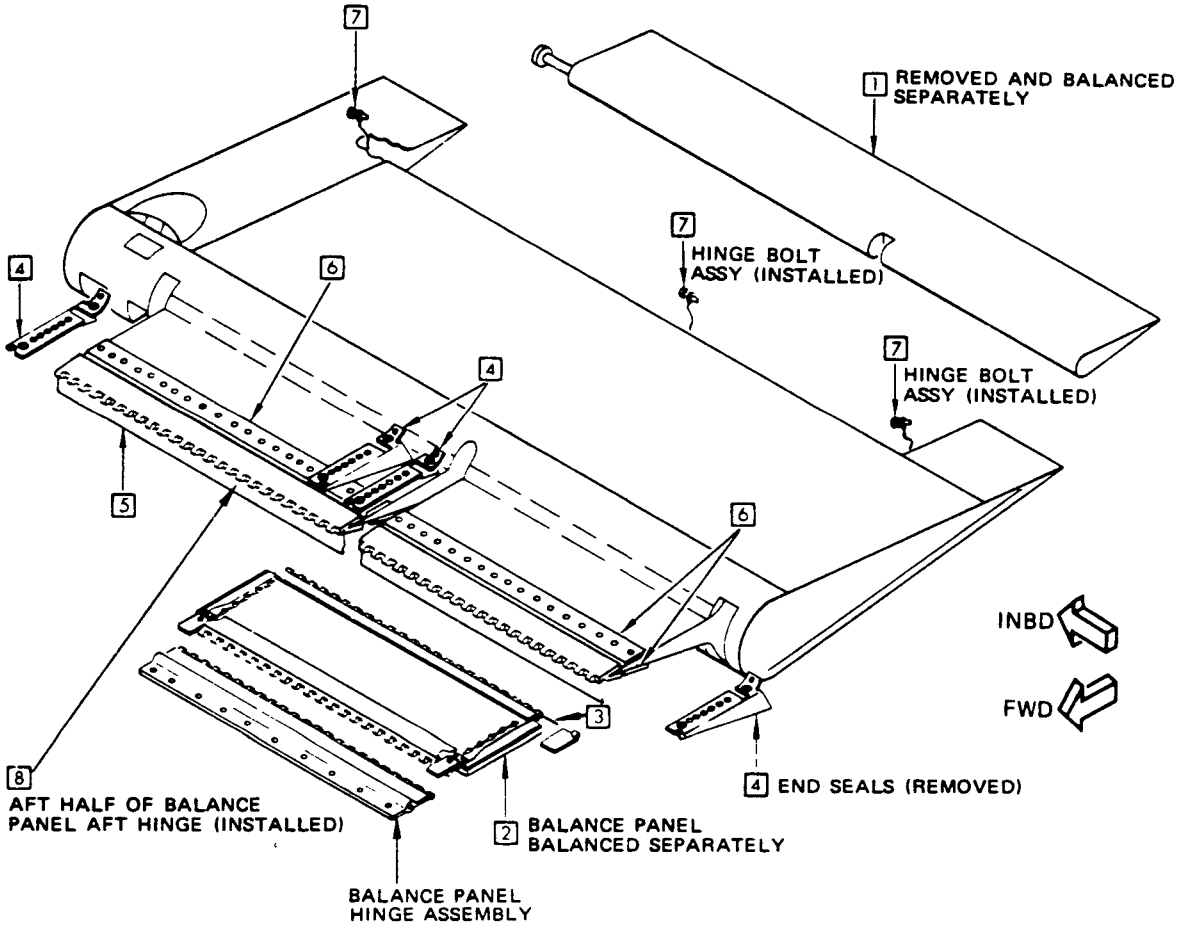
WITH SINGLE TAB CONTROL ROD INSTALLATION

Same as configuration I except tab control rod 6-63233 is removed.

WITH DUAL TAB CONTROL ROD AND LINKAGE

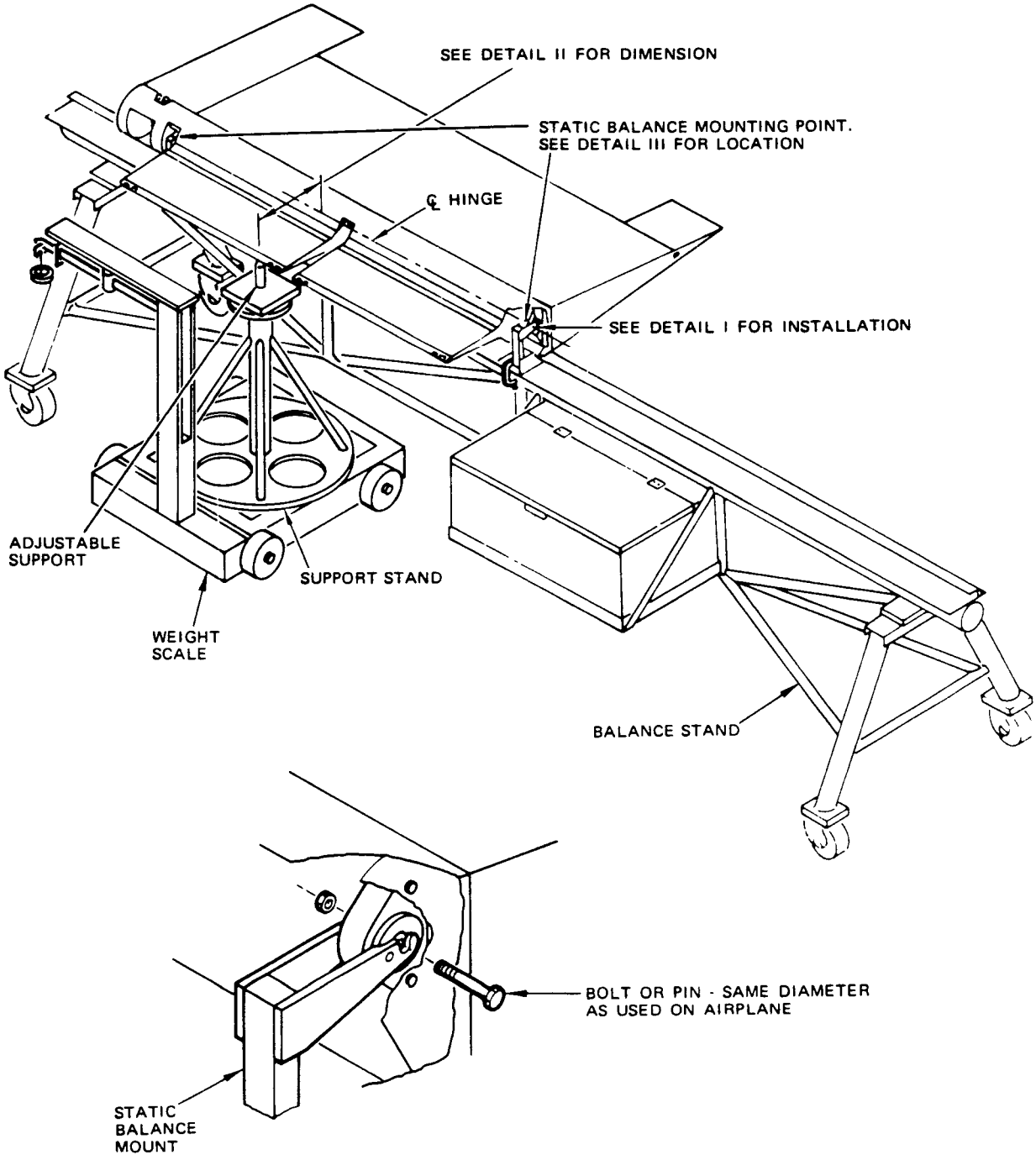
Same as configuration I except tab control rod assemblies 6-63233 and 69-11426-2, and linkage assemblies 65-18410-1 and 66-12410-1 are to be removed.

NOTE: Paint and protective finishes must be applied to the aileron prior to balancing.



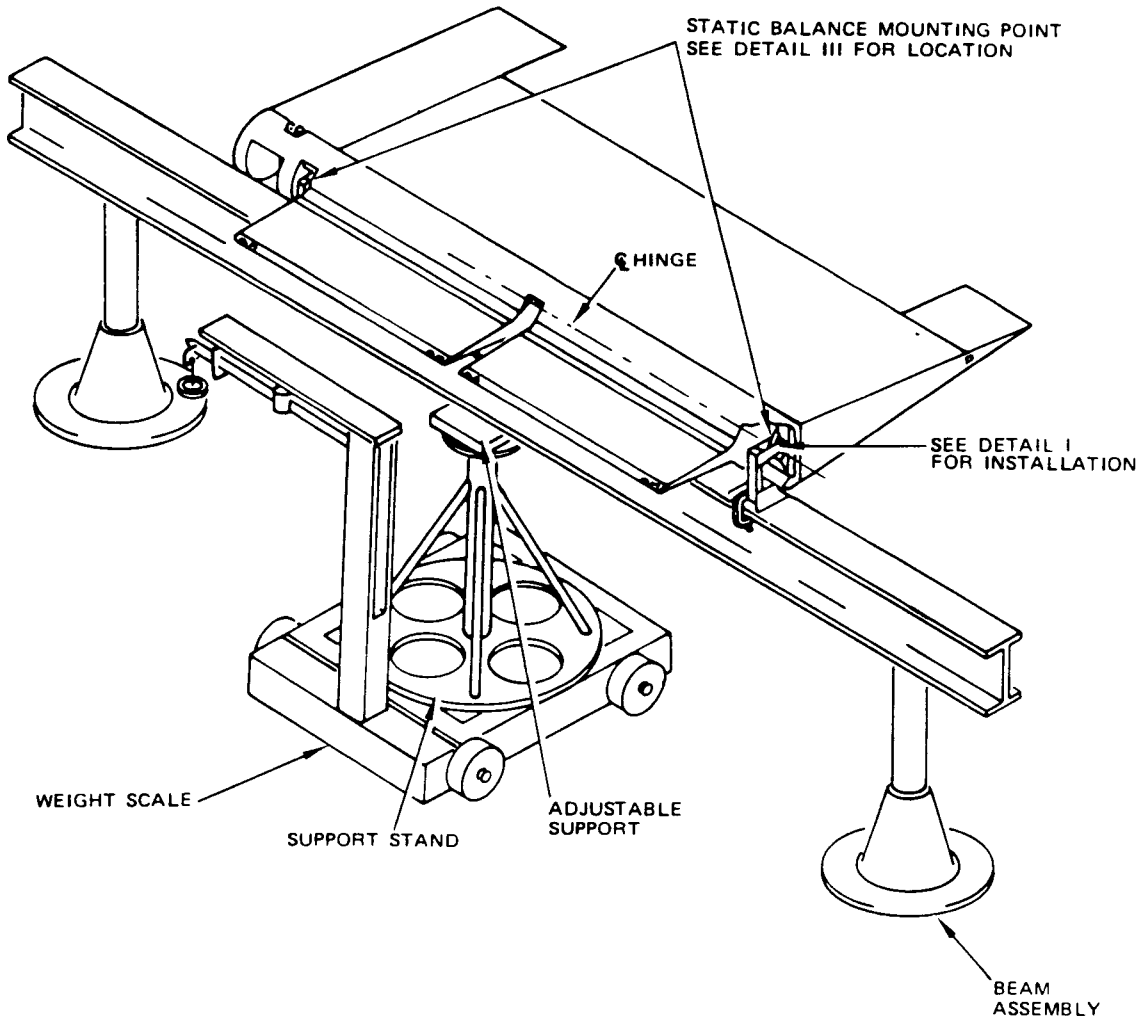
INBOARD AILERON - BALANCING CONFIGURATION

Inboard Aileron - Preparation for Balancing
Figure 1 (Sheet 2)

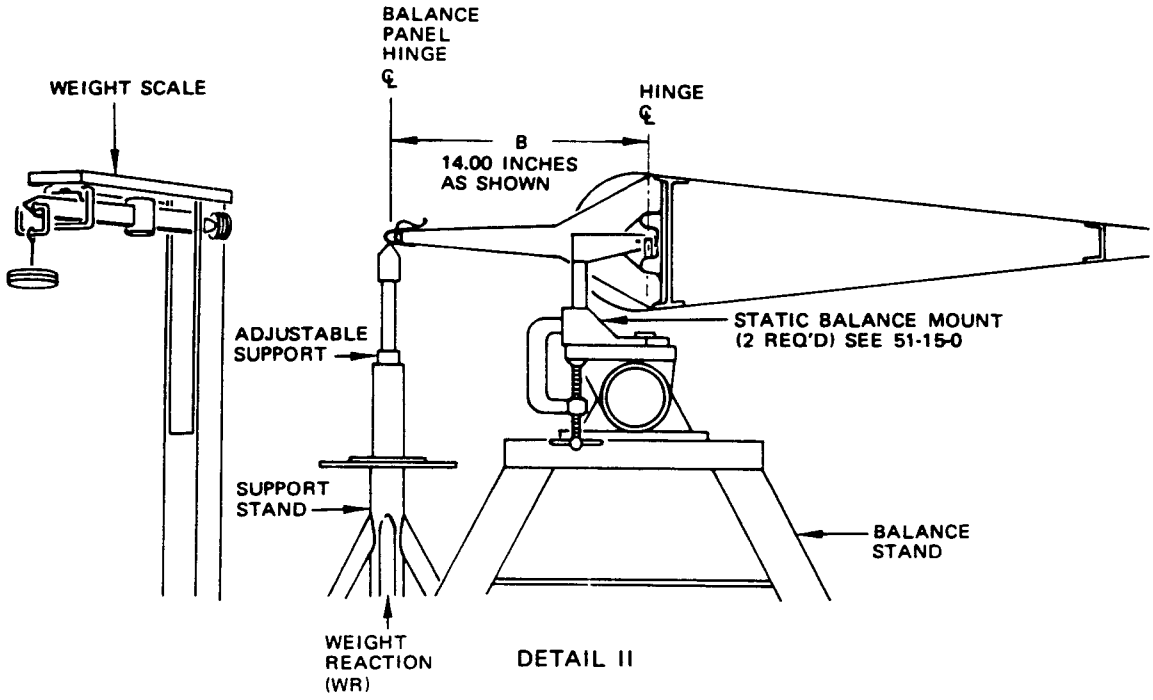


DETAIL I

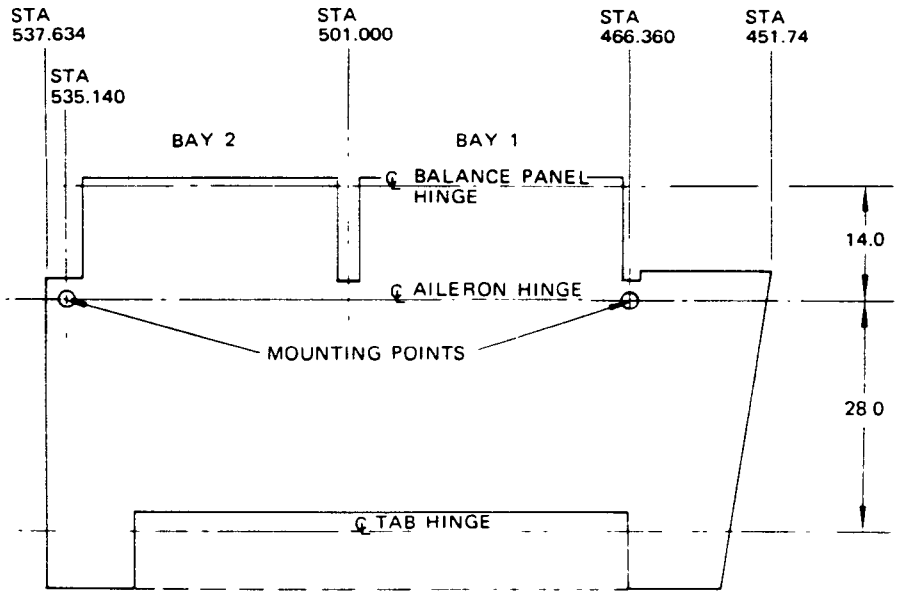
Inboard Aileron Support During Balancing
Figure 2 (Sheet 1)



Inboard Aileron Support During Balancing
Figure 2 (Sheet 2)

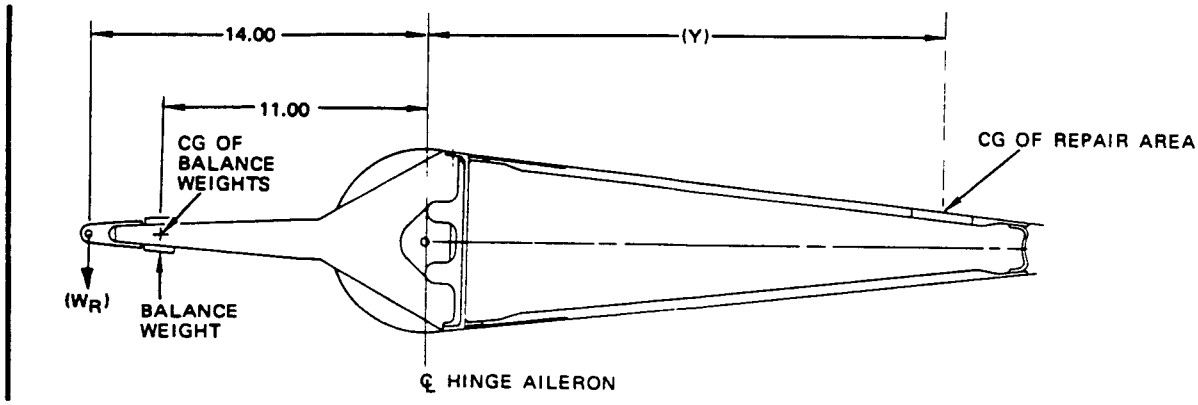


DETAIL II



DETAIL III

Inboard Aileron Support During Balancing
Figure 2 (Sheet 3)



Inboard Aileron - Moment Arm Diagram
Figure 3

TRIAL MOMENT (POUND-INCHES)	QUANTITY OF 69-18086 WEIGHTS REQUIRED	QUANTITY OF 69-18086-1 WEIGHTS REQUIRED
0 TO 145 [B]	2	2
145.01 TO 161 [B]	2	1
161.01 TO 175 [B]	1	1
175.01 TO 191 [B]	1	0
191.01 TO 205 [B]	0	0
205.01 TO 215 [A]	0	0

UPPER SURFACE BALANCE WEIGHTS
TABLE I

CHECK BALANCE MOMENT (POUND-INCHES)	WEIGHTS REQUIRED (65-1091-16) [C]
0 - 139	18
139.01 - 143	17
143.01 - 147	16
147.01 - 151	15
151.01 - 155	14
155.01 - 159	13
159.01 - 163	12
163.01 - 167	11
167.01 - 171	10
171.01 - 175	9
175.01 - 179	8
179.01 - 183	7
183.01 - 187	6
187.01 - 191	5
191.01 - 195	4
195.01 - 199	3
199.01 - 203	2
203.01 - 205	1
205.01 - 215	0 [A]

LOWER SURFACE BALANCE WEIGHTS
TABLE II

SINGLE CONTROL ROD CONFIGURATION
(ROD NOT INSTALLED)

Inboard Aileron - Balance Weight Requirements
Figure 4 (Sheet 1)

TRIAL MOMENT (POUND-INCHES)	QUANTITY OF 69-18086 WEIGHTS REQUIRED	QUANTITY OF 69-18086-1 WEIGHTS REQUIRED
0 TO 171 [B]	2	2
171.01 TO 187 [B]	2	1
187.01 TO 201 [B]	1	1
201.01 TO 217 [B]	1	0
217.01 TO 231 [B]	0	0
231.01 TO 241 [A]	0	0

UPPER SURFACE BALANCE WEIGHTS
TABLE III

CHECK BALANCE MOMENT (POUND-INCHES)	WEIGHTS REQUIRED (65-1091-16) [C]
0 - 165	18
165.01 - 169	17
169.01 - 173	16
173.01 - 177	15
177.01 - 181	14
181.01 - 185	13
185.01 - 189	12
189.01 - 193	11
193.01 - 197	10
197.01 - 201	9
201.01 - 205	8
205.01 - 209	7
209.01 - 213	6
213.01 - 217	5
217.01 - 221	4
221.01 - 225	3
225.01 - 229	2
229.01 - 231	1
231.01 - 241	0 [A]

LOWER SURFACE BALANCE WEIGHTS
TABLE IV

DOUBLE CONTROL ROD CONFIGURATION
(RODS AND LINKAGE NOT INSTALLED)

Inboard Aileron - Balance Weight Requirements
Figure 4 (Sheet 2)

TRIAL MOMENT (POUND-INCHES)	QUANTITY OF 69-18086 WEIGHTS REQUIRED	QUANTITY OF 69-18086-1 WEIGHTS REQUIRED
0 TO 135 [B]	2	2
135.01 TO 151 [B]	2	1
151.01 TO 165 [B]	1	1
165.01 TO 181 [B]	1	0
181.01 TO 195 [B]	0	0
195.01 TO 205 [A]	0	0

UPPER SURFACE BALANCE WEIGHTS
TABLE V

CHECK BALANCE MOMENT (POUND-INCHES)	WEIGHTS REQUIRED (65-1091-16) [C]
126-128	18
129-132	17
133-136	16
137-140	15
141-144	14
145-148	13
149-152	12
153-156	11
157-160	10
161-164	9
165-168	8
169-172	7
173-176	6
177-180	5
181-184	4
185-188	3
189-192	2
193-194	1
195-205	0 [A]

LOWER SURFACE BALANCE WEIGHTS
TABLE VI

SINGLE OR DOUBLE CONTROL ROD CONFIGURATION
(RODS AND LINKAGE INSTALLED)

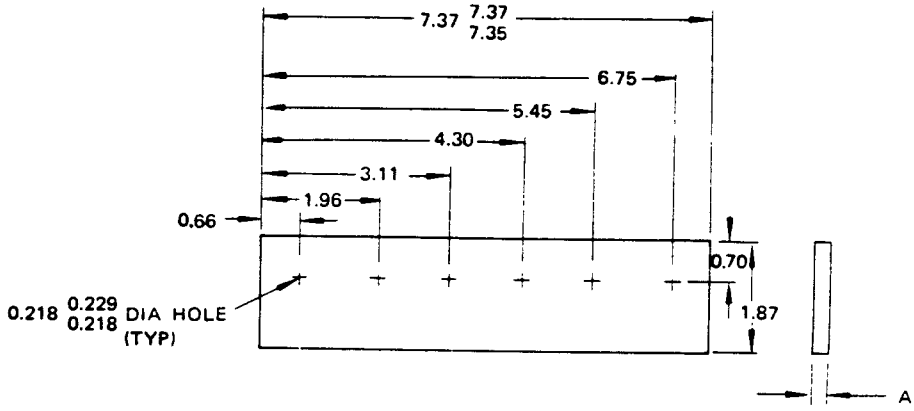
NOTE

[A] REQUIRED MOMENT RANGE. THE AILERON IS BALANCED WHEN MOMENT IS IN THIS RANGE.

[B] ADD REQUIRED WEIGHTS IN CORRECT POSITIONS ON UPPER SURFACE OF HORN. (SEE FIGURE 6) CARRY OUT CHECK BALANCE AS REQUIRED BY PARAGRAPH 3.D. AND ADD (AS NECESSARY) THE BALANCE WEIGHTS AS SHOWN IN THE APPLICABLE TABLES. (SEE FIGURE 6 FOR MOUNTING LOCATIONS OF BALANCE WEIGHTS.)

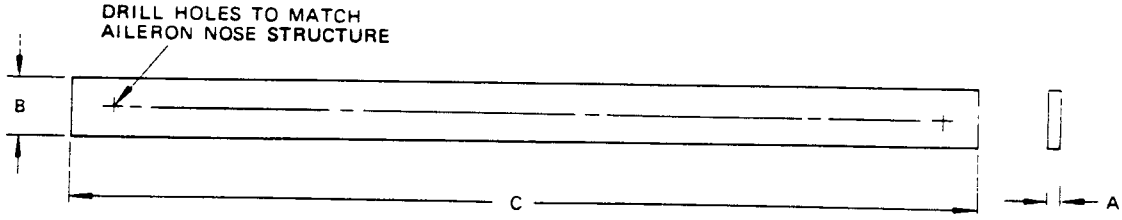
[C] MAXIMUM NUMBER (INCLUDING THOSE INSTALLED AT MANUFACTURE) MUST NOT EXCEED 26.

Inboard Aileron - Balance Weight Requirements
Figure 4 (Sheet 3)



BOEING P/N	WEIGHT POUNDS	DIM A	MATERIAL	FINISH
65-1091-1 AND 65-1091-3	0.28	0.063	NAVAL BRASS ACCORDING TO QQ-B-638 CLASS A	CADMIUM PLATE TO MEET REQUIREMENTS OF QQ-P-416, TYPE II, CLASS 2 AND APPLY TWO COATS OF BMS 10-11, TYPE I PRIMER
65-1091-16	0.35	0.065	6% ANTIMONY LEAD COMPOSITION ACCORDING TO L-16	APPLY TWO COATS OF BMS 10-11, TYPE I PRIMER

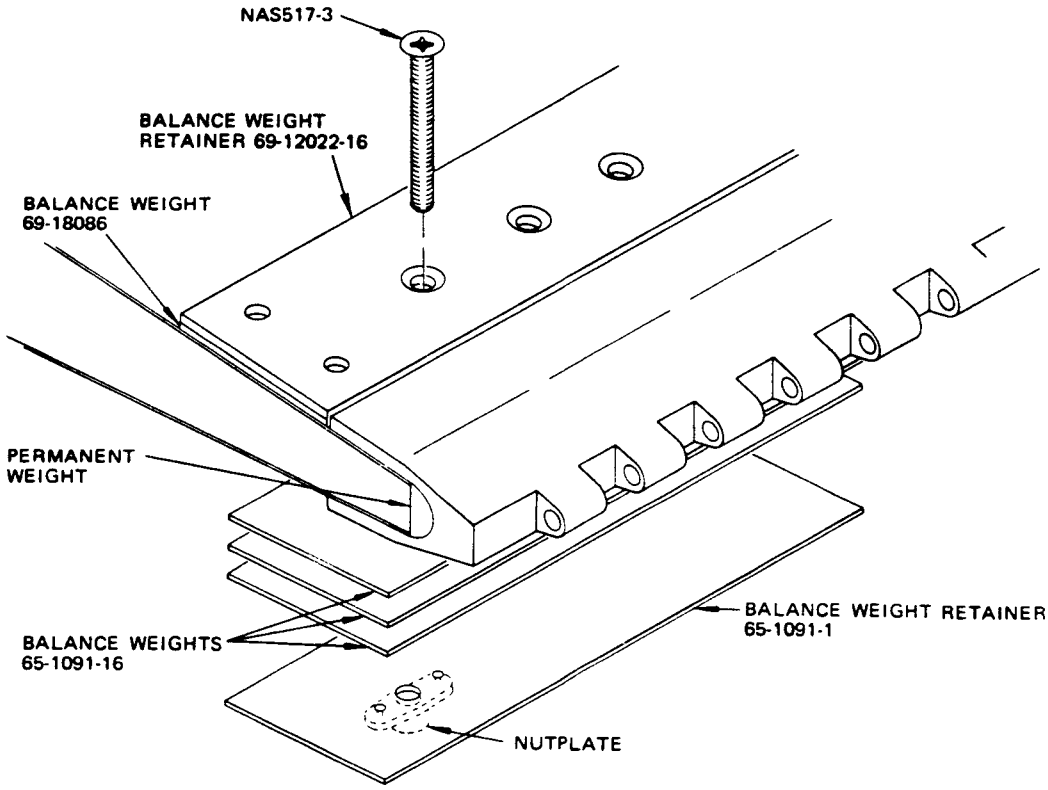
BALANCE WEIGHTS 65-1091-1, 65-1091-3 AND 65-1091-16



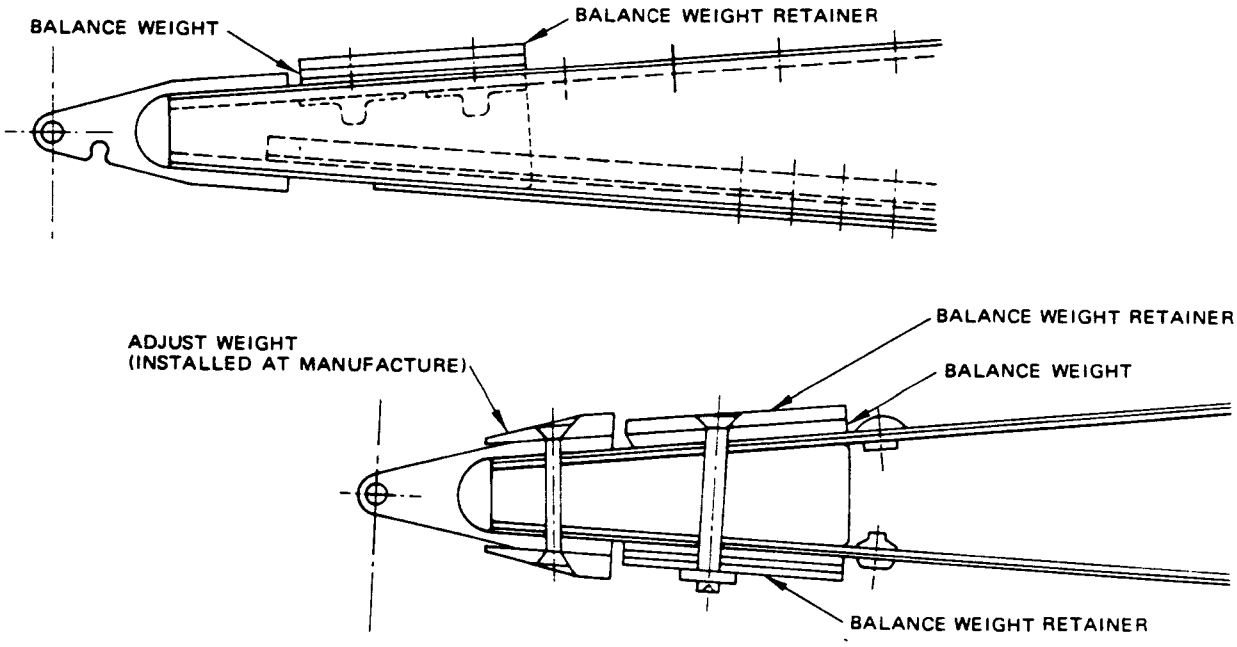
BOEING P/N	WEIGHT POUNDS	DIMENSIONS			MATERIAL	FINISH
		A	B	C		
69-12022-15	1.92	0.112	1.87	32.28	4130 STEEL NORMALIZED ACCORDING TO AN-QQ-S-625	CADMIUM PLATE ACCORDING TO QQ-P-416, TYPE II, CLASS 2 AND APPLY ONE COAT OF BMS 10-11, TYPE I PRIMER PLUS ONE COAT OF BMS 10-11, TYPE II ENAMEL
69-12022-16	1.80	0.112	1.87	30.40	8630 OPTIONAL NORMALIZED ACCORDING TO AN 5-12	
69-18086	1 47	0.06 OR 0.065	1.90	32.30	6% ANTIMONY LEAD COMPOSITION ACCORDING TO L-16	APPLY TWO COATS OF BMS 10-11, TYPE I PRIMER
69-18086-1	1.38	0.06 OR 0.065	1.90	30 40		

BALANCE WEIGHTS 69-12022-15, 69-12022-16, 69-18086 AND 69-18086-1

Inboard Aileron - Balance Weight Dimensions and Installation
Figure 5 (Sheet 1)

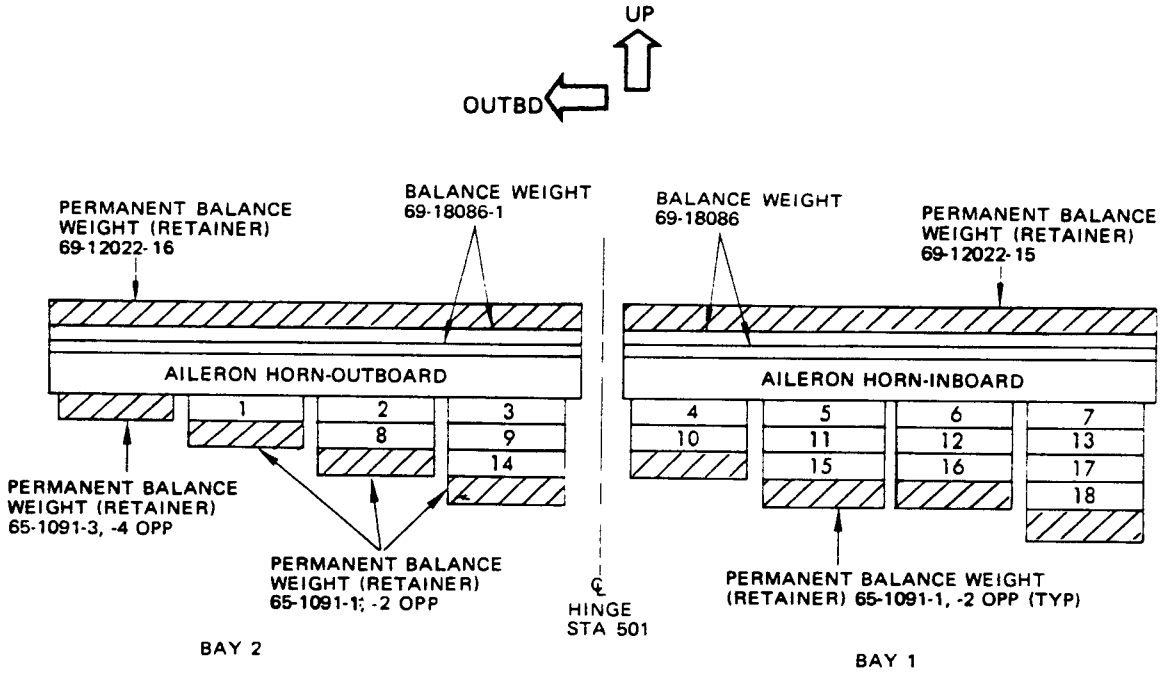


TYPICAL INSTALLATION



ALTERNATIVE INSTALLATIONS

Inboard Aileron - Balance Weight Dimensions and Installation
Figure 5 (Sheet 2)



MAXIMUM QUANTITIES OF BALANCE WEIGHTS ARE AS SHOWN.
INSTALL 65-1091-16 IN NUMERICAL ORDER, POSITIONS 1 THROUGH 18 AS REQUIRED.

Balance Weight Mounting Diagram
Figure 6

INBOARD AILERON BALANCE PANELS - REBALANCING

1. General

A. The inboard aileron balance panels are balanced in the following manner and to the configuration as defined in Fig. 1. During the balancing procedure the permanent weights (P/N 69-12022-8 on the upper surface of the outboard panel and P/N 69-12022-9 on the upper surface of the inboard panel) must be installed using all attaching hardware. The tab adjust weights (P/N 69-21080-1 on the lower surface of the panel) must be removed before rebalancing.

2. Specific Tools and Equipment

A. The equipment required during balancing are illustrated in Fig. 2. (See 51-15-0, Fig. 3 for complete description of these items.)

3. Balancing Procedures

A. Prepare the balance panel as described in Fig. 1.

NOTE: This procedure can be used to balance both balance panels of the inboard aileron assembly.

B. Weigh the balance panel and record the weight (W) to the nearest one-hundredth of a pound.

C. Mount the balance panel in the static balance mount (Fig. 2).

NOTE: The panel must rotate freely about the hinge line.

D. Locate a weighing scale and an adjustable support under the balance panel as shown in Fig. 2.

CAUTION: LOCATE THE SUPPORT TOOL SO THAT THE REACTION FITTING WILL NOT DAMAGE THE BALANCE PANEL.

E. Adjust the support tool to place the panel in a horizontal position and measure the weight reaction (WR) to the nearest one-hundredth of a pound at the known moment arm (B) (Fig. 2).

INBOARD AILERON TAB BALANCING

1. Rebalancing Procedures

A. Prepare the tab assembly to the configuration shown in Fig. 1. Weigh the tab assembly.

B. Lay out distances X Min and X Max as shown in Fig. 2 (See Fig. 3 for required dimensions).

C. Set up tab on balancing fixtures as shown in Fig. 4. Ascertain that tab is free to rotate without binding.

NOTE: Remove protractor level during balancing operations.

D. Place a 1.00-pound sliding weight aft of the aft pencil mark and approximately parallel to the tab hinge axial center line, with the midpoint mark in line with the center of the tab hinge fitting. Slowly move the weight towards the tab leading edge, maintaing the weight position parallel to the tab line axial center line, until tab trailing edge just begins to rise from the supporting blocks. Make use of the lines on the ruled paper attached to the tab skin (Fig. 2).

E. Note the position of the midpoint mark of the sliding weight and adjust with tab balance weights as follows:

(1) When the surface of the sliding weight with the midpoint mark is between the forward and aft pencil marks, balance weight adjustment is not required.

(2) When the surface of the sliding weight with the midpoint mark is forward of the forward pencil mark, the tab is tail-heavy. Balance weights must be added as follows:

(a) Determine the amount of balance weight to be added by trial and error or by the following method:

1) Measure distance Y (Fig. 4).

2) Calculate the approximate length in inches of additional balance weight required by using the applicable formula shown in Fig. 5.

(b) Make balance weight (Fig. 6).

(c) Temporarily install the balance weight. Attaching fasteners must be loosely installed (Fig. 7).

(d) Repeat steps A, B, C, and D.

(e) When the tab is balanced, permanently install the balance weights and continue with steps F thru H.

(3) When the surface of the sliding weight with the midpoint mark is aft of the aft pencil mark, the tab is nose-heavy. Balance weights must be removed as follows:

(a) Determine the approximate length in inches of balance weight to be removed by trial and error or by the following method:

1) Measure Distance Y (Fig. 4).

2) Calculate the approximate length in inches of balance weight to be removed by using the applicable formula shown in Fig. 5.

(b) Remove the balance weight from tab.

(c) Cut the balance weight to the required length.

(d) Temporarily install the balance weight. Attaching fasteners must be loosely installed (Fig. 7).

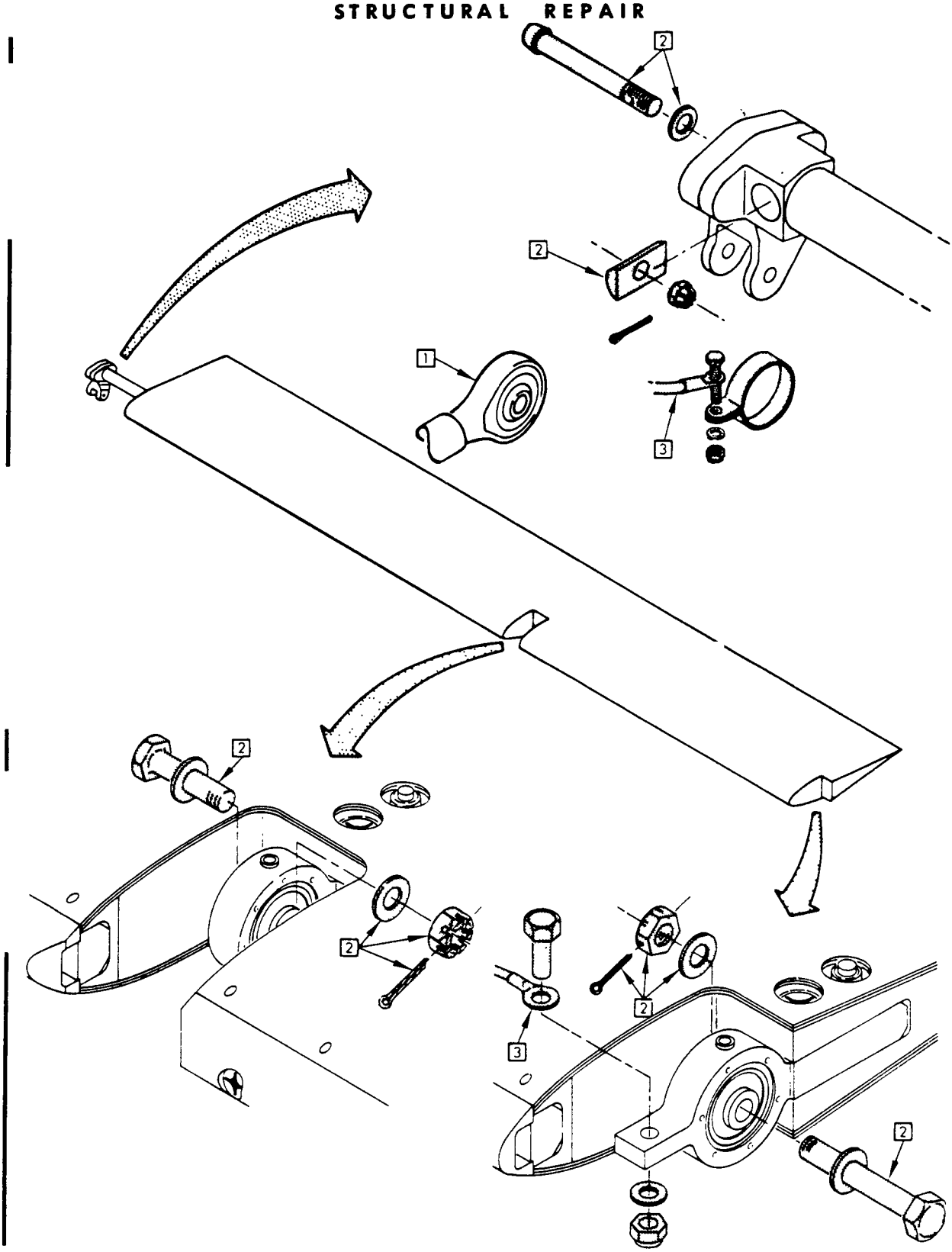
(e) Repeat steps A, B, C and D.

(f) When the tab is balanced, permanently install the balance weight.

F. Weigh the rebalanced tab assembly.

G. Record new tab weight on placard affixed to the tab structure.

H. From Fig. 8, Table I, determine the number of tab adjust weights (P/N 69-21080-1) to be installed on the inboard and outboard balance panels. Install the required tab adjust weights at the locations shown in 51-15-2, Fig. 1 (Ref 51-15-0, par. 7).



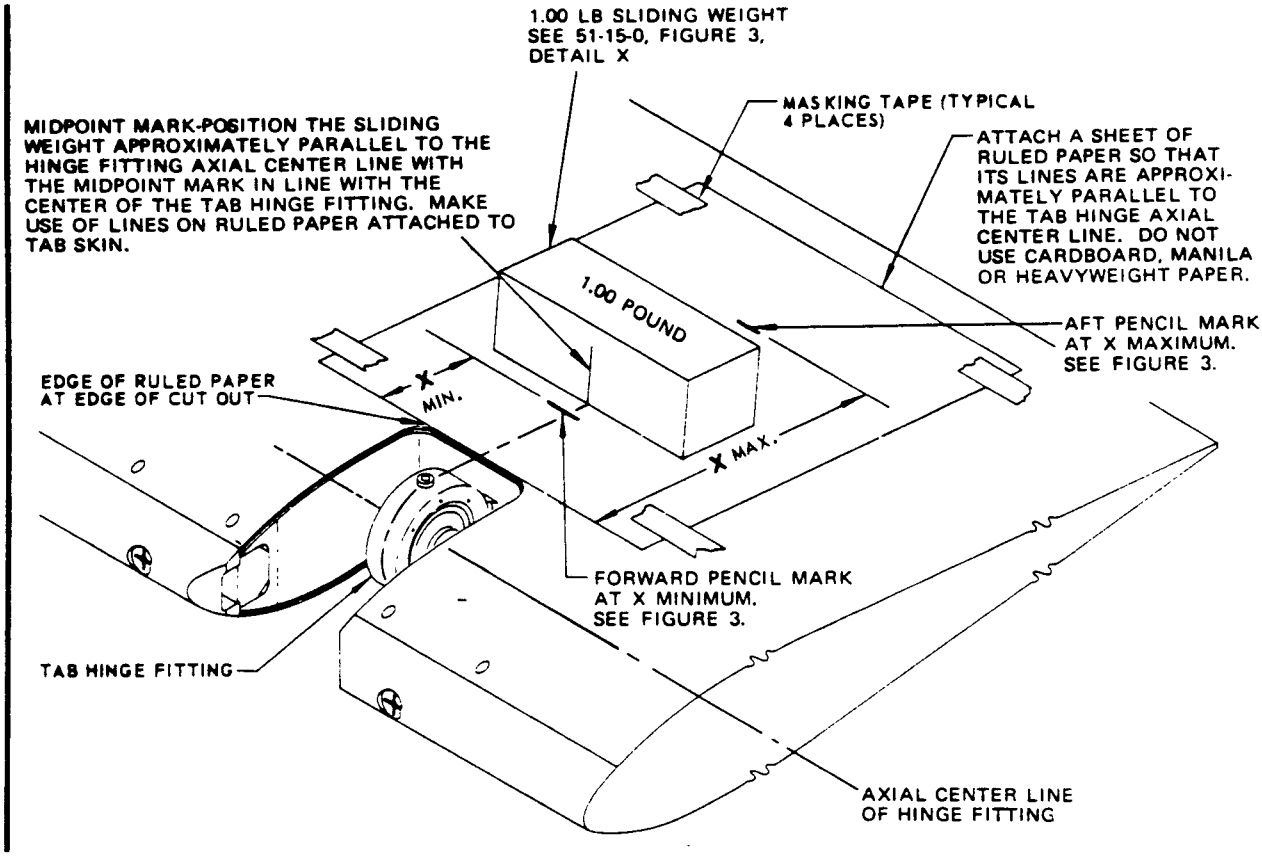
Inboard Aileron Tab - Preparation for Balancing
Figure 1 (Sheet 1)

BALANCING CONFIGURATION

PARTS REMOVED	PARTS INSTALLED
[1] CONTROL ROD (SINGLE CONTROL ROD CONFIGURATION) CONTROL RODS & LINKAGE (DOUBLE CONTROL ROD CONFIGURATION) [2] TAB HINGE BOLTS, WASHERS, NUTS, COTTER PINS & RADIUS FILLERS [3] TAB TO AILERON BONDING JUMPERS	ALL ACCESS PANELS CENTER & OUTBOARD TAB HINGE BEARING SUPPORT ASSEMBLIES, COMPLETE WITH BEARINGS AND ALL ATTACHING HARDWARE.

TABLE I

Inboard Aileron Tab - Preparation for Balancing
Figure 1 (Sheet 2)



Inboard Aileron Tab - Distance "X" Layout
Figure 2

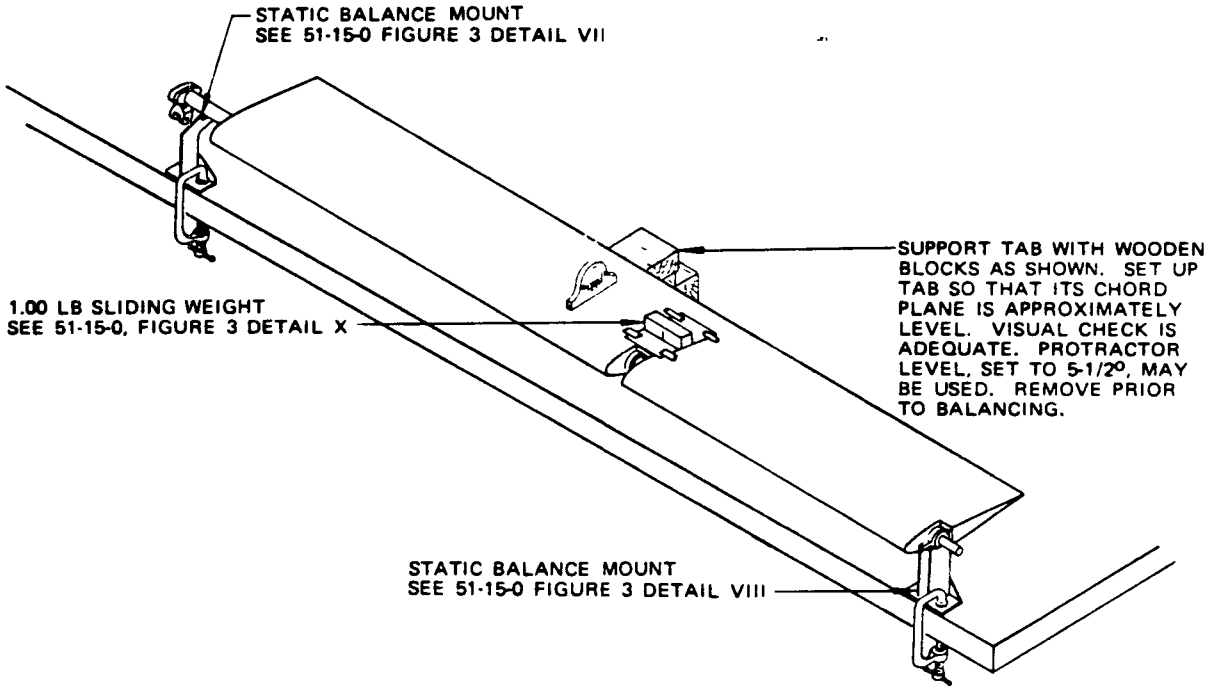
NOTE

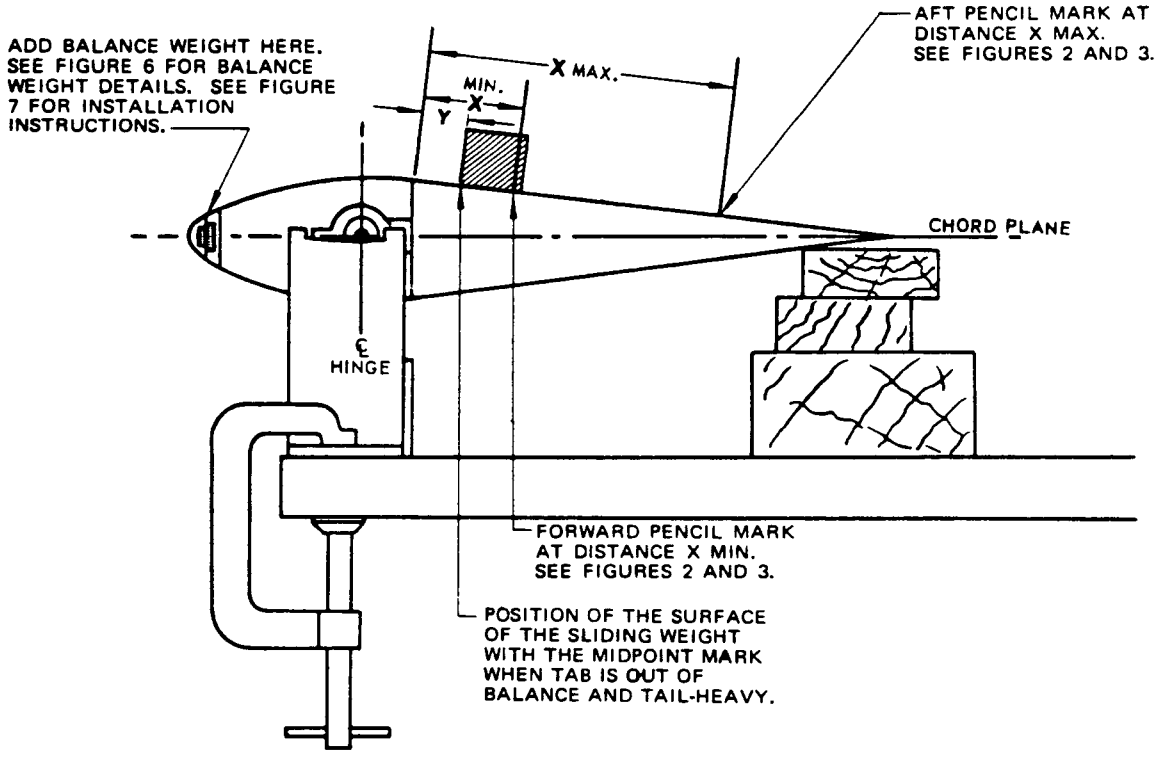
- INBOARD AILERON TABS BALANCED WITHIN THE LIMITS OF ABOVE TABLE WILL MEET THE REQUIRED MANUFACTURING BALANCING LIMITS OF 51-15-0, FIGURE 2.

[A] MAXIMUM ALLOWABLE WEIGHT OF TAB

TAB WEIGHT (LBS)	X MIN (INS)	X MAX (INS)
10-11	0.74	1.66
11-12	0.92	1.96
12-13	1.10	2.25
13-14	1.28	2.54
14-15	1.46	2.83
15-16	1.64	3.12
16-17	1.82	3.41
17-18	2.01	3.70
18-19	2.19	4.00
19-20	2.37	4.29
[A] 20-20.25	2.41	4.58

Inboard Aileron Tab - Distance "X" Dimension
Figure 3





Inboard Aileron Tab - Supported for Balancing
Figure 4

	MATERIAL	REBALANCE WEIGHT LENGTH TO BE ADDED	REBALANCE WEIGHT LENGTH TO BE REMOVED	
		INCHES MINIMUM [C]	INCHES MAXIMUM [D]	
FOR DET I FIG 6	TUNGSTEN ALLOY FANSTEEL 77 [B] MALLORY 1000HP MALLORY 1000PR	(X MIN - Y) x 8.77	(X MAX - Y) x 8.77	
	BRONZE [A] ARCHITECTURAL	(X MIN - Y) x 17.54	(X MAX - Y) x 17.54	
	STEEL 4130 [B]	(X MIN - Y) x 18.86	(X MAX - Y) x 18.86	
FOR DET II FIG 6	BRONZE ARCHITECTURAL	(X MIN - Y) x 7.94	(X MAX - Y) x 7.94	
	STEEL 4130	(X MIN - Y) x 8.54	(X MAX - Y) x 8.54	

NOTE

- CALCULATE THE REQUIRED BALANCE WEIGHT LENGTH TO BE ADDED OR REMOVED BY USING THE APPLICABLE FORMULA. BALANCE WEIGHT ADDED IN EXCESS OF THE REQUIRED MINIMUM GIVES FUTURE REPAIR CAPABILITY TO THE TAB, PROVIDED SUITABLE BALANCING RECORDS ARE KEPT. (SEE 51-15-0, FIGURE 2.)
- SEE FIGURES 3 AND 4 FOR VALUES X MIN AND X MAX.
- SEE FIGURE 4 FOR VALUE Y.

[A] MATERIAL USED FOR FACTORY INSTALLED BALANCE WEIGHT.

[B] OPTIONAL MATERIAL FOR FIELD SERVICE USE.

[C] APPLICABLE WHEN DISTANCE Y IS LESS THAN X MIN OF FIGURE 3.

[D] APPLICABLE WHEN DISTANCE Y IS MORE THAN X MAX OF FIGURE 3.

Inboard Aileron Tab - Balance Weight Lengths
Figure 5

NOTE

- BALANCE WEIGHTS OF DIFFERING MATERIALS AND LENGTHS PROVIDE A VARIABLE ADJUSTMENT FOR COMPENSATING FOR TAB OUT-OF-BALANCE CONDITIONS. BALANCE WEIGHTS OF DIFFERING MATERIALS MAY BE ADDED OR SUBSTITUTED FOR PREVIOUSLY INSTALLED WEIGHTS. REPLACEMENT WEIGHTS MUST BE MADE TO THE DIMENSIONS AND FROM THE MATERIALS DEFINED BY THIS FIGURE.

[A] MATERIAL USED FOR FACTORY INSTALLED BALANCE WEIGHTS. REFER TO TABLE.

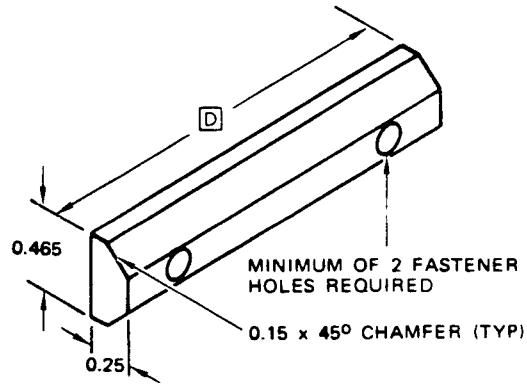
[B] OPTIONAL MATERIAL FOR IN-SERVICE USE. REFER TO TABLE.

[C] THIS BALANCE WEIGHT IS MADE TO THE SAME CONFIGURATION AS THE NOSE WEIGHT RETAINER, P/N 66-8838, BUT USING HEAVIER MATERIALS THAN THE DESIGNED 2024-T4 RETAINER. USE THE MATERIALS LISTED IN TABLE FOR THESE BALANCE WEIGHTS. INSTALL THESE WEIGHTS IN THE NOSE RETAINER BLOCK CAVITIES AS REQUIRED. THESE BALANCE WEIGHTS ARE AVAILABLE FROM THE BOEING COMPANY UNDER THE PART NUMBER 66-8838 WITH THE DESIRED MATERIAL BEING SPECIFIED.

[D] DETERMINE REQUIRED LENGTH USING FORMULAE IN TABLE OF FIGURE 5.

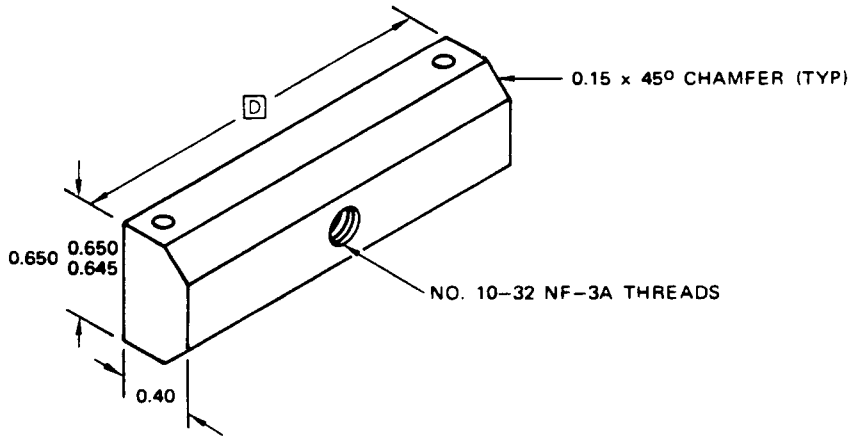
MATERIAL	IDENTIFICATION	SOURCE	FINISH
TUNGSTEN ALLOY [B]	FANSTEEL 77 MALLORY 1000HP MALLORY 1000PR	FANSTEEL METALLURGICAL CORP. NUMBER ONE TANTALUM PLACE NORTH, CHICAGO, ILL. 60064 MALLORY AND CO., 3029 E. WASHINGTON INDIANAPOLIS, IND. 46206	CADMIUM PLATE TO QQ-P-416 TYPE II, CLASS 2, AND FOLLOW WITH ONE COAT OF BMS 10-11, TYPE 1, PRIMER
STEEL [B]	4130	ANY SOURCE	
BRONZE [A] [B]	ARCHITECTURAL 283	REVERE COPPER AND BRASS, INC. OR EQUIVALENT	

Inboard Aileron Tab - Balance Weights
Figure 6 (Sheet 1)



[A] [B] BALANCE WEIGHT P/N 5-87421-2051 OR -2052

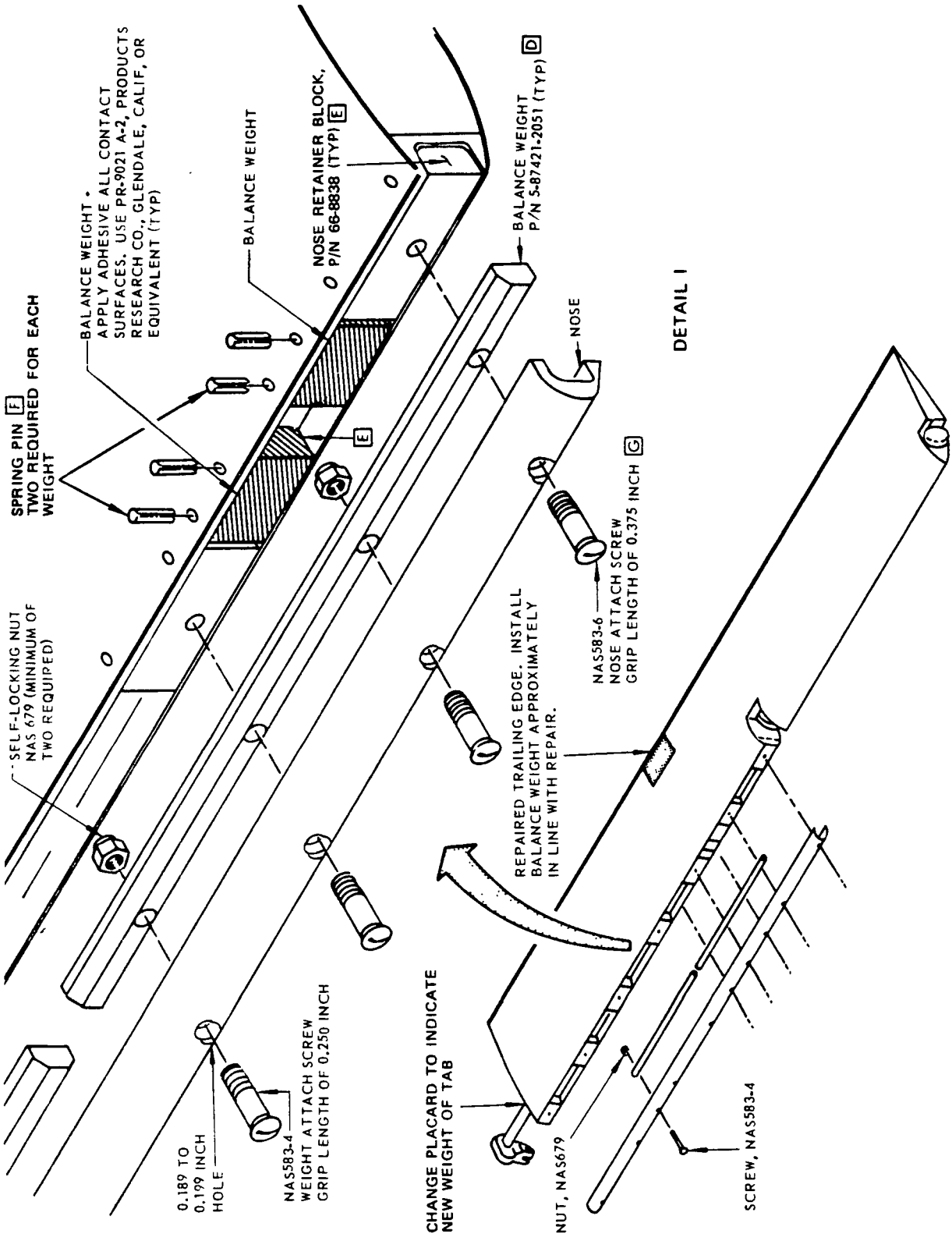
DETAIL I



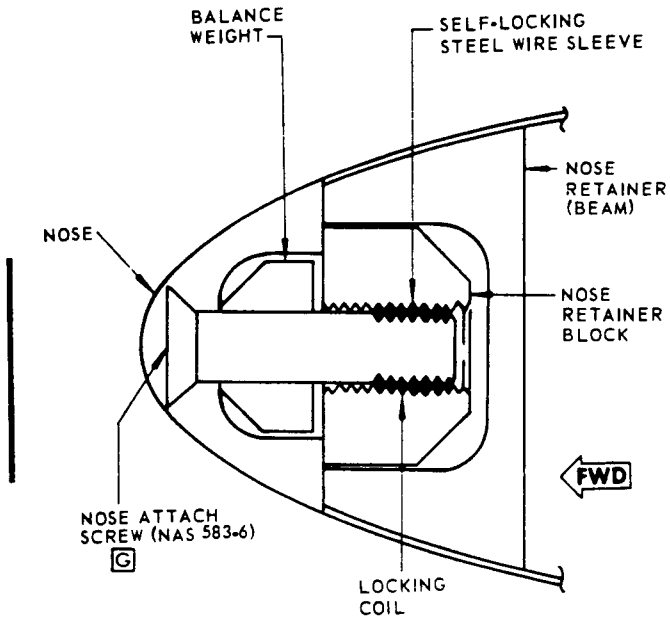
[B] [C] BALANCE WEIGHT P/N 66-8838

DETAIL II

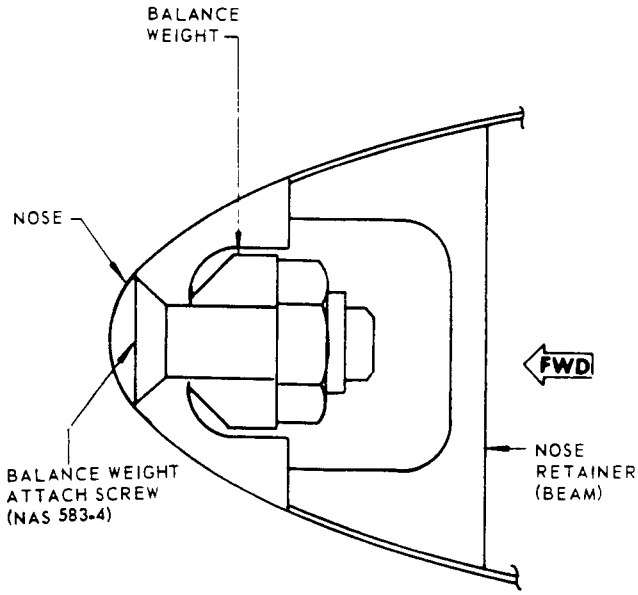
Inboard Aileron Tab - Balance Weight
Figure 6 (Sheet 2)



Inboard Aileron Tab - Rebalance Weight Installation
Figure 7 (Sheet 1)



CROSS SECTION OF TAB NOSE - TYPICAL NOSE ATTACHMENT



CROSS SECTION OF TAB NOSE - TYPICAL BALANCE WEIGHT ATTACHMENT

Inboard Aileron Tab - Rebalance Weight Installation
Figure 7 (Sheet 2)

NOTE

[A] (DELETED)

[B] (DELETED)

[C] (DELETED)

[D] FACTORY INSTALLED BALANCE WEIGHT IS MADE FROM ARCHITECTURAL BRONZE. THIS WEIGHT CAN BE LENGTHENED, SHORTENED, OR ITS MATERIAL CHANGED TO CARBON STEEL OR FANSTEEL. ADDITIONAL PIECES CAN BE INSTALLED IF SPACE IS AVAILABLE (SEE FIG. 6, 5-87421-2051 OR 5-87421-2052).

[E] WHEN FURTHER BALANCE WEIGHTS 5-87421-2051 AND 5-87421-2052 CANNOT BE ACCOMMODATED, INSTALL 66-8838 WEIGHTS IN THE NOSE CAVITY. MATERIAL THE SAME AS IN [D]. SEE DETAIL I FOR INSTALLATION INSTRUCTIONS; SEE FIG. 6 FOR FABRICATION INSTRUCTIONS.

[F] TWO SPRING PINS REQUIRED FOR EACH WEIGHT. USE BACP18L5P1000, MS16562-20 OR MS39086-25

[G] INSTALL SCREW AS FOLLOWS:

1. CLEAN THE NAS583-( ) SCREW AND FEMALE THREAD IN TAB LEADING EDGE WITH A CLEAN GAUZE AND METHYL ETHYL KETONE, METHYL ISOBUTYL KETONE, NAPHTHA OR ACETONE SOLVENT.

2. WIPE COUNTERSINK AREA OF BRONZE NOSE WEIGHT CLEAN. REMOVE ALL EXISTING PROTECTIVE FINISH IN THE COUNTERSUNK HOLE WITH SOLVENT MOISTENED GAUZE.

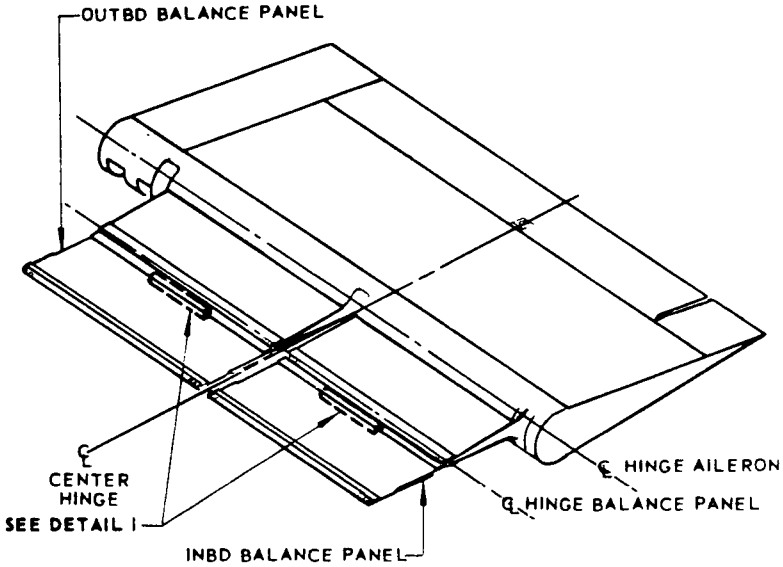
3. BUTTER ENTIRE LENGTH OF SCREW WITH HEAVY FILM OF BMS 5-29 GRADE 1 OR GRADE 2 OR BAC5010 TYPE 54 RESIN.

4. USING A TOOTHPICK, SMALL WIRE OR SIMILAR INSTRUMENT, PLACE A FEW DROPS OF RESIN INTO THE HELICOIL.

5. INSTALL SCREW ALL THE WAY. REMOVE THE SCREW, REPEAT 3 AND 4 AND INSTALL TO FULL TORQUE (25 INCH-POUNDS).

6. WIPE OFF EXCESS RESIN FROM THE VICINITY OF THE SCREW HEAD. WIPE CLEAN AND REAPPLY PROTECTIVE COATING ON BRONZE NOSE WEIGHT, ONE COAT OF BMS 10-11 PRIMER TYPE 1 AND ONE COAT BMS 10-60 ENAMEL. AREA MAY BE PAINTED IMMEDIATELY AFTER CLEANING. IT IS NOT NECESSARY TO WAIT FOR RESIN TO CURE.

Inboard Aileron Tab - Rebalance Weight Installation
Figure 7 (Sheet 3)



INSTRUCTIONS

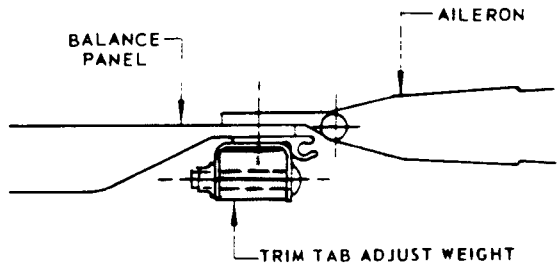
1. Identify tab adjust weights by referring to data on decal affixed to tab assembly or legend stamped on adjust weights.

2. Weigh repaired tab assembly as defined in Fig. 1.

3. Record new tab weight on decal affixed to tab assembly.

4. Determine from Table I the number of tab adjust weights P/N 69-21080-1 to be installed on the inboard and outboard balance panels.

5. Install the required tab adjust weights as shown in Detail I and locations shown in Fig. 1 of 51-15-2.



DETAIL I

Inboard Aileron Tab - Adjust Weight Installation
Figure 8 (Sheet 1)

TAB WEIGHT (LBS)	TOTAL NUMBER OF ADJUST WEIGHTS PART NO 69-21080-1	NUMBER OF ADJUST WEIGHTS TO BE INSTALLED	
		AT INBOARD BALANCE PANEL	AT OUTBOARD BALANCE PANEL
10.00 TO 11.00	0	0	0
11.01 TO 11.25	1	1	0
11.26 TO 11.50	2	1	1
11.51 TO 11.75	3	2	1
11.76 TO 12.00	4	2	2
12.01 TO 12.25	5	3	2
12.26 TO 12.50	6	3	3
12.51 TO 12.75	7	4	3
12.76 TO 13.00	8	4	4
13.01 TO 13.25	9	5	4
13.26 TO 13.50	10	5	5
13.51 TO 13.75	11	6	5
13.76 TO 14.00	12	6	6
14.01 TO 14.25	13	7	6
14.26 TO 14.50	14	7	7
14.51 TO 14.75	15	8	7
14.76 TO 15.00	16	8	8
15.01 TO 15.25	17	9	8
15.26 TO 15.50	18	9	9
15.51 TO 15.75	19	10	9
15.76 TO 16.00	20	10	10
16.01 TO 16.25	21	11	10
16.16 TO 16.50	22	11	11
16.51 TO 16 75	23	12	11
16.76 TO 17.00	24	12	12
17.01 TO 17.25	16	8	8
17.26 TO 17.75	17	9	8
17.76 TO 18.00	18	9	9
18.01 TO 18.50	19	10	9
18.51 TO 18.75	20 [B]	10	10
18.76 TO 19.25	21	11	10
19.26 TO 19.50	22	11	11
19.51 TO 20.00	23	12	11
20.01 TO 20.25 [A]	24	12	12

NOTE

[A] 20.25 MAX ALLOWABLE TAB WEIGHT

[B] MADE TO THE SAME DIMENSIONS AND SHAPE AS 69-21080-1 WEIGHTS EXCEPT THAT FANSTEEL IS USED INSTEAD OF LEAD. MARK TO DIFFERENTIATE BETWEEN PRODUCTION WEIGHTS OF LEAD AND FANSTEEL WEIGHTS. EACH FANSTEEL WEIGHT = 0.80 POUND.

TABLE I

Inboard Aileron Tab - Adjust Weight Installation
Figure 8 (Sheet 2)

OUTBOARD AILERON BALANCING

1. General

A. The outboard aileron must be balanced in a specific configuration to provide accurate results. Excess or missing parts will produce erroneous results and, consquently, a configuration check must be made before balancing. See Fig. 1 for the required configuration.

B. The control tab and balance panels must be removed from the outboard aileron and balanced as separate assemblies (Ref 51-15-5 and 51-15-6). However, for balancing purposes, the attaching hardware and grounding jumpers for the control tab must be installed in the correct locations on the aileron (Fig. 1).

C. Any decorative paint and protective finish must be applied prior to balancing the outboard aileron.

D. The aileron adjust weight retainers P/N 66-9903 and 66-9903-1 (a total of 15) must be installed on the aileron horn, complete with all hardware (Fig. 5 thru 7).

2. Special Tools and Equipment

A. The equipment required for balancing is illustrated in Fig. 2. (See also 51-15-0, Fig. 3).

3. Balancing Procedures with Outboard Aileron Removed from Airplane

A. Prepare the outboard aileron as described in Fig. 1 and install on the balance support stand using static balance mounts located at the hinges at WS 779.960 and WS 890.210 (Fig. 2).

NOTE: The aileron must rotate freely about the hinge line when installed on the support stand.

B. Locate a weighing scale and a adjustable support under the aileron as shown in Fig. 2. Ensure the point of contact of the adjustable support is located at a rib as near to the trailing edge of the aileron as is possible and in such a manner as not to cause damage to the surface.

C. Adjust the adjustable support until the aileron is in a balanced attitude (when the chord line is horizontal) and measure (to the nearest tenth of a pound) the weight reaction (WR) at the dimension (B) (Fig. 3).

D. Determine the actual trial moment by multiplying the weight reaction (WR) (pounds) by the distance, or moment arm, (B) (inches).

Trial moment = (WR)(B) pound-inches.

E. Using the trial moment obtained in par. 3.D., determine from Fig. 4, table I, the number of balance weight layers required to balance the aileron.

NOTE: One balance weight layer consists of fifteen weights, two P/N 66-9900 and thirteen P/N 66-9900-1, one weight being installed at each of the mounting positions.

F. Install the balance weight layers as required (Fig. 6).

G. Repeat the procedures of par. 3.B. thru 3.D. to obtain a new trial moment. The second trial moment is designated as the "check balance moment."

H. From Fig. 4, table II, determine the number of single weights required for the, "check balance moment" obtained in par. 3.G. Install the weights singly and in numerical sequence 1 thru 15, starting at the first mounting position with the least number of weights (Fig. 6).

I. The aileron is now balanced within the required limits of +193 ±9 pound-inches.

4. Sample Calculation for Balancing an Outboard Aileron

A. The following is a summation of the steps of par. 3.A. thru 3.I. (all values are assumed).

(1) Mount the aileron and measure the weight reaction and moment arm (par. 3.A. thru 3.C.).

Weight reaction (WR) = 10.34 pounds
Moment arm (B) = 24.75 inches

(2) Determine the trial moment (par. 3.D.).

(WR)(B) = (10.34 pounds)(24.75 inches)
= 255.9 pound-inches

(3) From Fig. 4, table I, six balance weight layers are required for this trial moment. Install as required according to par. 3.E. and 3.F.

(4) Determine the check balance moment (par. 3.G.).

(WR) = 7.88 pounds
(B) = 24.75 inches

Check balance moment = (WR)(B)
= (7.88 pounds)(24.75 inches)
= 195.03 pound-inches

(5) From Fig. 4, table II, 8 single weights are required for this "check balance moment." Install the weights singly and in numerical sequence 1 thru 15, starting at the first mounting position with the least number of weights (Fig. 6).

5. Adjustment of Balance after a Minor Repair to an Outboard Aileron While Installed

A. The effect of minor repairs on the outboard aileron must be calculated and, if necessary, the balance condition adjusted before putting the airplane back in service, provided there is space for the installation of the required balance weights. When there is not sufficient space for the addition of the required balance weights, remove the aileron and rebalance as described in par. 3 and 4.

B. Calculate the balance weight adjustment (required after repair) as follows:

(1) Determine the net weight of the repair (within 0.03 pound) by subtracting the weight of the removed damaged material from the weight of material used to make the repair (Ref 51-15-0).

(2) Measure the distance (Y) from the centerline of the aileron hinge to the center of gravity of the repair (Fig. 3).

(3) From table I, Fig. 3 obtain distance (Z).

(4) Calculate the weight required to balance the aileron by multiplying the net weight of the repair by distance (Y) and dividing the result by (Z).

$$\text{Balance weight required} = \frac{(\text{repair net weight})(Y)}{(Z)}$$

NOTE: Additional balance weights need not be installed when the balance weight required is less than 0.121 pound, however, this balance weight requirement must be accounted for during subsequent repair and balancing conditions.

(5) Add the required balance weights singly to each of the mounting positions as required (Fig. 6).

6. Sample Calculation for Adjustment of Balance Weights after a Minor Repair of an Installed Outboard Aileron

A. Calculate the effect of the repair as follows. (All values are assumed.)

(1)	Weight of removed damaged material	0.10 pound
(2)	Weight of material used to make repair	0.30 pound
(3)	Net weight of repair	0.20 pound
(4)	Distance (Y)	23.53 inches
(5)	Distance (Z)	5.31 inches

(6) Balance weight required $= \frac{0.20 \times 23.53}{5.31}$
$= 0.89$ pound

(7) Calculate the number of balance weights (66-9900 or 66-9900-1) required as follows.

(a) Balance weights 66-9900 at 0.143 pound
Weight required = 0.89 pound
Number of weights = 0.89 ÷ 0.143 = 6.22
Use 7 weights

(b) Balance weights 66-9900-1 at 0.121 pound
Weight required = 0.89 pound
Number of weights = 0.89 ÷ 0.121 = 7.35
Use 8 weights

OUTBOARD AILERON - BALANCING CONFIGURATION

PARTS REMOVED

[1] BALANCE PANELS WITH HINGE HALF AND ATTACHING HARDWARE

[2] CONTROL TAB

[3] TAB CONTROL RODS AND ASSOCIATED HARDWARE

[4] BONDING JUMPERS (4) AND ASSOCIATED HARDWARE BETWEEN BALANCE PANELS AND AILERON

NOTE

- PAINT OR PROTECTIVE FINISH MUST BE APPLIED BEFORE BALANCING.
- THE OUTBOARD AILERON ASSEMBLY (5-88190) MUST BE COMPLETE EXCEPT AS INDICATED.

PARTS INSTALLED

[5] ALL THREE SUPPORT HINGES (ROTATE TO LOWEST POSITION DURING BALANCING)

[6] ALL PERMANENT BALANCE WEIGHTS

[7] ALL ADJUST WEIGHT RETAINERS (INCLUDING ADJUST WEIGHT SUPPORT ANGLES OR STRAPS)

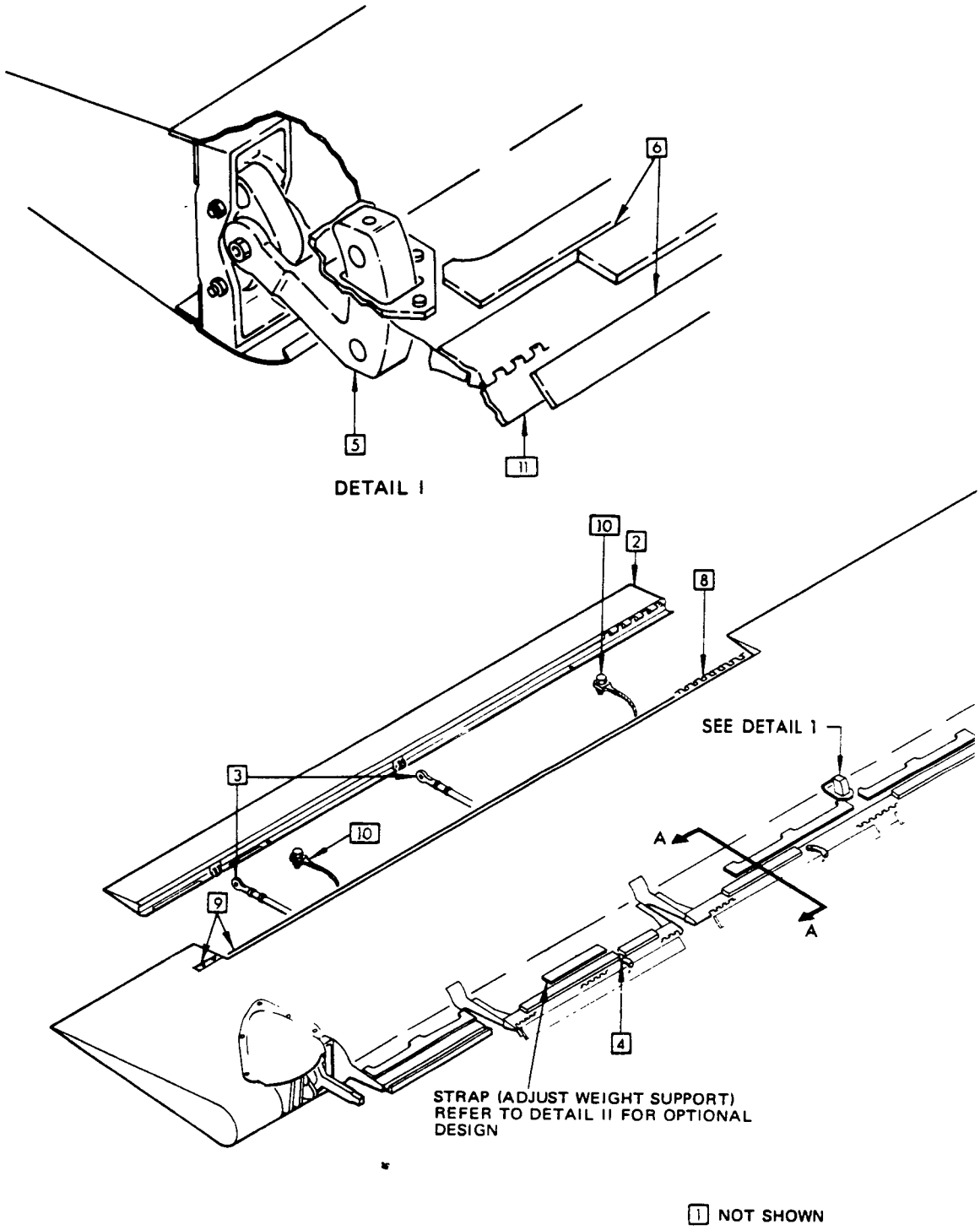
[8] TAB HINGE HALF ATTACHED TO AILERON

[9] TAB HINGE PIN AND RETAINERS

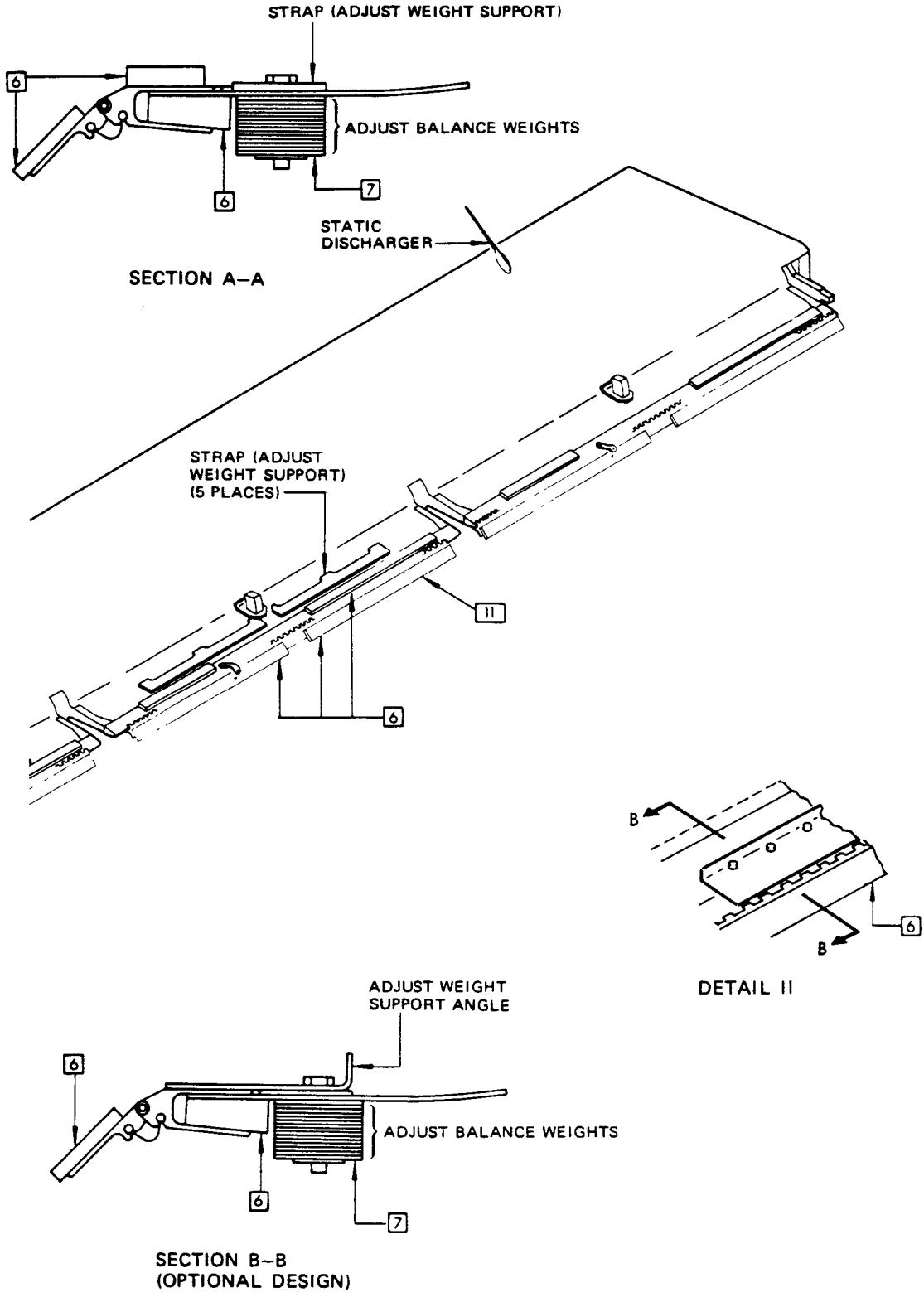
[10] TAB TO AILERON BONDING JUMPERS

[11] BALANCE PANEL HINGE HALVES (ROTATE TO LOWEST POSITION DURING BALANCING)

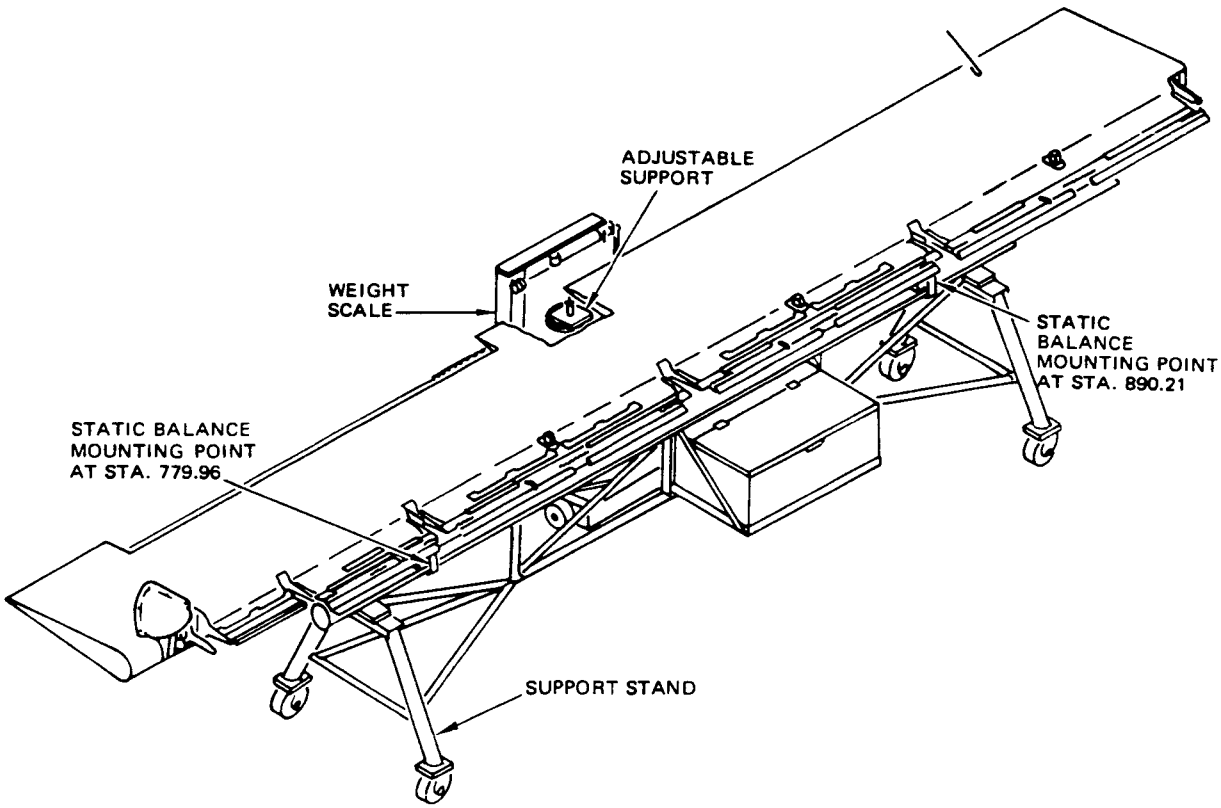
Outboard Aileron - Preparation for Balancing
Figure 1 (Sheet 1)

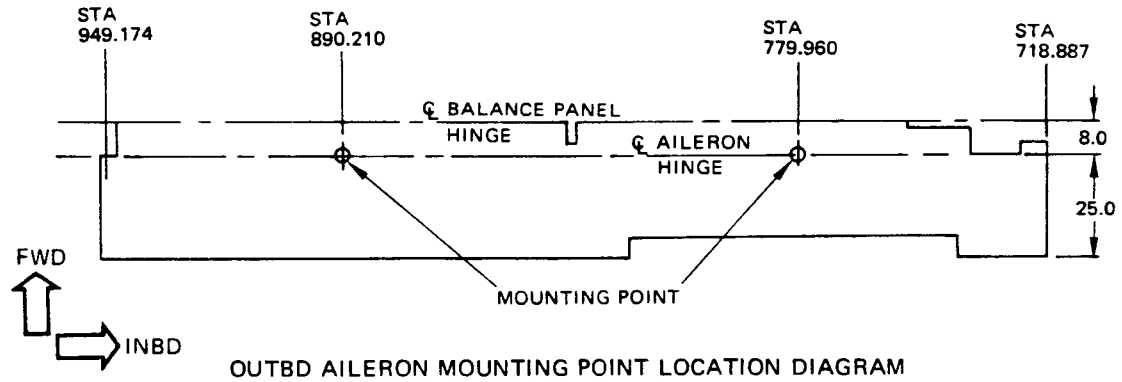


Outboard Aileron Preparation for Balancing
Figure 1 (Sheet 2)



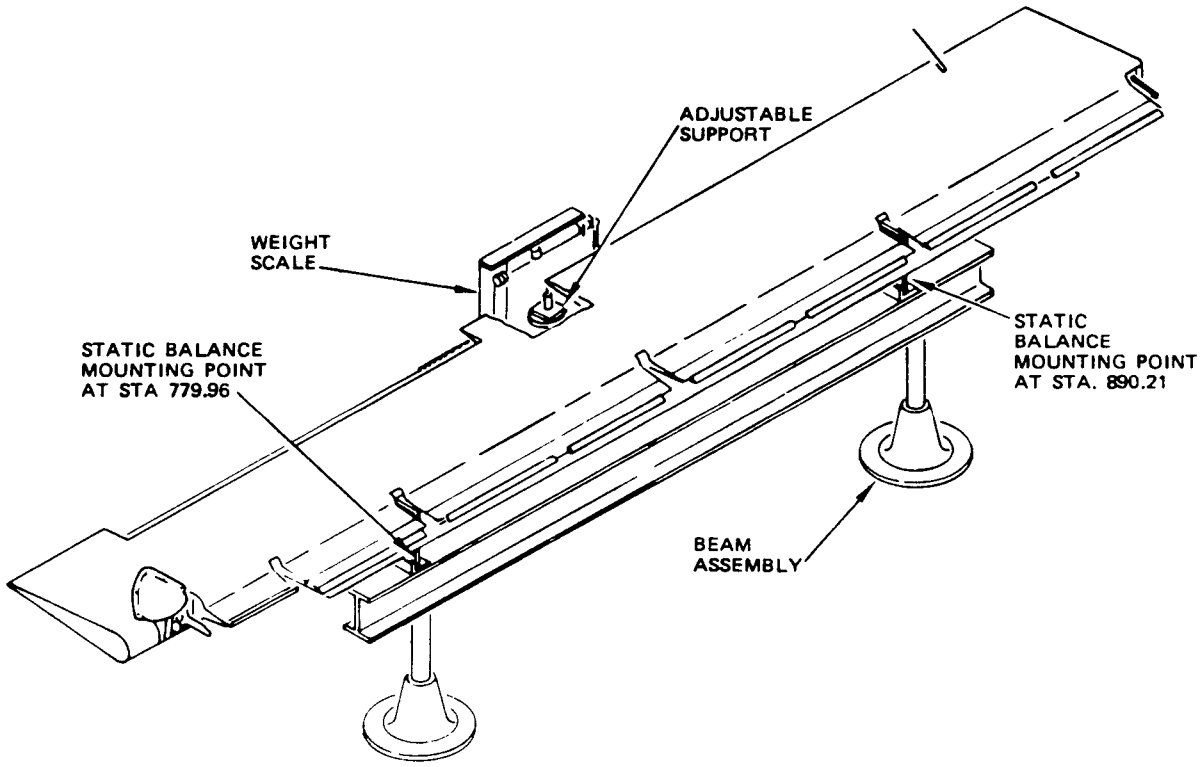
Outboard Aileron Preparation for Balancing
Figure 1 (Sheet 3)



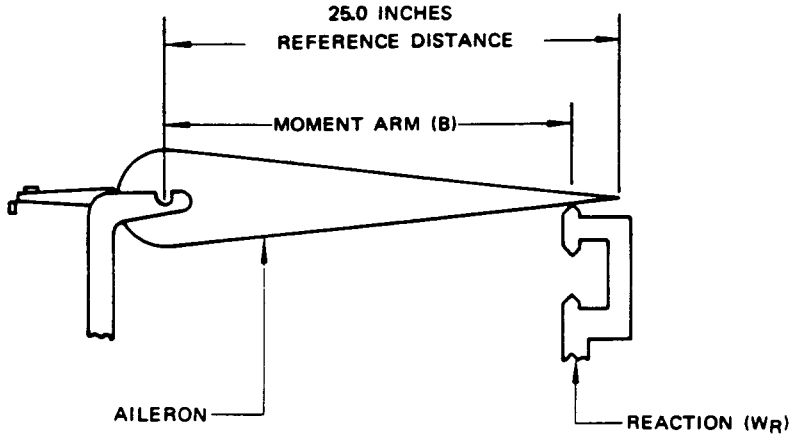


OUTBD AILERON MOUNTING POINT LOCATION DIAGRAM

Outboard Aileron - Setup for Balancing
Figure 2 (Sheet 1)



Outboard Aileron - Setup for Balancing
Figure 2 (Sheet 2)



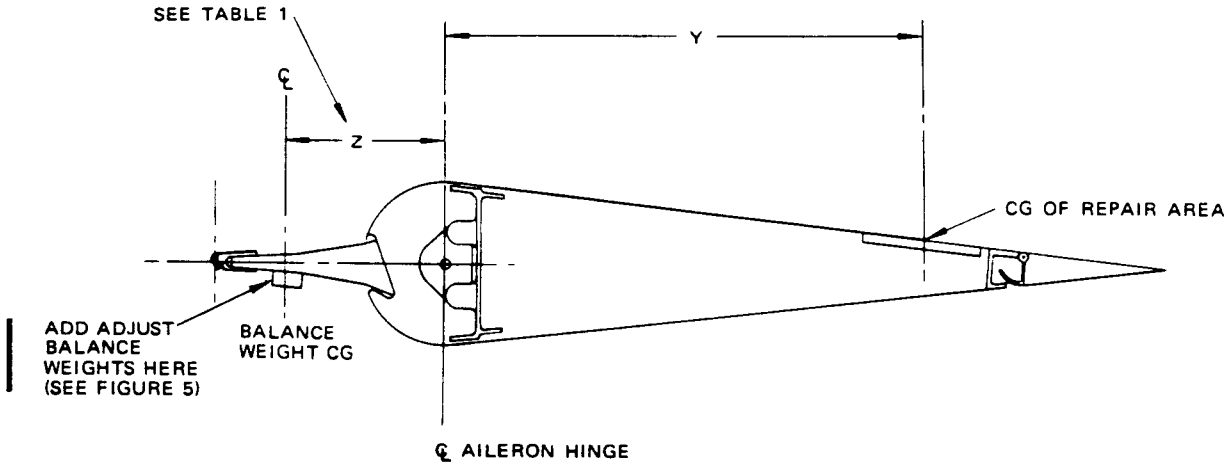


TABLE I

BAY NO.	Z DISTANCE
1	4 88
2	5.31
3	5.71
4	5.71

Outboard Aileron - Repair Weight and Moment Arm Diagram
Figure 3

TRIAL MOMENT POUND-INCHES [A]	NUMBER OF BALANCE WEIGHT LAYERS REQUIRED [B]
184-194	NOMINAL MOMENT
194-200	0
200-210	1
210-220	2
220-231	3
231-241	4
241-252	5
252-262	6
262-272	7

TABLE I

CHECK BALANCE MOMENT POUND-INCHES [C]	NUMBER OF BALANCE WEIGHTS REQUIRED 66-9900 OR -1 [D] [E]
184-194	NOMINAL
194-195	6
195-196	8
196-197	9
197-198	11
198-199	12
199-200	13
200-201	15

TABLE II

NOTE:

[A] IF THE TRIAL BALANCE MOMENT IS 200 LB-INS OR MORE, ADD THE NUMBER OF BALANCE WEIGHT LAYERS INDICATED BY TABLE I. IF TRIAL BALANCE MOMENT IS LESS THAN 200 LB-INS. REFER TO TABLE II.

[B] ONE BALANCE WEIGHT LAYER CONSISTS OF FIFTEEN WEIGHTS (2) 66-9900 AND (13) 66-9900-1. ONE WEIGHT IS INSTALLED ON EACH OF THE FIFTEEN MOUNTING POSITIONS ACCORDING TO FIG. 6.

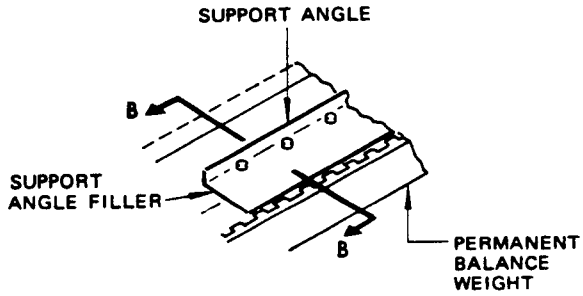
[C] IF CHECK BALANCE MOMENT IS LESS THAN 200 LB-INS. BUT NOT LESS THAN 194 LB-INS. ADD THE NUMBER OF SINGLE WEIGHTS INDICATED IN TABLE II.

[D] QUANTITY OF SINGLE BALANCE WEIGHTS (66-9900 AND 66-9900-1) REQUIRED TO OBTAIN FINAL AILERON BALANCE. THESE SINGLE WEIGHTS SHOULD BE INSTALLED IN NUMERICAL ORDER AS REQUIRED.

[E] EACH OF THE BALANCE WEIGHT MOUNTING POSITIONS SHOULD CONTAIN EQUAL NUMBER OF WEIGHTS AS NEAR AS POSSIBLE. ADDITIONAL WEIGHTS, UP TO THE MAXIMUM NUMBER PERMITTED, SHOULD BE ADDED SINGLY AND IN NUMBERICAL SEQUENCE 1 THRU 15 STARTING AT THE FIRST MOUNTING POSITION WITH THE LEAST NUMBER OF WEIGHTS.

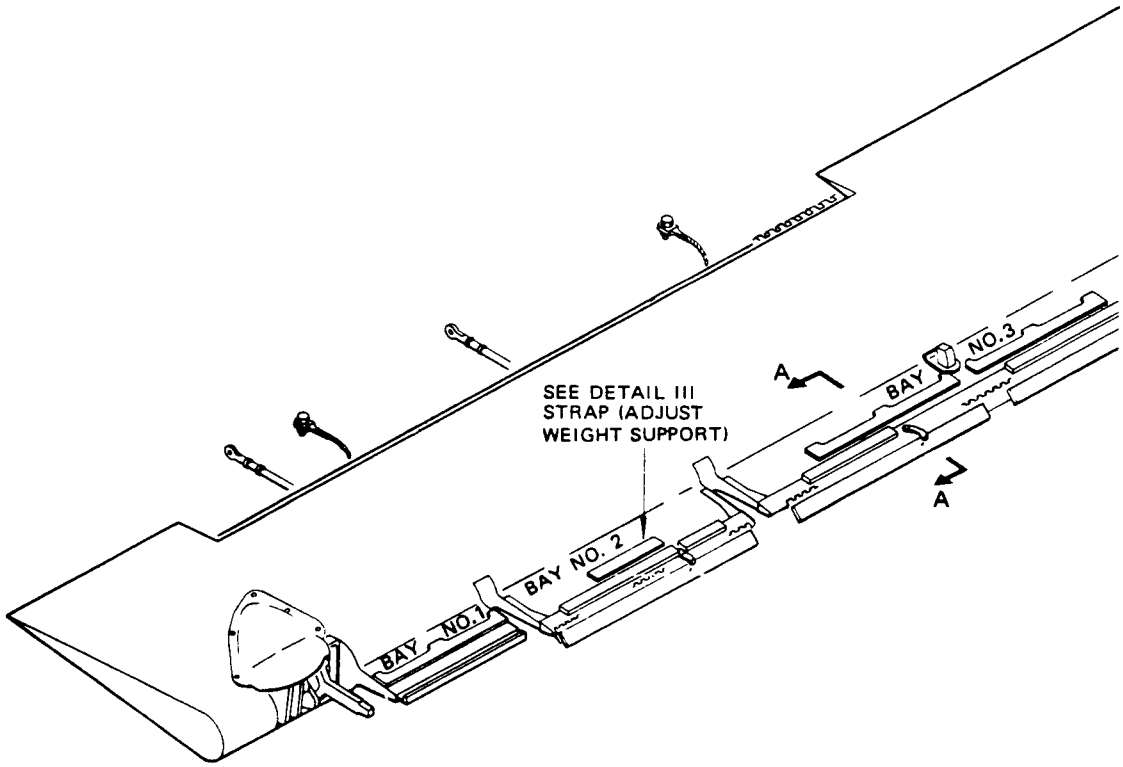
EXAMPLE: IF ALL MOUNTING POSITIONS HAVE SEVEN LAYERS EXCEPT POSITIONS 1, 2, AND 3 WHICH HAVE EIGHT, THEN THE FIRST ADDITIONAL WEIGHT SHOULD BE INSTALLED IN POSITION 4.

Outboard Aileron Balance Weight Requirements
Figure 4

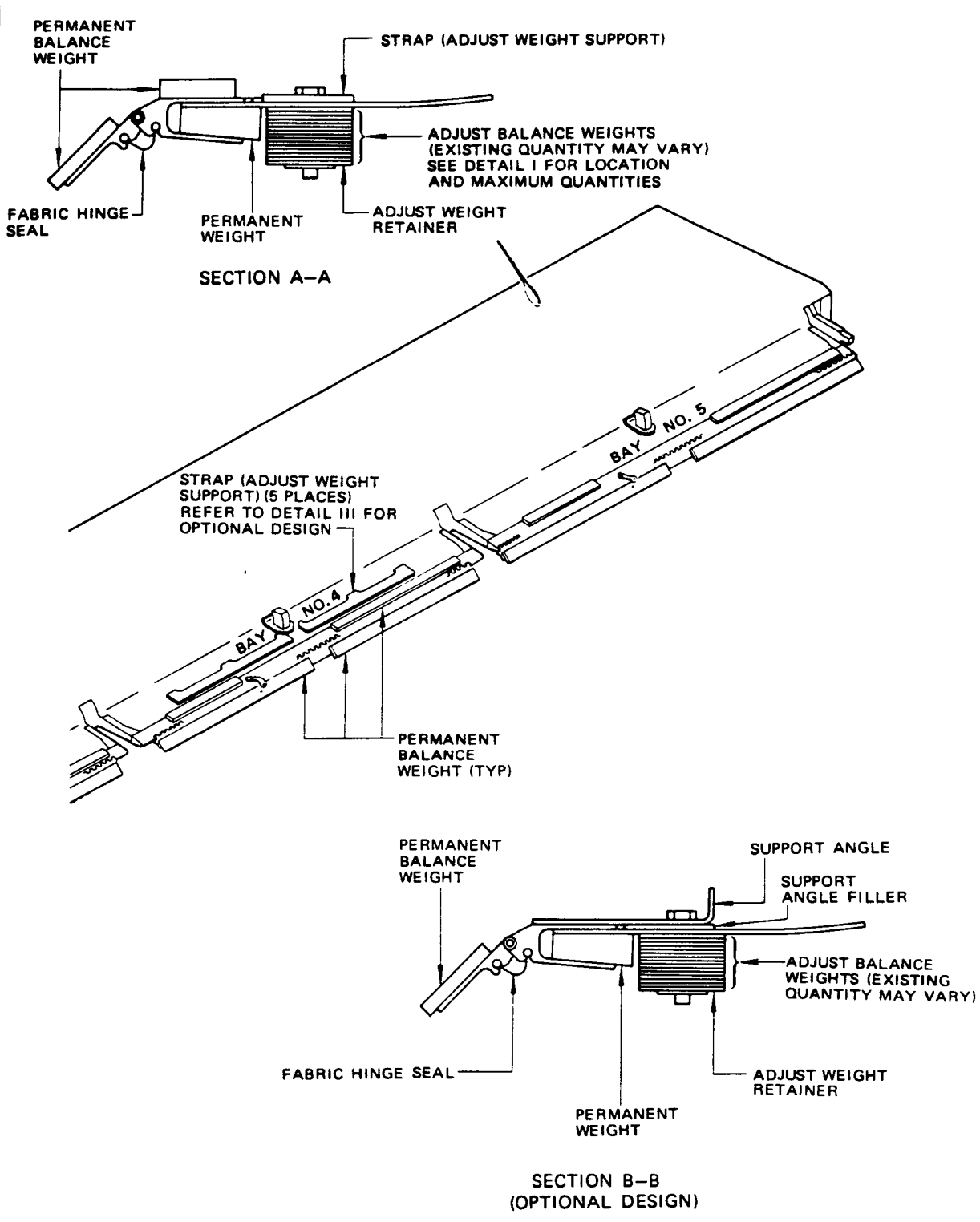


(OPTIONAL DESIGN)
TYPICAL FOR ALL BAYS

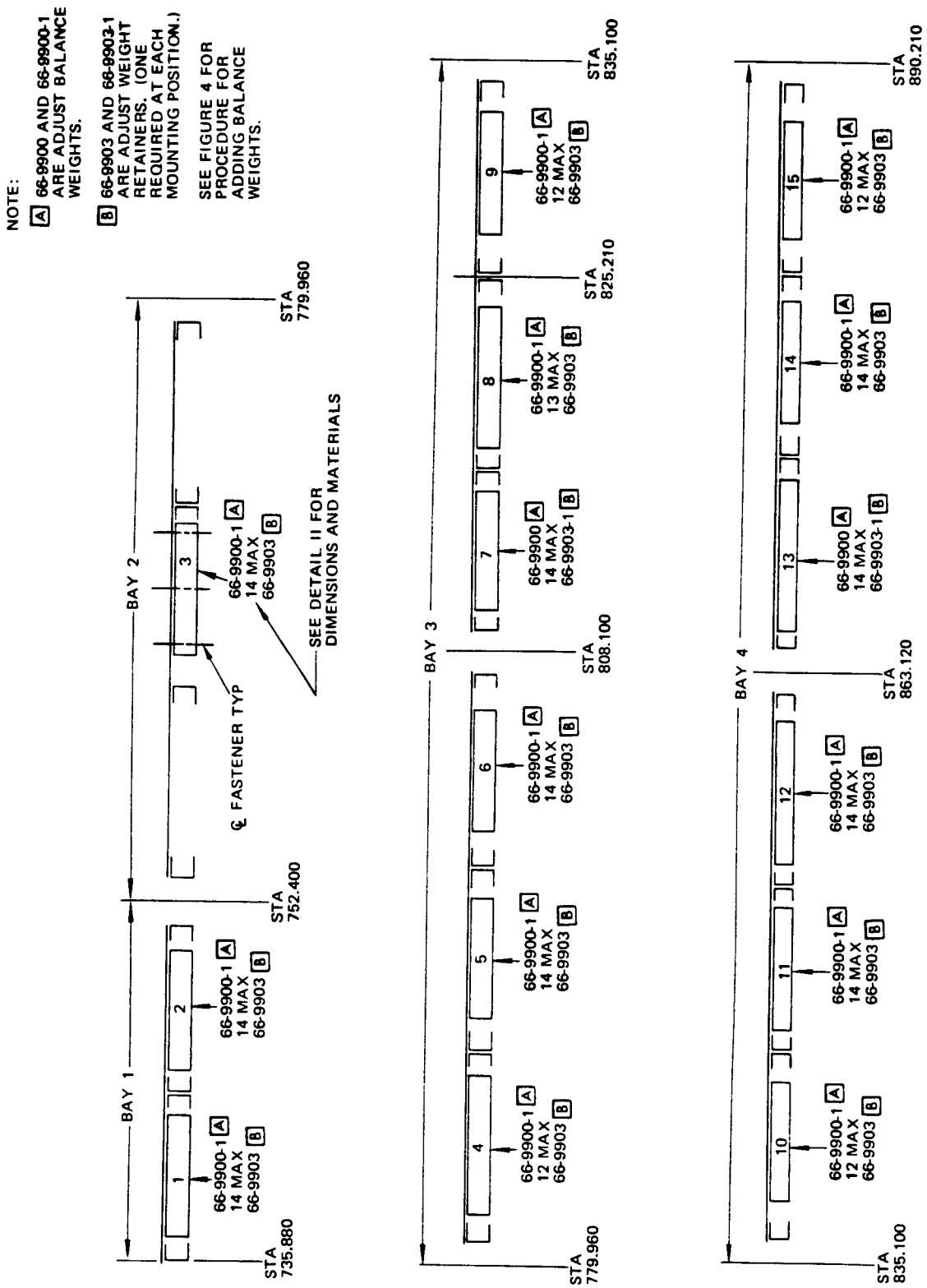
DETAIL III



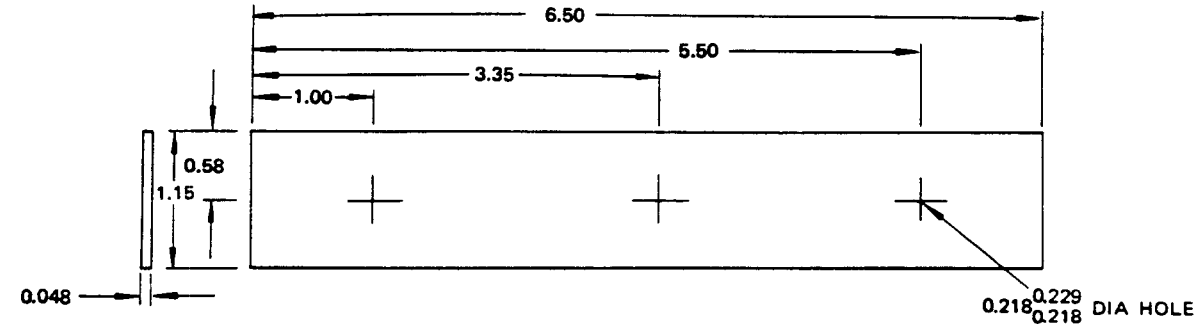
Outboard Aileron Balance Weights - Location and Installation
Figure 5 (Sheet 1)



Outboard Aileron Balance Weights - Location and Installation
Figure 5 (Sheet 2)



Outboard Aileron Balance Weight - Mounting Diagram
Figure 6

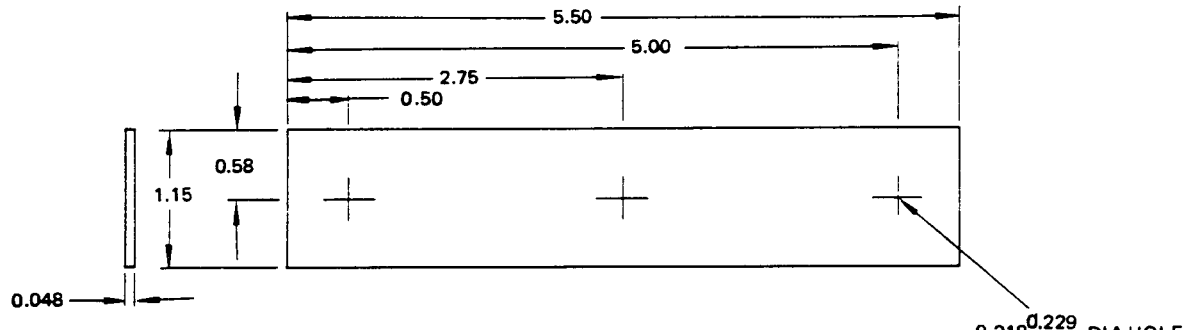


MATERIAL - 6% ANTIMONY LEAD
M-L-18331 (AER)

FINISH - APPLY TWO COATS OF
BMS 10-11 TYPE 1
PRIMER

WEIGHT 0.143 LBS

66-9900



MATERIAL - 6% ANTIMONY LEAD
M-L-18331 (AER)

FINISH - APPLY TWO COATS OF
BMS 10-11 TYPE 1
PRIMER

WEIGHT 0.121 LBS

66-9900-1

ADJUST BALANCE WEIGHTS
DETAIL II

Outboard Aileron Balance Weights - Weight Detail
Figure 7

OUTBOARD AILERON BALANCE PANELS - BALANCING PROCEDURES

1. General

A. The outboard aileron balance panels are identified throughout this subject by position on the outboard aileron as balance panels bay 2 through bay 5 (Fig. 1). Each balance panel must be balanced using the procedure within this subject specifically identified as such.

2. Special Tools and Equipment

A. The equipment required during balancing is illustrated in Fig. 2. (See also 51-15-0, Fig. 3.)

3. Balancing Procedures, Outboard Aileron Balance Panels

A. Balance the bay 2 balance panel as follows:

(1) Prepare the balance panel for balancing as shown in Fig. 3. The bolts which attach the balance panel to the aileron must be installed on the panel in the correct location at time of balancing.

(2) Mount the balance panel in the static balance mounts, as shown in Fig. 2. The panel must be free to rotate about its forward hinge line.

(3) With the panel in a horizontal position, measure the weight reaction (WR) at a known moment arm (B). The reaction is to be taken at a point where the reaction fitting will not damage the panel. Record the weight reaction (WR) to the nearest hundredth of a pound, and the distance (B) to the nearest 0.03 inch.

(4) Obtain the trial actual moment by multiplying the weight reaction (WR) by the moment arm (B).

Trial Actual Moment = (WR) (pounds) times (B) (inches)

(5) The panel is within acceptable limits if the trial actual moment is within 494 to 506 pound-inches. If the calculated moment is less than the minimum value, refer to balance panel weights table (Fig. 3) and read off the number of weights required.

(6) Install weights, P/N 69-12022-7 temporarily in the two locations shown on Fig. 3. Divide the number of weights as evenly as possible between the two mounting positions. Maximum quantity of seven per stack.

(7) Repeat steps 3.A.(2) thru 3.A.(4) to determine new or check balance moment of panel. If the moment is not within specified limits, the weights must be altered until a satisfactory balance is obtained.

(8) Install weights permanently.

B. Balance the bay 3 balance panel as follows:

(1) Prepare the balance panel for balancing as shown in Fig. 4. The bolts which attach the balance panel to the aileron hinge must be installed on the panel in the correct location at time of balancing.

(2) Mount the balance panel in the static balance mounts, as shown in Fig. 2. The panel must be free to rotate about its forward hinge line.

(3) With the panel in a horizontal position measure weight reaction (WR) at a known moment arm (B). The reaction is to be taken at a point where the reaction fitting will not damage the panel.

(4) Obtain the trial actual moment by multiplying the weight reaction (WR) by the moment arm (B).

Trial Actual Moment = (WR) (pounds) times (B) (inches)

(5) The panel is within acceptable limits, if the trial actual moment is from 245 to 255 pound-inches. If the calculated moment is less than the minimum value, refer to the balance panel weights table shown on Fig. 4, and read off the length of panel adjust weights, P/N 69-12022-1, required. Two weights of this length are required. Balance panels with honeycomb construction will require panel adjust weights 69-12022-2.

(6) Cut two weights to the length indicated in the table of Fig. 4 and install temporarily. See Fig. 4 for location. The ends of weights must not extend more than 0.80 inch beyond attaching rivets.

(7) Repeat steps 3.B.(2) thru 3.B.(4) to determine new or check balance moment of panel. If the moment is not within specified limits, the weights must be altered until a satisfactory balance is obtained.

NOTE: Weights are to be cut only to the lengths indicated in table, Fig. 4.

(8) Install weights permanently.

C. Balance the bay 4 panel as follows:

(1) Prepare the balance panel for balancing as shown in Fig. 5. The bolts which attach the balance panel to the aileron hinge must be installed on the panel in the correct location at time of balancing.

(2) Mount the balance panel in the static balance mounts, as shown in Fig. 2. The panel must be free to rotate about its forward hinge line.

(3) With the panel in a horizontal position, measure the weight reaction (WR) at a known moment arm (B). The reaction is to be taken at a point where the reaction fitting will not damage the panel.

CAUTION: SPECIAL CARE MUST BE TAKEN TO PREVENT DAMAGE AS THE BAY 4 BALANCE PANEL DOES NOT HAVE FIXED WEIGHTS AT THE AFT EDGE AND THE AFT SUPPORT MUST BEAR DIRECTLY ON THE BALANCE PANEL STRUCTURE. THE ADJUSTABLE SUPPORT MAY BE LOCATED ON THE FLANGE OF A STIFFENER NEAR THE CENTERLINE OF THE PANEL, AT A DISTANCE OF NOT MORE THAN 1 INCH FROM THE AFT EDGE.

(4) Obtain the trial actual moment by multiplying the weight reaction (WR) by the moment arm (B).

Trial Actual Moment = (WR) (pounds) times (B) (inches)

(5) The panel is within acceptable limits, if the trial actual moment is from 116 to 124 pound-inches. If the calculated moment is less than the minimum value, refer to the balance panel weights table shown on Fig. 5 and read off the length of panel adjust weight, P/N 69-12022-3, indicated.

(6) Cut two weights, P/N 69-12022-3, to the length indicated in table of Fig. 5. Install this weight combination temporarily on both stacks. See Fig. 5 for location. Two weights of each length are required, making a maximum of four weights possible.

(7) Repeat steps 3.C.(2) thru 3.C.(4) to determine new or check balance moment of panel. If the moment is not within specified limits, the weight must be altered until a satisfactory balance is obtained.

NOTE: Weights are to be cut only to the lengths indicated in table.

(8) Install weights permanently.

D. Balance the bay 5 balance panel as follows:

(1) Prepare the balance panel for balancing as shown in Fig. 6. The bolts which attach the balance panel to the aileron hinge must be installed on the panel in the correct location at time of balancing. The tab adjust weights, P/N 66-8420-4 or P/N 66-8420-3001 on the lower surface of the panel must be removed.

(2) Mount the balance panel in the static balance mounts, as shown in Fig. 2. The panel must be free to rotate about its forward hinge line.

(3) With the panel in a horizontal position, measure the weight reaction (WR) at a known moment arm (B). The reaction is to be taken at a point where the reaction fitting will not damage the panel.

(4) Obtain the trial actual moment by multiplying the weight reaction (WR) by the moment arm (B).

Trial Actual Moment = (WR) (pounds) times (B) (inches)

(5) The panel is within acceptable limits if the trial actual moment is from 72 to 78 pound-inches. If the calculated moment is less than the minimum value, refer to the balance panel weights table shown on figure 6, and read off the length of panel adjust weights, P/N 69-12022-10, required.

(6) Cut two weights, P/N 69-12022-10, to the length indicated in table of Fig. 6. Install this weight combination temporarily on both stacks. See Fig. 6 for location. Two weights of each length are required, making a maximum of four weights possible.

(7) Repeat steps 3.D.(2) thru 3.D.(4) to determine new or check balance moment of panel. If the moment is not within specified limits, the weight must be altered until a satisfactory balance is obtained.

NOTE: Weights are to be cut only to the lengths indicated in table, Fig. 6.

(8) Install weights permanently.

(9) After bay 5 balance panel rebalancing is complete, install the required outboard aileron tab adjust weights as instructed in 51-15-6, par. 4.

4. Sample Calculations for Balancing a Bay 5 Balance Panel

A. The following is a summation of par. 3.D.(1) thru 3.D.(8). (All values are assumed.)

(1) Mount the balance panel and measure the weight reaction and moment arm (par. 3.D.(2) and 3.D.(3)).

Weight reaction (WR) = 4.04 pounds
Moment arm (B) = 13.90 inches

(2) Determine trial moment (par. 3.D.(4)).

(WR)(B) = (4.04 pounds) (13.90 inches)
= 56.2 pound-inches

(3) From the table of Fig. 6, determine that a moment of 56.2 pound-inches requires two full-length weights (P/N 69-12022-10 at length of 23.25 inches) and two weights 19 inches long. Temporarily install two weights (one 23.25 inches long and one 19.00 inches long) on the inboard and outboard side of the panel.

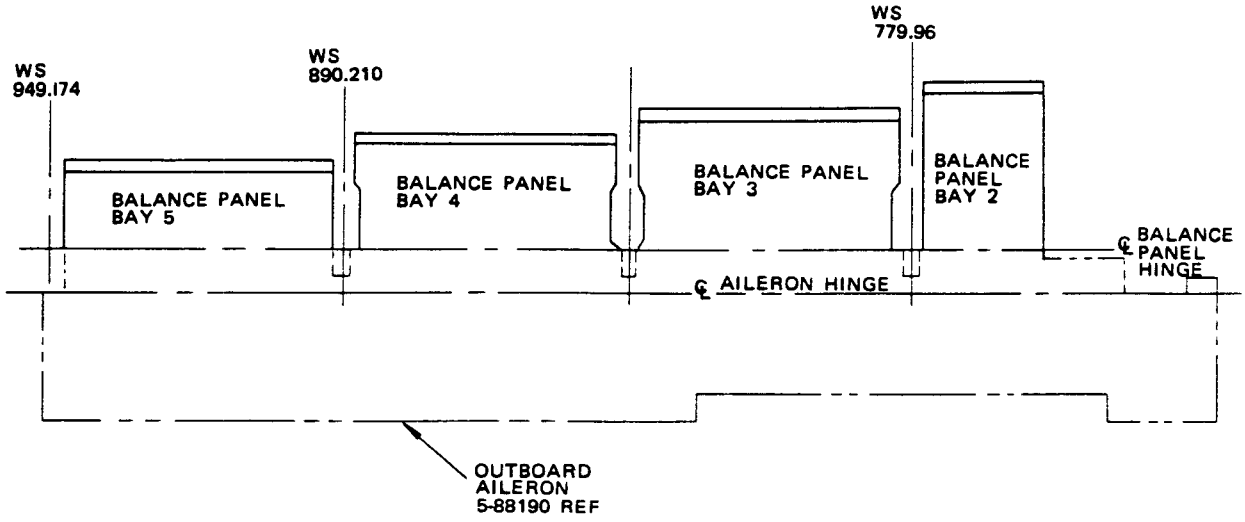
(4) Determine the new or check balance moment (par. 3.E.(7)).

(WR) = 5.44 pounds
(B) = 13.90 inches
(WR)(B) = 75.6 pound-inches

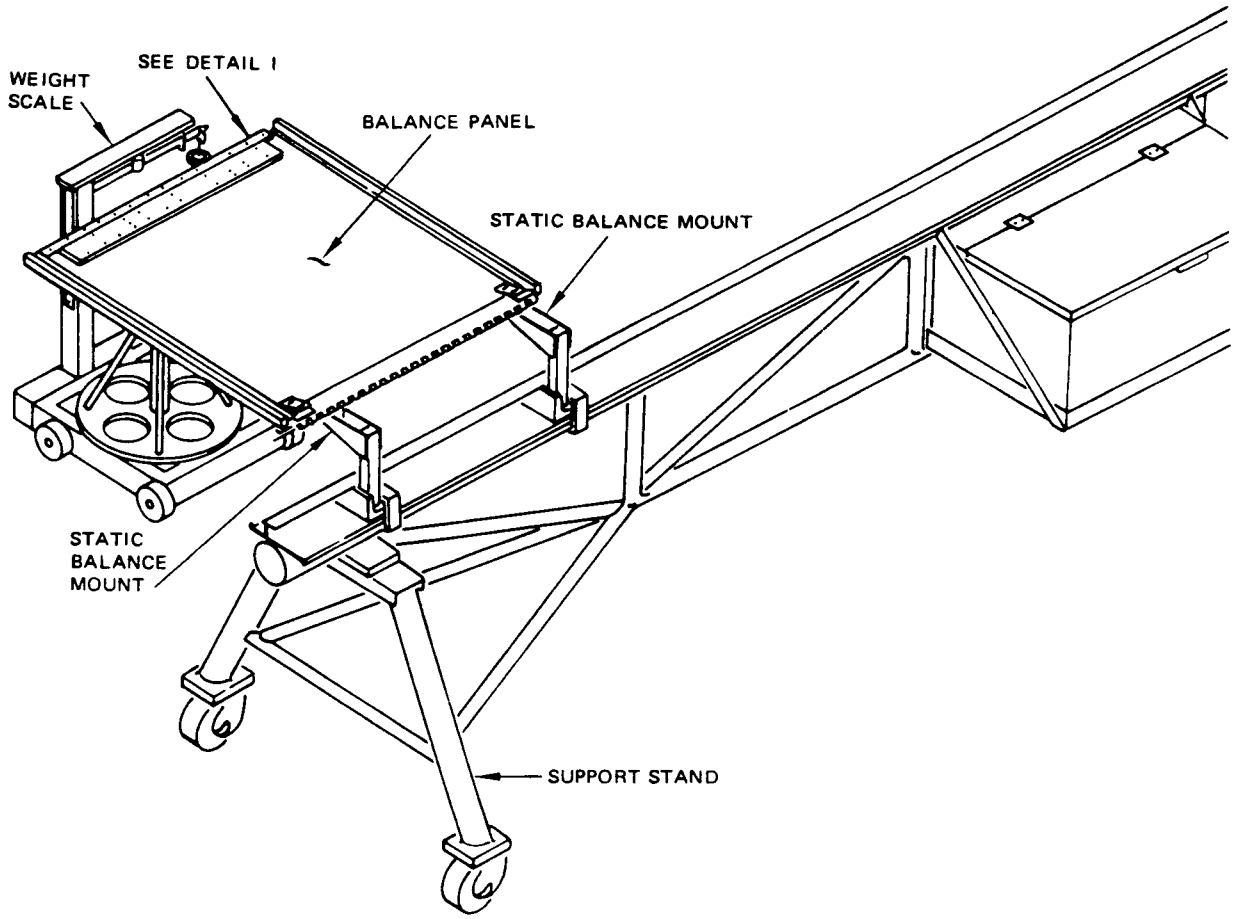
(5) This moment of Fig. 6 is within the required nominal moment range and the panel is balanced satisfactorily.

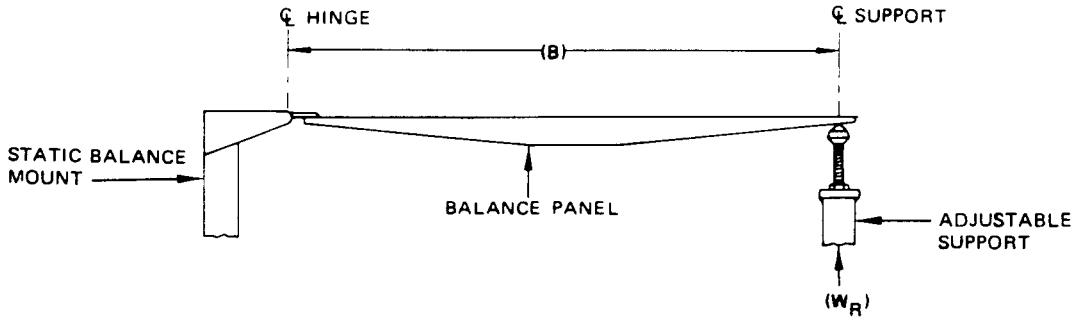
(6) Install the weights permanently.

(7) Install the required outboard aileron tab adjust weights as instructed in 51-15-6 par. 4.



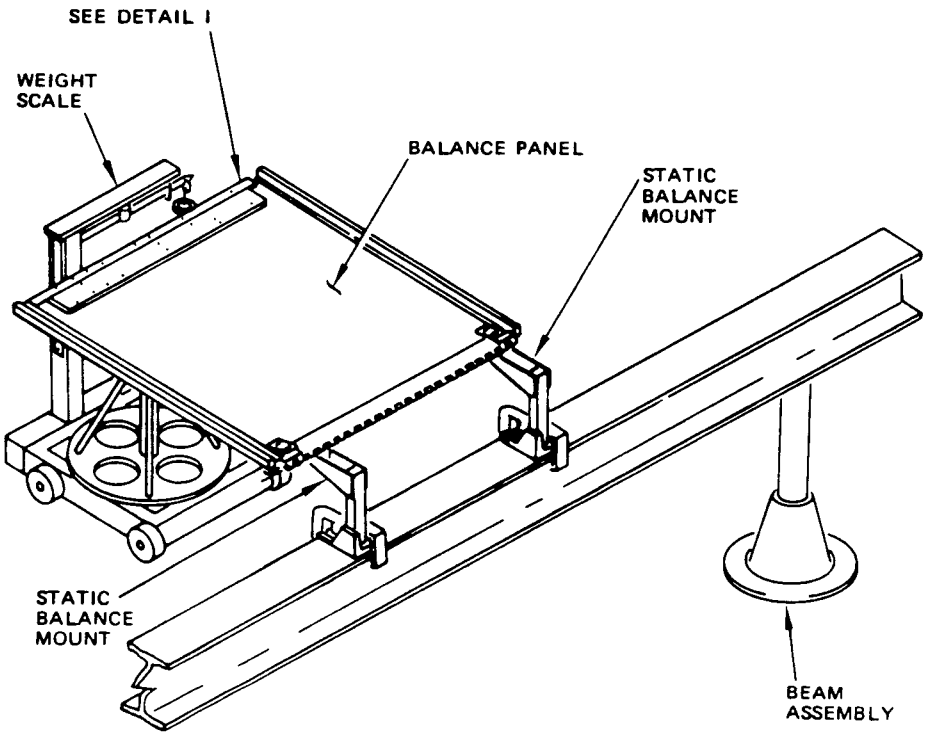
Outboard Aileron Balance Panel Locations
Figure 1





DETAIL 1

Outboard Aileron Balance Panel Supported for Balancing
Figure 2 (Sheet 1)



Outboard Aileron Balance Panel Supported for Balancing
Figure 2 (Sheet 2)

OUTBOARD AILERON BALANCE PANEL, BAY 2, BALANCING CONFIGURATION

PARTS REMOVED

1. Fabric Hinge Seal
2. Hinge and Link (Ref 51-15-4)
3. Seals
4. Retainer Assemblies
5. Seal Retainer Pins
6. Hinge Pins

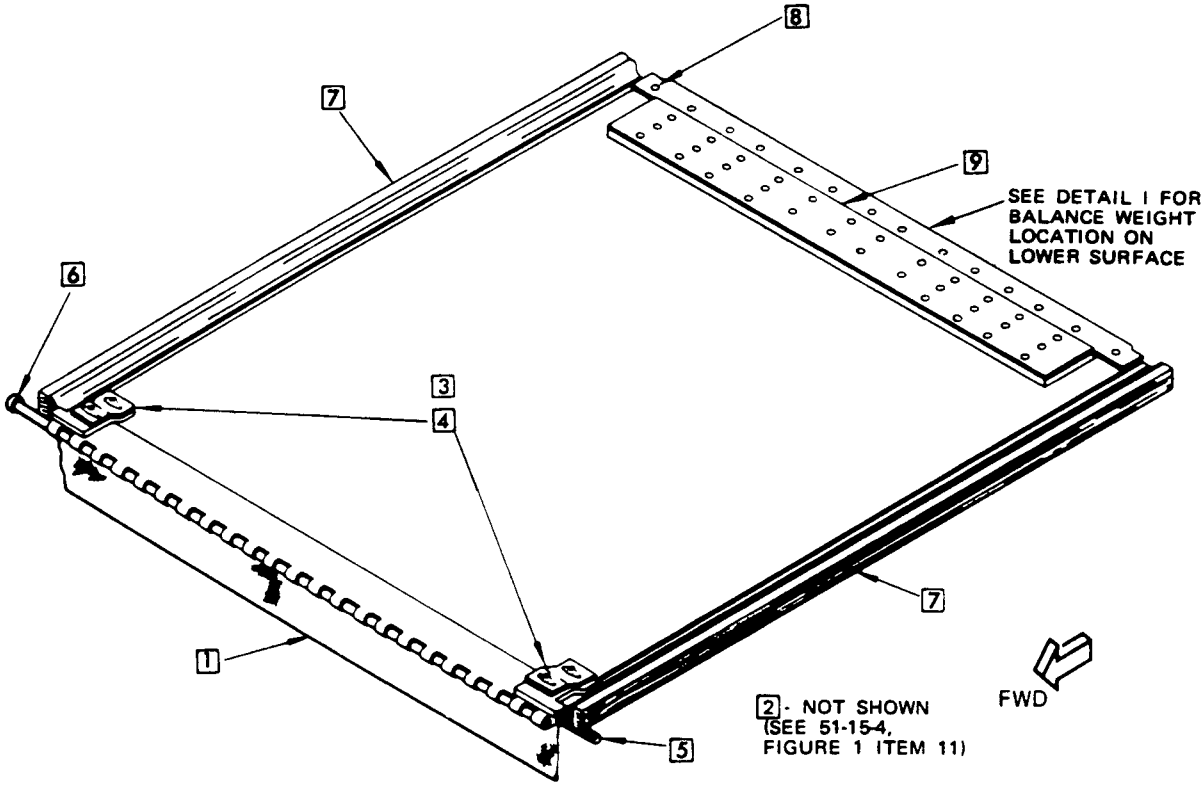
PARTS INSTALLED

7. End Seals
8. Panel Attachment Bolts
9. Fixed Balance Weights 69-12022-5 and 69-12022-6

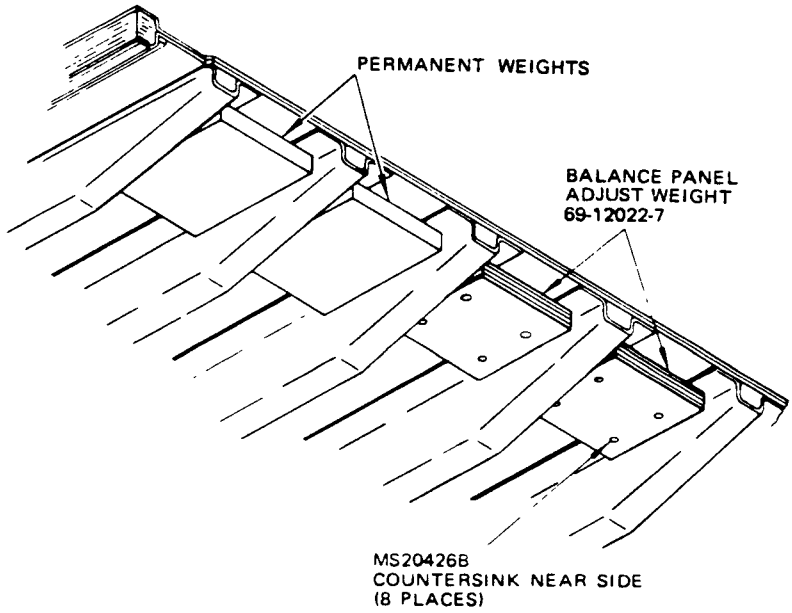
NOTE

- BONDING JUMPERS MUST BE INSTALLED WITH ALL ATTACHING HARDWARE AT THE CORRECT LOCATIONS ON THE PANEL.

Outboard Aileron Balance Panel, Bay 2 - Balancing Configuration
Figure 3 (Sheet 1)



MOMENT (POUND-INCHES)	NUMBER OF 69-12022-7 WEIGHTS REQUIRED
460 - 461	14
462 - 464	13
465 - 467	12
468 - 469	11
470 - 472	10
473 - 475	9
476 - 477	8
478 - 480	7
481 - 482	6
483 - 485	5
486 - 488	4
489 - 490	3
491 - 493	2
494 - 506	NOMINAL MOMENT RANGE



LOCATION AND INSTALLATION OF BAY 2 BALANCE PANEL ADJUST BALANCE WEIGHTS

DETAIL I

Outboard Aileron Balance Panel, Bay 2 - Balancing Configuration
Figure 3 (Sheet 2)

OUTBOARD AILERON BALANCE PANEL, BAY 3, BALANCING CONFIGURATION

PARTS REMOVED

1. Fabric Hinge Seal
2. Hinge and Link (Ref 51-15-4)
3. Seals
4. Retainer Assemblies
5. Seal Retainer Pins
6. Hinge Pins

PARTS INSTALLED

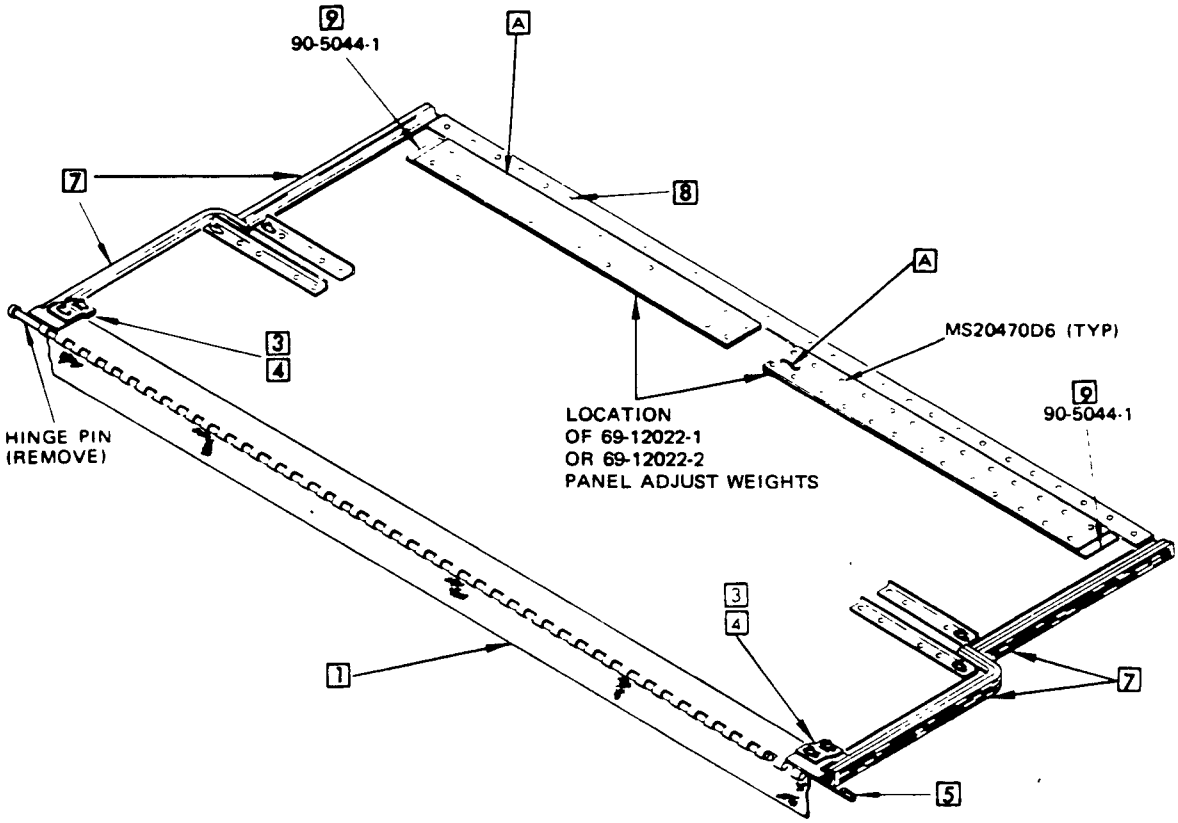
7. End Seals
8. Panel Attachment Bolts
9. Fixed Balance Weights 90-5044-1

NOTE

- BONDING JUMPERS MUST BE INSTALLED WITH ALL ATTACHING HARDWARE AT THE CORRECT LOCATIONS ON THE BALANCE PANEL.

A NOT MORE THAN ONE LAYER OF WEIGHTS PERMITTED.

Outboard Aileron Balance Panel, Bay 3 - Balancing Configuration
Figure 4 (Sheet 1)



BALANCE WEIGHT REQUIREMENTS			
SKIN AND RIB CONSTRUCTION		HONEYCOMB CONSTRUCTION	
MOMENT (POUND-INCHES)	LENGTH OF 69-12022-1 WEIGHT (TWO REQUIRED) (INCHES)	MOMENT (POUND-INCHES)	LENGTH OF 69-12022-2 WEIGHT (TWO REQUIRED) (INCHES)
211-214	21 4	215-218	20 25
215-218	19.5	219-220	18 3
219-220	17 5	221-223	16 7
221-223	16	224-225	15 1
224-226	14	226-227	13.5
227-228	12 5	228-230	11.9
229-231	11	231-232	10.3
232-234	9	233-235	8 7
235-236	7.5	236-237	7.0
237-239	6	238-240	5 4
240-242	4	241-242	3 8
243-244	2 5	243-245	2.2
245-255	NOMINAL MOMENT RANGE		

2 - NOT SHOWN (SEE 51-15-4, FIGURE 1 ITEM 11)

Outboard Aileron Balance Panel, Bay 3 - Balancing Configuration
Figure 4 (Sheet 2)

OUTBOARD AILERON BALANCE PANEL, BAY 4 BALANCING CONFIGURATION

PARTS REMOVED

[1] Fabric Hinge Seal

[2] Hinge Halves (Ref 51-15-4)

[3] Seals

[4] Retainer Assemblies

[5] Seal Retainer Pins

[6] Hinge Pins

PARTS INSTALLED

[7] End Seals

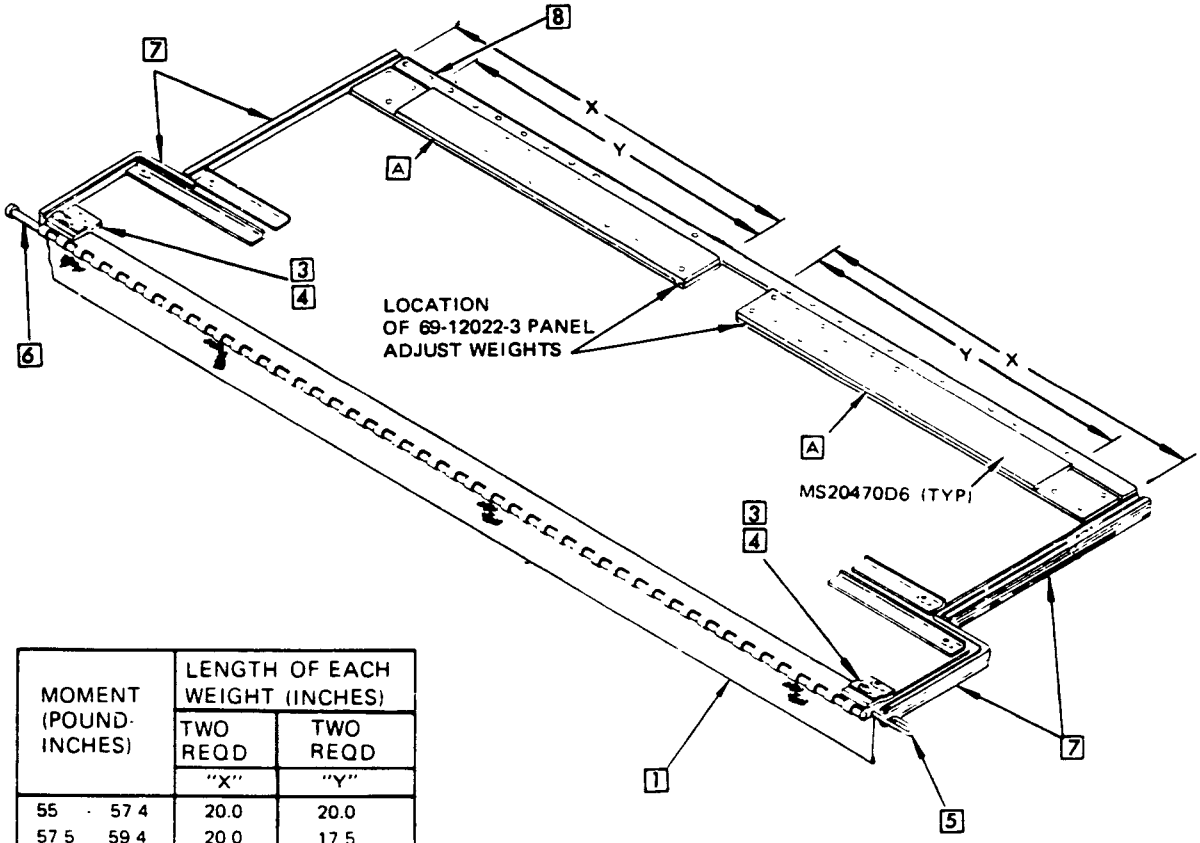
[8] Panel Attachment Bolts

NOTE

- BONDING JUMPERS MUST BE INSTALLED WITH ALL ATTACHING HARDWARE AT THE CORRECT LOCATIONS ON THE BALANCE PANEL.

[A] BALANCE PANEL MUST NOT HAVE MORE THAN TWO LAYERS OF WEIGHTS INSTALLED.

Outboard Aileron Balance Panel, Bay 4 - Balancing Configuration
Figure 5 (Sheet 1)



MOMENT (POUND-INCHES)	LENGTH OF EACH WEIGHT (INCHES)	
	TWO REQD "X"	TWO REQD "Y"
55 - 57 4	20.0	20.0
57 5 - 59 4	20 0	17 5
59 5 - 62 4	20 0	16 0
62 5 - 65 4	20 0	14 5
65 5 - 67 4	20 0	12 5
67 5 - 70 4	20 0	11 0
70 5 - 73 4	20 0	9 5
73 5 - 76 4	20 0	7 5
76 5 - 79 4	20 0	6 0
79 5 - 82 4	20 0	4 0
82 5 - 84.9	20 0	2 5
85.0 - 88.9	20 0	
89.0 - 90 9	17 5	
91 - 93 9	16 0	
94 - 96 9	14 5	
97 - 98.9	12 5	
99 - 101 9	11 0	
102 - 104 9	9 0	
105 - 107 9	7 5	
108 - 110.9	6 0	
111 - 113 9	4 0	
114 - 116	2 5	
116 - 124	NOMINAL MOMENT RANGE	

Outboard Aileron Balance Panel, Bay 4 - Balancing Configuration
Figure 5 (Sheet 2)

OUTBOARD AILERON BALANCE PANEL, BAY 5, BALANCING CONFIGURATION

PARTS REMOVED

[1] Fabric Hinge Seal

[2] Hinge and Link (Ref 51-15-4)

[3] Seals

[4] Retainer Assemblies

[5] Seal Retainer Pins

[6] Hinge Pins

[10] **Tab Adjust Weights [B]**

PARTS INSTALLED

[7] End Seals

[8] Panel Attachment Bolts

[9] Fixed Balance Weights (69-12022-11)

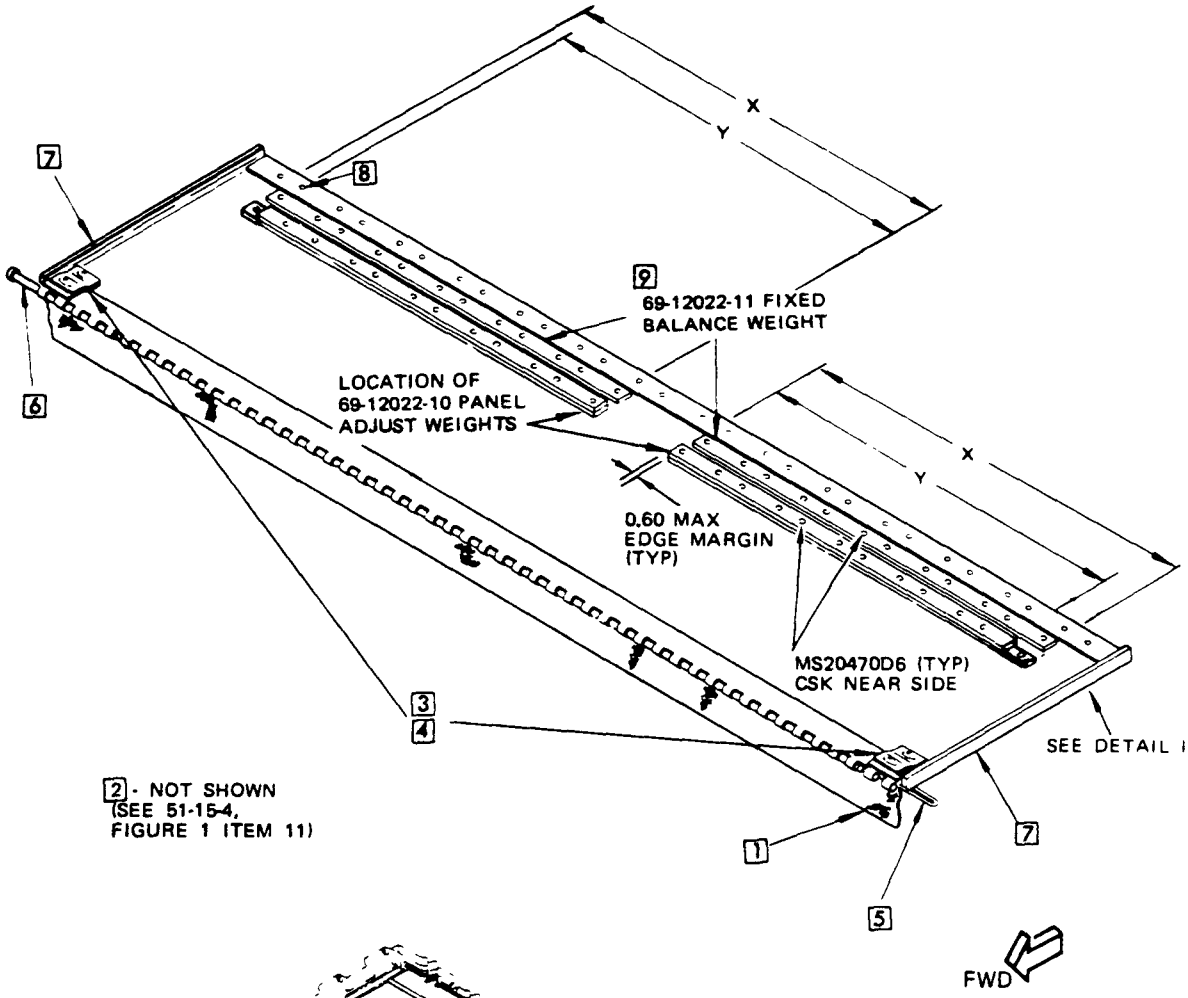
NOTE

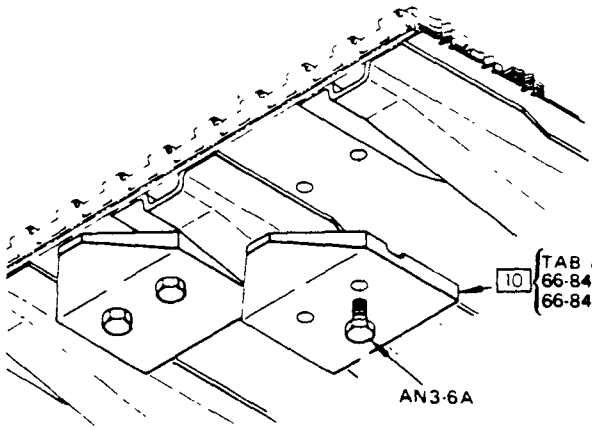
- BONDING JUMPERS MUST BE INSTALLED WITH ALL ATTACHING HARDWARE AT THE CORRECT LOCATIONS ON THE PANEL.

[A] BALANCE PANEL MUST NOT HAVE MORE THAN TWO LAYERS OF WEIGHTS.

[B] TAB ADJUST WEIGHTS 66-8420-3001 AND 66-8420-4 MUST NOT BE INSTALLED DURING BALANCING. AFTER PANEL BALANCING IS COMPLETE, INSTALL THE REQUIRED OUTBOARD AILERON TAB ADJUST WEIGHTS AS INSTRUCTED IN 51-15-6 PAR. 4.

Outboard Aileron Balance Panel, Bay 5 - Balancing Configuration
Figure 6 (Sheet 1)

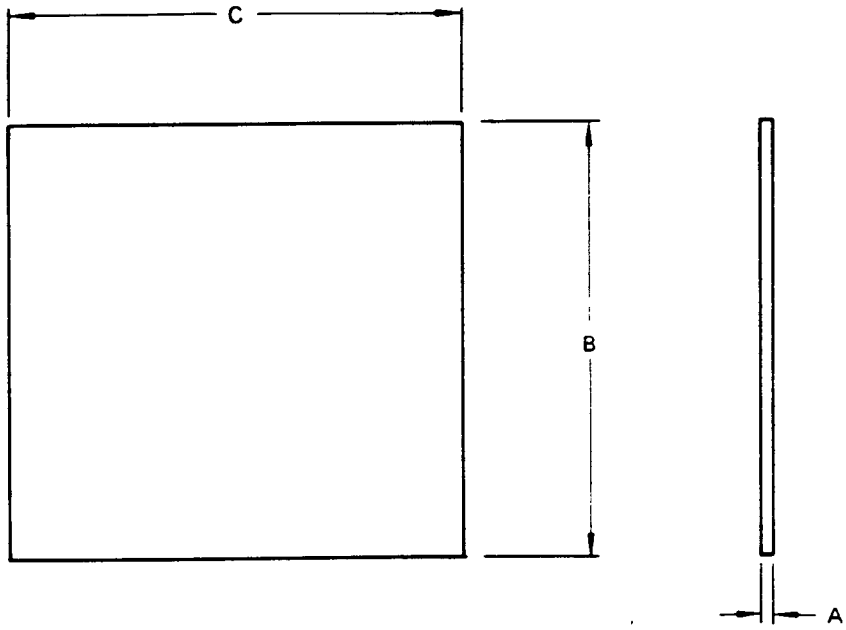




BOTTOM VIEW
DETAIL I

MOMENT (POUND-INCHES)	LENGTH OF EACH WEIGHT (INCHES)	
	TWO REQUIRED "X"	TWO REQUIRED "Y"
53 - 54.9	23.25	23.25
55 - 56.9	23.25	19 0
57 - 58.9	23.25	15 0
59 - 60.9	23.25	11.0
61 - 62 9	23.25	7 0
63 - 64.9	23 25	
65 - 66 9	19.0	
67 - 67 9	15 0	
68 - 69.9	11.0	
70 - 71.9	7.0	
72 - 78.0	NOMINAL MOMENT RANGE	

Outboard Aileron Balance Panel, Bay 5 - Balancing Configuration
Figure 6 (Sheet 2)



BAY NO.	BALANCE WEIGHT	A	B	C	MATERIAL
2	69-12022-7	0.050	2 40	2 50	NAVAL BRASS, QQ-B-638, COMP 1, 1/2 H, DENSITY 0.304 LBS PER CUBIC INCH OPTIONAL COMMERCIAL BRASS, QQ-B-613, COMP 1 OR 2
3	69-12022-1	0.050	2.35	21.40	
4	69-12022-3	0.063	2.35	20.00	
5	69-12022-10	0.063	0.94	23.28	

Outboard Aileron Balance Panel Weight Details
Figure 7

OUTBOARD AILERON TAB BALANCING

1. General

A. The outboard aileron tab is not balanced, however, the effective moment of the tab about the hinge line of the outboard aileron has to be determined. This moment is a function of the tab weight and the moment arm of the tab in relation to the aileron hinge line. Since this moment arm is a fixed value, the effect of the aileron tab can be calculated by its weight alone.

B. If a tab has to be repaired or replaced by a tab of different weight, the variation of weight can be compensated by the installation of different tab adjust weights on the number five balance panel. Due to the importance of the tab weight, the actual weight of a repaired tab, less the hinge pin and jumper assembly should be steel stamped on the placard prior to attaching to tab.

2. Preparation for Balancing

A. Remove tab hinge pin and bonding jumpers before weighing (Fig. 1).

3. Adjustment of Aileron Balance for Change in Tab Weight

A. When (after repair or repainting) the weight of the tab can be calculated, adjustment to the balance panel adjust weights may be made without removing the tab from the airplane. Weight must be determined to the nearest 0.01 pound. See Fig. 4 for the number of adjust weights required.

B. When the weight of the tab cannot be calculated, or if no space is available for additional adjust weights, the tab must be removed from the airplane and weighed.

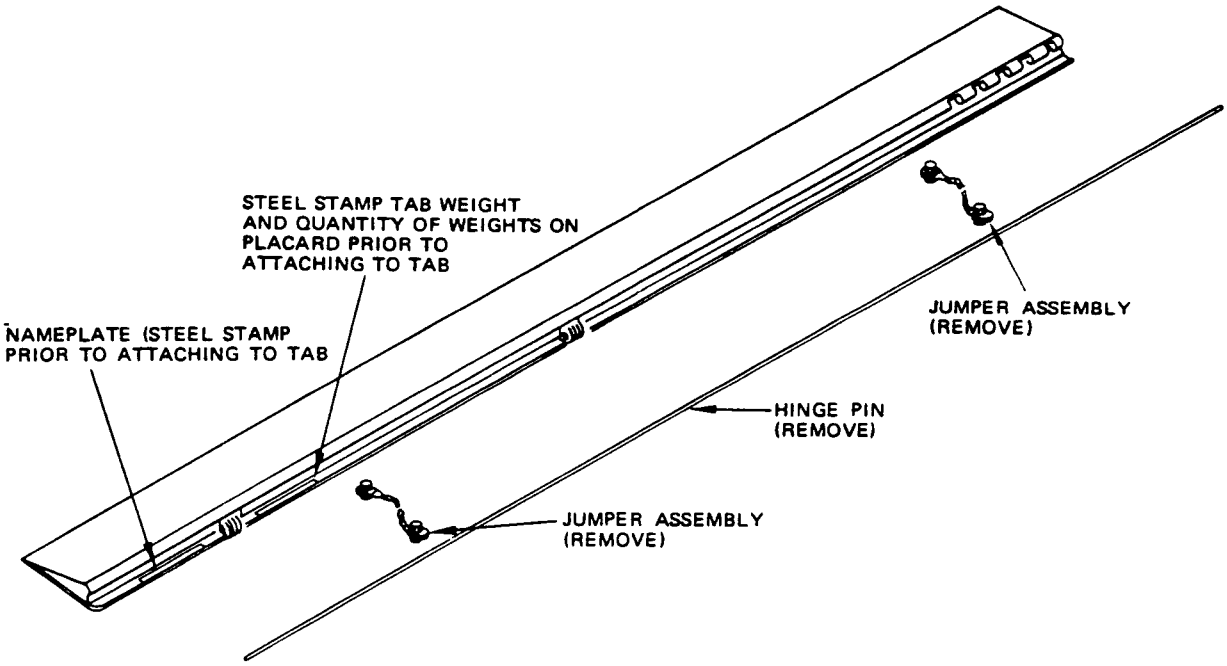
C. Stamp the correct tab weight and the required number of adjust weights on the placard in the space provided.

4. Outboard Aileron Tab Adjust Weights Installation (Fig. 2 and 3)

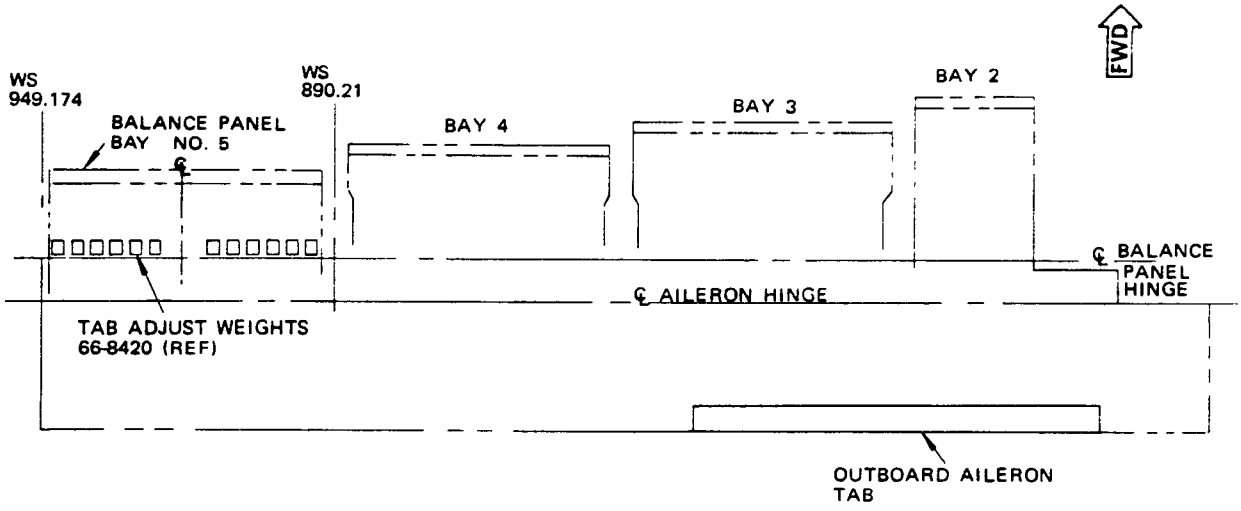
A. Examine decal affixed to tab assembly for tab weight (Fig. 1).

B. Determine number of adjust weights required according to outboard aileron tab adjust weights table (Fig. 4).

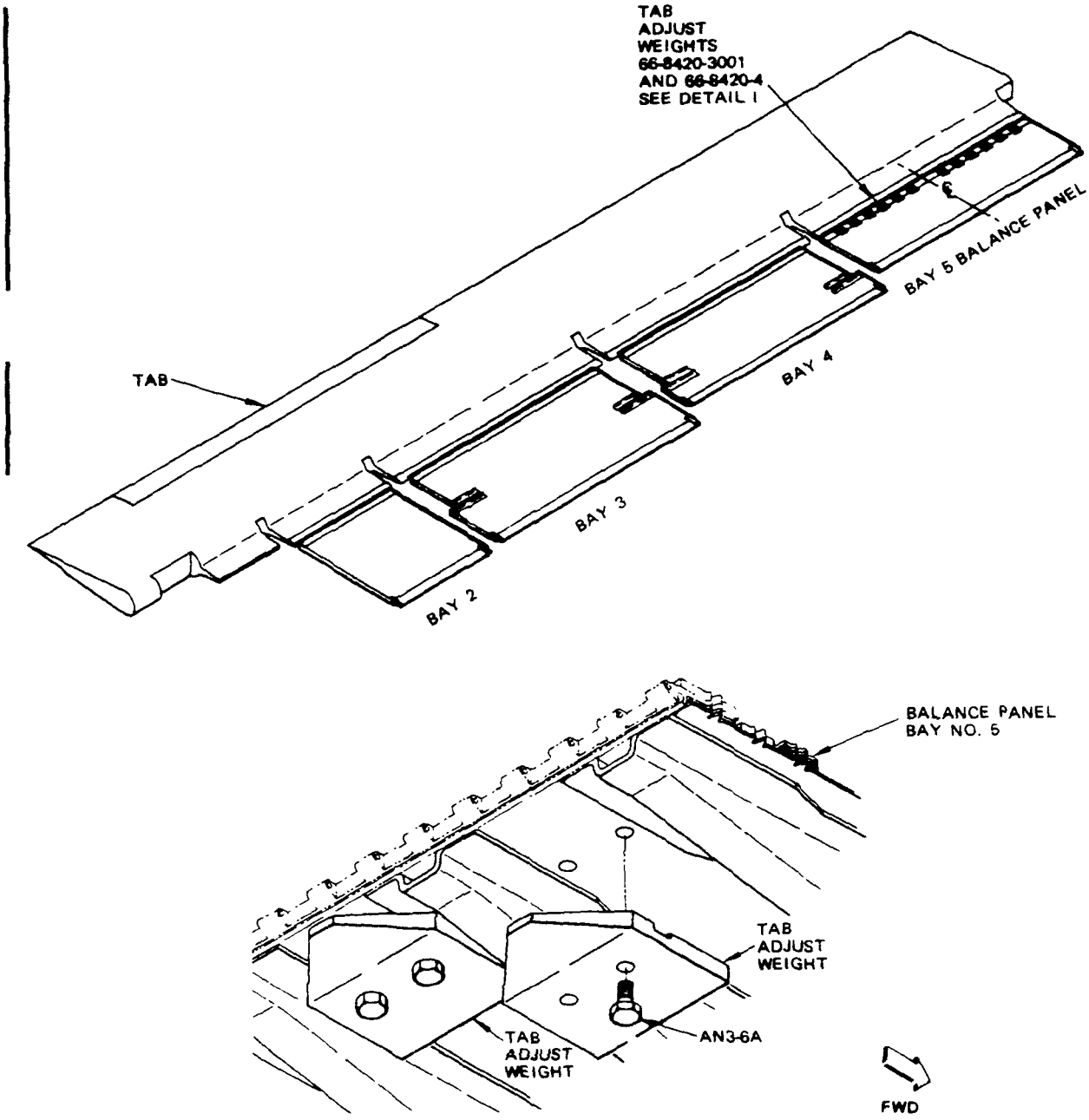
C. Install adjust weights on bay 5 balance panel, symmetrically to centerline as shown in Fig. 2 and 3. If odd number of adjust weight is required, install odd weight on end of inboard row of weights.



Outboard Aileron Tab - Preparation for Balancing
Figure 1



Outboard Aileron Tab Adjust Weight Location
Figure 2



LOCATION AND INSTALLATION OF *TAB ADJUST WEIGHTS*
ON LOWER SURFACE OF BALANCE PANEL BAY NO. 5

DETAIL I

Outboard Aileron Tab Adjust Weight Installation
Figure 3

OUTBOARD AILERON TAB ADJUST WEIGHT REQUIREMENTS		
TAB WEIGHT (POUNDS)	QUANTITY	
	66-8420-4 [A]	66-8420-3001 OR-1 [B]
2.50 to 2.69		0
2.70 to 2.88		1
2.89 to 3.08		2
3.09 to 3.27		3
3.28 to 3.46		4
3.47 to 3.65		5
3.66 to 3.85		6
3.86 to 4.04		7
4.05 to 4.23		8
4.24 to 4.42		9
4.43 to 4.62		10
4.63 to 4.81		11
4.82 to 5.00		12
5.01 to 5.18	1	11
5.19 to 5.36	2	10
5.37 to 5.53	3	9
5.54 to 5.71	4	8
5.72 to 5.88	5	7
5.89 to 6.05	6	6
6.06 to 6.23	7	5
6.24 to 6.40	8	4
6.41 to 6.58	9	3
6.59 to 6.75	10	2
6.76 to 6.92	11	1
6.93 to 7.10 [C]	12	0

NOTE

[A] MATERIAL: TUNGSTEN
WEIGHT: 1.11 (± 0.06) POUNDS

[B] MATERIAL: BRONZE
WEIGHT: 0.56 (± 0.03) POUND

[C] 7.10 POUNDS IS THE MAXIMUM ALLOWABLE WEIGHT OF TAB.

Outboard Aileron Tab Adjust Weights
Figure 4

ELEVATOR ASSEMBLY BALANCING

1. General

A. The static balance CG of the elevator major assembly is derived from the sum of the individual weights and moments of the elevator, control tab, stabilizer actuated tab and balance panels together with constants for components or parts not installed at time of balancing (Ref 51-15-0).

NOTE: Apply all paint or protective finish to the surface before balancing. Refer to 51-15-0 for detailed information on balancing requirements after refinishing.

2. Special Tools and Equipment

A. The tools and equipment required during balancing are illustrated in Fig. 2. (Refer to 51-15-0, Fig. 3 for complete description of these items.)

3. Elevator Assembly Balancing Procedure

A. Prepare the elevator as shown in Fig. 1 and mount in the balance stand at the elevator hinge stations as shown in Figs. 2 and 4.

NOTE: The elevator balance panels are individually weighed and are therefore omitted from the elevator assembly.

B. With the chord plane in a horizontal position, measure the reaction (WR) in pounds at moment arm (B) in inches. Locate the adjustable support, mounted on the platform scale, under the tab hinge centerline at elevator station 115.53 (Fig. 2, Sheet 2). The moment arm is 28.81 inches with the supports at those positions.

NOTE: The platform scale should be rezeroed after mounting the adjustable support with the ELEVATOR tab hinge support.

C. The trial actual moment is obtained by multiplying the reaction (WR) in pounds by the moment arm (B) of 28.81 inches.

Trial Moment = (WR) (B)

D. Refer to the Elevator Balance weight table, Fig. 3 and read off the number of weights, Boeing part numbers 69-10063 and 69-10063-1 required. (Parts differ only in shape, not in weight.)

NOTE: After maximum quantity of weights 69-10063 and 69-10063-1 have been installed, 69-10063-8 (quantity as required) weights may be substituted for 69-10063 weights to permit balancing. Substitution must be completed in bay 2 before proceeding to bays 3 and 4.

E. Install the weights determined above on the elevator horn in bays 2, 3, and 4, as shown in Fig. 4.

NOTE: Bay 2 must be completely filled with weights before any weights can be installed in bays 3 and 4. Fill bay 3 before installing any weights in bay 4.

A maximum of two weights can be installed at any location.

F. Obtain the check balance moment by repeating above steps B, C, D, and E. The moment must lie between 1012 and 1038 pound-inches.

NOTE: If the moment is not within the specified limits, the weights must be altered until satisfactory balance is obtained.

G. Sample Balancing Procedure. An example of balancing at station 115.53 is as follows:

Step A. Mount the elevator in the balance stand.

Step B. Measure the reaction (WR) at the known moment arm of 28.81 inches (WR) = 37.93 pounds.

Step C. The trial moment = (WR)(B)
= 37.93 pounds times 28.81 inches
= 1092.8 pound-inches

Step D. The Elevator Balance Weight Table, Fig. 3, requires (11) 69-10063 or (11) 69-10063-1 weights.

Step E. Install weights, as shown in Fig. 4.

Step F. Check balance moment = (WR)(B)
= 35.55 pounds times 28.81 inches
= 1024.2 pound-inches
The moment falls within the specified limits, indicating the surface is satisfactorily balanced.

4. Adjustment of Balance after Minor Repair with Elevator Installed

A. The effect of minor repairs made with the elevator installed on the airplane must be calculated and, if necessary, an adjustment made to the balance weights before putting the airplane back into service, provided there is space for the installation of the required balance weights. Where there is insufficient space for the addition of extra balance weights, the elevator must be removed and rebalanced as described in par. 3. Calculate the weight required to balance the repair as follows (Fig. 5):

(1) Determine the net weight of the repair (within 0.03 pound) by subtracting the weight of the material removed from the weight of the material used for repair.

(2) Measure the distance (X) between CG of repair area to forward row of rivets through the spar chord.

(3) Add 0.40 inch to distance (X) to determine distance (Y).

(4) Measure the distance (Z) between the balance panel hinge and the CG of the installed balance weights.

(5) Calculate the distance (U) between the centerline of the elevator hinge and CG of balance weights by subtracting the distance (Z) from the distance between the centerline of the balance panel to elevator hinge and the centerline of the elevator hinge (Dimension [T] of Fig. 5, Table 1).

(6) Calculate the weight (W) required to balance the repair:

$$(W) = \frac{(\text{Repair net weight in pounds})\ (Y \text{ in inches})}{(U \text{ in inches})}$$

NOTE: No addition of balance weights is necessary when the weight (W) is less than 0.50 pound; however, this additional weight (W) must be recorded and included in any rebalancing calculations should the elevator be repaired a second time.

(7) Install the additional balance weights P/N 69-10063 in bays 2, 3 and 4 as required by Fig. 4, filling all positions on bay 2 before adding weights in bay 3 and adding weights to bay 4 only after filling all positions on bays 2 and 3. The balance weights added should not be less than that calculated in par. 4.A.(6) but may be up to 0.50 pound more unless the required balance weight is less than 0.50 pounds. Any balance weight added in excess of that required must be included in any calculations made after any subsequent repairs.

5. Sample Calculation for Rebalancing after Minor Repair to an Installed Elevator

A. Calculate the effect of a repair to an installed elevator as follows: (All values are assumed.)

(1) Weigh the material removed from the damage area. 0.10 pound

(2) Weigh the material used in repair. 0.60 pound

(3) Net weight of repair. 0.60 - 0.10 = 0.50 pound

(4) Measure distance (X). 22.00 inches

(5) Add 0.40 inch to (X) distance to determine distance (Y). 22.40 inches

(6) Distance (Z). 2.56 inches

(7) Distance (T). 11.83 inches

(8) Distance (U) = (T) - (Z)
(U) = 11.83 - 2.56 = 9.27 inches

(9) Balance weights required.

$$\frac{(0.50 \text{ pound})\ (22.40 \text{ inches})}{(9.27 \text{ inches})} = 1.20 \text{ pounds}$$

(10) Balance weights P/N 69-10063 and P/N 69-10063-1 weigh 0.50 pound, therefore three weights of either part number are required. Record the excess weight of 0.30 pound.

ELEVATOR - BALANCING CONFIGURATION

PARTS REMOVED

[1] Stabilizer Actuated Tab

[2] Control Tab

[3] Balance Panels

[4] Forward control rod. This rod is part of the stabilizer actuated tab mechanism and must be removed from the bell-crank located on the hinge line of the elevator

PARTS INSTALLED

[5] Bonding Jumpers (and associated hardware) between elevator and tabs and between elevator and balance panels

[6] Bolts which attach tabs to elevator must be installed in correct locations

[7] Static Dischargers

[8] Balance Panel Hinge Pins

[9] Hinge Pin for stabilizer actuated tab

[10] Fabric Seals and Retainer Pins (2)

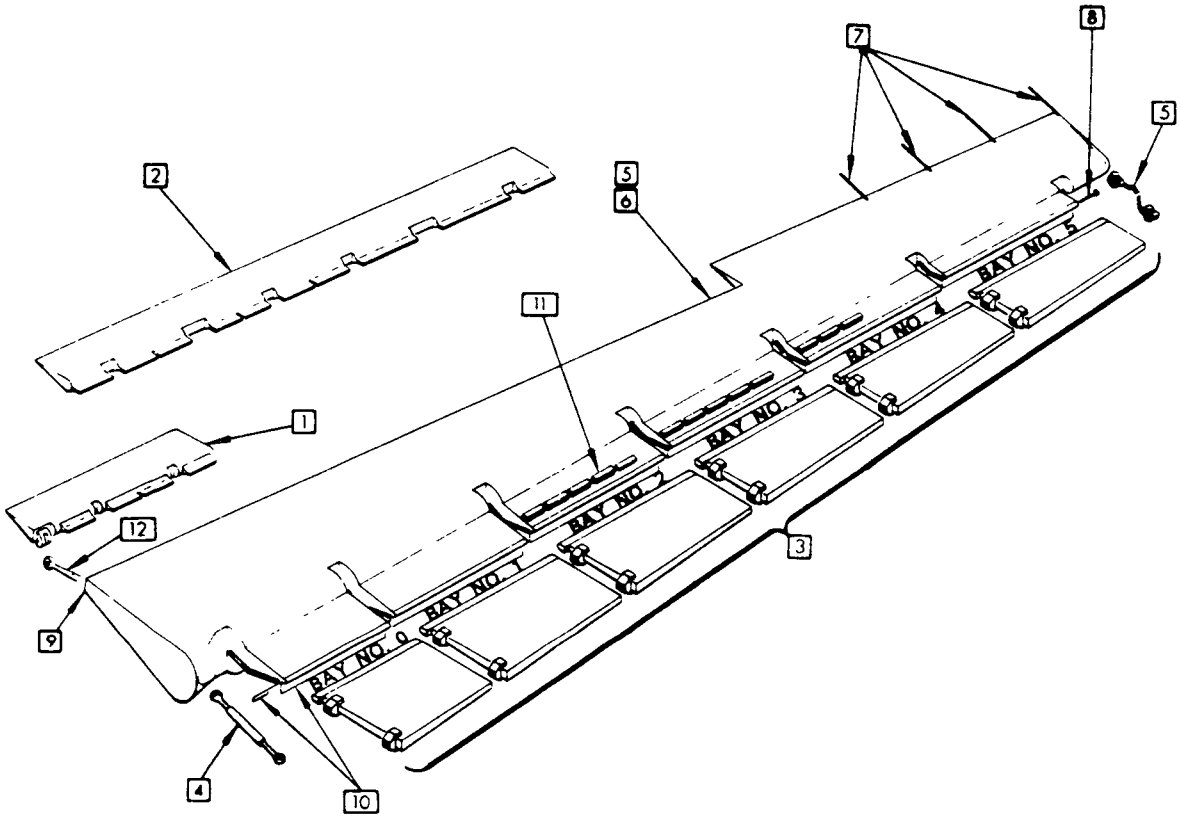
[11] Balance Weights

[12] Control rod for stabilizer actuated tab

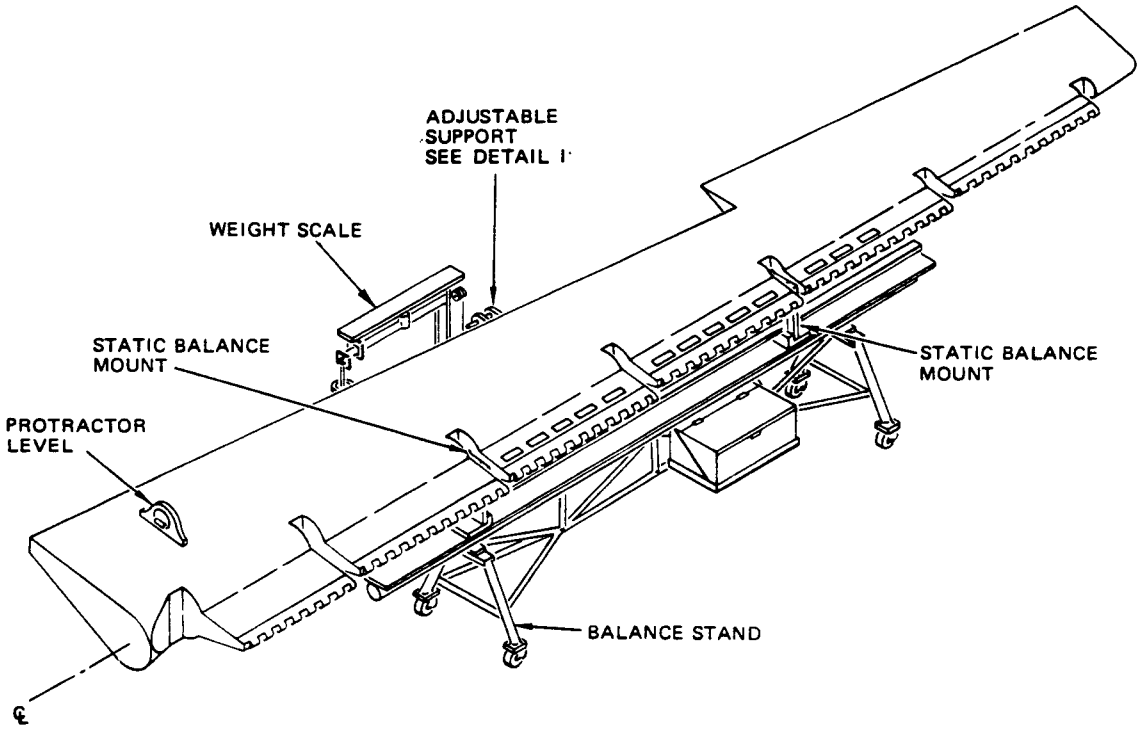
NOTE

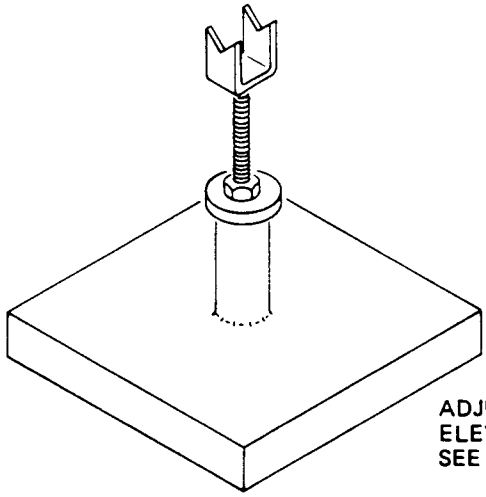
- PAINTED AND PROTECTIVE FINISHES MUST BE APPLIED TO THE ELEVATOR PRIOR TO BALANCING

REF DWG
50-9784



Elevator - Preparation for Balancing
Figure 1 (Sheet 2)

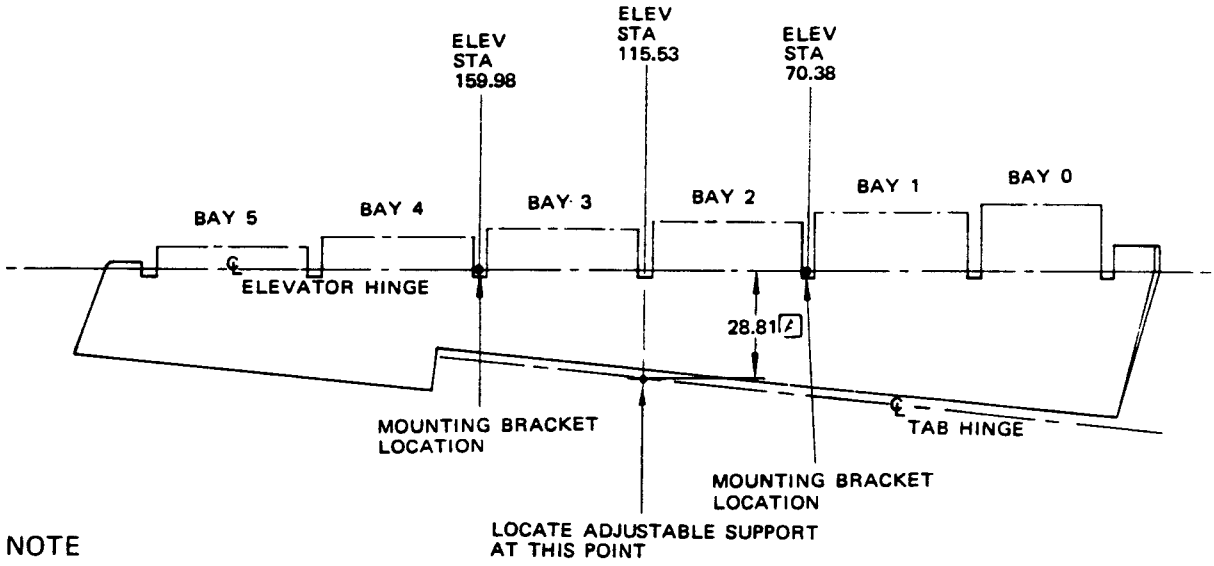




ADJUSTABLE SUPPORT WITH ELEVATOR TAB HINGE SUPPORT SEE 51-15-0, FIGURE 3.

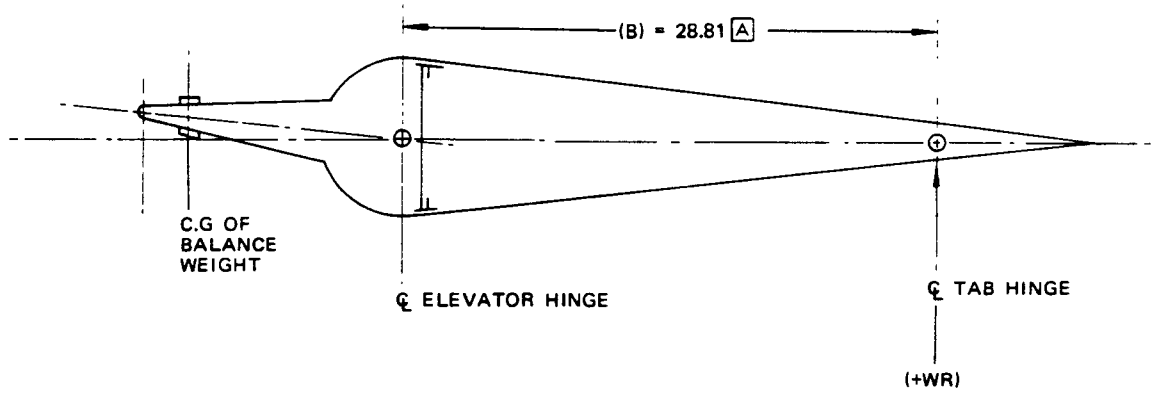
DETAIL I

Set Up for Elevator Balancing
Figure 2 (Sheet 1)



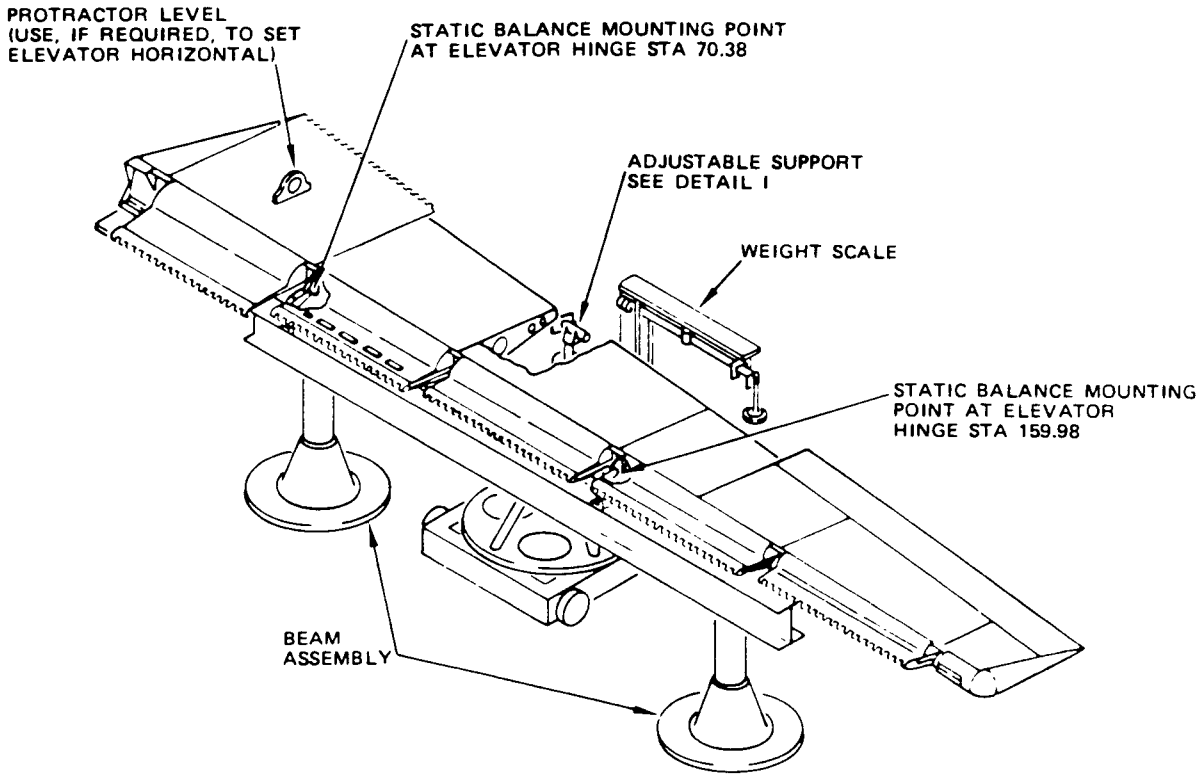
NOTE

A DISTANCE FROM ELEVATOR HINGE CENTER LINE TO TAB HINGE CENTER LINE AT ELEVATOR STATION 115.53



LOCATION OF ELEVATOR SUPPORT POINTS

Set Up for Elevator Balancing
Figure 2 (Sheet 2)



Setup for Elevator Balancing
Figure 2 (Sheet 3)

BALANCE WEIGHTS 69-10063 OR 69-10063-1		
LOCATION	TRIAL MOMENT (WR) (B) POUND-INCHES	QUANTITY REQUIRED
BAY 2	+1012 TO +1036 [A]	0
	+1036 TO +1042	2
	+1042 TO +1047	3
	+1047 TO +1053	4
	+1053 TO +1059	5
	+1059 TO +1064	6
	+1064 TO +1070	7
	+1070 TO +1076	8
	+1076 TO +1081	9
	+1081 TO +1087	10
	+1087 TO +1093	11
	+1093 TO +1098	12
	+1098 TO +1104	13
	+1104 TO +1110	14
	+1110 TO +1115	15
	+1115 TO +1121	16
	+1121 TO +1127	17
	+1127 TO +1131	18
BAY 3	+1131 TO +1136	1
	+1136 TO +1140	2
	+1140 TO +1145	3
	+1145 TO +1150	4
	+1150 TO +1155	5
	+1155 TO +1159	6
	+1159 TO +1164	7
	+1164 TO +1169	8
	+1169 TO +1173	9
	+1173 TO +1178	10
	+1178 TO +1183	11
	+1183 TO +1187	12
	+1187 TO +1192	13
	+1192 TO +1196	14
	+1196 TO †1201	15
	+1201 TO +1206	16
	+1206 TO +1210	17
	+1210 TO +1214	18
BAY 4	+1214 TO +1217	1
	+1217 TO +1221	2
	+1221 TO +1224	3
	+1224 TO +1228	4
	+1228 TO +1231	5
	+1231 TO +1235	6
	+1235 TO +1238	7
	+1238 TO +1242	8
	+1242 TO +1245	9
	+1245 TO +1249	10
	+1249 TO +1252	11
	+1252 TO +1256	12
	†1256 TO +1260	13

NOTE

REBALANCE TO THE MANUFACTURING MOMENT REQUIREMENTS WHICH IS BETWEEN + 1012, AND + 1038 INCH-POUNDS; HOWEVER, THE ELEVATOR IS SATISFACTORY IF THE MOMENT IS BETWEEN + 982 AND + 1088 INCH-POUNDS.

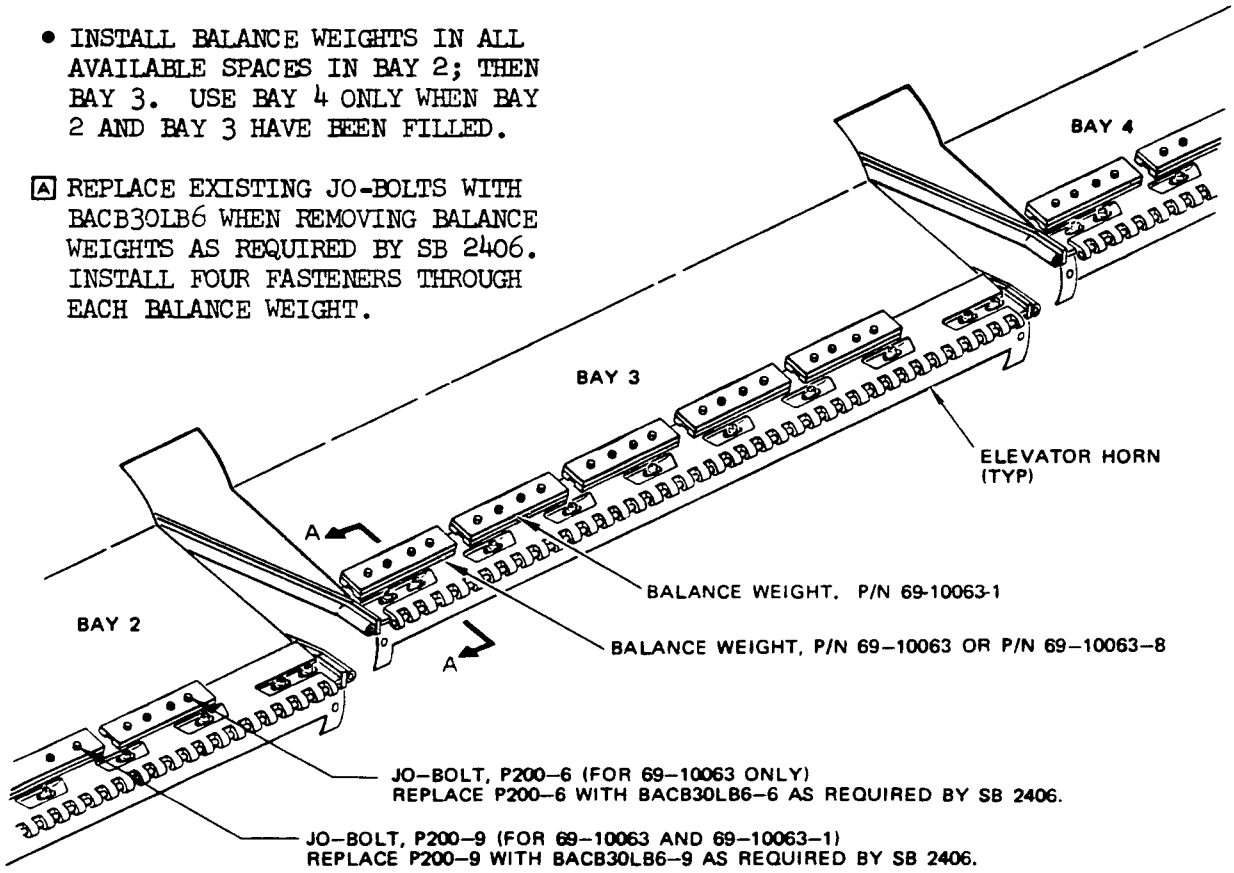
Elevator Balance Weight Requirements
Figure 3

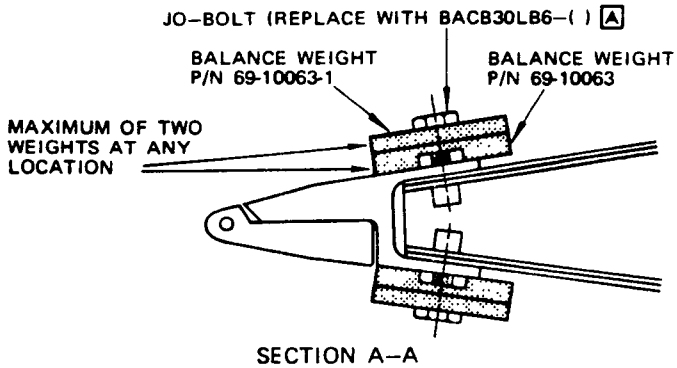
NOTE

- THE ACTUAL QUANTITY OF WEIGHTS WILL BE DETERMINED BY BALANCING. IF ALL WEIGHTS ARE REMOVED FROM ONE LOCATION, REPLACE EXISTING JO-BOLTS WITH BACB30LB6-2.

- INSTALL BALANCE WEIGHTS IN ALL AVAILABLE SPACES IN BAY 2; THEN BAY 3. USE BAY 4 ONLY WHEN BAY 2 AND BAY 3 HAVE BEEN FILLED.

[A] REPLACE EXISTING JO-BOLTS WITH BACB30LB6 WHEN REMOVING BALANCE WEIGHTS AS REQUIRED BY SB 2406. INSTALL FOUR FASTENERS THROUGH EACH BALANCE WEIGHT.



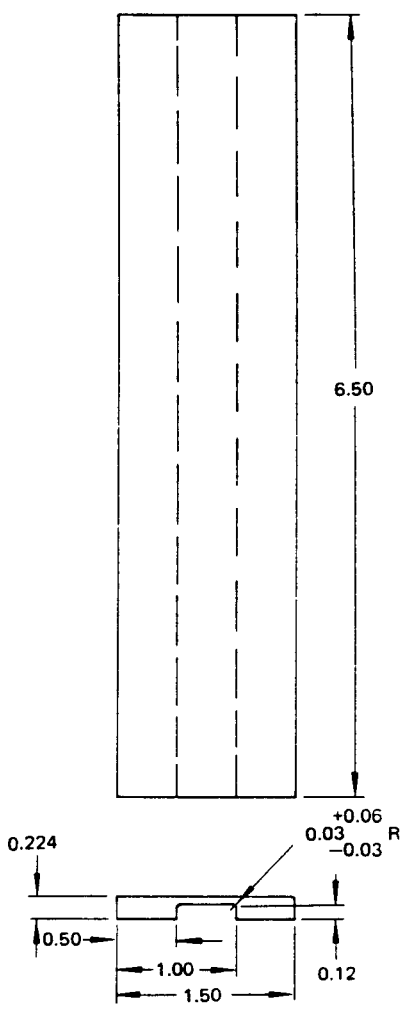


SECTION A-A

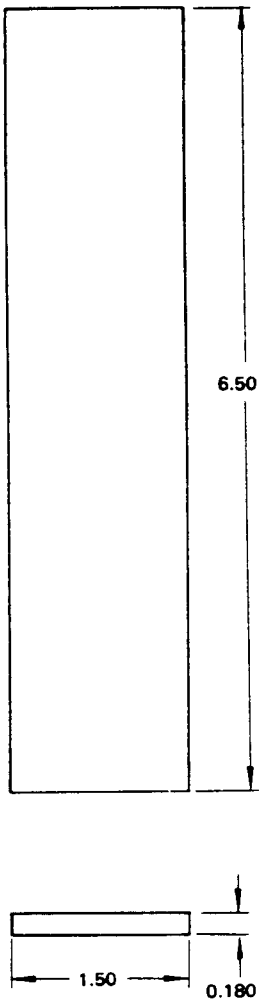
CAUTION:

SIZE, SHAPE AND LOCATION OF THE ADDED BALANCE WEIGHT AND ITS FASTENERS MUST NOT INTERFERE WITH FIXED STRUCTURE WITHIN REQUIRED ELEVATOR DEFLECTION RANGE. SUCH INTERFERENCE WILL AFFECT FLIGHT SAFETY.

Elevator Balance Weights - Installation and Dimensions
Figure 4 (Sheet 1)



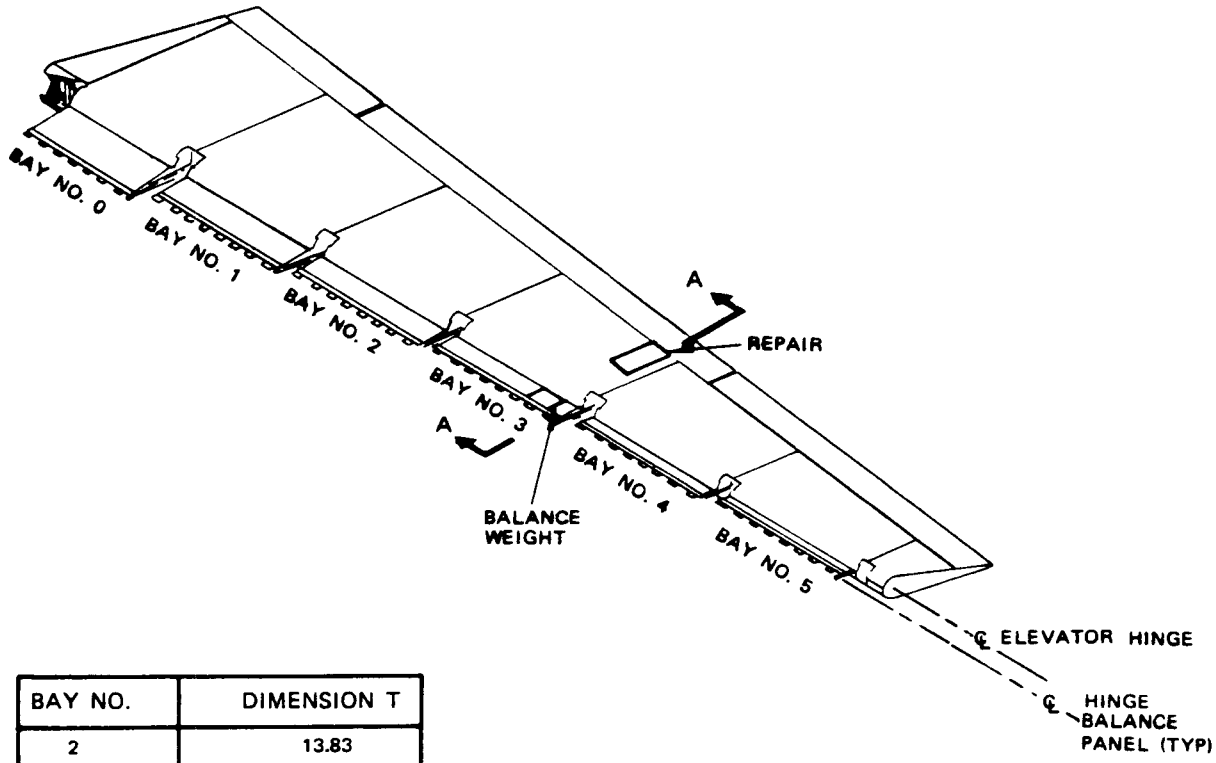
69–10063–8



69-10063-1

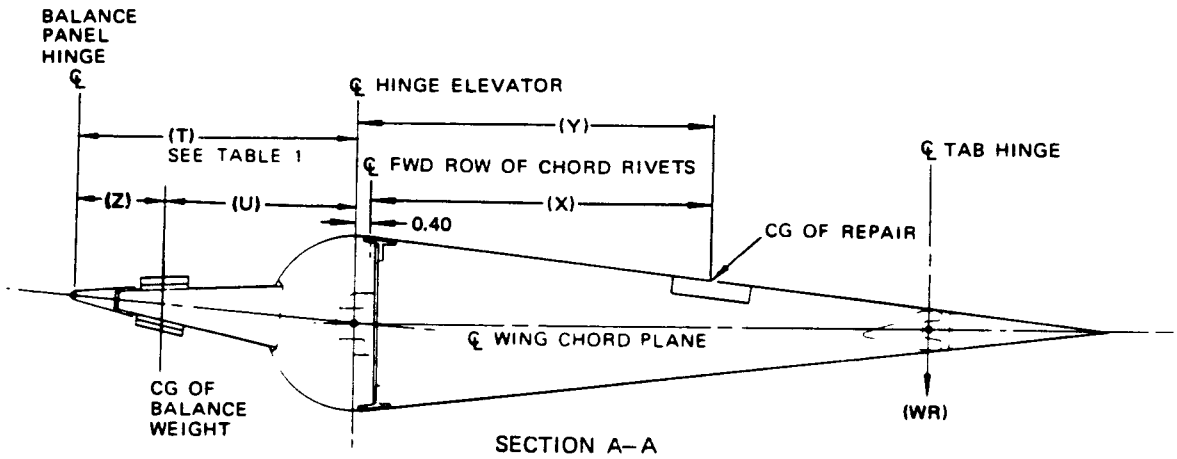
PART NO.	MATERIAL	FINISH
69-10063 (0.50 POUNDS) 69-10063-1 (0.50 POUNDS) 69–10063–8 (1.10 POUNDS)	STEEL 1020 OR 1025 MIL-S-7952 OPT 4130 AN-QQ-S-685 4340 AMS-6359 BAR 1018, 1020 OR 1025 QQ-S-633 FANSTEEL 77, FANSTEEL METALLURGICAL CORP. CHICAGO, ILL. OPT MALLORY 1000 HP OR 1000 PR MALLORY CO. INDIANAPOLIS, IND.	CADMIUM PLATE ACCORDING TO QQ-P-416, TYPE II, CLASS 2 AND APPLY ONE COAT EACH OF BMS 10-11, TYPE I PRIMER AND BMS 10-11 ENAMEL

Elevator Balance Weights - Installation and Dimensions
Figure 4 (Sheet 2)



BAY NO.	DIMENSION T
2	13.83
3	11.83
4	9.58

TABLE I



Elevator Repair Weight and Moment Arm Diagram
Figure 5

ELEVATOR BALANCE PANELS

1. General

A. The requirements for the elevator balance panels are expressed only in terms of required weight.

B. Panel adjust weights, part number 69-10063-2, are added as necessary to bring the panel to the desired weight. Each 69-10063-2 weight is approximately 0.15 pound. The intended locations for additional weights are readily determined by the countersunk rivets used to permit installation of these weights.

C. See Fig. 1 for balance panel locations.

2. Preparation for Balancing

A. The panels should be complete as shown in Fig. 2, plus the parts of the seal installations, Boeing part number 65-5647 or 65-8318, which attach to the panel. The tab adjust weights must be removed from bay 0 and bay 2 balance panels before weighing.

B. The condition of the panels at the time of weighing and the weight requirements are as follows:

(1) Bay 0 Balance Panel

(a) Seals installed: 10-2737-12, 10-60120-53, 10-60120-54 and -55

(b) Weigh panel and add or remove weights 69-10063-2 as required to reach 19.60 +0.40/-0.10 pounds.

(2) Bay 1 Balance Panel

(a) Seals installed: 10-2737-12, -17, -18, and -19

(b) Weigh panel, and add or remove weights 69-10063-2, as required, to reach 23.70 +0.40/-0.10 pounds.

(3) Bay 2 Balance Panel

(a) Seals installed: 10-2737-12, -18, -23, and -24

(b) Weigh panel, and add or remove weights 69-10063-2, as required, to reach 22.20 +0.40/-0.10 pounds.

(4) Bay 3 Balance Panel

(a) Seals installed: 10-2737-12, -18, -28, and -29

(b) Weigh panel, and add or remove weights 69-10063-2, as required, to reach 21.00 +0.40/-0.10 pounds.

(5) Bay 4 Balance Panel

(a) Seals installed: 10-2737-12, -18, -33, and -34

(b) Weigh panel, and add or remove weights 69-10063-2, as required, to reach 19.50 +0.40/-0.10 pounds.

(6) Bay 5 Balance Panel

(a) Balance weights installed: (2) 50-6237-3006

(b) Seals installed: 10-2737-12, -18, -38, and -39

(c) Weigh panel, and add or remove weights 69-10063-2, as required, to reach 33.50 +0.40/-0.10 pounds.

3. Balancing Procedure

A. Weigh the panel and add or remove 69-10063-2 balance weights to meet the requirements of par. 2.

B. Install or remove the weights in the positions and number as shown in Fig. 2. If Boeing weights are not available, fabricate as shown in Fig. 3.

(1) Place balance weights on the appropriate balance panel in the approximate installed position and, where possible, on the lower surface of the panel.

(2) Mark and remove rivets which interfere with the mounting of balance weight on the skin of the balance panel.

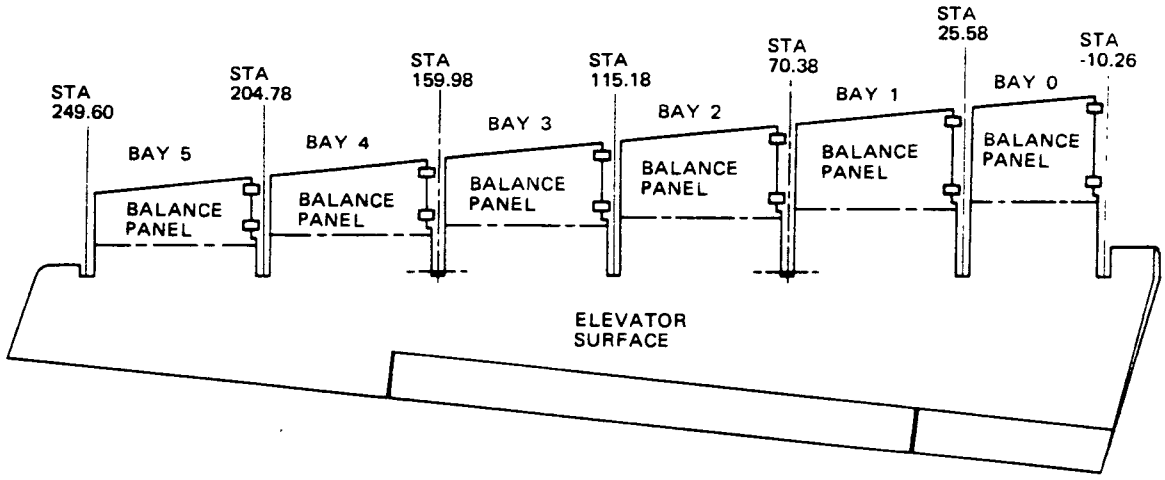
(3) Secure balance weight with 3/16-inch diameter blind lock rivets through skin and rib flange. Remove all jo-bolts at overhaul. Replace with P/N NAS1398B6 blind lock rivets. If necessary, enlarge hole to 0.256 inch (0.261-inch maximum) and install blind lock rivets, P/N NAS1398B8. Determine length as follows in all holes through panel.

NAS1398B6 (B8)	Total 69-10063-2 Weights
-3	1
-5	2
-7	3

C. Install the tab adjust weight, after rebalancing is complete, as follows:

(1) Install the required stabilizer actuated tab adjust weight on bay 0 balance panel, as instructed in 51-15-9, par. 2. (See Fig. 2 for location.)

(2) Install the required elevator control tab adjust weights on bay 2 balance panel, as instructed in 51-15-10, par. 2. (See Fig. 2 for location.)



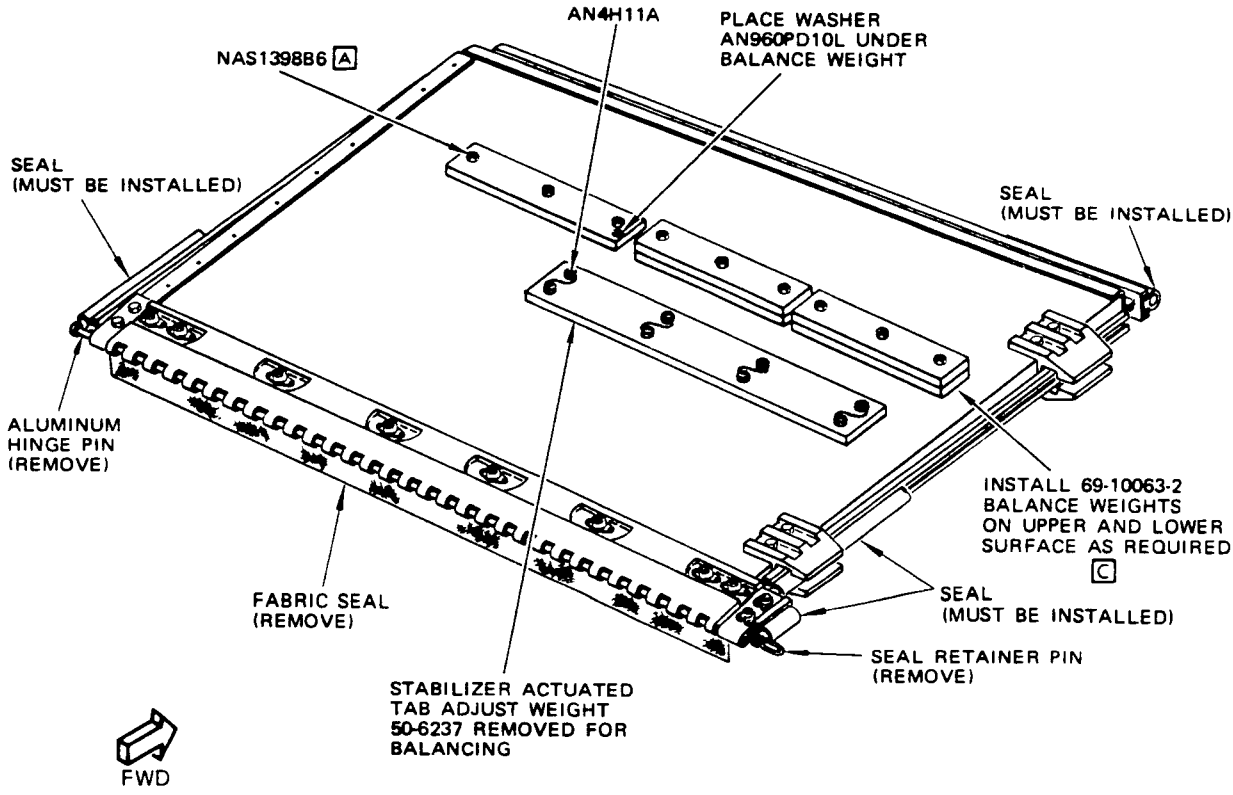
Elevator Balance Panels - Location
Figure 1

NOTE

[A] REPLACE EXISTING BACB30CC6 (JO-BOLT) WITH NAS1398B6 WHEN THE INSTALLATION OF 69-10063-2 BALANCE WEIGHTS ARE REQUIRED.

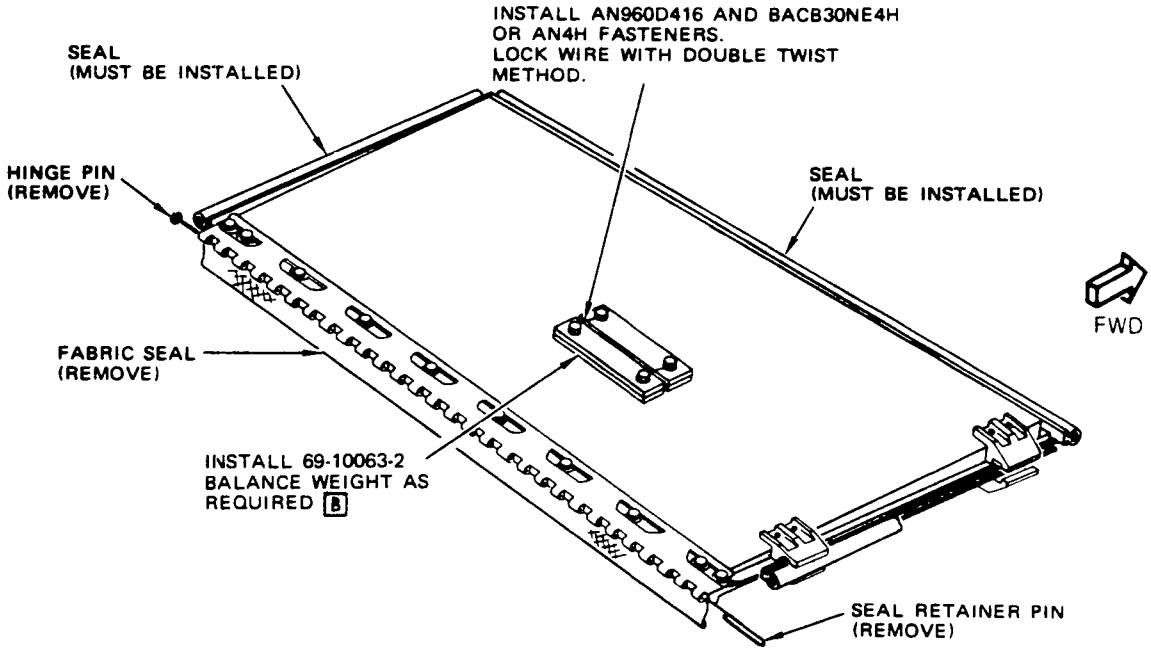
[B] THE NUMBER OF BALANCE WEIGHTS SHOWN IN EACH POSITION IS A MAXIMUM.

[C] THE NUMBER OF BALANCE WEIGHTS SHOWN IN EACH POSITION IS A MAXIMUM. THE SAME NUMBER OF BALANCE WEIGHTS MAY BE INSTALLED ON THE LOWER SURFACE AT THE SAME TIME. A MAXIMUM OF TEN WEIGHTS MAY BE INSTALLED ON BALANCE PANEL.

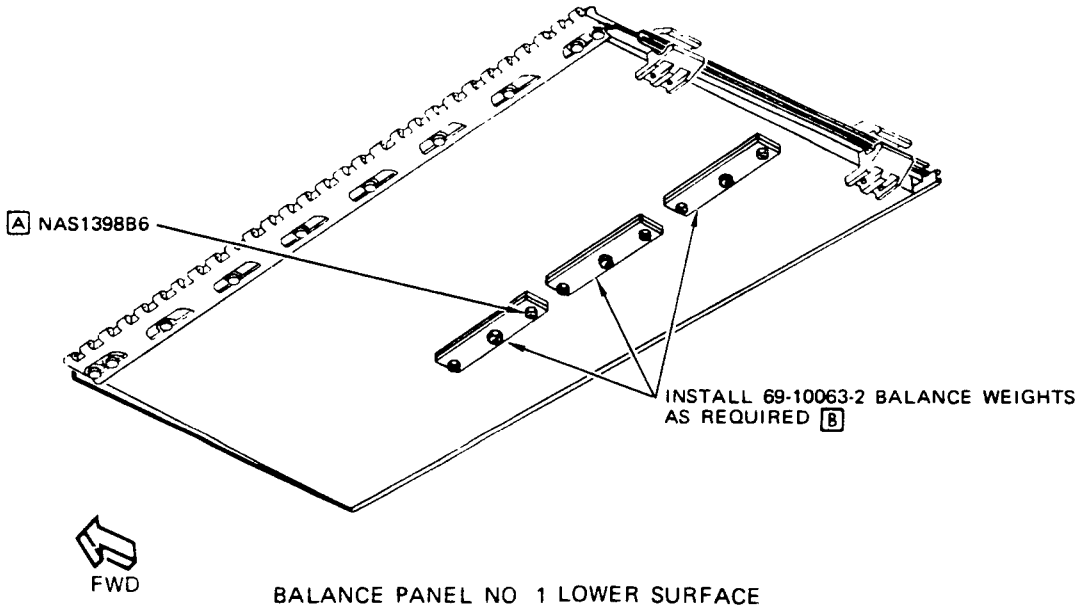


BALANCE PANEL NO. 0 UPPER SURFACE

Elevator Balance Panels - Balance Weight Installation and Requirements
Figure 2 (Sheet 1)

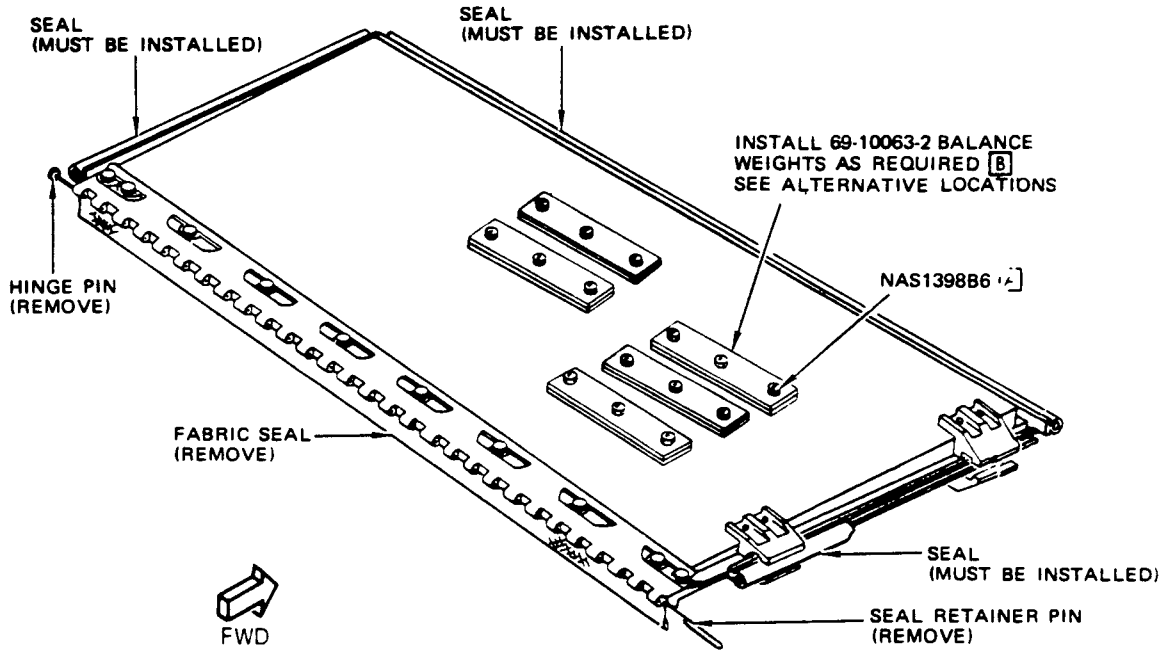


BALANCE PANEL NO. 1 UPPER SURFACE

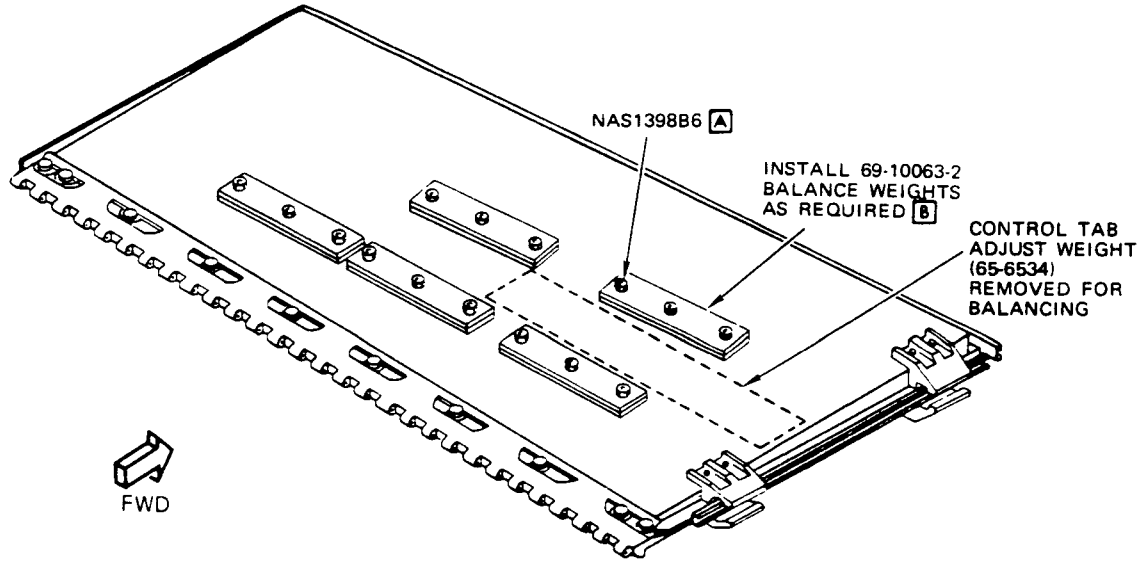


BALANCE PANEL NO 1 LOWER SURFACE

Elevator Balance Panels - Balance Weight Installation and Requirement
Figure 2 (Sheet 2)

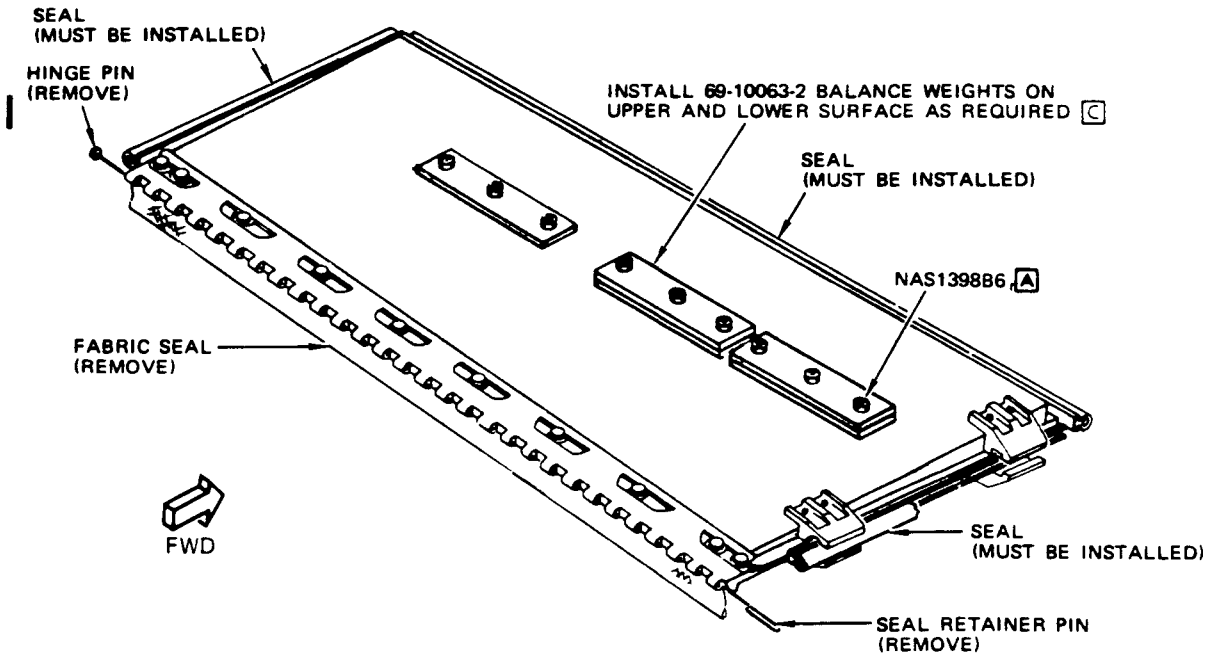


BALANCE PANEL NO. 2 UPPER SURFACE

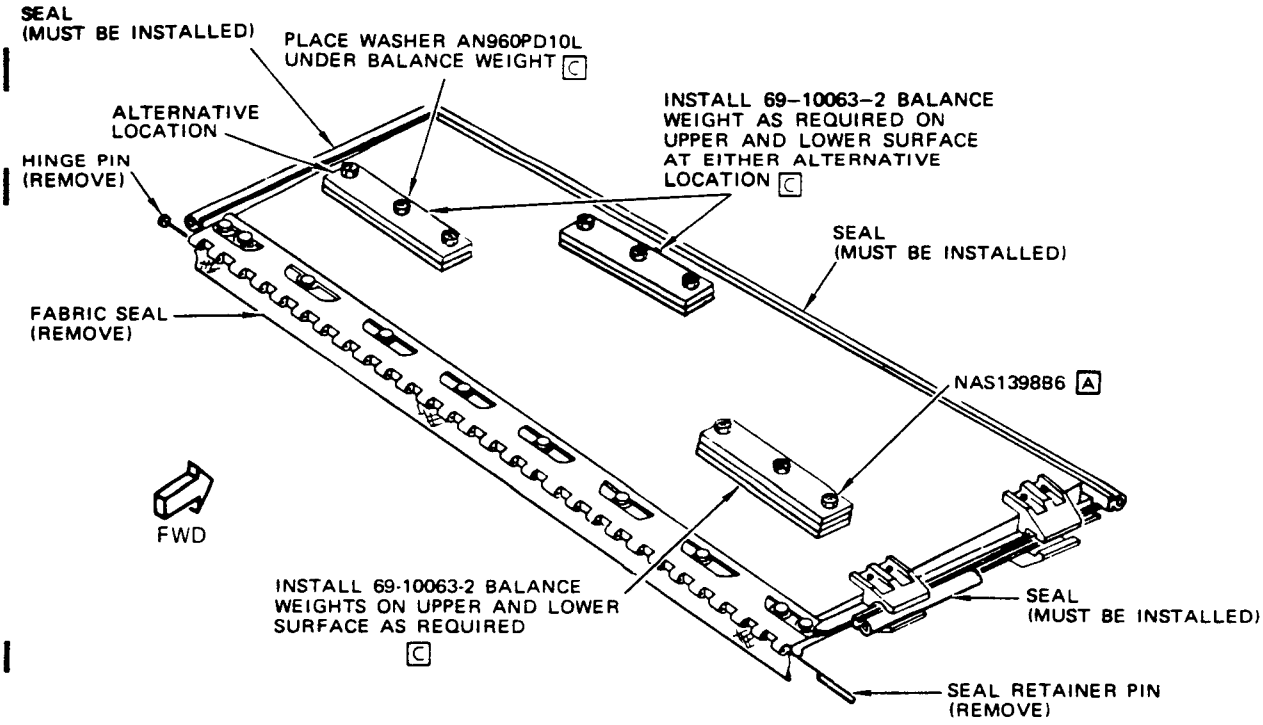


BALANCE PANEL NO. 2 UPPER SURFACE
ALTERNATIVE BALANCE WEIGHT LOCATION

Elevator Balance Panels - Balance Weight Installation and Requirement
Figure 2 (Sheet 3)

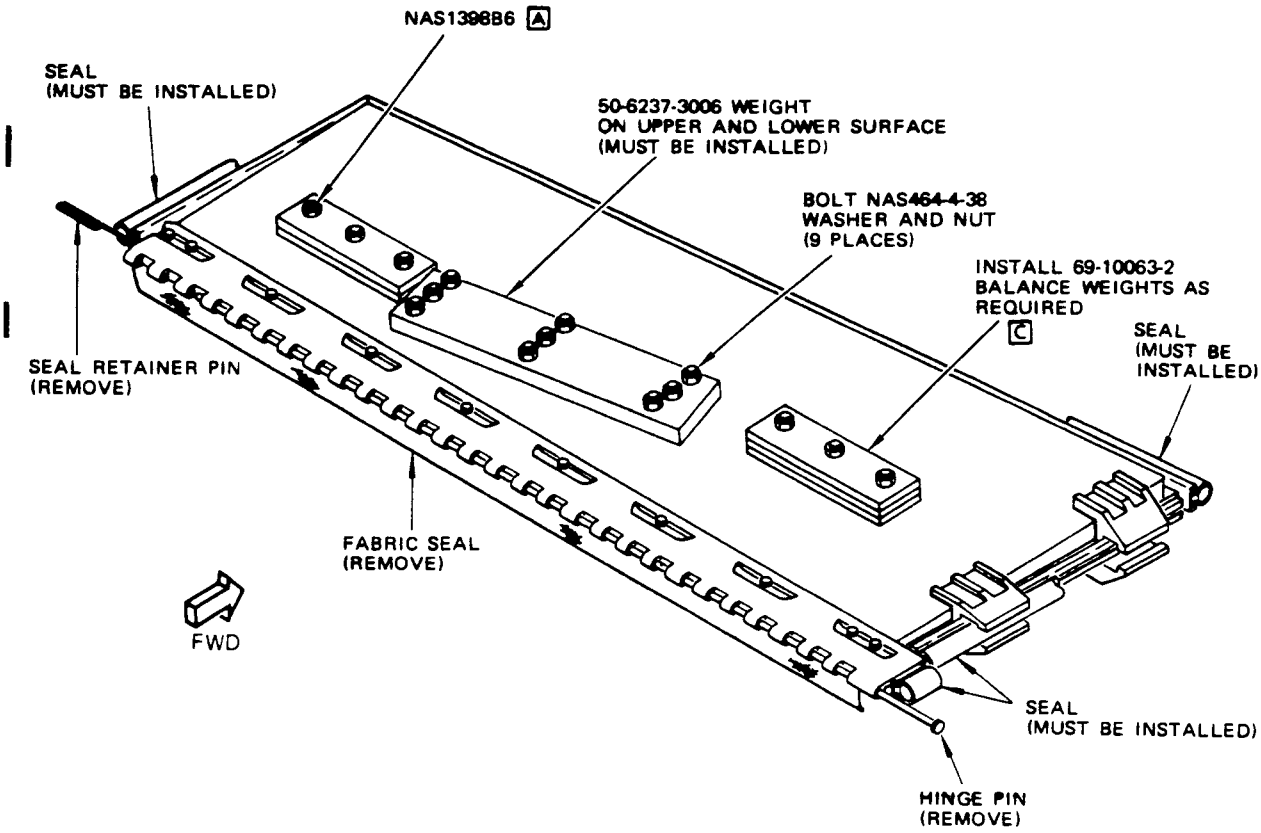


BALANCE PANEL NO. 3 UPPER SURFACE



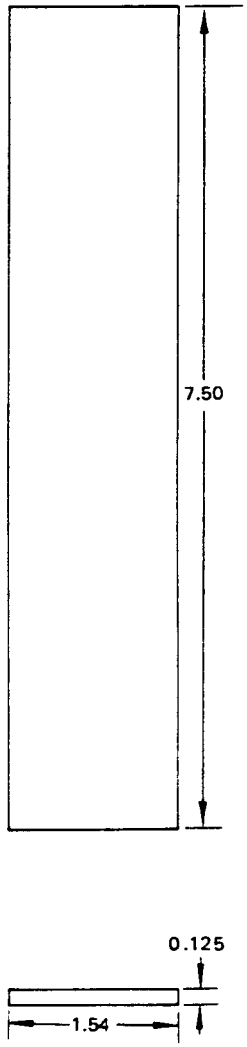
BALANCE PANEL NO. 4 UPPER SURFACE

Elevator Balance Panels - Balance Weight Installation and Requirement
Figure 2 (Sheet 4)



BALANCE PANEL NO. 5 UPPER SURFACE

Elevator Balance Panels - Balance Weight Installation and Requirement
Figure 2 (Sheet 5)



MATERIAL
CLAD 2024-T3

WEIGHT 0.15 POUNDS

PART 69-10063-2

Elevator Balance Panels - Weight Detail
Figure 3

ELEVATOR STABILIZER ACTUATED TAB REBALANCING

1. Rebalancing Procedures

A. Prepare tab control assembly for weighing as defined in Fig. 1.

B. Lay out distances X minimum and X maximum as shown in Fig. 2. See Fig. 3 for distance X dimensions.

C. Set up tab on rebalancing fixtures per Fig. 4. Ascertain that tab is free to rotate on rebalancing fixtures without binding.

NOTE: Remove protractor level during balancing operations.

D. Place a 1.00-pound sliding weight aft of the aft pencil mark approximately parallel to the tab hinge axial centerline, with the midpoint mark in line with the center of the tab hinge fitting. Slowly move the weight towards the tab leading edge, maintaining the weight position parallel to the tab hinge axial centerline, until the tab trailing edge just begins to rise from the supporting blocks. Make use of the lines on the ruled paper attached to the tab skin (Fig. 2).

E. Note the position of the midpoint mark of the sliding weight.

(1) If the surface of the sliding weight with the midpoint mark is anywhere between the forward and aft pencil marks, the tab needs no rebalance weight added or removed.

(2) If the surface of the sliding weight with the midpoint mark is forward of the forward pencil mark, the tab is tail-heavy. A certain amount of rebalance weight must be added.

(a) Determine the amount of rebalance weight to be added by trial and error method or as follows:

1) Measure distance Y (Fig. 4).

2) Calculate the approximate length in inches of additional rebalance weight required by using the applicable formula shown in Fig. 5.

(b) Fabricate rebalance weight (Fig. 6).

(c) Temporarily install the rebalance weight. Rebalance weight fasteners must be loosely installed (Fig. 7).

(d) Repeat steps A, B, C, and D.

(e) If the tab is found to be properly balanced, permanently install the rebalance weight and proceed with steps F thru I.

(3) If the surface of the sliding weight with the midpoint mark is aft of the aft pencil mark, the tab is nose-heavy. A certain amount of balance weight must be removed as follows:

(a) Determine the approximate length in inches of balance weight to be removed by trial and error method or as follows:

1) Measure distance (Y) (Fig. 4).

2) Calculate the approximate length in inches of balance weight to be removed by using the applicable formula shown in Fig. 5 Column 2.

(b) Remove the balance weight from tab.

(c) Saw, hand file or grind off the excess of balance weight.

(d) Temporarily install the balance weight. Balance weight fasteners must be loosely installed.

(e) Repeat steps A, B, C and D.

(f) When tab in properly balanced, permanently install the balance weight.

F. Weigh the balanced tab assembly as defined in Fig. 1.

G. Record new tab weight on placard affixed to the tab structure.

H. Select and install, if required, tab adjust weights as defined in par. 2 (Fig. 8).

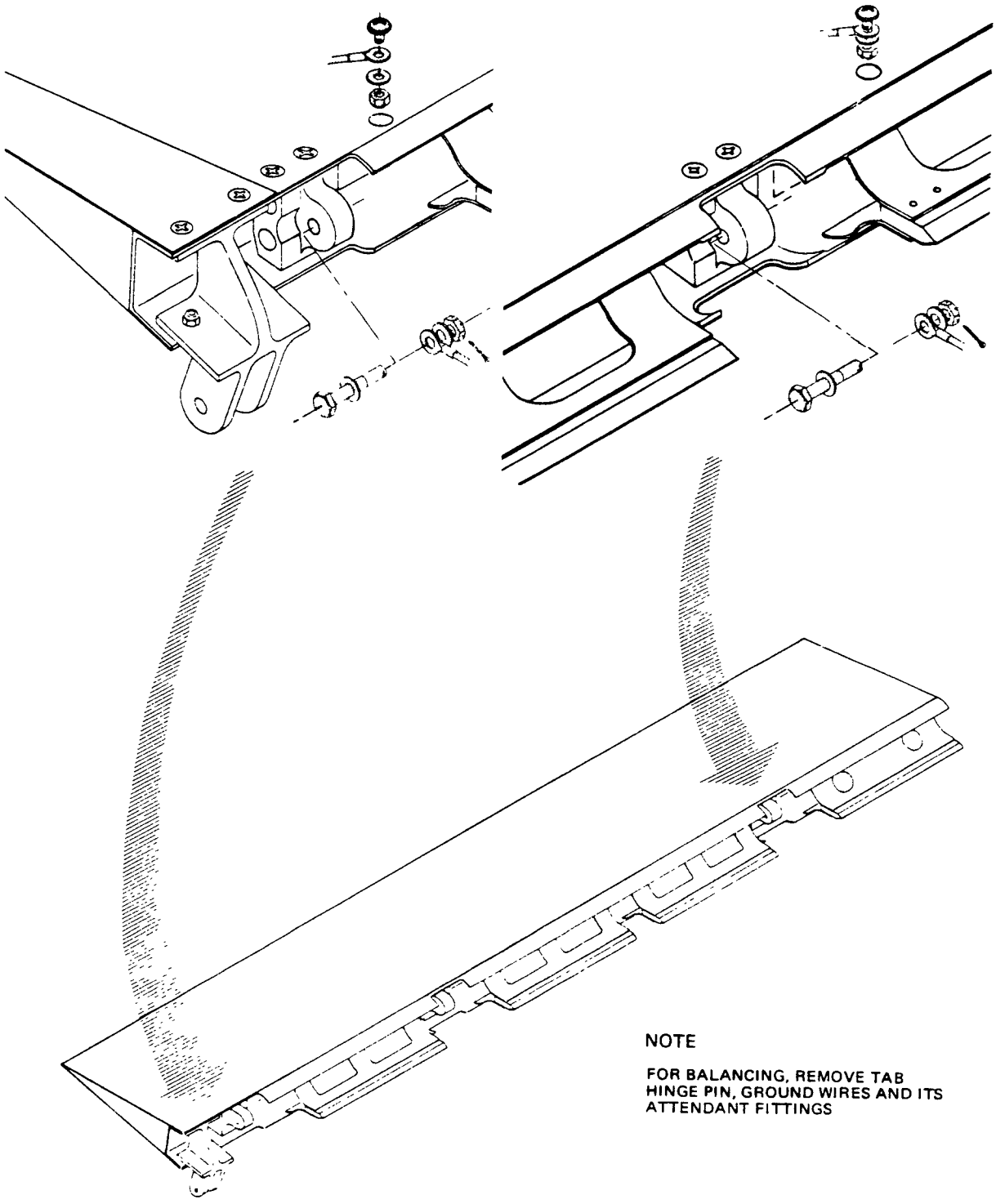
I. Reinstall rebalanced tab according to Maintenance Manual, Chapter 27.

2. Elevator Stabilizer Actuated Tab Adjust Weight Installation

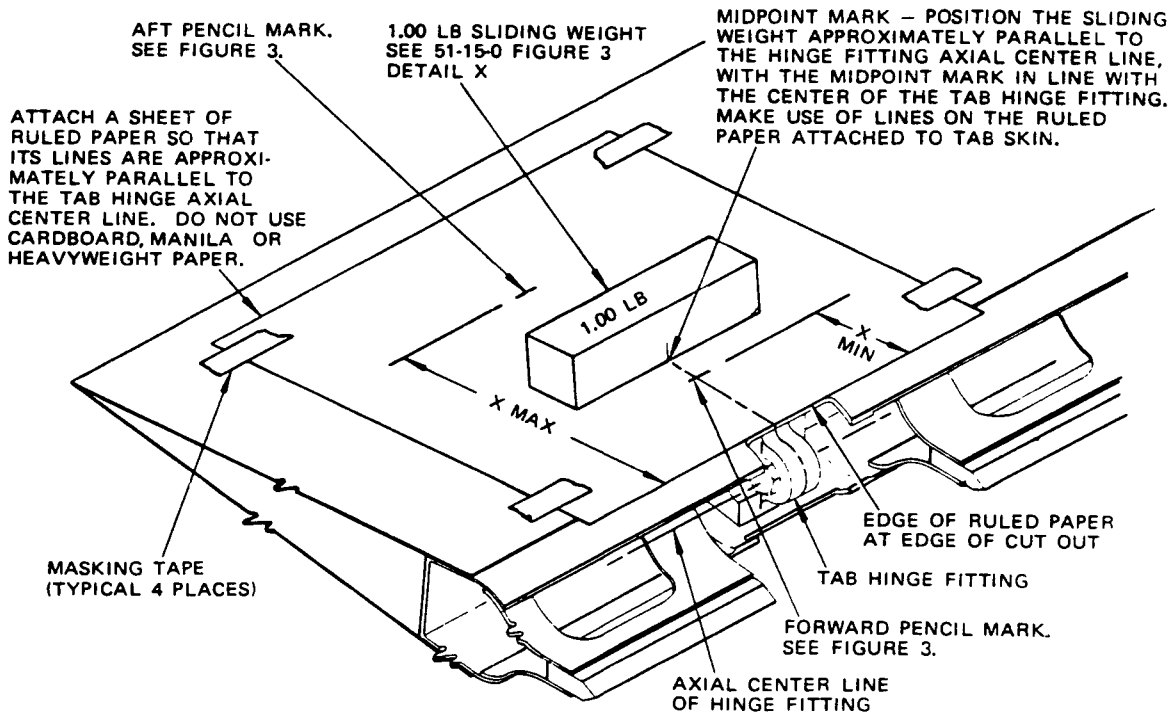
A. Examine placard affixed to tab assembly for tab weight.

B. Determine adjust weight required according to stabilizer actuated tab adjust weight table (Fig. 8).

C. Install the required tab adjust weight on bay 0 balance panel at the location shown in Fig. 8 of 51-15-8.



Elevator Stabilizer Actuated Tab - Preparation for Weighing
Figure 1



Distance "X" Layout - Elevator Stabilizer Actuated Tab
Figure 2

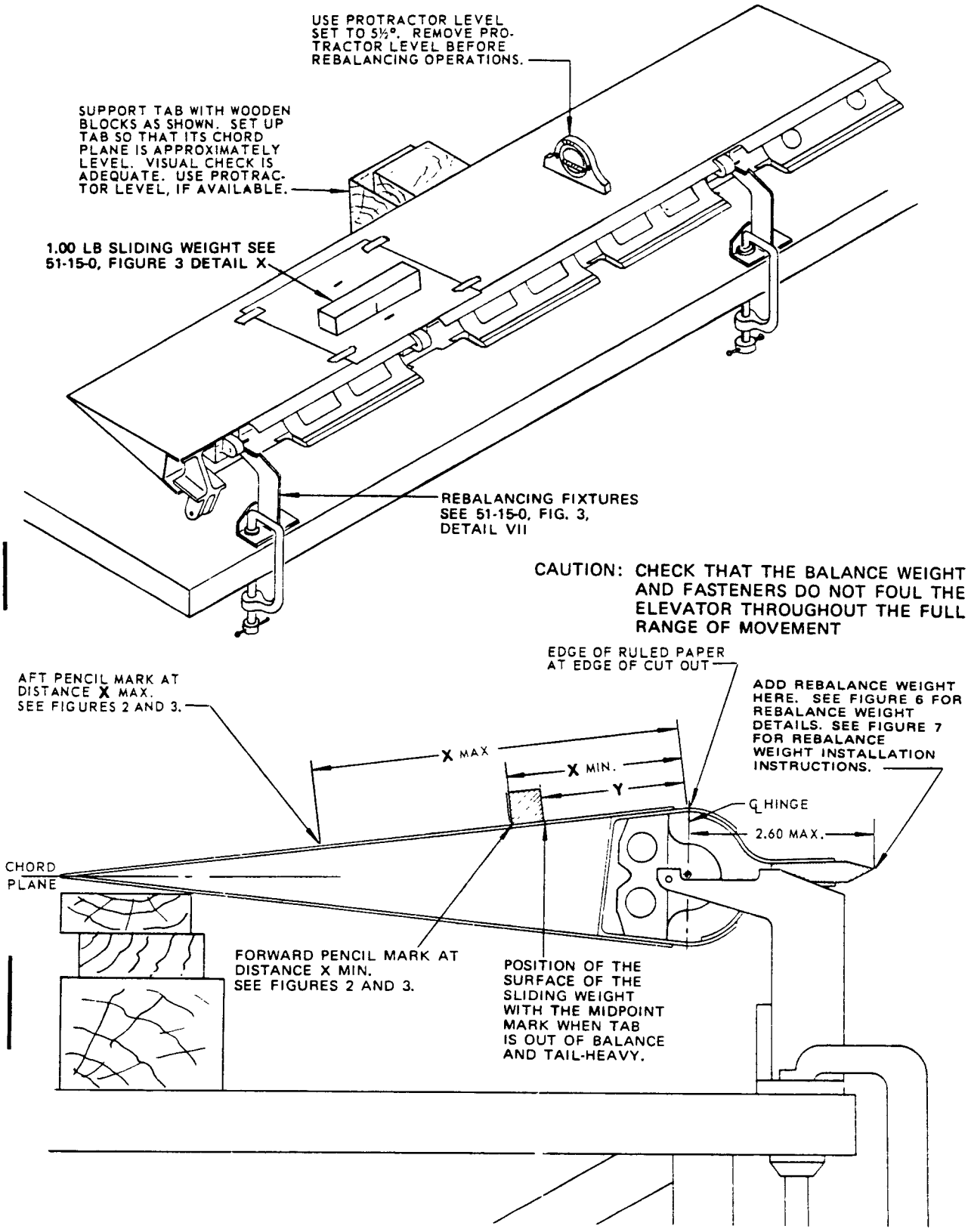
TAB WEIGHT (LBS)	X MIN (INCHES)	X MAX (INCHES)
7.5-8	1.22	2.09
8-9	1.44	2.26
9-10	1.66	2.62
10-11	1.88	2.97
11-12	2.10	3.32
12-13	2.33	3.67
13-14	2.55	4.02
14-15	2.77	4.37
15-16	2.99	4.73
16-17	3.21	5.08
17-18	3.43	5.43
18-19	3.65	5.73
19-20	3.87	6.13
20-21	4.10	6.48
21-22	4.32	6.84
22-23	4.54	7.19
23-24	4.76	7.54
24-25 [A]	4.98	7.89

NOTE

- IF BALANCE IS IN ACCORDANCE WITH THIS TABLE THE TAB IS BALANCED WITHIN THE REQUIRED MANUFACTURING LIMITS, SEE 51-15-0, FIGURE 1.

[A] 25 POUNDS MAXIMUM ALLOWABLE TAB WEIGHT

Elevator Stabilizer Actuated Tab - Distance "X" Dimensions
Figure 3



Elevator Stabilizer Actuated Tab - Rebalancing Arrangement
Figure 4

	MATERIAL	REBALANCE WEIGHT LENGTH TO BE ADDED	REBALANCE WEIGHT LENGTH TO BE REMOVED
		INCHES MINIMUM [C]	INCHES MAXIMUM [D]
FOR WEIGHT I FIG. 6	TUNGSTEN ALLOY [A] FANSTEEL 77 MALLORY 1000HP MALLORY 2000PR	(X MIN – Y) X 2.26	(X MAX -Y) X 2.26
	BRONZE [B] ARCHITECTURAL	(X MIN – Y) X 4.48	(X MAX -Y) X 4.48
	STEEL [B] 4130	(X MIN – Y) X 4.85	(X MAX -Y) X 4.85
FOR WEIGHT II FIG. 6	TUNGSTEN ALLOY [A] FANSTEEL 77 MALLORY 1000HP MALLORY 1000PR	(X MIN – Y) X 1.90	(X MAX -Y) X 1.90
	BRONZE [B] ARCHITECTURAL	(X MIN – Y) X 3.79	(X MAX -Y) X 3.79
	STEEL [B] 4130	(X MIN – Y) X 4.10	(X MAX -Y) X 4.10

NOTE

CALCULATE THE REQUIRED REBALANCE WEIGHT TO BE ADDED OR REMOVED BY USING THE APPLICABLE FORMULA. REBALANCE WEIGHT ADDED IN EXCESS OF THE MINIMUM REQUIRED GIVES FUTURE REPAIR CAPABILITY TO THE TAB, PROVIDED SUITABLE REBALANCING RECORDS ARE KEPT. (SEE 51-15-0, FIGURE 2.)

X MIN AND MAX SEE FIGURES 2 AND 3

Y SEE FIGURE 4

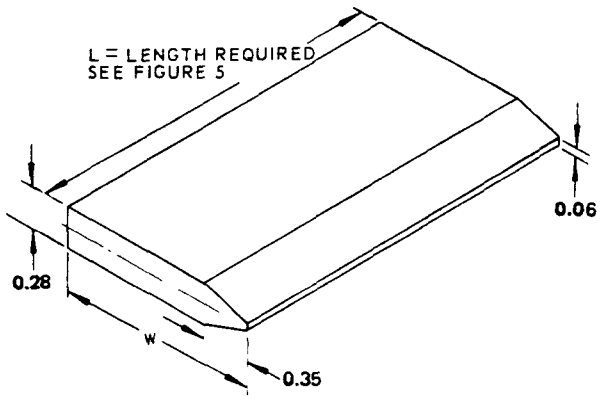
[A] MATERIAL USED FOR FACTORY INSTALLED BALANCE WEIGHT

[B] OPTIONAL MATERIAL FOR FIELD SERVICE USE

[C] APPLICABLE WHEN DISTANCE Y IS LESS THAN X_{MIN} OF FIG 3.

[D] APPLICABLE WHEN DISTANCE Y IS MORE THAN X_{MAX} OF FIG 3.

Elevator Stabilizer Actuated Tab - Rebalance Weight Lengths
Figure 5



	W	BAC PART NO.
WEIGHT I	1.37	66-35044-1
WEIGHT II	1.87 [C]	66-35044-2

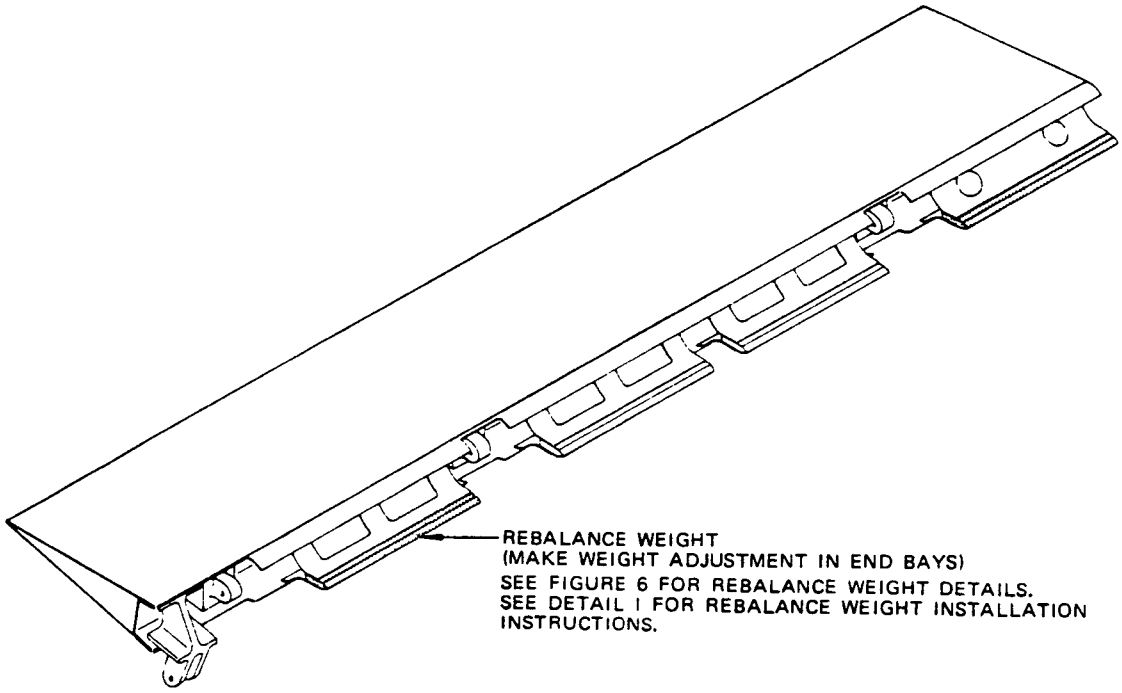
MATERIAL	IDENTIFICATION	SOURCE	FINISH
TUNGSTEN ALLOY [A]	FANSTEEL 77	FANSTEEL METALLURGICAL CORP., NUMBER ONE TANTALUM PLACE NORTH CHICAGO, ILL. 60064	CADMIUM PLATE PER QQ-P-416, TYPE II OR III CLASS B, FOLLOWED BY DIP IN 3 TO 5% SOLUTION BY WEIGHT OF CHROMIC ACID, FOLLOWED BY ONE COAT OF SOLVENT RESISTANT PRIMER, EQUAL PARTS BY VOLUME, E42GP13 AND V66KP11, SHERWIN-WILLIAMS CO., 101 PROSPECT AVE. NW. CLEVELAND, OHIO 44101
	MALLORY 1000HP MALLORY 1000PR	MALLORY AND CO., 3029 E. WASHINGTON INDIANAPOLIS, IND. 46206	
STEEL [B]	4130	ANY SOURCE	
BRONZE [B]	ARCHITECTURAL 283	REVERE COPPER AND BRASS, INC., 24 NORTH FRONT, NEW BEDFORD, MA. 02741	CADMIUM PLATE PER QQ-P-416, TYPE I, CLASS 2, FOLLOWED BY ONE COAT OF ZINC CHROMATE PRIMER PER MIL-P-6889, FOLLOWED BY ONE COAT OF SOLVENT RESISTANT PRIMER, EQUAL PARTS BY VOLUME, E42GP13 AND V66KP11, SHERWIN-WILLIAMS CO., 101 PROSPECT AVE. NW. CLEVELAND, OHIO 44101

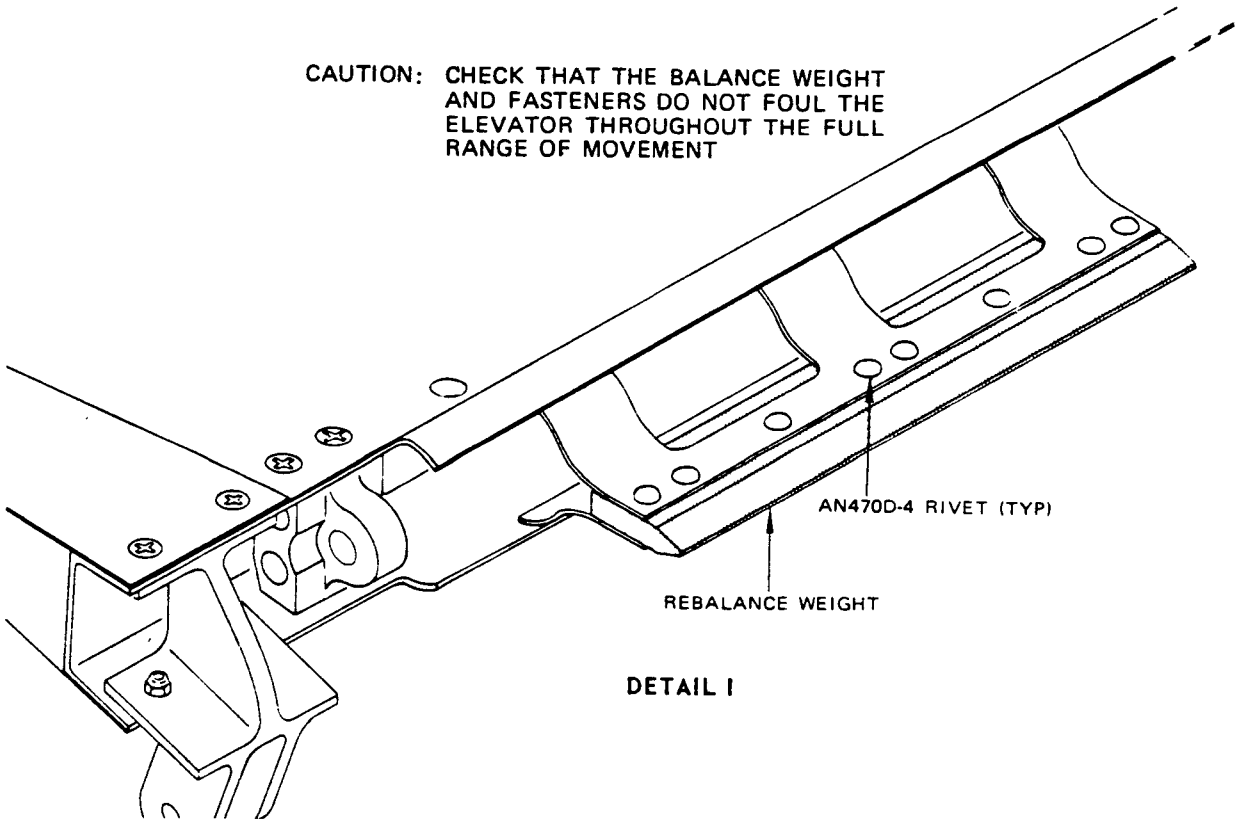
NOTE

[A] MATERIAL USED FOR FACTORY INSTALLED BALANCE WEIGHT

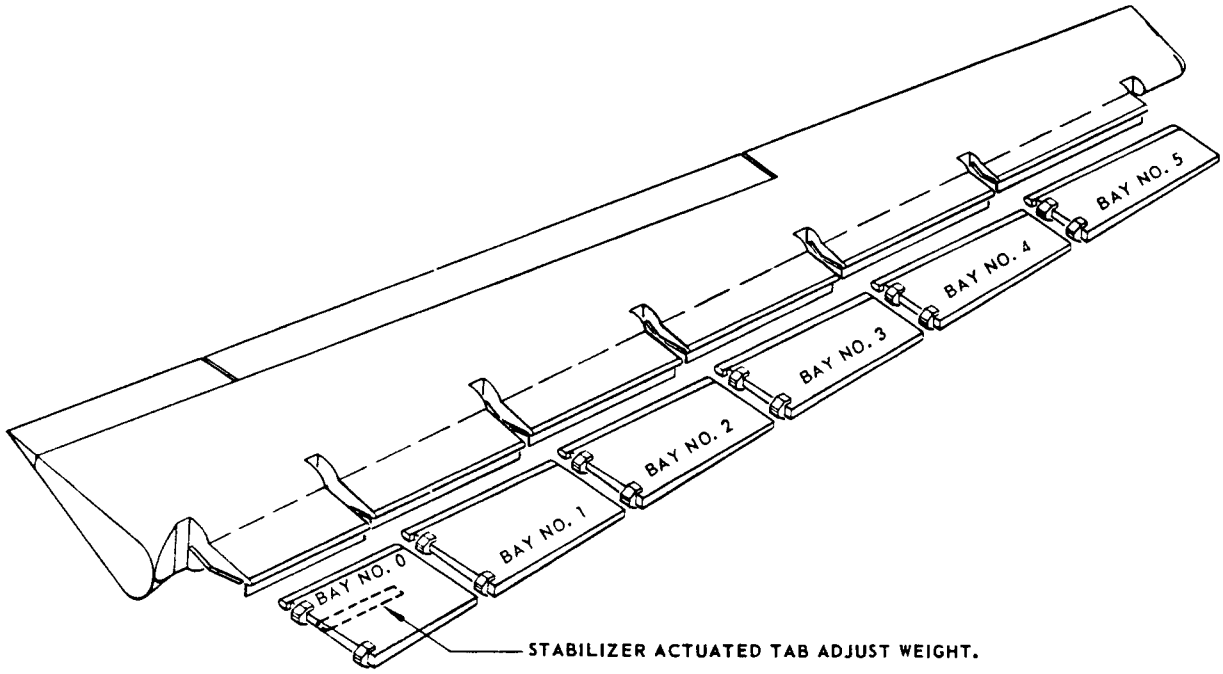
[B] OPTIONAL MATERIAL FOR FIELD SERVICE USE

[C] USE WIDER REBALANCE WEIGHT IF AVAILABLE SPACE IS INADEQUATE FOR 1.37 WIDE REBALANCE WEIGHTS





Elevator Stabilizer Actuated Tab - Rebalance Weight Installation
Figure 7



TAB WEIGHT (POUNDS)	ADJ. WT. PART NO.	WT. TOLERANCE (POUNDS)
7.50 to 8.00	NONE	
8.01 to 8.50	65-6534-19, or -33	1.11 (± 0.06)
8.51 to 9.00	65-6534-20, or -34	2.23 (± 0.10)
9.01 to 9.50	65-6534-21, or -35	3.33 (± 0.14)
9.51 to 10.00	65-6534-22, or -36	4.45 (± 0.18)
10.01 to 10.50	65-6534-23, or -37	5.57 (± 0.23)
10.51 to 11.00	65-6534-24, or -38	6.69 (± 0.26)
11.01 to 11.50	65-6534-25, or -39	7.82 (± 0.30)
11.51 to 12.00	65-6534-26, or -40	8.95 (± 0.34)
12.01 to 12.50	65-6534-55, or -62	10.12 (± 0.46)
12.51 to 13.00	65-6534-56, or -63	11.73 (± 0.52)
13.01 to 13.50	65-6534-57, or -64	12.37 (± 0.55)
13.51 to 14.00	65-6534-58, or -65	13.49 (± 0.55)
14.01 to 14.50	65-6534-59, or -66	14.62 (± 0.59)
14.51 to 15.00	65-6534-60, or -67	15.75 (± 0.64)
15.01 to 15.50	65-6534-61, or -68	16.88 (± 0.68)
13.51 to 14.00	65-6534-79 [A]	13.09 (± 0.55)
14.01 to 14.50	65-6534-80 [A]	14.12 (± 0.59)
14.51 to 15.00	65-6534-81 [A]	15.35 (± 0.64)
15.01 to 15.50	65-6534-82 [A]	16.48 (± 0.68)
15.51 to 16.00	65-6534-99 65-6534-100 65-6534-106	18.47 (total)
16.01 to 16.50	65-6534-99 65-6534-100 65-6534-103	19.61 (total)
16.51 to 17.00	65-6534-108	19.94

Elevator Stabilizer Actuated Tab-Adjust Weight Installation
Figure 8 (Sheet 1)

TAB WEIGHT (LBS.)	MATERIAL	[B]	ADJUST WEIGHT TOLERANCE (LBS.) WITH COUNTER BORED HOLES
15.51 - 16.00 [C]	Fanstee!	Except 12.22 Inches In Length	17.60 (± 0.68)
16.01 - 16.50 [C]		Except 12.99 Inches In Length	18.77 (± 0.72)
16.51 - 17.00		Except 13.77 Inches In Length	19.94 (± 0.77)
17.01 - 17.50		Except 14.55 Inches In Length	21.11 (± 0.81)
17.51 - 18.00		Except 15.33 Inches In Length	22.28 (± 0.86)
18.01 - 18.50		Except 16.10 Inches In Length	23.45 (± 0.90)
18.51 - 19.00		Except 16.88 Inches In Length	24.62 (± 0.95)
19.01 - 19.50		Except 17.66 Inches In Length	25.79 (± 0.99)
19.51 - 20.00		Except 18.43 Inches In Length	26.96 (± 1.04)
20.01 - 20.50		Except 19.39 Inches In Length	28.13 (± 1.08)
20.51 - 21.00		Except 20.16 Inches In Length	29.30 (± 1.13)
21.01 - 21.50		Except 20.94 Inches In Length	30.47 (± 1.17)
21.51 - 22.00		Except 21.72 Inches In Length	31.64 (± 1.22)
22.01 - 22.50		Except 22.49 Inches In Length	32.81 (± 1.26)
22.51 - 23.00		Except 23.27 Inches In Length	33.98 (± 1.31)
23.01 - 23.50		Except 24.05 Inches In Length	35.15 (± 1.35)
23.51 - 24.00		Except 24.83 Inches In Length	36.32 (± 1.40)
24.01 - 24.50		Except 25.60 Inches In Length	37.49 (± 1.44)
24.51 - 25.00	Fanstee!	Except 26.38 Inches In Length	38.66 (± 1.49)

INSTRUCTIONS

1. Identify tab adjust weights by referring to data on decal affixed to each tab assembly or legend stamped on adjust weights.
2. Remove adjust weights corresponding to repaired tab.
3. Weigh repaired tab.
4. Record new tab weight on decal affixed to tab assembly.
5. Select adjust weight corresponding to new tab weight from table.
6. Install new adjust weight at the locations shown in figure 2 of 51-15-8.

NOTES

[A] COUNTERBORED WEIGHTS ARE REQUIRED TO ASSURE CLEARANCE WHEN HONEYCOMB BALANCE PANEL COVERS ARE USED.

[B] SIMILAR TO 65-6534-82 IN CONFIGURATION. MAKE FROM FANSTEEL ONLY, AND STAMP WEIGHT ON PART.

[C] SEE TABLE ON SHEET 1 FOR PART NUMBERED ADJUST WEIGHTS FOR THESE WEIGHT RANGES.

Elevator Stabilizer Actuated Tab - Adjust Weight Installation
Figure 8 (Sheet 2)

ELEVATOR CONTROL TAB - BALANCING PROCEDURES

1. Rebalance a control tab as follows:

A. Prepare tab control assembly for weighing as defined in Fig. 1.

B. Lay out distances (X) minimum and (X) maximum as shown in Fig. 2. See Fig. 3 for distance (X) dimensions.

C. Set up tab on balancing fixtures per Fig. 4. Ascertain that tab is free to rotate on balancing fixtures without binding.

NOTE: Remove protractor level during balancing operations.

D. Place a 1.60-pound sliding weight aft of the aft pencil mark approximately parallel to the tab hinge axial centerline, with the midpoint mark in line with the center of the tab hinge fitting. Slowly move the weight towards the tab leading edge, maintaining the weight position parallel to the tab hinge axial centerline, until the tab trailing edge just begins to rise from the supporting blocks. Make use of the lines on the ruled paper attached to the tab skin (Fig. 2).

E. Note the position of the midpoint mark on forward edge of the sliding weight.

(1) If the surface of the sliding weight with the midpoint mark is anywhere between the forward and aft pencil marks, the tab needs no balance weight added or removed.

(2) If the surface of the sliding weight with the midpoint mark is forward of the forward pencil mark, the tab is tail-heavy. A certain amount of balance weight must be added.

(a) Determine the amount of balance weight to be added by trial and error method or as follows:

1) Measure distance (Y) (Fig. 4).

2) Calculate the approximate length in inches of additional balance weight required by using the applicable formula shown in Fig. 5.

(b) Make balance weight (Fig. 6).

(c) Temporarily install the balance weight. Balance weight fasteners must be loosely installed (Fig. 7).

(d) Repeat steps A, B, C, and D.

(e) If the tab is found to be properly balanced, permanently install the balance weight and proceed with steps F thru I.

(3) If the surface of the sliding weight with the midpoint mark is aft of the aft pencil mark, the tab is nose-heavy. A certain amount of balance weight must be removed as follows:

(a) Determine the approximate length in inches of balance weight to be removed by trial and error method or as follows:

1) Measure distance (Y) (Fig. 4).

2) Calculate the approximate length in inches of balance weight to be removed by using the applicable formula shown in Fig. 5, Column 2.

(b) Remove the balance weight from tab.

(c) Cut the weight to the length required.

(d) Temporarily install the balance weight. Balance weight fasteners must be loosely installed (Fig. 7).

(e) Repeat steps A, B, C and D.

(f) If tab is found to be properly balanced, permanently install the balance weight.

F. Weigh the balanced tab assembly as defined in Fig. 1.

G. Record new tab weight on placard affixed to the tab structure.

H. Select and install, if required, tab adjust weights as defined in par. 2 (Fig. 8, Sheet 2).

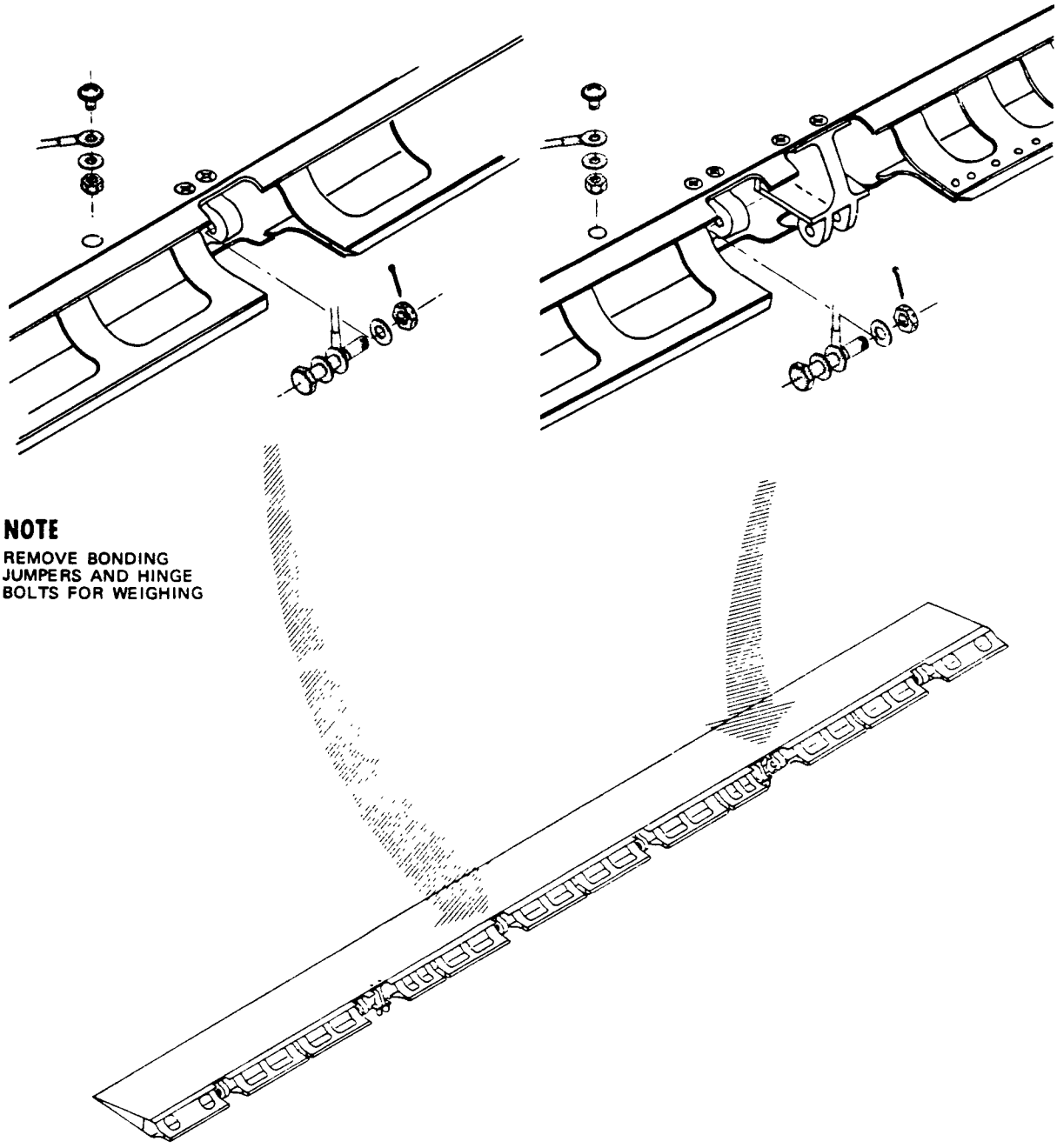
I. Reinstall balanced tab per Chapter 27, Maintenance Manual.

2. Elevator Control Tab Adjust Weight Installation

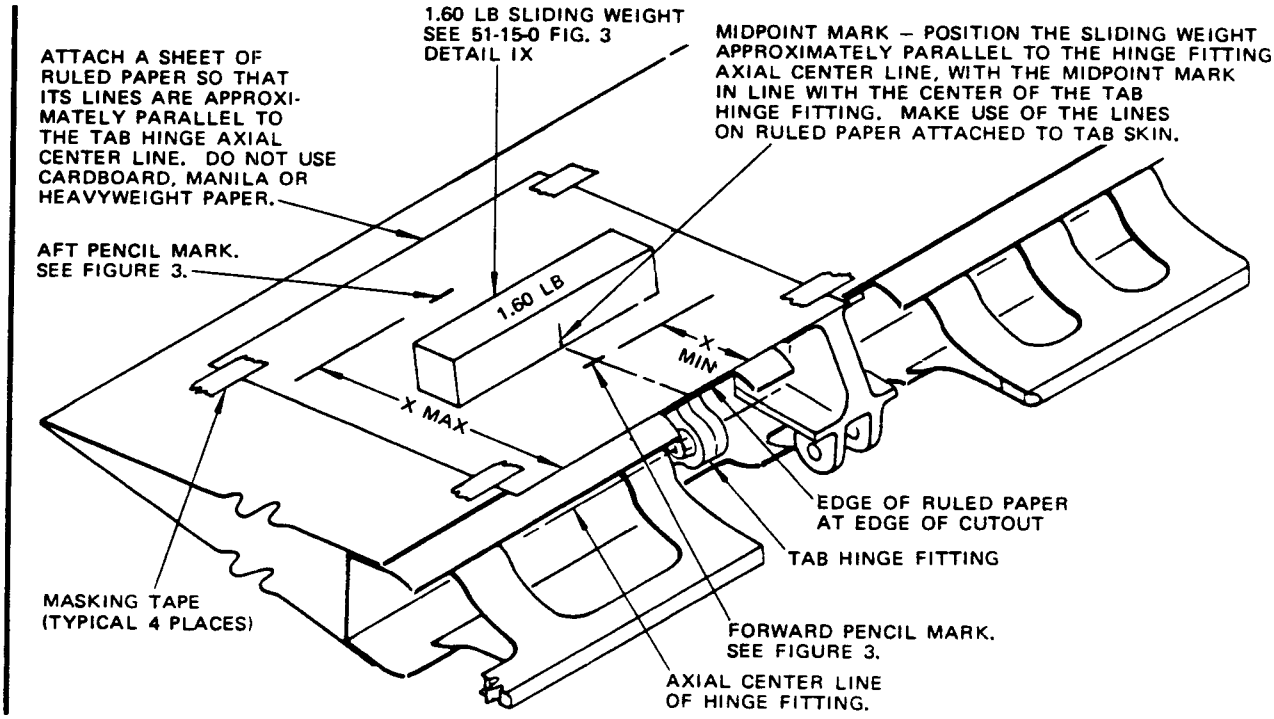
A. Examine placard affixed to tab assembly for tab weight.

B. Determine adjust weight required according to control tab adjust weight table (Fig. 8, Sheet 2).

C. Install the required tab adjust weight on bay 2 balance panel at the location shown in Fig. 8 of 51-15-8.



Elevator Control Tab - Preparation for Weighing
Figure 1



Distance "X" Layout - Elevator Control Tab
Figure 2

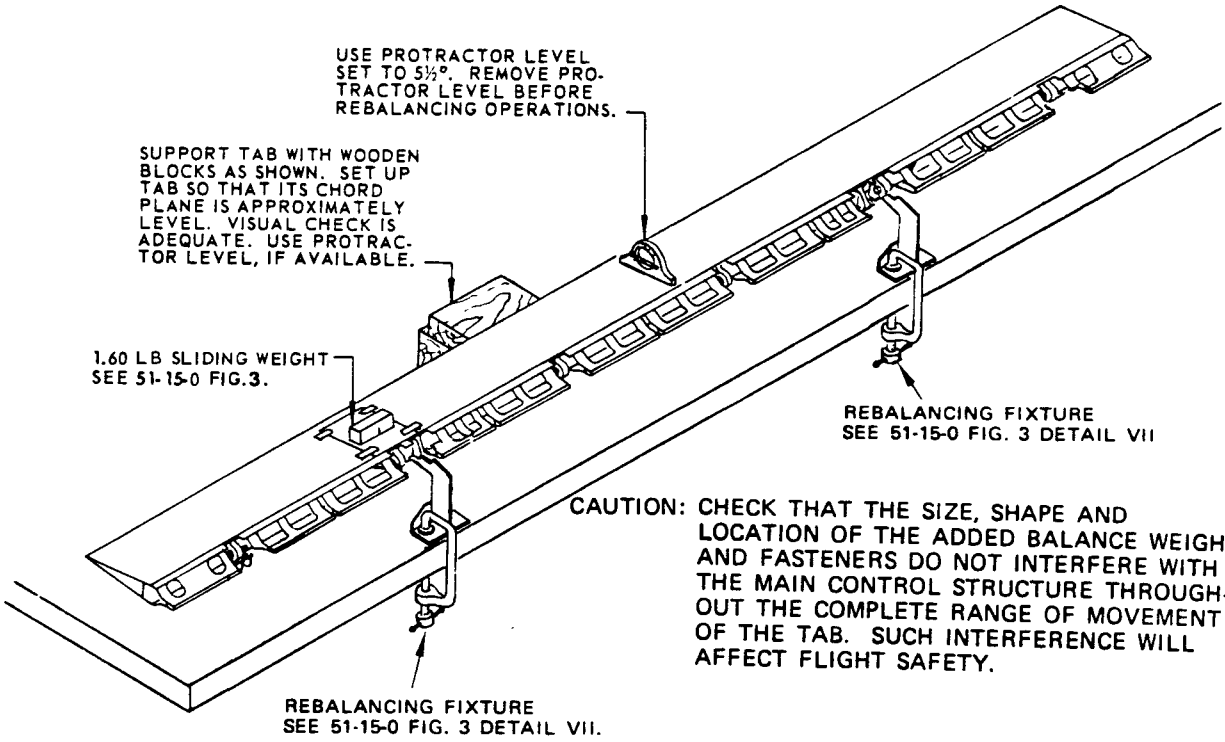
TAB WEIGHT (LBS)	X MIN (INCHES)	X MAX (INCHES)
22-23	2.63	4.29
23-24	2.77	4.51
24-25	2.90	4.73
25-26	3.04	4.95
26-27	3.18	5.17
27-28	3.32	5.39
28-29	3.46	5.43
29-30 [A]	3.60	5.46

NOTE

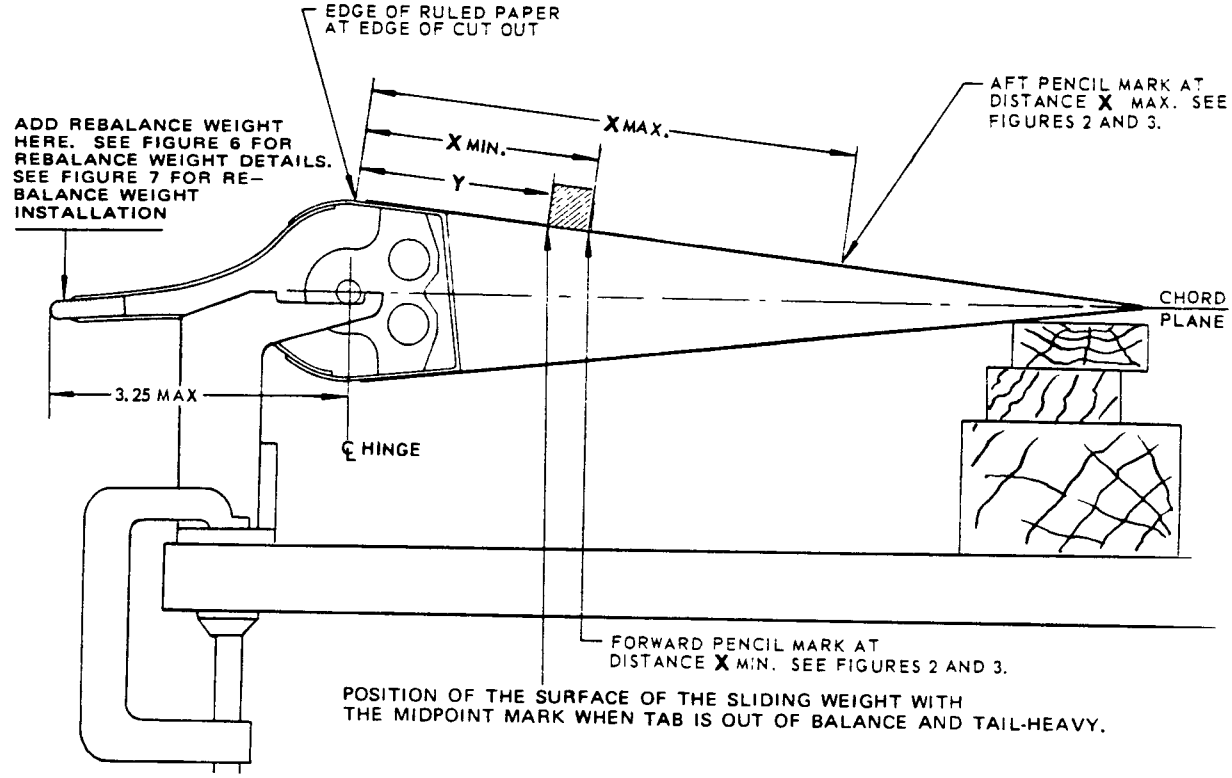
- IF BALANCE IS IN ACCORDANCE WITH THIS TABLE THE TAB IS BALANCED WITHIN THE REQUIRED MANUFACTURING LIMITS AS PER 51-15-0 FIGURE 2.

[A] 30.0 POUNDS MAXIMUM ALLOWABLE TAB WEIGHT

Elevator Control Tab - Distance "X" Dimensions
Figure 3



CAUTION: CHECK THAT THE SIZE, SHAPE AND LOCATION OF THE ADDED BALANCE WEIGHT AND FASTENERS DO NOT INTERFERE WITH THE MAIN CONTROL STRUCTURE THROUGHOUT THE COMPLETE RANGE OF MOVEMENT OF THE TAB. SUCH INTERFERENCE WILL AFFECT FLIGHT SAFETY.



Elevator Control Tab - Rebalancing Arrangement
Figure 4

	MATERIAL	REBALANCE WEIGHT LENGTH TO BE ADDED	REBALANCE WEIGHT LENGTH TO BE REMOVED
		INCHES MINIMUM [C]	INCHES MAXIMUM [D]
FOR WEIGHT I SEE FIGURE 6	TUNGSTEN ALLOY [A] FANSTEEL 77 MALLORY 1000 HP MALLORY 1000PR	(X MIN – Y) X 4.46	(X MAX – Y) X 4.46
	BRONZE ARCHITECTURAL [B]	(X MIN – Y) X 8.99	(X MAX – Y) X 8.99
	STEEL 4130 [B]	(X MIN – Y) X 9.69	(X MAX – Y) X 9.69
FOR WEIGHT II & III SEE FIGURE 6	TUNGSTEN ALLOY [A] FANSTEEL 77 MALLORY 1000 HP MALLORY 1000PR	(X MIN – Y) X 5.53	(X MAX – Y) X 5.53
	BRONZE ARCHITECTURAL [B]	(X MIN – Y) X 11.15	(X MAX – Y) X 11.15
	STEEL 4130 [B]	(X MIN – Y) X 12.02	(X MAX – Y) X 12.02

NOTE

CALCULATE THE REQUIRED BALANCE WEIGHT TO BE ADDED OR REMOVED BY THE APPLICABLE FORMULA. ADDING A LONGER BALANCE WEIGHT THAN THE MINIMUM REQUIRED PROVIDES THE TAB WITH A CAPABILITY FOR FUTURE REPAIRS WHILE INSTALLED. MAINTAIN BALANCING RECORDS. (SEE 51–15–0, FIGURE 2.)

X MIN AND MAX SEE FIGURES 2 AND 3

Y SEE FIGURE 4

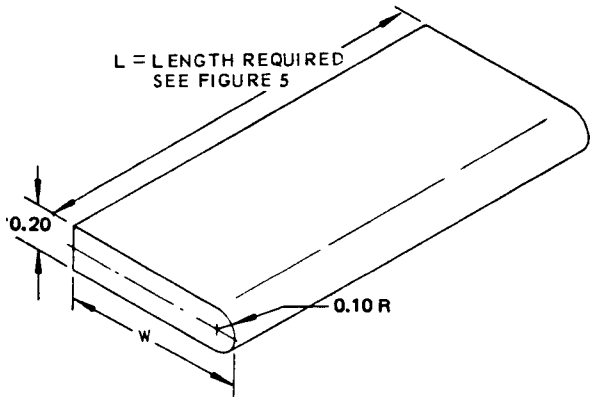
[A] MATERIAL USED FOR FACTORY INSTALLED BALANCE WEIGHT.

[B] OPTIONAL MATERIAL FOR FIELD SERVICE USE.

[C] APPLICABLE WHEN DISTANCE Y IS LESS THAN X_{MIN} OF FIG 3.

[D] APPLICABLE WHEN DISTANCE Y IS MORE THAN X_{MAX} OF FIG 3.

Elevator Control Tab - Rebalance Weight Lengths
Figure 5



	W	BAC PART NO.
WEIGHT I	1.10	69-4627-3
WEIGHT II	0.85	69-4627-801
WEIGHT III	0.85	69-4627-802

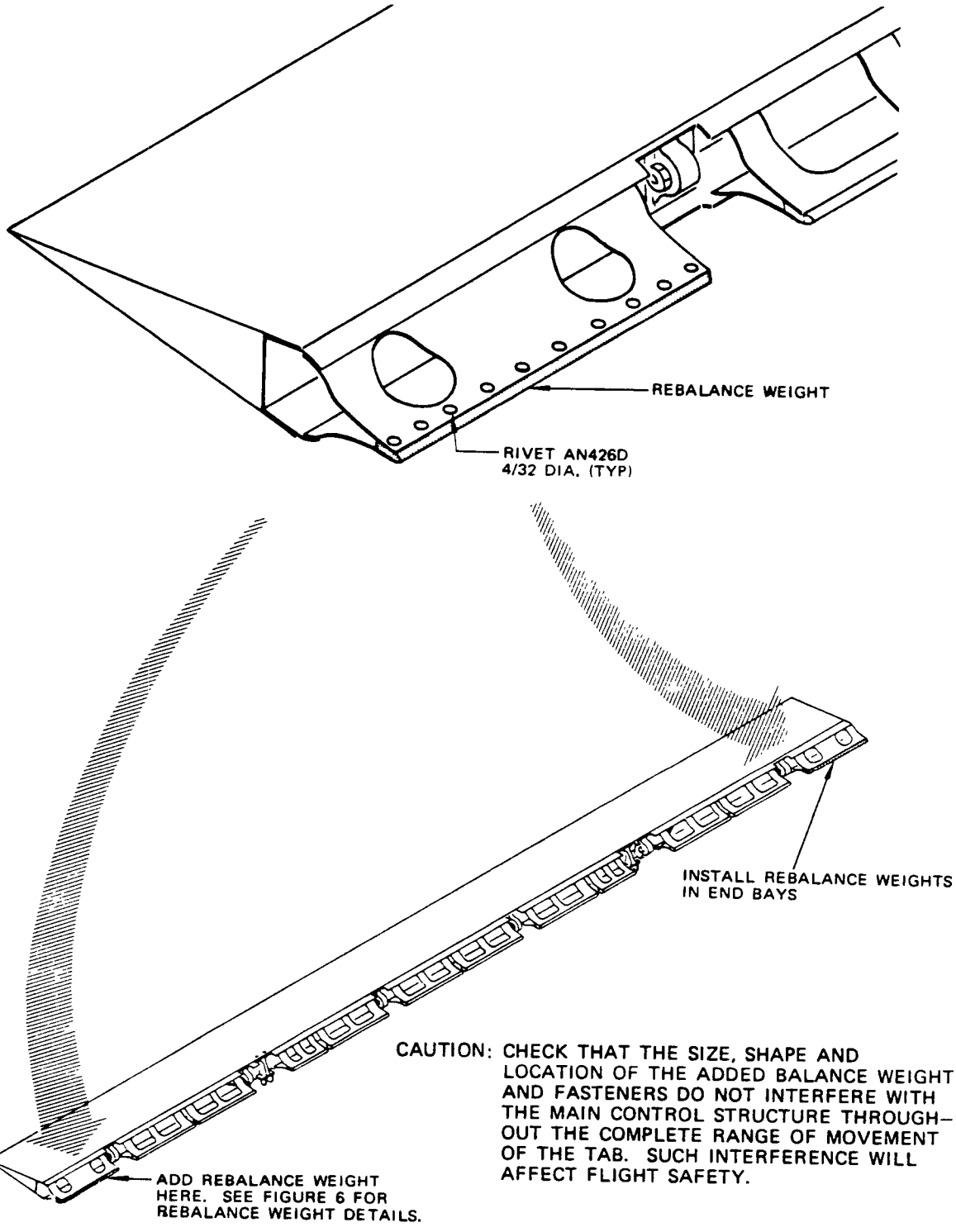
MATERIAL	IDENTIFICATION	SOURCE	FINISH
TUNGSTEN ALLOY [A]	FANSTEEL 77	FANSTEEL METALLURGICAL CORP., NUMBER ONE TANTALUM PLACE NORTH CHICAGO, ILL. 60064	CADMIUM PLATE PER QQ-P-416, TYPE II OR III CLASS B, FOLLOWED BY DIP IN 3 TO 5% SOLUTION BY WEIGHT OF CHROMIC ACID, FOLLOWED BY ONE COAT OF SOLVENT RESISTANT PRIMER, EQUAL PARTS BY VOLUME, E42GP13 AND V66KP11, SHERWIN-WILLIAMS CO., 101 PROSPECT AVE. NW. CLEVELAND, OHIO 44101
	MALLORY 1000HP MALLORY 1000PR	MALLORY AND CO., 3029 E. WASHINGTON INDIANAPOLIS, IND. 46206	
STEEL [B]	4130	ANY SOURCE	
BRONZE [B]	ARCHITECTURAL 283	REVERE COPPER AND BRASS, INC., 24 NORTH FRONT, NEW BEDFORD, MA. 02741	CADMIUM PLATE PER QQ-P-416, TYPE I, CLASS 2, FOLLOWED BY ONE COAT OF ZINC CHROMATE PRIMER PER MIL-P-6889, FOLLOWED BY ONE COAT OF SOLVENT RESISTANT PRIMER, EQUAL PARTS BY VOLUME, E42GP13 AND V66KP11, SHERWIN-WILLIAMS CO., 101 PROSPECT AVE. NW. CLEVELAND, OHIO 44101

NOTE

[A] MATERIAL USED FOR FACTORY INSTALLED BALANCE WEIGHT.

[B] OPTIONAL MATERIAL FOR FIELD SERVICE USE.

Elevator Control Tab - Rebalance Weight
Figure 6



Elevator Control Tab - Rebalance Weight Installation
Figure 7

INSTRUCTIONS

1. Identify tab adjust weights by referring to data on placard affixed to each tab assembly or legend stamped on adjust weights.

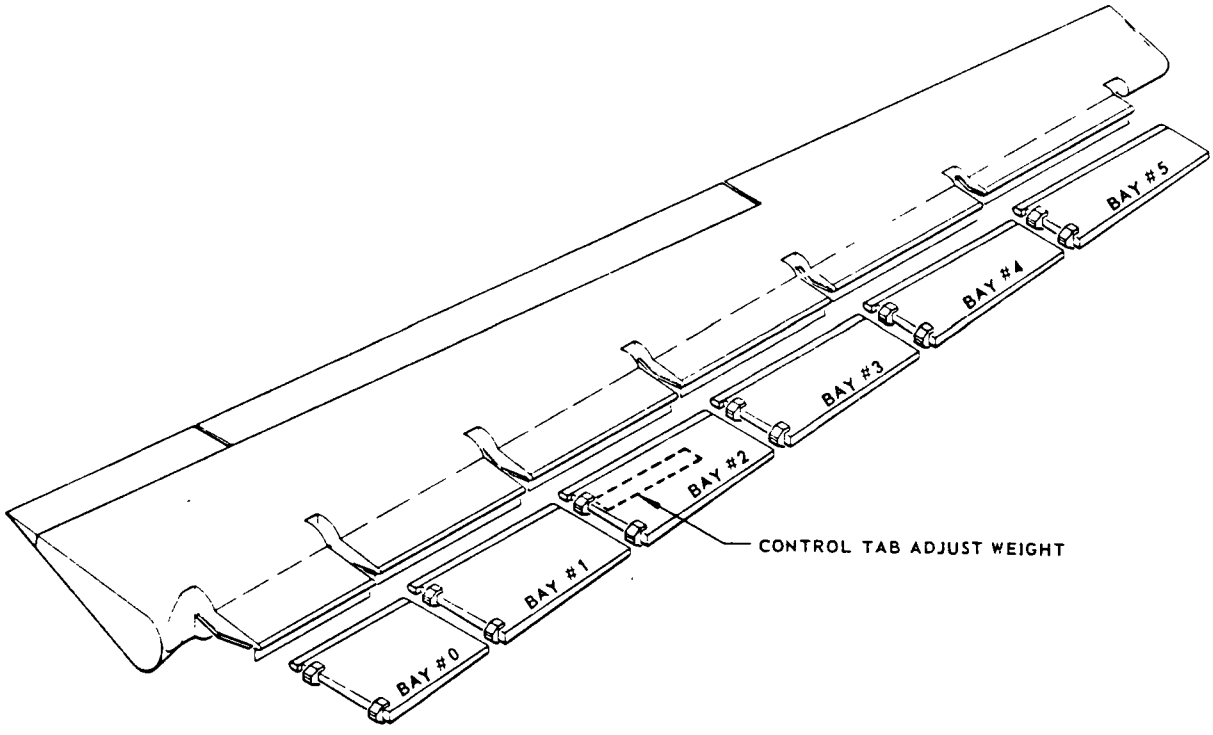
2. Remove adjust weights corresponding to repaired tab.

3. Weigh repaired tab assembly as defined in Fig. 1.

4. Record new tab weight on placard affixed to tab assembly.

5. Select adjust weight corresponding to new tab weight from table shown.

6. Install new adjust weight at the locations shown in Fig. 2 of 51-15-8.



Elevator Control Tab - Adjust Weight Installation
Figure 8 (Sheet 1)

TAB WEIGHT (POUNDS)	ADJ. WT. PART NO.	WT. TOLERANCE (POUNDS) [A]
22.00 to 22.50	65-6534-13, or -27	1.11 (± 0.07)
22.51 to 23.00	65-6534-14, or -28	2.22 (± 0.13)
23.01 to 23.50	65-6534-15, or -29	3.33 (± 0.19)
23.51 to 24.00	65-6534-16, or -30	4.45 (± 0.25)
24.01 to 24.50	65-6534-17, or -31	5.57 (± 0.32)
24.51 to 25.00	65-6534-18, or -32	6.68 (± 0.37)
25.01 to 25.50	65-6534-69, or -74	7.85 (± 0.34)
25.51 to 26.00	65-6534-70, or -75	8.98 (± 0.38)
26.01 to 26.50	65-6534-71, or -76	10.11 (± 0.43)
26.51 to 27.00	65-6534-72, or -77	11.22 (± 0.48)
27.01 to 27.50	65-6534-73, or -78	12.35 (± 0.53)
25.01 to 25.50	65-6534-83 [A]	7.50 (± 0.34)
25.51 to 26.00	65-6534-84 [A]	8.63 (± 0.38)
26.01 to 26.50	65-6534-85 [A]	9.76 (± 0.43)
26.51 to 27.00	65-6534-86, -89 (Opp.) [A]	10.80 (± 0.48)
27.01 to 27.50	65-6534-87, -88 (Opp.) [A]	11.93 (± 0.53)

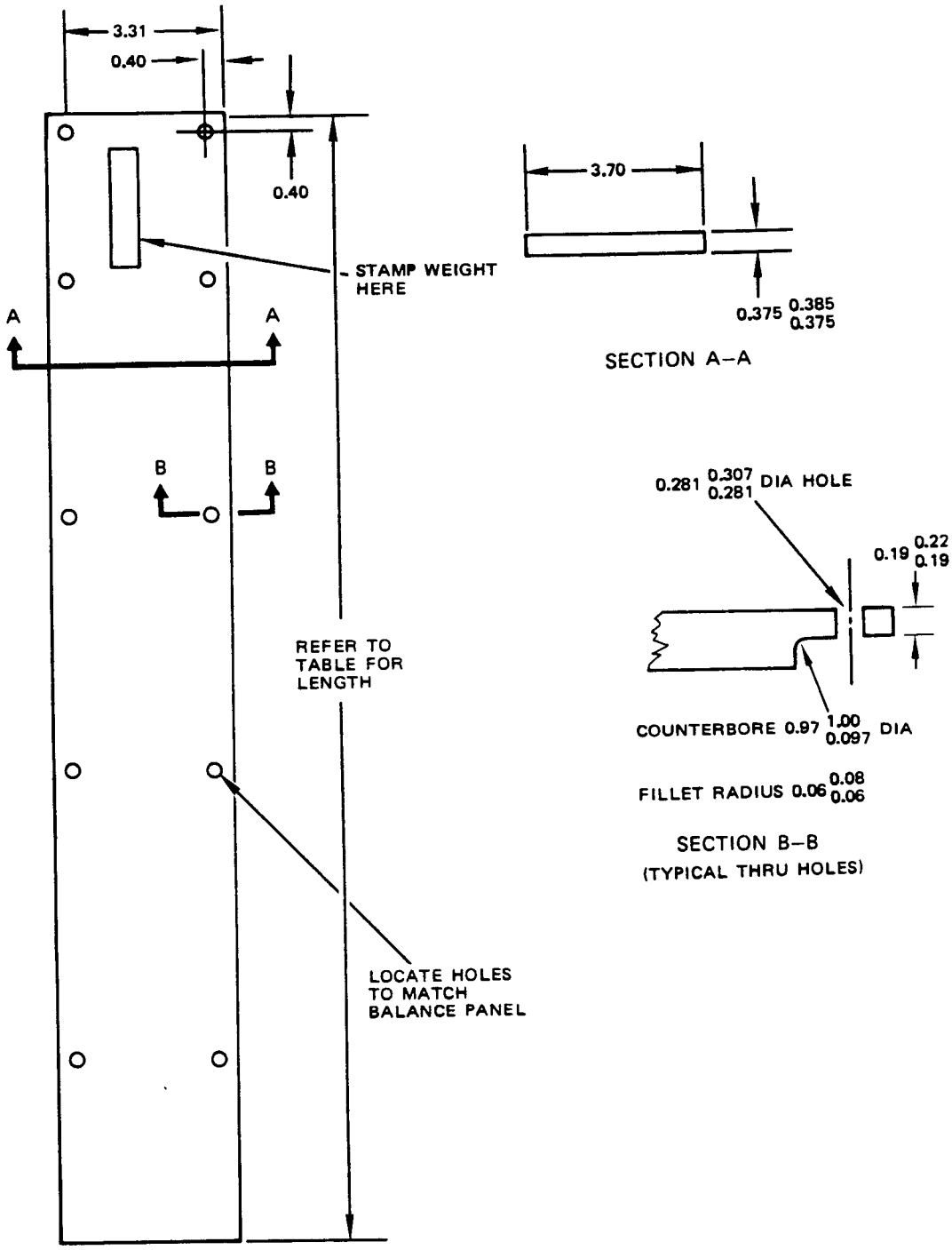
CONTROL TAB ADJUST WEIGHTS			
TAB WEIGHT	MATERIAL	[B]	ADJUST WEIGHT TOLERANCE (LBS.) WITH COUNTERBORED HOLES [A]
27.51 - 28.00	Fansteel	65–6534–109 (LENGTH 16.14)	12.75 (± 0.49)
28.01 - 28.50		65–6534–110 (LENGTH 17.57)	13.94 (± 0.54
28.51 - 29.00		65–6534–111 (LENGTH 18.98)	15.12 (± 0.58
29.01 - 29.50		65–6534–112 (LENGTH 20.63)	16.31 (± 0.63)
29.51 - 30.00	Fansteel	65–6534–113 (LENGTH 22.04)	17.49 (± 0.67)

NOTE

[A] COUNTER BORED WEIGHTS ARE REQUIRED TO ASSURE CLEARANCE WHEN HONEYCOMB BALANCE PANEL COVERS ARE USED

[B] MAKE FROM FANSTEEL AS SHOWN IN DETAIL I OR ORDER BY PART NO. FROM THE BOEING COMPANY

Elevator Control Tab - Adjust Weight Installation
Figure 8 (Sheet 2)



CONTROL TAB ADJUST WEIGHTS
DETAIL I

Elevator Control Tab - Adjust Weight Installation
Figure 8 (Sheet 3)

RUDDER BALANCING

1. General

A. Two different rudder configurations, a STANDARD RUDDER and a HIGH SPEED rudder are used on 707 airplanes. Both types of rudders are externally very similar, except that the high speed rudder differs from the standard rudder by an increase in permanent weights (tungsten alloy) forward of the hinge centerline of the rudder in bay number 5. This shifts the center of gravity of the rudder forward; therefore, the maximum speed capability of the high speed rudder is greater than that of the standard rudder.

CAUTION: DO NOT USE STANDARD RUDDER ON AIRPLANES WITH TURBOFAN (JT3D) ENGINES. THE HIGH SPEED RUDDERS CAN BE USED ON ALL AIRPLANES.

B. The static balance CG of the rudder major assembly is derived from the sum of the individual weights and moments of the rudder, control tab, and balance panels together with constants for other components or parts not installed at time of balancing.

WARNING: BEFORE BALANCING A RUDDER, CHECK THE ASSEMBLY NUMBER TO IDENTIFY THE TYPE. ENSURE THAT BALANCING IS CARRIED OUT, USING THE CORRECT PROCEDURES AND THE SPECIFIC BALANCE WEIGHT TABLES. INCORRECTLY BALANCED RUDDER ASSEMBLIES COULD PRODUCE AN UNSAFE FLIGHT CONDITION.

C. The types of rudders in use are:

(1) High speed rudder 50-9788-13 with 60 pound-inch moment overbalance in bay 5

(2) High speed rudders 50-9788-18, -20, -21, -25, -26, and -32 with 60 pound-inch moment overbalance in bay 2 or 3 for repaint or repair capability, and a 60 pound-inch moment overbalance in bay 5.

NOTE: These high speed rudders do not require balancing if records show that repairs and repainting moments have not exceeded the 60 pound-inch moment overbalance.

(3) Standard rudder 50-9788 and 50-9788-14

(4) Standard rudder 50-9788-19 and -27 with 60 pound-inch moment overbalance in bays 2 and 3 for repaint or repair capabilities.

NOTE: These standard rudders do not require balancing if records show that repairs and repainting moments have not exceeded the 60 pound-inch moment overbalance.

2. Special Tools and Equipment

A. The special tools and equipment required during balancing are defined in Fig. 2. (See also 51-15-0, Fig. 3.)

3. Balancing Procedure for Rudder Removed from Airplane

A. Prepare the rudder as described in Fig. 1 and install on the balance jig stand, using static balance test jigs at rudder hinge stations 48.67 and 191.38.

NOTE: Secure the hinge half at the forward end of the rudder horn in the fully up position as shown in Fig. 2. Secure the control rods in the neutral position.

B. With the chord plane horizontal, measure the reaction (WR) in pounds at moment arm (B) in inches. The weight reaction (WR) should be measured along one of the known dimension lines shown in Fig. 2.

C. Measure and record the moment arm (B). The distance from the skin trailing edge to the point where the weight reaction is being applied (A) subtracted from the known dimension lines shown in Fig. 2 gives the moment arm (B).

D. Calculate the trial actual moment by multiplying the weight reaction (WR) (measured in pounds) by the moment arm (B) (measured in inches).

Trial actual moment = (WR) times (B)

E. Select balance weights as follows:

(1) For high speed rudders with repaint capability, refer to balance weight table, Fig. 3, sheet 1, and read off number of weights, P/N 69-10063-4 or -5 or P/N 69-10063-6, as required.

(2) For standard rudders with repaint capability, refer to balance weight table, Fig. 3, sheet 2, and read off number of weights, P/N 69-10063-4 or -5 or P/N 69-10063-6, as required.

NOTE: If required by space limitations, P/N 69-10063-4 and -5 auxiliary weights may be replaced by 69-10063-6 weights. 69-10063-4 and -5 differ in shape only, not weight. Balance weight P/N 69-10063-6 is approximately five times as heavy as 69-10063-4 or -5. Do not install 69-10063-6 in combination with any other weight in the same stack. Since the density of tungsten alloy weights varies, a check balance moment must be obtained after installation of 69-10063-6 weights.

F. Install these weights on the rudder horns of bays 2 and 3 as shown in Fig. 4, Balance Weight Installation. The weights on bay 2 should be installed first, with weights on bay 3 being used if necessary.

G. Obtain the check balance moment by repeating steps A thru C. The moment must lie between 1250 and 1440 pound-inches for high speed rudders with repair capability, and between 1425 and 1500 pound-inches for standard rudders with repair capability.

NOTE: Each weight, P/N 69-10063-4 or -5, has a moment of 6.5 pound-inches when installed on bay 2, and 5.0 pound-inches when installed on bay 3. The rudders are correctly balanced when the moment is within the specified limits. However, to provide for maximum in-service repair capability, an installed rudder should be balanced to the fully forward CG position within the limits of Fig. 3.

4. Sample Calculation for Balancing a Rudder

A. The following is a summation of the steps of par. 3.A. thru 3.C. (All values are assumed.)

(1) Mount the rudder in the balance fixture and measure the weight reaction and moment arm (par. 3.A. thru 3.C.).

Weight reaction (WR) = 34.70 pounds
Moment arm (B) = 47.50 inches

(2) Determine trial moment (par. 3.D.).

(WR)(B) = (34.70 pounds)(47.50 inches)
= 1648.2 pound-inches

(3) This moment requires the addition of balance weights as follows:

(a) Standard rudder (Fig. 3) requires four balance weights P/N 65-10063-6 and four weights P/N 65-10063-4 or -5

(b) High speed rudder (Fig. 3) requires five balance weights P/N 65-10063-6 and five weights P/N 65-10063-4 or -5 on bay 2, and four weights P/N 65-10063-4 or -5 on bay 3.

(4) Install weights as required by Fig. 4.

(5) Determine the check balance moment (par. 3.C).

(WR) = 30.20 pounds
(B) = 47.50 inches
Check balance moment = (WR)(B)
= (30.20 pounds)(47.50 inches)
= 1434.50 pound-inches

(6) This moment falls within the required balance limits of the tables of Fig. 3, indicating the surface is satisfactorily balanced (Ref par. 3.G.).

5. Adjustment of Balance after a minor Repair with Rudder Installed

A. The effect of minor repairs on the rudder must be calculated and, if necessary, the balance condition adjusted before putting the airplane back in service, provided there is space for the installation of the required balance weights. Where there is not sufficient space for the addition of the required balance weights, rebalance as described in par. 3 and 4. Adjust the rudder balance condition as follows:

(1) Determine net weight of repair (within 0.03 pound) by subtracting weight of removed damaged material from material used for repair (Ref 51-15-0).

(2) Measure distance (Y) from the centerline of the rudder hinge to the CG of repair area (Fig. 5).

(3) Measure distance (Z) between CG of balance weights and centerline of balance panel hinge (Fig. 5).

(4) Subtract distance (Z) from distance (T) to obtain dimension (U). See table I. Fig. 5, for distance (T).

(5) Calculate balance weight required by multiplying net weight of repair by (Y) and dividing result by (U).

(6) Install balance weight in position shown and in same bay as distance (T) was measured (Fig. 4 and 5). Total weight must not be less than that calculated in par. 5.A.(5), but may be up to 0.50 pound more. Any excess balance weight installed must be accounted for during subsequent repairs. When the resultant weight is less than 0.50 pound, no addition of balance weight is required; however, this balance requirement must be taken into account if the same control surface is repaired and rebalanced a second time.

6. Sample Calculation for Rebalancing after Repair to an Installed Rudder (Ref par. 5)

A. Calculate the effect of a repair to a rudder as follows: (All values are assumed.)

(1)	Weigh the material removed from damage area.	0.10 pound
(2)	Weigh all material used to make the repair.	0.60 pound
(3)	Subtract 0.10 from 0.60 to obtain net weight.	0.50 pound
(4)	Measure distance (Y).	19.38 inches

(5) Measure distance (Z) = 2.44 inches

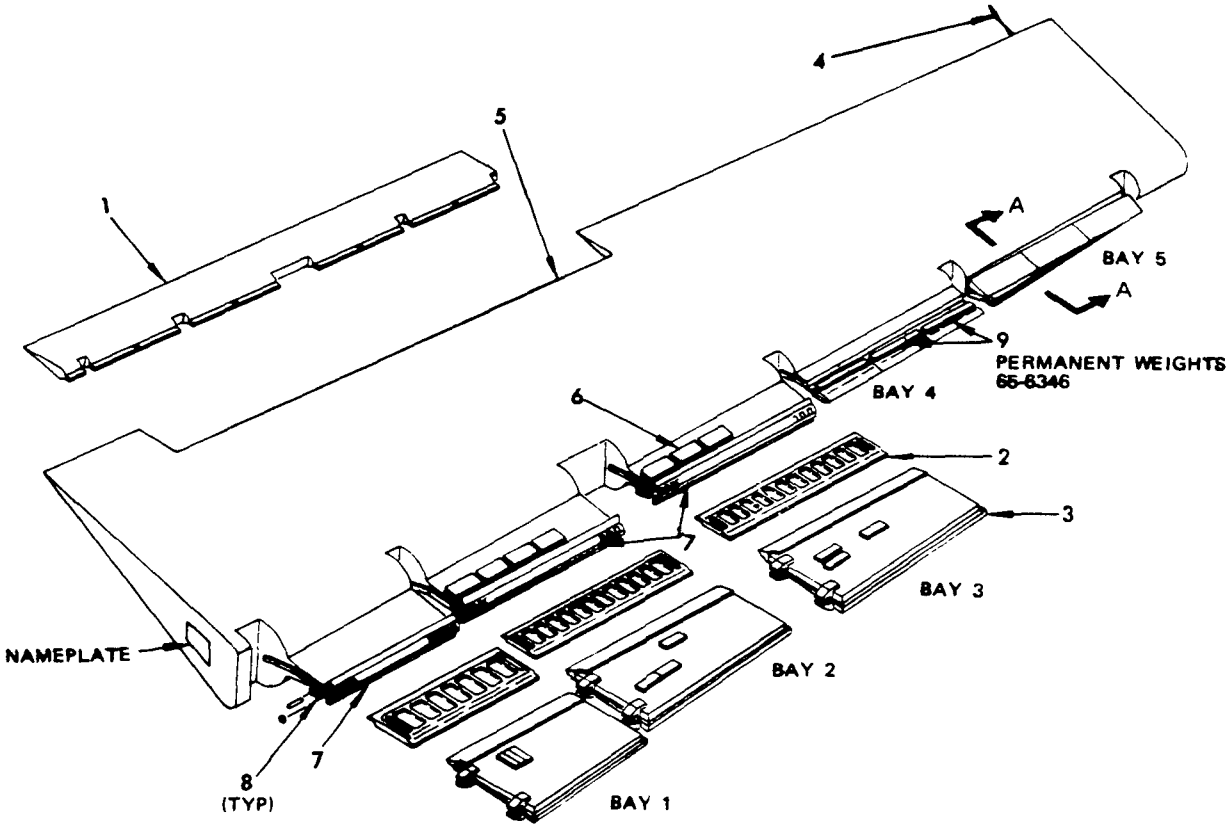
(6) Determine distance (U). (U) = (T) - (Z)
= 12.50 - 2.44
= 10.06 inches

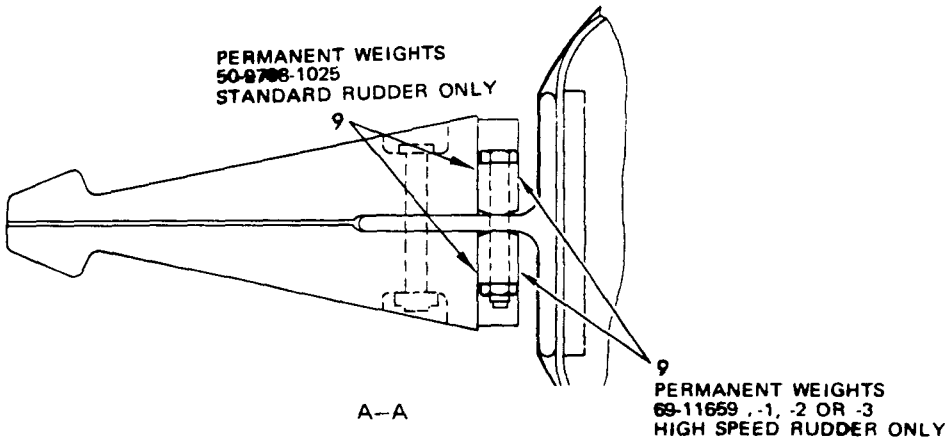
(7) Calculate the balance weight required:

$$\frac{\text{(Net weight of repair)(Y)}}{\text{(dimension U)}}$$

$$= \frac{0.50 \times 19.38}{10.06} = 0.96 \text{ pound}$$

(8) From Fig. 4, determine that two weights, P/N 69-10063-4 or -5 are required. Install the weights next to either bay 2 or 3 nearest the repair.





Preparation for Balancing
Figure 1 (Sheet 1)

RUDDER ASSEMBLY - BALANCING CONFIGURATION

PARTS REMOVED

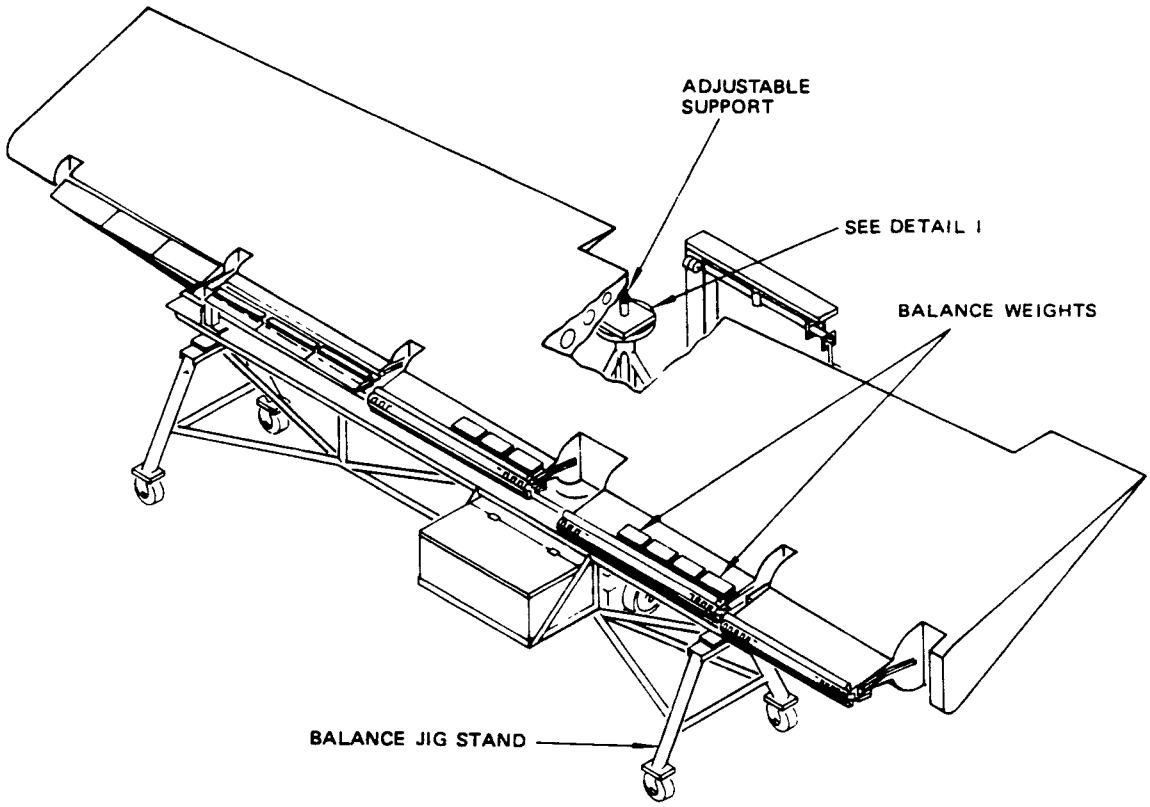
1. CONTROL TAB
2. BALANCE PANEL EXTENSION
3. BALANCE PANEL

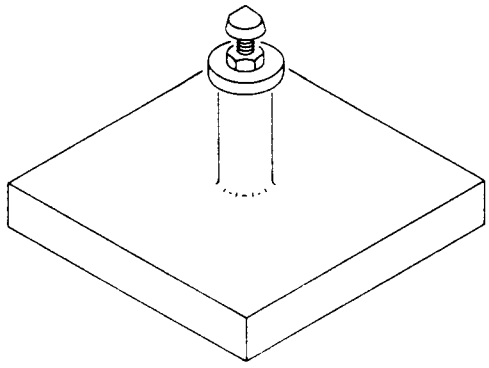
NOTE: All paint and protective finish must be applied before balancing.

RUDDER TAB CONTROL ROD WILL REMAIN IN RUDDER PLACED IN NEUTRAL POSITION.

PARTS INSTALLED

4. STATIC DISCHARGERS
5. CONTROL TAB HINGE BOLTS WITH ASSOCIATED NUTS AND WASHERS, AND BONDING JUMPERS
6. BALANCE WEIGHTS
7. RUDDER - BALANCE PANEL HINGE ASSEMBLIES.
8. SEALS AND SEAL RETAINERS
9. PERMANENT WEIGHTS

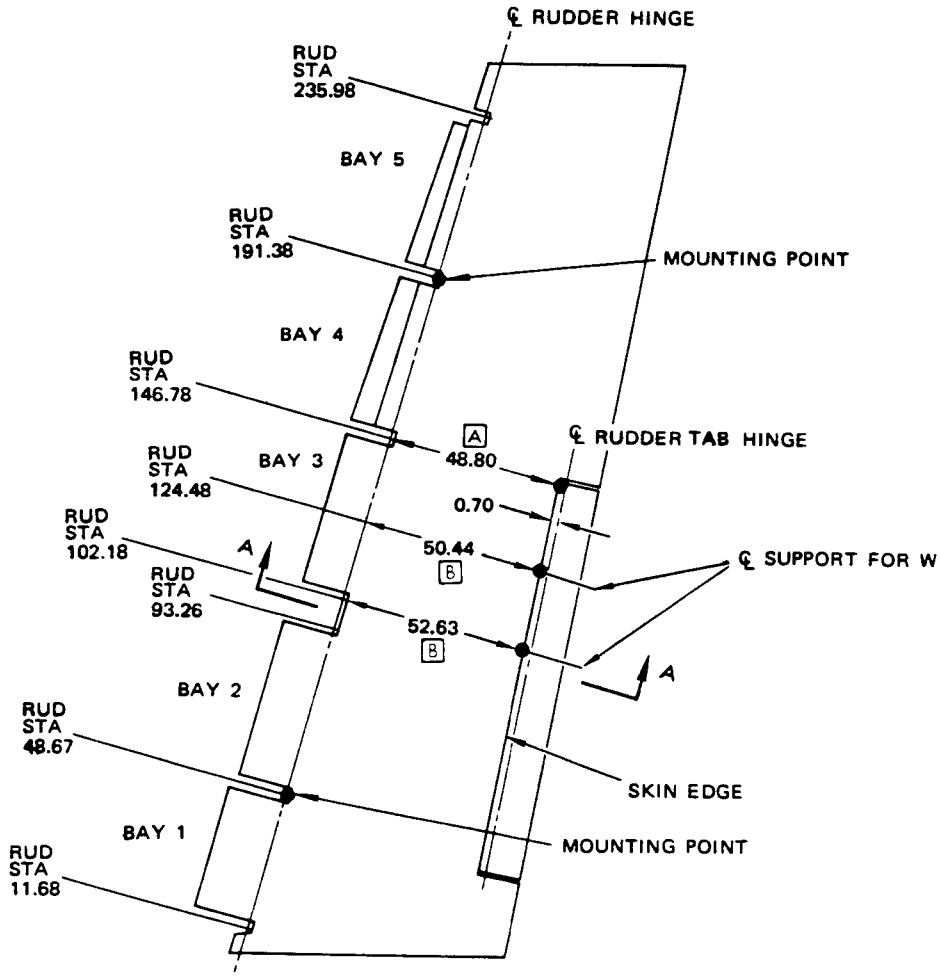


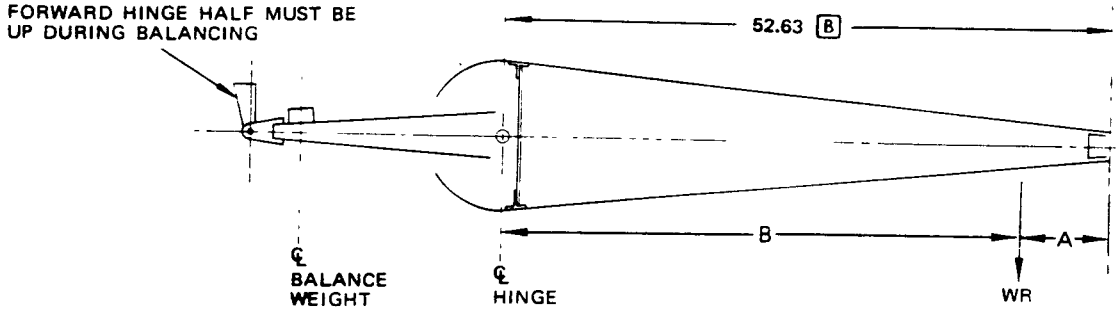


ADJUSTABLE SUPPORT FITTING

DETAIL I

Rudder Support During Balancing
Figure 2 (Sheet 1)



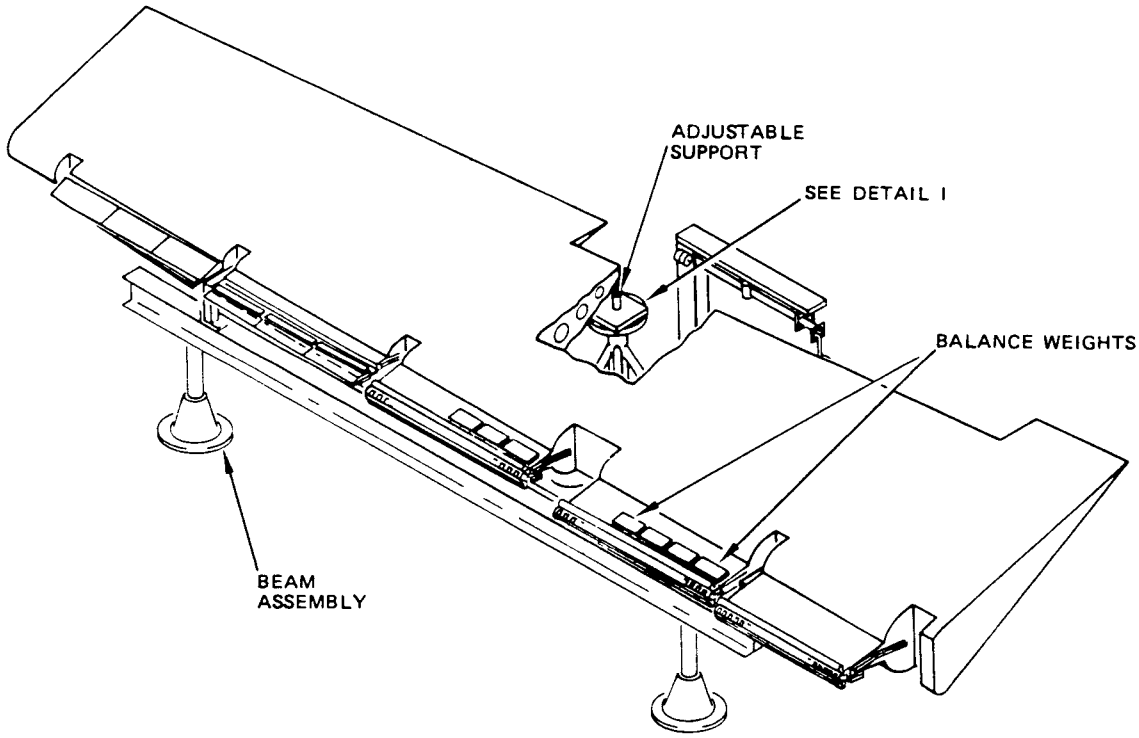


A DISTANCE FROM RUDDER HINGE CENTERLINE TO TAB BEARING CENTERLINE AT STATION 146.78

B DISTANCE FROM RUDDER HINGE CENTERLINE TO SKIN TRAILING EDGE

RUDDER MOUNTING POINT LOCATIONS

Rudder Support During Balancing
Figure 2 (Sheet 2)



Rudder Support During Balancing
Figure 2 (Sheet 3)

HIGH SPEED RUDDER WITH REPAINT CAPABILITY				
TRIAL MOMENT POUND-INCHES	NUMBER OF WEIGHTS REQUIRED			
	BAY 2		BAY 3	
	69-10063-6	69-10063-4 OR -5	69-10063-6	69-10063-4 OR -5
1435 NOMINAL MOMENT				
1250 TO 1440	0	0	0	0
1440 TO 1448	0	2	0	0
1448 TO 1455	0	3	0	0
1455 TO 1461	0	4	0	0
1461 TO 1468	0	5	0	0
1468 TO 1475	1	1	0	0
1475 TO 1481	1	2	0	0
1481 TO 1488	1	3	0	0
1488 TO 1494	1	4	0	0
1494 TO 1501	1	5	0	0
1501 TO 1508	2	1	0	0
1508 TO 1514	2	2	0	0
1514 TO 1521	2	3	0	0
1521 TO 1527	2	4	0	0
1527 TO 1534	2	5	0	0
1534 TO 1541	3	1	0	0
1541 TO 1547	3	2	0	0
1547 TO 1554	3	3	0	0
1554 TO 1560	3	4	0	0
1560 TO 1566	3	5	0	0
1566 TO 1574	4	1	0	0
1574 TO 1580	4	2	0	0
1580 TO 1587	4	3	0	0
1587 TO 1593	4	4	0	0
1593 TO 1600	4	5	0	0
1600 TO 1606	5	1	0	0
1606 TO 1613	5	2	0	0
1613 TO 1619	5	3	0	0
1619 TO 1626	5	4	0	0
1626 TO 1633	5	5	0	0
1633 TO 1643	5	5	0	2
1643 TO 1653	5	5	0	4
1653 TO 1663	5	5	1	1
1663 TO 1673	5	5	1	3
1673 TO 1683	5	5	1	5
1683 TO 1693	5	5	2	2
1693 TO 1703	5	5	2	4
1703 TO 1713	5	5	3	1
1713 TO 1723	5	5	3	3
1723 TO 1733	5	5	3	5
1733 TO 1743	5	5	4	2
1743 TO 1754	6	1	4	3
1754 TO 1764	6	1	5	0
1764 TO 1776	6	2	5	1
1776 TO 1782	6	3	5	1
1782 TO 1788	6	4	5	1
1788 TO 1801	7	1	5	1
1801 TO 1807	7	2	5	1
1807 TO 1826	8	0	5	1

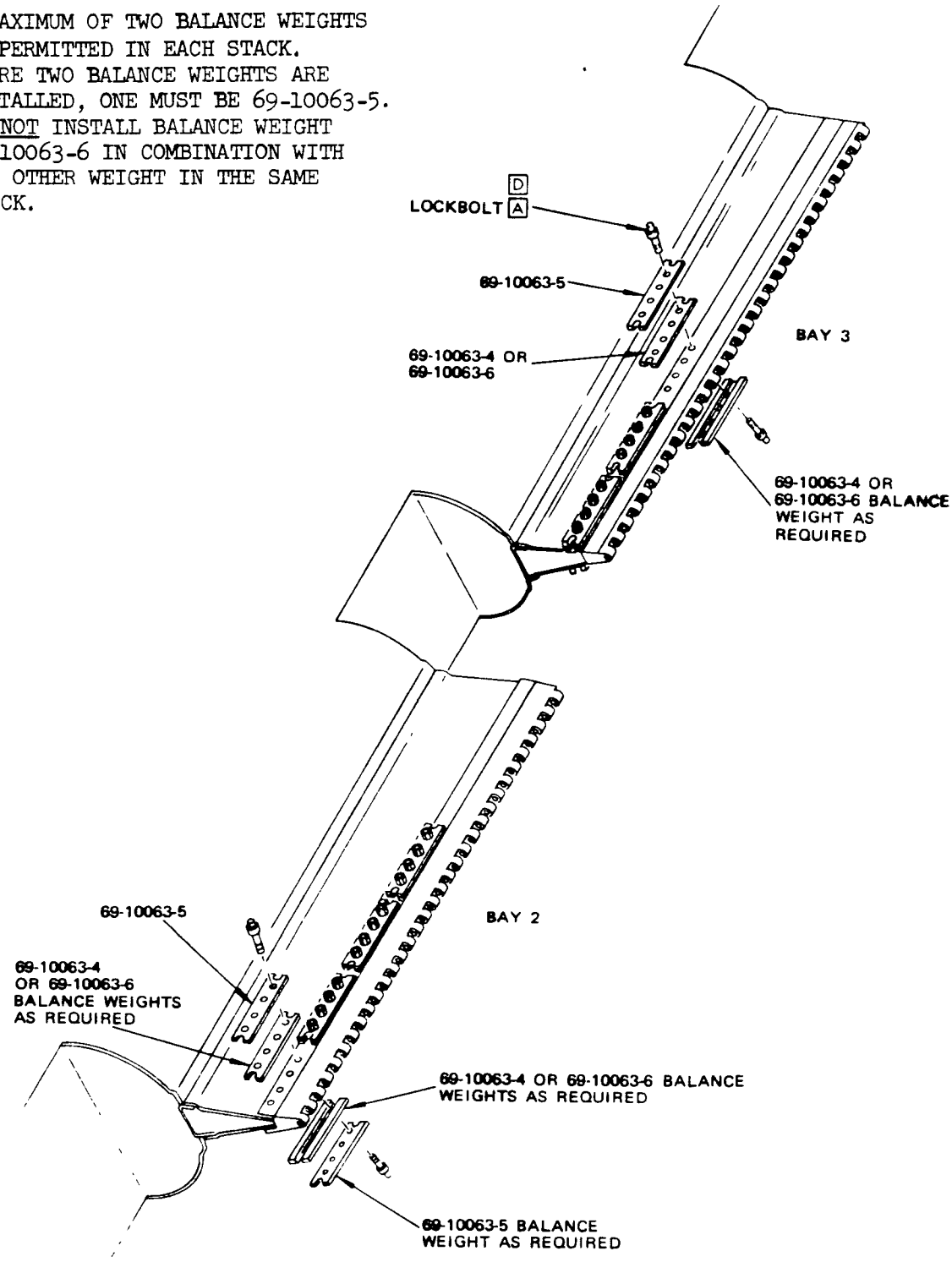
Rudder Balance Weight Requirements
Figure 3 (Sheet 1)

STANDARD RUDDER WITH REPAINT CAPABILITY				
TRIAL MOMENT POUND-INCHES	NUMBER OF WEIGHTS REQUIRED			
	BAY 2		BAY 3	
	69-10063-6	69-10063-4 OR -5	69-10063-6	69-10063-4 OR -5
1495 NOMINAL MOMENT				
1425 TO 1500	0	0	0	0
1500 TO 1508	0	2	0	0
1508 TO 1515	0	3	0	0
1515 TO 1521	0	4	0	0
1521 TO 1528	0	5	0	0
1528 TO 1535	1	1	0	0
1535 TO 1541	1	2	0	0
1541 TO 1548	1	3	0	0
1548 TO 1554	1	4	0	0
1554 TO 1561	1	5	0	0
1561 TO 1568	2	1	0	0
1568 TO 1574	2	2	0	0
1574 TO 1581	2	3	0	0
1581 TO 1587	2	4	0	0
1587 TO 1594	2	5	0	0
1594 TO 1601	3	1	0	0
1601 TO 1607	3	2	0	0
1607 TO 1614	3	3	0	0
1614 TO 1620	3	4	0	0
1620 TO 1626	3	5	0	0
1626 TO 1634	4	1	0	0
1634 TO 1640	4	2	0	0
1640 TO 1647	4	3	0	0
1647 TO 1653	4	4	0	0
1653 TO 1660	4	5	0	0
1660 TO 1666	5	1	0	0
1666 TO 1673	5	2	0	0
1673 TO 1679	5	3	0	0
1679 TO 1686	5	4	0	0
1686 TO 1693	5	5	0	0
1693 TO 1703	5	5	0	2
1703 TO 1713	5	5	0	4
1713 TO 1723	5	5	1	1
1723 TO 1733	5	5	1	3
1733 TO 1743	5	5	1	5
1743 TO 1753	5	5	2	2
1753 TO 1763	5	5	2	4
1763 TO 1773	5	5	3	1
1773 TO 1783	5	5	3	3
1783 TO 1793	5	5	3	5
1793 TO 1803	5	5	4	2
1803 TO 1814	6	1	4	3
1814 TO 1824	6	1	5	0
1824 TO 1836	6	2	5	1
1836 TO 1842	6	3	5	1
1842 TO 1848	6	4	5	1
1848 TO 1861	7	1	5	1
1861 TO 1867	7	2	5	1
1867 TO 1886	8	0	5	1

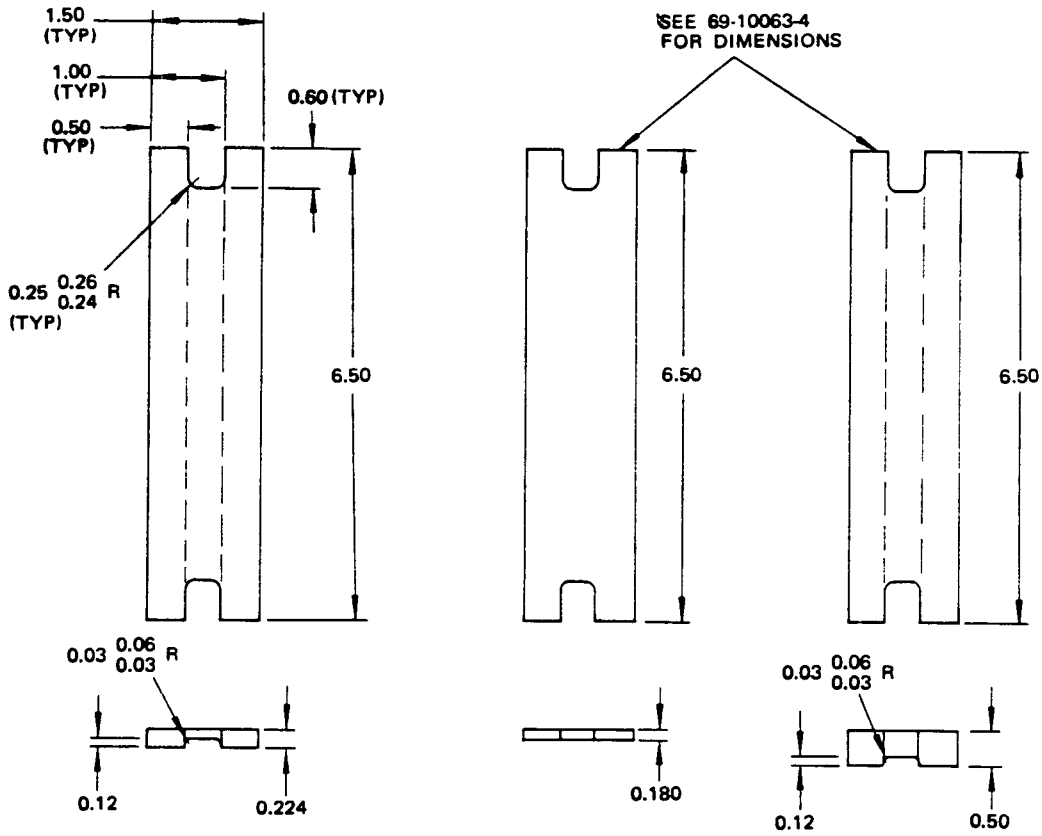
Rudder Balance Weight Requirements
Figure 3 (Sheet 2)

CAUTION

A MAXIMUM OF TWO BALANCE WEIGHTS IS PERMITTED IN EACH STACK. WHERE TWO BALANCE WEIGHTS ARE INSTALLED, ONE MUST BE 69-10063-5. DO NOT INSTALL BALANCE WEIGHT 69-10063-6 IN COMBINATION WITH ANY OTHER WEIGHT IN THE SAME STACK.



Rudder Balance Weight Dimensions and Installation
Figure 4 (Sheet 1)



WEIGHT = 0.50 POUNDS
69-10063-4 [B]

WEIGHT = 0.50 POUNDS
69-10063-5 [B]

WEIGHT = 2.50 POUNDS
69-10063-6 [C]

NOTE

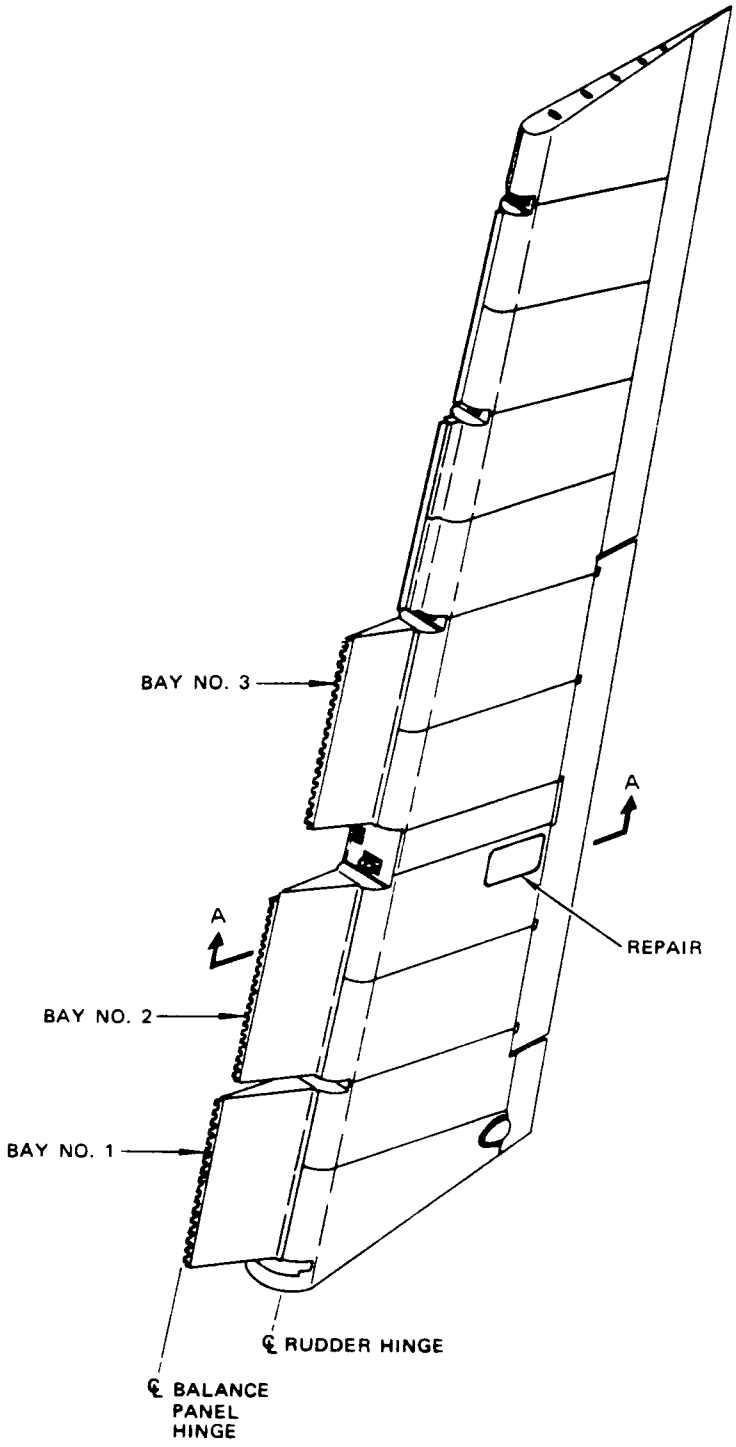
[A] REPLACE EXISTING JO-BOLTS WITH BACB30LB6 WHEN REMOVING OR INSTALLING BALANCE WEIGHTS. INSTALL FOUR FASTENERS THROUGH EACH BALANCE WEIGHT.

[B] 1020 OR 1025 MIL-S-7852; 4130 AN-QQ-685; 4340 AMS 6359; 1018, 1020 OR 1025 BAR QQ-S-633. CADMIUM PLATE ACCORDING TO QQ-P-416, TYPE II, CLASS 2. APPLY ONE COAT OF BMS 10-11, TYPE I PRIMER AND ONE COAT OF BMS 10-11 ENAMEL.

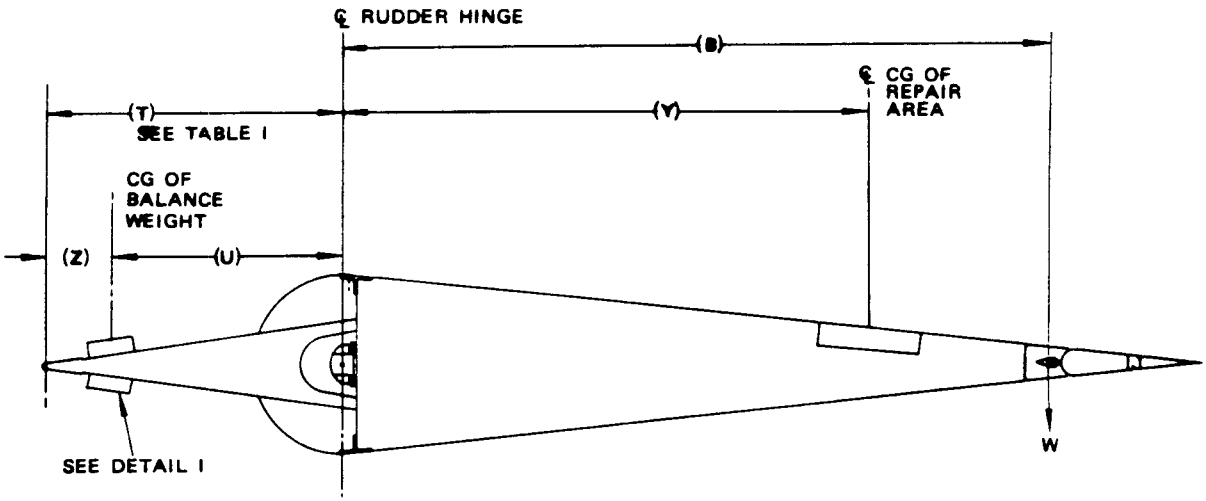
[C] FANSTEEL 77 (FANSTEEL METALURICAL CORP., NORTH CHICAGO, ILL.) OR MALLORY 1000HP OR 1000PR (MALLORY CO., INDIANAPOLIS, IND.) CADMIUM PLATE ACCORDING TO QQ-P-416, TYPE II, CLASS 2, FOLLOWED BY CHROMIC ACID DIP (3-5% BY WEIGHT) AND ONE COAT OF BMS 10-11, TYPE I PRIMER.

[D] FOR AIRPLANES WITH SERVICE BULLETIN 2459 INCORPORATED.

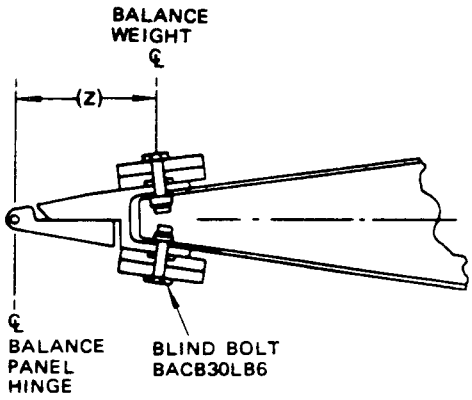
Rudder Balance Weight Dimensions and Installation
Figure 4 (Sheet 2)



Rudder Repair Weight and Moment Arm Diagram
Figure 5 (Sheet 1)



SECTION A–A



DETAIL I

T	BAY NO.
15.50	2
12.50	3

TABLE I

Rudder Repair Weight and Moment Arm Diagram
Figure 5 (Sheet 2)

RUDDER BALANCE PANELS - BALANCING

1. General

   A. The requirements for the rudder balance panels are expressed only in terms of a required weight.

   B. Balance panel adjust weights, 69-10063-2, are added as required to bring the panel to the desired weight. Each 69-10063-2 part weighs approximately 0.15 pound.

2. Special Tools and Equipment - Platform Scale (Ref 51-15-0)

3. Balance Procedure for Balancing Panels

   A. The panels should be prepared as shown in Fig. 2, including the parts of the seal assembly which attach to the panel. See Fig. 1 for panel locations.

   B. The condition of the panels at time of balancing and the weight requirements are detailed as follows:

      (1) Bay No. 1 Balance Panel (Fig. 2)

         (a) Install bolts which attach the panel to the panel extension.

         (b) Seals installed: 10-60120-19, -22, -25

         (c) Weigh panel and install balance panel adjust weights, 69-10063-2 as required to reach 29.5 (+0.50/-0.10) pounds.

      (2) Bay No. 2 Balance Panel (Fig. 2)

         (a) Install bolts which attach the panel to the panel extension.

         (b) Seals installed: 10-60120-20, -23, -26

         (c) Weigh panel and install balance panel adjust weights, 69-10063-2 as required to reach 40.6 (+0.50/-0.10) pounds.

      (3) Bay No. 3 Balance Panel (Fig. 2)

         (a) Install bolts which attach the panel to the panel extension.

         (b) Seals installed: 10-60120-21, -24, -26

         (c) Weigh panel and install balance panel adjust weights, 69-10063-2 as required to reach 36.8 (+0.50/-0.10) pounds.

C. During repair of balance panels, remove all jo-bolts attaching panel adjust weights, 69-10063-2, to panel.

D. Reinstall weights with blind lock rivets, NAS1398B6. If necessary, enlarge hole to 0.256 inch (0.261 inch maximum) and install three blind lock rivets, NAS1398B8. Determine length as follows in all holes through panel structure:

NAS1398B6 (B8)	Total 69-10063-2 weights
-3	1
-5	2
-7	3

4. Balance Procedures for Balance Panels after Minor Repair

A. After a minor repair, weighing of the panel is not necessary if records or calculations show that the weight limits are within the limits of pars. 3.B.(1) thru 3.B.(3).

B. After a major repair, balance as described in par. 3.

5. Balance Procedure for Balance Panel Extensions (Fig. 3)

A. The requirements for the rudder balance panel extensions are expressed only in terms of a required weight.

B. Balance panel adjust weights, 65-6346-31, are added to the panel extensions as required to meet the specified weight limits.

C. For balancing, the balance panel extensions should be prepared as shown in Fig. 3, including those parts of seal installation which attach to the panels.

NOTE: The rudder control tab adjust weights, are to be removed before weighing bay 2 balance panel extension (Fig. 3 and 51-15-13 Fig. 8).

D. The condition of the panel extensions at time of balancing and the weight requirements are detailed as follows:

(1) Bay No. 1 Balance Panel Extension

(a) Install bolts and washers which attach the hinge half to the panel extension.

(b) Standard balance weights installed: none

(c) Seal retainer installed: 65-4115-7 or 65-4115-18

(d) Seals installed: 10-60120-7 and 10-60120-10

(e) Weigh panel extension and install panel adjust weights, balance 65-6346-31 as required to reach 22.2 (+0.20/-0.10) pounds (Fig. 3).

(2) Bay No. 2 Balance Panel Extension

(a) Install bolts and washers which attach the hinge half to the panel extension.

(b) Standard balance weights installed: (2) 65-6346-5

(c) Remove rudder control tab adjust weights.

(d) Seal retainer installed: 65-4115-8 or 65-4115-49

(e) Seals installed: 10-60128-8 and 10-60120-11

(f) Weigh the extension and add 65-6346-31 auxiliary balance panel adjust weights as required to reach 20.1 (+0.20/-0.10) pounds (Fig. 3).

(g) Install the required rudder control tab adjust weights on bay 2 balance panel extension as described in 51-15-13, par. 1. See Fig. 3 for location.

(3) Bay No. 3 Balance Panel Extension

(a) Install bolts and washers which attach hinge half to the panel extension.

(b) Standard balance weights installed: (15) 65-6346-8
(11) 65-6346-21

(c) Seal retainer installed: 65-4115-9 or 65-4115-50

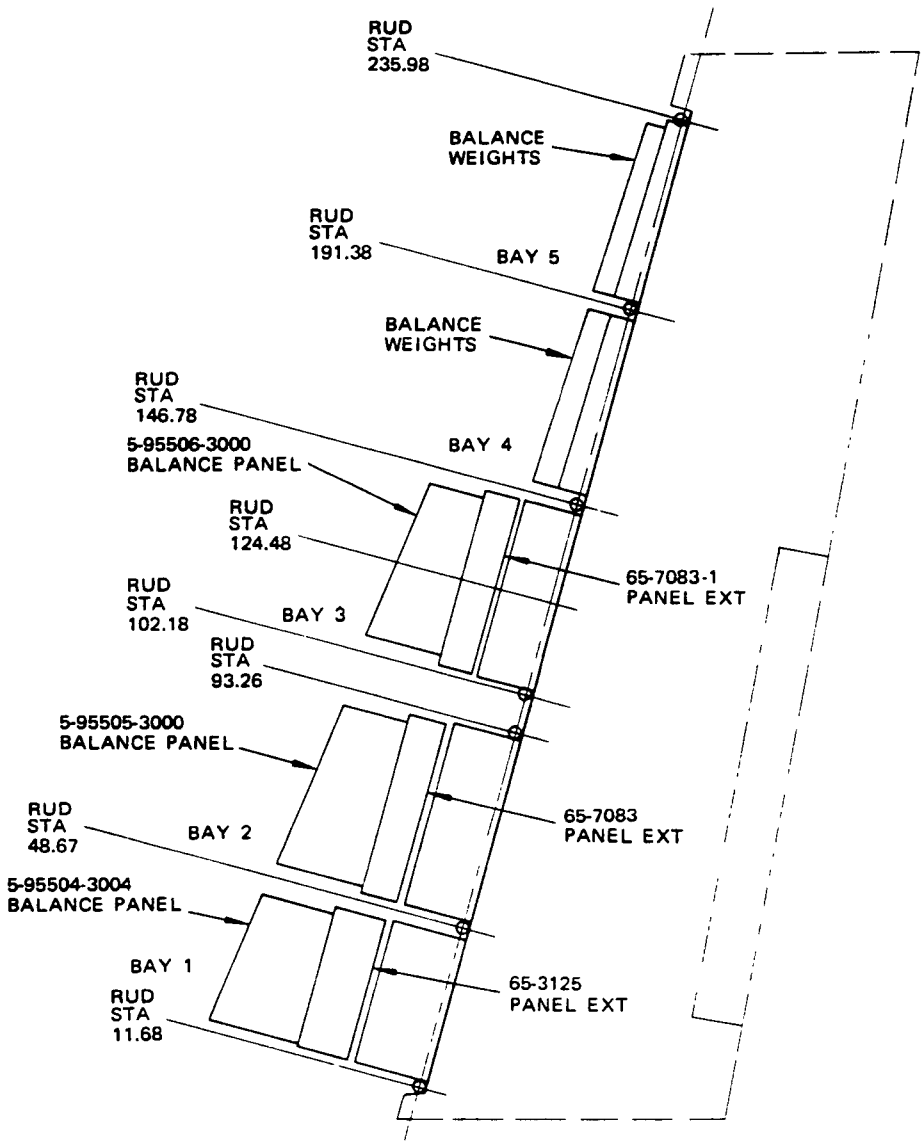
(d) Seals installed: 10-60120-9 and 10-60120-12

(e) Weigh the balance panel extension and add 65-6346-31 balance panel adjust weights as required to reach 57.6 (+0.40/-0.30) pounds (Fig. 3).

6. Balancing Procedure for Balance Panel Extension after Repair

A. After a minor repair, weighing of the panel is not necessary if records or calculations show that the weight limits of par. 1.D. or 3 have not been exceeded. Install or remove balance weights in the positions shown in Fig. 3.

B. After a major repair, balance as described in par. 9.

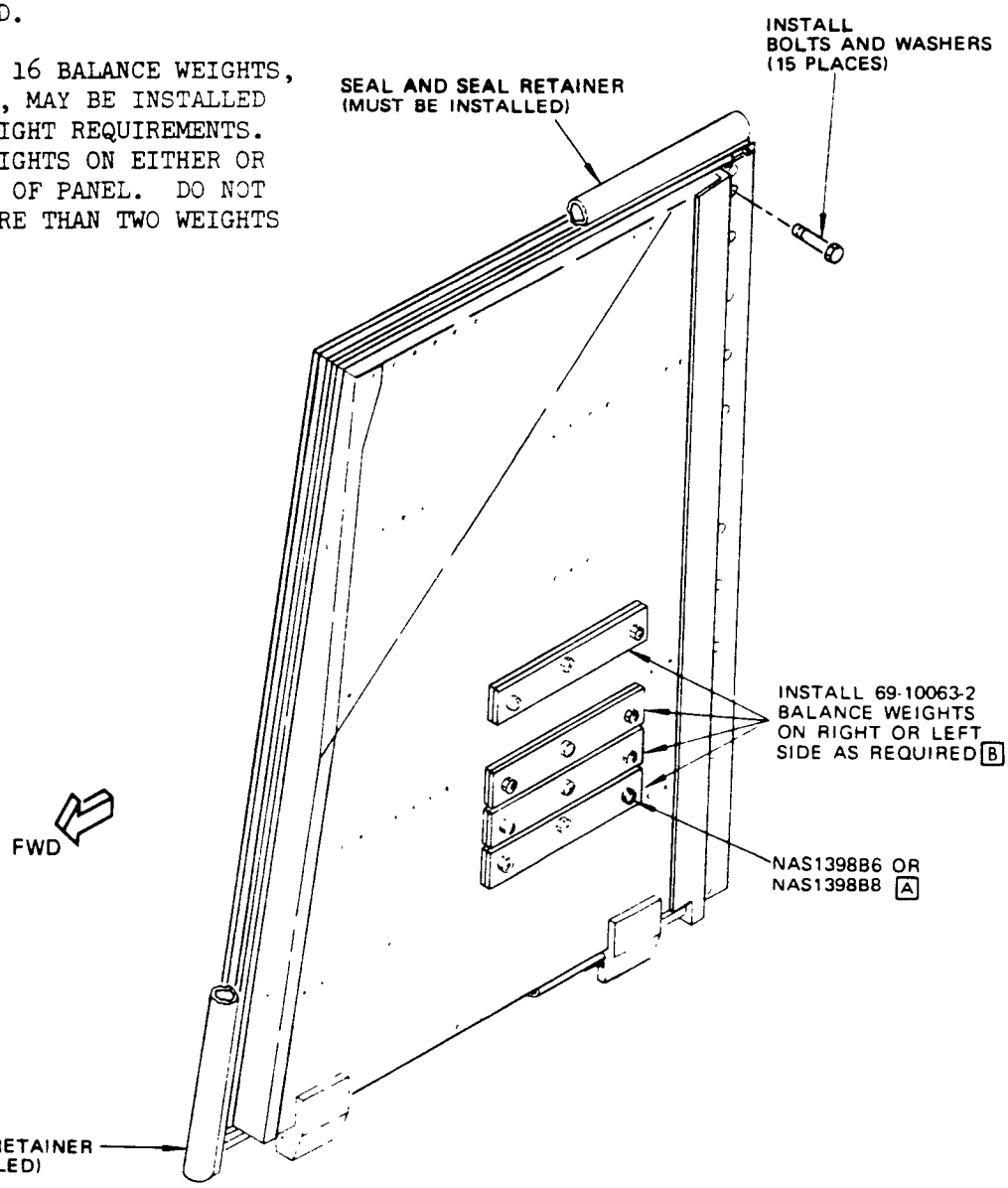


Rudder Balance Panels and Panel Extensions - Location
Figure 1

NOTE

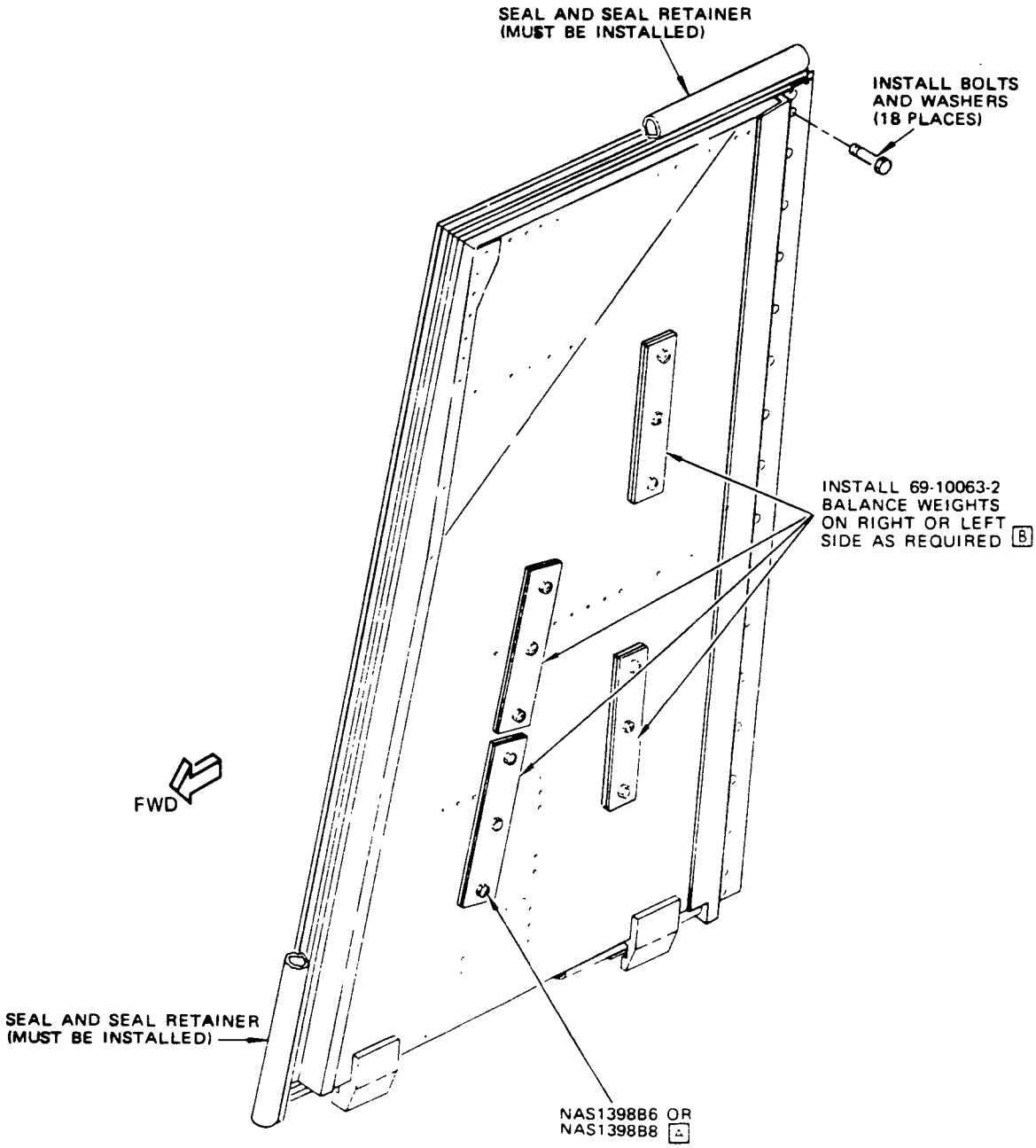
[A] REPLACE EXISTING BACB30CC6 (JO-BOLT) WITH NAS1398B6 OR NAS1398B8 WHEN INSTALLATION OF 69-10063-2 BALANCE WEIGHTS IS REQUIRED.

[B] A TOTAL OF 16 BALANCE WEIGHTS, 69-10069-2, MAY BE INSTALLED TO MEET WEIGHT REQUIREMENTS. INSTALL WEIGHTS ON EITHER OR BOTH SIDES OF PANEL. DO NOT INSTALL MORE THAN TWO WEIGHTS PER STACK.



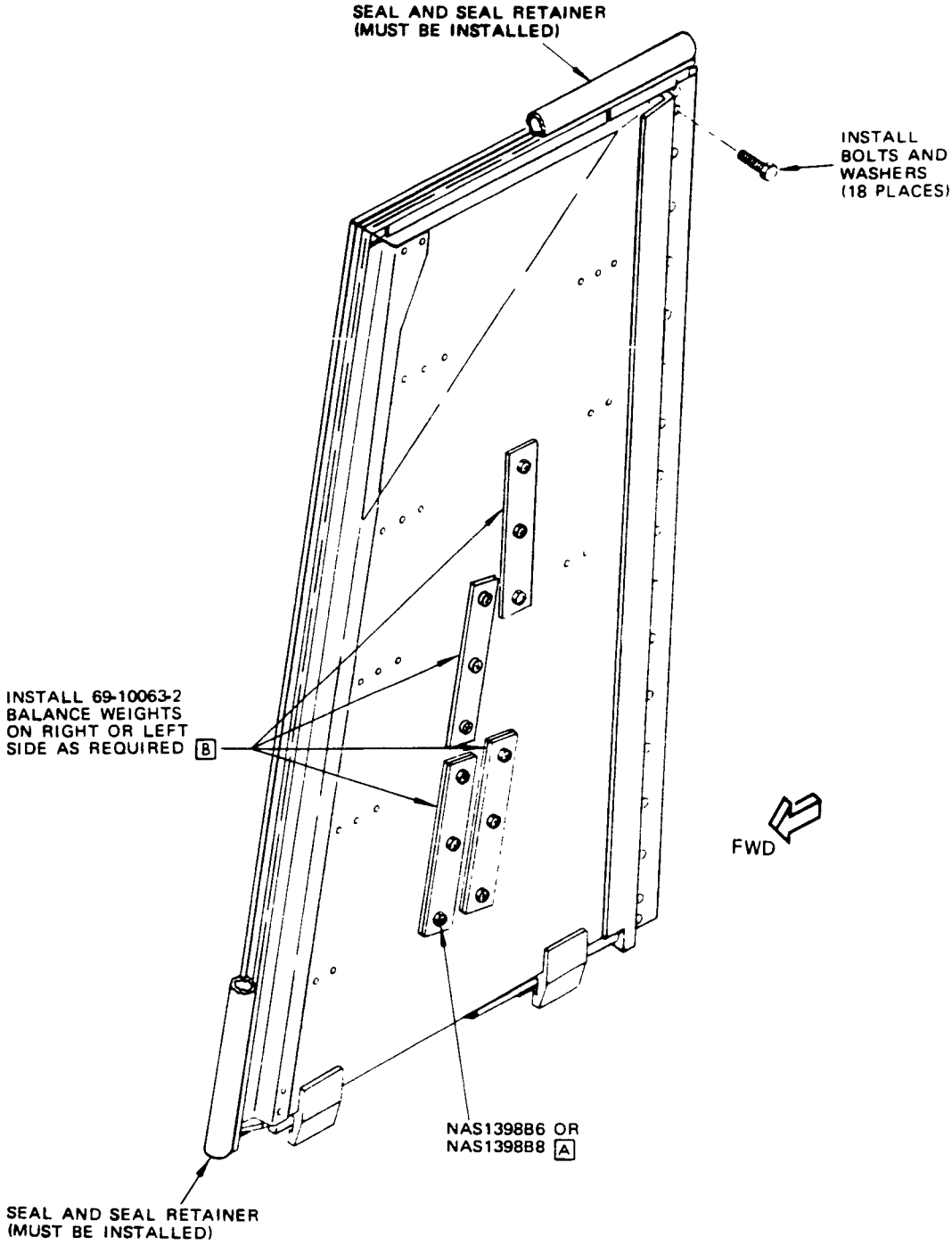
BALANCE PANEL BAY NO. 1
5-95504-3004

Rudder Balance Panels - Weight Installation and Requirements
Figure 2 (Sheet 1)



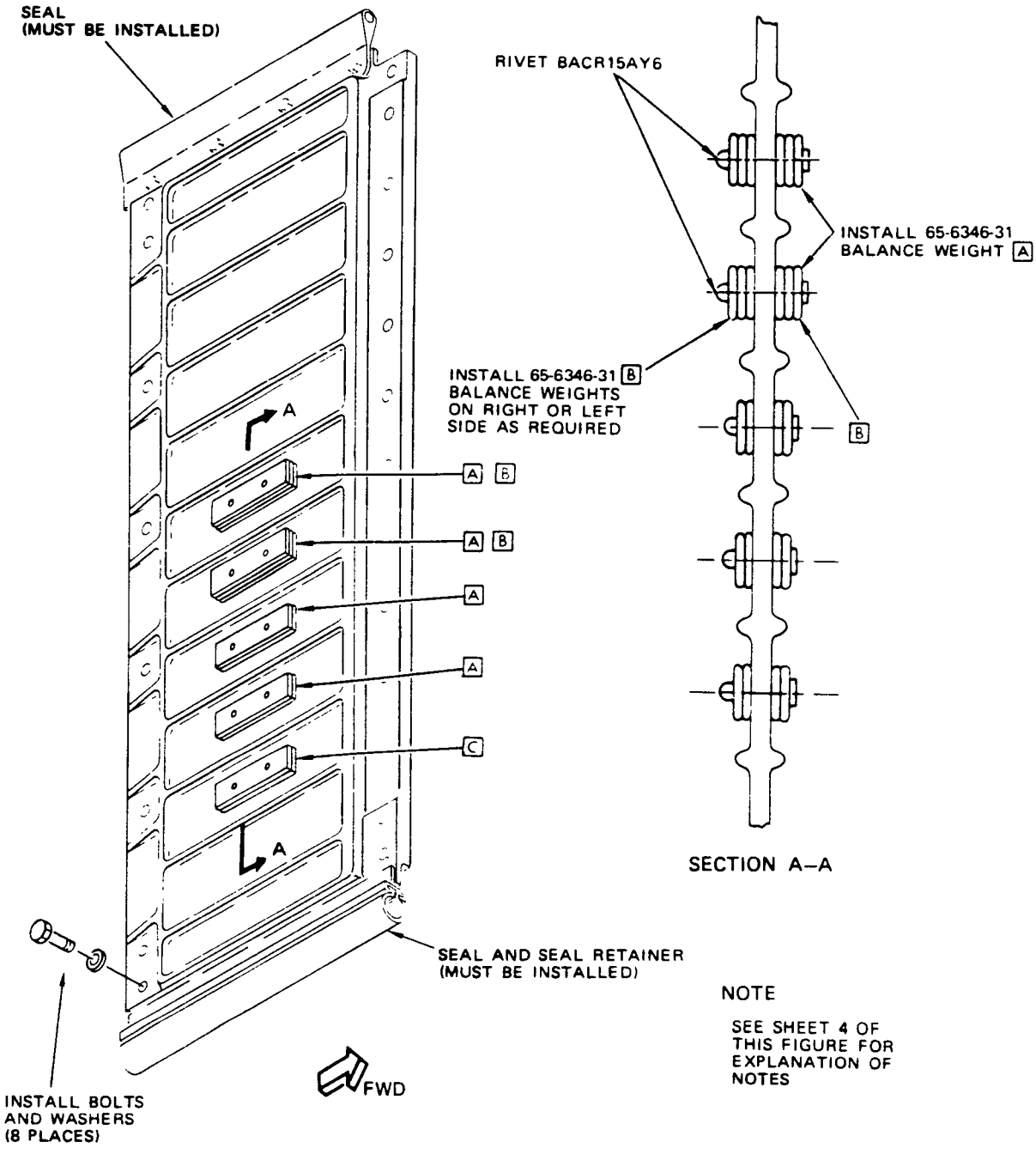
BALANCE PANEL BAY NO. 2
5-95505-3000

Rudder Balance Panels - Weight Installation and Requirements
Figure 2 (Sheet 2)



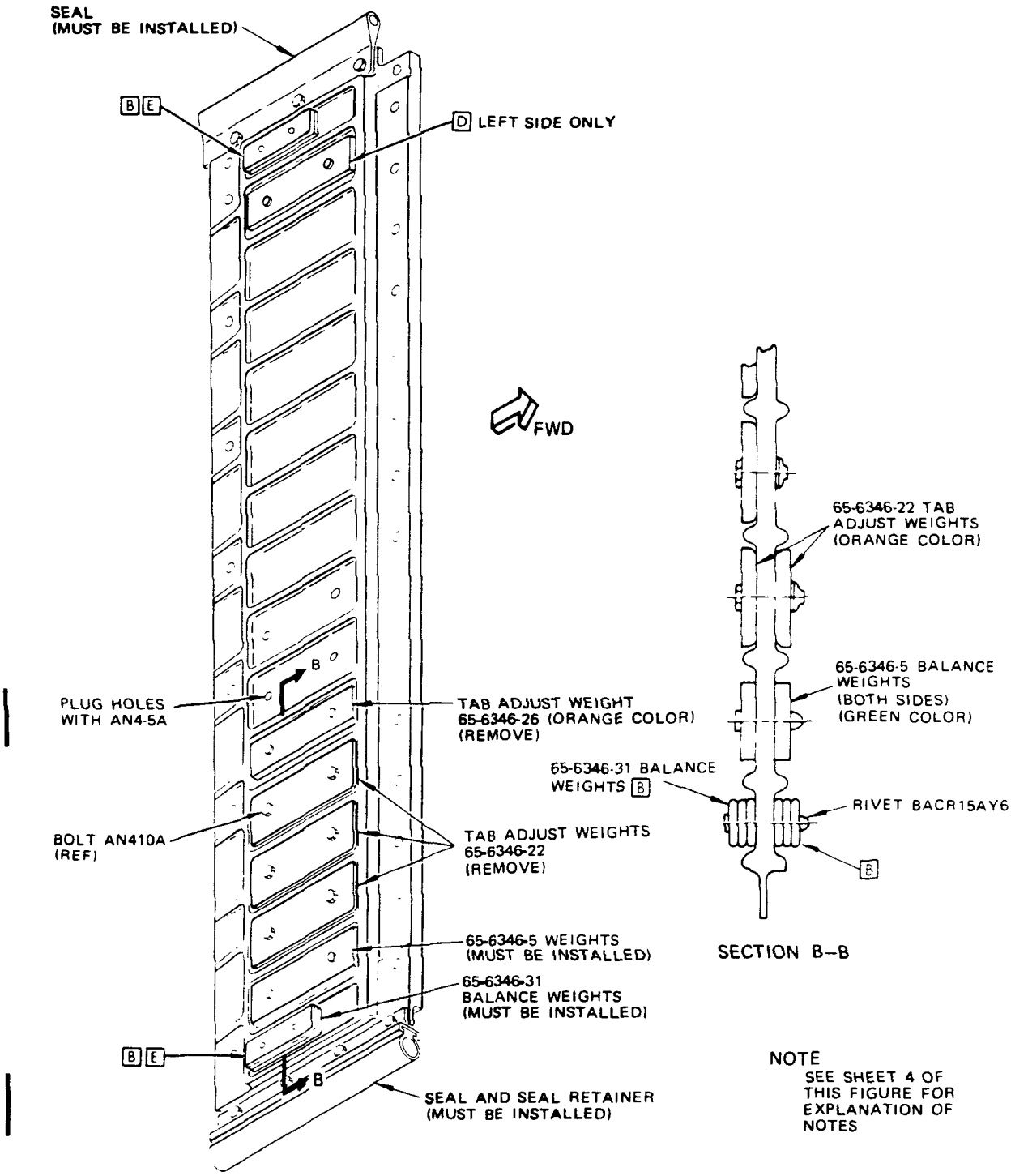
BALANCE PANEL BAY NO 3
5-95506-3000

Rudder Balance Panels - Weight Installation and Requirements
Figure 2 (Sheet 3)



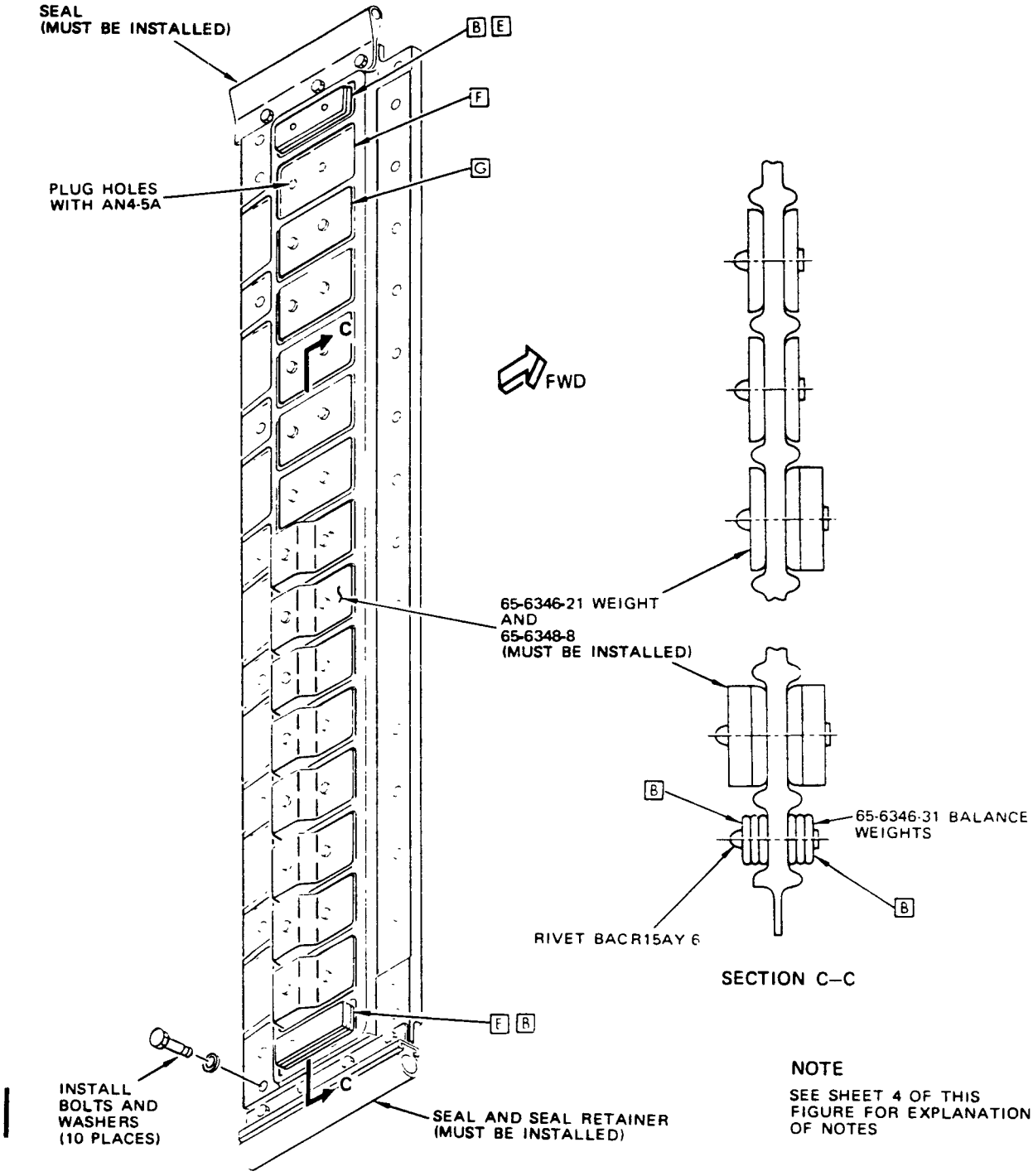
EXTENSION PANEL BAY NO. 1
65-3125

Rudder Balance Panel Extension - Weight Installation and Requirement
Figure 3 (Sheet 1)



EXTENSION PANEL BAY NO 2
65-7083

Rudder Balance Panel Extension - Weight Installation and Requirement
Figure 3 (Sheet 2)



EXTENSION PANEL BAY NO. 3
65-7083-1

Rudder Balance Panel Extension - Weight Installation and Requirement
Figure 3 (Sheet 3)

NOTE

[A] A TOTAL OF 20, 65-6346-31 BALANCE WEIGHTS MAY BE INSTALLED IN THE FOUR POSITIONS INDICATED TO MEET WEIGHT REQUIREMENTS.

[B] DO NOT INSTALL 65-6346-31 WEIGHTS IN STACKS OF THREE UNLESS 10 ARE REQUIRED.

[C] WHERE A GREATER NUMBER OF WEIGHTS IS REQUIRED THAN PERMITTED BY [A] , ADD 65-6346-31 WEIGHTS IN ANY AVAILABLE POCKET ON EITHER OR BOTH SIDES OF THE PANEL. DO NOT STACK MORE THAN TWO HIGH.

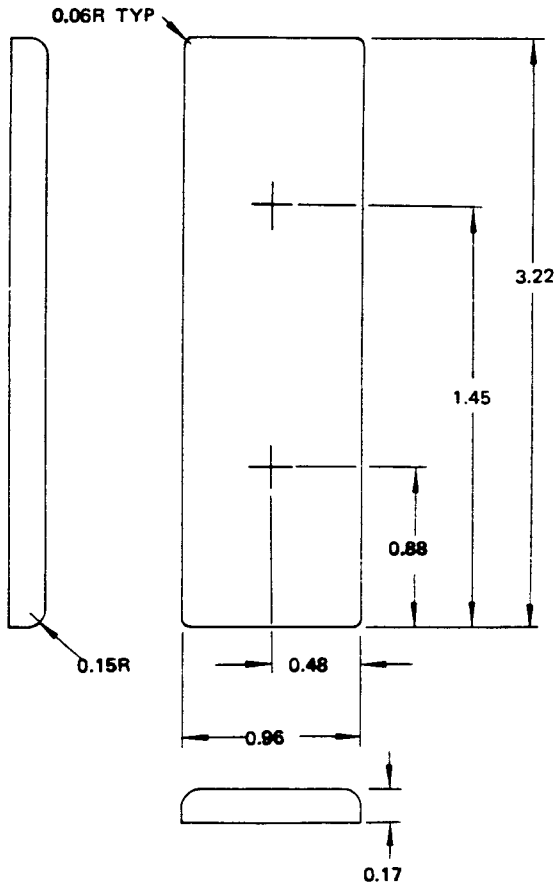
[D] INSTALL 65-6346-5 WEIGHT ONLY IF ALL THE 65-6346-31 WEIGHTS ARE NOT SUFFICIENT TO MEET WEIGHT REQUIREMENTS.

[E] A TOTAL OF 10, 65-6346-31 BALANCE WEIGHTS MAY BE INSTALLED IN THE TWO POSITIONS INDICATED TO MEET WEIGHT REQUIREMENTS.

[F] ADD 65-6346-21 BALANCE WEIGHT ON EITHER OR BOTH SIDES ONLY IF ALL 65-6346-31 BALANCE WEIGHTS ARE NOT SUFFICIENT FOR WEIGHT REQUIREMENTS.

[G] REMOVE 65-6346-21 WEIGHT ON EITHER OR BOTH SIDES IF NO 65-6346-31 WEIGHTS ARE INSTALLED AND THE PANEL WEIGHT EXCEEDS THE REQUIRED LIMITS.

Rudder Balance Panel Extension - Weight Installation and Requirement
Figure 3 (Sheet 4)



65-6346-31

1020 OR 1025 STEEL
MIL-S-7952
8630 MIL-AN-S-12
4130 AN-QQ-S-685

RUDDER CONTROL TAB REBALANCING

1. Rebalancing Procedures

A. Weigh tab assembly in the configuration shown in Fig. 1.

B. Lay out distances X Min and X Max as shown in Fig. 2. See Fig. 3 for distance X dimensions.

C. Set up tab on rebalancing fixtures (Fig. 4). Ascertain that tab is free to rotate on rebalancing fixtures without binding.

NOTE: Remove protractor level during balancing operations.

D. Place a 1.60-pound sliding weight aft of the aft pencil mark and approximately parallel to the tab hinge axial centerline, with the midpoint mark in line with the center of the tab hinge fitting. Slowly move the weight towards the tab leading edge, maintaining the weight position parallel to the tab hinge axial centerline, until the tab trailing edge just begins to rise from the supporting blocks. Make use of the lines on the ruled paper attached to the tab skin (Fig. 2).

E. Note the position of the midpoint mark of the sliding weight (Fig. 4).

(1) If the surface of the sliding weight with the midpoint mark is anywhere between the forward and aft pencil marks, the tab needs no rebalance weight added or removed.

(2) If the surface of the sliding weight with the midpoint mark is forward of the forward pencil mark, the tab is tail-heavy. A certain amount of rebalance weight must be added.

(a) Determine the amount of rebalance weight to be added by trial and error method or as follows:

1) Measure distance Y (Fig. 4).

2) Calculate the approximate length in inches of additional rebalance weight required by using the applicable formula shown in Fig. 5.

(b) Fabricate rebalance weight (Fig. 6).

(c) Temporarily install the rebalance weight. Rebalance weight fasteners must be loosely installed (Fig. 7).

(d) Repeat steps A, B, C, and D.

(e) If the tab is found to be properly balanced, permanently install the rebalance weight and proceed with steps F thru I.

(3) If the surface of the sliding weight with the midpoint mark is aft of the aft pencil mark, the tab is nose-heavy. A certain amount of rebalance weight must be removed.

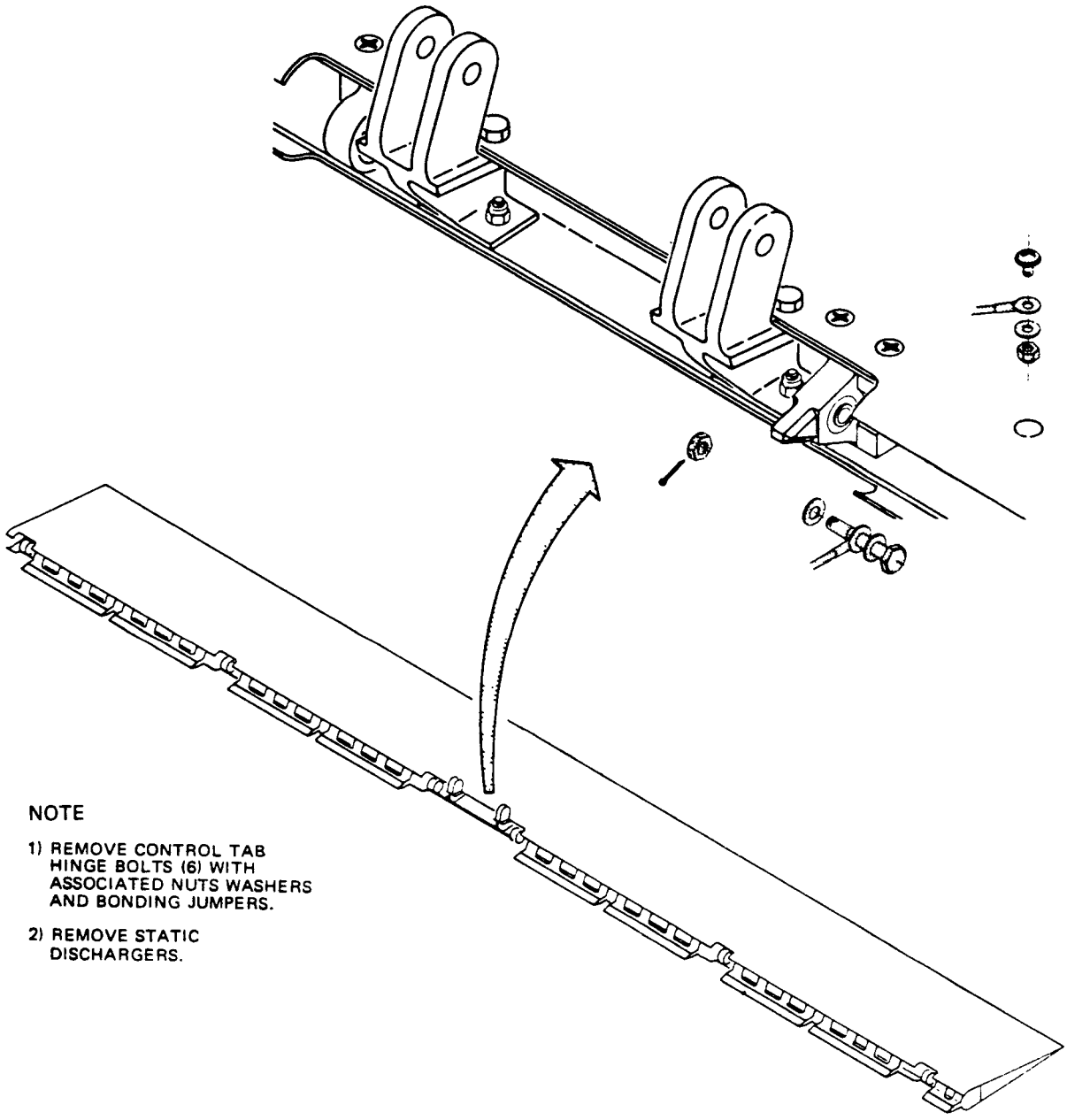
(a) Use a procedure similar to that described in par. 1.E.(2), then proceed with steps F thru I.

F. Weight the rebalanced tab assembly as defined in Fig. 1.

G. Record new tab weight on decal affixed to the tab structure.

H. Select and install, if required, tab adjust weights per Fig. 8.

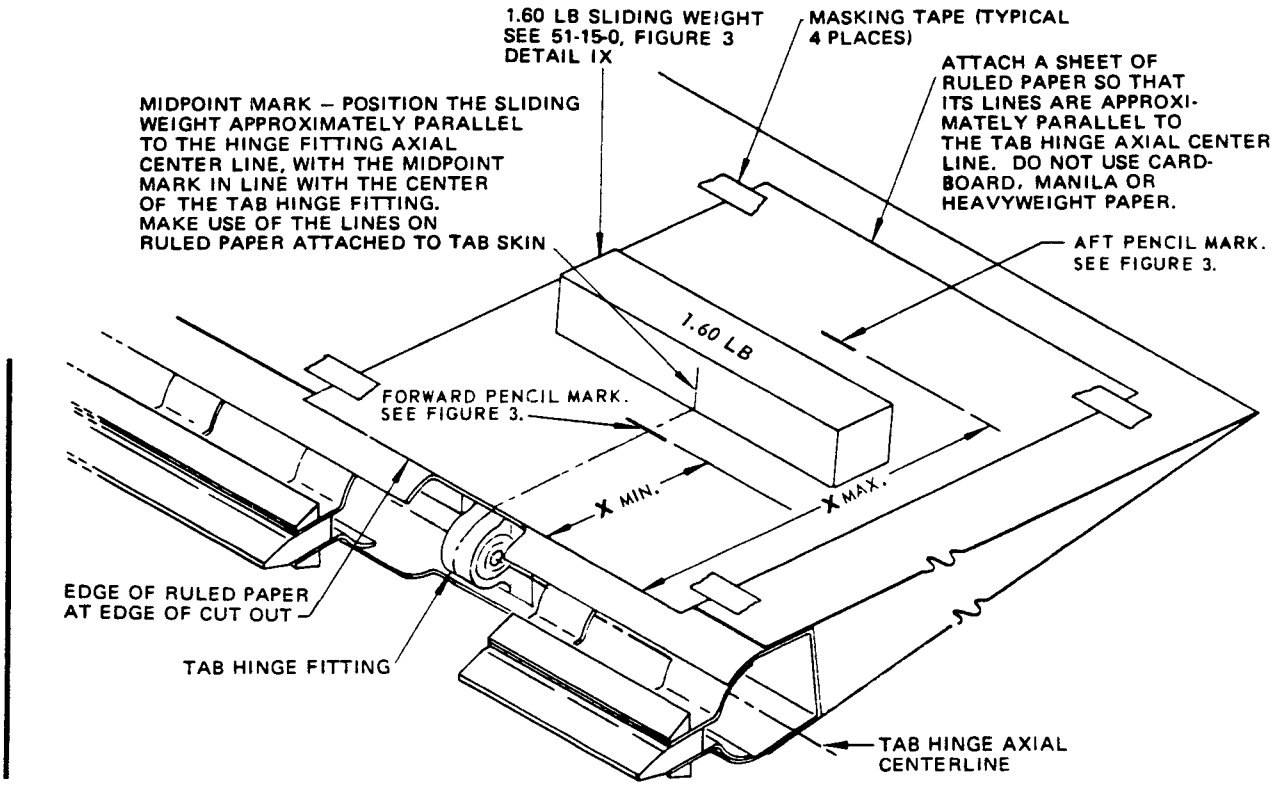
I. Reinstall rebalanced tab per Maintenance Manual, Chapter 27.



NOTE

1) REMOVE CONTROL TAB HINGE BOLTS (6) WITH ASSOCIATED NUTS WASHERS AND BONDING JUMPERS.

2) REMOVE STATIC DISCHARGERS.



Distance "X" Layout - Rudder Control Tab
Figure 2

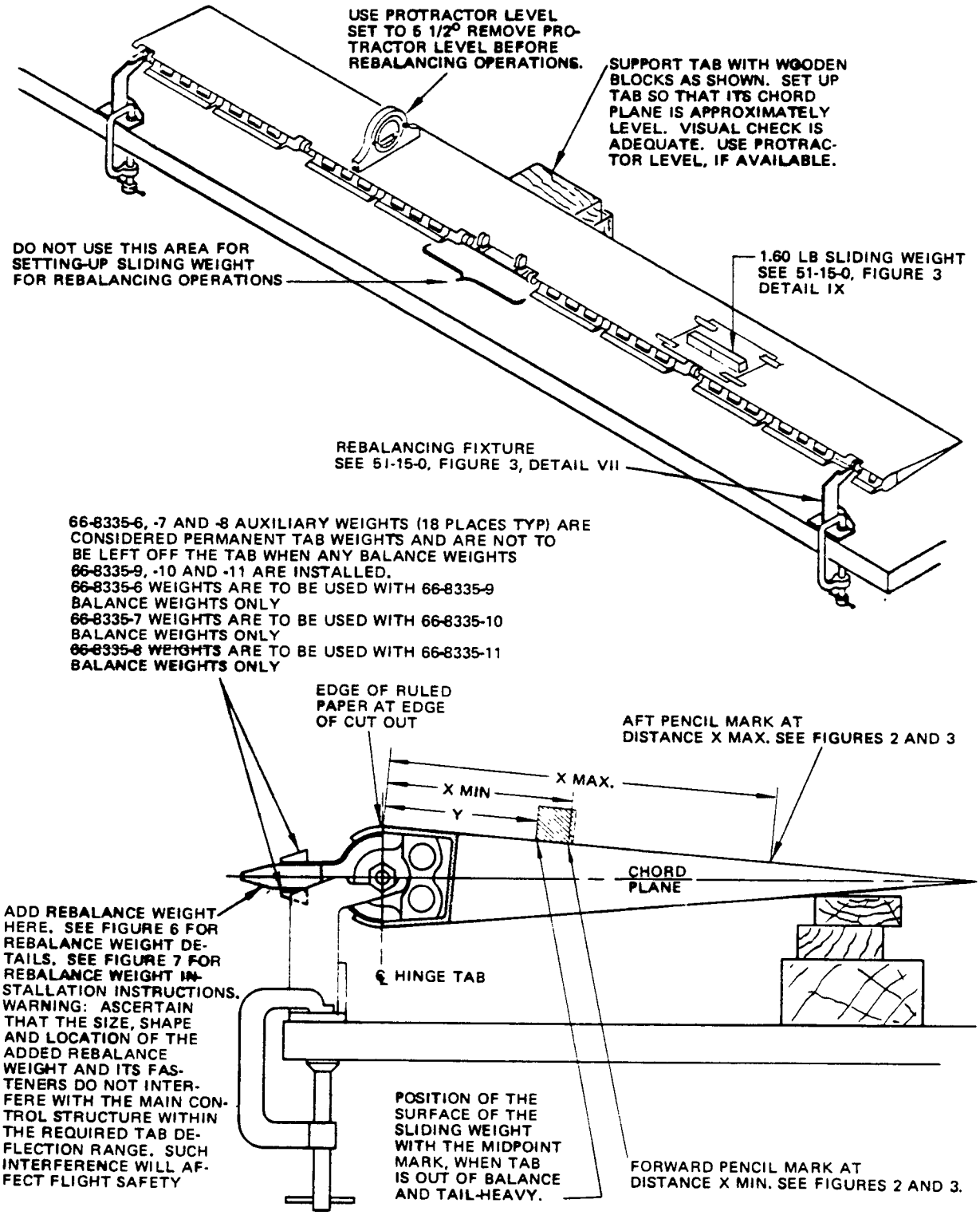
NOTE

- IF BALANCE IS IN ACCORDANCE WITH THIS TABLE THE TAB IS BALANCED WITHIN THE REQUIRED MANUFACTURING LIMITS AS PER 51-15-0, FIGURE 2.

[A] MAXIMUM ALLOWABLE TAB WEIGHT

TAB WEIGHT LBS	X MIN (INCHES)	X MAX (INCHES)
27 TO 28	3.67	6.23
28 TO 29	3.82	6.48
29 TO 30	3.97	6.73
30 TO 31	4.12	6.99
31 TO 32	4.27	7.24
32 TO 33	4.42	7.49
33 TO 34	4.57	7.74
34 TO 35	4.73	7.99
35 TO 36	4.88	8.24
36 TO 37 [A]	5.03	8.49

Rudder Control Tab - Distance "X" Dimensions
Figure 3



Rudder Control Tab - Rebalancing Arrangement
Figure 4

NOTE

CALCULATE THE REQUIRED REBALANCE WEIGHT LENGTH TO BE ADDED OR REMOVEDBY USING THE APPLICABLE FORMULA. REBALANCE WEIGHT LENGTH ADDED IN EXCESS OF THE MINIMUM REQUIRED GIVES FUTURE REPAIR CAPABILITY TO THE TAB, PROVIDED SUITABLE REBALANCING RECORDS ARE KEPT. (SEE 51-15-0, FIGURE 2.)

X MIN SEE FIGURE 3

Y SEE FIGURE 4

[A] MATERIAL USED FOR FACTORY INSTALLED BALANCE WEIGHT.

[B] OPTIONAL MATERIAL FOR FIELD SERVICE USE

[C] APPLICABLE WHEN DISTANCE Y IS LESS THAN X_{MIN} OF FIG 3.

[D] APPLICABLE WHEN DISTANCE Y IS MORE THAN X_{MAX} OF FIG 3.

MATERIAL	REBALANCE WEIGHT LENGTH TO BE ADDED	REBALANCE WEIGHT LENGTH TO BE REMOVED	USED ON
	INCHES MINIMUM [C]	INCHES MAXIMUM [D]	
TUNGSTEN ALLOY FANSTEEL 77 [A] MALLORY 1000HP MALLORY 1000PR	(X MIN – Y) x 3.00	(X MAX –Y) x 3.00	66-8335-4
	(X MIN –Y) x 3.50	(X MAX –Y) x 3.50	66-8335-1, -2, -3, -9, -10 AND -11
STEEL 4130 [B]	(X MIN –Y) X 6.45	(X MAX –Y) X 6.45	66-8335-4
	(X MIN –Y) x 7.44	(X MAX –Y) x 7.44	66-8335-1, -2, -3, -9, -10 AND -11

Rebalance Weight Lengths - Rudder Control Tab
Figure 5

NOTE
SEE TABLE I FOR MATERIAL AND FINISH REQUIREMENTS

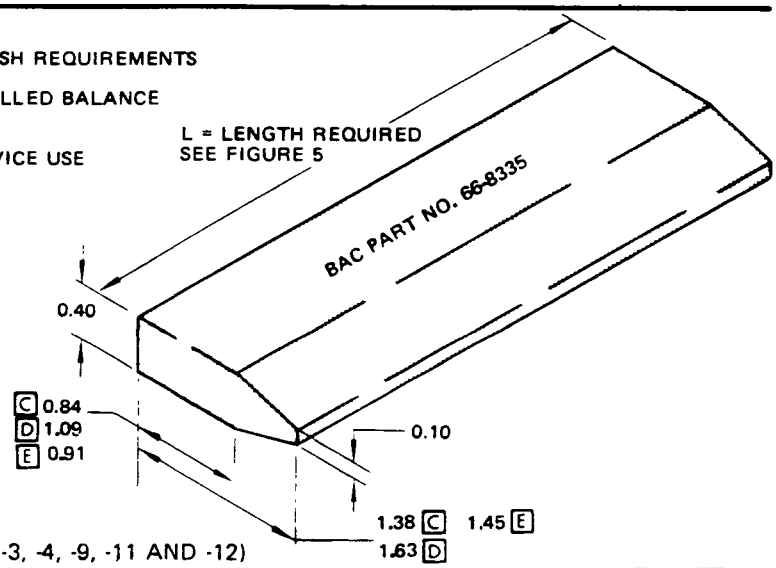
[A] MATERIAL USED FOR FACTORY INSTALLED BALANCE WEIGHT

[B] OPTIONAL MATERIAL FOR FIELD SERVICE USE

[C] FOR PART NO. 66-8335-1, -2 AND -3

[D] FOR PART NO. 66-8335-4

[E] FOR PART NO. 66-8335-9, -10 AND -11

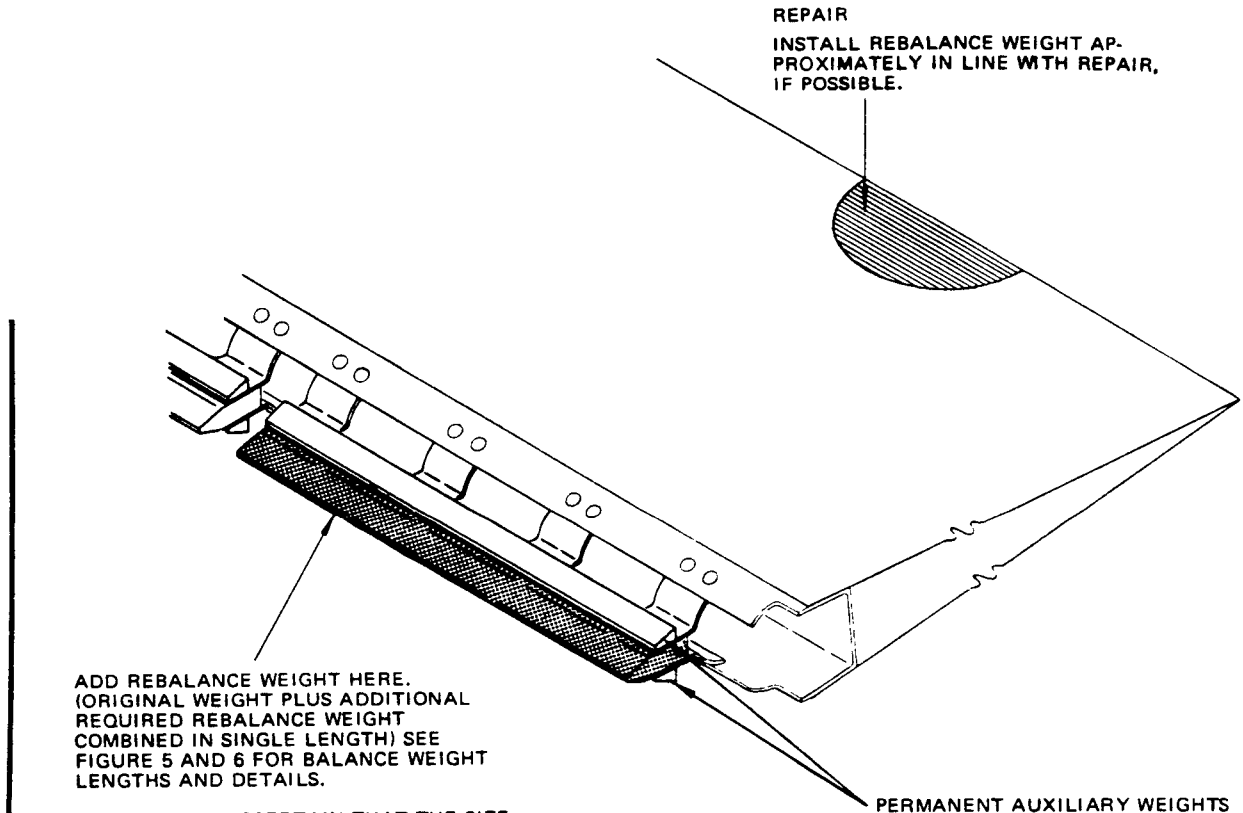


DETAIL I – (PART NO. 66-8335-1, -2, -3, -4, -9, -11 AND -12)

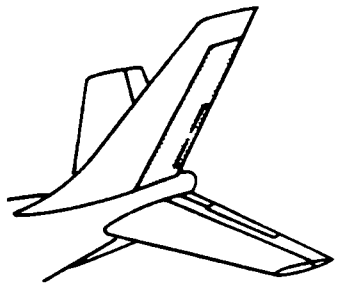
MATERIAL	IDENTIFICATION	SOURCE	FINISH
TUNGSTEN	FANSTEEL 77	FANSTEEL METALLURGICAL CORP. NUMBER ONE TANTALUM PLACE, CHICAGO, ILL. 60064	CADMIUM PLATE PER QQ–P–416 TYPE II OR III CLASS B FOLLOWED BY DIP IN 3 TO 5% SOLUTION BY WEIGHT OF CHROMIC ACID FOLLOWED BY ONE COAT OF SOLVENT RESISTANT PRIMER, EQUAL PARTS BY VOLUME, E42GP13 AND V66KP11, SHERWIN-WILLIAMS CO., 101 PROSPECT AVE. NW CLEVELAND, OHIO 44101
ALLOY — [A]	MALLORY 1000HP MALLORY 1000PR	MALLORY AND CO., 3029 E. WASHINGTON, INDIANAPOLIS, IND. 46206	
STEEL [B]	4130	ANY SOURCE	

TABLE I

Rebalance Weights - Rudder Control Tab
Figure 6



Rudder Control Tab - Rebalance Weight Installation
Figure 7

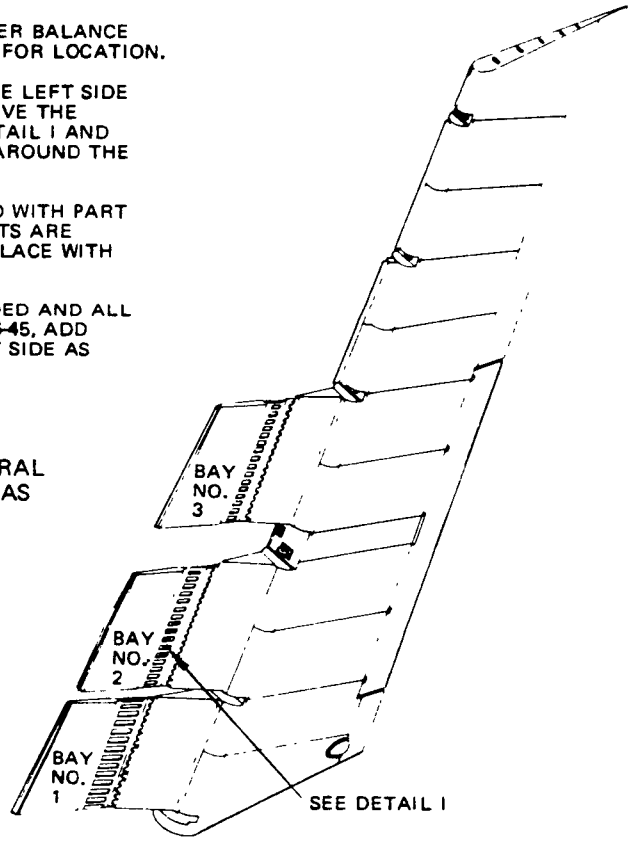


INSTRUCTIONS

1. IDENTIFY TAB ADJUST WEIGHTS BY REFERRING TO DATA ON DECAL AFFIXED TO EACH TAB ASSEMBLY OR LEGEND STAMPED ON ADJUST WEIGHTS.
2. REMOVE ADJUST WEIGHTS CORRESPONDING TO REPAIRED TAB.
3. WEIGHT REPAIRED TAB ASSEMBLY AS DEFINED IN FIGURE 1.
4. RECORD NEW TAB WEIGHT ON DECAL AFFIXED TO TAB ASSEMBLY.
5. SELECT ADJUST WEIGHT CORRESPONDING TO NEW TAB WEIGHT FROM TABLE SHOWN.
6. INSTALL NEW ADJUST WEIGHTS.ON 2 RUDDER BALANCE PANEL EXTENSION. SEE 51-15-12, FIGURE 3 FOR LOCATION.
7. IF IT IS NECESSARY TO GAIN ACCESS TO THE LEFT SIDE OF THE BALANCE PANEL EXTENSION, REMOVE THE INSTALLATION BOLTS AS INDICATED IN DETAIL I AND ROTATE THE BALANCE PANEL EXTENSION AROUND THE HINGE AS REQUIRED.
8. IF ALL THE AVAILABLE SPACES ARE FILLED WITH PART 65-6346-22 AND ADDITIONAL ADJUST WEIGHTS ARE NEEDED, REMOVE PART 65-6346-22 AND REPLACE WITH 65-6346-45 AS REQUIRED.
9. IF ADDITIONAL ADJUST WEIGHTS ARE NEEDED AND ALL THE SPACES ARE FILLED WITH PART 65-6346-45, ADD PART 65-6346-22 AS REQUIRED ON THE LEFT SIDE AS SHOWN IN DETAIL I.

CAUTION

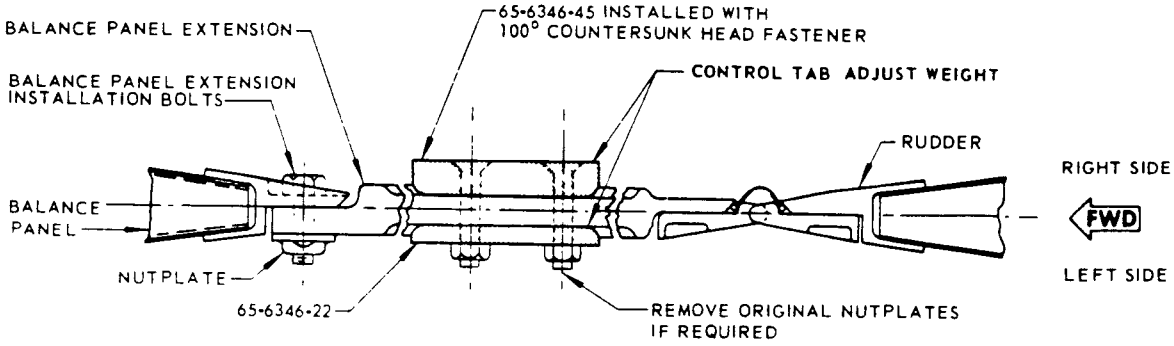
CHECK THAT THE ORIGINAL STRUCTURAL CLEARANCES AND RUDDER TRAVEL HAS BEEN MAINTAINED.



Adjust Weight Installation - Rudder Control Tab
Figure 8 (Sheet 1)

TAB WEIGHT	ADJUST WEIGHT				
	QTY	PART NO.		QTY	PART NO.
27.00 - 28.00		(NONE)			
28.01 - 28.50	1	65-6346-22	AND	1	65-6346-24
28.51 - 29.00	2	65-6346-22	AND	1	65-6346-25
29.01 - 29.50	3	65-6346-22	AND	1	65-6346-26
29.51 - 30.00	4	65-6346-22	AND	1	65-6346-30
30.01 - 30.50	5	65-6346-22	AND	1	65-6346-27
30.51 - 31.00	7	65-6346-22			
31.01 - 31.50	8	65-6346-22			
31.51 - 32.00	9	65-6346-22	AND	1	65-6346-28
32.01 - 32.50	10	65-6346-22	AND	1	65-6346-23
32.51 - 33.00	11	65-6346-22			
33.01 - 33.50	12	65-6346-22			
33.51 - 34.00	8	65-6346-22	AND	4	65-6346-45
34.01 - 34.50	4	65-6346-22	AND	8	65-6346-45
34.51 - 35.00	12	65-6346-45			
35.01 - 35.50	12	65-6346-45	AND	1	65-6346-22
35.51 - 36.00	12	65-6346-45	AND	2	65-6346-22
36.01 - 36.50	12	65-6346-45	AND	3	65-6346-22
36.51 - 37.00	12	65-6346-45	AND	4	65-6346-22

ADJUST WEIGHT PART NUMBER	WEIGHT TOLERANCE (POUNDS)
65-6346-22	1.73 (± .11)
65-6346-23	.30 (± .02)
65-6346-24	1.05 (± .07)
65-6346-25	1.16 (± .07)
65-6346-26	1.27 (± .08)
65-6346-26	1.27 (± .08)
65-6346-27	1.48 (± .09)
65-6346-28	.19 (± .02)
65-6346-30	1.38 (± .09)
65-6346-45	2.32 (± .13)



DETAIL I

Adjust Weight Installation - Rudder Control Tab
Figure 8 (Sheet 2)