1. Shy Edge Distance On Spliced Member — Splice Plate

**NOTE:** The following restrictions apply:

Shy edge distance on spliced member with single or double row of fasteners.

Not for use on machined, forged or cast parts and/or parts involving the use of interference fit fasteners or original splice joints using fasteners larger than 3/16 inch diameter.

- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Repair limited to four fasteners out of ten
- Edge distance on splice plate must be correct
- Installation of fasteners in shy edge distance holes shall not result in bulging or breakout
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

**A. Procedure**

**NOTE:** The following procedure is performed in conjunction with Figure 201.

(1) **Primary Method**

(a) Remove existing plate.

(b) Fabricate replacement splice plate.

(c) Install replacement splice plate.

(d) Pick up existing splice fasteners.

(e) Add fasteners through plate and spliced member.

**NOTE:** Use fasteners equal to number, type and size of fasteners with shy edge distance.

(2) **Alternate Repair**
(a) Interspace fasteners adjacent to each fastener having shy edge distance.

NOTE: Add same type and size fastener.

(b) See General Limitations, Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General.

(3) Inspect for presence of foreign objects.

(4) Record all maintenance actions in accordance with current Federal Aviation Regulations.
Shy Edge Distance On Splice Plate
Figure 201
NOTE: The following restrictions apply:

Shy edge distance on splice plate with single or double row of fasteners - spliced member.

Not for use on machined, forged or cast parts and/or parts involving the use of interference fit fasteners or original splice joints using fasteners larger than 3/16 inch diameter.

• Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
• Repair limited to four fasteners out of ten
• Edge distance on splice plate must be correct
• Installation of fasteners in shy edge distance holes shall not result in bulging or breakout
• Repair installations utilizing this repair must result in equal to or greater capability than the original structure
• The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
• Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

NOTE: The following procedure is performed in conjunction with Figure 202.

(1) Remove existing plate.
(2) Fabricate replacement splice plate.
(3) Install replacement splice plate.
(4) Pick up existing splice fasteners.
(5) Maintain original edge distance requirements.
(6) Inspect for presence of foreign objects.
(7) Record all maintenance actions in accordance with current Federal Aviation Regulations.
Shy Edge Distance On Splice Plate
Figure 202
3. Shy Edge Distance — Intersection of Two Flanges

NOTE: The following restrictions apply:

- Not for use on machined, forged or cast parts and/or parts involving the use of interference fit fasteners.
- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

NOTE: The following procedure is performed in conjunction with Figure 203.

1. Install joggled repair plate parallel to flange of member with shy edge distance.
2. Pick up three existing fasteners through repair plate.
3. Maintain original edge distance requirements.
4. Inspect for presence of foreign objects.
5. Record all maintenance actions in accordance with current Federal Aviation Regulations.
Shy Edge Distance - Intersection of Two Flanges

Figure 203

Shy Edge Distance

SECTION B - B

JOUGLED REPAIR PLATE WITH PROPER E.D.
4. Shy Edge Distance — Clip or Gusset

NOTE: The following restrictions apply:
- Not for use on machined, forged or cast parts and/or parts involving the use of interference fit fasteners.
- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

NOTE: The following procedure is performed in conjunction with Figure 204.

(1) Fabricate clip and/or gusset from same material callout and same thickness as detail drawing of each defined part.
(2) Install special clip or gusset.
(3) Maintain original edge distance requirements.
(4) Inspect for presence of foreign objects.
(5) Record all maintenance actions in accordance with current Federal Aviation Regulations.
Shy Edge Distance - Clip or Gusset  
Figure 204
5. Shy Material at Edge — End or Cutout of Sheet Metal Part

**NOTE:** The following restrictions apply:

- Shy material at edge, end or cut-out of sheet metal parts caused by router gouge, saw cut or similar tool misuse.
- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.

- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- For material loss resulting in shy edge distance see the following:
  - Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
  - Shy Edge Distance On Spliced Member - Splice Plate, 51-70-00, Repair
  - Shy Edge Distance On Spliced Member - Spliced Member, 51-70-00, Repair
  - Shy Edge Distance - Intersection of Two Flanges, 51-70-00, Repair
  - Shy Edge Distance - Clip or Gusset, 51-70-00, Repair
  - Shy Edge Distance on Flange End, 51-70-00, Repair
  - Fastener Hole Breaking Out - Flange End, 51-70-00, Repair

For material loss on lightening hole flange, see Cracked Lightening Hole Flange, 51-70-00, Repair.

Maximum depth of material loss: 0.375 inch.

For cracks on skin edges, see Cracks on Edges of Flat or Contoured Skins, 51-70-00, Repair.

Repair installations utilizing this repair must account for any effect from all previous repairs or modifications.

**A. Procedure**

1. Blend smoothly into adjacent areas.
2. Inspect for presence of foreign objects.
3. Record all maintenance actions in accordance with current Federal Aviation Regulations.

6. Shy Edge Distance on Flange End

**NOTE:** The following restrictions and limitations apply:

- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.

- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair is not applicable if installation of fastener in shy edge distance hole results in bulging or breakout
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications
A. Procedure

(1) Add repair plate of like material, temper and thickness as part with shy edge distance with proper edge distance picking up three fasteners. See Figure 205.

(2) Alternate Repair

(a) Where existing fastener spacing and locations permit, add same type and size fastener between fastener having shy edge distance and next fastener.

**NOTE:**

The following restrictions apply:

- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.
- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

**NOTE:** The following is performed in conjunction with Figure 206.

(1) Cut out bad fastener hole with 1/8 inch minimum radius in corner of cut out.
(a) Add filler plate fabricated from the same material callout and thickness as the discrepant flange in cut out and add angle of same material and thickness as member lacking edge distance.

(b) Added angle to be attached with a minimum of three fasteners in each leg.

(2) Where existing fastener spacing and location permits, add same type and size fastener between breakout and next fastener.

(3) Inspect for presence of foreign objects.

(4) Record all maintenance actions in accordance with current Federal Aviation Regulations.

8. Fastener Head, Tail, Collar or Nut Riding Radius of Flange

NOTE: The following restrictions apply:

Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.

- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Fastener shanks must not show between faying surfaces
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications
A. Preparation

CONSUMABLES

Aluminum ................................................................. 7075-T6 or same material as existing flange

B. Procedure

NOTE: The following is performed in conjunction with Figure 207.

(1) If flange width is more than 7/8 inch with aluminum alloy rivets fasteners, repair as follows:
   (a) Add extra staggered fasteners midway between the discrepant fasteners.

   NOTE: Add same type and size fasteners.

   (b) Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General.

(2) If flange width is less than 7/8 inch, fasteners are other than aluminum alloy rivets or edge distance and spacing of added fasteners cannot be maintained, repair as follows:
   (a) Fabricate a radius block.

   1 Use 7075-T6 or same material as discrepant flange.

   2 Sufficient thickness to provide surface area for total fastener head or collar bearing. Edge profile to match radius of flange.

   3 Length of 3.0 X D, where D is diameter of fastener.

   4 Width equal to defective flange or not less than 1.5 X D, as applicable.

   5 Apply 2012 or 3012 finish. See Epoxy Primer Coating - Preparation and Application (Including Finish 2012), 51-07-10, Repair or Waterborne Epoxy Primer - Preparation and Application (Finish 3012), 51-07-10, Repair.

   (b) Individual radius block required for each individual hole.

   (c) Fasteners of same size, type and material as specified on applicable engineering drawing.

   NOTE: Correct grip length of fasteners shall be maintained per applicable installation document.

   (d) Blend and radius periphery of hole adjacent to flange radius. Maintain 63 RMS, alodine per MIL-C-5541 and touch up paint as follows:

   1 Finish 2012 or 3012 per primer coating specification or to match blended part. See Epoxy Primer Coating - Preparation and Application (Including Finish 2012), 51-07-10, Repair or Waterborne Epoxy Primer - Preparation and Application (Finish 3012), 51-07-10, Repair.

   (e) Drill radius block to match discrepant hole with 1/64 oversize hole in block only. For fastener head usage, chamfer hole per blueprint requirements or see Hole Preparation Specification - Metallic and Composite Structure Fasteners, 51-42-00, Repair.

   (f) Install fastener with radius block under head / collar.

   (g) Fay surface seal radius block. See Sealing Pressurized Areas, Skin Joints, Faying Surfaces, Access Closures and Coating Exterior Surfaces, 51-22-00, Repair.

(3) Inspect for presence of foreign objects.

(4) Record all maintenance actions in accordance with current Federal Aviation Regulations.
Fastener Head, Tail, Collar or Nut Riding Radius of Flange

Figure 207

1/64 Oversize Hole in Block Only

0.030 Min Clearance

Thickness Sufficient to Provide Total Fastener Head or Collar Bearing

1.5 Min Edge Distance

Block Profiled to Match Radius

Break and Radius Periphery of Hole Adjacent to Radius

29357C00

Fastener Head, Tail, Collar or Nut Riding Radius of Flange
Figure 207

51-70-00
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9. Excessive Depth of Countersink — Shallow Head / Flush High Strength Fasteners

NOTE: The following restrictions apply:

- Not for use on machined, forged or cast parts and/or parts involving the use of interference fit fasteners.
- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Maximum of three countersinks out of ten with a minimum of four non-discrepant countersinks between the next group of three discrepant countersinks out often
- See specific repair for dimensional and material limitations
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

NOTE: The following is performed in conjunction with Figure 208.

This repair is applicable to the following fastener types:

- NAS1055 flush steel Hi Shear
- GAB510A and GAB510B flush titanium and steel Hi Lok
- GAB510L3 and GAB510L4 flush steel low head bolts
- NAS1416, NAS1418, NAS1436 and NAS1438 flush steel lockbolts countersunk in age hardened, high strength aluminum alloys and in Ti-6Al-4V STA and Ti-6Al-6V-2SN annealed Titanium
- GAB510AA flush titanium interference fit (Hi-Tigue) fasteners countersunk in Ti-6Al-4V STA and Ti-6Al-6V-2SN annealed titanium only

Repairs are listed in order of preference.

Applicability of repair 1 must be determined unsuitable before considering repair 2.

(1) Repair 1

(a) Where the calculated “C” dimension, based on use of the drawing requiring fastener is equal to or greater than Table 201 value shown, install the drawing required fastener utilizing a reduced diameter set (to insure bearing on fastener head only).

(b) Fill the cavity over the head flush with aerodynamic sealer. See Sealing of Surfaces for Aerodynamic Smoothness, 51-14-00, Repair when a flush surface is required.

(2) Repair 2

(a) Where the calculated “C” dimension is below the Table 201 value shown, ream and countersink as required.

(b) Install any of the replacement fasteners listed in Table 202 for the particular hole diameter and material listed.

(c) Fill any remaining cavity over the replacement fastener heads as for in Step 9.A.(1)(b).

(d) Measure “C” dimension based on use of the replacement fastener must be equal to or greater than the Table 202 value for the repair to be applicable.

(3) Inspect for presence of foreign objects.
Record all maintenance actions in accordance with current Federal Aviation Regulations.

Table 201: C Dimension

<table>
<thead>
<tr>
<th>NOMINAL HOLE DIAMETER</th>
<th>TABLE 201: C DIMENSION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AGE HARDENED ALUMINUM ALLOY SERIES MATERIAL (NOT APPLICABLE FOR GAB510AA)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2000 SERIES</td>
<td>7000 SERIES</td>
</tr>
<tr>
<td>3/16 inch</td>
<td>0.160</td>
<td>0.125</td>
</tr>
<tr>
<td>1/4 inch</td>
<td>0.250</td>
<td>0.190</td>
</tr>
</tbody>
</table>

Table 202: Minimum Allowable Measure C

<table>
<thead>
<tr>
<th>NOMINAL HOLE DIAMETER</th>
<th>REPLACEMENT FASTENER TO BE USED</th>
<th>MINIMUM ALLOWABLE MEASURE C DIMENSION FOR REPLACEMENT FASTENER NOTED</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>AGE HARDENED ALUMINUM ALLOY SERIES MATERIAL</td>
<td>TI-6AL-4V STA TI-6AL-4V ANNEALED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2000 SERIES</td>
<td>7000 SERIES</td>
</tr>
<tr>
<td>3/16 inch</td>
<td>NAS1203 NAS583 NAS1221-3-P GAB510F-3</td>
<td>0.250</td>
<td>0.190</td>
</tr>
<tr>
<td>For replacement of GB510AA3 only</td>
<td>GAB510AC3</td>
<td></td>
<td>0.098</td>
</tr>
<tr>
<td>1/4 inch</td>
<td>NAS1204 NAS584 NAS1221-4-P GAB510F-4</td>
<td>0.312</td>
<td>0.250</td>
</tr>
<tr>
<td>For replacement of GB510AA4 only</td>
<td>GAB510AC4</td>
<td></td>
<td>0.127</td>
</tr>
</tbody>
</table>
10. Shallow Countersink or Dimple — High Rivet Head

NOTE: The following restrictions apply:

This repair applies to MS20426, C088 or NAS1199 type rivets.

- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.
- Not for use with blind rivets, NAS1097, C2896, NAS1200, GAR501V or GAR501W shallow head type rivets.
- Excess head height not to exceed 0.006 for 3/32 inch diameter rivets, 0.013 for 1/8 inch diameter rivets, 0.017 for 5/32 inch diameter rivets, 0.024 for 3/16 inch diameter rivets or 0.035 for 1/4 inch diameter rivets. See Figure 209
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure.
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications.

A. Procedure

NOTE: The following is performed in conjunction with Figure 209.

1. Shallow countersink or dimple causing high rivet head on structure that cannot be reworked to drawing requirements can be repaired by shaving rivet head. See Aerodynamic Contour Smoothness, 51-14-00, Repair.

2. Inspect for presence of foreign objects.

3. Record all maintenance actions in accordance with current Federal Aviation Regulations.
11. Deep Countersink or Dimple — Oversize, Oblique or Elongated Hole

**NOTE:** The following restrictions apply:

- This repair applies to MS20426, C088 or NAS1199 type rivets.
- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.
- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Repair applicable to excess depth of up to 0.019
- Drill for next size must clean up hole completely
- Not for use with blind rivets, NAS1097, C2896, NAS1200, GAR501V or GAR501W shallow head type rivets
- Maximum of one out of eight holes in a row with no two adjacent
- Rivet head must fill countersink
- Finished surface must meet the requirement of Aerodynamic Contour Smoothness, 51-14-00, Repair
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

**A. Procedure**

**NOTE:** The following is performed in conjunction with Figure 210.

1. Drill out hole for next larger diameter rivet.
(2) Leave dimple or countersink as for drawing specified rivet except that countersink for oblique condition shall be straightened.

(3) Install next larger diameter rivet to fill dimple or countersink and mill head flush.

(4) Inspect for presence of foreign objects.

(5) Record all maintenance actions in accordance with current Federal Aviation Regulations.
COUNTERSINK OR DIMPLE

0.019 MAX

REPAIR

TOO DEEP OR OVERSIZED

ELONGATED

OVERSIZE

ELONGATED

OBLIQUE

Countersink or Dimple Too Deep
Figure 210
12. **Incorrect Holes or Countersinks — Shallow Head Rivets**

**NOTE:** The following restrictions and limitations apply:

This repair applies to NAS1097, C2896, NAS1200 or GAR501V rivets.

Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.

- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Maximum of 2 rivets out of 8
- See Deep Countersink or Dimple - Oversize, Oblique or Elongated Hole, 51-70-00, Repair for MS20426, C088 or NAS1199 type rivets
- Replacement rivet head and shank must fill hole and countersink. The countersink depth for the replacement rivet shall not exceed 85% of the part thickness at the hole
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure's intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

**A. Procedure**

**NOTE:** The following is performed in conjunction with Figure 211.

Condition 1 - Hole is elongated, oversize, or oblique to correct countersink. Countersink is oblique or off center to correct diameter hole.

Condition 2 - Countersink is elongated but concentric to correct diameter hole.

Condition 3 - Countersink is too deep but concentric to correct diameter hole.

1. **Repair condition 1 hole as follows:**
   (a) Drill out hole for next larger diameter NAS1097, C2896, NAS1200 or GAR501V rivet.
   (b) Countersink for next larger diameter NAS1097, C2896, NAS1200 or GAR501V rivet.
   (c) Install new rivet.

2. **Repair condition 2 hole as follows:**
   (a) Remove existing fastener.
   (b) Countersink only as required to remove elongation.
   (c) Install same diameter MS20426, C088, NAS1199 or MS20427MC rivet.
   (d) Mill head flush in accordance with the tolerance and zone requirements. See Aerodynamic Contour Smoothness, 51-14-00, Repair.

3. **Repair condition 3 hole as follows:**
   (a) Remove existing fastener.
   (b) Install same diameter MS20426, C088, NAS1199 or MS20427MC rivet.
   (c) Mill head flush in accordance with the tolerancing and zone requirements. See Aerodynamic Contour Smoothness, 51-14-00, Repair.

4. Inspect for presence of foreign objects.
(5) Record all maintenance actions in accordance with current Federal Aviation Regulations.
Incorrect Holes or Countersinks

Figure 211

GULFSTREAM IV
STRUCTURAL REPAIR MANUAL

HOLE
ELONGATED

CONDITION 1

OVERSEIZE

CONCENTRIC COUNTERSINK ELONGATED

OBLIQUE

CONDITION 2

COUNTERSINK

OBLIQUE

CONDITON 3

OFF CENTER

REPAIR FOR CONDITION 1

REPAIR FOR CONDITIONS 2 AND 3

Incorrect Holes or Countersinks
Figure 211

51-70-00
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13. Oversize, Elongated or Damaged Holes

NOTE: For Hi-Shear, Hi-Lok, Hi-Tigue, lockbolt, lockbolt stump or blind high strength fasteners.

The following restrictions apply:

Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners or for applications involving the use of cold-worked holes.

- GAB511AM, GAB510R, GA3511AN, GAB510S, GAB511AU and GAB510AU fasteners used on surfaces sloped between 3° and 7° require GAN512W self aligning collars in place of the GAN512DF collars
- GAB511BE, GAB510AB, GAB511BF and GAB510AC fasteners used on surfaces sloped between 3° and 7° require GAN512FD self-aligning collars in place of the GAN512FC collars. Where the preceding fasteners are used against surfaces sloped more than 7° and where the other fasteners are used with the collars against surfaces sloped more than 3° install the collars against G23 tapered washers of the appropriate angle, increase the length of the fastener as necessary.
- Where the drawing calls for Stat-O-Seals and / or O-rings, oversized fasteners, shall be no more than 1/64 inch oversize. Seal backup washers shall be reamed 1/64 inch oversize to match fasteners
- 1/64 inch oversize fastener may be used up to a maximum of 15 adjacent fasteners
- 1/32 inch oversize fasteners may be used provided there are no 2 adjacent fasteners replaced
- Replacement fasteners listed in the accompanying table are not necessarily carried in stock, size for size
- Where salvage fastener replacement is authorized by documentation, such as a specification, drawing or Engineering Order, the provisions of the individual authorization take precedence over the provisions of this repair
- This repair pertains to defective hole shanks only, not to countersinks
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

(1) Determine the minimum hole size necessary to clean out any existing elongation, mislocation or hole damage.

(2) Select appropriate replacement fastener. See Table 203.

NOTE: Use the 1/64 oversize wherever possible instead of the 1/32 oversize fastener.

(a) Ream hole up for replacement fastener.

NOTE: Since the replacement fastener may not necessarily be in stock, the reaming operation should not be undertaken until the salvage fastener availability is assured.

Hole size selected shall provide the same degree of fit as for the original fastener / hole combination.

(b) Install replacement fastener.

CAUTION: MS21043 SILVER PLATED NUTS SHALL NOT BE USED DIRECTLY AGAINST ALUMINUM STRUCTURE.

(c) The replacement fastener and collar shall be installed with wet primer wherever dissimilar metals are in contact and all sealing and installation requirements stipulated for the
original fastener shall be met.

(3) Alternate Repair

(a) Ream and if required, countersink the hole.

(b) Install bushing or special thin wall bushing produced from corrosion resistant steel (CRES) as annotated by Gulfstream Technical Operations.

NOTE: Details of the bushing or sleeve, as well as the hole preparation and installation instructions, shall be specified by Gulfstream Technical Operations.

(c) After installation of the bushing or sleeve, install the drawing required fastener with wet primer and associated washers, collar, etc.

(4) Inspect for presence of foreign objects.

(5) Record all maintenance actions in accordance with current Federal Aviation Regulations.

Table 203: Fastener Replacement Table

<table>
<thead>
<tr>
<th>ORIGINAL FASTENER</th>
<th>1/64 INCH OVERSIZE REPLACEMENT FASTENER</th>
<th>1/32 INCH OVERSIZE REPLACEMENT FASTENER</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAS1054 Hi Shear</td>
<td>GAP510AG / GAC580G</td>
<td>GAP510AK / GAC580G</td>
</tr>
<tr>
<td>Protruding, shear head</td>
<td>GAB511AN / GAN512DR</td>
<td>GAB511AP / GAN512DE</td>
</tr>
<tr>
<td></td>
<td>GAB511AM / GAN512DR</td>
<td>GAB511CS / GAN512DE</td>
</tr>
<tr>
<td>NAS1055 Hi-Shear</td>
<td>GAP510AH / GAC580G</td>
<td>GAP510AJ / GAC580G</td>
</tr>
<tr>
<td>Flush, shear head</td>
<td>GAB510S / GAN512DF</td>
<td>GAB510T / GAN512DE</td>
</tr>
<tr>
<td>GAB511D, Hi-Lok</td>
<td>GAB511AM / GAN512DF</td>
<td>GAB511CS / GAN512DE</td>
</tr>
<tr>
<td>NAS1426-1432</td>
<td></td>
<td>GAB511AP / GAN512DE</td>
</tr>
<tr>
<td>Protruding shear head</td>
<td>Lockbolt Stump</td>
<td></td>
</tr>
<tr>
<td>NAS1446-1452</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lockbolt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAB510B Hi-Lok</td>
<td>GAB510R / GAN512DF</td>
<td>GAB510BD / GAN512DE</td>
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<tr>
<td>Flush shear head</td>
<td>GAB510S / GAN512DF</td>
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<tr>
<td>Lockbolt Stump</td>
<td></td>
<td></td>
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<tr>
<td>NAS1436-1442</td>
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<tr>
<td>Lockbolt</td>
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<td></td>
</tr>
<tr>
<td>GAB111G Hi-Lok</td>
<td>GAB511AN / GAN512DR</td>
<td>GAB511AP / GAN512DE</td>
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<tr>
<td>Protruding, CRES, shear head</td>
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<td></td>
</tr>
<tr>
<td>GAB510E Hi-Lok,</td>
<td>GAB510S / GAN512DF</td>
<td>GAB510T / GAN512DE</td>
</tr>
<tr>
<td>Flush, CRES, shear head</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAS2606-2612</td>
<td></td>
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</tr>
<tr>
<td>Lockbolt Stump</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAB511K Hi-Lok</td>
<td>GAB511AM / GAN512DF</td>
<td>GAB511CS / GAN512DE</td>
</tr>
<tr>
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<td>GAB511AP* / GAN512DE</td>
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<tr>
<td>Lockbolt Stump</td>
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<td>(aluminum structure)</td>
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<tr>
<td>C020 Hi-Lok</td>
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<td>GAB511CS* / GAN512DE</td>
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<tr>
<td>Protruding, Titan, shea</td>
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<td>(aluminum structure)</td>
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<tr>
<td>head</td>
<td></td>
<td>GAB511AP* / GAN512DE</td>
</tr>
<tr>
<td>GAB510A Hi-Lok</td>
<td>GAB510R / GAN512DR</td>
<td>GAB510BD / GAN512DE</td>
</tr>
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<td>NAS2506-2512</td>
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<td>Lockbolt Stump</td>
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<td></td>
</tr>
<tr>
<td>C021 Hi-Lok</td>
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</tr>
</tbody>
</table>
### GULFSTREAM IV

**STRUCTURAL REPAIR MANUAL**

<table>
<thead>
<tr>
<th>ORIGINAL FASTENER</th>
<th>1/64 INCH OVERSIZE REPLACEMENT FASTENER</th>
<th>1/32 INCH OVERSIZE REPLACEMENT FASTENER</th>
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<tbody>
<tr>
<td>GAB511E Hi-Lok NAS1466-1472 Protruding Head Lockbolt NAS1496-1502 Lockbolt Stump</td>
<td>GAB511AN / GAN512GV (aluminum structure) GAN512CV (other structure)</td>
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</tr>
<tr>
<td>GAB510C Hi-Lok NAS1456-1462 Lockbolt NAS1486-1492 Lockbolt Stump Flush Ten Head</td>
<td>GAB510S / GAN512GV (aluminum structure) GAN512CV (other structure)</td>
<td>GAB510T (1)</td>
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<tr>
<td>GAB510C Hi-Lok NAS2006-2100 Lockbolt NAS1486-1492 Lockbolt Stump Protruding Flush Ten Head</td>
<td>GAB511AN* / GAN512GV (aluminum structure) GAN512CV (other structure)</td>
<td>GAB511AP* (1)</td>
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<tr>
<td>NAS2106-2112 Lockbolt Flush Titan, Ten Head</td>
<td>GAB510*S / GAN512GV (aluminum structure) GAN512CV (other structure)</td>
<td>GAB510T* (1)</td>
</tr>
<tr>
<td>GAB511BC Hi-Tigue, Protruding Ti., shear head</td>
<td>GAB511BE GAN512FC GAN512FH</td>
<td>GAB511BF GAN512FC GAN512FH</td>
</tr>
<tr>
<td>GAB510AA Hi-Tigue, Flush Ti., shear head</td>
<td>GAB510AB GAH512FC GAN512FH</td>
<td>GAB510AC GAN512FC GAN512FH</td>
</tr>
<tr>
<td>GAB511BL Hi-Tigue, Protruding CRES., shear head</td>
<td>GAB511BK GAN512FH GAB510AB GAN512FC GAN512FH</td>
<td>GAB511BM GAN512FH GAB511BF GAN512FC GAN512FH</td>
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<tr>
<td>GAB510AG Hi-Tigue, Flush CRES., shear head</td>
<td>GAB510AH GAN512FH GAB510AB GAN512FC GAN512FH</td>
<td>GAB510AJ GAN512FH GAB510AC GAN512FC GAN512FH</td>
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<tr>
<td>GAB511BN Hi-Tigue, Protruding MP35N shear head</td>
<td>GAB511BP GAN512FH</td>
<td>GAB511BR GAN512FH</td>
</tr>
<tr>
<td>GAF510C, NAS1669 Jo Bolt, Protruding, shear head</td>
<td>NAS 1751</td>
<td></td>
</tr>
<tr>
<td>GAF511C, NAS1670 Jo Bolt, Flush shear head</td>
<td>NAS 1751</td>
<td></td>
</tr>
</tbody>
</table>

(1) Use MS21042 nut with AN960D washer against aluminum structure, AN 960 washer against steel structure or AN 960C washer against titanium or stainless steel structure. See Fasteners Bolts / Screws, 51-41-00, Structural Identification for torque nuts.

**NOTE:** Where required, MS21042, MS21043 or GAN510AE nuts with appropriate washers may be used in lieu of the Hi-Lok or Hi-Tigue collars specified. See Fasteners Bolts / Screws, 51-41-00, Structural Identification for torque nuts.

### 14. Extraneous Holes in Aluminum Alloy Parts and Assemblies

**NOTE:** The following restrictions and limitations apply:

Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.
• Original condition and repair shall be clearly described
• Not to be used for conditions which are specifically covered elsewhere in this manual
• For an assembled ‘stack’, parts must be plugged separately
• Do not touch countersink both sides of any single part that is less than 0.063 thick
• The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
• Repair is not applicable if installation of fastener in shy edge distance hole results in bulging or breakout
• Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

(1) Method A for Condition 1

NOTE: This repair is designed for the following two hole conditions:
• Condition 1 - Mislocated fastener holes
• Condition 2 - Tooling holes in close proximity to fastener holes

Using AD rivet material in standard rivet hole.

(a) Where discrepant hole does not exceed limits, plug with AD or DD rivet MS20426 or NAS1097, as applicable as follows (see Table 204):

1 Drill hole to smallest diameter.
2 If neither exposed surface of part or assembly requires flush finish (for clearance, aerodynamic smoothness, etc.) and discrepant hole is not countersunk, install shank of AD rivet wet. See Sealing Pressurized Areas, Skin Joints, Faying Surfaces, Access Closures and Coating Exterior Surfaces, 51-22-00, Repair.
3 Shop head both sides.
4 If flush finish is required, touch countersink faying surface 0.010 / 0.020 X 100° prior to shank installation.
5 Micro shave countersunk face flush.
6 Alodine per MIL-C-5541 and apply touch up paint as follows:
   a See Integral Fuel Tank Coating - MIL-C-27725 Application, 51-22-00, Repair for inside tank.
   b See Epoxy Primer Coating - Preparation and Application (Including Finish 2012), 51-07-10, Repair for outside tank.

(b) If hole is countersunk, use flush-head rivet.

NOTE: Use MS20426 or NAS1097 rivet depending on depth of existing countersink.

1 If flush finish is required on opposite surface, touch countersunk 0.020 / 0.040 and finish rivet flush; if not, plug rivet may be installed with upset raised head.

NOTE: If not, plug rivet may be installed with upset raised head.

(2) Method B for Condition 1

NOTE: This method is to be used primarily when the hole represents a leak path in a fluid or pressure boundary structure. Method A is generally preferred for its superior hole filling characteristics.
(a) Verify hole diameter with micrometer or equivalent; if within tolerance. See Table 205.


2. Install fastener.

(b) If requirements above are not met, ream hole to next oversize diameter and install fastener noted.

(c) Wet install the plug fastener. See Sealing Pressurized Areas, Skin Joints, Faying Surfaces, Access Closures and Coating Exterior Surfaces, 51-22-00, Repair.

(d) Brush seal the head and collar of the plug fastener after installation. See Sealing Pressurized Areas, Skin Joints, Faying Surfaces, Access Closures and Coating Exterior Surfaces, 51-22-00, Repair.

NOTE: Flush or raised head fasteners may be used for plugging under same conditions applicable to use of rivets (Method A).

(e) Permissible to install with appropriate AN960 washers under collar for grip length adjustment.

NOTE: Two washers maximum allowed.

(3) Condition 2

(a) The minimum acceptable distance between the centerline of a fastener hole and the edge of a tooling hole shall be no less than the distance called out for the centerline of the fastener to the edge of the part to use as is. See Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General.

NOTE: For closer distances between fastener and tooling hole the following repairs may be made, provided that the repair plate can lie in contact with the defective part.

Repair Method A is preferred and should be used whenever the dimensions of the part permit.

The repair plate should be of the same material and temper as the defective part, except that 2024-T3 may be substituted for 2014-T6 if material of the repair plate is one gage heavier than the defective part.

The rivets should be the same as the general riveting in the area. The size of the repair plate should be adjusted to pick up existing fasteners where this is practicable.

If the repair plate cannot lie directly in contact with the defective part, i.e., where the defective part is one of the middle layers of a multi-layer stack up, then contact Gulfstream Technical Operations.

A rivet should be installed in the original rivet hole. If the part with the tooling hole can be separated from the assembly, plug the tooling hole with “AD” rivet material touch countersunk flush, both sides. Otherwise, leave the hole open.

Do not touch countersink both sides of any single part that is less than 0.063 thick.
Table 204: Hole Diameter

<table>
<thead>
<tr>
<th>HOLE DIAMETER</th>
<th>NOMINAL RIVET DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.063 - 0.071</td>
<td>1/16</td>
</tr>
<tr>
<td>0.097 - 0.106</td>
<td>3/32</td>
</tr>
<tr>
<td>0.127 - 0.140</td>
<td>1/8</td>
</tr>
<tr>
<td>0.158 - 0.174</td>
<td>5/32</td>
</tr>
<tr>
<td>0.190 - 0.209</td>
<td>3/16</td>
</tr>
<tr>
<td>0.251 - 0.276</td>
<td>1/4</td>
</tr>
</tbody>
</table>

Table 205: Fasteners

<table>
<thead>
<tr>
<th>HOLE DIAMETER</th>
<th>METHOD B1 PROTRUDING HEAD</th>
<th>METHOD B2 COUNTERSUNK FASTENER</th>
<th>COLLAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1850 - 0.1880</td>
<td>HSTB410-6</td>
<td>HSTB409-6</td>
<td>HST70-6</td>
</tr>
<tr>
<td>0.1980 - 0.2010</td>
<td>HSTB110-6</td>
<td>HSTB611-6</td>
<td>HST84-6</td>
</tr>
<tr>
<td>0.2135 - 0.2165</td>
<td>HSTB210-6</td>
<td>HSTB711-6</td>
<td>HST84-6</td>
</tr>
<tr>
<td>0.2450 - 0.2480</td>
<td>HSTB410-8</td>
<td>HSTB409-8</td>
<td>HST79-8</td>
</tr>
<tr>
<td>0.2605 - 0.2635</td>
<td>HSTB110-8</td>
<td>HSTB611-8</td>
<td>HST84-8</td>
</tr>
<tr>
<td>0.2760 - 0.2790</td>
<td>HSTB210-8</td>
<td>HSTB711-8</td>
<td>HST84-8</td>
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<tr>
<td>0.3075 - 0.3105</td>
<td>HSTB410-10</td>
<td>HSTB409-10</td>
<td>HST79-10</td>
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<tr>
<td>0.3231 - 0.3261</td>
<td>HSTB110-10</td>
<td>HSTB611-10</td>
<td>HST84-10</td>
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<tr>
<td>0.3385 - 0.3415</td>
<td>HSTB210-10</td>
<td>HSTB711-10</td>
<td>HST84-10</td>
</tr>
<tr>
<td>0.3700 - 0.3730</td>
<td>HSTB410-12</td>
<td>HSTB409-12</td>
<td>HST79-12</td>
</tr>
</tbody>
</table>
15. Minor Scratches, Wrinkles, Dents or Depressions in Pressurized and Nonpressurized Sheet Metal

**NOTE:** The following restrictions and limitations apply:

- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.
- Skins that are pressure boundary members require Gulfstream Technical Operations provided engineering review and approval prior to repair.
- See Aerodynamic Contour Smoothness, 51-14-00, Repair prior to proceeding with this repair.
- Wrinkles shall not exceed a height equal to 10 percent of the material thickness.
- Dents or depressions shall be no less than 1/10 inch in width and the diameter shall not exceed 1 1/2 inches, nor a depth of 0.010 inch.
- Wrinkles, dents or depressions which appear to have been caused by impact with a sharp object, or, which are not smoothly contoured, must be penetrant inspected per ASTM-E1417.
- A scratch shall not be closer to a fastener hole than two fastener shank diameters.
- Reduction in metal depth due to blended scratches shall not exceed the minimum thickness dimension of the specific sheet metal drawing requirements. Blended scratches shall not extend from any sealant groove location to an adjacent edge of the faying surface. Liquid penetrant inspect per ASTM-E1417 to ensure that the scratches have been completely removed.
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure.
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications.
A. Preparation

CONSUMABLES

Epoxy topcoat (GAC finish code 3020) .................................................. Deft 01-X-059 / 01-X-059C

B. Procedure

(1) Condition 1 - Wrinkles, Dents or Depressions

(a) Smoothly surfaced wrinkles, dents or depressions within the limits are acceptable as is. See limitations above.

WARNING: IF DAMAGE EXCEEDS CONDITION 1A, A FERRY PERMIT IS REQUIRED FROM THE OPERATORS REGULATORY AGENCY.

(2) Condition 1A - Wrinkles, Dents or Depressions more severe than Condition 1.

NOTE: This repair procedure is to allow the aircraft to return to its home base for final assessment of the damage and subsequent repair.

(a) Inspect area.

(b) Perform fluorescent penetrant inspection, if wrinkles, dents and / or depressions are 0.060 greater than the following limitations:

   1 Wrinkles exceed a height equal to 10 percent of the material thickness.
   2 Dents or depressions shall be no less than 1/10 inch in width and the diameter exceed 1 1/2 inches, or a depth of 0.010 inch.
   3 See Aerodynamic Contour Smoothness, 51-14-00, Repair prior to proceeding with this repair.

(c) If free of cracks, rework the area. See Step 15.B.(3)(c) thru Step 15.B.(3)(e).

(d) Fill with aerodynamic sealer. See Sealing of Surfaces for Aerodynamic Smoothness, 51-14-00, Repair.

(e) Blend to contour.

(3) Condition 2 - Minor Scratches

(a) If damage does not penetrate Alclad on aluminum alloy sheet metal - repair is not required. If estimated depth of blended damage does not exceed the depth limitations noted, then blend out smoothly. See Step 15.B.(3)(c).

(b) The depth of scratch or damage shall be determined by the use of an optical micrometer or equivalent inspection procedure.

(c) All skins containing visible scratches or damage which does not exceed limitations shall be reworked by blending out smoothly using aluminum oxide or other approved abrasive materials. The extent of the blend area shall not exceed a maximum width of 1/2 inch to either side or end of the scratch or damage. The depth of the blend shall be just sufficient to remove evidence of the scratch or damage. No fingernail pickup shall occur when the nail is moved along the blended area, and the surface smoothness of the reworked area shall be equal to or better than that of the parent material.

(d) Following rework, the skins may be subjected to ultrasonic material thickness inspection checking equipment testing, or shall be checked by other suitable inspection methods to insure that the blend area does not exceed the maximum allowable scratch or damage depth.
(e) Surfaces already alodined or anodized shall receive chemical treatment per MIL-C-5541 immediately following blending. See Chromate Conversion Coating of Aluminum Alloys, 51-21-00, Repair. Replace any paint type finishes removed during the blending operation.

(f) Unpainted alclad surfaces where the depth of the damage and / or blend out does not penetrate the Alclad do not require any further treatment.

(g) Defects regarding unpainted Alclad surfaces where the depth of damage and / or blend out penetrates the Alclad and which will not be subsequently painted, such as wing and winglet leading edges.

C. Repair

(1) Remove scratches or other imperfections on the air passage surface.

**NOTE:** The following procedure is included as a guide:

(a) Using air driven motor and muslin buffing wheel, rotate buffer and apply Lea compound Grade C (Lea Mfg. Co.) or equivalent, allow to dry while rotating and adding compound as required during operations.

(b) Move the wheel rapidly from side to side to avoid burning. If burning does appear, add buffing compound Lea Rok Grade No. 316 (White Bar - Lea Mfg. Co.) or equivalent.

(c) Where necessary to remove deep scratches use 500 grit or finer silicon carbide paper and rework surface as required to remove swirls and scratches.

(2) Test for clad removal areas as follows:

(a) Test for clad removal areas by using one drop of clad test solution in suspect areas. Clad test solution is prepared by adding 10 grams of sodium hydroxide and 20 grams of potassium nitrate to 100 milliliters of distilled water. Clad test solution shall be allowed to remain on suspect area for 30 seconds to 1 minute. A whitish etch area indicates sufficient clad, whereas a black discoloration indicates clad penetration.

(b) Immediately neutralize suspect areas with neutralizer solution (10 percent by weight chromic acid solution in distilled water), and rinse with distilled water. Blot with absorbent paper towels.

(c) Document location and size of clad removal areas.

(3) Repair of clad removal areas:

(a) In areas where clad has been removed, use Met-All polish (Dars Met All Industries, Inc., Long Island City, New York) or other material qualified to MIL-P-6888, polishing to a high gloss consistent finish.

(b) Wipe the area with Acetone (ASTM D329), Methyl Propyl Ketone (MPK) or Methyl Ethyl Ketone (MEK) to remove residue from Met-All polish.

(c) Apply clear epoxy topcoat (Gulfstream finish 3020) to localized clad penetrated areas if applicable.

(d) After a 30 minute air dry time, cure the 3020 for 3 hours at 125 – 10°F.

**NOTE:** See Aluminum and Aluminum Alloy - Corrosion Removal, 51-13-21, Repair for an alternate method for testing and repair of clad surfaces.
16. Rivet Set Cuts

NOTE: The following restrictions apply:

- Not for use on machined, forged or cast parts and/or parts involving the use of interference fit fasteners.
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure.
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Maximum of 2 adjacent fasteners with set cuts
- Maximum of eight set cuts on any skin panel or web
- Maximum depth of final blend shall not exceed 25% of sheet thickness
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

NOTE: The following is performed in conjunction with Figure 213.

(1) If depth of cut is 1/4 of sheet thickness or less, blend out cut smoothly following blending techniques and surface treatment of standard repair Minor Scratches, Wrinkles, Dents or Depressions in Pressurized and Nonpressurized Sheet Metal, 51-70-00, Repair.

(2) Fluorescent penetrant inspect to ensure complete removal of cut.

(3) Where the blend out occurs on an air passage surface, fill the depression flush to the adjacent air passage surface with aerodynamic sealer before the application of final finishers. See Sealing of Surfaces for Aerodynamic Smoothness, 51-14-00, Repair.

NOTE: Liquid penetrant inspection, per ASTM E-1417 or magnetic particle inspect per MIL-STD-1949 to ensure that the cuts have been completely removed.

(4) Inspect for presence of foreign objects.

(5) Record all maintenance actions in accordance with current Federal Aviation Regulations.
17. Crack in Radius of Flange

NOTE: The following restrictions apply:

- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.
- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- For Condition 1 - cumulative length of multiple cracks must not exceed 10% of the flange lengths and individual cracks must be separated by at least 3 inch of sound material
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

Liquid penetrant inspect per ASTM E-1417 or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

A. Procedure

NOTE: The following is performed in conjunction with Figure 214.

(1) Condition 1 - Crack up to 1/4 inch long and extending for no more than 10% of the flange radius length.
   (a) Rout out crack smoothly with 1/8 inch minimum radius, blend into any adjacent edges and use.
   (b) Surface finish of reworked edges must be equal to or better than the original part
requirement.

(2) Condition 2 - Crack more than 1/4 inch long but no greater than 6 inches long or extending for more than 10% but no more than 30% of the flange radius length.

(a) Rout out crack smoothly, polish all edges and leave flange in place.

(b) Manufacture a reinforcing angle of the same configuration, material, temper, finish and thickness as the cracked flange and adjacent portion of web.

(c) Install the reinforcing angle in a position nested against the inside radius of the damaged part and extending a sufficient distance beyond any inside end of the crack to pick up two additional flange fasteners at each such end.

(d) The web leg of the reinforcing angle is to pick up added fasteners through the web, the same number as through the flange leg and of the same material and diameter except that where the cracked flange contains only one fastener, two added web fasteners shall be installed.

(e) Maintain the same spacing as for the flange and provide for two fastener diameters edge distance except that a reduced edge distance may be allowed where necessary. See Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General.

(3) Alternate Repair B

(a) Cut off the entire length of flange.

(b) Manufacture a replacement angle section of the same configuration, material, temper, finish and thickness as the original flange.

(c) Install the special angle on either side of the web as circumstances dictate, picking up added fasteners through the web, the same number as through the flange leg and of the same material and diameter, except that where the cracked flange had contained only one fastener, two added web fasteners shall be installed.

(d) Maintain the same spacing as for the flange leg and provide for two fastener diameters edge distance except that a reduced edge distance may be allowed where necessary. See Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General.

**NOTE:** Where no flange fasteners exist, where the existing flange type fasteners cannot be installed, or where existing web fasteners would interfere with the angle installation, contact Gulfstream Technical Operations for approval of number and location of angle to web attachment fasteners to use.

(4) Inspect for presence of foreign objects.

(5) Record all maintenance actions in accordance with current Federal Aviation Regulations.
Crack in Radius of Flange

**CONDITION 1**

- 1/4 INCH MAX AND LESS THAN 10% OF RADIUS LENGTH
- WEB
- FLANGE
- REPAIR FOR CONDITION 1

**CONDITION 2**

- BETWEEN 1/4 INCH AND 6 INCHES OR BETWEEN 10% AMD 30% OF RADIUS LENGTH
- WEB
- FLANGE
- MUST PICK UP TWO FASTENERS BEYOND EDGE OF CRACK ON BOTH LEGS
- REPAIR FOR CONDITION 2

**ALTERNATE REPAIR B:**

Either Side of Web

Crack In Radius of Flange
Figure 214

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STRUCTURAL REPAIR MANUAL

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18. Cracked Lightening Hole Flange

NOTE: The following restrictions apply:

- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.
- Maximum flange width is 3/4 inch
- Repair is not applicable where it is necessary to use existing fasteners or where any existing fasteners fall within two diameters of any added fastener
- Blind rivets shall be used only when absolutely necessary. Flush blind rivets are not permitted
- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

NOTE: The following procedure is performed in conjunction with Figure 215.

(1) File out crack smoothly.

NOTE: Liquid penetrant inspect per ASTM E-1417, or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

(2) Blend out crack smoothly.

(3) Add repair angle as shown picking up two added fasteners each side of crack.

(4) Attach other leg of angle with four fasteners.

(5) Use AD rivets of size listed below for aluminum structure and NAS1198, NAS1199 or NAS1200 rivets of size listed below for titanium structure.

<table>
<thead>
<tr>
<th>FLANGE THICKNESS</th>
<th>RIVET SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 0.040</td>
<td>3/32 inch</td>
</tr>
<tr>
<td>0.041 - 0.064</td>
<td>1/8 inch</td>
</tr>
<tr>
<td>0.065 - 0.090</td>
<td>5/32 inch</td>
</tr>
</tbody>
</table>

NOTE: Liquid penetrant inspect per ASTM E-1417, or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

(6) Inspect for presence of foreign objects.

(7) Record all maintenance actions in accordance with current Federal Aviation Regulations.
19. Lateral Crack in Flange or Angle Leg

NOTE: The following restrictions apply:

- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.
- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- This repair is not applicable when crack is within four fasteners of a splice
- Repair is not applicable for beyond centerline cracks in the same area of both adjoining flanges
- No more than two cracks per 6 inches of flange length
- Where cracks not extending past the flange centerline occur in both legs of angle within two fastener spaces, repair as for Condition 2
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

NOTE: The following procedure is performed in conjunction with Figure 216.

(1) Condition 1

(a) Rout out the crack smoothly with 1/8 inch minimum radius and polish all edges.
(b) Add repair plate of same material, heat treat, finish and thickness as cracked member.
(c) Chamfer or radius edge of repair plate to nest into bend radius of angle.
(d) Attach repair plate with an equal number of rivets on both sides of blend out.
(e) See Table 206 for the minimum required number, type and size of rivets.
(f) This repair may be used where only two rivets can be installed between the blend out and the flange end by installing only those two rivets through the repair plate on that side of the blend out.

(2) Condition 2
(a) Rout out the crack smoothly with 1/8 inch minimum radius and polish all edges.
(b) Add repair angle of same material, heat treat, finish and thickness as cracked member.
(c) Attach repair angle with an equal number of rivets on both sides of blend out.
(d) Duplicate rivet pattern on other leg of repair angle and flange.
(e) See Table 206 for the minimum required number, type and size of rivets.
(f) This repair may be used where only two rivets can be installed between the blend out and the flange end by installing only those two rivets through each leg of repair angle on that side of the blend out.

NOTE: Liquid penetrant inspect per ASTM E-1417 or magnetic particle inspect per MIL-STD-1949 to ensure that crack has been completely removed.

(3) Inspect for presence of foreign objects.
(4) Record all maintenance actions in accordance with current Federal Aviation Regulations.

Table 206: Type, Number and Size of Rivets Required on Each Side of Crack

<table>
<thead>
<tr>
<th>FLANGE THICKNESS</th>
<th>FLANGE WIDTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up to 0.50 inch</td>
</tr>
<tr>
<td>Up to 0.040</td>
<td></td>
</tr>
<tr>
<td>Rivet Type(^{(1)}) (Qty Dia) A</td>
<td>(3) 3/32</td>
</tr>
<tr>
<td>Rivet Type(^{(1)}) (Qty Dia) B</td>
<td>(3) 1/8</td>
</tr>
<tr>
<td>0.041 - 0.064</td>
<td></td>
</tr>
<tr>
<td>Rivet Type(^{(1)}) (Qty Dia) A</td>
<td>(3) 1/8</td>
</tr>
<tr>
<td>Rivet Type(^{(1)}) (Qty Dia) B</td>
<td>(3) 1/8</td>
</tr>
<tr>
<td>0.065 - 0.080</td>
<td></td>
</tr>
<tr>
<td>Rivet Type(^{(1)}) (Qty Dia) A</td>
<td>(4) 1/8</td>
</tr>
<tr>
<td>Rivet Type(^{(1)}) (Qty Dia) B</td>
<td>(3) 1/8</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Rivet types: A (aluminum alloy) MS20470-AD solid protruding MS20426-AD solid dimpled, B (aluminum alloy) NAS1097-AD solid CSK GR500L blind protruding, C (required for titanium) NAS1198 solid A286 protruding, D (required for titanium) NAS1199 solid A286 CSK.

NOTE: Where existing rivets are to be picked up, they shall be at least as large and there shall be at least as many as the table specifies.
20. Drill Marks

**NOTE:** The following restrictions apply:

- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners or to within six fasteners of a splice.
- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Blended edge of drill mark shall not be closer than two final hole size diameters to any fastener hole
- Maximum depth of final blend shall not exceed the lesser of 30% of the part thickness or 0.062
- Length of the drill mark shall not exceed the lesser of 1/3 the width of the member on which it occurs or 0.38
- Drill mark damage shall not exist within part cross section through fastener holes
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

**A. Procedure**

**NOTE:** The following procedure is performed in conjunction with Figure 217.

1. **Condition 1**
   - Blend out the drill mark smoothly without increasing the existing penetration depth.
   - The surface smoothness of the blended area shall be equal to or better than that of the basic part.
(2) Condition 2 thru 4
   (a) Locally blend out the depression to a smooth match with the surrounding surface without increasing the existing penetration depth.
   (b) The surface smoothness of the blended area shall be equal to or better than that of the basic part.
   NOTE: Where the blended drill marks occurs on an air passage surface, fill the depression flush to the adjacent air passage surface with aerodynamic sealer before the application of final finishes. See Sealing of Surfaces for Aerodynamic Smoothness, 51-14-00, Repair.

(3) Inspect for presence of foreign objects.
(4) Record all maintenance actions in accordance with current Federal Aviation Regulations.

21. Crack or Puncture in Interior or Exterior Skins

   NOTE: The following restrictions apply:
   Crack or puncture greater than 1 inch from any flange.
   Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.
   • Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
   • This repair not applicable when cleanout of crack or hole is closer than 1 inch to any nearby adjoining member, edge of part, or edge of another hole
   • This repair is applicable to aluminum alloy skins only
   • Repair installations utilizing this repair must result in equal to or greater capability than the original
The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.

For skin cracks on aluminum honeycomb panels, see Metal Honeycomb and Metal to Metal Bonded Assemblies, 51-79-10, General

This repair is not applicable to damage greater in length than 0.50 inches

Pressurized skin repair doublers are to be installed on the inside (pressure side)

Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

NOTE: The following procedure is performed in conjunction with Figure 218.

(1) Condition 1 - Interior or exterior skin crack or puncture more than 1 inch from nearest adjoining member or edge and such that a circular hole of no more than 1/4 inch diameter will completely clean out all evidence of damage.

   (a) Repair per Extraneous Holes in Aluminum Alloy Parts and Assemblies, 51-70-00, Repair.

(2) Condition 2 - Interior skin crack or puncture more than 1 inch from nearest adjoining member or edge and not exceeding a maximum dimension of 1/2 inch.

   (a) Rout damage out completely and clean out with a 0.50 inch diameter hole.

   (b) Make and install a centered 2.25 inch diameter doubler of the same material, heat treat, thickness, and finish as the damaged skin.

   (c) Attach doubler with eight added fasteners evenly spaced around a 1.50 inch diameter fastener circle.

   (d) Fastener size type and spacing shall be as designated by Gulfstream Technical Operations.

   (e) Patch shall be bonded to skin using faying surface sealant MIL-S-8802. See Fuel Resistant Sealing Compound - Fillet and Faying (−65°F to +360°F Service), 51-21-00, Repair.

(3) Condition 3 - Exterior or air passage skin crack or puncture more than 1 inch from nearest adjoining member or edge and not exceeding a maximum dimension of 1/2 inch.

   (a) Same as Condition 2 except patch plate is to be installed against inner surface.

   (b) Also, make and attach a centered 0.44 inch diameter filler disc of the same material, heat treat, thickness, and finish as the damaged skin, to the patch plate with 1 NAS1097-AD4 rivet.

   (c) Filler is to be bonded to patch plate with MIL-S-8802 and finished to the requirements of the affected skin. See Fuel Resistant Sealing Compound - Fillet and Faying (−65°F to +360°F Service), 51-21-00, Repair.

(4) Condition 4 - Skin crack or puncture more than 1 inch from any adjacent flange, longer than 1/2 inch in length, but no longer than 25% of the skin panel or bay width.

   (a) Repair in the same manner as for Condition 2 or Condition 3 as applicable except that the number, size and location of all fasteners between the patch plate and the original skin and between the filler and the patch plate shall be as designated by a Gulfstream Technical Operations engineer.
NOTE: Liquid penetrant inspect per ASTM E 1417 or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

(b) When air passage areas are affected, proper attention should be given to ensure proper aerodynamic smoothness is maintained over repaired area. See Aerodynamic Contour Smoothness, 51-14-00, Repair and Sealing of Surfaces for Aerodynamic Smoothness, 51-14-00, Repair.

(5) Inspect for presence of foreign objects.

(6) Record all maintenance actions in accordance with current Federal Aviation Regulations.
Crack or Puncture In Interior or Exterior Skins and Greater Than One Inch From Any Flange

Figure 218

STRUCTURAL REPAIR MANUAL

NO LESS THAN 1.0 INCH (TYPICAL)

FILLER - SHOWN INSTALLED IN CLEARED OUT DAMAGE ON SKIN EXTERIOR USING 1 RIVET AS SHOWN

ADDED CIRCULAR DOUBLER WITH 8 FASTENERS AS SHOWN (CONDITION 3 SHOWN)

NO LESS THAN 1.0 INCH (TYPICAL)

29368C00

Crack or Puncture In Interior or Exterior Skins and Greater Than One Inch From Any Flange
Figure 218

51-70-00
Page 244
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22. Crack or Puncture in Continuous or Spliced Interior or Exterior Skin — Flanged Side

NOTE: The following restrictions apply:

- This repair is for flanged side of support member.
- Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners.

- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Crack or hole when cleaned out shall be within 1 inch of fastener row
- For titanium skins, filler attachment rivets shall be NAS1200-3
- Maximum of three cracks per skin spaced no closer than 6 fasteners
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

NOTE: The following procedure is performed in conjunction with Figure 219.

(1) Condition 1 - Interior or exterior skin reinstated crack or puncture within 1 inch of adjacent flange fastener row, on flanged side of support member, and such that a circular hole of no more than 1/4 inch diameter will completely clean out all evidence of damage.

   (a) Repair per Extraneous Holes in Aluminum Alloy Parts and Assemblies, 51-70-00, Repair.

(2) Condition 2 - Interior skin crack or puncture within 1 inch of adjacent flange fastener row, on flanged side of support member, and not exceeding a maximum dimension of 1/2 inch.

   (a) Rout out damage smoothly to clean out with a minimum radius of 0.125 inch and in each instance make and install the joggled backing plate only, as described in Repair for Condition 3.

   NOTE: Liquid penetrant inspect per ASTM E 1417 or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

(3) Condition 3 - Exterior or air passage skin crack or puncture within 1 inch of adjacent flange fastener row, on flanged side of support member and not exceeding a maximum dimension of 1/2 inch.

   (a) Clean out damage completely with a minimum radius of 0.125 inch, removing the minimum amount of material to create an outline suitable for the manufacture and installation of a metal filler with a minimum dimension of 1/4 inch.

   (b) Make and install a joggled backing plate of the same material, heat treat, finish and thickness as the damaged skin, picking up the existing row of flange fasteners, minimum 1 additional row of fasteners through the skin approximately as shown and at least 1 additional fastener on each side or end of the cleaned out damage.

   (c) Fastener callout, size and spacing shall be specified by Gulfstream Technical Operations engineering.

   (d) Make and attach the filler, of the same material, heat treat, finish, and thickness as the damaged skin, to the joggled backing plate, to the flange or where edge distance limitations require, through the flange into the backing plate with a minimum of 1
NAS1097AD3, CSK in air passage side. (See Limitation 4 for titanium skins.)

**NOTE:** Liquid penetrant inspect per ASTM E 1417 or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

(e) Fay and fillet seal in pressurized areas. See Fuel Resistant Sealing Compound - Fillet and Faying (−65°F to +360°F Service), 51-21-00, Repair.

(f) Alternate Repair

1 Use feathered backing plates. See Crack or Puncture in Continuous or Spliced Interior or Exterior Skin - Opposite Flanged Side, 51-70-00, Repair.

(4) Condition 4

**NOTE:** Skin crack or puncture within 1 inch of adjacent flange fastener row, on flanged side of support member, and longer than 1/2 inch in length, but no longer than 25% of the skin panel or bay width.

(a) Repair in the same manner as for Condition 2 or Condition 3 as applicable except that the callout, number, size, and location of all fasteners between the backing plate and the original skin and between the filler and the backing plate shall be as designated by Gulfstream Technical Operations engineering.

**NOTE:** Liquid penetrant inspect per ASTM E 1417 or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

(b) When air passage areas are affected, proper attention should be given to ensure proper aerodynamic smoothness is maintained over repaired area. See Aerodynamic Contour Smoothness, 51-14-00, Repair and Sealing of Surfaces for Aerodynamic Smoothness, 51-14-00, Repair.

(5) Inspect for presence of foreign objects.

(6) Record all maintenance actions in accordance with current Federal Aviation Regulations.
Crack or Puncture on Flanged Side of Support Member

Figure 219

REPAIR SHOWN FOR CONDITION 2

SECTION A - A

Crack or Puncture on Flanged Side of Support Member
Figure 219
23. Crack or Puncture in Continuous or Spliced Interior or Exterior Skin — Opposite Flanged Side

NOTE: The following restrictions apply:

- Not for use on machined, forged or cast parts and/or parts involving the use of interference fit fasteners.
- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Crack or hole when cleaned out shall be within 1 inch of fastener row
- Maximum of three cracks per skin spaced no closer than 6 fasteners
- For titanium skins, backing plate and filler shall be of same material as skin and filler attachment rivets shall be NAS1200-3 or NAS1199-3 milled flush
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

A. Procedure

NOTE: The following procedure is performed in conjunction with Figure 220.

(1) Condition 1 - Interior or exterior skin reinstated crack or puncture within 1 inch of adjacent flange fastener row, on the skin side opposite the flanged side of the support member and such that a circular hole of no more than 1/4 inch diameter will completely clean out all evidence of damage.

(a) Repair per Extraneous Holes in Aluminum Alloy Parts and Assemblies, 51-70-00, Repair.

NOTE: Liquid penetrant inspect per ASTM E-1417, or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

(2) Condition 2 - Interior skin crack or puncture within 1 inch of adjacent flange fastener row, on the skin side opposite the flanged side of the support member and not exceeding a maximum dimension of 1/2 inch.

(a) Rout out damage smoothly to clean out with a minimum radius of 0.125 inch and in each instance make and install a backing plate only, as described in Step 23.A.(3).

NOTE: Liquid penetrant inspect per ASTM E-1417, or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

(3) Condition 3 - Exterior or air passage skin crack or puncture within 1 inch of adjacent flange fastener row, on the skin side opposite the flanged side of the support member and not exceeding a maximum dimension of 1/2 inch.

(a) Clean out damage completely with a minimum radius of 0.125 inch, removing the minimum amount of material to create an outline suitable for the manufacture and installation of a metal filler with a minimum dimension of 1/4 inch.

(b) Make and install a backing plate of 2024-T81 material, 0.025 thick, between the support member and the damaged skin, picking up the existing row of flange fasteners and a minimum of 5 additional fasteners of size and spacing to be determined by Gulfstream Technical Operations engineering.

(c) Feather edges of the backing plate to minimize bulge along the length of the support member.
(d) For spliced skins - a step due to the addition of the backing plate is permissible providing the step is within the limits of specifications. See Aerodynamic Contour Smoothness, 51-14-00, Repair.

(e) Attach the filler of the same material, heat treat, finish and thickness as the damaged skin, to the backing plate with a minimum of 1 NAS1097AD3, CSK in air passage side.

**NOTE:** Liquid penetrant inspect per ASTM E-1417, or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

(4) Condition 4 - Skin crack or puncture within 1 inch of adjacent flange fastener row, on the skin side opposite the flanged side of the support member and longer than 1/2 inch in length, but no longer than 2 inch or 25% of the length of the adjacent flange.

(a) Repair in the same manner as for Condition 2 or Condition 3 as applicable except that the callout, number, size and location of all fasteners between the backing plate and the original skin and between the filler and the backing plate shall be as designated by Gulfstream Technical Operations engineering.

**NOTE:** Liquid penetrant inspect per ASTM E-1417, or magnetic particle inspect per MIL-STD-1949 to ensure that cracks have been completely removed.

(b) When air passage areas are affected, proper attention should be given to ensure proper aerodynamic smoothness is maintained over repaired area. See Aerodynamic Contour Smoothness, 51-14-00, Repair and Sealing of Surfaces for Aerodynamic Smoothness, 51-14-00, Repair.

(5) Inspect for presence of foreign objects.

(6) Record all maintenance actions in accordance with current Federal Aviation Regulations.
Crack or Puncture - Opposite Flanged Side of Support Member

Figure 220

Repair shown for condition 2

Crack shown routed out

Continuous skin

Feathered edge backing plate

SECTION A - A

Crack or Puncture - Opposite Flanged Side of Support Member

Figure 220
24. Cracks on Edges of Flat or Contoured Skins

**NOTE:** The following restrictions apply:

This repair applies to either unrestrained or fastened / spot welded to adjacent structure.

Not for use on machined, forged or cast parts and / or parts involving the use of interference fit fasteners and / or titanium skins.

- Maintain edge distance and spacing requirements per Minimum Fastener Edge and Center-to-Center Distances, 51-70-00, General
- Maximum length of any crack shall not exceed 1/4 inch
- Maximum of two cracks permissible along any one edge of a skin
- Minimum of six fasteners or spot welds required between cracks
- For shy material along edge of part, see Shy Material at Edge - End or Cutout of Sheet Metal Part, 51-70-00, Repair
- Repair installations utilizing this repair must result in equal to or greater capability than the original structure
- The repaired structure must perform the original structure’s intended function such as fuel or air tightness, etc.
- Repair installations utilizing this repair must account for any effect from all previous repairs or modifications

**A. Procedure**

**NOTE:** The following procedure is performed in conjunction with Figure 221.

(1) Blend out crack smoothly without increasing total depth of crack penetration.

(2) Liquid penetrant inspect per ASTM E-1417 surface smoothness of the blended area shall be equal to or better than that of the basic part.

(3) Where possible, fill routed area with aerodynamic filler. See Sealing of Surfaces for Aerodynamic Smoothness, 51-14-00, Repair.

(4) Inspect for presence of foreign objects.

(5) Record all maintenance actions in accordance with current Federal Aviation Regulations.
Cracks on Edges of Flat or Contoured Skins
Figure 221