1. Corrosion Removal

A. General

There are several corrosion removal techniques available. The methods normally used are chemical, hand sanding with abrasive paper or metal wool, pumice slurry abrading, mechanical sanding or buffing with abrasive mats, grinding wheels or rubber mats and abrasive blasting, including abrasive blasting with glass beads. The method used will depend on the metal alloy, the degree of corrosion and the accessibility of the area or part. All methods can be classified as chemical or mechanical. In most corrosion removal rework, the mechanical method is recommended. Many of the chemicals used in the chemical removal method are highly corrosive and extreme care must be exercised to prevent flow of chemicals into joints and seams and onto highly stressed steel parts. Improper use of corrosion removing chemicals will make corrosion even worse or can chemically damage the components.

B. Preparation

CONSUMABLES

- Isopropyl alcohol
- Methyl Isobutyl Ketone (MIBK)
- Sodium hydroxide
- Nitric acid
- Potable water
- Lint free cloths

C. Fairing and Blending Reworked Areas

(1) After corrosion removal, all depressions should be faired or blended with the surrounding surface to minimize stress concentrations. Fairing shall be accomplished as follows:

(a) Select proper abrasive from Table 201. Remove rough edges and all corrosion from the damaged area per the removal procedures presented in the following paragraphs.

(b) After removing corrosion at individual corrosion sites, smoothly blend corrosion removal depressions as shown in Figure 201. In areas having closely spaced multiple corrosion sites, the intervening material shall be removed to minimize surface irregularities or waviness. See Figure 202.

(c) Blend areas where proper clearance does not exist to provide the configuration as shown in Figure 203 as close as possible to these dimensions. Blend the remaining area to fair gradually with no sharp or abrupt changes.

(d) Remove all surface blemishes. Select proper abrasive to obtain desired surface finish.

D. Rework Measurement

(1) After corrosion removal and fairing of the corrosion area, depth measurements must be made to ensure that limits on material removal have not been exceeded. A dial depth gage or impression materials may be used to obtain the desired measurements defined in Corrosion Levels and Rework Limits, 51-13-10, General.
E. Corrosion Removal - Mechanical

NOTE: The mechanical corrosion removal method is recommended for most cases of corrosion damage. Hand sanding with abrasive paper or metal wool, pumice slurry abrading, mechanical sanding or buffing with abrasive mats, grinding wheels, wire brushes or rubber mat. The use of carbide tipped scrapers and abrasive blasting are the mechanical means used for corrosion removal and rework. The general procedures for mechanical corrosion removal are presented in the following paragraphs. For corrosion removal on specific alloys, refer to the applicable paragraphs of this section.

(1) Hand Sanding - The removal of light surface corrosion may be accomplished using the following procedures:

(a) If surface treatment is performed on parts that were shot peened during manufacture, the surface must either be returned to the original / design condition or verification must be obtained that the original condition has not been compromised. Contact Gulfstream Technical Operations to obtain assistance and information.

(b) Disassemble component if necessary to gain access to corrosion. This is essential at all joints, laps, faying surfaces, multi part assemblies and for corrosion found in crevices.

(c) Prepare surfaces by stripping any organic coatings (e.g. paint). See Corrosion Rework Preparations, 51-13-10, General.

CAUTION: DO NOT USE STEEL WOOL OR STEEL BRUSHES TO REMOVE COATINGS OR CORROSION FROM ALUMINUM ALLOYS. DO NOT USE POWER EQUIPMENT WHEN REMOVING MATERIAL. THE DEPTH OF THE REWORK SHALL NOT EXCEED THAT IS PRACTICAL TO ACCOMPLISH BY HAND.

(d) Remove all signs of surface corrosion by hand sanding with any of the 400 grit or finer abrasive materials listed in Table 201.

(e) After removal of all signs of surface corrosion, visually inspect for pitting or other forms of advanced corrosion, determine the thickness of the remaining material and compare this measurement to the minimum design tolerances. If advanced stages of corrosion are present or the remaining material thickness is less than the minimum design tolerances allow, consult the appropriate ATA chapter of this manual or contact Gulfstream Technical Operations.

(f) For aluminum sheet (i.e., skin, leading edges) where the remaining material thickness is acceptable and the material is to remain unpainted or is to be polished, the following procedure shall be used to test for the integrity of the cladding. Surfaces that were originally primed / painted should have the original finishes restored. See Standard Surface Treatment Methods, 51-13-10, General or applicable portions of Chromate Conversion Coating of Aluminum Alloys, 51-21-00, Repair, Surface Preparation and Painting Procedure, 51-07-10, Repair and Application of Epoxy Polyamide Primer Coating, 51-07-10, Repair.

WARNING: TEST SOLUTIONS MAY BE TOXIC OR CORROSIVE. AVOID CONTACT WITH SKIN, EYES OR CLOTHING. MAINTAIN ADEQUATE VENTILATION. IF SOLUTION CONTACTS SKIN, IMMEDIATELY, THOROUGHLY FLUSH WITH CLEAN COLD WATER.

CAUTION: DO NOT USE ACID OR ALKALINE SOLUTIONS IN AREAS WHERE THEY MAY BECOME TRAPPED, SUCH AS UNDER RIVET HEADS OR IN FAYING SURFACES.
1. Clean area with a 50 / 50 MIBK and isopropyl alcohol solution or equivalent and dry with a clean, lint free cloth.

2. Using an eye dropper, apply a 10% sodium hydroxide solution to the area to be tested. Wait 30 - 60 seconds. Remove solution with a clean, dry cloth. The cladding is penetrated if a dark gray to black discoloration occurs. Lack of this discoloration shows that the cladding is intact. Immediately following the evaluation, flush the area with water, then apply several drops of a 10% nitric acid solution. After 10 - 20 seconds, again flush the area with water and dry completely with clean dry cloths.

3. See Minor Scratches, Wrinkles, Dents or Depressions in Pressurized and Nonpressurized Sheet Metal, 51-70-00, Repair for alternate method for the inspection, test and repair of clad aluminum surfaces.

(g) On unprimed / unpainted clad aluminum surfaces where the cladding has been penetrated, the area shall be brush chemical conversion coated. See Standard Surface Treatment Methods, 51-13-10, General or Chromate Conversion Coating of Aluminum Alloys, 51-21-00, Repair. If the cladding is not to be penetrated, no further treatment is required.

(h) Treat the area where corrosion has been removed with a Type II corrosion inhibiting compound listed in Corrosion Inhibitors, 51-13-10, General.

(2) Wire Brushing - Wire brushing is a mechanical abrasive operation usually performed using a hand wire brush or a wire brush mounted on a motor driven wheel. By using brushes of various lengths and gages of wire, a wide range of abrasive action is possible. Wire brushing is used to remove heavy corrosion and imbedded paint or dirt, especially where chemical treatment is impractical. A typical wire brushing procedure follows:

(a) Protect adjacent components from scale, chips, corrosion products and chemical agents.

(b) If grease or soil is present, clean area. See Corrosion Rework Preparations, 51-13-10, General.

WARNING: THE USE OF GOGGLES OR FACE SHIELD IS MANDATORY WHEN USING MOTOR DRIVEN BRUSHES.

(c) Remove any loose corrosion with a hand scraper.

(d) Wire brush area to a firm metal substrate.

(3) Grinding - Grinding is a method of removing heavy corrosion by means of motorized grinding wheels or abrasive belts. Part of the base metal is ground away with the corrosion. A typical grinding procedure follows:

(a) Protect adjacent components from scale, chips, corrosion products and chemical agents.

(b) If grease or soil is present, clean area. See Corrosion Rework Preparations, 51-13-10, General.

WARNING: THE USE OF GOGGLES OR FACE SHIELD IS MANDATORY WHEN USING MOTOR DRIVEN GRINDERS.

CAUTION: MOTORIZED GRINDING, IF NOT CAREFULLY MONITORED, CAN REMOVE MORE MATERIAL THAN NECESSARY OR IT CAN OVERHEAT METAL PARTS AND ENDANGER STRUCTURAL INTEGRITY. THE USE OF OTHER LESS AGGRESSIVE REWORK METHODS IS PREFERRED.

(c) Remove paint and corrosion by grinding until a sound, corrosion free surface is reached. Continue grinding to remove coarse irregularities. Use progressively finer abrasive paper
to polish the surface to the desired finish.

(4) Abrasive Blasting - Abrasive blasting is a method of cleaning or finishing metals and other materials by bombarding the surface with a stream of abrasive particles. Abrasive blasting is a fast method for removing surface corrosion and scale from metal surfaces. Standard blasting practices should be adopted with the following requirements observed:

**WARNING: AVOID EXCESSIVE INHALATION OF ABRASIVE DUST. PROVIDE VENTILATION AS REQUIRED.**

(a) Cabinet Blasting - Cabinet blasting is preferred. External gun blasting may be used if adequate confinement and recovery are provided for the abrasives.

1. Abrasive to be used is glass beads (150 mesh or finer).
2. Parts to be blast cleaned should be removed from other components if possible; otherwise areas adjacent to part must be protected from scale, chips, corrosion products and abrasive impingement.
3. If grease or soil is present, clean area. See Corrosion Rework Preparations, 51-13-10, General.
4. Close tolerance surfaces such as bushings, bearings, close tolerance shafts, threads, etc., shall be protected from blast impingement.
5. Remove only the corrosion products by abrasive blasting with glass beads.

(b) External Gun Blasting - The frequency of occurrence of filiform corrosion in the airplane industry has led to the development of portable abrasive blasters. A typical external gun blasting procedure for removing filiform corrosion on aluminum skin follows:

1. Remove any heavy soils with alkaline emulsion cleaner.
2. Strip the protective finish (both enamel and primer).
3. Mechanically remove the filiform corrosion by blasting with glass beads (approximately 150 mesh).
4. After blasting, remove any enamel or primer that may remain in the corrosion cleanup area. Flush with water and clean the surface in preparation for surface treatment.

(c) Portable Abrasive Blaster - Filiform corrosion can be quickly removed by use of a portable abrasive blaster. In order that operators may be informed of available abrasive blasters, a brief description of one of the units follows:

1. One unit found to be effective is the Model E-10A Clemco Eductomatic Portable Blast Cleaner, manufactured by Clemco Industries, 1950 Elk Horn Court at 20th, San Mateo, California 94403. It weighs 7 pounds and includes an abrasive reservoir (which holds up to 4 pounds of glass beads), suction abrasive pickup, swivel blast nozzle and vacuum abrasive return. See Figure 204.
2. The blast head has a concentric arrangement. The inner tube blasts the glass beads against the airplane surface and the outer passage retrieves the beads and dust and separates them. A double acting control valve regulates both the blast and the suction. The blast head is connected by a swivel joint to the body of the unit. This feature makes it possible to direct the blast in any direction by rotating the blast head while holding the main body of the machine in an upright position.
During blasting, the air source must be regulated to 80 psi pressure maximum. The blast nozzle should be held on the surface so that it removes corrosion in an approximate one inch diameter path. Use of the equipment requires a moderate amount of skill that can be gained by practicing on a test panel.

The glass beads quickly remove corrosion (about 36 linear inches per minute) but removes almost none of the cladding on the aluminum surface.

The blast gun, glass beads, air source and a work stand are all that are needed to accomplish the mechanical corrosion removal.

F. Corrosion Removal - Chemical

(1) The chemical corrosion removal method may be used on the airplane where the chemical flow can be controlled and the applied area can be thoroughly washed with water. Since the chemicals used for corrosion removal are highly corrosive themselves, extreme care must be exercised to prevent the chemicals from flowing onto or becoming trapped in lap joints, faying surfaces, splices, etc. On parts removed from the airplane, the chemical removal method may be found to be the most desirable. The chemical agents used in corrosion removal are of the acid type. Since each metal has specific chemicals that are used for corrosion removal, the corrosion removal procedures are outlined in the applicable paragraphs.

G. Special Corrosion Removal Techniques

(1) Special corrosion removal techniques shall be used when corrosion damage has occurred due to causes other than normal aircraft service. An example of this is corrosion damage from mercury spillage where corrosion can occur very rapidly. The transport of animals can cause a highly corrosive environment for structures and requires special detection, inspection and removal techniques. The general procedures are outlined in the applicable paragraphs of this section.
### Table 201: Abrasives for Surface Blending and Mechanical Removal of Corrosion and Paint

<table>
<thead>
<tr>
<th>MATERIAL TO PROCESS</th>
<th>RESTRICTION</th>
<th>OPERATION</th>
<th>ABRASIVE CLOTH OR PAPER</th>
<th>ABRASIVE FABRIC OR PAD</th>
<th>WOOL</th>
<th>PUMICE</th>
<th>LAPPING COMPOUND</th>
<th>ABRASIVE WHEEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless steel alloys</td>
<td>Does not apply to heat treats of 220 ksi and above</td>
<td>Corrosion and paint removal</td>
<td>150 grit or finer</td>
<td>150 grit or finer</td>
<td>Fine to ultra fine</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Stainless steel alloys</td>
<td></td>
<td>Finishing</td>
<td>400 grit or finer</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Nickel chromium</td>
<td></td>
<td>Corrosion and paint removal</td>
<td>150 grit or finer</td>
<td>150 grit or finer</td>
<td>Fine to ultra fine</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Nickel chromium</td>
<td></td>
<td>Finishing</td>
<td>400 grit or finer</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Aluminum alloys</td>
<td>Do not use silicon carbide abrasives</td>
<td>Corrosion and paint removal</td>
<td>150 grit or finer</td>
<td>7/0 grit or finer</td>
<td>Fine to ultra fine</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Aluminum alloys</td>
<td></td>
<td>Finishing</td>
<td>400 grit or finer</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
CORROSION DAMAGE BEFORE REWORK
INDIVIDUAL CORROSION SITE HAS BEEN
CLEANED UP TO THE EXTENT THAT ALL
LOOSE CORROSION PRODUCTS
HAVE BEEN REMOVED

DEPRESSION AFTER CORROSION REMOVAL
ROUGH EDGES HAVE BEEN SMOOTHE
AND ALL CORROSION HAS BEEN
REMOVED. HOWEVER, DEPRESSION
HAS NOT BEEN SHAPED

DEPRESSION AFTER SHAPING
BLENDING HAS BEEN ACCOMPLISHED IN
THE CORRECT RATIO AND DIRECTION

Single Depression Fairing
Figure 201
MULTIPLE CORROSION
SITE DAMAGE BEFORE
REMOVAL

SEE
DETAIL A

TRANSVERSE
10D MINIMUM

10 D MINIMUM

LONGITUDINAL

BOTTOM OF DEPRESSION
AFTER REWORK

DAMAGE REMOVED AND SURFACE SMOOTHED WITH SHALLOW ELLIPTICAL DISH-OUT
INTERVENING MATERIAL BETWEEN CLOSELY SPACED MULTIPLE DEPRESSIONS
REMOVED TO FORM SINGLE, SMOOTH SURFACE DEPRESSION

NOTES:
1. SEE SPECIFIC REPAIR
   FOR MAXIMUM
   ALLOWABLE DEPTH
2. SINCE MAXIMUM DEPTH
   VARIES AT DIFFERENT
   LOCATIONS, MAXIMUM
   SIZE OF DEPRESSION
   WILL ALSO VARY
3. THE BLENDING RATIO SHALL
   BE MAINTAINED AT ALL
   TIMES UNLESS OTHERWISE
   SPECIFIED IN A SPECIFIC
   REPAIR

0.125 - 0.50
INCH RADIUS
(TYPICAL)

DEPTH (D)

RUN-OUT

EXAMPLE OF 1 : 10 BLENDING RATIO

DETAIL A

Multiple Depression Fairing / Blend Out Ratio
Figure 202

GULFSTREAM IV
STRUCTURAL REPAIR MANUAL

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Limited Clearance Fairing
Figure 203
PORTABLE ABRASIVE BLASTER COMPONENTS

MAJOR COMPONENTS OF THE CLEMCO PORTABLE BLAST CLEANER MODEL E-10A ARE IDENTIFIED. IT AND SIMILAR UNITS QUICKLY REMOVE FILIFORM CORROSION

FOR BEST RESULTS THE BLAST NOZZLE SHOULD BE HELD ON THE SURFACE SO THAT IT REMOVES CORROSION IN AN APPROXIMATELY 1.0 INCH DIAMETER PATH

BLAST NOZZLE ON WORK SURFACE

THE BLAST OF THE CLEMCO PORTABLE BLAST CLEANER HAS A CONCENTRIC ARRANGEMENT. THE INNER TUBE BLASTS THE GLASS BEADS AGAINST THE CORRODED SURFACE AND THE OUTER PASSAGE RETRIEVES GLASS BEADS AND DUST

BLAST HEAD

Portable Abrasive Blaster
Figure 204