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ERICKSON AIR-CRANE
INCORPORATED
FAA TYPE CERTIFICATE NO. H6EA TC TYPE CERTIFICATE NO. H-91

ERICKSON SPECIFICATION: **ES 9208**

TITLE: **PRODUCT DEFINITION AND ACCEPTANCE CRITERIA**

PREPARED BY:

SIGNATURES ON FILE

APPROVED BY:

REV: H

DATE: 2-22-22

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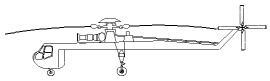

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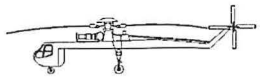

TABLE OF REVISIONS

REV	DESCRIPTION	BY	APPROVED	DATE
IR	INITIAL RELEASE	J. AVGERIS	W.L.J.	8/17/11
A	ADDED SECTION 19 AND SECTION 20.	A. WARREN	JR AVGERIS	9/8/11
B	REVISED SECTION 5 TO DEFINE SURFACE IMPERFECTION LIMITS OF VARIOUS PARTS.	J. WHITAKER	W.L.J.	10/31/11
C	ADDED FLATNESS REQUIREMENTS TO SECTION 5	D. MAYER	W.L.J	3/7/12
D	REVISED LENGTH OF EXCESSIVE MATERIAL ALLOWED IN SECTION 9.2 AND 9.3. ADDED SECTION 9.4. REFORMAT.	D. MAYER	JR AVGERIS	9/13/13
E	REVISED MARKING REQUIREMENTS FOR OVERSIZED SKINS IN SEC 9.2.2 AND 9.3.2. REVISED 9.5 TO ADD ALLOWANCES OMISSION OF PILOT HOLES. ADDED 14.5 AND 18.3 TO ALLOW FOR OMISSION OF ORGANIC COATINGS AND TRIMMING OF WIRING HARNESSES.	T. PETRIE	JR AVGERIS	10/30/13
F	REMOVED REQ'T TO REMOVE TEMPORARY MARKING ON OVERSIZED AND INCOMPLETE PARTS. INCREASED MAXIMUM OVERSIZE LIMIT ON SKINS FROM 1" TO 2". REVISED SEC'S 9.5.2 AND 9.5.3 TO INCLUDE ALL HOLES.	T. PETRIE	JR AVGERIS	11/18/13
G	ADD TABLE 9.5 ALLOWING EXCEPTIONS TO SEC 9.5 PN APPLICABILITY, ADD SEC 19.3 FOR CLARIFICATION OF PARTS LIST WEIGHTS, ADD SEC 21 FOR CLARIFICATION OF CAGE CODE APPLICABILITY.	T. PETRIE	JR AVGERIS	2/17/15
H	ADD SECTION 22 DEFINING "K" SUFFIX DESIGNATION, KIT PARTS	D. MAYER	DocuSigned by: JR Avgeris 08144A4EDEA24B3...	22-Feb-2022

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1. SCOPE:

This specification authorizes product definition/acceptance criteria to be used in conjunction with Erickson Air-Crane drawings. This specification will define criteria such as tolerances, process criteria and acceptance criteria that is not defined on the drawing. Unless otherwise specified, dimensions are in inches.

2. APPLICABILITY:

This specification applies when invoked on the Engineering Parts List or as designated in ES2000. When ES9208 is invoked, the practices and standards described herein may be used in fabrication and inspection of the parts unless a drawing note appears on the drawing specifically excluding the practice or standard.

3. ANGULAR TOLERANCE FOR SHEET METAL FLANGES:

3.1. The angular tolerance for sheet metal flanges with a flange height greater than 0.44 but not more than 1.5 shall be ± 2°. The flange angle as produced shall not vary more than 1° over its entire length. Good shop practice shall be followed and kinks or crimps are not acceptable.

3.2. The angular tolerance for sheet metal flanges with a flange height of 0.44" or less shall be ± 30°. The flange angle as produced shall not vary more than 1° over its entire length. Good shop practice shall be followed and kinks or crimps are not acceptable.

Paragraph 3.1 does not apply when the field of drawing calls out a specified angular tolerance for sheet metal flanges.

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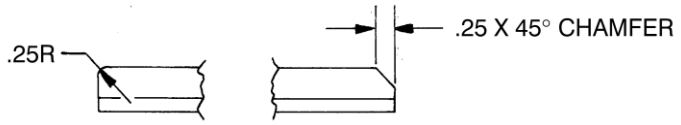
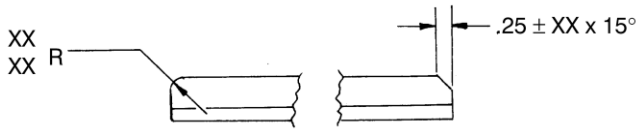
4. CHAMFER OR RADIUS ON EXTERNAL CORNERS.

4.1. Extruded parts with a 0.25 X 45° chamfer or less, or 0.25 radius or less, specified or drawn on an undimensioned drawing are allowed to have either a 0.25 radius or a 0.25 X 45° chamfer dependent on the process used.



Paragraph 4.1 does not apply when the field of drawing calls out a chamfer of .25 X 45° or less, or a .25 radius or less, each having a specified linear tolerance.



5. ALLOWABLE SURFACE IMPERFECTIONS

5.1. The visual inspection for nicks, dents, scratches, machining tool marks and scuff marks shall be conducted by Quality Assurance personnel. The allowance of these detected irregularities are determined by engineering drawing requirements and the following:

5.1.1. Irregularities such as nicks, dents, scratches, machining tool marks and scuff marks on parts whose failure could directly result in an unsafe condition in operation, are allowable when they are .0005 inch deep or less. For all other parts, irregularities such as nicks, dents, scratches, machining tool marks and scuff marks are allowable up to .002 inch deep. Anything beyond .002 inch is acceptable if drawing requirements are maintained.

5.1.2. Surface irregularities, which have been shot peened over, are allowed if they meet the surface requirements of the engineering drawing and under 10x magnification, exhibit shotpeen coverage throughout the irregularity.

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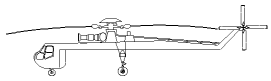

5.2. Flatness, straightness, waviness and contour:

5.2.1. Localized pressure to fit the part to its checking device (surface plates, checking fixtures, dies, molds, etc.) at the faying surface shall be as follows:

5.2.1.1. 2 pound for metal thicknesses less than 0.045 inch

5.2.1.2. 5 pound for metal thicknesses greater than 0.045 inch

5.2.1.3. Pressure shall be applied at 12-inch intervals, or at equivalent smaller intervals as follows:

(a) One-half of the specified weight for 6-inch intervals
(b) One quarter of the specified weight for 3-inch intervals on large parts

5.2.2. If a specific method of assembly is called out after forming, parts shall conform to the process tooling (surface plates, checking fixtures, dies, molds, etc) within the specified prefit methods and requirements that are called out. Localized pressure as described in 5.2.1 shall be applied to meet standard engineering drawing tolerances. NOTE: Any number of 2 or 5 pound-force units may be applied if the 12 inch interval equivalent noted in 5.2.1 is maintained.

5.2.3. Acceptance criteria for parts which are slightly warped during machining operations or heat treatment:

5.2.3.1. During machining operations or heat treatment, parts may develop a slight warp or twist. Metallic parts with engineering flatness requirements shall meet the following criteria (after necessary rework):

(a) Parts less than 0.160 inch thick shall be capable of being brought within engineering drawing tolerances by the application of light pressures not to exceed 10 pounds.

(b) Parts greater than 0.160 inch thick shall be capable of being brought within engineering drawing tolerances be the application of light pressures not to exceed 50 pounds.

NOTES: This applies to all parts whether they are flat, contain webs, or have integral stiffeners. The thickest portion of each part which controls the flatness shall determine the applicable pressure limitations involved.

If a specific method of assembly is called out after machining, parts shall conform to the process tooling (surface plates, checking fixtures, dies, molds, etc) within the specified prefit methods and requirements that are called out. Localized pressure, as described in 5.2.1, shall be applied to meet standard engineering drawing tolerances.

Any number of 10 or 50 pound-force units may be applied if the 12 inch interval equivalent noted in 5.2.1 is maintained.

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6. REPLACEMENT FASTENERS (LIMITED USAGE)

NOTE: These allowances are for occasional replacements, repetitive use in any location requires investigation and possible drawing correction. Complete pattern replacement of Lockbolts or rivets with Hi–lok fasteners is acceptable without limitation of 6.1 b,c.

6.1. Solid Rivets, Hi–Loks, Lock Bolts.
In cases where non–blind fastener installation is difficult or impossible for reasons of temporary inaccessibility, unavailability of the fastener, unavailability or interference of the tooling, Tables I through IV may be used to provide replacement blind fasteners providing the following are met: (Note: Tables I through IV may also be applied in the reverse condition.)

(a) The number of replacement blind fasteners shall not exceed 10% (1 in 10, 10 in 100, etc.) of the total number of solid rivets, Hi–Loks or Lockbolts that are required to join any one detail part or assembly to any other detail part or assembly. For example, where a stringer joins to a skin, a frame joins to a skin panel assembly or skin panel assemblies are joined together. This applies to Tables I through IV.

(b) Hi–Lok fasteners (Table III) may be used to replace steel lockbolts where installed space does not permit.

(c) The number of replacement Hi–Loks (Table IV) for aluminum lockbolts shall not exceed 10 percent (1 in 10,10 in 100, etc) of the original total number of aluminum lockbolt.

(d) All hole sizes for replacement fastener shall conform to SS5100.

(e) Blind and non–blind fasteners shall not be mixed together in splice joints.

(f) All blind fasteners shall be wet installed using epoxy primer per MIL–P–23377 or sealant per AMS-S-8802. Both ends of the rivet must be covered with primer or sealant upon completion of the installation.

(g) Rivet length shall be determined by Manufacturing Personnel through the use of a grip gage.

(h) Minimum sheet thickness must be met where specified.

6.1.1. Aluminum Hi-Loks can replace Aluminum Lockbolts, Aluminum rivets or aluminum sleeved blind fasteners providing the following is met:

a. A pattern of 1 to 4: Replace 100% of the pattern.

b. A pattern of 5 to 10: Replace 1 fastener or 100% of the pattern.

c. A pattern of 11 or more : Individual replacement fastener in a line of fasteners are allowed provided that the next replacement fastener is 9 fasteners or more away; or 100% of the pattern.

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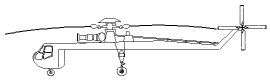

6.1.2. Steel Hi-Loks can replace steel rivets or steel sleeved blind fasteners provided the above are met:

TABLE 1 (SOLID RIVETS)

NAS523 CODE	DRAWING CALLOUT	BLIND REPLACEMENTS	MIN. SHEET THICKNESS
BB	MS20426AD4	NAS1739B4 M7885/7–4	0.063(a)
	MS20426AD5	NAS1739B5 M7885/7–4	0.071 (a)
	MS20426AD6	NAS1739B6 M7885/7–4	0.090 (a)
BJ	MS20470AD4	NAS1738B4 M7885/6–4	0.040 (b)
	MS20470AD5	NAS1738B5 M7885/6–5	0.050 (b)
	MS20470AD6	NAS1738B6 M7885/6–6	0.063 (b)
LZ	NAS1097AD4	NAS1739B4 M7885/7–4	0.063 (a)
	NAS1097AD5	NAS1739B5 M7885/7–4	0.071 (a)
	NAS1097AD6	NAS1739B6 M7885/7–4	0.090 (a)

a) Minimum sheet thickness must be met on the sheet that lies against the manufactured countersunk head to avoid knife edge conditions.

b) For solid universal head rivets to be replaced with blind protruding head rivets, each of the sheets being riveted must meet the minimum sheet thickness requirement.

TABLE II (HI–LOKS)

NAS523 CODE	DRAWING CALLOUT	BLIND REPLACEMENT	MIN. SHEET THICKNESS(a)
AHT	HL20PB–5	MS90354–05	N.A.
	HL20PB–6	MS90354–06	N.A
	HL20PB–8	MS90354–08	N.A.
	HL20PB–10	MS90354–10	N.A
	HL20PB–12	MS90354–12	N.A.
	HL20PB–14	MS90354–14	N.A.
	HL20PB–16	MS90354–16	N.A.
WY	HL19PB–5	MS90353–05	0.080
	HL19PB–6	MS90353–06	0.090
	HL19PB–8	MS90353–08	0.125
	HL19PB–10	MS90353–10	0.160
	HL19PB–12	MS90353–12	0.190

a) Minimum sheet thickness must be met where specified, on the sheet that lies against the manufactured countersunk head to avoid knife edge conditions.

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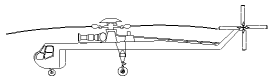

TABLE III (STEEL LOCK BOLTS)

NAS523 CODES	DRAWING CALLOUT	STANDARD REPLACEMENT	COLLARS	MIN. SHEET THICKNESS(a)	BLIND REPLACEMENT	MIN. SHEET THICKNESS(a)
	NAS1415	HL19PB-5	NOTE (1)	0.050	MS90353-05	0.125
EA	NAS1416	HL19PB-6	NOTE (1)	0.063	MS90353-06	0.125
JY	NAS1418	HL19PB-8	NOTE (1)	0.080	MS90353-08	0.190
OP	NAS1420	HL19PB-10	NOTE (1)	0.100	MS90353-10	0.250
	NAS1422	HL19PB-12	NOTE (1)	0.125	MS90353-12	0.312
	NAS1425	HL20PB-5	NOTE (2)	N/A	MS90354-05	N/A
DY	NAS1426	HL20PB-6	NOTE (2)	N/A	MS90354-06	N/A
JW	NAS1428	HL20PB-8	NOTE (2)	N/A	MS90354-08	N/A
OS	NAS1430	HL20PB-10	NOTE (2)	N/A	MS90354-10	N/A
	NAS1432	HL20PB-12	NOTE (2)	N/A	MS90354-12	N/A
DZ	NAS1436	HL19PB-6	NOTE (1)	0.063	MS90353-06	0.125
JX	NAS1438	HL19PB-8	NOTE (1)	0.080	MS90353-08	0.190
OO	NAS1440	HL19PB-10	NOTE (1)	0.100	MS90353-10	0.250
	NAS1442	HL19PB-12	NOTE (1)	0.125	MS90353-12	0.312
DX	NAS1446	HL20PB-6	NOTE (2)	N/A	MS90354-06	N/A
JV	NAS1448	HL20PB-8	NOTE (2)	N/A	MS90354-08	N/A
OR	NAS1450	HL20PB-10	NOTE (2)	N/A	MS90354-10	N/A
	NAS1452	HL20PB-12	NOTE (2)	N/A	MS90354-12	N/A
DV	NAS1456	HL21PB-6	NOTE (2)	0.090	MS90353-06	0.125
	NAS1458	HL21PB-8	NOTE (2)	0.125	MS90353-08	0.190
DW	NAS1460	HL21PB-10	NOTE (2)	0.160	MS90353-10	0.250
	NAS1462	HL21PB-12	NOTE (2)	0.190	MS90353-12	0.312
DS DT	NAS1455	HL20PB-5	NOTE (2)	N/A	MS90354-05	N/A
	NAS1466	HL20PB-6	NOTE (2)	N/A	MS90354-06	N/A
	NAS1468	HL20PB-8	NOTE (2)	N/A	MS90354-08	N/A
	NAS1470	HL20PB-10	NOTE (2)	N/A	MS90354-10	N/A
	NAS1472	HL20PB-12	NOTE (2)	N/A	MS90354-12	N/A
RC RD	NAS1486	HL21PB-6	NOTE (2)	0.090	MS90353-06	0.125
	NAS1488	HL21PB-8	NOTE (2)	0.125	MS90353-08	0.190
	NAS1490	HL21PB-10	NOTE (2)	0.160	MS90353-10	0.250
	NAS1492	HL21PB-12	NOTE (2)	0.190	MS90353-12	0.312
RE RF	NAS1496	HL20PB-6	NOTE (2)	N/A	MS90354-06	N/A
	NAS1497	HL20PB-5	NOTE (2)	N/A	MS90354-05	N/A
	NAS1498	HL20PB-8	NOTE (2)	N/A	MS90354-08	N/A
	NAS1500	HL20PB-10	NOTE (2)	N/A	MS90354-10	N/A
	NAS1502	HL20PB-12	NOTE (2)	N/A	MS90354-12	N/A

Note (1). Hi–Lok Collars; HL70, HL79, HL82, HL87TW, HL1094 or the drawing requirements are to be used.

Note (2). Hi–Lok Collars; HL75, HL1087A or the drawing requirements are to be used.

a) Minimum sheet thickness must be met where specified, on the sheet that lies against the manufactured countersunk head to avoid knife edge conditions.

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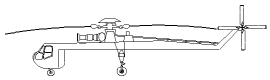

TABLE IV (ALUMINUM LOCK BOLTS)

NAS523 CODES	DRAWING CALLOUT	STANDARD REPLACEMENT	COLLARS	MIN. SHEET THICKNESS(a)	BLIND REPLACEMENT	MIN. SHEET THICKNESS(a)
CP	NAS1516	HL21PB-6	NOTE (2)	0.090	MS90353-06	0.090
	NAS1518	HL21PB-8	NOTE (2)	0.125	MS90353-08	0.125
	NAS1520	HL21PB-10	NOTE (2)	0.160	MS90353-10	0.160
	NAS1522	HL21PB-12	NOTE (2)	0.190	MS90353-12	0.190
CS	NAS1525	HL20PB-5	NOTE (2)	N/A	MS90354-05	N/A
	NAS1526	HL20PB-6	NOTE (2)	N/A	MS90354-06	N/A
	NAS1528	HL20PB-8	NOTE (2)	N/A	MS90354-08	N/A
	NAS1530	HL20PB-10	NOTE (2)	N/A	MS90354-10	N/A
	NAS1532	HL20PB-12	NOTE (2)	N/A	MS90354-12	N/A
DJ	NAS1535	HL19PB-5	NOTE (1)	0.050	MS90353-05	0.080
	NAS1536	HL19PB-6	NOTE (1)	0.063	MS90353-06	0.090
	NAS1538	HL19PB-8	NOTE (1)	0.080	MS90353-08	0.125
	NAS1540	HL19PB-10	NOTE (1)	0.100	MS90353-10	0.160
	NAS1542	HL19PB-12	NOTE (1)	0.125	MS90353-12	0.190
CW	NAS1546	HL21PB-6	NOTE (2)	0.090	MS90353-06	0.090
	NAS1548	HL21PB-8	NOTE (2)	0.125	MS90353-08	0.125
	NAS1550	HL21PB-10	NOTE (2)	0.160	MS90353-10	0.160
	NAS1552	HL21PB-12	NOTE (2)	0.190	MS90353-12	0.190
CV	NAS1555	HL20PB-5	NOTE (2)	N/A	MS90354-05	N/A
	NAS1556	HL20PB-6	NOTE (2)	N/A	MS90354-06	N/A
	NAS1558	HL20PB-8	NOTE (2)	N/A	MS90354-08	N/A
	NAS1560	HL20PB-10	NOTE (2)	N/A	MS90354-10	N/A
	NAS1562	HL20PB-12	NOTE (2)	N/A	MS90354-12	N/A

Note (1). Hi–Lok collars; HL70, HL79, HL82, HL87TW, HL1094 or the drawing requirements are to be used.
Note (2). Hi–Lok collars; HL75 and HL1087A or the drawing requirements are to be used.

a) Minimum sheet thickness must be met where specified, on the sheet that lies against the manufactured countersunk head to avoid knife edge conditions.

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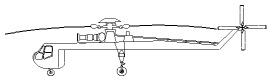

7. REPLACEMENT FASTENERS (LIMITED USAGE)

7.1. Tables V and VI may be used to provide replacement fasteners drawing callout providing the following criteria are met:

(a) All hole sizes for replacement fasteners shall conform to SS5100.

(b) Rivet length shall be determined by Manufacturing Personnel grip gage.

(c) Minimum sheet thickness must be met where specified.

TABLE V

NAS523 CODES	DRAWING CALLOUT	REPLACEMENT FASTENER(S)	MIN. SHEET THICKNESS(a)
AA	MS20600AD4	NAS1738B4 M7885/6–4	N/A
	MS20600AD5	NAS1738B5 M7885/6–5	N/A
	MS20600AD6	NAS1738B6 M7885/6–6	N/A
AB	MS20600B4	NAS1738B4 M7885/6–4	N/A
	MS20600B5	NAS1738B5 M7885/6–5	N/A
	MS20600B6	NAS1738B6 M7885/6–6	N/A
JS	MS20600M4	NAS1738MW4	N/A
	MS20600M5	NAS1738MW5	N/A
	MS20600M6	NAS1738MW6	N/A
AC	MS20601AD4	NAS1739B4 M7885/7–4	0.063
	MS20601AD5	NAS1739B5 M7885/7–5	0.071
	MS20601AD6	NAS1739B6 M7885/7–6	0.090
AE	MS20601B4	NAS1739B4 M7885/7–4	0.063
	MS20601B5	NAS1739B5 M7885/7–5	0.071
	MS20601B6	NAS1739B6 M7885/7–6	0.090
JT	MS20601M4	NAS1739MW4	0.040
	MS20601M5	NAS1739MW5	0.050
	MS20601M6	NAS1739MW6	0.071

a) Minimum sheet thickness must be met where specified, on the sheet that lies against the manufactured countersunk head to avoid knife edge conditions.

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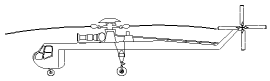

TABLE VI

NAS523 CODES	DRAWING CALLOUT	REPLACEMENT FASTENER(S)	MIN. SHEET THICKNESS(a)
AFJ	NAS1919B04	NAS1738B4 M7885/6–4, NAS1919B04S	N/A
	NAS1919B05	NAS1738B5 M7885/6–5, NAS1919B05S	N/A
	NAS1919B06	NAS1738B6 M7885/6–6, NAS1919B06S	N/A
WE	NAS1919C04	NAS1738CW4, NAS1919C04S	N/A
	NAS1919C05	NAS1738CW5, NAS1919C05S	N/A
	NAS1919C06	NAS1738CW6, NAS1919C06S	N/A
WD	NAS1919M04	NAS1738MW4, NAS1919M04S	N/A
	NAS1919M05	NAS1738MW5, NAS1919M05S	N/A
	NAS1919M06	NAS1738MW6, NAS1919M06S	N/A
AFH	NAS1921B04	NAS1739B4 M7885/7–4, NAS1921B04S	0.040
	NAS1921B05	NAS1739B5 M7885/7–5, NAS1921B05S	0.050
	NAS1921B06	NAS1739B6 M7885/7–6, NAS1921B06S	0.071
WH	NAS1921C04	NAS1739CW4, NAS1921C04S	0.040
	NAS1921C05	NAS1739CW5, NAS1921C05S	0.050
	NAS1921C06	NAS1739CW6, NAS1921C06S	0.071
WF	NAS1921M04	NAS1739MW4, NAS1921M04S	0.040
	NAS1921M05	NAS1739MW5, NAS1921M05S	0.050
	NAS1921M06	NAS1739MW6, NAS1921M06S	0.071

a) Minimum sheet thickness must be met where specified, on the sheet that lies against the manufactured countersunk head to avoid knife edge conditions.

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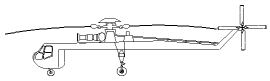

8. EDGE ACCEPTANCE OF ALUMINUM SHEET METAL DETAILS

8.1. The tolerance of 0.000 –0.015 is optional in place of the existing break sharp edge requirement of 0.005 –0.015 (radius or chamfer) provided:

(a) The process used is capable of this tolerance without producing a knife edge and all details shall remain free of burrs.

(b) This applies only to aluminum sheet 0.012 –0.125 thick.

8.1.1. Paragraph 8.1 shall not apply to:

(1) Specific Field of Drawing notes pertaining to radius/chamfered edges

(2) Fastener holes that have been opened to final size

(3) SS1038 or SS1040 flanged holes.

9. ACCEPTABLE ASSEMBLY METHODS

9.1. Shimming aluminum to other Metallic Airframe Components

9.1.1. Applicability

During the assembly of sheet metal or thin walled machined fittings with forgings, castings, other sheet metal members or thin walled machine fittings, gaps may occur that require shimming for proper fit.

9.1.2. Limitations

a. The elements of this shimming section do not apply to the assembly of the following areas of the aircraft:

Rotor heads	Intermediate gear box attachment	Engine mounts
Transmissions	Tail gear box attachment	Stabilizer fittings
Transmission beams	Longeron Splice	Nose gear attachment
Manufacturing breaks	P-clips	Bulkhead fittings
Stiff leg fittings	Hard point fittings	Main landing gear attachment
Pylon transition fittings	Hydraulic sled attachment	Tail Rotor Drive Shaft supports

b. Gaps are not allowed for machined fitting components equal to 0.070 inches or greater. Sheet metal components or extrusions with thickness greater than or equal to 0.070 inches are considered to be equivalent to machined fittings.

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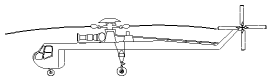

c. Measured gaps up to the limits listed in Table 9.1(see also Figure 9.1) are closed using the fasteners required by the drawing. Gaps greater than those listed in the table, up to a maximum of .063 inches, can be shimmed using solid shims, or 50% laminated shims, flat or tapered, sized to fit the gap without strain or clamp–up.

9.1.3. Definitions:

a. High Speed Machining(HSM) is defined as a process by which a machined component is cut at high rates of speed and feed such as 16,000rpm at 250 in/min. For the purpose of this document, there is no difference in criteria between conventional machined components and high speed machined components that are 0.070 in. or greater.

b. Thin Walled Machining (TWM) is defined as a machined component on which any feature has a final thickness less that 0.070inches.

c. Gaps are spaces measured between mating parts. Gaps measured under the head or tail of a fastener are not addressed herein. Reference SS9201

d. In order to determine gap size, finger pressure (thumb and forefinger) is applied to the mating parts during assembly before “take up” of mechanical fasteners.

e. In cases where it is impractical to use finger pressure to determine gap size, the spring type CLECO fasteners may be used in order to determine gap size. Draw type CLECO fasteners shall not be used.

9.1.4. Procedure:

a. Measure gap and determine proper shim size. The length of the shim shall be determined by individual circumstances as shown in the figures. Shim width is to approximate the width of the flange or other member to which it will be attached.

b. Shim shall be made of 7075–T6 unless the same material as the corresponding metal material, heat treatment and finish is available.

c. Where appropriate, shim shall be installed making sure it does not ride the radius of the mating part. Chamfer of the shim edge may be necessary to avoid the radius.

d. Shims are to pick up existing fasteners, which shall be increased in grip length as required by the added thickness of the stack up.

e. In addition, added shims (with the exception of floating frame designs) are to be bonded in place to a metal member using SS8622–006 or SS8622–007 adhesive per SS8669 Class II B (clean room requirements waived). See Figures 9.1–1 through 9.1–5 for shimming examples.

f. Insulate per SS8630

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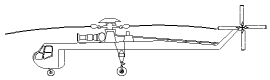

TABLE 9.1 ALLOWABLE GAPS PRIOR TO FASTENER INSTALLATION				
JOINT COMBINATIONS	Sheet Metal or Extrusion less than 0.070" Thk	Sheet Metal or Extrusion 0.070" Thk or Greater	Machined Fitting Less Than 0.070" Thk	Machined Fitting 0.070" Thk or Greater
Sheet Metal or Extrusion less than 0.070" Thk	0.020 in	0.020 in	0.020 in	0.020 in
Sheet Metal or Extrusion 0.070" Thk or Greater	0.020 in	0.000 in	0.010 in	0.000 in
Machined Fitting Less Than 0.070" Thk	0.020 in	0.010 in	0.010 in	0.010 in
Machined Fitting 0.070" Thk or Greater	0.020 in	0.000 in	0.010 in	0.000 in
Example: A joint made up of a 0.094" extruded angle and a 0.050" thick machined fitting can have up to a 0.010" gap prior to fastener installation.				

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9.1. Shimming Metallic Airframe Components (cont)

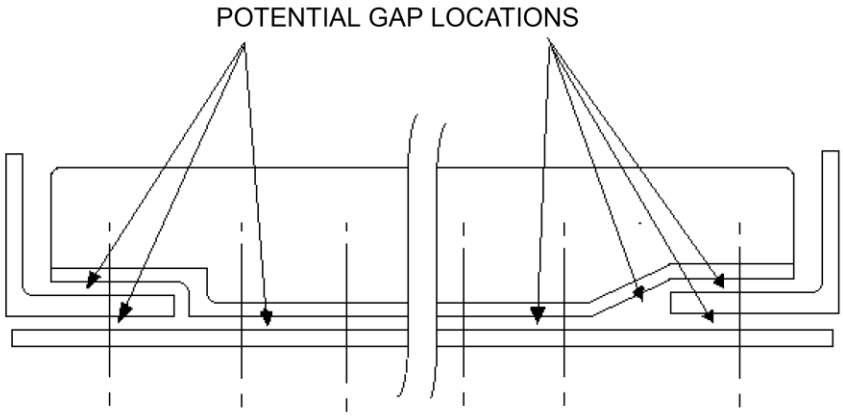

Figure 9.1 GAP LOCATIONS

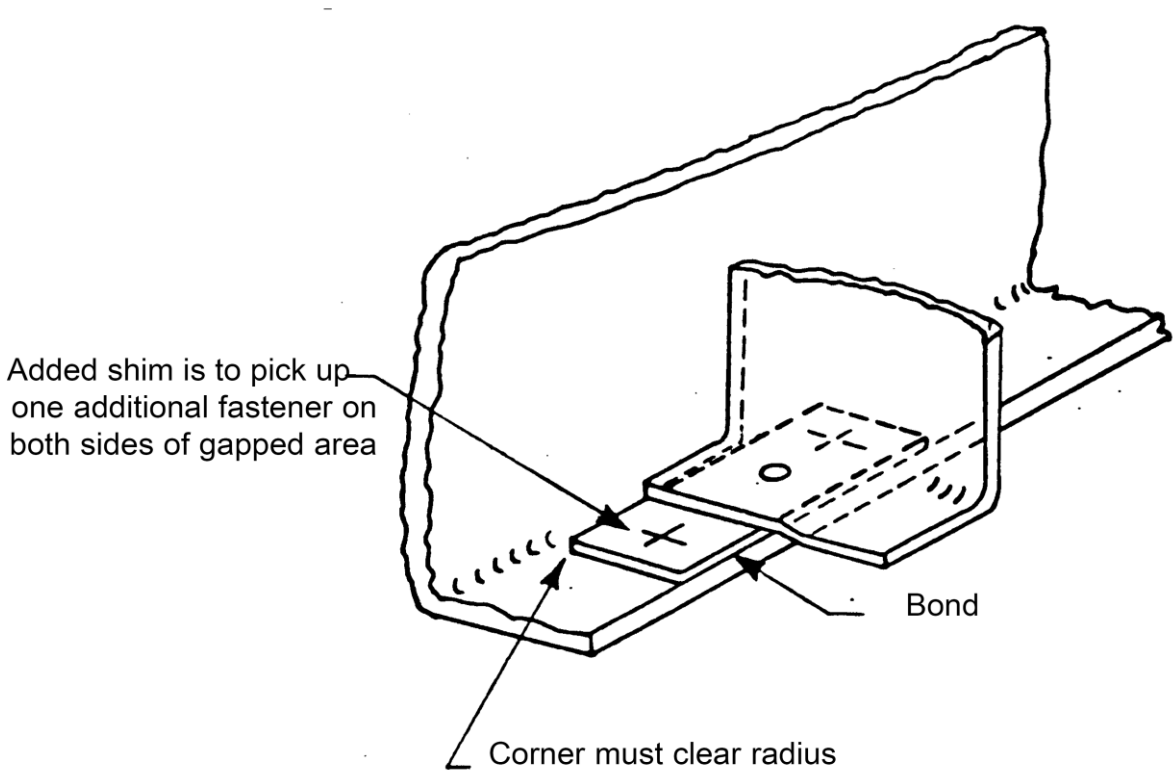

Figure 9.1-1

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9.1. Shimming Metallic Airframe Components (cont)

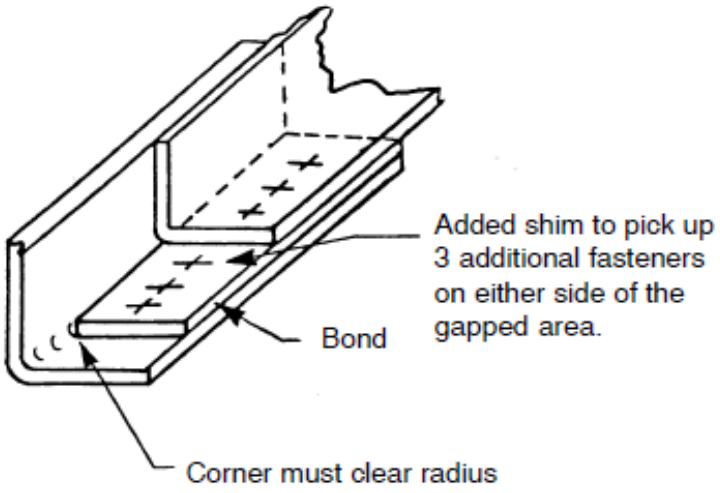

Figure 9.1-2

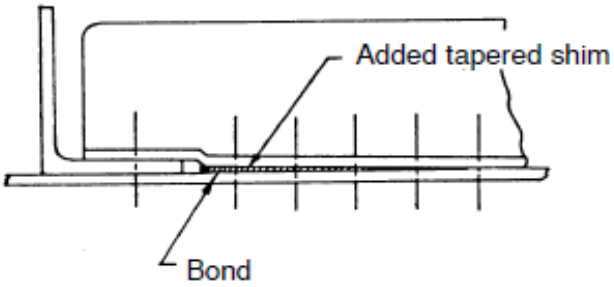

Figure 9.1-3

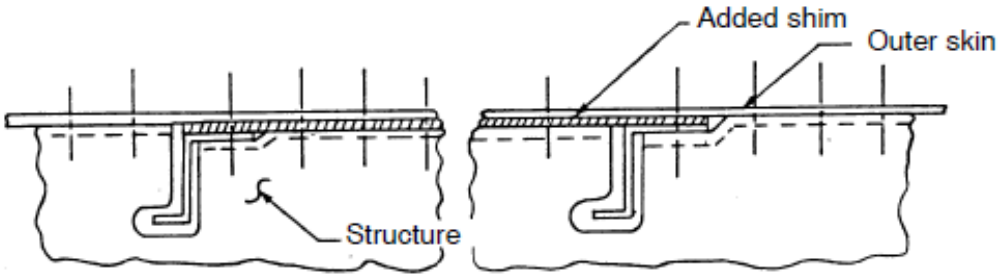

Figure 9.1-4

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9.1. Shimming Metallic Airframe Components (cont)

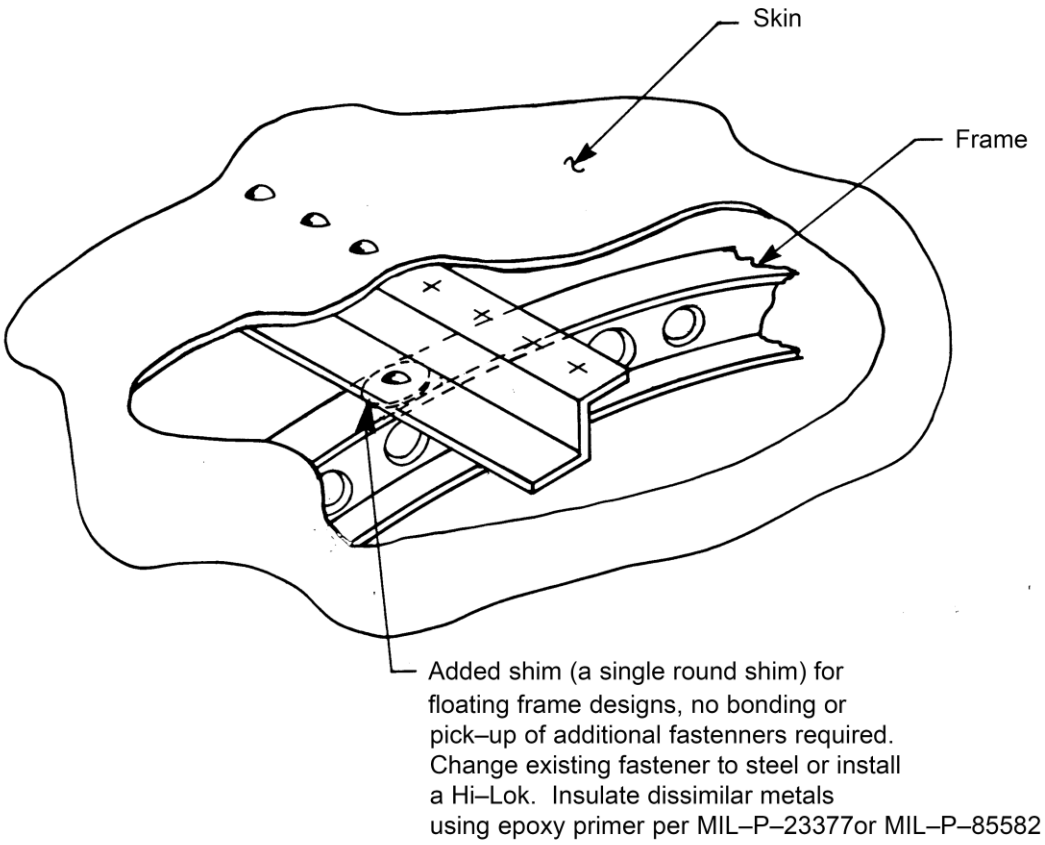

Figure 9.1-4

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9.2. Trimming or lengthening of Metallic Airframe Skins

9.2.1. Applicability

a. Trimming or lengthening of metallic skins to eliminate overlap, next assembly interference and/or improve cosmetic appearance.

9.2.2. Limitations

a. Metallic skins are defined as:
Aluminum
Steel
Stainless Steel
Titanium
Up to and including 0.125 material thickness.

b. No fasteners are to be eliminated or bypassed as the result of trimming.

c. The minimum edge distance between the center of the nearest hole and part edges shall be 2D or greater unless otherwise specified by the engineering drawing. D = maximum diameter of the fastener shank being installed.

d. After all trimming operations, remove all burrs and sharp edges created by trimming.

e. Areas exposed by trimming are to be touched up locally in accordance with the table below:

Material	Process Specification
Aluminum	MIL-DTL-5541
Steel	MIL–STD–865, Prime, if required per B/P
Stainless Steel	Not required
Titanium	Not required

NOTE: See Figure 9.2–1 for example of skin trimming.

f. Airframe metallic skins may be extended in length and width, including internal edges or cutouts within the perimeter of the part, beyond b/p requirements by up to 2" in order to maintain the 2D hole edge distance requirement and/or to improve the fit or cosmetic appearance of the skin. Skins with this condition will be marked with letter designation "M" at the end of the part number using non permanent marking methods per ES0037 indicating that the part has excessive material on the perimeter as well as internal features.

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9.2. Trimming Metallic Airframe Skins (cont)

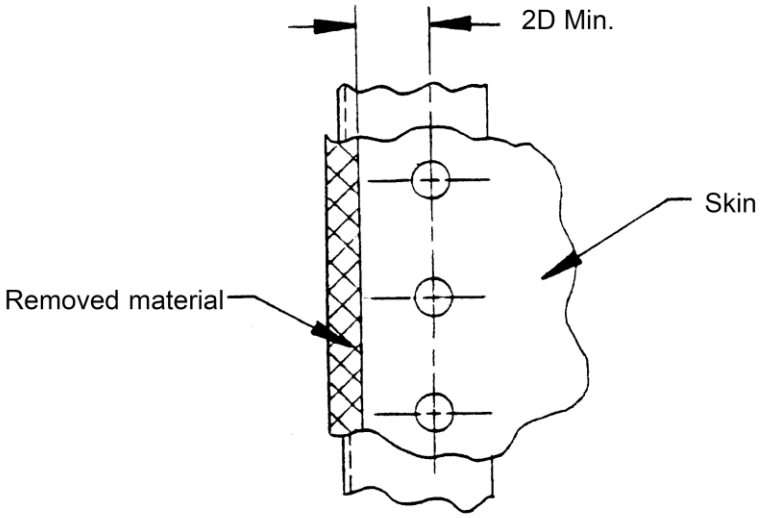

Figure 9.2-1

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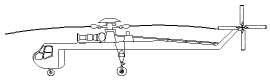

9.3. Trimming Metallic Airframe Components

9.3.1. Applicability

a. End and/or edge of part trim. Trimming of sheet metal and extruded parts to provide clearance between adjacent parts.

9.3.2. Limitations

a. Extent of trimming should only be to provide minimum (0.003 inch) clearance between adjacent structure and the part being trimmed.

b. Metallic components are defined as:
Aluminum
Sheet
Extrusion
Steel
Stainless Steel
Titanium

c. No fasteners are to be eliminated or bypassed as the result of trimming.

d. This does not apply to composite parts, rotor blades, rotor heads, transmissions, forgings, machined or cast parts.
Exceptions: Interference that occurs on forged frame splices may be trimmed as shown in Figure 9.3–8.

e. The minimum edge distance between the center of the nearest hole and part edges shall be 2D or greater unless otherwise specified by the engineering drawing. D = maximum diameter of the fastener shank being installed.

f. After trimming operations remove all burrs and sharp edges created by trimming.

g. Areas exposed by trimming are to be touched up locally in accordance with the table below:

Material	Process Specification
Aluminum	MIL-DTL-5541
Steel	MIL–STD–865, Prime, if required per B/P
Stainless Steel	Not required
Titanium	Not required

h. Airframe metallic components may be extended in length and width, including internal edges or cutouts within the perimeter of the part, beyond b/p requirements by up to 2” in order to maintain the 2D hole edge distance requirement and/or to improve the fit or cosmetic appearance of the components. Components with this condition will be marked with letter designation “M” at the end of the part number using non permanent marking methods per ES0037 indicating that the part has excessive material on the

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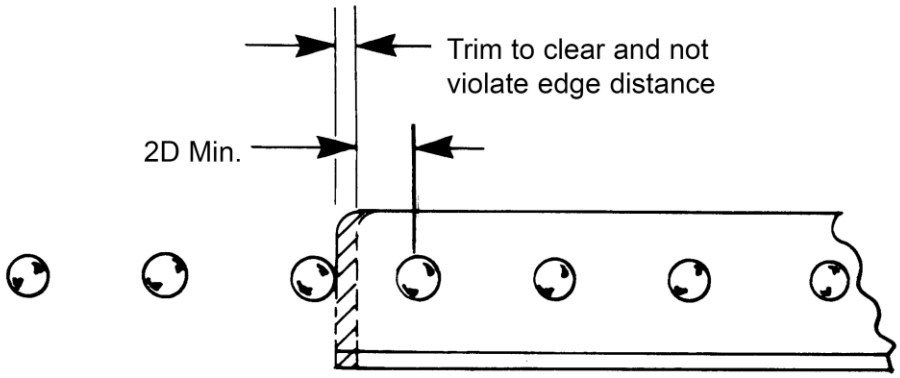
perimeter as well as internal features.

i. See Figures 9.3–1 thru 9.3–10. for trimming examples.

9.3. Trimming Metallic Airframe Components (cont)



Conditions: Part touches fastener

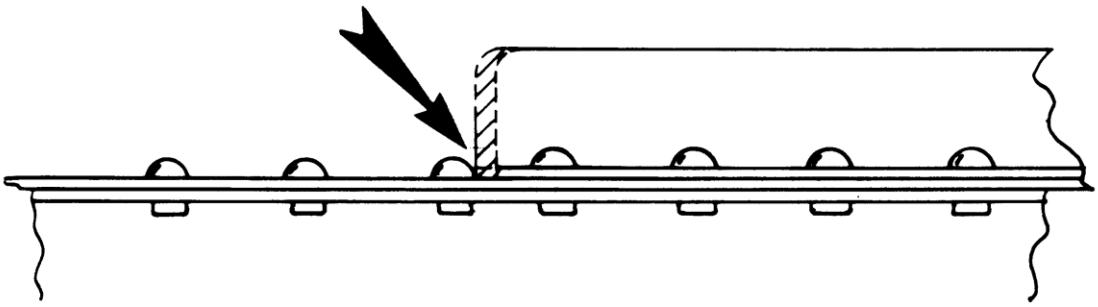


Figure 9.3-1

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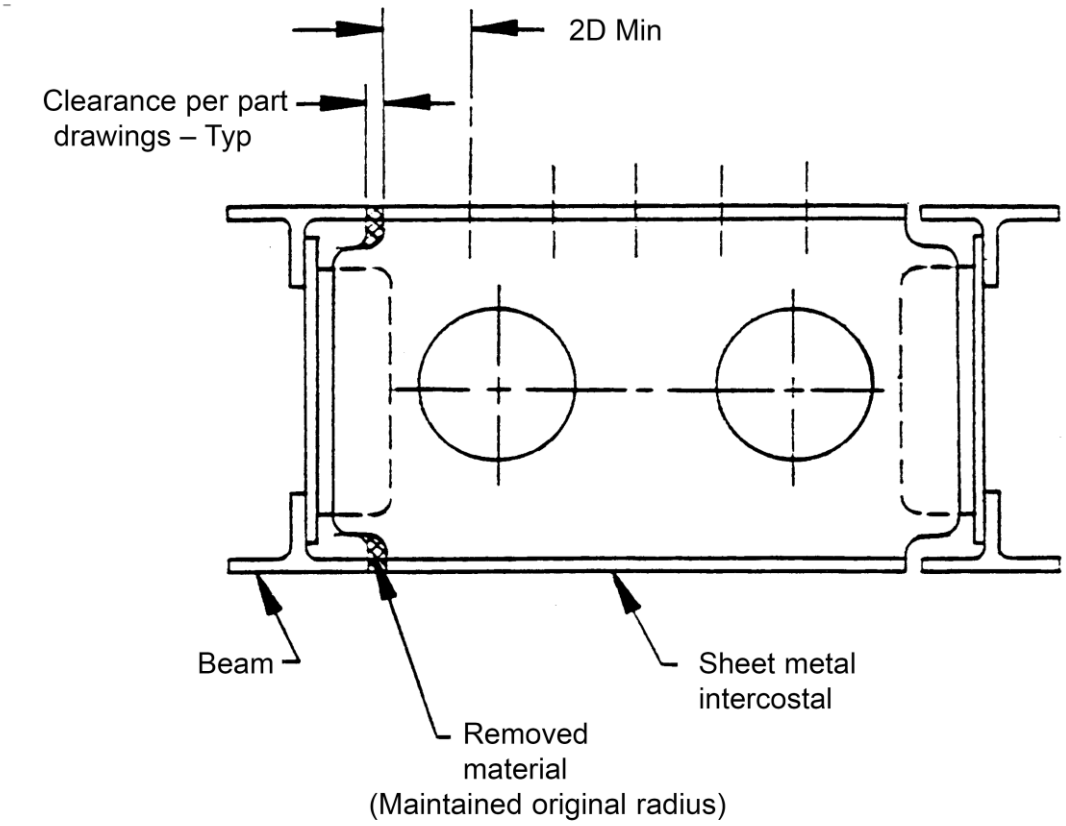
9.3. Trimming Metallic Airframe Components (cont)



D = Max. dia of fastener

Figure 9.3-2

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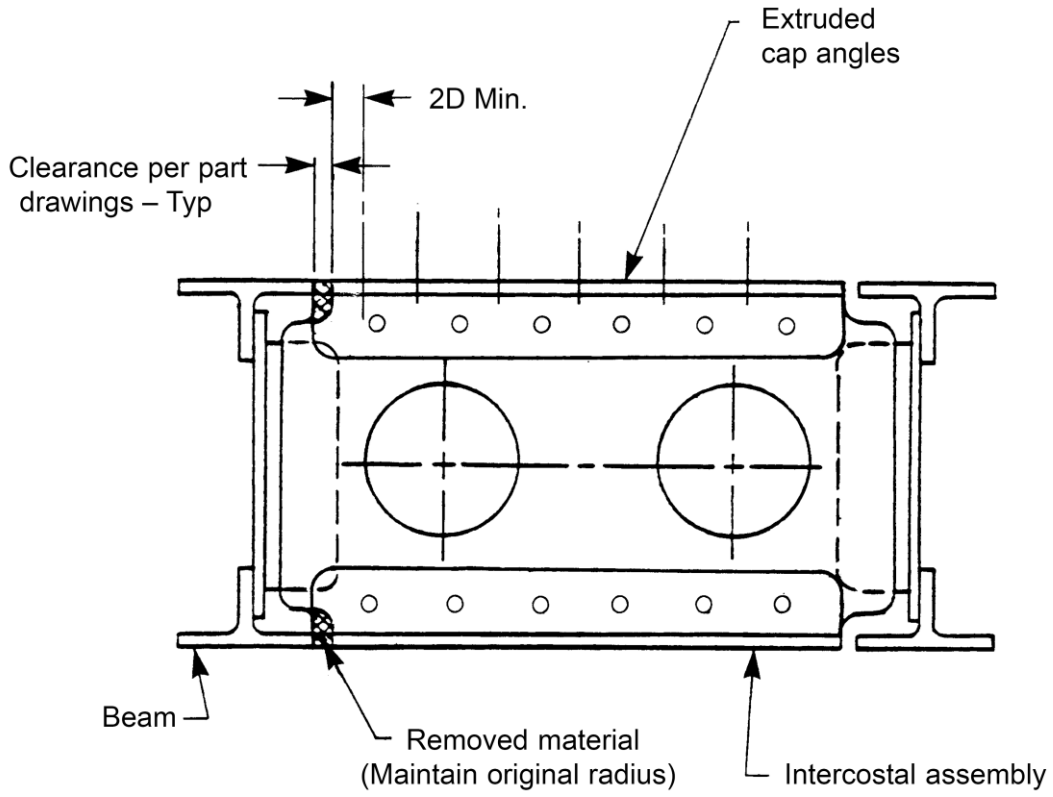
9.3. Trimming Metallic Airframe Components (cont)



D = Max. dia of fastener

Figure 9.3-3

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9.3. Trimming Metallic Airframe Components (cont)

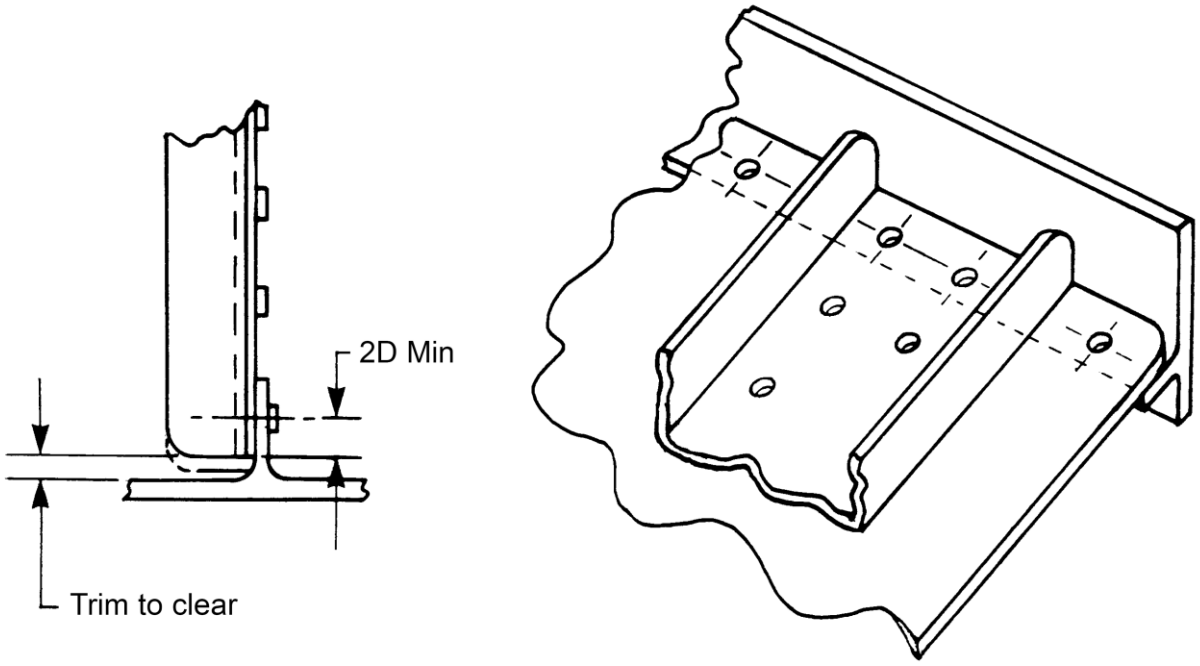

Figure 9.3-4

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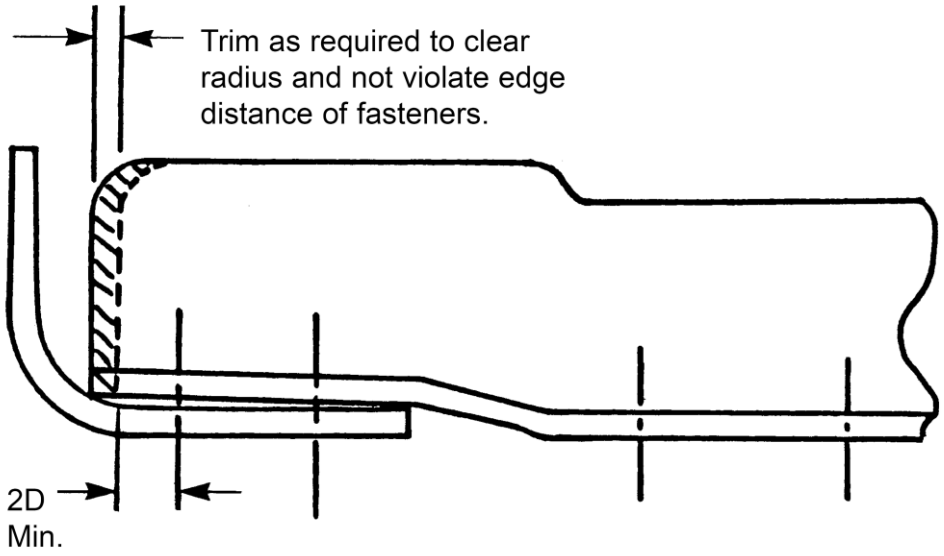
9.3. Trimming Metallic Airframe Components (cont)



Caution: Part rides radius

Figure 9.3-5

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9.3. Trimming Metallic Airframe Components (cont)

FILLERS & SPACERS

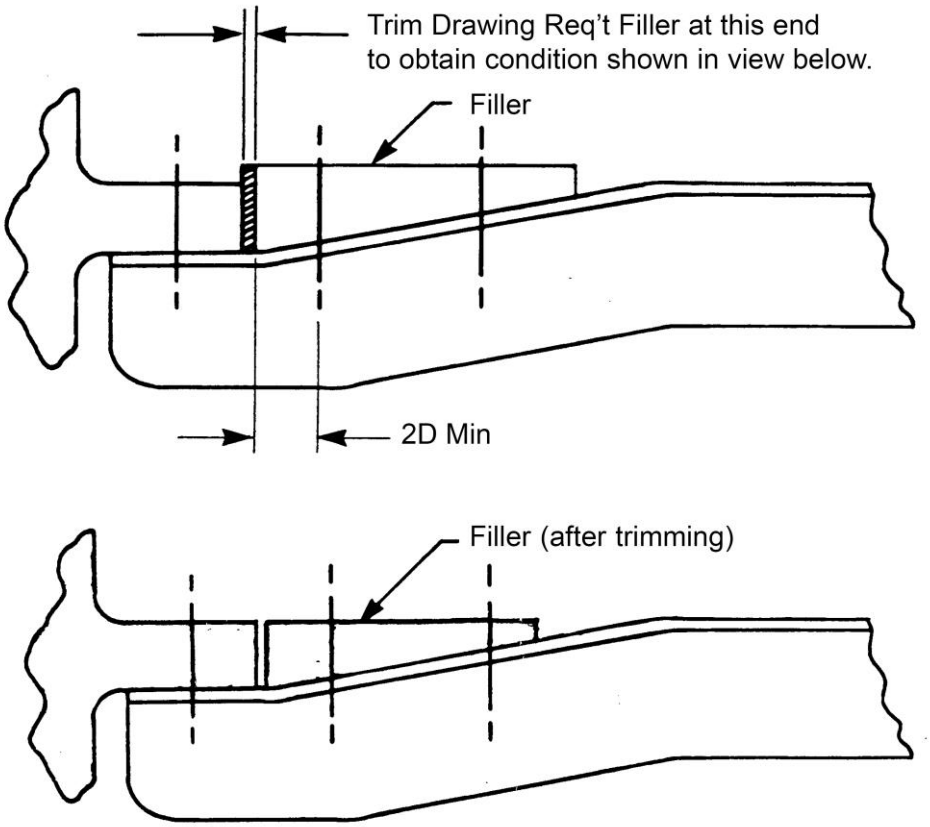

Figure 9.3-6

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9.3. Trimming Metallic Airframe Components (cont)

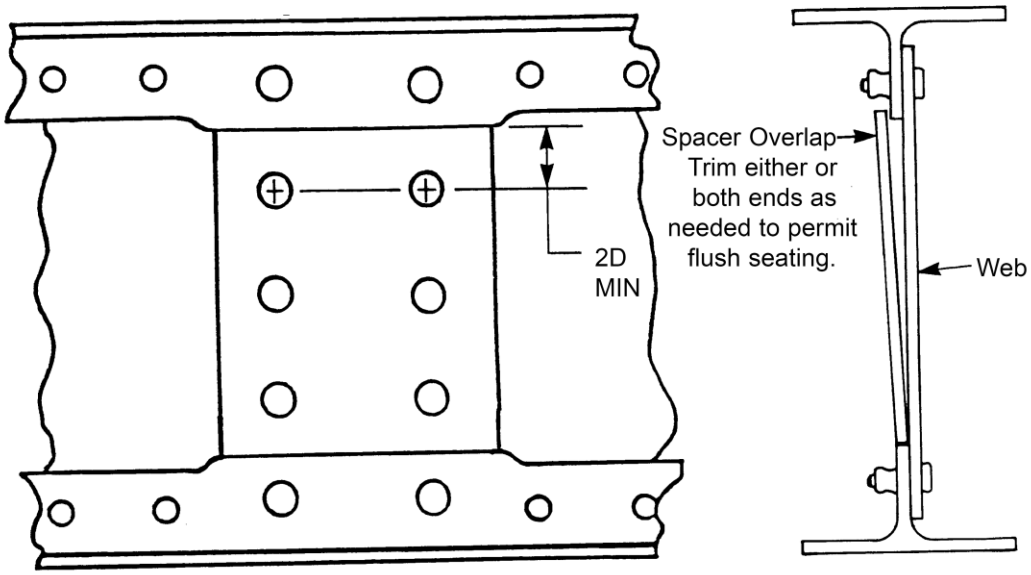

Figure 9.3-7

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9.3. Trimming Metallic Airframe Components (cont)

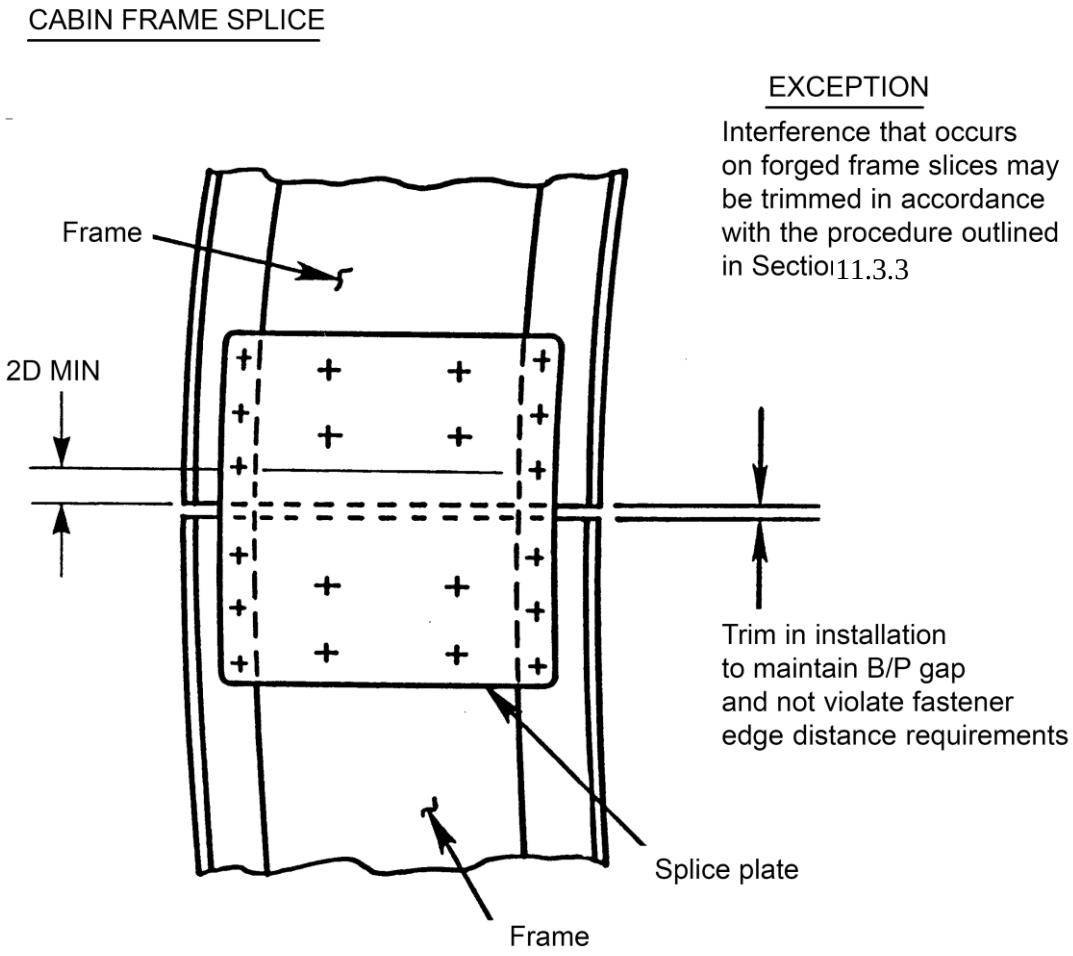

Figure 9.3-8

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9.3. Trimming Metallic Airframe Components (cont)

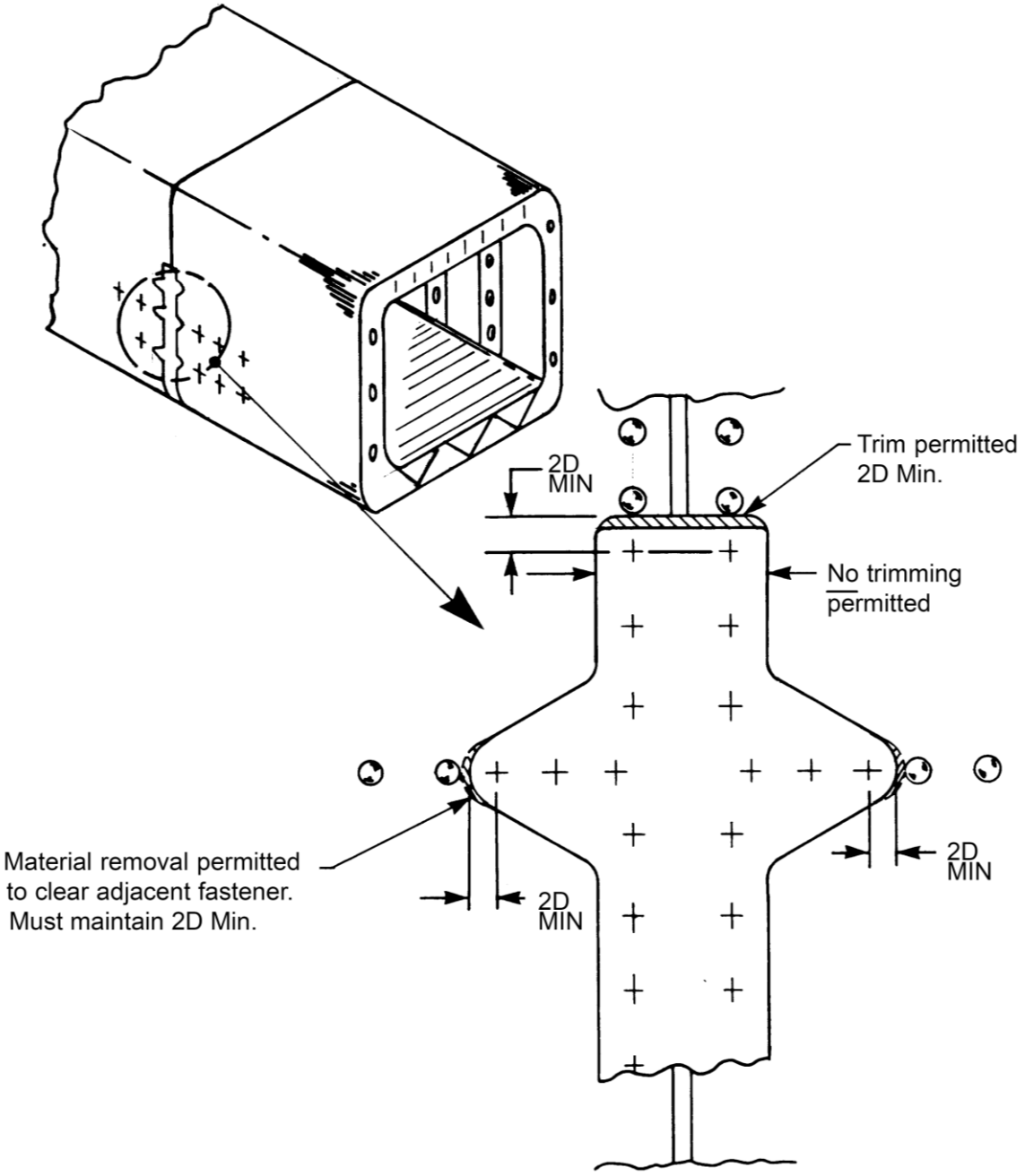

Figure 9.3-9

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9.3. Trimming Metallic Airframe Components (cont)

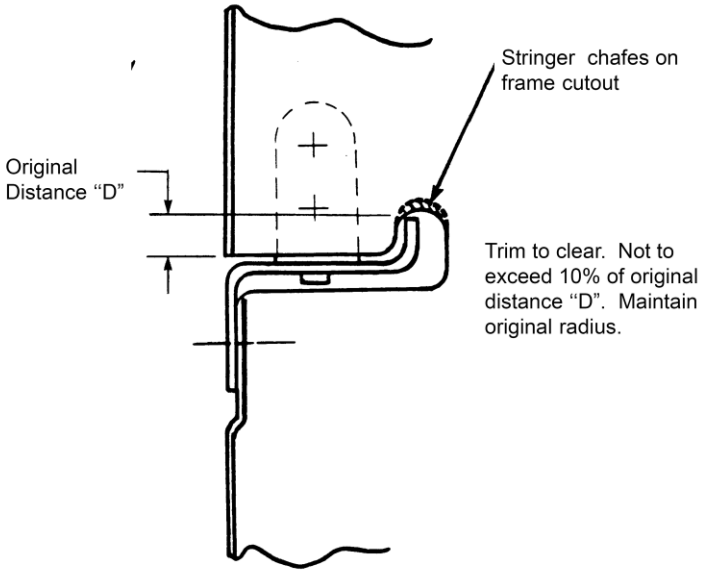

Figure 9.3-10

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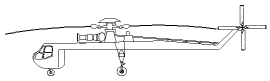

9.4. Trimming or lengthening of non-metallic components

9.4.1. Applicability

a. Trimming or lengthening of composite components to eliminate overlap, next assembly interference and/or improve cosmetic appearance.

9.4.2. Limitations

a. Composite components are defined as:
Doors
Door seals
Covers
Windows
Window seals

b. No fasteners are to be eliminated or bypassed as the result of trimming

c. The minimum edge distance between the center of the nearest hole and part edges shall be 2.5D or greater unless otherwise specified by the engineering drawing. D=maximum diameter of the fastener shank being installed.

d. Airframe composite components may be extended in length and width, including internal edges or cutouts within the perimeter of the part, beyond b/p requirements by up to 2" in order to maintain 2.5D hole edge distance requirement and/or to improve the fit or cosmetic appearance of the component. Components with this condition will be marked with letter designation "M" at the end of the part number using non permanent marking methods per ES0037 indicating that the part has excessive material on the perimeter as well as internal features.

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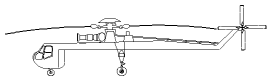

9.5. Holes

9.5.1. Applicability

a. This section applies to holes in aluminum, steel, titanium, stainless steel sheet metal, aluminum extrusions, thin walled machined components under 0.070 inch thickness as well as composite doors, covers and windows. This section does not apply to fastener through forgings, castings or machined fittings .070 inch thick or greater. See Table 9.5-1 for list of exceptions.

Table 9.5-1 ADDITIONAL PN'S APPLICABLE TO SECTION 9.5.
6420-62155
6420-62156
6420-62157
6420-62158
6420-62159
6420-62160
6420-62161

9.5.2. Omission of Holes

a. In order to ensure the proper location of mounting hardware at the next assembly, holes may be omitted from piece parts or sub assemblies. Parts with this condition will be marked with letter designation "M" at the end of the part number using non permanent marking methods per ES0037 indicating that the part is missing one or more holes.

9.5.3. Addition of Holes

a. In order to aid in the proper location of mounting hardware at the next assembly, holes may be added to piece parts or sub assemblies. Parts with this condition will be marked with letter designation "M" at the end of the part number using non permanent marking methods per ES0037 indicating that the part has additional holes.

9.6. Pilot Holes that Break into finished fastener holes

9.6.1. Applicability

a. This section applies to mislocated pilot holes that break into finished fastener holes in aluminum, steel, titanium, stainless steel sheet metal, aluminum extrusions and thin walled machined components under 0.070 inch thickness.

9.6.2. Limitations

a. This does not apply to composite parts, rotor blades, rotor heads, transmissions, forgings, cast or machined parts 0.070 inch thick or greater.

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b. The minimum edge distance between the center of the nearest hole and part edges shall be 2D or greater unless otherwise specified by the engineering drawing. D = maximum diameter of the fastener shank being installed.

c. Next larger fastener diameter. Hole size shall be per SS5100. Hole shall completely clean up the mislocated pilot hole.

d. Exposed edges shall be cleaned and touched up in accordance with Table 9.6–1 below:

TABLE 9.6–1	
Material	Process Specification
Aluminum	MIL-DTL-5541, primer if required by B/P
Steel	MIL–STD–865, prime, if required per drawing
Stainless Steel	Not required
Titanium	Not required
All materials must be deburred and sharp edges removed prior to assembly.	

e. Install next larger fastener. The same style and type of fastener must be used. Example: BJ4 rivet must be replaced by a BJ5 rivet.

9.7. Dimensional tolerance for formed sheet metal flanges

9.7.1. Applicability

These criteria shall define the acceptable dimensional tolerance on the width of the formed flanges on sheet metal parts.

9.7.2. Criteria

The standard dimensional tolerance on the width of formed sheet metal flanges shall be +/–.030, except, if the following conditions are satisfied, a conditional tolerance of +.060 –.000 shall apply.

9.7.3. Conditions

a. The engineering drawing does not specify a dimensional tolerance for the flange width that is tighter than the standard tolerance.

b. The (non–formed) web dimension of the part must satisfy a tolerance of +0.000/ –0.030.

c.

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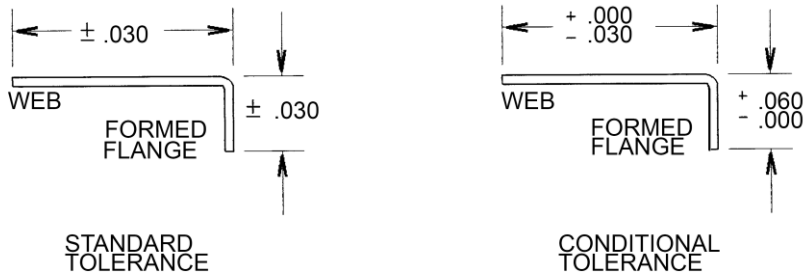

9.8. Acceptance criteria to meet proper grip length of mechanically locked fasteners

9.8.1. Fastener grip length – The requirement for proper grip length is necessary to ensure joint integrity. Improper grip length selection may cause fastener looseness or possible head failure. The requirement for proper grip length shall apply to all mechanically locked fasteners.

9.8.2. Applicability – in the event of conflict between the contents herein and any specifications or standards referenced in the field of drawing, the referenced document on the drawing shall take precedence.

9.8.2.1. Section 9.8 is not applicable for the assembly and/or installation of dynamic components such as rotor systems, transmission and drive systems, engine speed controls or the dynamic portions of flight control systems.

9.8.3. Compensation for assembly tolerance stack–up – Only when the hardware specified on the engineering drawing does not meet the installed fastener requirements may the following length deviations and use of washers be implemented.

9.8.3.1. Acceptable fastener length deviations –

9.8.3.1.1. Assemblies using composite materials – When the assembly to be fastened is comprised of at least one composite member the fastener length may be varied +/– 2 consecutive length dash numbers from the length noted on the engineering drawing to meet variations in composite material thickness.

9.8.3.1.2. Assemblies using metallic Airframe components – Fastener length may be varied +/– 1 length dash number from the length noted on the engineering drawing to meet variations in total material thickness.

9.8.3.2. Use of washers – washers may be used to adjust grip length only when proper

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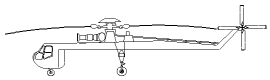

grip cannot be achieved with the fastener alone and only per the following. The list of fasteners approved for the use of washers to adjust grip length is shown in table 9.8–l. Washers shall be 0.016 in., 0.032 in., or 0.064 in thickness. For single washer applications the total washer thickness shall not exceed 0.032 in. The total thickness for multiple washer applications shall not exceed 0.096 in.

Table 9.8–1
Fasteners approved for grip length adjustments by the use of washers.

NASl4l4 thru NAS1422	MS90353
NAS1424 thru NAS1432	MS90354
NAS1436 thru NAS1442	NAS1738
NAS1446 thru NASl452	NAS1739
NAS1456 thru NAS1462	M7885/6
NASl465 thru NAS1472	M7885/7
NAS1475 thru NAS1482	M7885/8
NAS1486 thru NAS1492	M7885/9
NAS1496 thru NAS1502	All HL Hi-Loks
NASl5l6 thru NAS1522	
NAS1525 thru NAS1532	
NAS1535 thru NAS1542	
NAS1546 thru NAS1552	
NAS1555 thru NAS1562	

9.8.3.2.1. Lockbolt and Hi-Lok type fasteners – (NASl4l4–1562, HL) Protruding head – A maximum of two washers may be used to adjust grip length. The preferred washer location is under the collar. If insulating washers are used, or if the collar has an integral washer, only 1 additional washer may be used and the preferred location is under the collar. Flush head – one washer may be used under the collar to adjust grip length.

9.8.3.2.2. Pull through type blind rivets (MS90353, MS90354, NAS1738, NAS1739, M7885/6 thru M7885/9). Protruding head – A single washer may be used to adjust the grip length. On installations where the blind side is inaccessible the washer shall be located under the manufactured head. On installations where the blind side is accessible the washer may be located under the formed head or under the manufactured head unless the application is on an exterior

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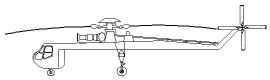

surface. On exterior surface applications the washer shall be located under the formed head. Flush head– Where the blind side of the fastener is accessible, one washer may be used under the formed head to adjust grip length.

9.8.3.2.3. Selection of washers – To avoid a dissimilar metal condition the material of the washer used to correct grip length shall be the material of any additional washers defined in the field of the engineering drawing. If the engineering drawing does not specify a washer, then the washer material shall be selected according to table 9.8–2 with regards to the material that the washer contacts.

Table 9.8-2 Washer material and callout for grip adjustment

Parent Material	Washer Material	Callout
Aluminum	Aluminum	AN960KDx
Steel	Steel	AN960x
Cres	Cres	AN960Cx
Titanium	Cres	AN960Cx
Graphite	Cres	SS5072CxH
Electrical grounding and bonding per SS7007 shall take precidence over the above section regarding electrical/electronic assemblies.		

9.8.3.3. Limitations of hardware use – When the fastener length is varied as described in 9.8.3.1 and/or washers are used as described in 9.8.3.2, the assembly shall not violate any clearance requirements.

9.9. Acceptance criteria to meet proper grip length of 1/4 turn CAMLOC fasteners.

9.9.1. Purpose - The purpose of this section is to allow grip length adjustment of ¼ turn fasteners from that on the engineering drawing to compensate for assembly tolerance stack–up.

9.9.2. Compensation for assembly tolerance stack–up – Only when the hardware specified on the engineering drawing does not meet the installed fastener requirements may the following length deviations be implemented.

9.9.3. Acceptable fastener length deviations

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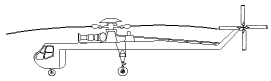

9.9.3.1. Assemblies using composite materials – When the assembly to be fastened is comprised of conforming parts, with at least one composite member, and is assembled and gauged with the appropriate installation tools, the fastener length may be varied 2 grip length dash numbers from the length noted on the engineering drawing to meet variations in composite material thickness.

9.10. Acceptance criteria for pin hole locations (Limited Usage)
NOTE: These allowances are only for use when the Engineering Drawing does not specify locations. In case of any conflict with this specification, the Engineering Drawing shall govern.

9.10.1. Purpose:
During the manufacture of sheet metal components, the use of pin holes may be required for positioning, alignment and/or assembly operations. This section provides guidelines for acceptable locations for pin holes.

9.10.2. Limitations:
This section applies to Aluminum, Steel or Titanium sheet metal Airframe components. This criteria does not apply to Flight Safety or Flight Essential components. The criteria specified herein may only be used to define acceptable locations if not already specified on the Engineering drawing.

9.10.3. Definitions:

9.10.3.1. Pin Holes are defined as .188" diameter holes which are used during the manufacturing process of sheet metal components. These holes are used to hold a sheet metal part in position during routing, blanking, or cutting operations, and to align the part correctly with the forming tool(s) during forming operation(s). Occasionally, pin holes are also used to locate parts during assembly and assembly operations.

9.10.3.2. Edge Distance is defined as the distance from the center of the hole to the edge of the part.

9.10.3.3. External Tabs are defined as a detail of the sheet metal part which is trimmed off as part of the manufacturing operation and does not remain on the final part.

9.10.3.4. Web Area is defined as the portion of a part, such as a frame, which may contain pin holes and/or is not formed (e.g., bent flange) as a step of the manufacturing

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process.

9.10.4. Guidelines for acceptable pin hole locations "General" (see Figure 9.10–1 for examples):

9.10.4.1. Pin holes located in external tabs are the preferred method. However, if pin holes must be in the body of the part, they may be located in sheet metal details provided the following guidelines are met.

9.10.4.2. Pin holes which coincide with fastener locations are acceptable and may override the guidelines within section 9.10.5 below. Pin holes coinciding with fastener locations within a pattern shall utilize the center fastener hole location or at least the third fastener from the edge of the pattern where practical.

9.10.4.3. Where practical, pin holes in aluminum parts, which do not coincide with fastener locations, shall be subsequently plugged using MS20470AD6 bucked rivets. In all parts, pin holes may not be left unplugged if environmental sealing requirements exist.

9.10.4.4. Pin holes may not be located in any portion of a part which will be subsequently formed, such as a bent flange or a beaded panel, unless all other requirements of this specification are complied with. Example of exception; pin hole located near flanged hole in web per para 9.10.5.6

9.10.4.5. Pin holes shall not be located such that they may interfere with subsequent manufacturing and assembly operations.

9.10.5. Guidelines for acceptable pin hole locations "specific" (see Figures 9.10–1 & 9.10–2 for examples)

9.10.5.1. Pin holes at each end of part, for parts that are a minimum of 5" long shall be located a minimum of 1.25" from edge and approximately at center of edge length.

9.10.5.2. General pin hole spacing shall be approximately 15" for parts that are greater than 18" long.

9.10.5.3. Pin holes in long narrow parts (i.e., less than 3" wide) shall have a minimum spacing of 2", along the length of the part.

9.10.5.4. Preferred location for pin holes in an unobstructed web area shall be approximately in the center, unless this is not practical and all other requirements are met.

9.10.5.5. Minimum edge distance of .56" shall be maintained from the edge of part or cut edge of detail (e.g., edge of a cutout, bend relief, hole, etc., or final edge location

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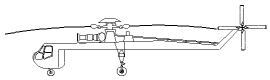

of part to be subsequently trimmed or cut) to the center of the pin hole.

9.10.5.6. A minimum distance of .35" shall be maintained from the tangent lines of formed details (e.g., joggles, flanged cutouts, bent flanges, etc.) or final tangent line location of detail to be subsequently formed, to the center of the pin hole.

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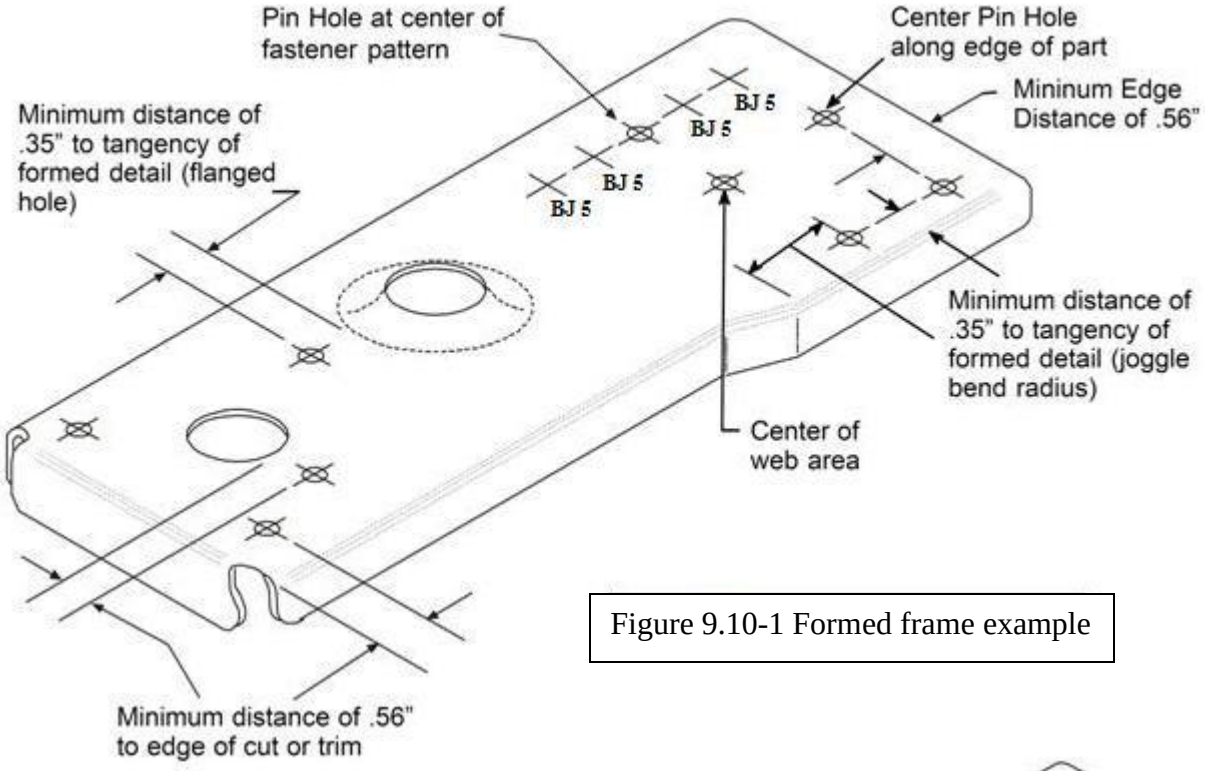

Figure 9.10-1 Formed frame example

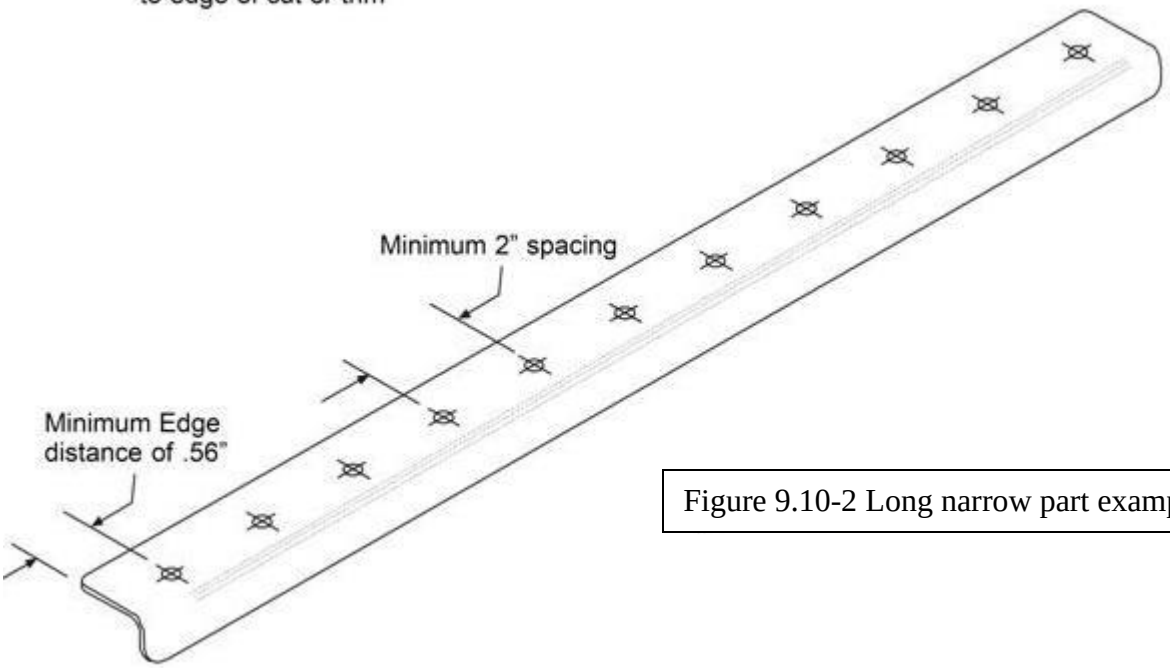

Figure 9.10-2 Long narrow part example

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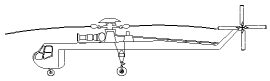

10. INTERCHANGEABLE FASTENERS (STUMP & PULL TYPE LOCKBOLTS)

10.1. Stump and pull type lockbolts may be used in place of each other provided finish, grip, size and collar material are the same (see NAS 1080 for proper collar selection). Substitution may be in either direction for each size fastener in each category in the Table 10.1–1.

TABLE 10.1–1

PULL TYPE & STUMP	SIZE	PULL TYPE LOCKBOLTS	STUMP TYPE LOCKBOLTS
STEEL 100 SHEAR	3/16	NAS1436	NAS1416
	1/4	NAS1438	NAS1418
	5/16	NAS1440	NAS1420
	3/8	NAS1442	NAS1422
STEEL PROTRUDING HD SHEAR	3/16	NAS1446	NAS1426
	1/4	NAS1448	NAS1428
	5/16	NAS1450	NAS1430
	3/8	NAS1452	NAS1432
STEEL 100° HD (MS24694) TENSION	3/16	NAS1456	NAS1486
	1/4	NAS1458	NAS1488
	5/16	NAS1460	NAS1490
	3/8	NAS1462	NAS1492
STEEL PROTRUDING HD TENSION	5/32	NAS1465	NAS1497
	3/16	NAS1466	NAS1496
	1/4	NAS1468	NAS1498
	5/16	NAS1470	NAS1500
	3/8	NAS1472	NAS1502
STEEL 100° HD (MS20426) TENSION	5/32	NAS1475	NAS6925
	3/16	NAS1476	NAS6926
	1/4	NAS1478	NAS6928
	5/16	NAS1480	NAS6930
	3/8	NAS1482	NAS6932
ALUMINUM 100° HD (MS24694) TENSION	3/16	NAS1516	NAS1546
	1/4	NAS1518	NAS1548
	5/16	NAS1520	NAS1550
	3/8	NAS1522	NAS1552
ALUMINUM PROTRUDING HD TENSION	5/32	NAS1525	NAS1555
	3/16	NAS1526	NAS1556
	1/4	NAS1528	NAS1558
	5/16	NAS1530	NAS1560
	3/8	NAS1532	NAS1562

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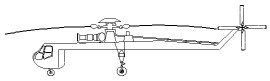

11. SAFETY WIRING / SAFETY CABLE

11.1. Safety Cable per AS 3509, AS 3510, and AS 3511 when used in accordance with AS 4536, installed with calibrated Safety Cable manufacturer recommended tools, may be used as an approved alternate to Safety Wire per MS 20995 installed in accordance with MS33540.

11.1.1. The following list indicates the proper alternates:

1. MS20995C alternate is AS3510 of corresponding diameter and length.
2. MS20995N alternate is AS3509 of corresponding diameter and length.
3. MS20995F No alternate is currently available.
4. MS20995NC alternate is AS3510 of corresponding diameter and length.
5. MS20995AB No alternate is currently available.
6. MS20995CY No alternate is currently available.

Safety Cable shall not be used for shear or sealing wire applications or in applications where the ferrule/end fitting could cause an interference.

Safety Cable shall not be used where verification of safety wire application per MS33540 is a Critical
Characteristic (CC).

12. ACCEPTANCE CRITERIA TO MEET THREAD PROTRUSION

12.1. Definitions

12.1.1. Thread Protrusion – is the term defining the requirements for the protrusion of a free running threaded fastener beyond the surface of an engaged nut to ensure complete engagement of the mating threads.

12.1.2. Grip Length – is the distance from the under head bearing surface to the start of the thread.

12.2. Justification for Thread Protrusion **–** The requirement for thread protrusion **is** necessary because the first 2 lead threads of the chamfered end of a threaded fastener are not designed to carry loads, but are present to facilitate assembling the nut to the fastener. Also, the 2 lead threads provide inadequate locking when self–locking nuts are used.

12.3. Applicability – In the event of conflict between the contents herein, and any specifications or standards referenced in the field of drawing, the referenced documents on the drawing shall be considered a superseding requirement.

12.3.1. Fasteners – The requirement for thread protrusion shall apply to free running bolts, studs, or screws.

12.3.2. Nuts **–** The requirement for thread protrusion shall apply to free running and self–locking 6 and 12 point hex nuts, fixed and floating blind nuts, and barrel nuts**.**

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12.4. Limits of protrusion – Unless otherwise specified on the engineering drawing, a bolt, stud, or screw end shall extend beyond the nut at least the length equivalent to 2 pitches, including the chamfer. (Figure12.4–1., Table 12.4–1.) Maximum thread protrusion shall be limited by any assembly clearance requirements.

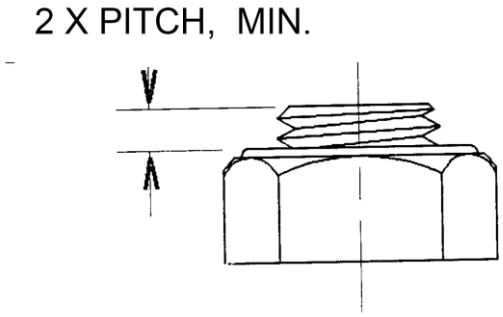

Figure 12.4-1

Table 12.4–1. Minimum Acceptable Protrusion			
UNC		UNF	
size	min protrusion, in.	Size	min protrusion, in.
4-40	0.050	4-48	0.042
6-32	0.063	6-40	0.050
8-32	0.063	6-36	0.055
10-24	0.083	10-32	0.063
1/4-20	0.100	1/4-28	0.071
5/16-18	0.111	5/16-24	0.083
3/8-16	0.125	3/8-24	0.083
7/16-14	0.143	7/16-20	0.100
½-13	0.154	1/2-20	0.100
5/8-11	0.182	5/8-18	0.111
3/4-10	0.200	3/4-16	0.125
7/8-9	0.222	7/8-14	0.143
1-8	0.250	1-12	0.167

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12.5. Compensation for assembly tolerance stack–up – Section 12.5 is not applicable for the assembly and/or installation of dynamic components such as rotor systems, transmission and drive systems, engine speed controls, and the dynamic portions of flight control systems.

NOTE: Only when the hardware specified on the engineering drawing does not meet the thread protrusion requirements specified herein may the following length deviations and addition of washers be implemented.

12.5.1. Acceptable bolt, or screw length deviation

12.5.1.1. Assemblies using composite materials. – Due to variations in total composite material thickness, and fastener length variations, the bolt, or screw length may be varied +/–2 consecutive length dash numbers from the length noted on the engineering drawing.

12.5.1.2. Assemblies not using composite materials. – Due to variations in total material thickness, and fastener length variations, the bolt, or screw length may be increased one consecutive length dash number from the length noted on the engineering drawing. Paragraph 12.5.1.2 shall not apply to electrical/electronic assemblies. Electrical/electronic assembly requirements shall be as specified in SS7500.

12.5.2. Use of washers. – In all cases, except as noted below, a maximum total of 3 washers, in any combination of thickness, may be used to insure proper grip length.

12.5.2.1. Assemblies in General. – The number of washers specified on the engineering drawing plus any washers added to insure proper grip length shall be a total of two (2) under the nut, and one (l) under the head. (Figure 12.1–2).

12.5.2.2. Assemblies using nut plates or barrel nuts. **–** The number of washers specified on the engineering drawing plus any washers added to insure proper grip length shall be a total of two (2) under the head. (Figure 12.1–2).

12.5.2.3. Assemblies using studs or fasteners with countersunk heads. – The number of washers specified on the engineering drawing plus any washers added to insure proper grip length shall be a total of two (2) under the nut. (Figure 12.1– 2).

12.5.2.4. Protection against electrolytic corrosion. – To avoid a dissimilar metal condition**,** the material of any additional washer(s) used under the nut to insure proper grip length shall be the material of the washer defined on the engineering drawing for use under the nut . If the engineering drawing does not specify a washer under the nut, then the washer material shall be selected according to MIL – STD – 889 (DISSIMILAR METALS). Similarly, the material of any additional washer(s) used under the head to insure proper grip length shall be the material of the washer defined on the engineering drawing for use under the head If the engineering drawing does not specify a washer under the head, then the washer material shall be selected according to MIL – STD – 889 (DISSIMILAR METALS). Paragraph 12.5.2.4 shall not apply to electrical/electronic assemblies.

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Protection against electrolytic corrosion for electrical/electronic assemblies shall be per the requirements of SS7007.

12.5.2.5. Selection of washers

Washers shall be selected from the following standards:

AN960 WASHER, FLAT
MS20002 WASHER, COUNTERSUNK AND PLAIN, HIGH STRENGTH
MS21206 WASHER, COUNTERSUNK AND PLAIN, FOR USE WITH BOLTS AND NUT UP TO AND INCLUDING 220 FTU
SS4409 WASHER–METALLIC, SPECIAL
S5S5072 WASHER (FOR COMPOSITE APPLICATIONS)

12.5.3. Limitations of hardware variations When the bolt, or screw length is varied as described in 12.5.1, and/or washers are used as described in 12.5.2, the assembly shall not violate any clearance requirements, the nut shall not bottom out on the imperfect threads, and the load transferred by the assembled parts to the bolt, stud, or screw shall not be carried by the threaded portion of the bolt, stud, or screw.

12.5.3.1. Engineering shall be notified when the bolt, or screw length is varied as described in 12.5.1 and/or washers are used as described in 12.5.2. Any assembly that requires repetitive corrective action to ensure thread protrusion as described herein requires investigation and possible drawing correction.

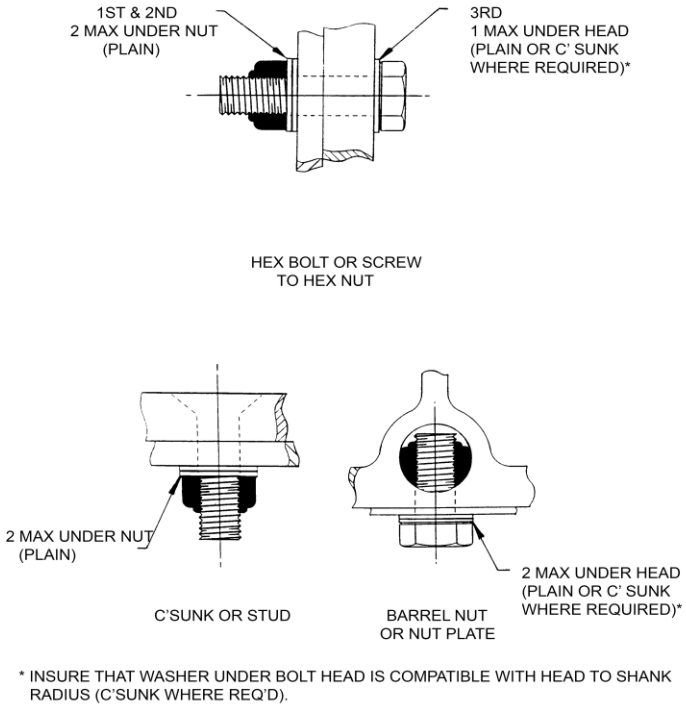

Figure 12.5-2

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13. ACCEPTANCE CRITERIA FOR EDGE AND PITCH DISTANCE

13.1. Purpose

The purpose of this section is to define the minimum acceptable edge and pitch distance requirements for fasteners installed through sheet metal assemblies and thin walled machined components under .070 inch thickness.

13.2. Scope

This section provides acceptance criteria for minor product characteristics not defined on the engineering drawings.

13.3. Limitations

13.3.1. This section does not apply to fastener through forgings, castings or machined fittings .070 inch thick or greater. Included tables do not apply to composite structure, which shall be reworked to meet dwg. requirements.

13.4. Definitions

13.4.1. Edge distance (ED) is the distance between a fastener centerline and the edge of a part (see Figure 13–1).

13.4.2. Pitch distance is the distance between the centerline of adjacent fasteners (see Figure 13–1).

13.4.3. A row of rivets is defined as a line of rivets extending between two frames, stringers, intercostals or other members as shown in Figure 13–1A.

13.4.4. Edge distance shall be acceptable when any one of the following or combination of the following conditions are met:

13.4.4.1. The edge distance is greater than or equal to two times the nominal shank diameter.

13.4.4.2. The edge distance is defined on the drawing in the form of a note, dimension or scaled from the EMD (Engineering Master Drawing).

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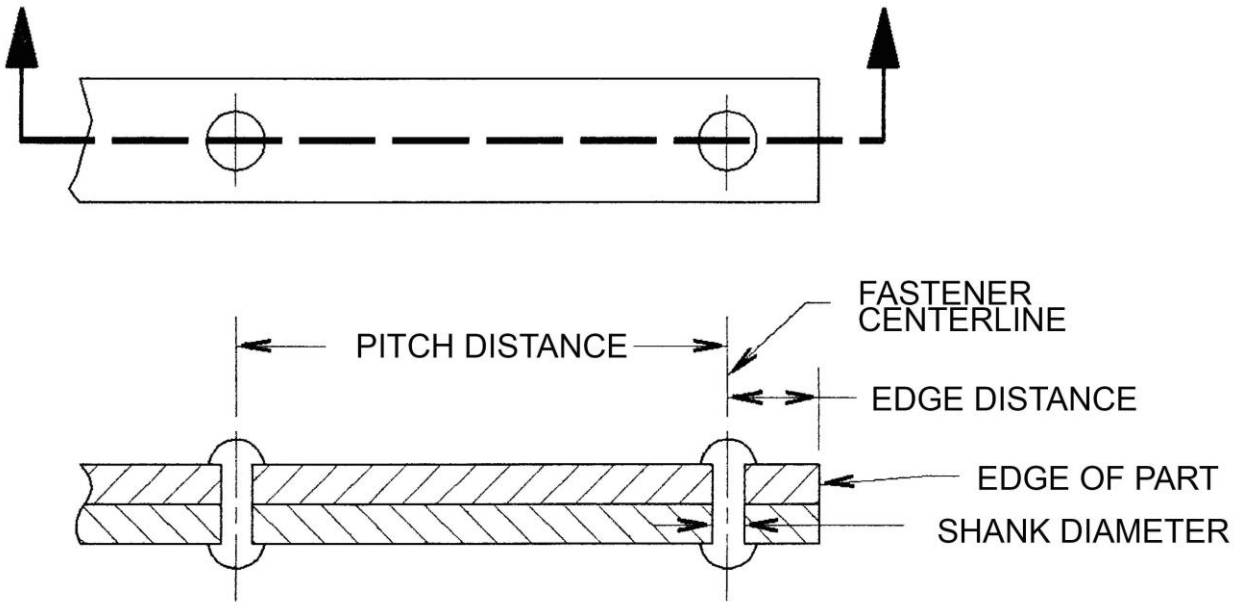

Figure 13.1

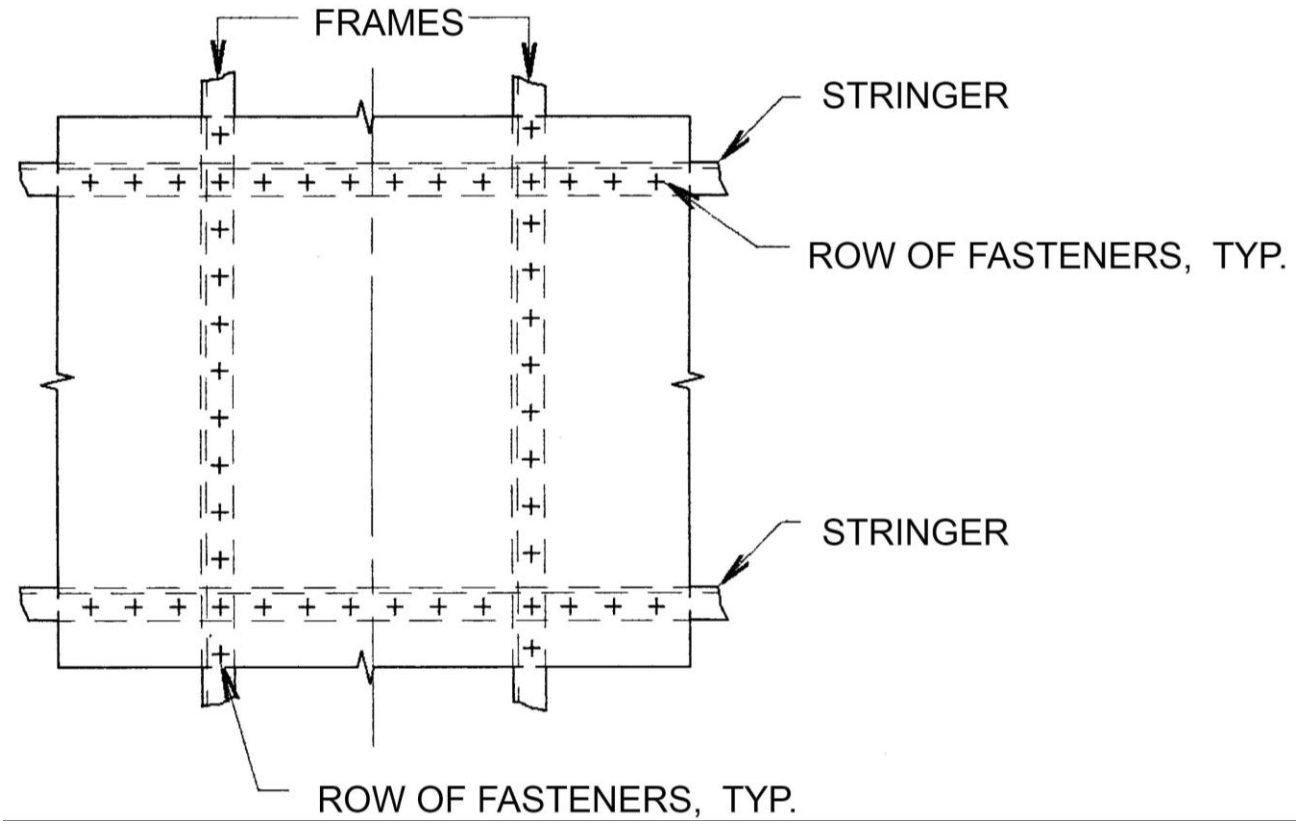

Figure 13-1A

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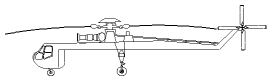

13.4.5. Pitch distance shall be acceptable when one of the following or combination of the following conditions are met:

13.4.5.1. Minimum pitch

This distance shall be as required by engineering drawing, 4 times nominal fastener shank diameter (4D), or as defined in Table 13–1 for protruding head fasteners in aluminum structure, Table 13–2 for countersunk fasteners in aluminum structure or Table 13–3 for dimpled holed fasteners in aluminum structure.

13.4.5.2. Maximum Pitch

Protruding Head and Flush Head Fasteners – Maximum allowable pitch is the nominal pitch distance as required on the engineering drawing +1D (nominal fastener shank diameter).

13.4.5.3. Exceptions to Para. 13.4.5

13.4.5.3.1. Hard tooled holes must meet drawing tolerances, (spray dot tools are not considered hard tools).

TABLE 13–1
MINIMUM ACCEPTABLE PITCH DISTANCE
FOR PROTRUDING HEAD FASTENERS

THESE VALUES APPLICABLE TO FASTENER INSTALLATION INTO 2014, 2024, 2219, 7075 AND 7079 ALLOYS IN ANY FULLY HARDENED TEMPER

Fastener Type	
MS20470 Rivets	Three times nominal shank diameter of fastener (3D)
All Others	Four times nominal shank diameter of fastener (4D)

TABLE 13–2
MINIMUM ACCEPTABLE PITCH DISTANCE
FOR COUNTERSUNK FASTENERS

THESE VALUES APPLICABLE TO FASTENER INSTALLATION INTO 2014, 2024, 2219, 7075 AND 7079 ALLOYS IN ANY FULLY HARDENED TEMPER

Fastener Type	
MS20426, NAS 1097 Rivets	Three times nominal shank diameter of fastener (3D)
All Others	Four times nominal shank diameter of fastener (4D)

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TABLE 13–3
MINIMUM ACCEPTABLE PITCH DISTANCE
FOR DIMPLE HOLE FASTENERS

THESE VALUES APPLICABLE TO FASTENER INSTALLATION INTO
2014, 2024, 2219, 7075 AND 7079 ALLOYS IN ANY FULLY HARDENED
TEMPER

Fastener Type	
MS20426 Rivets	Three times nominal shank diameter of fastener (3D)

13.5. General notes

13.5.1. When determining the minimum edge distance requirements for replacement with the next larger size fasteners, the diameter of the larger fastener shall be used.

13.5.2. When determining the minimum pitch distance requirements for any two adjacent fasteners of different diameters, the nominal shank diameter of the larger fastener shall be used.

14. COATINGS AND FINISHES

14.1. Shot peened surfaces

14.1.1. Metal detail parts requiring shot peening may be touch up shot peening per SS8769, as required, to meet engineering drawing requirements.

14.2. Plated surfaces

14.2.1. Metal detail parts requiring plating (example: Cadmium plate per QQ–P–416) may be touch–up plated per MIL–STD–865 at assembly, as required, to meet engineering drawing requirements. (See SS 8407 for baking requirements which may restrict touch–up of parts on assembly).
NOTE: Not intended to correct misplated parts.

14.3. Touch-up for cadmium plated electrical connectors and connector accessory plating abrasions

14.3.1. Cadmium plated connectors, backshells and cable clamps which are determined to be rejectable for scratches which expose or are suspected of exposing bare metal, during electrical harness fabrication, assembly, or installation shall be touched–up as follows.

14.3.1.1. Corrosion protection shall be provided by treatment of a chemical conversion coating per Mil–DTL–5541.

14.3.1.2. Top coat sealing of the treated area per ES0043.

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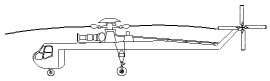

14.4. Painting of close tolerance machined surfaces

14.4.1. Unless otherwise specified, machined surfaces with a total tolerance of less than .003 inch, shall not be painted. For example, gears or splined teeth, bearing surfaces, keyways, threads, reamed or honed holes, and super finished surfaces (16 RMS or better). All other surfaces shall be painted as required by the engineering drawing.

14.5. Painting requirements

14.5.1. Organic coatings such as primer and top coatings may be eliminated from piece parts or sub-assemblies provided that the applicable coatings are applied at a later assembly or installation. See ES0043 for conditions. Parts with this condition will be marked with letter designation "M" at the end of the part number using non permanent marking methods per ES0037 indicating that the part is missing one or more organic coatings.

14.5.2. Conversely, organic coatings such as primer and top coatings may be added to piece parts or sub-assemblies provided that the applicable coatings are required at a later assembly or installation. See ES0043 for conditions. Parts with this condition will be marked with letter designation "M" at the end of the part number using non permanent marking methods per ES0037 indicating that the part has additional organic coatings.

15. ACCEPTANCE CRITERIA FOR CASTINGS / FORGINGS

15.1. The following machining operations may be performed by the supplier on cast or forged parts:

1. It is allowable to machine any casting/forging tooling points to required drawing dimensions.

2. It is allowable to machine any surface of a casting/forging up to 0.060 to meet drawing dimensional requirements.

3. The only allowable machining methods for titanium castings/forgings are turning or milling.

15.1.1. The supplier must retain records of machining operations, on internal operation sheets, by lot number, indicating the castings/forgings that have been machined and the amount of stock removed.

15.1.2. Forgings that are subsequently machined over 90% of their surface are acceptable up to .060" per diameter, .030" per surface, over the drawing maximum material condition, provided that tooling points are not affected.

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16. SCREW THREADS

16.1. Screw threads on electrical connectors

16.1.1. The thread gaging note on Spec or Source Control Drawings, does not apply to military, (AN, MS or MIL), or vendor electrical connectors. (These connectors meet the requirements of their applicable procurement specifications).

17. CONTROL COMPONENTS

17.1. Proof pressure testing of fluid components and proof testing of control cable assemblies and push rods.

17.1.1. Unless specifically defined on the engineering drawing, the following tolerances for proof load/pressure, burst pressure and times apply:

A. Control Cable Assemblies;

Proof load;	+ 5 – 0 percent
Time at load;	From 45 to 75 seconds

B. Fluid System Components,Lines, Fittings, and Hoses:

Proof pressure;	+10 percent / – 0 percent
Burst pressure;	+10 percent / – 0 percent
Time at pressure;	+30 / –5 seconds

C. Pushrods:

Proof Load;	+20 / – 0 pounds (lbs.)
Ultimate load;*	+20 / – 0 pounds (lbs.)
Time at load;	From 3 to 60 Seconds

*NOTE: Ultimate load test is a one-time test requirement.

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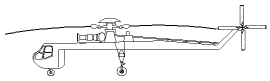

18. ELECTRICAL COMPONENTS

18.1. Grommet Alternates

Grommets per MIL–DTL–22529 may be used as an approved alternate to MS 21266 grommets installed in accordance to SS8640 with exceptions noted herein. The MIL–DTL–22529 grommets do not require adhesive bonding per SS8640.

The following table indicates the proper alternates:

Table 18-1
GROMMET ALTERNATES

MS21266 Dash#	Sheet Thickness	M22529 Range	M22529 Dash #
MS21266–1	0.015 / 0.052	0.036 / 0.063	M22529/2–2C–0085
MS21266–2	0.052 / 0.085	0.070 / 0.093	M22529/2–4C–0085
MS21266–3	0.085 / 0.128	0.105 / 0.134	M22529/2–6C–0085
MS21266–4	0.128 / 0.192	0.178 / 0.198	M22529/2–7C–0085
MS21266–5	0.192 / 0.255	0.240 / 0.260	M22529/2–8C–0085

18.1.1. Notes / exceptions:

18.1.1.1. Where clips intrude into the hole, castles on the M22529 grommets shall be trimmed to .03 max height without sharp edges, allowing fit between the clips without damage to the cushion. The first two castles on each end of the grommet shall not be removed. The gap/seam (.08 max) shall be at the top of the hole or orientated to remove minimal castles around clips. The castles shall be trimmed only as necessary to prevent interference.

18.1.1.2. M22529 grommets may be used on 7/8 (.875) inch diameter holes and larger and shall not be used on lightening holes.

18.1.1.3. M22529 grommet material shall only be used on flanges or straight edges where the minimum flat edge distance exceeds .18 inches, allowing the edge to fully bottom into the grommet.

18.2. Wire marking criteria for all EAC wiring (including electro/mechanical components).

18.2.1. Wiring shall be marked in accordance with SS7333 or SS7334. SS7333 marking processes are preferred.

18.2.2. Wiring may be marked per SS7334 using Hot Impression Stamping provided all initial qualification and continual acceptance testing is performed.

18.3. Trimming or Lengthening of Wire Harnesses

18.3.1. Applicability

a. Trimming or lengthening of wiring harness to allow for variability caused by routing/installation of wiring.

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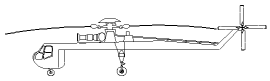

18.3.2. Conditions

a. Wiring harnesses may not be trimmed to below minimum drawing requirements.

b. Wiring harnesses that are terminated on one end may be extended in length by up to 2 feet on their non-terminated end. Wiring harnesses that are terminated on both ends may have one end left un-terminated and lengthened up to 2 feet provided that all parts required to terminate the harness are included with the harness. Wiring harnesses with this condition will be marked with letter designation "M" at the end of the part number using non permanent marking methods per ES0037 indicating that the part has excessive material.

19. STANDARD DEFINITION WHEN DIMENSIONS & REQUIREMENTS APPLY

19.1. Unless otherwise specified on the Engineering drawing or document, all dimensions apply:
- prior to the application of coatings (organic – paint, enamels, varnish, etc.)
- after the application of plating / chemical conversions (inorganic – cadmium, anodize, nickel, oxides, etc.)

19.2. Unless otherwise specified on the Engineering drawing or document, all surface roughness requirements apply to mechanically worked surfaces (i.e. machined, ground, sanded surfaces), and not to as-plated surfaces.

19.3. All weights listed in the engineering drawing parts list are for reference only.

20. MATERIAL AND PROCESS SPECIFICATIONS

20.1. See ES2000 Material and Process Specification Index for a list of approved revisions and alternate documents of material and process specifications listed on Engineering drawings or documents.

20.2. See ES2000 for additional supplemental information and selection criteria related to material and process specifications listed on Engineering drawings or documents.

21. APPROVED SOURCES OF SUPPLY

21.1. Source/specification controlled parts are to be controlled by the cage code listed in the approved sources of supply or specification control block. Any company title, address, or contact information etc. listed in the source of supply block is intended to be for reference only and is not to be used to define the supplier. When a cage code is not listed, company titles are to be used to define the approved source of supply. In the event of a conflict between the cage code and the company title listed on the drawing, the buyer is to verify that the suppliers PN for the source controlled item has not changed from what is listed on the drawing. If the suppliers PN has changed, contact EAC engineering for assistance.

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22. KIT PARTS, "K" SUFFIX DESIGNATION

It is sometimes beneficial for a variety of reasons to deliver a part or parts in a configuration that does not meet the engineering definition per the engineering drawing. In this case, when the configuration differences meet the criteria listed below the item is identified with a suffix letter "K". Kit part numbers are assigned and defined by the cognizant manufacturing engineer (ME) and do not appear on the engineering drawing; however, an item identified with a "K" designation shall meet the engineering configuration defined on the drawing once it is installed on the aircraft. It is the responsibility of the installer to ensure the final installed configuration complies with the applicable airworthiness requirements.

A "K" designated part (Kit) may be created and provided under the following circumstances and shall be part marked per ES0037, section 3.7 (bag and tag), or any non-permanent marking method. Additionally, "K" designated parts, or Kits, may include "M" designation parts within them.

Complete Assembly with Additional Parts: A fully complete assembly may be provided with some components of its next assembly to ease its location and installation on the aircraft. The kit part number shall be the same as the assembly part number of the complete assembly, with a "K" suffix.

Partial Assembly or Installation: An assembly or installation may be provided only partially assembled to avoid having to disassemble it so it can be located and installed on the aircraft. It is also permissible to provide some components of its next assembly or installation to ease its location and installation on the aircraft. The kit part number shall be the same as the assembly or installation part number of the partial assembly or installation with the "K" suffix.

Partially Assembled Detail: A detail part may be provided with some components of its next assembly to ease its location and installation on the aircraft. The kit part number shall be the same as the detail part number with the "K" suffix.

These parts are identified, stocked, and supplied to the customer with the "K" designated part numbers. They are to be installed in accordance with Technical Bulletins, Service Instructions, Alert Service Bulletins, Structural Repair Manual, Standard Procedures Manual, Maintenance Manuals, Illustrated Parts Catalog, or other approved documentation.

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