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TASK 20-00-00-912-001

1. Airworthiness Limitation Precautions

A. General

(1) Critical Design Configuration Control Limitations (CDCCLs)

(a) All occurrences of CDCCLs found in this chapter of the AMM are identified by this note after each applicable CDCCL design feature:

1) NOTE: CDCCL – Refer to the task: Airworthiness Precautions (AMM 20-00-00/201), for important information on Critical Design Configuration Control Limitations (CDCCLs).

(b) Design features that are CDCCLs are defined and controlled by Special Federal Aviation Regulation (SFAR) 88, and can be found in Airworthiness Limitations (AWL) and Certification Maintenance Requirements (CMR) document, D6-38278-CMR.

(c) CDCCLs are a means of identifying certain design configuration features intended to preclude a fuel tank ignition source for the operational life of the airplane.

(d) CDCCLs are mandatory and cannot be changed or deleted without the approval of the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency.

(e) A critical fuel tank ignition source prevention feature may exist in the fuel system and its related installation or in systems that, if a failure condition were to develop, could interact with the fuel system in such a way that an unsafe condition would develop without this limitation. Strict adherence to configuration, methods, techniques, and practices as prescribed is required to ensure the CDCCL is complied with.

(f) Any use of parts, methods, techniques or practices not contained in the applicable CDCCL must be approved by the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency.

(2) Airworthiness Limitation Instructions (ALIs)

(a) All occurrences of fuel tank system ALIs found in this chapter of the AMM are identified by this step after the General section in the applicable ALI inspection task:

1) ALI – Refer to the task: Airworthiness Limitation Precautions (AMM 20-00-00/201), for important information on airworthiness limitation instructions (ALIs).

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(b) Inspection tasks that are ALIs are defined and controlled by Special Federal Aviation Regulation (SFAR) 88, and can be found in Airworthiness Limitations (AWL) and Certification Maintenance Requirements (CMR) document, D6-38278-CMR.

(c) These ALIs identify inspection tasks related to fuel tank ignition source prevention which must be done to maintain the design level of safety for the operational life of the airplane.

(d) These ALIs are mandatory and cannot be changed or deleted without the approval of the FAA officethat is responsible for the airplane model Type Certificate, or applicable regulatory agency. Strict adherence to methods, techniques and practices as prescribed is required to ensure the ALI is complied with.

(e) Any use of methods, techniques or practices not contained in these ALIs must be approved by the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency.

B. Access

(1) Location Zones

100 Lower Half of Fuselage
200 Upper Half of of Fuselage
500 Left Wing
600 Right Wing

C. Critical Design Configuration Control Limitations (CDCCLs)

(1) Obey the procedures for items that are identified as CDCCLs.

WARNING: OBEY THE MANUFACTURER'S PROCEDURES WHEN YOU DO MAINTENANCE THAT HAS AN EFFECT ON A CDCCL. IF YOU DO NOT OBEY THE PROCEDURES, IT CAN INCREASE THE RISK OF A SOURCE OF FUEL TANK IGNITION. INJURIES TO PERSONNEL, AND DAMAGE TO EQUIPMENT CAN OCCUR IF THERE IS A FIRE OR EXPLOSION.

D. Airworthiness Limitation Instructions (ALIs)

(1) Obey the procedures for tasks that are identified as ALIs.

WARNING: OBEY THE MANUFACTURER'S PROCEDURES WHEN YOU DO MAINTENANCE THAT HAS AN EFFECT ON AN ALI. IF YOU DO NOT OBEY THE PROCEDURES, IT CAN INCREASE THE RISK OF A SOURCE OF FUEL TANK IGNITION. INJURIES TO PERSONNEL, AND DAMAGE TO EQUIPMENT CAN OCCUR IF THERE IS A FIRE OR EXPLOSION.

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PRESSURE-SENSITIVE DECALS - REMOVAL/INSTALLATION

1. General
   A. This procedure covers application and repair of pressure sensitive plastic film decals.
   B. Apply external sectionalized decal in such a sequence that the overlapping end is downstream from the line of flight.
   C. Activate pressure sensitive adhesives when applying decals at ambient temperatures below 60°F.
   D. Clean plastic film decals with naphtha. Do not use adhesive activator.
   E. Interior decals may also be installed using the same process as pressure-sensitive placards (Ref. 20-10-121).
2. Equipment and Materials
   A. Solvents and Thinners (Ref. 20-30-31)
      (1) Aliphatic Naphtha - TT-N-95
      (2) Cleaning Solvent - BMS 3-2
      (3) Methyl Isobutyl Ketone - TT-M-268
      (4) No. 2911 Thinner
      (5) Activator Solvents
         (a) A-2 Activator
         (b) Cyclohexanone
         (c) A-3 Activator
   B. Paints and Finishes (AMM 20-30-41/201)
      (1) Enamel - BMS 10-11 Type 2
      (2) Vinyl-Type Paint - MIL-P-8793
      (3) Vinyl Process Pastes - 3900 Series
      (4) No. 2960 Edge Sealer
      (5) No. 700 Finishing Clear
   C. Miscellaneous
      (1) Masking Tape - UU-T-106 (AMM 20-30-51/201)
      (2) Felt squeegee
      (3) Cheesecloth (AMM 20-30-51/201)
      (4) Plastic scraper (See AMM 51-31-0/201 for approved plastic scrapers)
      (5) Abrasive paper, 140 grit
      (6) Scotchcal Cutter - Boeing tool St 732

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(7) Pin, air release tool 391X
(8) Pin, air release tool 71604
(9) Power Grip MultiPin Air Release Tool MPP-1

3. Remove Decals
A. Exterior decals are removed by paint stripping in accordance with BAC5725.
B. Interior decals, such as indicia strips on instrument panels, instructional decals, etc., installed on interior of airplane are removed by either heat softening or by solvent breakdown.
(1) Remove interior decals by heat softening with an approved heat source.
(a) Carefully warm the decal to about 120 degrees fahrenheit to loosen the adhesive. A recommended heat source is a 250 watt lamp mounted in an approved fixture.

CAUTION: OVERHEAT WILL CAUSE SOME DECALS TO MELT, NECESSITATING REMOVAL BY SOLVENT.

(b) Lift corner of decal with an approved scraper and peel decal from substrate.

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE ABRASIVE PADS (SCOTCH-BRITE) OR ABRASIVE PAPER ON THE ALUMINUM SURFACE UNLESS THE SCRIBE LINE INSPECTIONS WERE MADE. ABRASIVE PADS CAN SMOOTH THE ALUMINUM SURFACE AND HIDE SCRIBE LINE MARKS. IF YOU USE ABRASIVE PADS TO REMOVE PAINT OR PRIMER BEFORE YOU DO THE SCRIBE LINE INSPECTIONS, YOU CAN BE REQUIRED TO DO REPEAT INSPECTIONS BASED ON THE SCRIBE LINE INSPECTION SERVICE BULLETIN 737-53A1262.

(c) If required, clean substrate using cheesecloth pad moistened with solution made of equal parts of cleaner and water.
(2) Remove interior decals by solvent breakdown.
(a) Wet decal with Aliphatic Naphtha using brush or cloth.
(b) After decal is wrinkled (approximately 2 minutes after wetting), rewet surface again.
(c) After approximately 2 minutes, slide softened decal off of substrate or scrape off using spatula.
(d) If required, clean substrate using cheesecloth pad moistened with Aliphatic Naphtha.

4. Install Decal
A. Clean receiving surfaces.
(1) Clean corroded aluminum surfaces per Chapter 51, Corrosion Removal and Control.
(2) Clean wax-coated aluminum surfaces per Chapter 12, Cleaning and Washing, until area shows a water-break-free surface.

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(3) Clean unpainted polyester or phenolic plastics with Aliphatic Naphtha and a clean cloth. Wipe cleaner dry with a clean cloth. Do not allow to air-dry.
(4) Lightly sand cork surfaces with 150-grit abrasive paper until a clean cork surface is obtained. Remove sanding dust with a clean dry cloth.
(5) Clean all other surfaces thoroughly with naphtha cleaner and a clean dry cloth. Do not allow cleaner to evaporate, but wipe dry with a clean cloth.

B. Prepare decal for installation.
(1) On decals with an area of less than 1 square foot, remove the backing and lay the decal face down on a smooth surface.
(2) On decals with an area of greater than 1 square foot, position the decal on the receiving surface using masking tape.
(a) Cut a sheet of carrier tape approximately 4 inches longer than the decal and about the same width. When using premasked decals, the premask may be used as a carrier.
(b) Place the carrier over the decal, with the edge to be hinged 2 to 3 inches beyond the decal edge.
(c) Hinge the carrier to the receiving surface with masking tape.
(d) Wipe the carrier on with a plastic scraper. Using short strokes, work from the midpoint of the hinge to The edges, removing all wrinkles and air bubbles.
(e) Fold the carrier and decal back at hinge, along the surface with the backing upward. Use masking tape to hold in this position.
(f) Remove the decal backing.
(3) On strip decals, remove about 1 foot of backing and lay the decal face down on a smooth surface.
(4) Activate the adhesive surface of solvent activated decals with A-2 activator or cyclohexanone.

NOTE: If ambient temperature is below 60°F, use A-3 activator.

(a) Dip a felt squeegee in activator solvent and blot excess solvent with an absorbent cloth.
(b) Draw the felt squeegee evenly across the adhesive side of the decal. Do not allow activator to touch film face.
1) Activate strip decals for approximately 6 inches.
2) Activate the entire surface of all other decals using overlapping strokes.

WARNING: A-2 AND A-3 ACTIVATORS AND CYCLOHEXANONE ARE TOXIC AND FLAMMABLE. USE IN WELL VENTILATED AREAS AND AVOID PROLONGED INHALATION OF VAPORS.

C. Apply decal to regular surface.
(1) Position decals with areas less than 1 square foot and adhere one edge to surface. Hold remainder of decal taut and slightly away from receiving surface with a piece of backing on the adhesive side.

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(2) Swing the carrier of decals with an area greater than 1 square foot, into position holding the free end taut and slightly away from the receiving surface with a piece of backing on the adhesive.
(3) Align and adhere about 3 inches of strip decals to the receiving surface.
  (a) Using the applied section as a hinge, strip up to 3 feet of the backing and, if necessary, activate the adhesive.
  (b) Align the stripping and hold it taut and slightly away from the receiving surface.
(4) Starting at the hinge, rub the decal onto the surface using the approved plastic scraper with short fan-like strokes. Do not allow the adhesive to touch the receiving surface until the plastic scraper presses it down.

CAUTION: MAKE SURE THAT YOU ONLY USE APPROVED SCRAPERS ON THE AIRPLANE SKIN. SCRAPERS THAT ARE NOT APPROVED CAN MAKE SCRATCHES ON THE SKIN AND CAUSE FATIGUE CRACKS.

CAUTION: DO NOT USE ABRASIVE PADS (SCOTCH-BRITE) OR ABRASIVE PAPER ON THE ALUMINUM SURFACE UNLESS THE SCRIBE LINE INSPECTIONS WERE MADE. ABRASIVE PADS CAN SMOOTH THE ALUMINUM SURFACE AND HIDE SCRIBE LINE MARKS. IF YOU USE ABRASIVE PADS TO REMOVE PAINT OR PRIMER BEFORE YOU DO THE SCRIBE LINE INSPECTIONS, YOU CAN BE REQUIRED TO DO REPEAT INSPECTIONS BASED ON THE SCRIBE LINE INSPECTION SERVICE BULLETIN 737-53A1262.

(5) Continue stripping, activating and applying strip decals until all of the decal has been applied.
(6) When applying strip decals around a corner and a splice occurs, overlap decal a minimum of 2 inches.

D. Apply decal over irregular surfaces.
(1) Decals applied over a joint between two surfaces which move with respect to each other.

CAUTION: DO NOT DAMAGE THE AIRPLANE SKIN WHEN YOU CUT THE DECAL. DAMAGE TO THE SKIN SUCH AS NICKS, CUTS, SCRATCHES, OR SCRIBE LINES WILL REDUCE THE FATIGUE STRENGTH AND DURABILITY OF THE STRUCTURE.

  (a) For gaps of 0.100 inch and greater, cut the decal at the approximate center of the gap and wrap the decal around both edges. See Method A, Fig. 401.
    1) If you damage the skin or sealant, obey all the specified steps, cautions and references to inspect and repair the sealant and skin in AMM 51-31-00/201 and the applicable structural repair manual.

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(b) For gaps of less than 0.100 inch, cut the decal flush with the forward or upper skin edge and wrap the decal around the aft or lower skin edge. See Method B.
1) If you damage the skin or sealant, obey all the specified steps, cautions and references to inspect and repair the sealant and skin in AMM 51-31-00/201 and the applicable structural repair manual.

(2) Decals applied across lap joints

CAUTION: DO NOT DAMAGE THE AIRPLANE SKIN WHEN YOU CUT THE DECAL. DAMAGE TO THE SKIN SUCH AS NICKS, CUTS, SCRATCHES, OR SCRIBE LINES WILL REDUCE THE FATIGUE STRENGTH AND DURABILITY OF THE STRUCTURE.

(a) The decal, when it is applied, is wrapped smoothly and continuously around the edge of the lap joint. See Method C (preferred method).
(b) An alternate method, acceptable where the decal extends along the lap joint for a considerable distance, is to cut the decal flush with the overlap edge and butt the remainder of the decal with the overlap edge. See Method D.
1) If you damage the skin or sealant, obey all the specified steps, cautions and references to inspect and repair the sealant and skin in AMM 51-31-00/201 and the applicable structural repair manual.

(3) Decals applied to exterior emergency exit handles. See Method E.
(a) Before removing the backing paper, place the decal on the handle and slit the decal overlap around each rounded corner.
(b) Remove the backing paper and apply the decal, pressing the overlap around the edges of the handle.

(4) Using tool St 732, cut decals, except pressure sensitive Polyester, around the heads of fasteners on removable panels and punch the decal into the recessed slot. Cut and remove an area of film, of pressure sensitive polyester decals, the approximate size of a nonflush rivet or fastener using tool St 732. Press the decal film firmly in place around the rivet or fastener. Allow the adhesive to cure for 1/2 hour before sealing edges.

CAUTION: DO NOT DAMAGE THE AIRPLANE SKIN WHEN YOU CUT THE DECAL. DAMAGE TO THE SKIN SUCH AS NICKS, CUTS, SCRATCHES, OR SCRIBE LINES WILL REDUCE THE FATIGUE STRENGTH AND DURABILITY OF THE STRUCTURE.

(5) When application is made over pressurized areas, to prevent air bubbles underneath the decal carefully puncture the unperforated film at each pressurized area (e.g., over a rivet) using a fine needle, pin, or similar pointed object . Do not use a knife or razor.

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(6) Bubbles may be eliminated at any time within 8 hours after application using the following procedure:
(a) Carefully puncture the decal at one edge of bubble using a fine needle, pin, or similar pointed object . Do not use a knife or razor blade.
(b) Softly press out the entrapped air with a squeegee or thumb moving toward the puncture.
(c) If you damage the skin or sealant, obey all the specified steps, cautions and references to inspect and repair the sealant and skin in AMM 51-31-0/201 and the applicable structural repair manual.

E. Remove carrier, or premask and masking tape, by pulling back parallel to decal surface. If additional painting is to be done to the surrounding area, leave premask in place.

F. Seal Edges
(1) When paint has been applied up to the edges of decals, the paint shall be used to seal the edges.
(a) If the decal is premasked the premask shall be removed only after the finishing coat of paint has been applied up to the decal and the paint will still flow sufficiently well to seal edges. If this condition is not met seal the edges by the recommended method.
(2) Brush the edges of the following decals with No. 700 Finishing Clear to a dry film thickness of 0.0015 to 0.0020 inch.
(a) Solvent activated, vinyl decals

WARNING: EDGE SEALER NO. 700 FINISHING CLEAR IS TOXIC AND FLAMMABLE.

(b) BMS 10-26, Type 1 and Type 3 pressure sensitive, elastomeric vinyl decals
(c) Solvent activated, reflective decals
(d) Pressure sensitive, reflective decals
(e) Pressure sensitive, aluminized, mylar decals

NOTE: The edges of decals with an area of less than 1 square foot may be sprayed.
On strip decals brushing of leading edges only is mandatory, brushing of other edges is preferred but optional.

(3) Seal the edges of pressure sensitive polyester decals per Clear Skydrol Resistant Overcoat, Chapter 51, after allowing adhesive to cure for a minimum of 1/2 hour.

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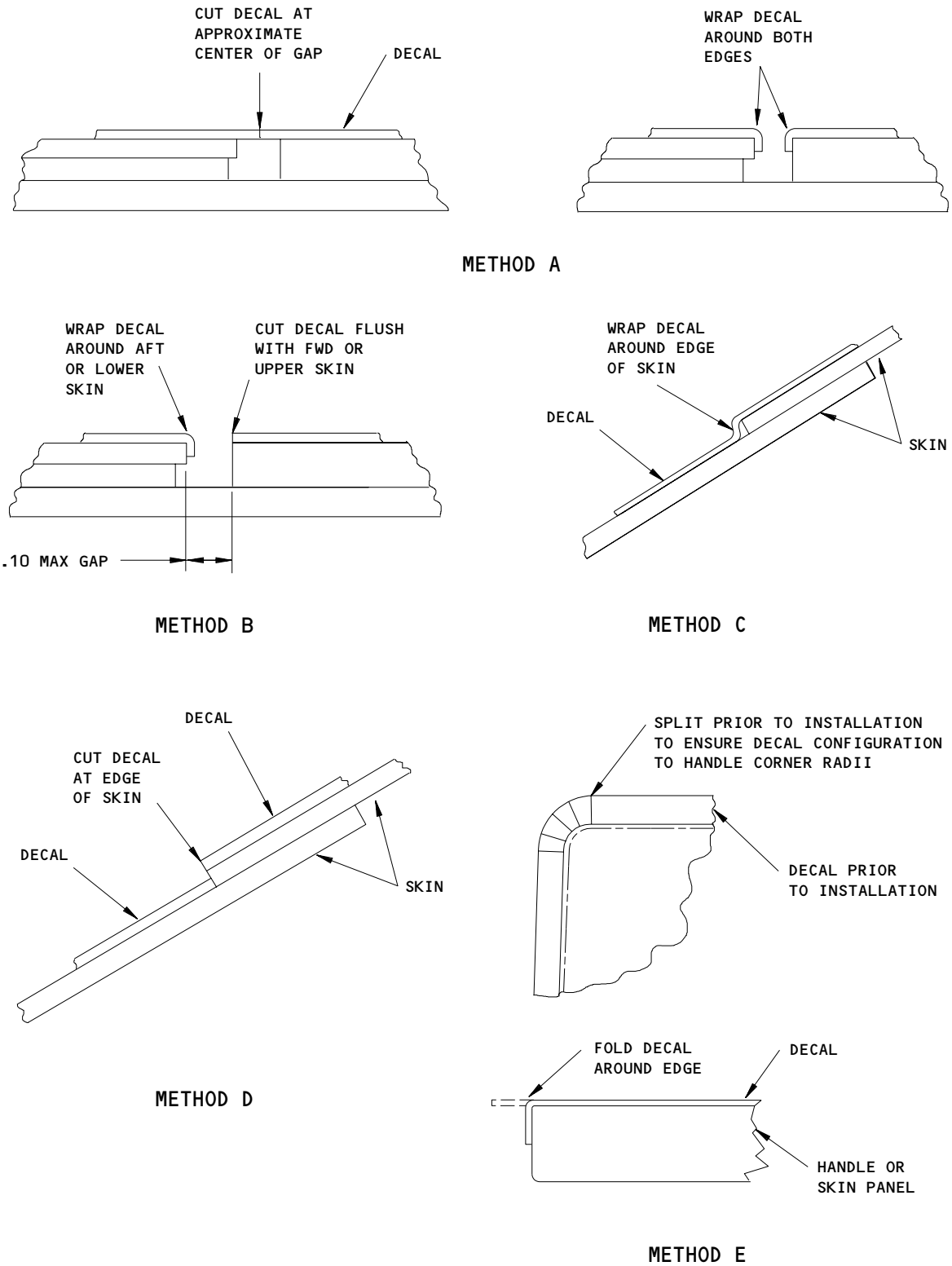

Decal Application Over Irregular Surfaces
Figure 401

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(4) Brush apply the applicable color of BMS 10-11 Type 2 enamel on all exposed rivet or fastener heads on pressure sensitive polyester decals. Overlap the edge of the decal by 1/4 inch.
(5) Brush the edges of the reflective, vinyl decals with No. 3960 edge sealer to a dry film thickness of 0.0015 to 0.0020 inch.

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PRESSURE-SENSITIVE DECALS - APPROVED REPAIRS

1. General
   A. Damaged exterior decals may be repaired by applying patches of similar type decals. Damaged interior decals are replaced.
2. Equipment and Materials
   A. Edge Sealer - 2960
3. Repair of Exterior Decals
   A. Cut away all loose decal film taking care not to cut airplane skin.

      CAUTION: DO NOT DAMAGE THE AIRPLANE SKIN WHEN YOU CUT THE DECAL. DAMAGE TO THE SKIN SUCH AS NICKS, CUTS, SCRATCHES, OR SCRIBE LINES WILL REDUCE THE FATIGUE STRENGTH AND DURABILITY OF THE STRUCTURE.

      (1) If you damage the skin or sealant, obey all the specified steps, cautions and references to inspect and repair the sealant and skin in AMM 51-31-0/201 and the applicable structural repair manual.

   B. Cut a patch of decal film of the same type and color as the original decal and of sufficient size to overlap the undamaged portion of the decal by 1/4 inch.
   C. Apply the patch per the applicable method of paragraph 3.
   D. Edge seal all around repair.

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ALUMINUM FOIL MARKERS - REMOVAL/INSTALLATION

1. General
   A. Replace aluminum foil markers with creases, torn edges, or obliterated wording.
   B. Replace aluminum foil markers with poor adhesion on exterior primed or painted surfaces.
   C. Remove and replace aluminum foil markers with poor adhesion on interior primed or painted surfaces.
   D. Remove and replace aluminum foil markers with poor adhesion on bare metal surfaces.

      NOTE: Aluminum foil markers that are being installed over textured surfaces or that have poor adhesion may be installed using the same procedure as pressure-sensitive placards to produce a more desirable installation. Refer to 20-11-16, Pressure-sensitive Placards - Removal/Installation.

2. Equipment and Materials
   A. BMS 5-14 Cement
   B. BMS 5-55 Adhesive
   C. Toluene - JAN-T-171 Grade A or TT-T-548
   D. Xylene - TT-X-916
   E. BMS 3-2, Type 1 solvent
   F. Abrasive paper - 180 and 150 aluminum oxide grit
   G. Clean lint-free cheesecloth, gauze or white rags
   H. IBM Model C typewriter with pica type, or equivalent equipped with medium, dark opaque or blueprint black ribbon, or equivalent
   I. Metal Conditioner and Rust Remover - MIL-M-10578, Type II
3. Prepare for Installation
   A. Add any required information to the aluminum foil marker using a typewriter. Set the impression controls on the typewriter to the highest value that will not cut through the aluminum foil marker.
   B. When necessary, trim the aluminum foil marker to its final size before removing the protective backing.
   C. Clean receiving surface immediately prior to application of aluminum foil marker.
      (1) Aluminum Surfaces
         (a) Clean heavy corroded aluminum surfaces with a wire brush and heavy greased surfaces with BMS 3-2 solvent.
         (b) Apply a solution of one part metal conditioner to three parts water, by volume, with a brush, rag or sponge to the surface.
         (c) Allow solution to remain on metal about 1/2 minute.
         (d) Wipe off solution thoroughly, first with damp rags, then with clean dry rags.

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(2) Clean unpainted surfaces of polyester, epoxy, phenolic or polyurethane with xylene or isopropyl alcohol.
(3) Clean aluminized paint EC-843 coated surfaces by first sanding with 180 grit abrasive paper followed by normal cleaning with BMS 3-2 solvent.
(4) Clean cork surfaces by lightly sanding with 150 aluminum oxide grit abrasive paper until a clean cork surface is obtained. Remove sanding dust by vacuuming or with a clean dry cloth.
(5) Clean all other surfaces with BMS 3-2 solvent.

D. On cadmium plated surfaces, laminated, unpainted polyester materials, laminated, unpainted phenolic materials, unpainted rough surfaces use the following steps prior to aluminum foil marker application.
(1) Apply a light coat of BMS 5-14 adhesive to the cleaned surface.
(2) Allow adhesive to dry, 5 to 20 minutes, until the surface is tacky but will not transfer to a clean finger when lightly touched.
(3) Proceed to the applicable aluminum foil marker installation procedure.

E. On primed or painted rough interior surfaces use the following steps prior to aluminum foil marker application.

NOTE: Do not use this method on exterior surfaces exposed to weathering.

(1) Apply a light coat of BMS 5-55 adhesive to the cleaned surface.
(2) Allow adhesive to dry, 5 to 20 minutes, until the surface is tacky, but will not transfer to a clean finger when lightly touched.
(3) Proceed to the applicable aluminum foil marker installation procedure.

4. Install (Apply) Aluminum Foil Marker

A. General
(1) Support the surfaces of thin panels during application of aluminum foil markers.
(2) Do not use a wrinkled, torn, or curled aluminum foil marker.
(3) Do not touch or contaminate the adhesive on the aluminum foil marker after the protective backing has been removed.
(4) The aluminum foil marker and receiving surface must be free of moisture during application.
(5) During application of a large or complicated aluminum foil marker, a small section of backing left attached will aid in handling and offer protection during application.

B. Install Cellophane Backed Aluminum Foil Markers
(1) Immerse the aluminum foil marker in 50 to 120°F water for 30 to 120 seconds.
(2) Withdraw aluminum foil marker and blot excess water with a clean, dry cloth.
(3) With dry hands, peel back one edge of the cellophane backing by running a finger across the edge of the aluminum foil marker.

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(4) Carefully remove the backing from the aluminum foil marker.
(5) Proceed to paragraph E.

C. Install Paper Backed Aluminum Foil Markers
(1) Remove the paper backing from the aluminum foil marker.
(a) When the paper backing is cut, bend slightly along the cut line, grasp the backing and peel it slowly from the aluminum foil marker so as to avoid wrinkling.
(b) When the paper backing is not cut, peel back one edge of the paper backing by running a finger across the edge of the aluminum foil marker. The backing may be provided with a tab to aid in backing removal.
(2) Proceed to paragraph E.

D. Install Aluminum Foil Markers without Self-Contained Adhesive
(1) On primed, painted or plastic interior airplane surfaces, not exposed to weathering, use the following procedure:
(a) Prepare the receiving surface per paragraph 3.C. and 3.E.
(b) Apply a light coat of BMS 5-55 adhesive to the back of the aluminum foil marker and allow the adhesive to dry until it is tacky, but will not transfer to a clean finger when lightly touched.
(c) Proceed to paragraph E.
(2) On bare metal surfaces use the following procedure.
(a) Prepare the receiving surface per paragraph 3.C. and 3.D.
(b) Apply a light coat of BMS 5-14 adhesive to the back of the aluminum foil marker and allow the adhesive to dry until it is tacky but will not transfer to a clean finger when lightly touched.

E. Position the aluminum foil marker, press down lightly to secure it in place.

F. Starting at one end, roll the aluminum foil marker firmly down taking care to prevent undue entrapment of air. To prevent roll marks, do not allow the edge of the roller to contact the aluminum foil marker.

NOTE: To prevent marring, protect the face of the aluminum foil marker when pressing into place.

G. Remove air pockets by pricking with a pin and smoothing down with a roller.

H. If necessary, remove excessive adhesive using toluene on BMS 5-14 adhesive or BMS 3-2 on BMS 5-55 adhesive.

I. Remove any protective paper facing by stripping it parallel to the aluminum foil marker surface.

J. Check for edge adherence by running a fingernail along the edge of the aluminum foil marker, being careful not to lift the edge.

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K. In areas of possible fire resistant hydraulic fluid contamination, apply clear hydraulic fluid-
resistant overcoat per 51-21-61.

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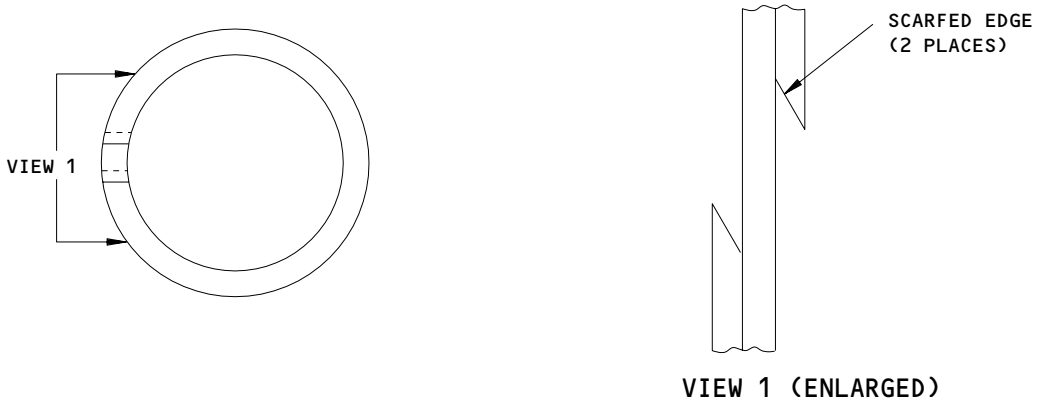
TEFLON BACKUP RING - REMOVAL/INSTALLATION

1. Install Teflon Backup Ring
   A. When installing split teflon backup rings the direction of spiral shall be clockwise with scarfed ends facing as shown in Figure 401.
2. Install Teflon Backup Ring
   A. When installing split teflon backup rings the direction of spiral shall be clockwise with scarfed ends facing as shown in Figure 401.



Teflon Backup Ring Installation
Figure 401

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CONTROL CABLE GROMMET - REMOVAL/INSTALLATION

1. General
   A. Control cable grommets in 3/4-, 1-, and 1-1/4-inch holes may be replaced either with control cable removed or installed. If a NAS1368 type plastic grommet must be replaced with the control cable installed, either the NAS1368 grommet is split for installation or is replaced by the BACG20H nylon grommet, which is a split type grommet.
2. Equipment and Materials
   A. Sharp Knife, Razor Blade, or Suitable Cutting Equipment
   B. Grommet Flipping Tool - 3T1065C - Preferred. ST1065D Alternate used with yoke ST1010-
   C. Adhesive - BMS 5-126, Type II, Class 1 or Type III, Class 1 (Ref. 20-30-11)
   D. Adhesive - BMS 5-55 (Ref. 20-30-11)
   E. Cleaner - Methyl Isobutyl Ketone, Acetone, Isopropyl, or Ethyl Alcohol (Ref. 20-30-31)
3. Remove Grommet
   A. Remove grommet from bulkhead by cutting as required.
4. Install Grommet (Fig. 401)
   A. Install grommet with control cable removed.
      (1) Clean contact area with appropriate solvent.
      (2) Apply BMS 5-126, adhesive to NAS1368 grommet bonding area.
      (3) Position grommet in bulkhead.
      (4) Insert flipping tool and flip grommet.

      NOTE: Grommet may fit loosely in bulkhead hole but should not be able to be removed without cutting.

   B. Install grommet with control cable installed.
      (1) Clean contact area with BO1051.
      (2) For NAS1368 grommet:
         (a) Insert flipping tool in grommet and flip grommet.
         (b) Split NAS1368 grommet with slant cut.
         (c) Apply BMS 5-126 adhesive to grommet contact area.
      (3) For BACG20H grommet:
         (a) Apply BMS 5-55 adhesive on grommet contact area.
      (4) Install grommet into bulkhead hole.
      (5) Align slit at the 12 o'clock position.

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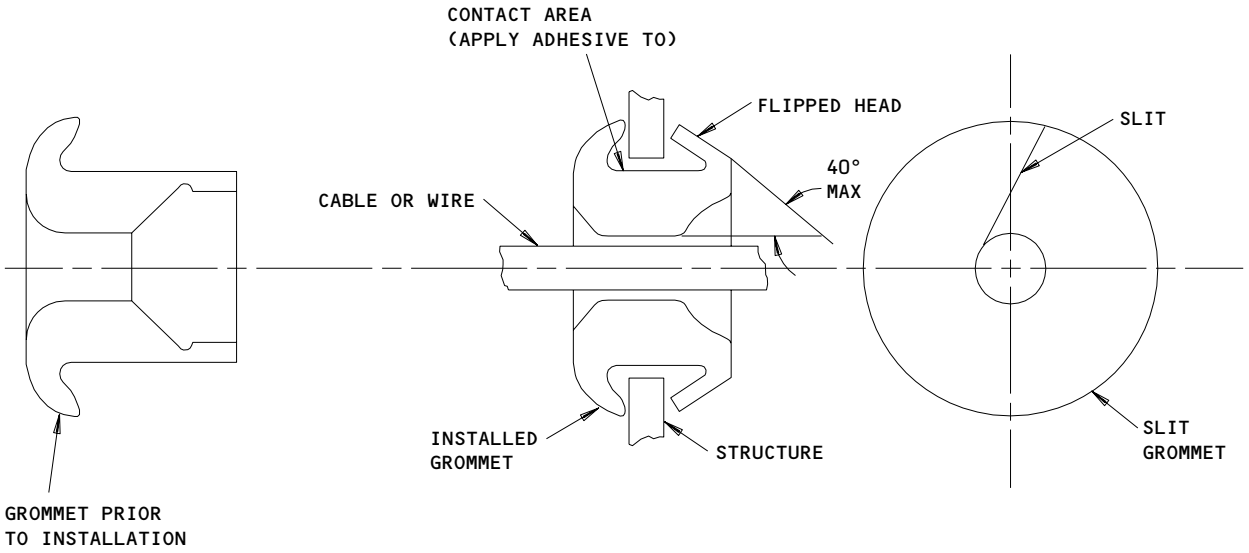
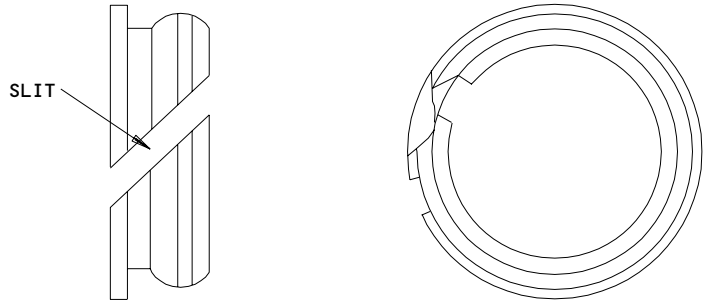


FLIP-TYPE CABLE GROMMET (NAS1368)



NYLON CABLE GROMMET (BACG20H)

Control Cable Grommets Installation
Figure 401

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SEALS ON OPEN ELECTRICAL TERMINALS IN FUEL VAPOR AREAS - MAINTENANCE PRACTICES

1. General
   A. This procedure contains one task. The task is to seal the open electrical terminals and connections in fuel vapor areas.
   B. When you replace or install components on the lighting systems in fuel vapor areas, seal these open items:
      (1) Lamp terminals
      (2) Terminal strips
      (3) Circuit breakers
      (4) Transformers
      (5) Switches
      (6) Hardwire
      (7) Wire junctions.
   C. Lamp terminals with a rubber sleeve are open.
   D. Do not seal the dual grounds in fuel vapor areas or the wire junctions in fuel tanks.
   E. Do not seal the generator terminals on the engines or APU.
   F. Install wire and protectors on all secondary switch leads and seal all secondary switch terminals in the fuel vapor areas. Make sure insulated splices are not open.
2. Seal the Open Terminals
   A. Equipment
      (1) Paint brush, 1-inch wide - Commercially available
   B. Consumable Materials
      (1) Aliphatic Naphtha - TT-N-95
      (2) Sealant BMS 5-45 TYPE II
      (3) Sealant BMS 5-37
      (4) Sealant BMS 5-95
      (5) Sealant BMS 5-142
   C. References
      (1) SWPM 20-30-00, Protection of Electrical Connections in a Flammable Leakage Zone
   D. Procedure
      (1) Remove all dirt and grease for a minimum of one inch adjacent to the area you will seal. Use a cloth made moist with Naphtha.

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CAUTION: DO NOT SEAL THE SHANK OF LAMP TERMINALS THAT ARE A SPRING-LOADED PART OF THE BAYONET LAMP SOCKET BASE. SEAL ONLY THE TERMINAL END AND ATTACHED HARDWARE. SEALANT ON THE SHANK LIMITS MOVEMENT OF THE LAMP CONTACT WHICH CAN CAUSE THE LIGHT ASSEMBLY TO BECOME TOO HOT. IF IT BECOMES TOO HOT, A FAILURE CAN OCCUR.

(2) Apply one layer of sealant to the open areas. Make sure you seal all the open areas.
   (a) Refer to SWPM 20-30-00 for approved sealants.
(3) On ring torque terminals, apply sealant as follows:
   (a) Apply sealant to the side of the terminal which a metal object can hit if it falls (Fig. 201).

      NOTE: Seal each terminal as far as the attached hardware. You can fully seal the attached hardware. If there are barriers between phases or between components, the seal must extend into the space given protection by the barriers.

   (b) If the edges of the terminals are less than 0.5 inch from each other, apply sealant to the edges.

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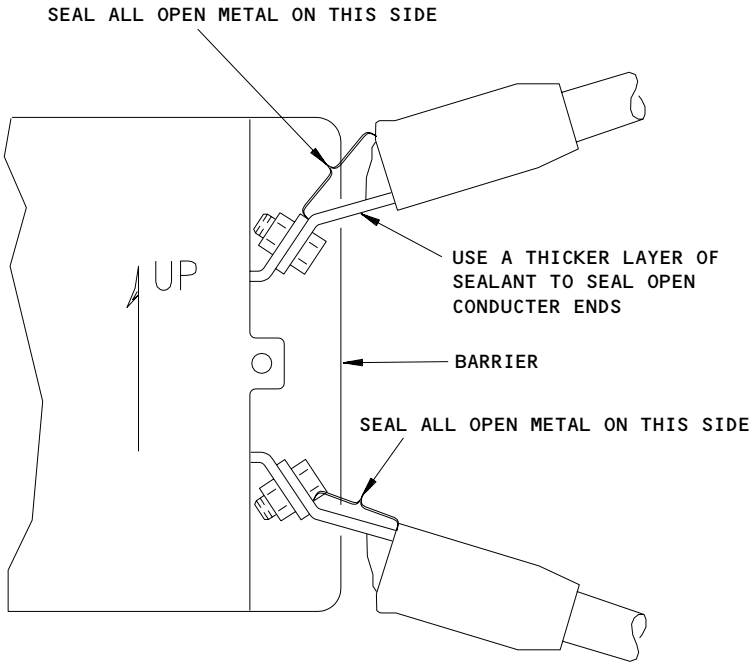

Sealant Installation on Ring Tongue Terminals
Figure 201

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FLARELESS TUBING ASSEMBLY - REMOVAL/INSTALLATION

1. General
   A. All flareless tubing must be removed and/or installed in accordance with the following procedures. System identification, tubing assembly configuration, and tubing material must be established before removal. If the assembly to be removed contains a temporary repair, this temporary repair should be converted to a permanent configuration if parts and/or tools are available.

      WARNING: BLEED ALL PRESSURE FROM SYSTEM IN ACCORDANCE WITH APPLICABLE MAINTENANCE INSTRUCTIONS BEFORE STARTING REMOVAL.

   B. When disconnecting tubing or any attaching units, always take necessary precautions to prevent spillage of fluids. Should any fluids spill on the airplane, identify fluid and decontaminate the area accordingly (AMM Chapter 12, Cleaning and Washing).
   C. Undamaged nuts and fittings may be reused as long as seal areas produce a seal on assembly, nuts turn smoothly and nut corners are not rounded.

      CAUTION: DO NOT USE TITANIUM FITTINGS IN ANY OXYGEN SYSTEM TUBING. TITANIUM AND TITANIUM ALLOYS ARE OXYGEN REACTIVE. IF A FRESHLY FORMED TITANIUM SURFACE IS EXPOSED IN GASEOUS OXYGEN, SPONTANEOUS COMBUSTION COULD OCCUR AT LOW PRESSURES.

      NOTE: It is recommended that titanium or steel fittings be used as replacements for aluminum fittings in the high pressure and normal brake return systems between the antiskid module and parking brake module. Titanium or steel fittings may be used as replacements for aluminum fittings in other systems.

   D. Improper presetting of BACS13AP flareless sleeves can cause severe leaks. It is recommended that flareless sleeves be preset by machine. Hand presetting should only be used where tube configuration or inaccessibility prevents machine presetting.
   E. When installing tubing, obtain alignment of fittings and tubing before tightening connections. Do not use fitting nuts to bring tubing and connections into alignment.

      NOTE: If the fitting nut is used to "stretch" the tubing to bring the sleeve into contact with mating surface, extra stress is applied to the preset or swaged sleeve and tube and, adds to the probability of leakage, blow-off, or other failure.

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F. Color marking of reconnectable fitting joints on Boeing airplanes is used in two ways.
   (1) A yellow paint stripe across a fitting joint indicates that a special procedure with higher torque was used at installation. Fitting connections with the yellow paint stripe are considered "permanent" connections and are not to be disconnected for routine maintenance. When a joint with the yellow paint stripe is disturbed, the fitting connection must be tightened using special torque values and the yellow stripe across the joint must be replaced. The replacement method is given under "Install Flareless Tubing Assembly".
   (2) A pink paint stripe across a fitting joint indicates that a fitting joint was properly torqued during assembly of the airplane. The stripe was used as a manufacturing aid. Fitting joints with the pink paint stripe may be disconnected during routine maintenance. When a joint with a pink paint stripe is disturbed, the joint is to be retighten using normal installation procedures. Replacement of the pink paint stripe is optional.

      NOTE: The paint marking is defined as a pink stripe of Torque Seal Lacquer, 1/8 inch wide, extending 1/2 inch on each mating half of the connection.

G. When you remove, install, or do work with hydraulic tube assemblies, obey the guidelines that follow:
   (1) When you remove tubes, make sure the tubes and port fittings have tags that identify the correct connection location.
   (2) Do not move or change the tube bends. If you move or change the bend in the tube, these bad effects can occur:
      (a) If you move or change a bend in the tube, it can become possible that the tube will align with the incorrect port. If this occurs, incorrect reconnection or cross-connection of the tubes can become possible.
      (b) If you move or change the bend in the tube, it can be possible that the tube will have too much stress when it is connected.

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2. Equipment and Materials
   A. Lubricant (See table below)
   B. Bonding Meter - Model T477W Microhm Bridge, Type W Bonding Meter, Avtron Manufacturing, Inc., Cleveland, Ohio

SYSTEM TYPE	APPROVED THREAD COMPOUNDS STRAIGHT THREAD FITTINGS
Compressed Gas	Antiseize Compound AMS 3-80
Deicing or (Anti-icing)	
Instrument Air	Antiseize Compound AMS 3-80
Pneumatic	Antiseize Compound AMS 3-80, Pneumatic Grease MIL-G-4343
Air Conditioning	
Fire Protection	Antiseize Compound AMS 3-80 Or Grease MIL-G-6032
Coolant	
Water Injection	Antiseize Compound AMS 3-80
Fuel	Hydraulic Fluid MIL-H-5606 or Shock Strut Fluid BMS 3-32
Lubrication	
Hydraulic MIL-H-5606	Hydraulic Fluid MIL-H-5606 or Shock Strut Fluid BMS 3-32
Hydraulic BMS 3-11	Skydrol Assy Lube MCS 352B or BMS 3-11 Hydraulic Fluid
Hydraulic MIL-H-6083	Hydraulic Fluid MIL-H-5606, MIL-H-6083 or Shock Strut Fluid BMS 3-32
Misc. Tubing	Antiseize Compound AMS 3-80 or Grease MIL-G-6032

Refer to 20-30-21

3. Remove Flareless Tubing Assembly
   A. Gain access to tube assembly fittings.
   B. Remove support clamps on tubing to be removed and adjacent tubing assemblies as required.

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C. Loosen adjacent tubing assemblies and clamp if necessary.

WARNING: MAKE SURE EACH TUBE AND THE PORT FITTINGS HAVE TAGS TO IDENTIFY THE CORRECT INSTALLATION LOCATION. IF YOU DO NOT PUT TAGS ON THE TUBES AND PORT FITTINGS, CROSS-CONNECTION OF THE TUBES CAN OCCUR DURING INSTALLATION. IF THE TUBES ARE CROSS-CONNECTED, UNINTENDED OPERATION OR MALFUNCTION OF AIRPLANE SYSTEMS CAN RESULT AND CAUSE INJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

D. When you remove tubes, make sure the tubes and port fittings have tags that identify the correct connection.

E. Remove tubing assembly from airplane.

CAUTION: DO NOT LEAVE HYDRAULIC LINES AND FITTINGS UNCAPPED. DIRT OR DEBRIS COULD ENTER. CONTAMINATION OF HYDRAULIC LINES, DAMAGE TO SYSTEM COMPONENTS AND LEAKAGE OF HYDRAULIC FLUID COULD OCCUR.

CAUTION: DO NOT ALLOW HYDRAULIC FLUID SPILLAGE AND LEAKAGE TO ACCUMULATE WITHOUT WIPING IT UP. DAMAGE COULD RESULT.

F. Install protective caps on tube assemblies and mating connections.

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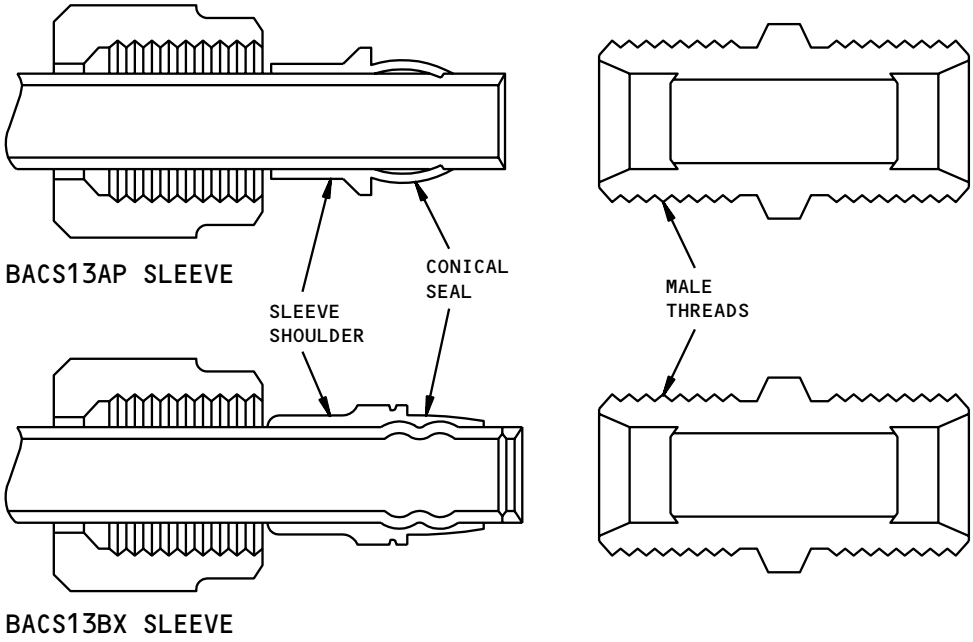
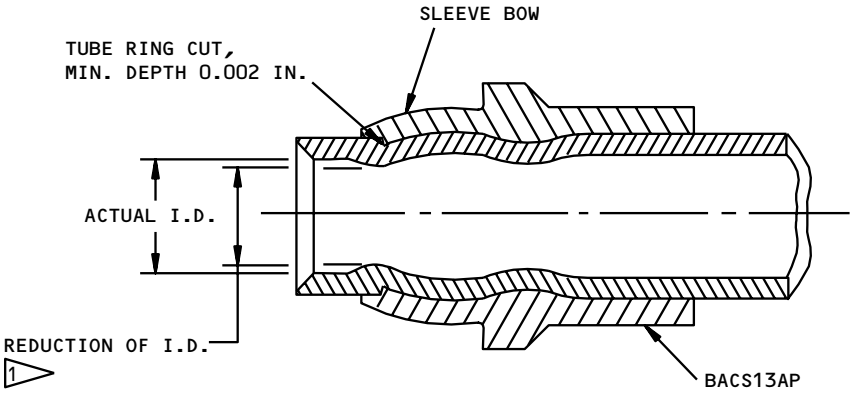


LUBRICATION POINTS

Flareless Tubing Assembly Lubrication Points



1 CHECK THAT THE REDUCTION OF I.D. DOES NOT EXCEED 0.015 IN. PRIOR TO INSTALLATION

Maximum Preset Flareless Sleeve Collapse
Figure 401

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TUBING SIZE (INCHES)		INSTALLATION TORQUE ON FLARELESS TUBING FITTINGS *[3] *[4] (POUND-INCHES, ± 5%) NOTE: USE CARE WHEN SELECTING CORRECT TORQUE FOR REDUCER FITTINGS. THE BOSS OR BULKHEAD SIZE DETERMINES FITTINGS INSTALLATION TORQUE.	
OD	TUBE DASH NO.	STEEL & TITANIUM TUBES *[1]	ALUMINUM AND ANNEALED CRES TUBES *[2]
3/16	-3	100	80
1/4	-4	140	110
5/16	-5	190	140
3/8	-6	270	170
1/2	-8	500	280
5/8	-10	700	360
		575	
3/4	-12	900	450
1	-16	1200	750
1-1/4	-20	1600	900
1-1/2	-24	2000	900

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TUBING SIZE (INCHES)		INSTALLATION TORQUE ON FLARELESS TUBING FITTINGS *[3] *[4] (POUND-INCHES, ± 5%) NOTE: USE CARE WHEN SELECTING CORRECT TORQUE FOR REDUCER FITTINGS. THE BOSS OR BULKHEAD SIZE DETERMINES FITTINGS INSTALLATION TORQUE.	
OD	TUBE DASH NO.	STEEL & TITANIUM TUBES *[1]	ALUMINUM AND ANNEALED CRES TUBES *[2]
2	-32	2000	---

*[1] TORQUE VALUES APPLICABLE TO THE FOLLOWING TUBE ENDS:
- A. 21-6-9 CRES AND ALL OTHER CRES TUBE ENDS WITH BACS13BD OR BACS138X SWAGED SLEEVE AND 21-6-9 CRES TUBE ENDS WITH CRYOLIVE SLEEVE
- B. MIL-T-6845, MIL-T-8504, AND MIL-T-8808 CRES FLARED TUBE ENDS
- C. MIL-T-6845 CRES WITH PRESET BACS13AP *[6] OR CRYOLIVE SLEEVES
- D. HOSE END FITTINGS WITH STEEL INSERTS (NIPPLES)
- E. ALL TITANIUM TUBE ENDS

*[2] TORQUE VALUES APPLICABLE TO THE FOLLOWING TUBE ENDS:
- A. 6061-T6 ALUMINUM WITH BAC13BD OR BACS13BX SWAGED SLEEVES (SIZES 04 THRU 16) OR CRYOLIVE SLEEVE ASSEMBLIES
- B. 6061-T6 ALUMINUM WITH PRESET BACS13APSLEEVES *[6]
- C. ANNEALED CRES WITH PRESET BACS13AP SLEEVES *[6]
- D. FLARELESS TYPE HOSE END FITTINGS WITH ALUMINUM INSERTS (NIPPLES)
- E. ALUMINUM FLAED TUBE ENDS

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*[3] CARE SHOULD BE TAKEN IN SELECTING THE CORRECT TORQUE FOR REDUCER FITTINGS. THE BOSS OR BULKHEAD SIZE DETERMINES THE FITTING INSTALLATION TORQUE

*[4] TUBE MATERIAL SPECIFICATIONS:

A. 6061-T6 ALUMINUM - MIL-T-7081, WW-T-700/6
B. ANNEALED CRES - MIL-T-8504, MIL-T-8606, MIL-T-8808
C. 1/8 HARD CRES - MIL-T-6845
D. 21-6-9 CRES - BMS 7-185
E. TI-3AL-2.5V - BMS 7-234

*[5] ON MIL-T-6845 TORQUE VALUES ARE APPLICABLE TO STANDARD MS FLARELESS TUBE ENDS (BACS13AP SLEEVES (304-1/8h) TUBING WITH A MINIMUM WALL THICKNESS AS GIVEN BELOW:

SIZE	-4	-5	-6	-8	-10	-12
WALL THICKNESS	0.020	0.020	0.028	0.035	0.049	0.049

TORQUE EXCEPTION FOR SPECIAL THIN WALL MIL-T-6845 (304-1/8h) TUBING IS AS FOLLOWS:

SIZE	-8	-10	-12
WALL THICKNESS	0.028	0.035	0.042
TORQUE (LB-IN)	365	575	725

*[6] TORQUE VALUES ARE APPLICABLE TO STANDARD MS FLARELESS TUBE ENDS (BACS13AP SLEEVES) OR CRYOLIVE SLEEVES ON 6061-T6 ALUMINUM AND MS FLARELESS TUBE ENDS (BACS1Q3AP SLEEVES) ON ANNEALED CRES TUBING WITH A MINIMUM WALL THICKNESS AS GIVEN BELOW:

SIZE	-3	-4	-5	-6	-8	-10	-12	-16
WALL THICKNESS	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.035

TORQUE EXCEPTION FOR SPECIAL THIN WALL ANNEALED CRES TUBING IS AS FOLLOWS:

SIZE	-6	-10	-12
WALL THICKNESS	0.020	0.020	0.020
TORQUE (LB-IN)	160	250	325

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Resistance Between Bulkhead Fittings and Hydraulic Tubing			
TUBE SIZE	MAXIMUM RESISTANCE (MILLIOHM)		
	ALUMINUM	TITANIUM	
		PERMASWAGE	WELD-ON
-04	----	6	12
-06	0.70	4	8
-08	----	2.5	5
-10	0.41	1.5	3

Resistance Across Union/Tee Fittings (Tube-to-Tube)		
TUBE SIZE	MAXIMUM RESISTANCE (MILLIOHM)	
	ALUMINUM	TITANIUM
-04	----	12
-06	1.30	8
-08	----	5
-10	0.75	3

Installation Torques for Flareless Fittings in Pressurized Areas						
TUBE SIZE (INCH)	0.250	0.375	0.500	0.625	0.750	1.000
TITANIUM, CRES TUBE	210	400	750	1050	1350	1800
ALUMINUM TUBE	170	250	420	540	675	1125

4. Install Flareless Tubing Assembly
   A. Check tube ends and fittings for any defects or contamination that could affect sealing effectiveness of the installation. Check for chafe or dent damage to the tube.

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B. Lubricate sleeve and fittings.
   (1) Apply thread compound per applicable system to entire circumference of male threads, shoulder, and conical seal surface of flareless sleeve immediately prior to installation.

       NOTE: No compound should be allowed in the interior of tube or bore of fitting. Do not apply thread compound when assembling dri-lubed B-nuts.

C. Position tubing assembly in airplane leaving tube clamps loose to allow for alignment of tube in fitting.
D. Look at the tags to make sure the tubes are aligned with the correct port fittings.
E. Align tube and fitting by hand and bottom tube end in fitting.
F. Hold tube end bottomed and in alignment in fitting and screw B-nut by hand until B-nut bottoms on sleeve shoulder.
G. Tighten assembly by holding union with a wrench and torque tightening B-nut to recommend value.

   NOTE: Do not use B-nut to wrench tube into alignment or allow B-nut to bottom.

H. Nuts which are inaccessible for torque tightening may be tightened by hand until a distinct increase in torque occurs, then tighten an additional 1/6 to 1/3 (one or two hex flats) turn.

   CAUTION: CLAMPS MUST ALWAYS BE TIGHT. THIS HELPS PREVENT FOREIGN MATERIALS AND CONTAMINANTS FROM BEING LODGED BETWEEN THE TUBE AND THE CLAMP SURFACES. IT IS CRITICAL THAT THESE SURFACES BE KEPT AS CLEAN AS POSSIBLE TO AVOID ABRASION.

I. Tighten all tube clamps.

   NOTE: Maximum allowable collapse of tube after torquing BACS13AP sleeves shall not exceed 0.015 inch less than the actual tube diameter.

J. If you disconnect more than one hydraulic tube and you think there is a possibility you connected the tubes incorrectly or cross-connected the tubes, do an operational check:

   NOTE: Use your own judgement to determine if a check is necessary.

   (1) Do the post-installation test of one or more of the components to which the tubes are connected as a check.

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K. If you disconnected electrical wires to get access to the hydraulic tubes and you think there is a possibility that you connected the wires incorrectly or cross-connected the wires, do and operational check:

NOTE: Use you own judgement to determine if a check is necessary.

(1) Do the post-installation test of one or more of the components in the system which uses the wires as a check.

L. Do a leak test:
(1) Pressurize the system for a minimum of 5 minutes.
(2) With the system pressurized, rub the tube and fittings with a clean white cloth to find leakage.

NOTE: You can tighten the tube again to the torque valve specified above, if you find leakage. If leakage occurs in subsequent leak tests, you must replace appropriate parts.

5. Electrical Resistance Requirements Inside Fuel Tank

WARNING: ENSURE THAT BOND RESISTANCE DOES NOT EXCEED VALUES LISTED. BOND RESISTANCE IS CRITICAL IN THE EVENT OF A LIGHTNING STRIKE. IF THE METER USED TO VERIFY THE BOND RESISTANCE IS NOT EXPLOSIONPROOF, THE HAZARDOUS GAS CONTENT OF THE ATMOSPHERE AS MEASURED BY A COMBUSTIBLE GAS DETECTOR MUST BE LESS THAN 10 PERCENT OF THE LOWER EXPLOSIVE LIMIT.

A. Fitting installations which do not meet the requirements for resistance should either be reworked or replaced and resistance checked again. Do not use bonding jumpers to bridge high-resistance hydraulic installations.
B. Resistance between bulkhead fittings and hydraulic tubing.
(1) Measure resistance between bulkhead fittings and hydraulic tubes. Check that resistance meets the requirements.
C. Resistance across in-line union/tee fittings (tube-to-tube).
(1) Measure resistance across in-line union/tee fittings tube-to-tube. Check that resistance meets the requirements.

6. Installation of Flareless Fittings in Pressurized Areas, Struts, Fuel Tanks, or Cargo Areas

A. Special care must be taken to ensure that fittings will not leak after tightening. The installation torque shall be applied as follows:

NOTE: This procedure is known as the double torque method.

(1) Flareless fitting with BACS13AP sleeves must be tightened twice (tightened, loosened, and retightened).

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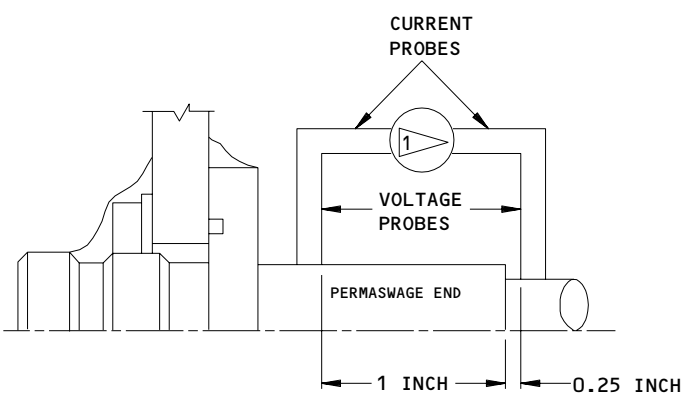
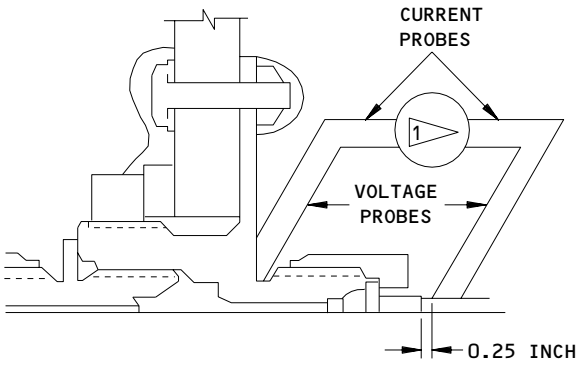
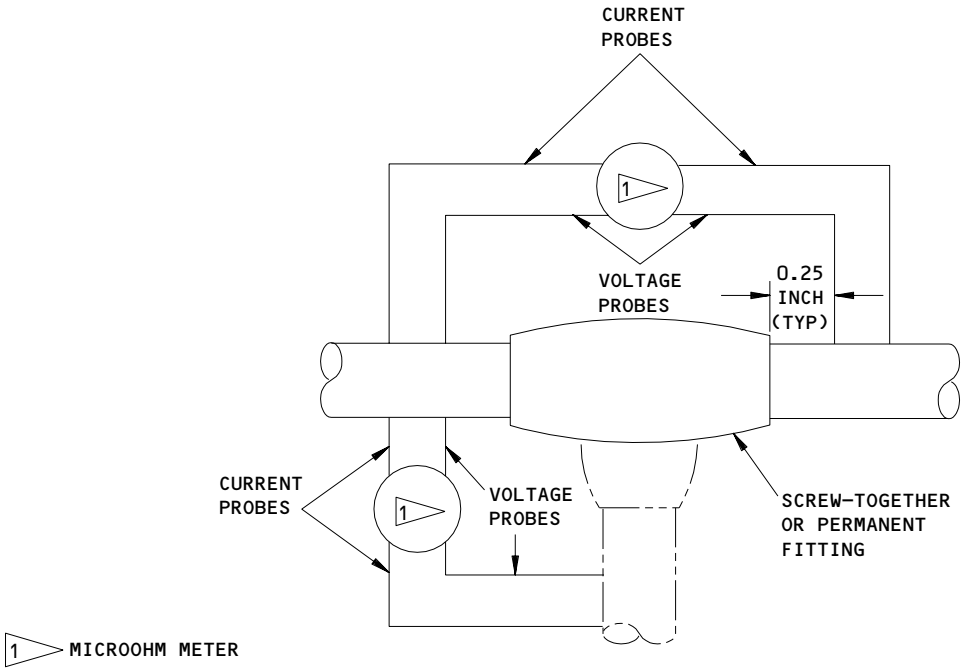


PERMASWAGE BULKHEAD FITTING



SCREW TOGETHER WELD-ON BULKHEAD FITTING

Bulkhead Fittings



Union/Tee Fittings
Figure 402

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(2) Flareless fittings with BACS13BX, BACS13BD, welded-on or NAS176O-type sleeves must be tightened as follows:
(a) Tighten fitting to torque specified for flareless tubing.
(b) Back fitting off to relax torque.
(c) Retighten to torque value specified.

B. On wing fuel tank installations, check electrical resistance.

C. Make repairs, as required, per AMM 20-10-51/801.

D. Do a leak test:
(1) Pressurize the system for a minimum of 5 minutes.
(2) With the system pressurized, rub the tube and fittings with a clean white cloth to find leakage.

NOTE: You can tighten the tube again to the torque valve specified above, if you find leakage. If leakage occurs in subsequent leak tests, you must replace appropriate parts.

E. If you disconnected more than one hydraulic tube and you think there is a possibility you connected the tubes incorrectly or cross-connected the tubes, do an operational check:

NOTE: Use your own judgement to determine if a check is necessary.

(1) Do the post-installation test of one or more of the components in the system which uses the wires as a check.

F. If you disconnected electrical wires to get access to the hydraulic tubes and you think there is a possibility that you connected the wires incorrectly or cross-connected the wires, do and operational check:

NOTE: Use you own judgement to determine if a check is necessary.

(1) Do the post-installation test of one or more of the components in the system which uses the wires as a check.

7. Tubing Clearances

A. Maintain following minimum clearances between tubing and all other components, including hoses, fittings, structure, and other tubing. These clearances are intended to prevent tube damage in any operating position as follows:
(1) The minimum clearance for all mechanical systems except hydraulic tubing will be from adjacent structure, fixed structure, fixed and moving equipment and other tubing and fitting connectors will be as follows:
(a) Supported locations 0.10 inch
(b) Unsupported locations 0.20 inch
(c) Supported and unsupported locations for flammables gas, fuel, and oxygen systems will be 2.0 inches from electrical wires and cables

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(2) Minimum clearance for hydraulic system.
   (a) A minimum 0.06 inch for tubes supported to structure or other rigid members.
   (b) A minimum of 0.25 inch with adjacent structure, tubing or connectors, or other installations.
   (c) A minimum of 0.25 inch in areas where relative motion of adjoining components exists.
   (d) A minimum of 0.06 inch between individual coils of all coiled tubes.
   (e) A minimum of 0.05 inch from electrical wiring installations.

(3) Install the hydraulic tubes with a minimum of force on the clamps or the tubing.

(4) Where the tubes are held by clamps to an adjacent structure, make sure the tubes are clear of the adjacent structure. The minimum clearance is 0.10 inch. Where the tube is attached directly with a clamp to the structure, the clearance can be the thickness of the clamp.

(5) Where the tubes are not held by clamps to an adjacent structure, make sure all tubes are clear of the adjacent structure, equipment installations, and other items. The minimum clearance is 0.25 inch.

(6) Make sure the tubes are clear of any mechanism that operates. The minimum clearance is 0.38 inch. This minimum clearance can be 0.25 inch where the tubes are attached by clamps to adjacent structure and the tubes will not rub or touch the mechanism that operates.

(7) If one tube goes across a tube or if two tubes are parallel, make sure there are sufficient clamps attached. The clearance must be 0.25 inch minimum or the thickness caused when two clamps are attached side-by-side.

   NOTE: You can add side-by-side clamps to get the necessary clearance.

(8) To get the necessary clearances with the loop-type clamps, use BACS18AF3 or BACS18AF4 spacers to make the necessary height. On the U-type clamps, use BACS18AN spacers. Do not use NAS42 or NAS43 clamps on hydraulic tubes.

   NOTE: Do not use more than four spacers together. If you use more than four spacers, find the cause and correct the problem.

(9) Make sure the tubes are clear of the control cables between the break points or the fairleads and the control cable linkage. The minimum clearance is 0.625 inch.

(10) The minimum clearance between the tubes in clampblocks and the channels on the clampblocks is 0.060 inch. If this clearance is found to be less, check spacer tube length (NAS43003-) and/or correct the preloaded condition of the tubes in the clampblock.

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8. Tubing Clamp Spacing

A. Maintain tube clamp spacing within the limits shown unless otherwise specified.

Tube Clamp Spacing			
Tubing OD Inches	Material	Clamp Spacing Inches	
		General Areas	Exceptions *[1]
1/4	Steel	16.0	12
3/8	Steel	20.0	15
3/8	Aluminum	16.5	12
1/2	Steel	23.0	17
1/2	Aluminum	19.0	14
5/8	Steel	22.0	18.5
5/8	Aluminum	22.0	16.5
3/4	Steel	27.5	20.5
3/4	Aluminum	24.0	18
1.0	Steel	30.0	22.5
1.0	Aluminum	26.5	19.5
1 1/4	Steel	31.5	23.5
1 1/4	Aluminum	28.5	21

*[1] Exceptions: Wings, Rear Spar, Engine Strut and Engine Aft Fairing

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FLARELESS TUBING ASSEMBLY - APPROVED REPAIRS

1. General
   A. This procedure contains eleven tasks.
      (1) Tube repair
      (2) Swage BACS13BD and BACS13BX Flareless Sleeves with the Harrison Elastomer Swagers 5175 5570, and 5720
      (3) Swage BACS13BX Flareless Sleeves with the 6633K01 Harrison Roller Swaging Kit
      (4) Preset BACS13AP Flareless Sleeves
      (5) The Installation of the CRYOLIVE Flareless Sleeve Assembly
      (6) The Installation of the BACC42W H-Coupling
      (7) The Installation of the 3P02111 Cryofit Coupling
      (8) The Installation of Permaswage Fittings
      (9) The Installation of Rynglok Unions
      (10) The Repair of Hydraulic Tubing with Flexible Hoses
      (11) Aluminum Fuel Tubes - Temporary Weld Repair Method
   B. These procedures give the approved repairs for hydraulic, pneumatic, water, and other tube assemblies. Repair procedures include the replacement of defective tube ends or the replacement of small damaged tube parts. Flareless tubes and sleeves, H-Coupling assemblies, Cryofit couplings, Permaswage fittings or Rynglok unions are the different types of parts that can be used.
      (1) For small damaged areas, the permanent repair of aluminum tubing can be accomplished by removing short sections of tubing and installing a rigid tube coupling. For larger areas of tube damage, which exceed the limit of the tube section cutout required for installation of a single tube coupling, a longer section of the tube must be cut away and replaced with a new section of, connected by rigid couplings. Alternatively, some repairs may be accomplished by replacing the entire end of a tube using a rigid tube coupling. All tube repair work must conform to the applicable standards and practices.

         NOTE: Acceptability of tube wear limits must be reviewed on an individual basis.

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(2) When repairing a section of a tube, correctly align the tube and the fittings. Make sure the fittings touch the bottom at the two ends of the repaired section. Do not use fitting nuts to align the fittings. Stresses applied to fittings during tubing installation when fitting nuts are used to obtain alignment add to the probability of leakage, blowoff, or other failures.

(3) A temporary repair method for aluminum tubing involves the weld repair of small punctures, cracks and wear-through. Since this method can cause hard spots and stress concentrations, the repaired tube is limited for flight hour service use. A permanent weld repair method involves the removal of the damaged section of tubing and replacing it by welding in a new section.

(4) Approved steel tube assemblies can be used to replace titanium tube assemblies.

(5) When doing repairs, the type of flareless tube sleeves will determine the installation method to use.

(6) Use approved power swaging equipment, or roller swaging, to do all swaged-on sleeves and fittings.

(a) Preset BACS13AP flareless sleeves by machine. Preset by hand only when a hydraulic or pneumatic-operated presetting tool is not available. If presetting by hand, it is recommended that some preset samples are made first. After making the samples, cut them into sections, length-wise, and make an inspection of the ring cut depth before presetting the part to be repaired.

NOTE: Consult with Boeing before conducting any repairs to oxygen tubing.

(7) A CRYOLIVE sleeve assembly can be installed, consisting of CRYOLIVE sleeve, coupling nut and protective cover/inspection tool, by removing the assembly from liquid nitrogen and sliding it on the tube end.

NOTE: The size 10, size 12 and size 16 coupling nuts used with the CRYOLIVE sleeve are slightly longer than standard MS type coupling nuts and are not interchangeable with MS type coupling nuts.

(8) The H-coupling assembly is a repair coupling consisting of a union coupling, slide, and nut that can be installed in any straight section of tubing using two open-end wrenches of applicable size. This assembly is approved for usage on fuel and hydraulic high-pressure lines of 21-6-9 CRES, titanium 3AL-2.5V, and 304-1/8 hard CRES tubing. This assembly is also approved for repair of 304 CRES annealed and 6061-T6 aluminum tubing lines using 1500 PSI working pressure or less.

(9) A Cryofit coupling can be used for the in-line repair of 3AL-2.5V titanium tubing. To install the Cryofit coupling in a straight tube section, shrink-fit the coupling in its position.

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(10) A Permaswage coupling can be used for in-line repair of 6061-T6 aluminum, 21-6-9 CRES or 304-1/8 hard CRES, and 3AL-2.5V titanium tubing.

(11) You can use the Rynglok union for inline repair of 6061-T6 aluminum, 21-6-9 CRES or 304-1/8 hard CRES, and 3AL-2.5V titanium tubing. Rynglok unions are made of lightweight 6AL-4V titanium alloy and are not to be used in oxygen systems, in fuel cells, or in repair of tubes installed in engines.

C. Do a leak check on completed repairs of all hydraulic tubes disconnected during the repair procedure.
   (1) Pressurize the hydraulic tubes for a minimum of 5 minutes.
   (2) Rub all the fittings with a clean white cloth.
   (3) Look for hydraulic fluid on the cloth to find leakage.

D. When removing, installing, or doing work with hydraulic tube assemblies, obey the guidelines that follow:
   (1) When removing tubes, make sure the tubes and port fittings have tags that identify the correct connection location.
   (2) Do not move or change the tube bends. If moving or changing the bend in a tube, these bad effects can occur:
      (a) If moving or changing a bend in a tube, it can be possible that the tube will align with the incorrect port. If this occurs, incorrect re-connection or cross-connection of the tubes can become possible.
      (b) If moving or changing the bend in a tube, it can be possible that the tube will have too much stress when it is connected. Stress can cause cracks in the tubes.
   (3) If more than one hydraulic tube has been disconnected and there is a possibility the tubes are connected incorrectly or cross-connected, do an operational check of the system.

      NOTE: Use good judgment to determine if a check is necessary.

      (a) Do a post-installation test of one or more components to which the tubes are connected as a check.
   (4) If any electrical wires were disconnected to gain access to the tubes and there is a possibility that the wires are incorrectly connected or cross-connected, do an operational check.

      NOTE: Use good judgment to determine if a check is necessary.

      (a) Do the post-installation test of one or more of the components to which the wires are connected as a check.

E. Hydraulic system pressure definitions are below.
   (1) Maximum Working Pressure:
      (a) Anytime repairs to the tubes are made on the airplane, or when any hydraulic component is to be checked.
   (2) Proof Pressure:
      (a) If the tubes are repaired and to be tested in the shop.
   (3) Burst Pressure:
      (a) This is for design reference only.

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F. B-Nut Torquing:
   (1) The correct torquing can be applied to B-nuts only if the tubing material is identified correctly (aluminum, titanium or steel).
   (2) If the normal finish color of the B-nut is covered by the gray drilube coating, a color-coded ring is applied.
   (3) If a steel or titanium B-nut connects to an aluminum tube or fitting, use the lower torque value (aluminum).
G. Use tube materials as shown in tables.

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TABLE 1 APPROVED TUBE MATERIALS			
TUBING MATERIAL	BMS	MIL	OTHER
ALUMINUM 6061-T6	---	WW-T-700/6 *[1] T-7081	---
CRES 21-6-9	7-185	---	---
1/8 HARD CRES 304-1/8G	---	T6845	AMS 5566
ANNEALED CRES 304	---	T-8504	---
ANNEALED CRES 321	---	T-8808	---
TITANIUM 3AL-2.5V	7-234	---	AMS 4945

*[1] LOW PRESSURE, NON-HYDRAULIC SYSTEMS ONLY

TABLE 1A APPROVED TUBE MATERIALS							
TUBE SIZE		04	06	08	10	12	16
Tube Material	21-6-9 CRES (BMS 7-185)	0.016	0.020	0.026	0.033	0.039	0.052
	3AL-2.5V Titanium (AMS 4945)	0.016	0.019	0.026	0.032	0.039	0.051
	304 1/8 Hard CRES (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065
	6061-T6 Aluminum (MIL-T-7081) or AMS 4083) Return/Supply/Suction Only	0.035	0.035	0.035	0.035	0.035	0.035

NOTE: CONSULT BOEING BEFORE USING ALTERNATE TUBE MATERIAL/WALL THICKNESS COMBINATIONS FOR 3000 PSI HYDRAULIC SYSTEM APPLICATIONS.

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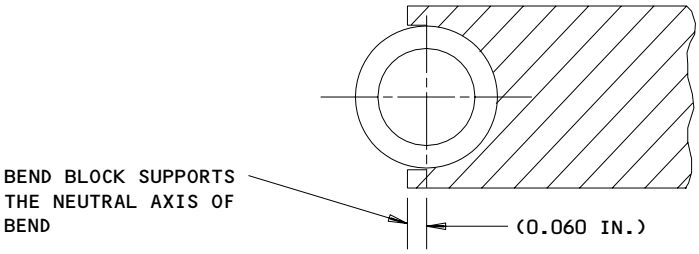

NOTE: YOU MUST REPLACE TUBES IF A BEND IS COLLAPSED OR IF THE BEND OVALITY WAS MORE THAN PERMITTED DURING BENDING.

TUBE BEND BLOCK

OPERATING PRESSURE	TUBE OD	TUBE MATERIAL	PERMITTED OVALITY (PERCENT OF *SPECIFIED OD) 1
0 TO 1000 PSI LINES	ALL SIZES	STEEL	10
		ALUMINUM	10
1000 PSI TO 3000 PSI LINES (INCLUDING RETURN LINES)	ALL SIZES	Ti-3AL-2.5V	3
		STEEL, 304 1/8 H 21-6-9	5
		ALUMINUM	5

1 PERCENT (OVALITY) = $\frac{\text{OD MAX} - \text{OD MIN}}{\text{OD SPECIFIED*}}$ X 100

(NOTE: OD MEASURED IN SAME PLANE.)

* SPECIFIED DIAMETER = DRAWING SPECIFIED TUBE DIAMETER

Permitted Ovality of Hydraulic Tube Bends
Figure 801

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2. Tube Repair
   A. Use Hydraulic System Design Pressure/IN PSI/ as shown in Table 2 during repairs.

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TABLE 2
HYDRAULIC SYSTEM DESIGN PRESSURES

COMPONENT	MAXIMUM WORKING PRESSURE PSI	PROOF PRESSURE PSI	BURST PRESSURE PSI
Pressure lines (including hoses and fittings) and units with air under full system pressure (such as accumulators)	3000	6000	12000
Return and case drain lines, fittings and units	600	900	1500
Return line hoses	600	1500	3000
Pump supply reservoirs, units, lines and fittings	65	100	200
Airbleed line (upstream of regulator)	250	500	1000
Drains and vents open to atmosphere	15	50	75

B. General
(1) You can repair tubes if you obey the permitted repair limits. When it is possible do the following:
(a) Replace the damaged tube.
(b) Replace the damaged part with a tube splice.
(c) Repair the damaged tube with a fitting (if the damaged area is sufficiently small).
(2) When removing, installing, or doing work with hydraulic tube assemblies, obey the guidelines that follow:
(a) When removing tubes, make sure the tubes and port fittings have tags that identify the correct connection location.
(b) Do not move or change the tube bends. If moving or changing the bend in a tube, these bad effects can occur:
1) If moving or changing a bend in a tube, if can be possible that the tube will align with the incorrect port. If this occurs, incorrect re-connection or cross-connection of the tubes can become possible.

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2) If moving or changing a bend in a tube, it can be possible that the tube will have too much stress when it is connected. Stress can cause cracks in the tubes.

(c) If some tube assemblies must be bent to fit an installation, do not bend the tubes more than permitted by the ovality limits in Fig. 801. It is recommended that a bend block, or tool equivalent to the Parker G-824 hand bender, be used. Make sure the bend block supports the tube bend beyond the neutral axis of the bend, as shown in Fig. 801.

(d) Do not repair dents or chafed areas. Replace the tube or tube section if the defect depth is more than the permitted values. It is not necessary for you to repair or replace tubes with a defect depth less than these values.

(3) To repair a damaged tube section, cut out the damaged tube section and replace it with a fitting or with the assembled tube and fitting assembly.

(4) To replace a BACU24AB swage union, cut out the damaged fitting and replace it with a B-nut, BACS13AP sleeve, BACS13BX sleeve or a CRYIOLIVE flareless sleeve assembly and an MS21924 bulkhead union.

(5) To make tube repairs, use tube sections of the same material and use the fittings as shown in Fig. 802. Make a splice repair of 21-6-9 and Ti-3AL-2.5V tubes with a 304-1/8h tube of the wall thickness.

(6) The permitted limits of hydraulic line damage caused by dents or chafes in the "Permitted Tube Defect Depth" table.

(7) A repair of a tube section can be in one of three groups. The groups have a relation to the location of the tube damage and the quantity of damage. The three groups are as follows:

(a) Replace a tube end section that has a flareless end fitting, and can be move apart, with an assembled tube and fitting assembly.

(b) Replace a tube center section that has a short damaged segment with a single union.

(c) Replace a tube center section that has a lot of damage with an assembled tube and fitting assembly.

(8) If more than one hydraulic tube has been disconnected and you think there is a possibility the tubes are connected incorrectly or cross-connected, do an operational check of the system.

NOTE: Use good judgment to determine if a check is necessary.

(a) Do a post-installation test of one or more components to which the tubes are connected as a check.

(9) If any electrical wires were disconnected to gain access to the tubes and there is a possibility that the wires are incorrectly connected or cross-connected, do an operational check.

NOTE: Use good judgment to determine if a check is necessary.

(a) Do a post-installation test of one or more components to which the wires are connected as a check.

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(10) Electrical rigid conduit repair.
(a) Smooth dents are permitted to the electrical rigid conduit with these limits as shown in Figure
1) Dent depth damage is not more than 20 percent of the outer diameter.
2) The conduit is not dented or has a scratch that causes it to have kinks, to rub, or to show the inner wire.
3) The dent is smooth and does not make a sharp wrinkle on the outer surface of the conduit.
4) There are no cracks in the conduit.
5) Dents are not permitted on rigid electrical conduits in the fuel tanks.
(b) Repair or replace the electrical rigid conduits if the damage is more than the limits.
(c) If you must form the rigid conduit tube to fit an installation, do not bend more than permitted by the forming limits for electrical rigid conduits as shown in Figure 801A.

C. Repair of a Tube (Make a Splice)
(1) Make a decision about the type of repair necessary. Use Fig. 802 to make a decision about the group the repair is in.
(2) Find the necessary tube cutout length when you use a single union to replace a damaged tube area.
(3) To use assembled tube ends or a center section to do a repair, find the cutout length and install as follows:
(a) Make an estimate of the total length (L1) of the repair section necessary to replace the damaged tube.
(b) Cut and trim the repair tube as follows:
1) Use the correct size ratchet chipless cutter.
2) Turn the cutter drive screw counterclockwise to retract the cutter wheel.
3) Put the cutter over the tube.
4) Turn the screw clockwise until the cutter touches the tube at the necessary cut location.
5) Turn the screw 1/8 to 1/4 turn and rotate the cutter until the cutter is easy to rotate. The tube should now be cut.
6) Remove the tool.
7) To deburr the tube use the correct stem subassembly and deburring tool.
a) To assemble the tool, see Fig. 803.
8) Push down on the plunger and install the tool into the end of the tube.
9) Release the plunger. Let the plug fill the inside of the tube.
10) Rotate the deburring tool until the inside burr is removed.
11) Remove the tool with the plug expanded. The expanded plug should remove metal particles from the inside of the tube.

NOTE: Make sure not to drop metal particles in the area of the repair.

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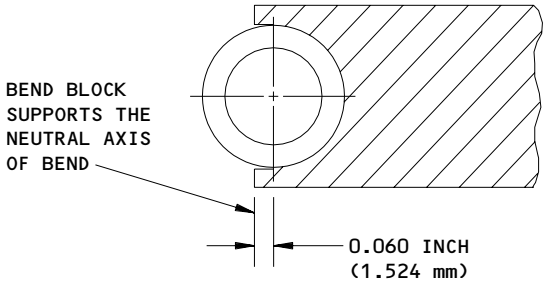
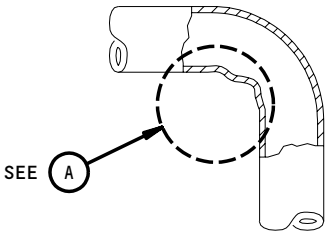
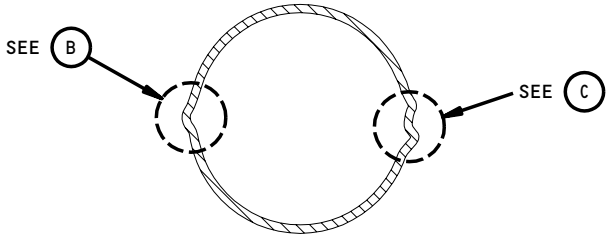


NOTE: IF THE OVALITY OF ANY PART OF THE BEND IS MORE THAN THE MAXIMUM PERMITTED OVALITY, DISCARD THE TUBE.

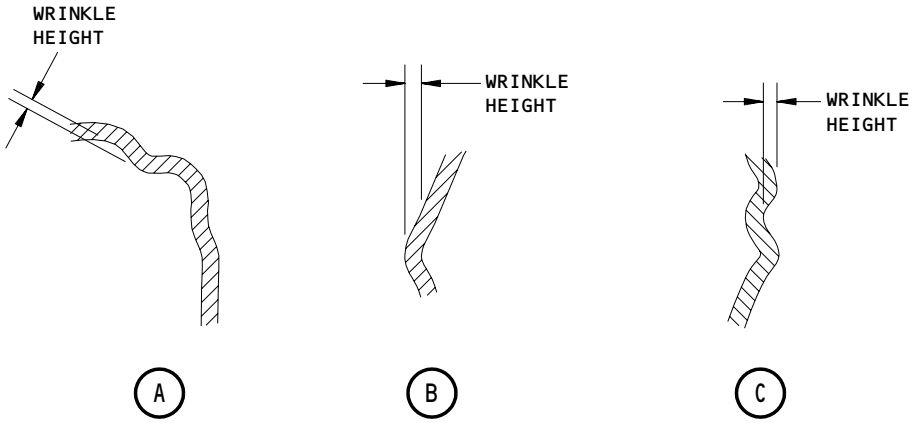
TUBE BEND BLOCK



RADIAL
WRINKLE



LONGITUDINAL
WRINKLE



WRINKLE MEASUREMENTS

Electrical Conduit Forming and Repair Limits
Figure 801A (Sheet 1)

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CONDUIT SIZE (OD)	CONDUIT MATERIAL	ALLOWABLE WRINKLE HEIGHT INCH (mm)	ALLOWABLE OVALITY (PERCENT OF SPECIFIED OD)
1.0 OR LESS	STAINLESS STEEL	0.040 (1.016)	10
	ALUMINUM ALLOY	0.020 (0.508)	10
OVER 1.0	STAINLESS STEEL	0.060 (1.524)	10
	ALUMINUM ALLOY	0.030 (0.762)	10

Electrical Conduit Forming and Repair Limits
Figure 801A (Sheet 2)

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CONDUIT SIZE (OD) INCH (mm)	MAXIMUM DENT DEPTH INCH (mm)
0.25 (6.35)	0.050 (1.27)
0.31 (7.87)	0.063 (1.60)
0.38 (9.65)	0.075 (1.90)
0.50 (12.70)	0.100 (2.54)
0.63 (16.00)	0.125 (3.17)
0.75 (19.05)	0.150 (3.81)
0.88 (22.85)	0.175 (4.45)
1.00 (25.40)	0.200 (5.08)
1.25 (31.75)	0.250 (6.35)
1.50 (38.10)	0.300 (7.62)
1.75 (44.45)	0.350 (8.89)
2.00 (50.80)	0.400 (10.16)

Electrical Conduit Forming and Repair Limits
Figure 801A (Sheet 3)

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REPAIR METHOD	TUBE JOINING PART NO.	TUBE JOINING ILLUSTRATION	TUBE MATERIAL	TOOL REQUIRED	APPROVED SIZES	ASSOCIATED APPROVED FITTINGS FITTING NUTS 5	ASSOCIATED APPROVED FITTINGS UNIONS 1
RECONNECTABLE	BACS13AP (BITE-TYPE) 4 2		6061T6	B C	04,06,08,10,12	MS21921 AL OR BACN10CS STEEL	MS21902 AL OR MS21924 STEEL
			304 ANN.	B C	04,06,08,10,12	MS21921 } STEEL BACN10CS }	MS21902 } STEEL MS21924 }
			304 1/8h.	B C	04,06,08,10,12	BACN10NR-Ti	BACU24K-Ti
WITH FLARELESS FITTING SLEEVES	BACS13BX 4 3 2 IN SIZES -20 & -24; 7 5 BACS13BD (ELASTOMER SWAGE) 6 4		6061T6	A	06,08,10,12,16,20	MS21921 AL OR BACN10CS STEEL	MS21902 AL OR MS21924 STEEL
			304 ANN.	A	16,20	MS21921 } STEEL BACN10CS }	MS21902 } STEEL MS21924 }
			304 1/8h.	A	06,08,10,12,16,20,24	BACN10NR-Ti	BACU24K-Ti
			21-6-9	A	04,06,08,10,12,16		
	BACS13BX 4 3 2 (ROLLER SWAGE)		6061T6	D	04,06,08,10,12,16	MS21921 } STEEL BACN10CS }	MS21902 } STEEL MS21924 }
			21-6-9	D	04,06,08,10,12,16	BACN10NR-Ti	
			T1-3AL-2.5V	D	04,06,08,10,12,16		
PERMANENT UNIONS TUBE-TO-TUBE	CRYOLIVE 921721		6061T6	G	04,06,08,10,12	6	MS21902 } STEEL MS21924 }
			21-6-9	G	04,06,08,10,12,16		
			T1-3AL-2.5V	G	04,06,08,10,12,16		
			304 1/8h.	G	04,06,08,10,12,16		
	BACC42W		6061T6	G	04,06,08,10	NONE NECESSARY	NONE NECESSARY
			304 ANN.	G	04,06,08,10,12,16		
	REPAIR H - FITTING BACC42W-T		304 1/8h.	G	04,06,08,10,12,16		
			21-6-9	G	04,06,08,10,12,16		
			T1-3AL-2.5V	G	04,06,08,10		
	3P02111 CRYOFIT		T1-3AL-2.5V	F	04,06,08,10,12,16		
	PERMASWAGE D10282-D (AL)		6061T6	E	04,06,08,10,12		
	PERMASWAGE D10282 -- (CRES)		T1-3AL-2.5V	E	04,06,08,10,12,16		
			304 1/8h.	E	04,06,08,10,12,16		
			21-6-9	E	06,08,10,12,16		
	RYNGLOK 8D10IT - (TITANIUM)		6061T6	H	04,06,08,10,12,16,20		
			T1-3AL-2.5V	H	04,06,08,10,12,16,20		
			304 1/8h.	H	04,06,08,10,12,16,20		
			21-6-9	H	04,06,08,10,12,16,20		

A HARRISON PORTABLE SWAGERS #5175 AND #5720 OR EQUIVALENT STATIONARY SWAGER #5570
B PRESSURE PRESETTING TOOLS ST878D
C HAND PRESETTING TOOLS ST879A
D HARRISON ROLLER SWAGE TOOL KIT 6633K01
E DEUTSCH PERMASWAGE KITS: D12000 SERIES
#D12102C03-01A00 FOR SIZES 04 AND 06 (1/4" AND 3/8"),
#D12102C06-26A00 FOR SIZES 08, 10 AND 12 (1/2", 5/8" AND 3/4")
#D12102C11-04 FOR SIZE 16 (1").
ONE PUMP UNIT, PART #D12025-001, IS NECESSARY FOR SWAGING WITH THE TOOL KITS SHOWN.
DLT SERIES
SEE FIGURE 825 FOR INDIVIDUAL TOOL NUMBERS.
CONSULT DEUTSCH FOR TOOL KIT NUMBERS.
ONE PUMP UNIT, DLT02MAPP1000 (PNEUMATIC, 10,000 PSI) OR DLT01MAPM1000 (MANUAL, 10,000 PSI) IS NECESSARY FOR SWAGING WITH THE TOOL KITS SHOWN.
F RAYCHEM: TS3P0211
G NONE NECESSARY - HAND TOOLS ONLY
H AEROQUIP RYNGLOK KIT: RTST8-02 -006 FOR SIZES 04, 06, 08, 010, 012, 016 AND 20.

NOTE: SEE FIGURE 824 TO MAKE AN ORDER FOR PARTS.

1 OR OTHER UNIONS, REDUCERS, ELBOWS, AND TEES WITH MS 33514 OR MS 33515 FITTINGS ENDS

2 STANDARD CADMIUM PLATED SLEEVE BACS13AP (SIZE)

3 STANDARD CADMIUM PLATED SLEEVE BACS13BX (SIZE) HP
BACS13BD (SIZE) HP

4 CAUTION: DO NOT USE CADMIUM PARTS ON TITANIUM MATERIAL BECAUSE OF THE RISK OF CORROSION BETWEEN THE TWO METALS.

5 BACS13BD2OH.HP AND BACS13BD24H.HP HAVE BEEN SUPRESSED BY BAC13BX2OH.HP AND BAC13BX24H.P.

6 DO NOT USE ALUMINUM NUTS OR TUBE MATERIALS OTHER THAN ALUMINUM.

7 USE ONLY THE CRYOLIVE FLARELESS SLEEVE ASSEMBLY, CONSISTING OF THE CRYOLIVE SLEEVE, COUPLING NUT AND PLASTIC CAP. THE CRYOLIVE FLARELESS SLEEVE ASSEMBLY, IN SIZES 10, 12 AND 16, REQUIRES USE OF A LONGER LENGTH AMCI P/W 9211699 (MATERIAL CODE) (SIZES) IN COUPLING NUT, THE LONGER LENGTH COUPLING NUTS ARE NOT INTERCHANGEABLE WITH STANDARD BACN10- AND MS21921 COUPLING NUTS.

Tube Material and Fitting Selection Chart
Figure 802

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(c) Swage the necessary flareless sleeves to the repair tube as told in the applicable section:
  1) Swage BACS13BD and BACS13BX Flareless Sleeves with the Harrison Elastomer Swagers 5175, 5570, and 5720.
  2) Swage BACS13BX Flareless Sleeves with the 6633K01 Harrison Roller Swaging Kit.
  3) Preset BACS13AP Flareless Sleeves.
  4) Remove the CRYOLIVE, sleeve/coupling nut/protective cap assembly from the liquid nitrogen and slide the assembly on to the tube, allowing it to warm to room temperature.

(d) Assemble and tighten the flareless fittings which are part of the repair section (AMM 20-10-51/401).

(e) Measure all of the tube assembly length (L1).

(f) Find the necessary cutout length (L2).

(g) Remove the pressure from the systems where you will do the repairs.

(h) Cut out the damaged tube (L2). Trim the tube ends.

(i) When making an installation, refer to the applicable section as follows:
  1) To use the Harrison elastomer swager to install BACS13BD and BACS13BX flareless sleeves, refer to "Swage the BACS13BD and BACS13BX flareless sleeves with the Harrison elastomer swagers, 5175, 5570, and 5720".
  2) To use the 663K01 Harrison roller swaging kit to install BACS13BX flareless sleeves, refer to "Swage the BACS13BX Flareless Sleeves with the 6633K01 Harrison Roller Swaging Kit".
  3) To install BACS13AP flareless sleeves, refer to "Preset the BACS13AP Flareless Sleeves".
  4) If using H-couplings (BACC42W) for repair, refer to "Install the BACC42W H-coupling".
  5) If using Cryofit unions (3P02111) for repair, refer to "Install the 3P02111 Cryofit Coupling".
  6) If using Permaswage unions (D10283) for repair, refer to "Install the Permaswage Fittings".
  7) To install CRYOLIVE flareless sleeve assembly, refer to "Install the CRYOLIVE Flareless Sleeve Assemblies".
  8) If using Rynglok tube to tube unions for repair, refer to "Install the Rynglok Union".

  NOTE: Use only the complete CRYOLIVE Flareless Sleeve Assembly, consisting of a CRYOLIVE sleeve, coupling nut and plastic cap. The CRYOLIVE flareless sleeve assembly, in sizes 10, 12 and 16, requires use of a longer length coupling nut. The longer length coupling nuts are not interchangeable with standard BAC10- and MS21921 coupling nuts.

(j) Install the repair section and tighten the nuts (AMM 20-11-05).

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(k) When using a Cryofit union or H-coupling in the repair section, install it after tightening the flareless fittings in their positions.
(l) When using a Permaswage union in the repair section, allowances must be made for swage growth. Tighten the repair section in position after installation of the Permaswage union.
(m) When replacing a tube bend section, make sure to keep the minimum straight length specifications for all fittings.
(n) When using a CRYOLIVE flareless sleeve/coupling nut in conjunction with a permanent Cryofit, H-coupling or Permaswage union, tighten the flareless coupling nut hand tight before installing the permanent fitting to minimize axial preload on the CRYOLIVE sleeve.

3. Swage the BACS13BD and BACS13BX Flareless Sleeves with the Harrison Elastomer Swagers 5175, 5570, and 5720

A. Equipment
(1) Harrison Portable Swagers - 5175 and 5720 Harrison Stationary Swager, 5570 Sierracin-Harrison, 3020 Empire Ave, Burbank, CA 91504
(2) Tiplar bore gage or Mueller bore gage or an equivalent
(3) Regulated air pressure (0-100 psi)

B. Consumable Materials
(1) Lubricant - Extreme Pressure, Anti-Scoring No. 3 (AMM 20-30-21)

C. Procedure
(1) Get the necessary tools as shown in the instruction manual supplied with the Harrison elastomer swager.
(2) Apply a light layer of antiscoring lubricant to the outer surfaces of the bushings and expanders of the drawbar assemblies. Make sure the tube and sleeve are clean and dry.

WARNING: POINT THE TUBE AWAY FROM PERSONS AND EQUIPMENT WHEN YOU SWAGE. DRAWBOLTS CAN BREAK AND COME QUICKLY OUT OF THE TUBE. THE DRAWBOLTS CAN HIT PERSONS OR EQUIPMENT AND CAUSE INJURY OR DAMAGE.

NOTE: Do not let the lubricant go into the grooves of the sleeve. Lubricant in the grooves will prevent correct swaging.

(3) Apply the specified swage pressure and hold the pressure for a minimum of 2 seconds.
(a) See Fig. 814 for specified pressure.
(4) Do a check of the groove depth with a Tiplar or Mueller bore gage.
(5) Do a check on the external dimensions of the swaged fitting,
(6) Make sure the tooling die marks on the tube OD do not have a height or depth larger than 10 percent of the tube wall specified thickness. Other permitted defects include marks or scratches on the outer tube which are less than 0.20 inch (5.08 mm) in length and 0.002 inch (0.051 mm) in depth.

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(7) Make sure the seal areas of the sleeves and unions are not scratched or damaged during fabrication. Make sure each seal area keeps the usual finish specifications.
(8) Make sure the tool and die marks on the external skirt and shoulder areas of the sleeves and unions are not more than 0.002 inch (0.051 mm) in height. Also, these marks must not touch the nut.

ALLOWABLE TUBE DEFECT DEPTH
HYDRAULIC PRESSURE (3000 PSI) AND RETURN LINES (1500 PSI)

TUBE MATERIAL (PRESSURE)	DEFECT TYPE	TUBE OUTER DIAMETER						
		1/4	3/8	1/2	5/8	3/4	-1	1-1/4
TI-3AL-2.5V 21-6-9 (3000 PSI)	Chafed	0.006	0.007	0.008	0.010	0.011	0.012	---
	Dented	0.005	0.007	0.010	0.015	0.018	0.020	---
304 1/8 H (3000 PSI)	Chafed	0.006	0.007	0.008	0.010	0.011	0.012	---
	Dented	0.005	0.010	0.020	0.030	0.040	0.040	---
6061T6 (1500 PSI EXCEPT *)	Chafed	0.015	0.015	0.010	0.005	0.004	0.003	0.003
						*0.015	*0.015	*0.015
	Dented	0.015	0.015	0.010	0.005	0.005	0.005	0.005

ALL DIMENSIONS ARE IN INCHES * SUCTION LINE, 150 PSI

NOTE: The above limits were made under laboratory conditions and are an aid only.

4. Swage the BACS13BX Flareless Sleeves with the 6633K01 Harrison Roller Swaging Kit
   A. Equipment
      (1) Harrison Roller Swage Tube Repair Kit, 6633K01 — Sierracin-Harrison
   B. Procedure
      (1) Gather together any necessary tools as indicated in the operating instruction manual supplied with the Harrison Roller Swage Tube Repair Kit.
      (2) Apply the specified torque to the expander mandrel (Fig. 817).
      (3) After swaging, make sure the BACS13BX sleeve and tube agree with the specifications.

          NOTE: Do not trim the tube after you roller swage. If it is necessary, remove burrs with an approved deburring tool.

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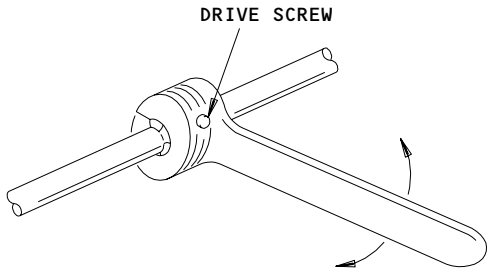
TUBE SIZE	CHIPLESS CUTTER PART NUMBER	CUTTER WHEEL PART NUMBER
04	D9872	D9872-114
06	D9872	D9872-114
08	D9853	D9853-214
10	D9853	D9853-214
12	D9853	D9853-214

DEUTSCH CHIPLESS CUTTERS AND CUTTER WHEELS



Cutter Tool Operation
Figure 803

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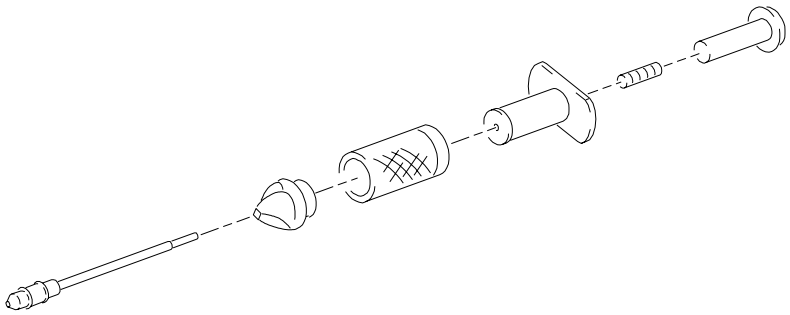
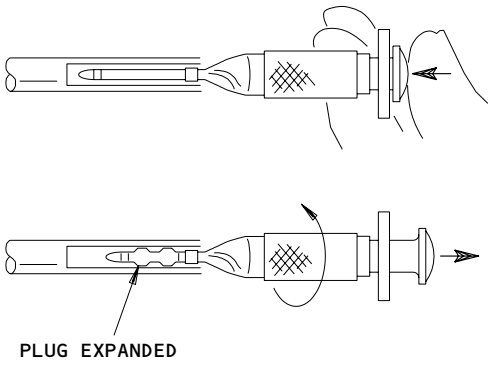
TUBE SIZE	TUBE WALL THICKESS (INCHES)	STEM SUBASSEMBLY PART NUMBER	DEBURRING TOOL PART PART NUMBER
04	0.016 - 0.028	D9851-13-04	D9851
04	0.028 - 0.050	D9851-13-03	D9851
06	0.016 - 0.035	D9851-13-06	D9851
06	0.035 - 0.058	D9851-13-07	D9851
08	0.016 - 0.042	D9851-13-08	D9850
10	0.016 - 0.058	D9851-13-10	D9850

DEUTSCH STEM SUBASSEMBLIES AND DEBURRING TOOLS



DEBURRING TOOL ASSEMBLY



DEBURRING TOOL INSERTION AND EXTRACTION

Deutsch Deburring Tool
Figure 804

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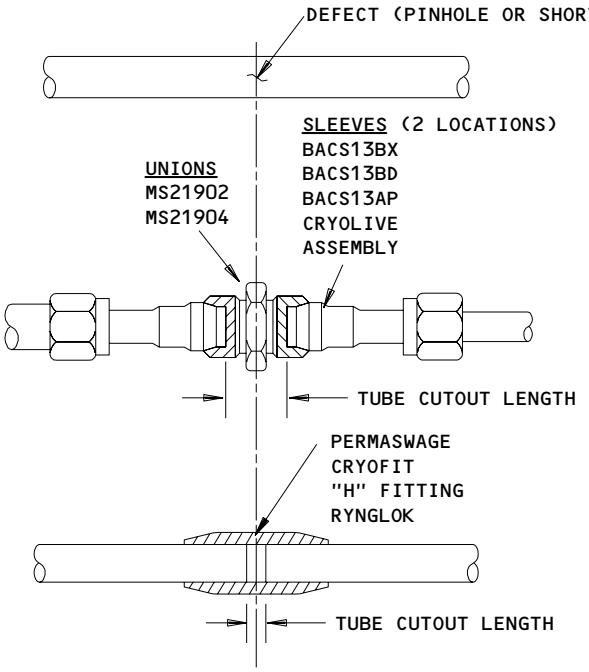

NOTE: FITTING NUTS NOT SHOWN.

TUBE CUTOUT LENGTHS IN INCHES

TUBE SIZE		04	05	06	08	10	12	16	20	24
UNION	SLEEVE									
MS21902	BACS13AP	0.59	0.56	0.68	0.76	0.86	1.05	----	----	----
	BACS13BX BACS13BD (HARRISON ELASTOMER SWAGER) CRYOLIVE ASSEMBLY	0.63	0.60	0.72	0.80	0.90	1.09	0.96	0.96	0.96
	BACS13BX (HARRISON ROLLER SWAGER)	0.82	----	0.95	1.03	1.21	1.40	1.40	----	----
MS21924	BACS13AP	1.18	1.18	1.29	1.42	1.55	1.78	----	----	----
	BACS13BX BACS13BD (HARRISON ELASTOMER SWAGER) CRYOLIVE ASSEMBLY	1.22	1.22	1.33	1.46	1.59	1.82	1.68	1.67	1.67
	BACS13BX (HARRISON ROLLER SWAGER)	1.41	----	1.56	1.69	1.90	2.13	2.13	----	----
PERMASWAGE CRYOFIT "H" FITTING	NONE NECESSARY	0.150 INCH MAXIMUM							----	----
RYNGLOK	NONE NECESSARY	SEE FIGURE 836								----

Tubing Repair with Unions - Short Damage
Figure 805

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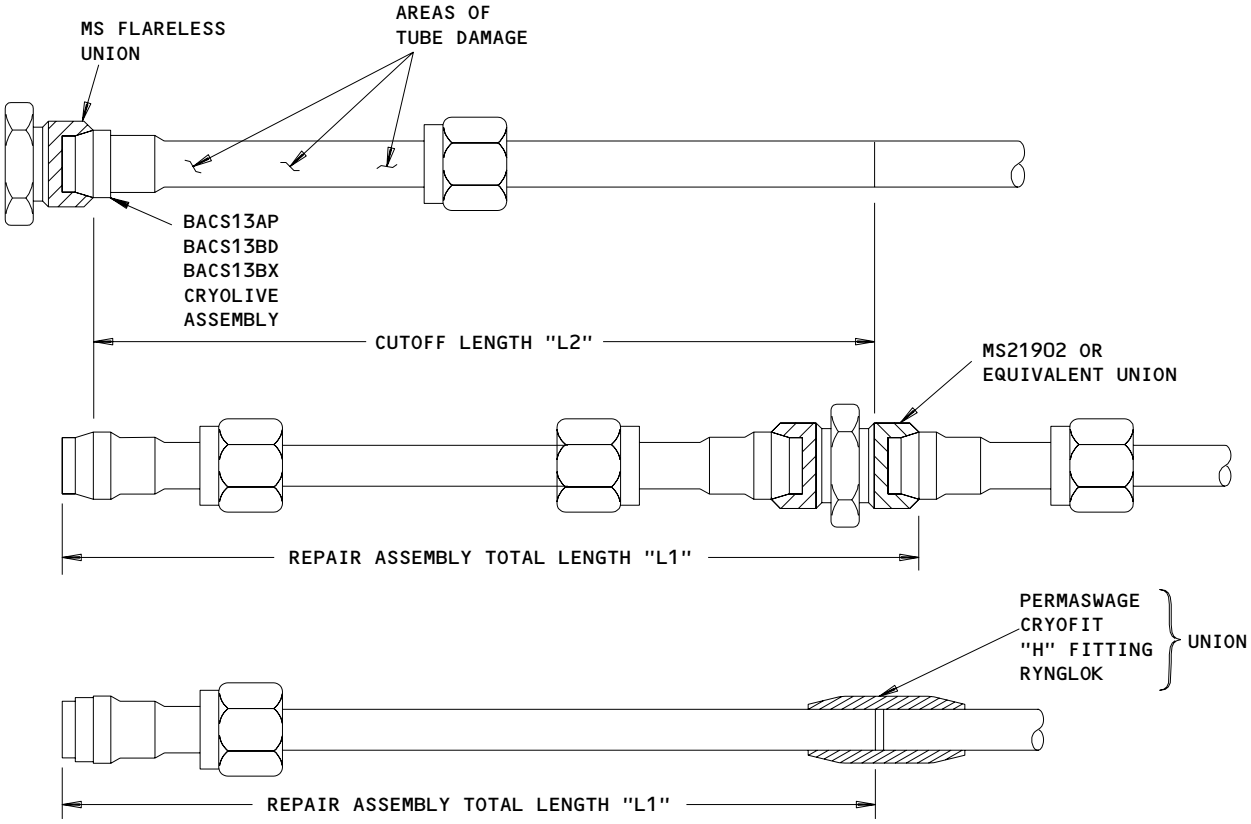

NOTE: THE LENGTHS L1 AND L2 ARE GIVEN IN FIGURE 808

Tubing Repair by End Replacement
Figure 806

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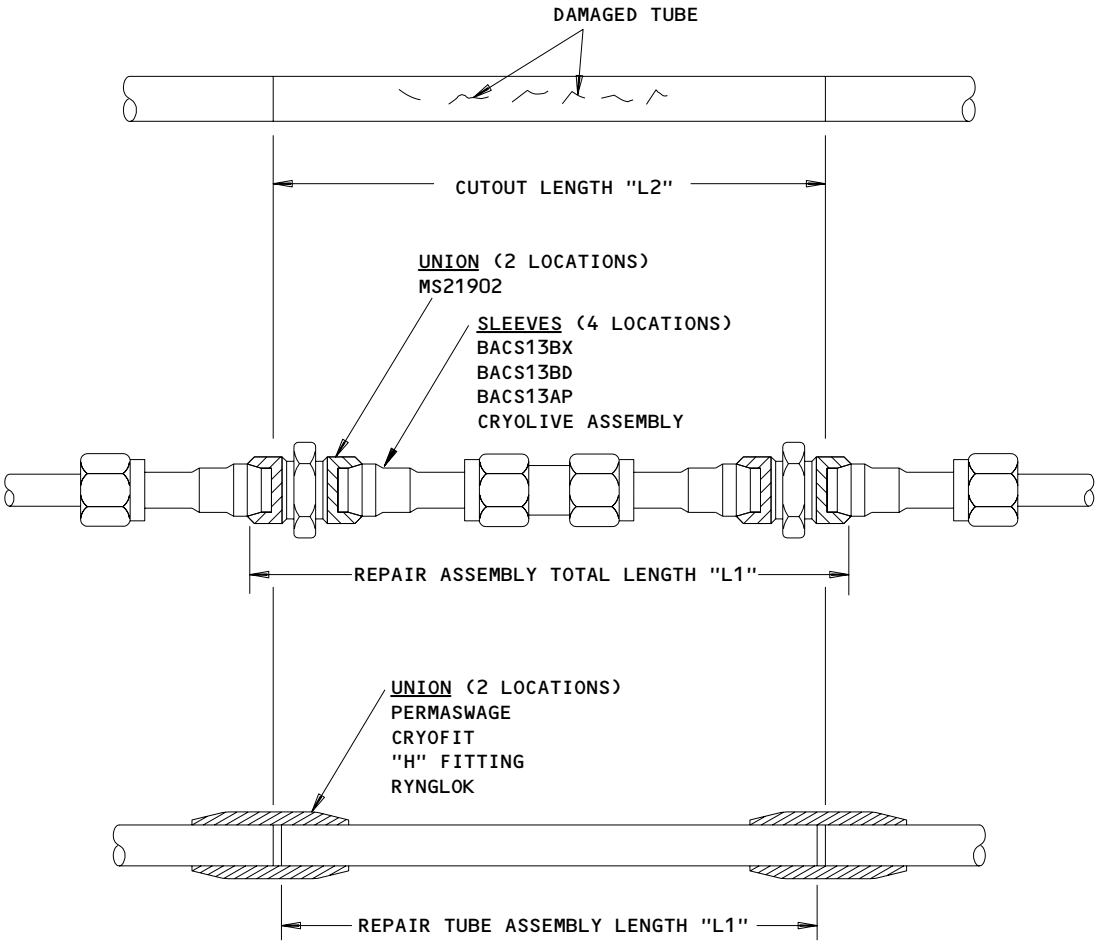

NOTE: THE LENGTHS L1 AND L2 ARE GIVEN IN FIGURE 808.

Tubing Repair by Section Replacement,
Figure 807

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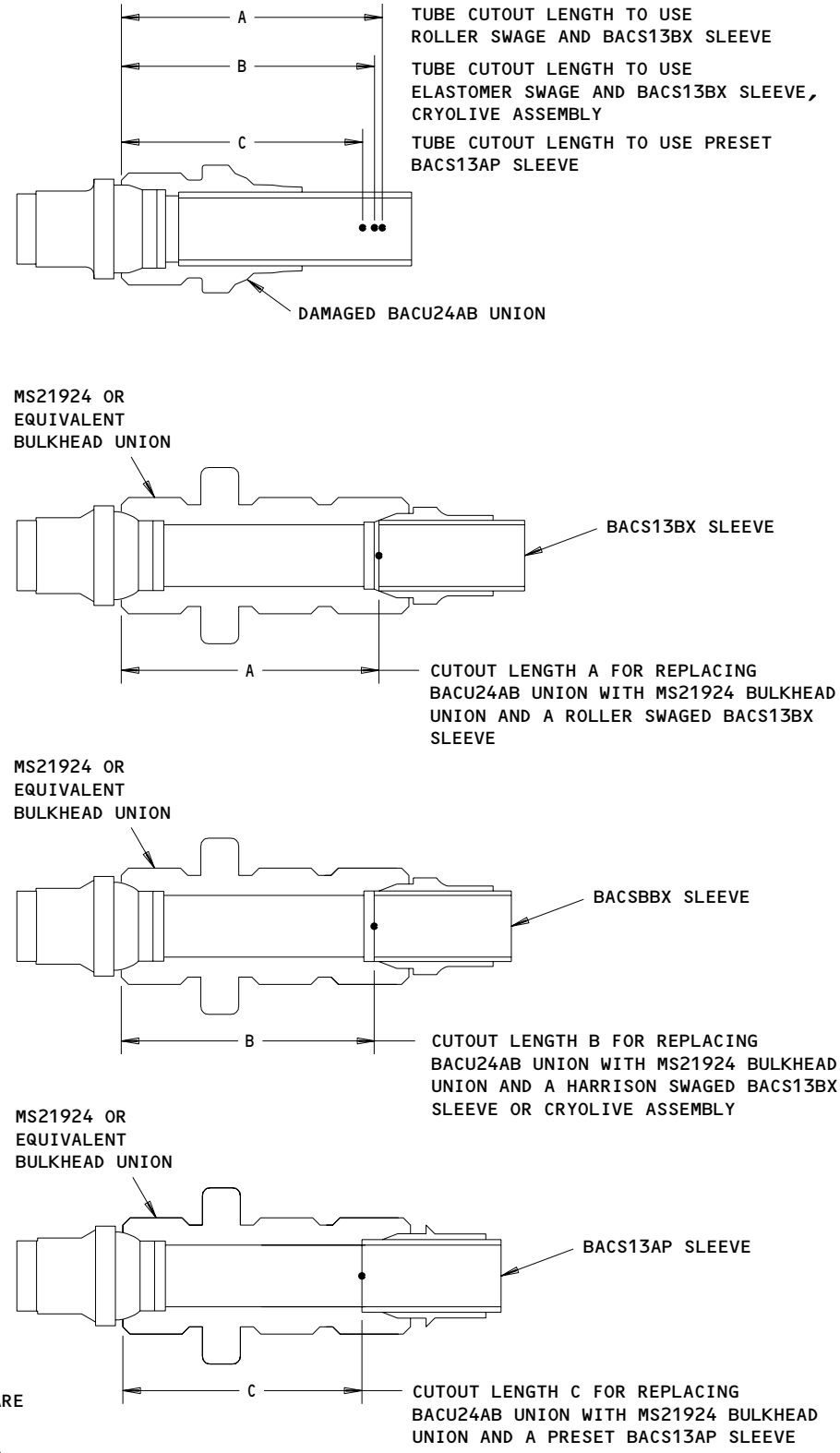

NOTE: THE LENGTHS A,B AND C ARE GIVEN IN FIGURE 806B.

COUPLING NUTS NOT SHOWN.

Tube Cutout Lengths for Replacement of Damaged BACU24AB Swage Unions
Figure 808

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FITTINGS REPLACING BACU24AB UNIONS				TUBE CUTOUT LENGTHS REQUIRED							
SLEEVE PART NO.	SWAGE METHOD	UNION PART NO.	DIM	04	06	08	10	12	16	20	24
BACS13BX	HARRISON ROLLER SWGE KIT #6633K01	MS21924	A FIG. 806A	1.562	1.705	1.886	2.100	2.334	2.319	NA	NA
BACS13BX	HARRISON PORTABLE SWAGERS #5175, #5720 OR EQUIV. STATNRY. #5570	MS21924	B FIG. 806A	1.487	1.612	1.791	1.965	2.199	2.122	2.119	2.049
CRYOLIVE ASSEMBLY	NONE REQUIRED	MS21924	B FIG. 806A	1.487	1.612	1.791	1.965	2.199	2.122	2.119	2.049
BACS13AP	HAND OR MACHINE PRESET	MS21924	C FIG. 806A	1.422	1.547	1.726	1.900	2.134	NA	NA	NA

REPAIR METHOD: YOU NEED TO REPLACE A DAMAGED BACU24AB SWAGE UNION. YOU WILL CUT OUT THE FITTING AND REPLACE IT WITH A BACS13BX OR BACS13AP SLEEVE, A COUPLING NUT AND MS21924 FLARELESS BULKHEAD UNION OF THE SAME OR SIMILAR MATERIAL AS THE UNION YOU ARE REPLACING.

TO MAKE THE REPAIR (REFER TO FIG. 806A):

STEP 1: CUT THE TUBE ADJACENT TO THE DAMAGED UNION – TO DIMENSION A,B, OR C DEPENDING ON THE SLEEVE AND SLEEVE INSTALLATION METHOD YOU PLAN TO USE.

STEP 2: SLIDE A FLARELESS COUPLING NUT ON TO THE TUBE. FOLLOW THE PROCEDURES FOR PRESETTING A BACS13AP SLEEVE OR SWAGING A BACS13BX SLEEVE TO THE TUBE END.

STEP 3: INSTALL THE MS21924 FLARELESS BULKHEAD UNION BETWEEN THE TWO TUBE ENDS AND TIGHTEN THE NUTS.

Procedure to Replace BACU24AB Union
Figure 809

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FITTINGS USED FOR REPAIR TUBE ASSEMBLY			"L2" CUTOUT LENGTH FORMULA 1	
FLARELESS SLEEVE		UNION	FOR TUBE END SECTION	FOR TUBE CENTER SECTION
PART NO.	SWAGE METHOD			
BACS13BX OR BACS13BD	HARRISON PORTABLE SWAGERS #5175 AND #5720 OR EQUIVALENT #5570	MS21902 OR EQUIVALENT	"L1" MINUS "2P"	"L1" MINUS "2P"
CRYOLIVE ASSEMBLY	NONE			
BACS13BX	HARRISON ROLLER SWAGE KIT #6633K01		"L1" MINUS "2Z"	"L1" MINUS "2Z"
BACS13AP	HAND OR MACHINE PRESET		"L1" MINUS "2H"	"L1" MINUS "2H"
BACS13BX OR BACS13BD	HARRISON PORTABLE SWAGERS #5175 AND #5720 OR EQUIVALENT STATIONARY SWAGER #5570	PERMASWAGE CRYOFIT "H" COUPLING	"L1" MINUS (P+0.10)	
CRYOLIVE ASSEMBLY	NONE			
BACS13BX	HARRISON ROLLER SWAGE KIT #6633K01		"L1" MINUS (Z+0.10)	
BACS13AP	HAND OR MACHINE PRESET		"L1" MINUS (H+0.10)	
		PERMASWAGE CRYOFIT RYNGLOK "H" COUPLING		"L1" MINUS 0.20

EXAMPLE: YOU HAVE MADE A DECISION THAT TO REPAIR TUBE DAMAGE, YOU WILL REMOVE A TUBE END SECTION AND REPLACE IT WITH A PREFABRICATED TUBE ASSEMBLY AS SHOWN ON FIGURE 806.

TO MAKE THE REPAIR TUBE END SECTION, YOU ROLLER SWAGED BACS13BX FLARELESS SLEEVES TO THE TUBE ENDS AND TIGHTENED THEM TO ONE END OF A MS21902 FLARELESS UNION.

STEP 1: MEASURE THE REPAIR TUBE ASSEMBLY TOTAL LENGTH "L1" (FIGURE 806).

STEP 2: OBSERVE THE CUTOUT LENGTH "L2" FORMULA (L1 MINUS 2Z) IN ABOVE TABLE.

STEP 3: FIND THE "Z" VALUE FOR TUBE SIZE IN FIGURE 809.

STEP 4. SUBTRACT (Z TIMES 2) FROM THE MEASURED "L1" FOR CUTOUT LENGTH "L2."

1 VALUES FOR "H", "P" AND "Z" ARE GIVEN IN FIGURE 809

"Procedure to Find the Tube Cutout Length ""L2"""
Figure 810

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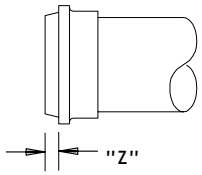
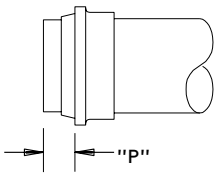
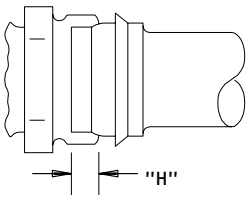
FLARELESS SLEEVE JOINT TYPE	TUBE SIZES								
	04	05	06	08	10	12	16	20	24
BACS13BX (ROLLER SWAGED) 	0.140	---	0.137	0.190	0.195	0.195	0.195	---	---
BACS13BX AND BD (ELASTOMER SWAGED) CRYOLIVE ASSEMBLY 	0.214	0.230	0.230	0.285	0.330	0.330	0.392	0.395	0.465
BACS13AP (PRESET) 	0.234	0.250	0.250	0.305	0.350	0.350	---	---	---

"Flareless Sleeve Tube End ""Z"", ""P"" and ""H"" Values"
Figure 811

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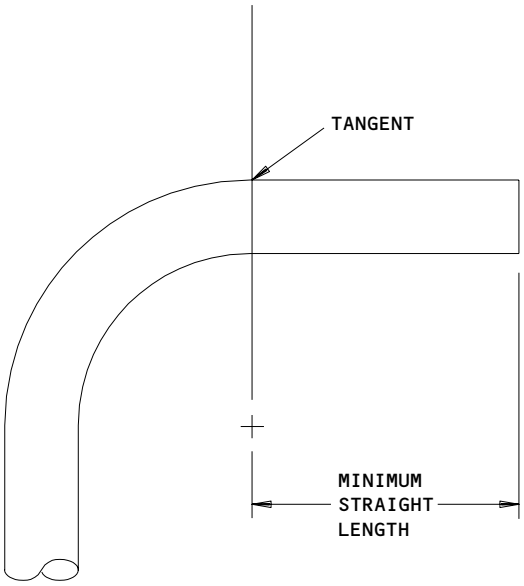

FITTING TYPE	TUBE END MINIMUM STRAIGHT LENGTH – INCHES								
	04	05	06	08	10	12	16	20	24
BACS13BD & BX (HARRISON ELASTOMER SWAGER) CRYOLIVE ASSEMBLY	1.23	1.25	1.28	1.39	1.48	1.51	1.47	1.46	1.46
BACS13BX (HARRISON ROLLER SWAGER)	2.25	2.25	2.25	2.25	2.25	2.25	2.25	—	—
BACS13AP (BITE TYPE)	0.80	0.90	1.00	1.10	1.15	1.15	—	—	—
D10282 * (PERMASWAGE)	1.07	—	1.15	1.65	1.70	1.80	1.90	—	—
BACC42W * (H – FITTING)	2.80	—	2.80	2.80	2.80	2.80	2.80		
3P02111 * (CRYOFIT)	0.71	—	0.90	0.98	1.17	1.35	1.76	—	—
80101T RYNGLOK	1.236	—	1.362	1.480	1.628	1.777	2.109	2.413	—

* BASED ON 1/2 FITTING LENGTH

Minimum Straight Length Specifications For
Figure 812

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(4) Make sure the seal areas of the sleeves are not scratched or damaged during fabrication. Make sure each seal area keeps the 63 RHR (no annular tool marks) finish specifications of its standard.
(5) Make sure the die marks on the external skirt and shoulder areas of the sleeves are not more than 0.002 inch (0.051 mm) in height. Also, make sure the die marks do not touch the nut.
(6) Make sure the tube inner surfaces at the swage area do not have scratches or marks caused by defective rollers.

5. Preset the BACS13AP Flareless Sleeves
A. General
(1) It is recommended to pressure preset and not preset by hand. If preset must be done by hand, it is recommended that some preset samples be made first. Then preset the section to be repaired. On the samples, cut away the sleeve to make sure that the ring out on the tube makes a circle around the tube circumference and has a depth of 0.002 inch (0.051 mm).
B. Equipment
(1) Cherry Lockbolt Gun - used with the hand presetting tool, Model G-85 Cherry Fasteners, Townsend Div. of Textron Corp., 1224 East Warner Ave, Box 2157, Santa Ana, CA 92707
(2) Presetting Tool used with Cherry Lockbolt Gun - ST878D
(3) Hand Presetting Tool and Holding Fixture - ST879A and ST879AF
C. Consumable Materials
(1) Lubricant - Extreme Pressure, Anti-Scoring No. 3 (AMM 20-30-21)
D. Procedure
(1) To do the pressure preset with the Cherry Lockbolt Gun G85:
(a) Attach the thrust sleeve and die holder to the Cherry Lockbolt Gun.
(b) Install the mandrel and the preset die in the Cherry Lockbolt Gun.
(c) Connect the air pressure line and use the correct pressure. Do several cycles of the Cherry Lockbolt Gun and make sure the pressure is set correctly.
(d) Assemble the split-clamp die, the clamp nut, and the sleeve. Put the assembly into the die holder.
(e) Put the B-nut on the tube and make the tube end touch the bottom of the die holder.
(f) Start the Cherry Lockbolt Gun. Hold the tube in its position while the die installs the sleeve on the tube. Maintain the pressure while you preset the sleeve on the tube.
(g) Unclamp the nut. Remove the tube and die from the holder. Open the die to show the preset sleeve.
(2) To preset the sleeve by hand do the following:
(a) Use the correct mandrel for the preset tool ST879A.
(b) Lubricate the threads, sleeve shoulder, and conical seal area of the fitting. Do not lubricate the tube.
(c) Assemble the sleeve on the tube. Insert the tube into the tool ST879A union. Tighten the nut.

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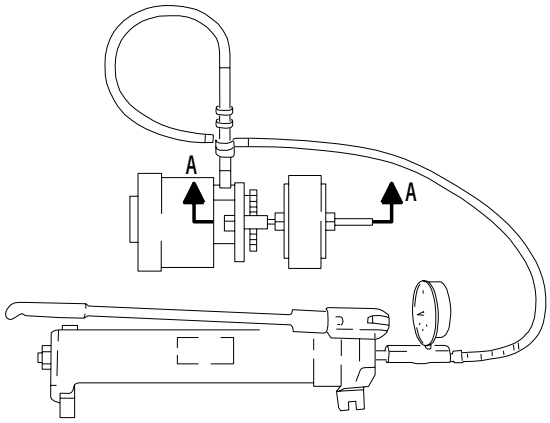
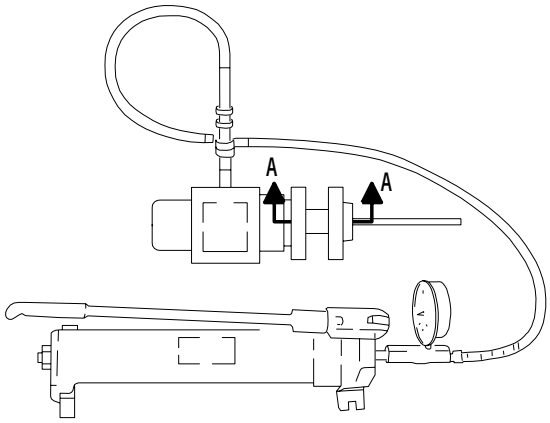
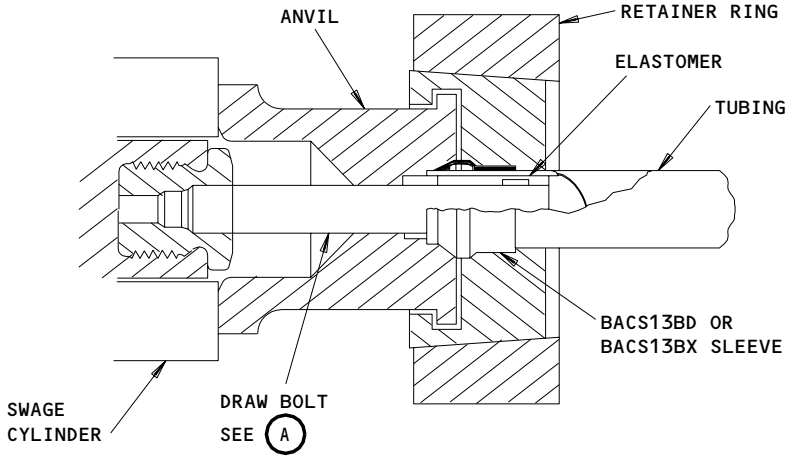


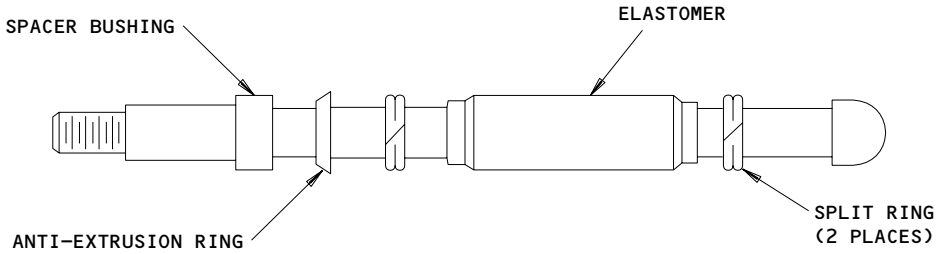
HARRISON MODEL 5720



HARRISON MODEL 5175



A–A



DRAW BOLT ASSEMBLY
(SHOWN EXTENDED)

(A)

Harrison Portable Elastomer Swagers for BACS13BX and BC Sleeves
Figure 813

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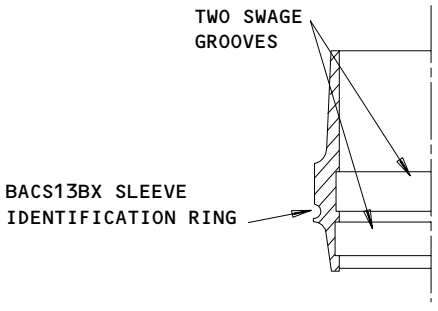
SWAGE PRESSURES NECESSARY TO INSTALL BACS13BD AND BACS13BX FLARELESS SLEEVES ON TUBE MATERIALS WITH THE HARRISON PORTABLE AND STATIONARY SWAGERS

TUBE SIZE	SWAGER MODEL NO.	21-6-9 CRES PER BMS 7-185			6061-T6 AL PER WW-T-700/6 OR MIL-T-7081			304, 321, AND 347 CRES 1		
		WALL (IN.)	SWAGE PRESSURE (PSI) 2 3		WALL (IN.)	SWAGE PRESSURE (PSI) ±5% 3		WALL (IN.)	SWAGE PRESSURE (PSI) 2 3	
			BACS13BD	BACS13BX		BACS13BD	BACS13BX		BACS13BD	BACS13BX
04	5175	0.016	675	475	----	---	---	0.020	----	475*
05	↓	0.020	1000	1000	0.035	450	450	----	----	----
06	↓	0.020	1200	1150	0.028 0.035	500	500	0.028	----	875 1150*
08	↓	0.026	2400	2000	0.035	950	950	0.035	----	1150 2000*
10	5570 5720	0.033	1200	850	0.020 0.028 0.035	250 375	250 375	0.035 0.042 0.049	----	450 850*
12	↓	0.039	1900	1600	0.035	600	600	0.058	----	1600*
16	↓	0.052	3700	3050	0.035	950	950	0.065 0.035	1650	3050* 1650
20	↓	---	----	----	0.035	1200	---	0.035	1650 2750*	----
24	↓	---	----	----	----	---	---	0.035	3600*	----

1 304 CRES (MIL-T-8504), 321 AND 347 CRES (MIL-T-8808), ASTERISK (*) IDENTIFIES 304 1/8 HARD CRES (MIL-T-6845).

2 MINIMUM SWAGE PRESSURE - IF YOU MUST SWAGE AGAIN, INCREASE IN 5% INCREMENTS.

3 THE BACS13BD 3-GROOVE SLEEVE WAS REPLACED BY THE BACS13BX 2-GROOVE SLEEVE IN SIZES -04 THRU -20. USE BACS13BD SLEEVES UNTIL YOU HAVE NO MORE. THE BACS13BX SLEEVE IS IDENTIFIED AS SHOWN:



Swage Pressures for Elastomer Swaging Flareless Sleeves
Figure 814

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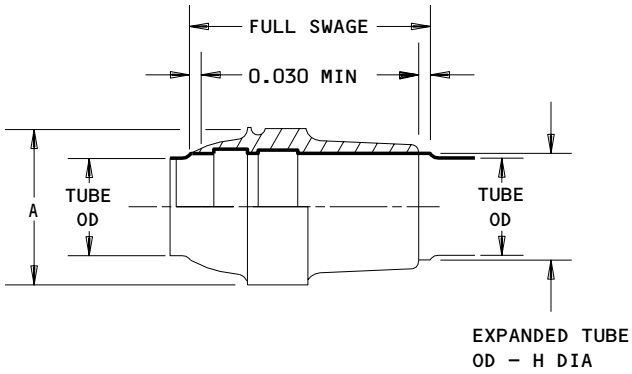

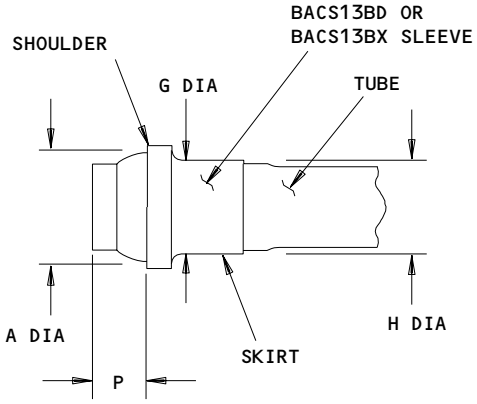

DIMENSIONS OF FLARELESS TUBE ENDS AND BACS13BD OR BACS13BX SLEEVES AFTER ELASTOMERIC SWAGING – INCHES

DIM.	SIZE								
	-4	-5	-6	-8	-10	-12	-16	-20	-24
P ±0.010	0.214	0.230	0.230	0.285	0.330	0.330	0.392	0.395	0.465
A MAX	0.374	0.437	0.493	0.673	0.789	0.964	1.214	1.474	1.723
G MAX	0.298	0.364	0.423	0.550	0.686	0.822	1.070	1.323	1.573
H MAX	0.260	0.322	0.385	0.511	0.636	0.761	1.011	1.262	1.517

BACS138D and BACS13BX Flareless Sleeve Dimensions After Swaging
Figure 815

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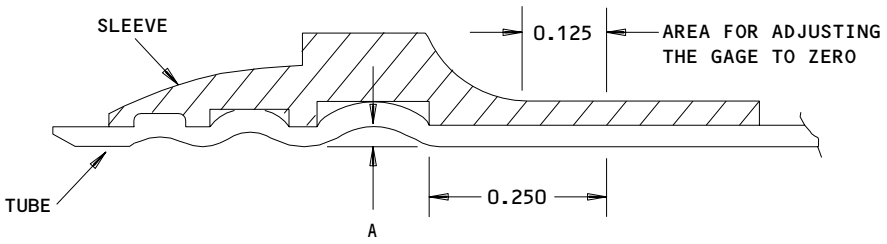
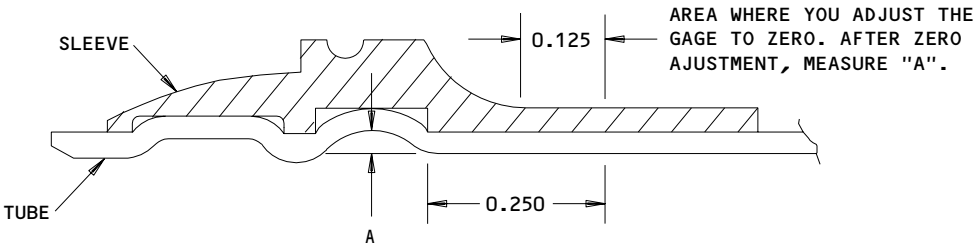


BACS13BD (THREE GROOVES SIZES -4 THROTUGH -16)
(TWO GROOVES, SIZES -20 AND -24)



BACS13BX (TWO GROOVES)

TUBE SIZE	DEPTH 2A - INCHES	
	MINIMUM	MAXIMUM
-4	0.014	0.024
-5	0.014	0.024
-6	0.016	0.026
-8	0.012	0.028
-10	0.020	0.032
-12	0.024	0.036
-16	0.024	0.038
-20	0.026	0.042
-24	0.026	0.042

TABLE - BACS13BD SWAGE
GROOVE DEPTH LIMITS

TUBE SIZE	DEPTH 2A - INCHES	
	MINIMUM	MAXIMUM
-4	0.020	0.032
-5	0.020	0.032
-6	0.020	0.032
-8	0.020	0.032
-10	0.022	0.034
-12	0.026	0.038
-16	0.028	0.040
-20	0.026	0.042
-24	0.026	0.042

TABLE - BACS13BX SWAGE
GROOVE DEPTH LIMITS

Groove Depth Measurement for BACS13BD and BACS13BX Sleeves
Figure 816

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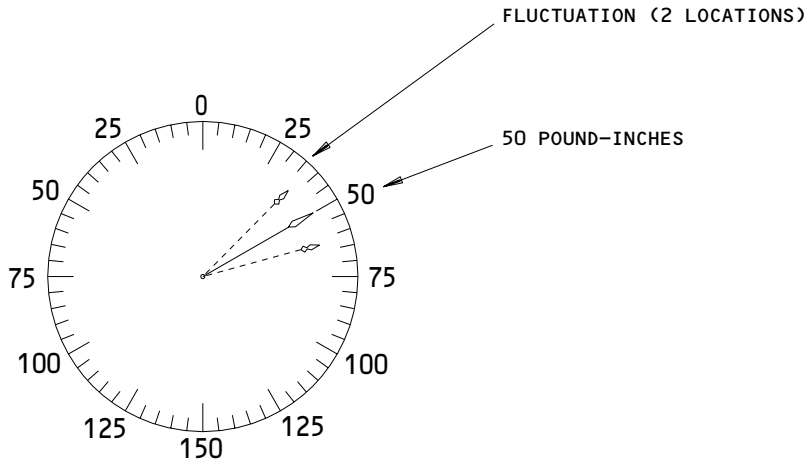

TORQUE WRENCH DIAL - PROCEDURE TO READ TORQUE

SWAGE TORQUES NECESSARY TO ROLLER SWAGE
BACS13BX SLEEVES TO Ti 3AL - 2.5V CWSR OR
21-6-9 CRES TUBE

OD DASH	TUBE SIZE AND MATERIAL WALL THICKNESS - INCHES		SWAGE TORQUE (POUNDS-INCH)	
	3AL-2.5V TITANIUM 1	21Cr-6Ni-9Mn CRES 2	MIN.	MAX.
-04	0.016	0.016	4	5
-06	0.019	0.020	12	15
-08	0.026	0.026	20	25
-10	0.032	0.033	40	45
-12	0.039	0.039	40	45
-16	0.051	0.052	80	85

1 AS SPECIFIED IN SPECIFICATION AMS 4944B/BMS7-234

2 AS SPECIFIED IN SPECIFICATION BMS7-185

Swage Torques for Roller Swage
Figure 817

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(d) If the ST879A preset tool is not available, you can preset the sleeves with a carbon steel union and nut as shown in procedure A or B of Fig. 823.

(3) After you preset, make sure the BACS12AP sleeve and tube joint have the following properties:

(a) Corrosion-resistant steel tubing (MIL-T-6845): Make sure that the sleeves have a maximum of 0.005 inch (0.127 mm) longitudinal end play. Make sure the sleeves do not turn freely on the tube under finger pressure (without the use of force).

(b) Annealed corrosion-resistant tubing (MIL-T-8504 and MIL-T-8808) and aluminum alloy tubing (MIL-T-7081 or WW-T-700/6). Sleeves can have 0.015 inch (0.381 mm) maximum longitudinal end play and turn on the tube under finger pressure.

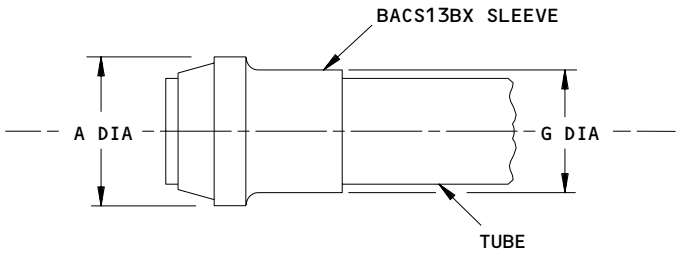
(c) These conditions apply to all tubing materials:

1) Make sure the tube inner diameter does not decrease more than 0.005 inch.

2) Make sure the sealing surface of the sleeve bow is free of scratches, marks, or other defects.

MAXIMUM PERMITTED SHOULDER AND SKIRT DIAMETERS (INCH)

DIA	TUBE SIZE					
	-04	-06	-08	-10	-12	-16
"A" MAX	0.374	0.493	0.673	0.789	0.964	1.214
"G" MAX	0.298	0.423	0.550	0.686	0.822	1.070



BACS13BX Sleeve Dimensions After Roller Swaging
Figure 818

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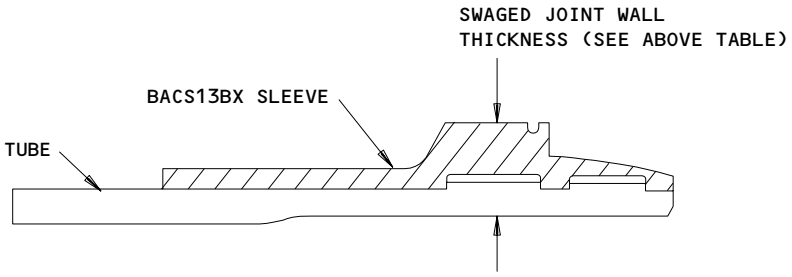
SWAGED JOINT WALL THICKNESS SPECIFICATION 1 2

SIZE	TUBE DIMENSIONS "NOMINAL" WALL THICKNESS - INCHES 2		SWAGED JOINT WALL THICKNESS FOR "NOMINAL" TUBE WALLS - INCHES 1	
	Ti 3AL-2.5V	21-6-9 CRES		
-04	0.016	0.016	0.068	TOLERANCE +0.002 -0.003
-06	0.019	0.020	0.066	
-08	0.026	0.026	0.100	
-10	0.032	0.033	0.101	
-12	0.039	0.039	0.132	
-16	0.051	0.052	0.143	

1 "NOMINAL" WALL THICKNESS DEFINITION: TUBE WALL THICKNESS WITHOUT TOLERANCES AS SPECIFIED BY TUBE SPECIFICATION: AMS 4944 FOR Ti 3AL-2.5V AND BMS 7-185 FOR 21-6-9 CRES.

2 IF THE THICKNESS OF A MEASURED TUBE WALL IS DIFFERENT THAN THE "NOMINAL", ADD OR SUBTRACT THE DIFFERENCE FROM THE NECESSARY SWAGED JOINT WALL THICKNESS FOR "NOMINAL" TUBE WALLS.

EXAMPLE: 1. MEASURED -10 SIZE TITANIUM 3AL-2.5V TUBE WALL = 0.035 INCH.
2. WALL DIFFERENCE IS 0.035 INCH MINUS 0.032 INCH = 0.003 INCH.
3. ADD 0.003 INCH TO 0.101 INCH = 0.104 INCH.



SECTION OF ROLLER SWAGED JOINT

BACS13BX Sleeve Roller Swaged Joint Wall Thickness Specifications
Figure 819

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3) The tube end is permitted to flare if the flare diameter does not prevent entrance of the MS21902 or MS21924 union into the MS flareless fitting end.

6. Install the CRYOLIVE Flareless Sleeve Assembly

A. General

WARNING: DO NOT USE CRYOLIVE FLARELESS SLEEVE ASSEMBLIES ON ANY OXYGEN LINES OR ON FLUID LINES INSIDE THE FIRE ZONES ON ENGINES OR APU'S. THE CRYOLIVE FLARELESS SLEEVE ASSEMBLY IS NOT APPROVED FOR THESE APPLICATIONS. DAMAGE TO EQUIPMENT OR INJURY TO PERSONS CAN OCCUR.

(1) The CRYOLIVE flareless sleeve is installed as part of an assembly consisting of the sleeve, a coupling nut and plastic cap that acts as an assembly tool and a protective cover for the tube end until the tube is installed in the airplane. The assembly is stored in liquid nitrogen until ready for use. During installation, the assembly is removed from the liquid nitrogen, slipped on the tube end and allowed to warm to room temperature. The sleeve shrink fits into position at the correct distance from the tube end as it warms to room temperature.

(2) The CRYOLIVE flareless sleeve assembly can be used with 304 1/8 hard CRES, and 21-6-9 CRES tube and 6061-T6 aluminum tube. Titanium coupling nuts (part of CRYOLIVE Assembly 921721T-) or CRES coupling nuts (part of CRYOLIVE Assembly 921721J-) can be used with the CRYOLIVE sleeve on 304 1/8 hard CRES, or 21-6-9 CRES tube. Aluminum coupling nuts (part of CRYOLIVE Assembly 921721W-) and aluminum mating fittings must be used to avoid galvanic corrosion when the CRYOLIVE flareless sleeve assembly is installed on 6061-T6 aluminum tube.

(3) The coupling nut used with the CRYOLIVE flareless sleeve assembly in sizes 10, 12 and 16 is longer than the standard MS21921/BACN10 coupling nut in the same sizes and is not interchangeable with the MS21921/BACN10 nuts.

(4) Ensure that the CRYOLIVE flareless sleeve assembly is installed so that the joint is not subjected to axial preload during final torquing of the joint.

B. Equipment

(1) CRYOLIVE Flareless Sleeve/Coupling Nut/Protective Cap Assemblies (Advanced Metal Component Incorporated, 1374 Willow Road, Menlo Park, California 94025)

(2) Tongs (Any suitable, also available from Advanced Metal Components, Incorporated by P/N AT911067-01)

(3) Insulated Gloves (Available from Advanced Metal Components, Incorporated by P/N OE-Glove-Liner, S-M-L or from Damart Corporation, 1811 Woodbury Avenue, Portsmouth, New Hampshire 03805 by P/N 264E)

(4) Work Box, Insulated (Available from Advanced Metal Components, Incorporated by P/N WB910825-01)

C. Consumable Materials

(1) G00262 Liquid Nitrogen

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(2) BOO148 Solvent - Methyl Ethyl Ketone - TT-M-261

D. Procedure

(1) Remove pressure from the system where you will do repairs and allow the hydraulic fluid to drain into a suitable container.

(2) Make sure that the tube end where you will install the CRYOLIVE flareless sleeve assembly is round, smooth and free of scratches and burrs.

(3) Use solvent to clean the tube in the area where you will install the CRYOLIVE flareless sleeve.

WARNING: DO NOT GET METHYL ETHYL KETONE (MEK) IN YOUR MOUTH OR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM MEK. PUT ON A PROTECTIVE SPASH GOGGLE AND GLOVES WHEN YOU USE MEK. KEEP MEK AWAY FROM SPARKS, FLAME, AND HEAT. MEK IS A POISONOUS AND FLAMMAVLE SOLVENT WHICH CAN CAUSE INJURY OR DAMAGE.

(4) Put on insulated gloves.

(5) Put liquid nitrogen BB-N-411, Type II, MIL-P-27401, Type II (-320°F), into a small, insulated container. Remove the CRYOLIVE flareless sleeve/coupling nut/protective cap assembly from the main storage container and put it into the small container of liquid nitrogen. Make sure the assembly is fully covered by the liquid nitrogen.

(6) Move the CRYOLIVE flareless sleeve/coupling nut/protective cap assembly in the liquid nitrogen (-320°F) to the repair location.

(7) Using tongs, remove the CRYOLIVE flareless sleeve assembly from the liquid nitrogen and allow the excess liquid nitrogen to run off.

WARNING: DO NOT PUT GLOVED HAND IN LIQUID NITROGEN. THE LIQUID NITROGEN CAN "WICK" INTO THE GLOVE MATERIAL AND CAUSE INJURY TO YOUR HAND.

(8) Grasp the CRYOLIVE flareless sleeve assembly with the gloved hand and immediately slide it on to the tube end until the assembly bottoms on the tube. Ensure that the tube end is visible in the slotted end of the protective cap.

(9) Allow the CRYOLIVE flareless sleeve to warm and shrink on to the tube.

CAUTION: THE TUBE END MUST BE FULLY BOTTOMED AGAINST THE INSIDE END OF THE CAP SO THAT THE SLEEVE IS CORRECTLY POSITIONED ON THE TUBE END. IF THE TUBE END IS NOT BOTTOMED AGAINST THE INSIDE END OF THE CAP, REMOVE THE PLASTIC CAP AND MEASURE THE TUBE PROTRUSION PER THE "P" DIMENSION REQUIREMENT OF FIGURE 811. IF THE "P" DIMENSION IS INCORRECT, THE INSTALLATION MUST BE REPLACED.

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(10) When ready to complete final joining/torquing of the coupling nut/CRYOLIVE flareless sleeve to the mating fitting, remove and discard the plastic cap by unscrewing the coupling nut.

NOTE: The plastic caps are manufactured from polycarbonate material and may be recycled.

7. Install the BACC42W H-Coupling

A. General

(1) The BACC42W H-coupling has a union, coupling, slide and nut. You can use the H-coupling on fuel and hydraulic high pressure (3000 psi) lines of Ti-3AL-2.5V, CRES 21-6-9, and CRES 304 1/8 hard tubing. This repair is also approved for line repair of CRES 304 annealed and 6061-T6 aluminum lines in 3000 psi or lower pressure applications. You can use this repair on tubing that is installed and in use.

WARNING: DO NOT USE BACC42W H-COUPLINGS ON ANY OXYGEN LINES OR ON FLUID LINES IN THE FIRE ZONES OF THE ENGINES OR APU'S. DAMAGE TO EQUIPMENT OR INJURY TO PERSONS CAN OCCUR.

(2) You can repair defects that have a maximum width of 3/8 inch. You must make splices on larger defects. The minimum workable splice section with two H-couplings and a length of tube is 4.5 inches.

B. Equipment

(1) Tube Coupling Assembly, BACC42W( ) (Sierracin-Harrison, 3020 Empire Way, Burbank, California)

NOTE: The number after the W in the part number gives the size of the coupling in sixteenths. For example, BACC42W6 fits 3/8-inch tube size. The BACC42W is superseded by BACC42W-T which is used on Ti-3AL-2.5V and all other hydraulic tubing. You can use BACC42W on all hydraulic tubes except Ti-3AL-2.5V.

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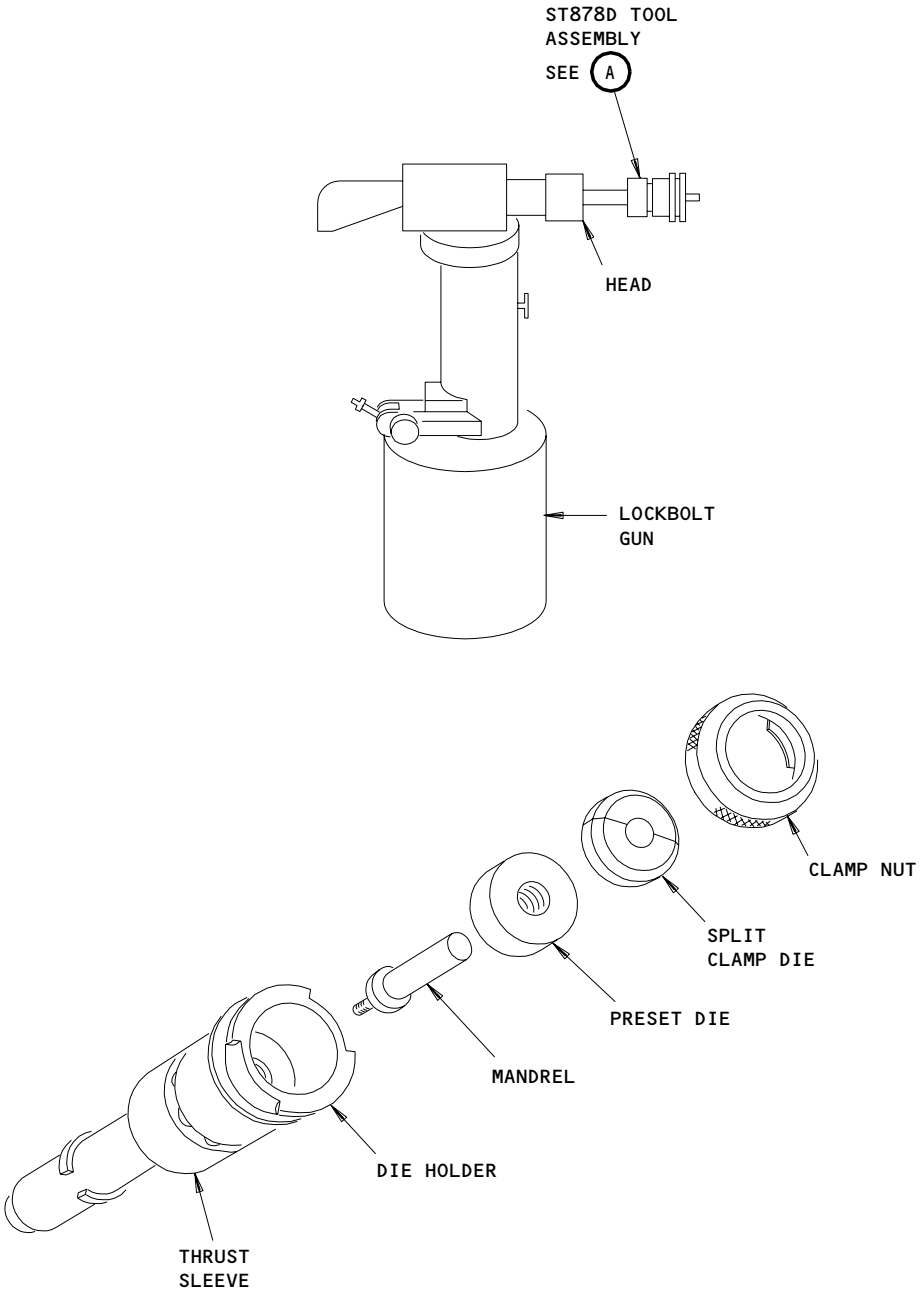

ST878D TOOL ASSEMBLY

A

Preset Pressures for the Cherry G-85 Lockbolt Gun With ST878D
Figure 820

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(2) Consumable Materials
(a) Masking tape (AMM 20-30-51)
(b) Solvent - General Cleaning of Metal (AMM 20-30-80)

C. Procedure

CAUTION: DO NOT TIGHTEN THE COUPLING ASSEMBLY BY HAND AFTER YOU REMOVE IT FROM THE SHIPPING CONTAINER OR BEFORE YOU INSTALL IT ON THE TUBE. THE COUPLING ASSEMBLY HAS NO MORE THEN ONE THREAD ENGAGED. YOU CAN COMPRESS THE UNION AND MAKE THE COUPLING ASSEMBLY DEFFICULT TO PUT IN POSITION.

(1) Remove pressure from the systems in area to be repaired.

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Pre-set Pressures for the Cherry G-85 Lockbolt Gun with ST878D Presetting Tool Assembly (BACS13AP Sleeves)				
PRESET PRESSURES - PSI				
TUBE SIZE	WALL THICKNESS	TOOL NO.	RECOMMENDED AIR PRESSURE (PSI)	
			ALUMINUM	STEEL
			6061-T6	AISI 304-1/8 HARD
3/16	0.020 THRU 0.035	ST878D-3-020 ST878D-3-035	22.5	30.0
1/4	0.020 THRU 0.035	ST878D-4-020 ST878D-4-035	27.5	40.0
5/16	0.020 THRU 0.035	ST878D-5-020 ST878D-5-035	30.0	40.0
3/8	0.020 THRU 0.035	ST878D-6-028 ST878D-6-035	30.0	52.5
1/2	0.028 THRU 0.035	ST878D-8-028 ST878D-8-035	42.5	75.0
5/8	0.028 THRU 0.083	ST878D-10-028 ST878D-10-083	50.0	80.0
3/4	0.028 THRU 0.049	ST878D-12-020 ST878D-12-049	52.5	85.0

ALL DIMENSIONS ARE IN INCHES

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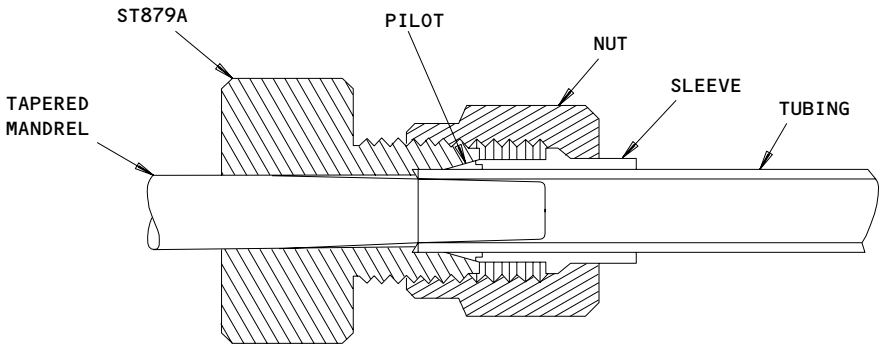
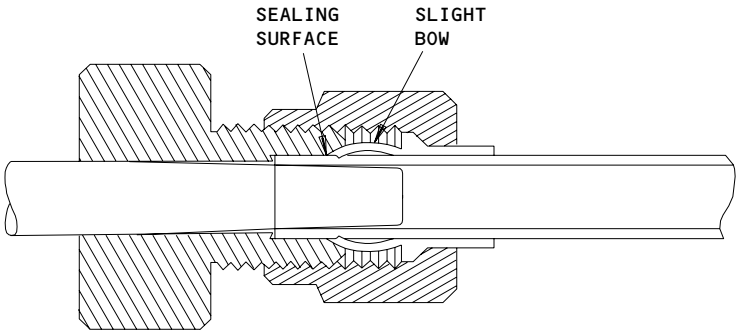


BEFORE PRESET BY HAND



AFTER PRESET BY HAND

Preset by Hand with Preset Tool ST879A
Figure 821

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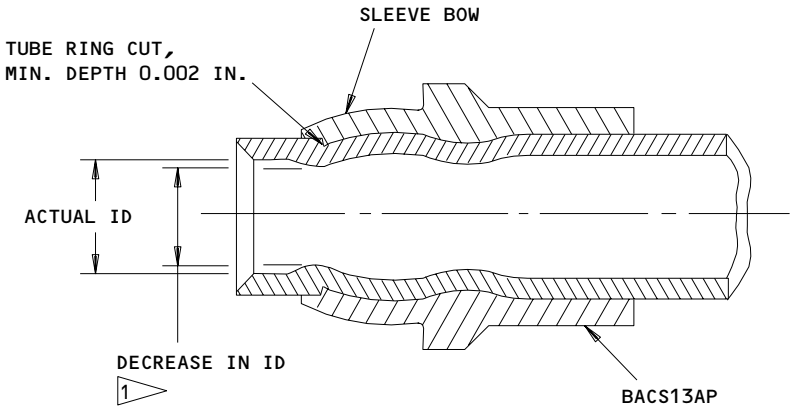
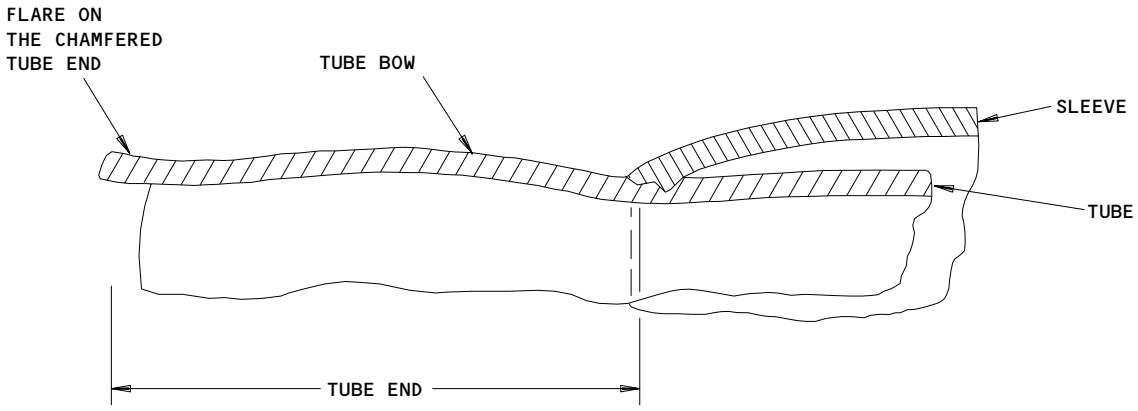


ASSEMBLED AND PRESET SLEEVE



TUBE END DEFORMATION

1 MAKE SURE THE ID DOES NOT DECREASE MORE THAN 0.005 IN. AFTER PRESET OR 0.015 IN. AFTER YOU TIGHTEN MANY TIMES.

Properties of Preset BACS13AP Flareless Sleeve/Tube End
Figure 822

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HAND PRESETTING FLARELESS FITTINGS – NO MANDREL [1]								
TUBE OD	1/4	5/16	3/8	1/2	5/8	3/4	1	1-1/4
STEEL TUBING								
(WALL THICKNESS) 304	0.020	0.020	0.028	0.035	0.049	0.058	---	---
PROCEDURE A [2] (DISPLACEMENT, TURNS)	1-1/6	1-1/6	1-1/6	1-1/6	1-1/6	1-1/6	---	---
PROCEDURE B (TORQUE) [3] POUND-INCHES 304	145	200	290	545	780	900	---	---
ALUMINUM TUBING								
6061T6 (WALL THICKNESS)	0.035	0.035	0.035	0.035	0.035	0.035	---	---
PROCEDURE A [2] (DISPLACEMENT, TURNS)	1-1/6	1-1/6	1-1/6	1	1	1	---	---
PROCEDURE B (TORQUE) [3] POUND-INCHES 6061T6	110	140	170	280	360	450	---	---

ALL DIMENSIONS ARE INCHES

[1] USE AN INTERNAL MANDREL PRESET TOOL ON TUBES WITH THINNER WALLS (REFER TO ST879A). WHEN IN DOUBT, MAKE A TEST PRESET TO MAKE SURE THE RING CUT MINIMUM DEPTH IS 0.002 INCH.

[2] MEASURE DISPLACEMENT FROM THE POINT WHERE THE FITTING, SLEEVE, AND NUT ARE FIRMLY HAND-TIGHTENED, AND A WRENCH IS NECESSARY TO FURTHER TIGHTEN.

[3] APPLY TORQUE, LOOSEN, AND APPLY INDICATED TORQUE THREE TIMES.

Displacement Turns and Torque Values for Hand Preset of Flareless Sleeves
Figure 823

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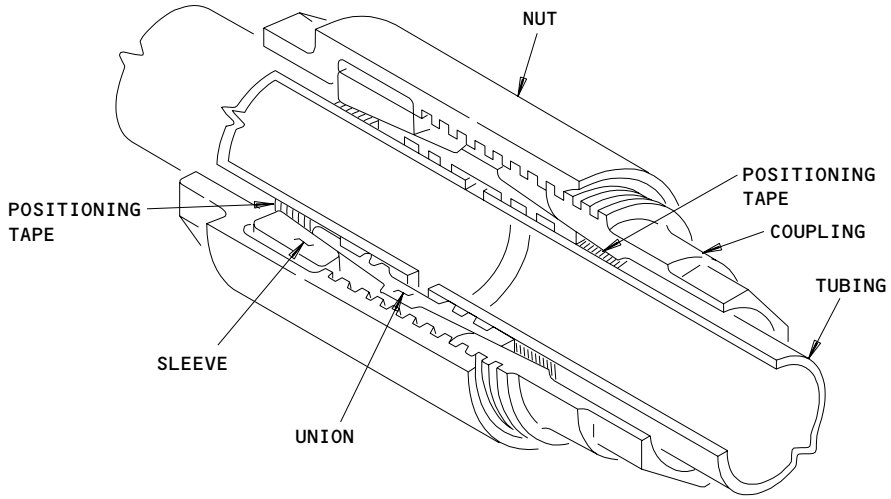
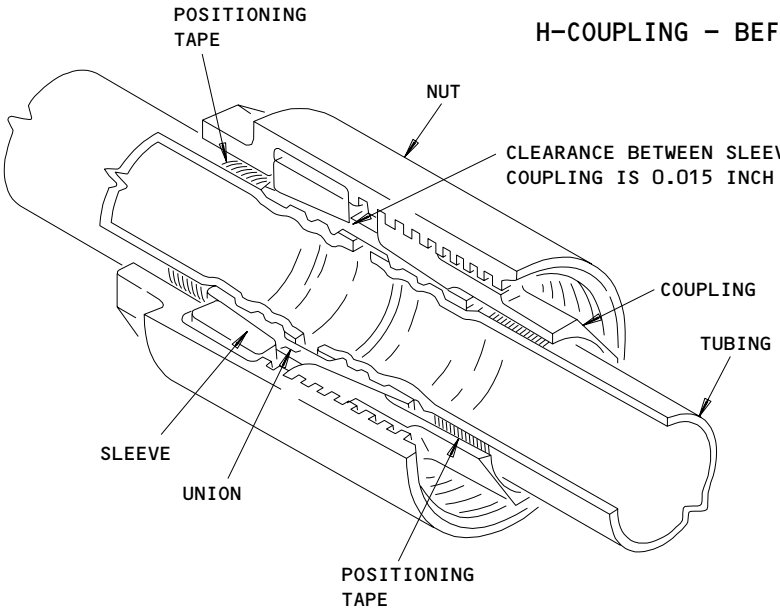


H-COUPLING - BEFORE INSTALLATION

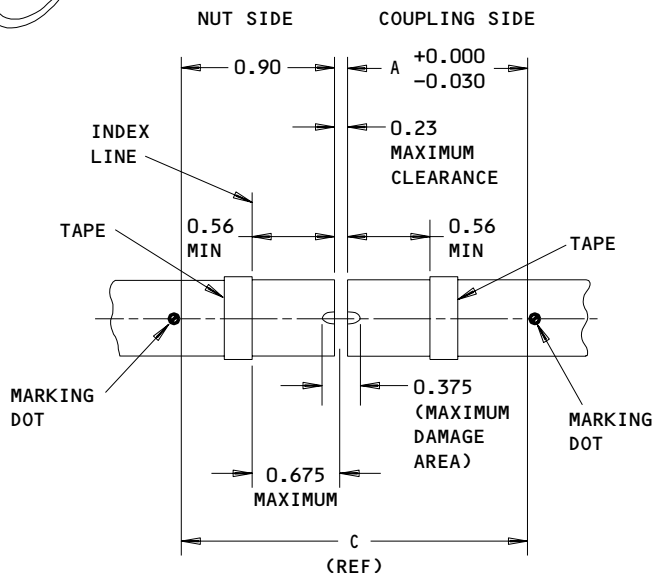


H-COUPLING - INSTALLED (TIGHTENED)

TUBE SIZE	DIMENSION A
04 THRU 10	1.440
12 THRU 16	1.740

NOTE: USE THESE DIMENSIONS TO FIND DIMENSION C.

ALL DIMENSIONS ARE IN INCHES.



H-Coupling Installation
Figure 824

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(2) Use solvent to clean the tube in the area where you will install the H-coupling.

WARNING: DO NOT GET SOLVENT IN YOUR MOUTH OR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENT.SOLVENTS ARE HAZARDOUS MATERIALS. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

(3) Cut the tube.
(4) Chamfer and remove burrs from the ID and OD edges. Clean the edges with solvent.
(5) Install tape on the nut side of the clearance at a minimum distance of 0.56 inch (14.224 mm) from the tube end and a maximum distance of 0.675 inch (17.145 mm) from the center of the clearance (Fig. 824).
(6) Use the same measurements to make a mark (index line) on the coupling side of the tube.
(7) Find and make a mark (marking dots) on the nut and coupling side of the tube.

NOTE: These marks will be used for the last inspection check (dimension "C").

(8) Install the coupling assembly over the coupling side of the tube.
(9) Make sure the large radius and the large diameter end of the sleeve are toward the center of the union.
(10) Install the nut and sleeve over the tape of the nut side of the tube.
(11) Make sure the sleeve large bore is toward the clearance.
(12) Align the tubes and move the union until it touches the tape on the nut side of the tube.
(13) Make sure the union meets or covers the index line on the coupling side of the tube.
(14) Install tape on the coupling side of the tube, with the tape edge even with the end of the union.
(15) Push the sleeve and the coupling body on the ends of the union.

NOTE: Make sure the tape does not move and the coupling body does not turn.

(16) Engage the threads of the nut with the coupling body and tighten the nut hand-tight.
(17) Examine the completed repair to make sure the two marking dots can be seen. If two dots cannot be seen, this shows that the sleeve and coupling are not fully seated against the center land of the union.
(18) Make sure dimension "C" does not increase.
(19) Do an inspection as follows:
  (a) Remove the nut.
  (b) Make sure the slide and coupling are no more than 0.015 inch from the union shoulder.
  (c) Make sure the union touches the tape.

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(d) If the clearance between the slide or coupling and the union is more than 0.015 inch (0.381 mm), install the nut and tighten it until you get the necessary clearance.
(e) Install the nut again and tighten the nut to the necessary torque value.
(f) If the union does not touch the tape, you must remove the coupling and a sufficient tube length. Install a new repair section.

8. Install the 3P02111 Cryofit Coupling

A. General

WARNING: DO NOT USE CRYOFIT COUPLINGS ON ANY OXYGEN LINES OR ON FLUID LINES INSIDE THE FIRE ZONES OF ENGINES OR APU'S. DAMAGE TO EQUIPMENT OR INJURY TO PERSONS CAN OCCUR.

(1) The Cryofit coupling is a fitting, which you can use to repair Ti-3AL-2.5V tubing as shown in Fig. 802. To install the fitting in a straight section, shrink fit it in its position.

B. Equipment
(1) Cryofit Repair Kit - TS3P02111 (Raychem Corporation, 300 Constitution Drive, Menlo Park, California 94025)

C. Consumable Materials
(1) Liquid nitrogen (AMM 20-30-31)
(2) Solvent - General Cleaning of Metal (AMM 20-30-80)
(3) Loctite 290 (AMM 20-30-11)
(4) Masking tape (AMM 20-30-51)

D. Procedure
(1) Remove pressure from the systems where you will do repairs.
(2) Use solvent to clean the tube in the area where you will install the Cryofit coupling.

WARNING: DO NOT GET SOLVENT IN YOUR MOUTH OR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENT. SOLVENTS ARE HAZARDOUS MATERIALS. REFER TO PRODUCT MATERIAL SAFETY DATA SHEETS (MSDS) AND LOCAL REQUIREMENTS FOR PROPER HANDLING PROCEDURES.

(3) Use tape to make a mark on the tube in order to be sure the Cryofit coupling is over the center of the tube repair.
(4) Cut the tube.

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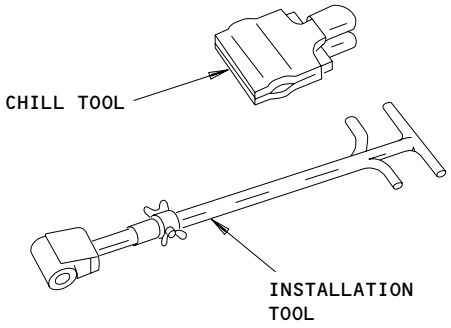
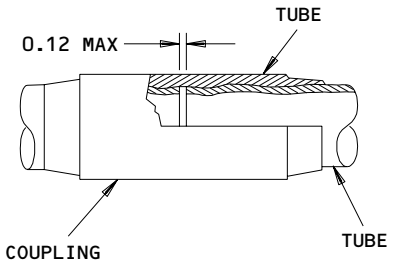
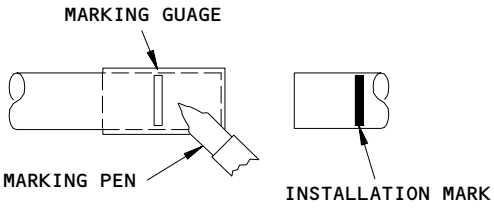
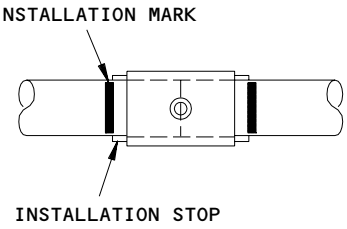




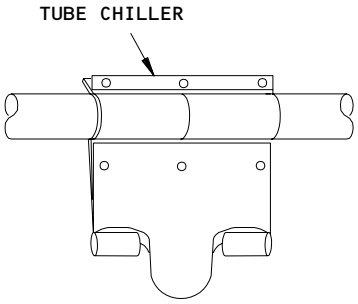
CRYOFIT COUPLING INSTALLATION



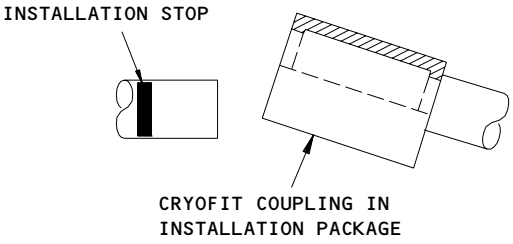
APPLICATION OF INSTALLATION MARK



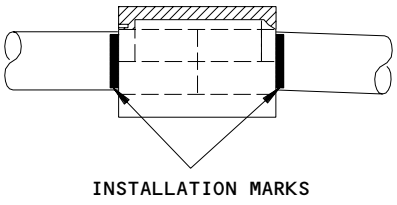
INSTALLATION STOP



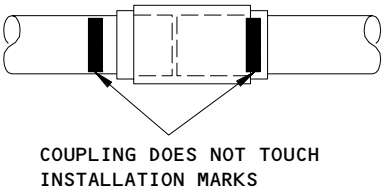
TUBE CHILLER APPLICATION



CORRECT POSITIONING OF
CROFIT FITTING ON TUBE



ACCEPTABLE



UNACCEPTABLE

POSITION OF INSTALLED FITTING ON TUBE

NOTE: CRYOFIT KIT TS3PO2111 INCLUDES ADDITIONAL ITEMS.

Cryofit Coupling 3PO2111 Repair
Figure 825

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(5) Chamfer and remove burrs from the ID and OD edges. Clean the edges with solvent.
(6) Put liquid nitrogen (-320°F) (-195.555°C) into a small, insulated container. Remove the Cryofit coupling from the main storage container and put it into the small container of liquid nitrogen. Make sure the fitting is fully covered by the liquid nitrogen.
(7) Move the Cryofit coupling in the liquid nitrogen (-320°F) (-195.555°C) to the repair location.
(8) Slip the test coupling (from the installation kit) over the tube ends to ensure that tubes are round and free of burrs. The test coupling should slide freely.
(9) Position the test coupling so that both tubes are visible in the coupling window. Ensure that a gap of less than 0.120 inch (3.048 mm) exists between the tube ends.
(10) Remove the test coupling and place the marking gauge over one of the tube ends. Using the marking pen, color in the rectangular slot on the gauge to provide an installation mark on the tube. Follow the same procedure to mark the remaining tube end.
(11) Place an installation stop (O-ring) in the middle of the mark on one of the tube ends. Check the location by positioning the test coupling so that it is butted against the stop. Both tube ends should be visible in the window and the test coupling should cover approximately half the installation mark on each tube. Adjust the tubes and installation stop as necessary. Remove the test coupling.
(12) Ensure that the tube ends within half the coupling length of the end are free of scratches. If a fitting must be installed over a tube end containing a scratch, apply a thin layer (one to two drops) of Loctite 290 around the tube circumference in the area under the serrations. Be careful not to let the Loctite into the tube. No Loctite application is required for tube ends without scratches.
(13) Remove a Cryofit coupling from the liquid nitrogen and immediately place it into an installation package. Close the package securely and immediately return the package to liquid nitrogen.
(14) Place the cooled tube chiller over the tubes to be joined. Remove the chiller after 20 to 30 seconds.

NOTE: This step may be omitted. However, placing the Cryofit coupling in contact with a tube which has not been pre-chilled with liquid nitrogen may initiate premature warming and shrinkage of the coupling.

(15) Install the coupling and following the steps below in rapid sequence:
(a) Remove the chiller.
(b) Using the cooled tongs, remove the Cryofit installation package from the liquid nitrogen and grasp the package between thumb and forefinger.
(c) Deflect the tube without the installation stop to allow the coupling to be slipped over the tube end.

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REPAIR WITH PERMASWAGE UNIONS,
APPROVED FITTING/TUBE MATERIAL COMBINATIONS

DEUTSCH PART NO.	FITTING MATERIAL	FOR USE WITH TUBE MATERIAL	APPROVED TUBE SIZES OD/WALL					
			04	06	08	10	12	16
D10282 (-) 1	21-6-9 CRES	21-6-9 CRES	0.016	0.020	0.026	0.033	0.039	0.052
		3AL-2.5V TI	0.016	0.019	0.026	0.032	0.039	0.051
		304-1/8 HARD CRES (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065
D10282D 1	6061T6 AL	6061T6 AL (MIL-T-7081)	0.035	0.035	0.035	0.035	0.035	0.035

NOTE: NO MATERIAL CODE (-) WITH THE PART NUMBER INDICATES 21-6-9 CRES FITTING WITH TWO INTERNAL GROOVES ON EACH END, ONE EACH FILLED WITH SILICONE. MATERIAL CODE D ON PART NUMBER INDICATES 6061T6 ALIMINUM FITTING WITH TWO INTERNAL GROOVES ON EACH END, ALL FILLED WITH SILICONE.

ALUMINUM UNIONS WITHOUT ALL GROOVES FILLED WITH THE SILICONE SEALANT ARE NOT APPROVED FOR BOEING AIRPLANES.

1 THE CORROSION RESISTANT STEEL D10282-(SIZE) AND ALUMINUM D10282D(SIZE) PERMASWAGE UNIONS ARE IMPROVED REPLACEMENTS FOR THE STANDARD CORROSION RESISTANT STEEL D10036-(SIZE) AND ALUMINUM D10036D(SIZE) UNIONS, RESPECTIVELY. THE OLD D10036 UNIONS WILL NOT PROVIDE LEAK-FREE PERFORMANCE AND SHOULD NOT BE USED ON BOEING AIRPLANES. D10282-(SIZE) AND D10282D(SIZE) UNIONS ARE NOT SHOWN IN DEUTSCH CATALOGS, BUT YOU CAN MAKE AN ORDER DIRECTLY TO DEUTSCH, METAL COMPONENTS DIVISION, 14800 SO. FUGUEORA ST., P.O. BOX 61188, LOS ANGELES, CA 90061.

Approved Fitting/Tube Material Combinations for Repair with Permaswage Unions
Figure 826

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(d) Slip the coupling on to the tube, realign the tubes and slide the coupling against the installation stop.
(e) Ensure that the Cryofit coupling is against the installation stop and that the fitting is in correct position relative to the installation marks.
(f) Allow the coupling to warm and shrink on to the tube. Remove the Cryofit installation package and the installation stop.
(g) Verify that both ends of the coupling lie within the installation marks on both tubes.

NOTE: If one or both ends of the fitting do not cover a portion of the installation mark, the installation is incorrect and must be replaced.

(16) Move the Cryofit coupling in the liquid nitrogen (-320°F) (-195.555°C) to the repair location.
(17) Use chilled tongs to install the Cryofit coupling as shown in the manufacturer's instructions.
(18) Do a check on the completed installation as shown in the Raychem operating instructions.

9. Install the Permaswage Fittings

A. General

(1) To do the Permaswage repair procedure, use the D12000 or DLT series swaging tool and the D10282 in-line tube unions (sizes 04, 06, 08, 10, 12, and 16). You can use CRES Permaswage fittings, as shown in Fig. 826 and Fig. 802, with 304-1/8 hard CRES tube to repair Ti-3AL-2.5V and 21-6-9 CRES. Repair 6061-T6 aluminum tubing with aluminum Permaswage fittings with D suffix in the basic part number.
(2) When doing a repair, remove the part of the tube with the defect. Put in a tube splice and install the splice with two fittings.
(a) Fittings and tubing material sizes are shown in Fig. 826.
(3) When removing tubes, make sure the tubes and port fittings have tags that identify the correct connection locations.

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(4) The splice must be shorter than the removed tube section. At a maximum length, make the splice shorter than the tube section by four times the growth value (four fittings). This permits an increase in length as a result of swaging. As a minimum length, make the splice longer than 0.300 inch (7.62 mm) less than the cutout. This permits tube gaps (not more than 0.150 inch [3.81 mm]).

NOTE: Include the length growth caused by swaging when you work with short tube sections with small flexibility. Short tube sections or tube repairs between rigidly installed fittings can buckle.

B. Equipment
(1) Deutsch Permaswage Kit - No. D12102C03-01A00 for sized 04 and 06 (1/4 and 3/8 inch), No. D12102C06-26A00 for sizes 08, 10 and 12 (1/2, 5/8 and 3/4 inch), No. D12102C11-04 for size 16 (1 inch). One pump, part No. D12025-001, is required for swaging with the tool kits listed (Deutsch Metal Components, PO Box 61188, 14800 S. Figueroa St., Los Angeles, California 90061).
(2) Deutsch Permaswage lightweight series (DLT Series) - Tool numbers are listed in Fig. 825. Tool kits come in different size combinations. Contact Deutsch for tool kit part numbers. Make sure that the DLT Series tooling has been inspected to the following Deutsch Tooling Control Documents:
(a) MCP-016 - Inspection Criteria of Deutsch MC, DLT Series, Swage Head Assembly - Standard Permaswage, 3,000-psi Application DAP-10-00-01 - Assembly, Disassembly, Inspection and Testing of DLT Swage Tools.
(b) One pump is required to actuate the power units, as shown in Fig. 828 (Deutsch Metal Components, PO Box 61188, 14800 S. Figueroa St., Los Angeles, CA 90061).

C. Consumable Materials
(1) Alodine - 1200 or 1200S (AMM 20-30-31)
(2) Primer - BMS 10-11, Type 1 (AMM 20-30-31)
(3) Solvent - Ethyl alcohol, O-A-396 (AMM 20-30-31)
(4) Abrasive Cloth - 240-grit, P-C-451 (AMM 20-30-51)

D. Prepare Tube for Installation
(1) Use the tools shown.
(2) Cut out the damaged section of the tube:
(a) Make sure the section that is cut out of the tube is a straight section with a minimum straight length. This will make sure the fitting and swage tool will fit.

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TUBE SIZE	SWAGE TOOL ASSEMBLY	SWAGE HEAD ASSEMBLY	POWER UNIT	INSPECTION GAGE
04	D12204	D12204-56	D12710-52	D12-9892-04
06	D12225-06	D12225-06-56	D12710-52	D12591-2-06
08	D12208	D12208-56	D12010-52	D12-9892-08
10	D12210	D12210-56	D12010-52	D12-9892-10
12*	D1222512	D1225-12-56	D12014-52	D12-9892-12
16	D12216	D12216-56	D12016-52	D12-9892-16

DEUTSCH STANDARD TOOLS

TUBE SIZE	SWAGE TOOL ASSEMBLY	SWAGE HEAD ASSEMBLY	POWER UNIT	INSPECTION GAGE
04	DLT05PSKT3000	DLT05PSHA3004	DLT05MAPW0000	D12-9892-04
06	DLT10PSKT3000	DLT10PSHA3006	DLT10MAPW0000	D12-9892-06
08	DLT20PSKT3000	DLT20PSHA3008	DLT20MAPW0000	D12-9892-08
10		DLT20PSHA3010		D12-9892-10
12	DLT30PSKT3000	DLT30PSHA3012	DLT30MAPW0000	D12-9892-12
16	DLT40PSKT3002	DLT40PSHA4016	DLT40MAPW0000	D12-9892-16
ONE OF THE FOLLOWING PUMPS IS NECESSARY TO ACTUATE THE POWER UNITS: DLT02MAPP1000 PEUMATIC PUMP 10,000 PSI DLT01MAPM1000 MANUAL PUMP 10,000 PSI				

DEUTSCH LIGHTWEIGHT TOOLS

*NOTE: THE 3/4-INCH SIZE SWAGE DIE IS DIFFERENT IN OUTER DIAMETER THAN THE SWAGE DIES USED BEFORE.

Swage and Inspection Tool Part Numbers
Figure 827

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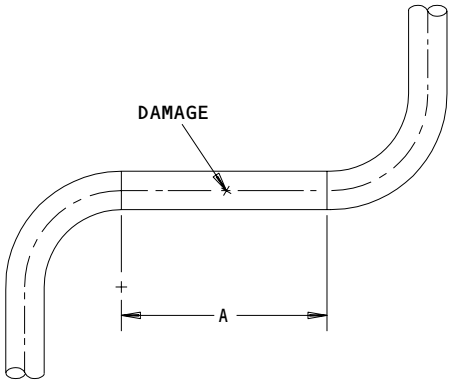

MINIMUM STRAIGHT LENGTH
FOR PERMASWAGE FITTING INSTALLATION (INCHES)

SIZE	04	06	08	10	12	16
FITTING LENGTH	1.540/ 1.530	1.690/ 1.680	2.700/ 2.686	2.780/ 2.766	2.920/ 3.906	3.209/ 3.195
"A" TUBE LENGTH (MIN)	2.15	2.30	3.30	3.40	3.55	3.80

Minimum Straight Length For Permaswage Fitting Installation
Figure 828

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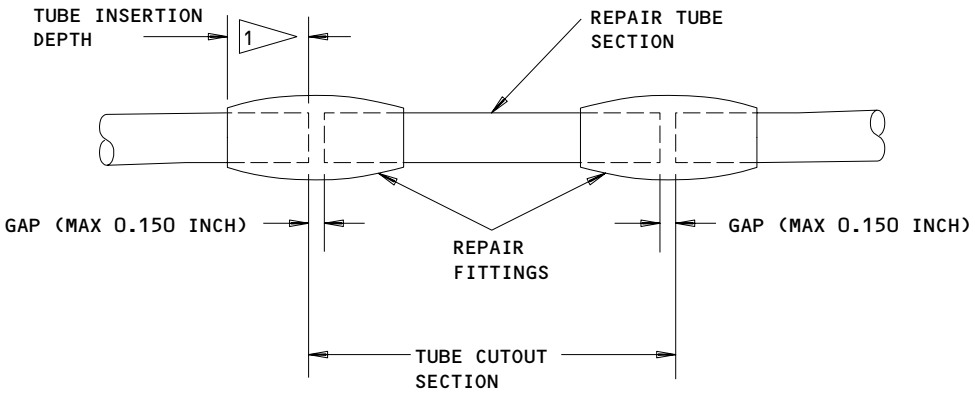

SWAGE GROWTH VALUES (INCH)

SIZE		04	06	08	10	12	16
MAT'L	CRES/ Ti	0.02	0.02	0.03	0.04	0.05	0.07
	Al	NONE	0.04	0.06	0.06		

1 THE "A" DIMENSION IS SHOWN IN FIGURE 829

Tube Splice Repair
Figure 829

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(b) Use one Permaswage fitting for the repair if the damaged section is no more than 0.150 inch (3.81 mm) long. In this case, the cut can be through the center of the damaged section.

WARNING: DO NOT USE PERMASWAGE FITTINGS ON ANY OXYGEN LINES OR ON FLUID LINES INSIDE THE FIRE ZONES OF ENGINES OR APU'S. DAMAGE TO EQUIPMENT OR INJURY TO PERSONS CAN OCCUR.

WARNING: DO NOT USE PERMASWAGE FITTINGS FOR REPAIR OF TUBING IN THE FUEL SYSTEM (SUCH AS FUEL PRESSURE SENSING LINES), ON PNEUMATIC DUCTS, FIRE EXTINGUISHER LINES, POTABLE WATER LINES OR WASTE WATER DRAIN LINES, OR FOR REPAIR OF ELECTRICAL CONDUITS. BOEING DOES NOT APPROVE PERMASWAGE FITTINGS FOR THESE APPLICATIONS.

(3) If the damage is too near a bend (less than 1/2 "A") or longer than 0.150 inch (3.81 mm), use a tube splice and two fittings to make the repair.

(4) For tube cutouts with a bend, use the cutout tube section as a template to mark and cut the new tube segment.

NOTE: The maximum gap between the tube ends is approximately 0.150 inch for the union installation.

(5) Clean the tube in the swage area:
   (a) Clean the not painted tube sections that will be repaired. Use an applicable solvent, for example, ethyl alcohol.
   (b) Make sure the sections are free of dirt, grease, and other unwanted material.
   (c) Remove paint and anodize the tubes.
   (d) Make sure the cleaned surfaces are smooth, uniform, bright, and free of unwanted materials.
   (e) Use a brush to apply a layer of Alodine 1200 to the open surfaces of aluminum tubes.

(6) Remove burrs from the tube ends:
   (a) To remove burrs from the inner bore of the tube ends, use Deutsch plug-type deburring tools or equivalent. See the deburring procedure.

NOTE: You must remove burrs from the tube inner diameter each time you cut the tube. Make sure the tube shavings do not get into the system. Do not release the spring pressure of the deburring tool while you pull the tool from the tube.

   (b) It is not usually necessary to remove burrs from the tube outer diameter. If it is necessary, use 240-grit abrasive cloth. Use a clean cloth to remove particles.

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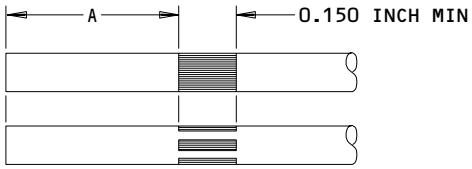
MATERIAL SURFACE	PROCEDURE TO CLEAN TUBE
BARE OR ALODINE	SOLVENT CLEAN
ANODIZE	HAND APPLY ABRASIVE MATERIAL, 180-GRIT OR FINER: FED SPEC P-P-121 FED SPEC P-C-451 ABRASIVE SCOTCH BRITE, TYPE A
PRIMER/PAINT	A. HAND APPLY ABRASIVE MATERIAL, 240-GRIT OR FINER B. LACQUER THINNER (REFER TO TT-T-266) (FLAMMABLE) FOR PRIMED SURFACES (MIL-P-6889) AND LACQUER BASE PAINT/ENAMEL

Cleaning and Paint Removal Procedures for Aluminum Tubes
Figure 828



MARK FOR THE MINIMUM TUBE INSERTION DEPTHS

Dimension (See Fig. 827)	Tube size and Insertion Depth - Inches					
	-04	-06	-08	-10	-12	-16
A	0.69	0.77	1.27	1.31	1.38	1.52

Witness Mark Location and Usual Marking Procedures
Figure 830

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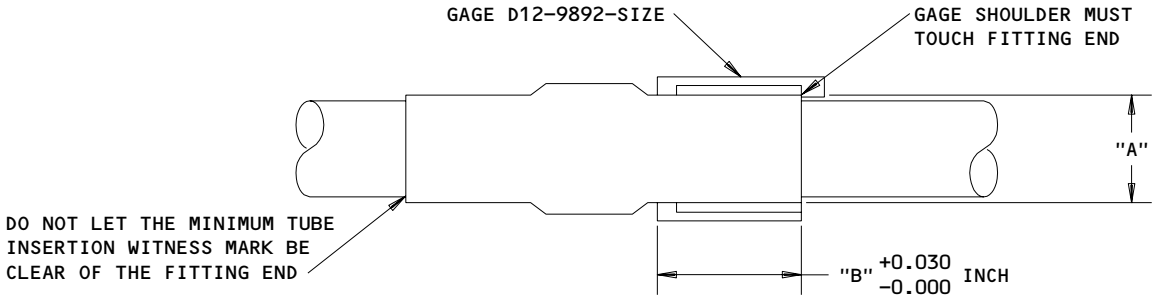

AFTER SWAGE DIMENSIONS (INCH)

TUBE DIA (IN.)	SWAGED DIA MAX "A" DIM. (IN.)	SWAGED LENGTH MIN "B" DIM. (IN.)
1/4 (-4)	0.315	0.46
3/8 (-6)	0.447	0.53
1/2 (-8)	0.606	1.02
5/8 (-10)	0.735	1.02
3/4 (-12)	0.863	1.02
1 (-16)	1.144	1.16

Final Swange Dimensions
Figure 831

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(7) Use one of these steps to apply witness marks:
  (a) Use a felt pen or equivalent to apply witness marks as shown in Fig. 831. Use Deutsch tools D12580-1, -2, -3 or equivalent.
  (b) Make marks directly on the tube to show the minimum insertion depths. Swage fittings to the marks.
(8) Apply paint to bare areas. For example, tool marks and areas where you removed paint (fittings and paint tubes).
(9) Apply Alodine 1200 to open areas of aluminum and BMS 10-11 primer to all other tubes and fittings.

E. Procedure
(1) Remove pressure from the systems where you will do the repair.
(2) Use a union and a tub.

NOTE: Keep the Permaswage fittings in their container until you are ready to install them.

(3) Make sure the tube is sufficiently long to do the repair.
(4) Clean the tube, then cut the tube.

NOTE: Seal the tube ends with a cap if you do not join the tubing immediately.

(5) Examine the unions for silicone seals.
(6) Move the union over the tube ends. Center the union on the witness marks or put it in position at the correct insertion depth.
(7) Swage the union to the tube as shown in the manufacturer's recommended procedures.
(8) Swage each end three times.

WARNING: MAKE SURE YOU MAKE NO PUMP ADJUSTMENT THAT CAN CAUSE THE SWAGE TOOL HYDRAULIC PRESSURE TO BE MORE THAN THE MANUFACTURER'S RECOMMENDATIONS. THE DEUTSCH RECOMMENDATION FOR D12000 SERIES TOOLS IS 5760 PSI MAXIMUM AND FOR THE DLT SERIES IS 10000PSI MAXIMUM. IF PRESSURE IS GREATER THAN THE ABOVE VALUES INJURY AND DAMAGE CAN OCCUR.

NOTE: After the initial swage, move the swage head between 30 and 45 degrees from the previous swage position before you swage again.

(9) Clean the die blocks regularly.
(10) Examine the end plates for loose retaining screws.
(11) Examine the finished swage as shown in the manufacturer's recommended procedure or measure with Vernier caliper.
(12) In the fuel tanks and vapor areas, do a check of the electrical resistance specifications across each tube/fitting interface (AMM 20-11-05).
(13) Make resistance measurements for all Permaswage repair installations in wing tanks and fuel vapor areas (AMM 20-11-05).

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(14) For Permaswage fitting repairs in general areas, do a leak test as follows:
  (a) Pressurize the system for 15 minutes minimum.
  (b) Make sure there is no sign of hydraulic leaks. Use your finger or a white cloth to do a check for leaks.
(15) Examine the tube-to-fitting interface for hydraulic leaks you can see.

NOTE: When dimensional or leakage specifications are not met, you can swage again. Then do a leak test. You must replace fittings you cannot seal.

(16) Apply BMS 10-11 primer to the Alodine areas of the finished tube joint where the bare metal is open.
(17) If more than one hydraulic tube has been disconnected and there is a possibility the tubes are connected incorrectly or cross-connected, do an operational check of the system.

NOTE: Use good judgment to determine if a check is necessary.

  (a) Do a post-installation test of one or more components to which the tubes are connected as a check.
(18) If any electrical wires were disconnected to gain access to the tubes and there is a possibility that the wires are incorrectly connected or cross-connected, do an operational check.

NOTE: Use good judgment to determine if a check is necessary.

  (a) Do the post-installation test of one or more of the components to which the wires are connected as a check.
  (b) Do a post-installation test of one or more components to which the tubes are connected as a check.

10. Install the Rynglok Union

A. General

WARNING: DO NOT USE RYNGLOK FITTINGS ON ANY OXYGEN LINES. DAMAGE TO EQUIPMENT OR INJURY TO PERSONS CAN OCCUR.

WARNING: DO NOT USE RYNGLOK FITTINGS FOR REPAIR OF TUBING IN THE FUEL SYSTEM (SUCH AS FUEL PRESSURE SENSING LINES) OR FUEL TANKS, ON PNEUMATIC DUCTS, FIRE EXTINGUISHER LINES, POTABLE WATER LINES OR WASTE WATER DRAIN LINES OR FOR REPAIR OF ELECTRICAL CONDUITS. BOEING DOES NOT APPROVE RYNGLOK FITTING FOR THESE APPLICATIONS.

NOTE: Do not use RYNGLOK tube to tube union fittings on fluid lines inside airplane fuel tanks. The RYNGLOK tube to tube union fitting is not qualified for these applications.

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(1) To do the Rynglok repair procedure, use the RTST8-02 series of tooling and the R8010T in-line tube unions (sizes 04, 06, 08, 10, 12, 16 and 20). You can use titanium Rynglok union with 304 1/8 hard CRES tube to repair Ti-3AL-2.5V and 21-6-9 CRES. The same fitting can be used with 6061-T6 aluminum tube to repair 6061-T6 aluminum tube, provided the bare areas of the tubing are painted after swaging to limit the possibility for galvanic corrosion to occur.
(2) When you do a repair, remove the part of the tube with the defect.
(3) If the tube damage is too long, put in a tube splice and install the splice with two fittings. The splice must be equal to or slightly shorter that the removed tube section.

B. Equipment
(1) Aeroquip Rynglok kit P/N RTSK8-02-006, covers tube sizes 04, 06, 08, 10, 12, 16 and 20. Individual tool part numbers are listed in Fig. 833. Other tool size combinations are available in kit form from Aeroquip.

C. Consumable Materials
(1) C00064 Alodine - 1200 or 1200S
(2) C00259 Primer - BMS 10-11, Type 1
(3) B00064 Solvent - Ethyl alcohol, O-A-396
(4) B00138 Abrasive Cloth - 240-grit, P-C-451

D. Prepare Tube for Installation

WARNING: DO NOT USE RYNGLOK UNIONS ON ANY OXYGEN LINES. DAMAGE TO EQUIPMENT OR INJURY TO PERSONS CAN OCCUR.

NOTE: Do not use RYNGLOK tube to tube union fittings on fluid lines inside airplane fuel tanks. The RYNGLOK tube to tube union fitting is not qualified for these applications.

(1) Use the tools shown.
(2) Cut out the damaged section of the tube using a chipless tube cutter:
(a) Make sure the section you cut out of the tube is a straight section with a minimum straight length. This will make sure the fitting and swage tool will fit.
(b) Use one Rynglok union for the repair if the damaged section is not too long. In this case, the cut can be through the center of the damaged section.
(3) For tube cutouts with a bend that has the required straight tube, use the cutout tube section as a template to mark and cut the new tube segment.
(4) Clean the tube in the swage area:
(a) Clean not painted tube sections that you will repair. Use an applicable solvent, for example, ethyl alcohol.
(b) Make sure the sections are free of dirt, grease, and other unwanted material. Remove paint and anodize from the tubes in the required area.

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(c) Remove burrs from the tube ends. Make sure the tube shavings do not get into the system. Use 240-grit abrasive cloth. Use a clean cloth to remove particles.
(d) Make sure the cleaned surfaces are smooth, uniform, bright, and free of unwanted materials.
(e) Use a brush to apply a layer of Alodine 1200 to the open surfaces of aluminum tubes.

(5) Use the following method to apply witness marks:
(a) Apply a witness mark using the appropriate size RTSG0-1 series gage (Fig. 838 and 839) and a Stanford Sharpie (or equivalent) felt tip pen with a fine or extra fine point. The marking gage should be bottomed on the end of the cut tube before applying the mark.

E. Procedure

(1) Remove pressure from the systems where you will do the repair.
(2) Use a Rynglok tube to tube union and appropriate tube material.as
(3) Make sure the tube where the repair will be made has sufficient straight length.
(4) Make sure the tube is visually clean.

NOTE: Seal the tube ends with a cap if you do not join the tubing immediately.

(5) Move the union over the tube ends. Put the edge of the fitting "ring" over the center of the witness mark (nominal tube insertion) (the edge of the fitting "ring" may be anywhere along the length of the positioning mark but nominal position is recommended).

WARNING: MAKE SURE YOU MAKE NO PUMP ADJUSTMENT THAT CAN CAUSE THE SWAGE TOOL HYDRAULIC PRESSURE TO BE OUTSIDE THE MANUFACTURERS RECOMMENDATIONS. THE AEROQUIP RECOMMENDATION FOR THE TOOL IS 8000 PSI TO 8500 PSI MAXIMUM. IF PRESSURE IS GREATER THAN THIS VALUE, INJURY AND DAMAGE CAN OCCUR.

(6) Swage the union to the tube as shown in the Aeroquip Rynglok Installation Guide.

NOTE: Fitting must always be fully nested into tool to maximize tool life.

(7) Examine the finished installation for correct ring advancement using the appropriate size RTSG0-51 inspection gage. The inspection gage should fit over the ring area such that the ring is flush with the center portion of the union.
(8) Pressurize the hydraulic system in which the repair has been made to operating pressure.
(9) Examine the tube-to-union interface for hydraulic leaks you can see. Repair any leaks.
(10) Apply Alodine 1200 to bare areas of aluminum tubing where paint was removed, followed by a coat of BMS 10-11 primer.

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11. Repair Hydraulic Tubing with Flexible Hoses

A. General

(1) The Boeing Company recommends that the operator do these procedures:

(a) Make a record of the flexible hoses that you install as temporary repairs for rigid lines.

(b) Make a schedule for the regular inspection of flexible hose installations. Make sure the installation stays an airworthy repair until the system is put back to its initial configuration.

(c) Make a procedure to make sure that flexible hoses, installed as temporary repairs, are replaced as soon as possible. You must replace the hoses no later than the scheduled time check approved by the assigned principal maintenance inspector.

(2) You can use many different repair techniques. The Boeing Company cannot know about or control these repair techniques. It is your responsibility to decide if this procedure is applicable to your repair techniques.

(3) This procedure is not acceptable for engine hydraulic tube repair or for the replacement of coiled flexible tubing. Engine hydraulic tubes are those tubes below or forward of the firewall, and within the engine cowls.

B. References

(1) AMM 29-11-00/201, Main Hydraulic Systems

C. Consumable Materials

(1) Hydraulic Tubing Repair Kit - P/N 65-92528-1 or equivalent

D. Install the Flexible Hose

(1) Use a flexible hose that has the specifications that follow:

(a) Make sure the flexible hose is specified for at least the same operating pressure and fluid type as the system in which you will install the flexible hose.

(b) Make sure the new flexible hose has a minimum of the same inner diameter as the damaged tube.

(c) Make sure the new flexible hose is sufficiently long to replace the damaged tube or the damaged section of the tube.

(d) Make sure the new flexible hose has sufficient slack, flex, twisting bending, clearance, and support specifications.

1) Slack

a) Do not install the hose assemblies in a way that will cause a mechanical load on the hose. Hoses will change length from +2% to -4% when pressurized. Supply sufficient slack or bend to make the allowance for a change in length and length tolerances.

2) Flex

a) When hose assemblies will have much vibration or flexing, make sure there is sufficient slack between the rigid fittings. Install the hose so flexing does not occur at the end fittings. The hose must stay straight for at least two hose diameters from the end fittings. Do not use clamp locations that will restrict or prevent the hose from flexing.

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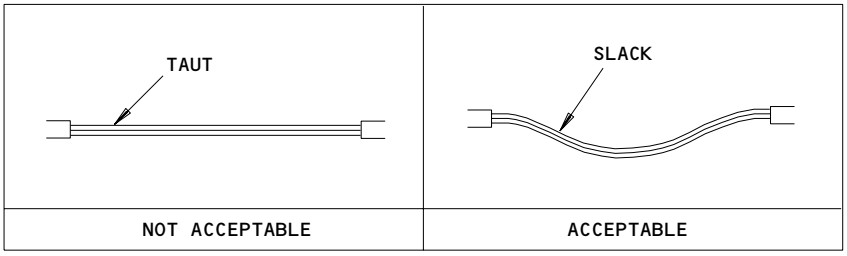
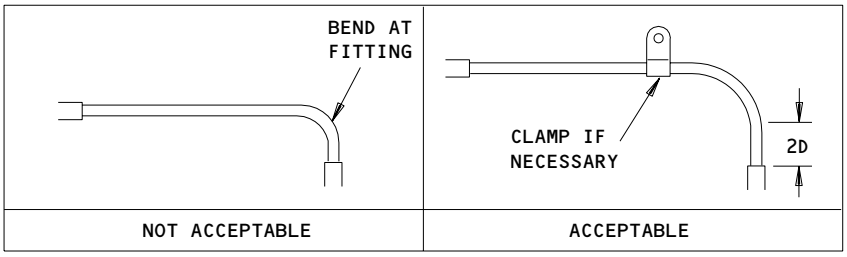
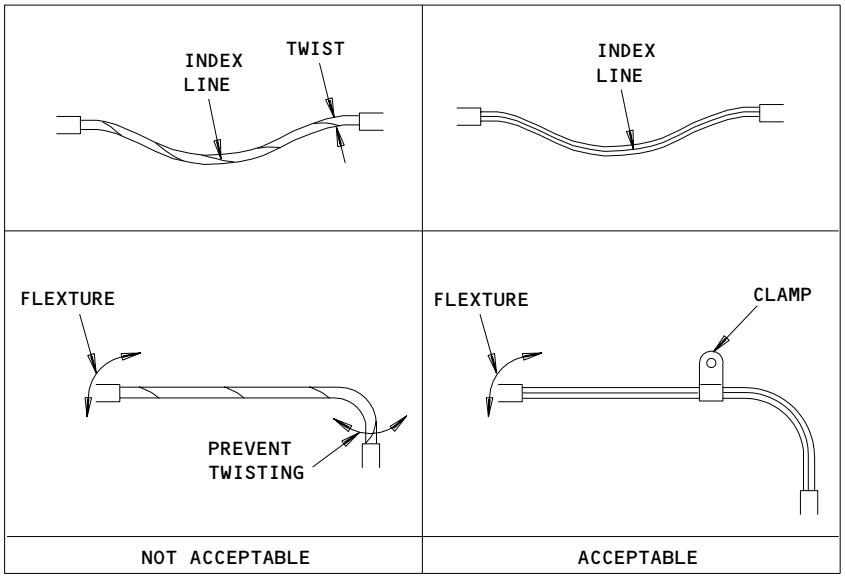


SLACK



FLEX



TWISTING

Hydraulic Tubing Repair with Flexible Hose
Figure 832 (Sheet 1)

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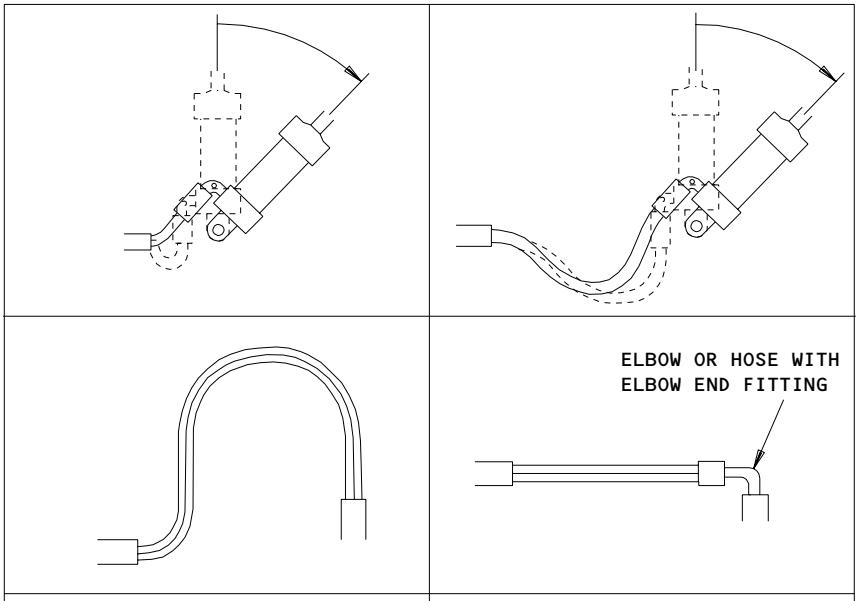
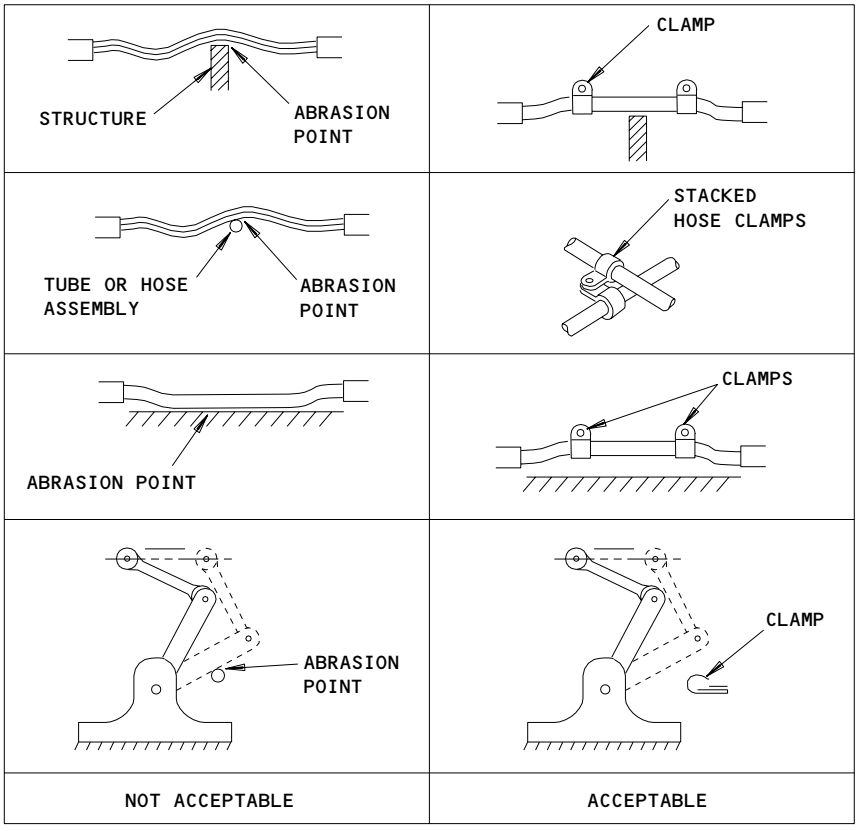


BENDING



CLEARANCE

Hydraulic Tubing Repair with Flexible Hose
Figure 832 (Sheet 2)

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3) Twisting
   a) Make sure you install the hoses without twists to prevent loose nuts and possible rupture of the hose. You can use swivel connections at one or two ends to release the twist stresses.
4) Bending
   a) To prevent sharp bends to the hose assembly, use elbow fittings, hose with elbow-type end fittings, or the applicable bend radii, as shown in table.

Bending		
AS 115 HOSE	HOSE INNER DIAMETER (INCH)	MINIMUM HOSE BEND RADIUS MEASURED AT INNER BEND (INCH)
-04	1/4	1.50
-06	3/8	2.50
-08	1/2	2.88
-10	5/8	3.25
-12	3/4	4.00

5) Clearance
   a) Make sure the hose assembly is clear of all other lines, equipment, and adjacent structure under all operating conditions. The hoses must have the minimum clearance specifications shown in table.

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Clearances	
HOSE CLEARANCE TO	MINIMUM CLEARANCE (INCH)
CONTROL CABLES AND LINKAGES	1.0 *[1]
CABLE AT PULLEYS	0.5
CABLE AT MID-SPAN	2.0
ELECTRICAL WIRING	0.5
HYDRAULIC TUBES OR HOSES	0.2

*[1] Measured at a relative position where the hose is closest to the cable or linkage.

6) Support
   a) Make sure the hose assembly has supports that do not cause deflection of rigid lines because of the relative motion that can occur. Use sufficient clamps to follow the contour of the structure to prevent hose abrasive wear, kinking, and entanglement during flexing. At a minimum, put clamps at locations where the tube clamps were. Make sure the hose is not rigidly supported by tight, rigid clamps around its outer diameter. If a hose between rigid connections must move longitudinally, clamps must be of a type that will not cause wear on the hose casing. Make sure the connections have supports at the tube, not at the hose.

(2) Remove pressure from the hydraulic system where you will do the repair (AMM 29-11-00).
(3) If you can replace all of the damaged tube with a flexible hose or a series of flexible hoses, do these steps:
   (a) Remove the damaged tube.
   (b) If necessary, prepare the ends of the tubes to which you will install the flexible hose. Use the applicable fittings as shown in the Tubing Repair paragraph.
(4) If the damaged tube is too long to replace by a flexible hose, do the steps that follow:
   (a) Cut out the damaged tube section to accept the flexible hose.
   (b) Prepare the ends of the cut tube with the applicable fittings as told in the Tubing Repair paragraph.
(5) Install the flexible hose per paragraph in Procedure.
(6) Supply the usual operating pressure to the repaired tube.
(7) Examine the hose and connections for leaks.
(8) Make sure the repair agrees with all specifications for slack, flex, twisting, bending, clearance, and support.

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12. Aluminum Fuel Tubes - Temporary Weld Repair Method

A. General

(1) This is a temporary repair method approved for 6061 and 5052-aluminum fuel system tubing, and is applicable only to tubes with wear-through damage, cracks, or punctures.

CAUTION: REPLACE THE TUBE WITH A TEMPORARY REPAIR WITH A NEW SECTION OF TUBE AS SOON AS POSSIBLE. IF YOU DO NOT REPLACE THE TUBE, DAMAGE COULD OCCUR.

(2) Repair is accomplished with tubing removed from airplane.

B. Consumable Materials

(1) Solvent, B0100, TT-M-261 or JIS-K-1524 (AMM 20-30-31)

(2) Solvent, TT-N-295

C. Prepare for the Aluminum Fuel Tube Repair

(1) Remove aluminum fuel tube to be repaired by referring to applicable maintenance manual removal and installation procedure.

D. Procedure

(1) Completely clean the inner and outer surfaces of all the tube section with solvent.

CAUTION: FULLY CLEAN THE TUBING. IF YOU DO NOT CLEAN THE TUBING, THE WELD CAN GET CONTAMINATED AND THE WELD QUALITY DECREASES.

(2) If tubing is cracked, drill 3/32-inch stop holes at each end of crack.

(3) To clean tubing, use wire brush to descale and remove all protective coatings and oxides from area to be welded.

NOTE: Wire brushes used for descaling must have bristles of austenitic corrosion-resistant steel or nickel-silver.

(4) Rub or rinse the tubing with solvent to remove all the residue.

(5) Fusion weld the damaged area by a gas tungsten arc process.

CAUTION: MAKE SURE THERE IS NOT TOO MUCH PRESSURE IN THE TUBING DURING THE WELDING. A HIGH PRESSURE CAN CAUSE A BAD WELD BEAD CONFIGURATION.

(6) Do a hydrostatic test of the tube to 240 psig per BAC 5001-2.
(a) Make sure there is no leakage.

(7) Finish repaired area with appropriate protective coatings BMS 10-11 Type I Primer required to meet original tube finish requirements.

(8) Install the repaired fuel tube per applicable maintenance manual procedure.

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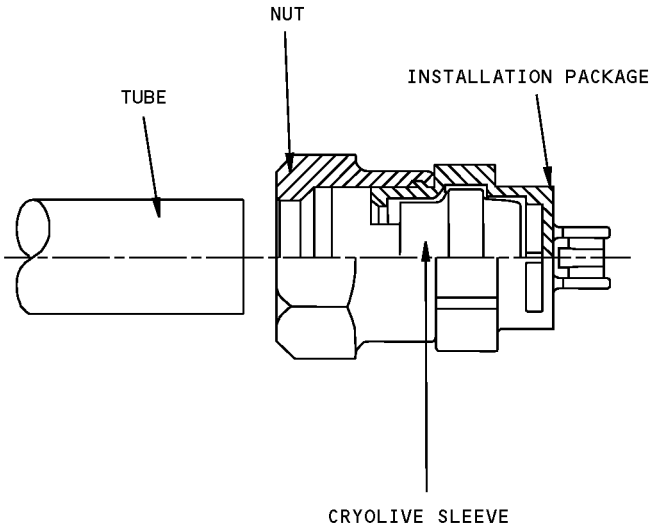
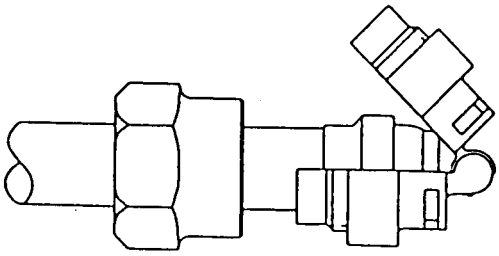


CRYOLIVE FLARELESS SLEEVE ASSEMBLY



Removal of Plastic Cap After Installation
Figure 833

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APPROVED CRYOLIVE SLEEVE/COUPLING NUT/PROTECTIVE CAP COMBINATIONS		
TUBE SIZE	COUPLING NUT MATERIAL	COMBINATION - SLEEVE/COUPLING NUT/PROTECTIVE CAP PART NO. *
04	304 CRES	921721J04
	7075-T73 AL	921721W04
	6AL-4V TI	921721T04
06	304 CRES	921721J06
	7075-T73 AL	921721W06
	6AL-4V TI	921721T06
08	304 CRES	921721J08
	7075-T73 AL	921721W08
	6AL-4V TI	921721T08
10	304 CRES	921721J10
	7075-T73 AL	921721W10
	6AL-4V TI	921721T10
12	304 CRES	921721J12
	7075-T73 AL	921721W12
	6AL-4V TI	921721T12
16	304 CRES	921721J16
	7075-T73 AL	(Combination Not Approved)
	6AL-4V TI	921721T16

* DO NOT REPLACE COUPLING NUTS INCLUDED WITH THE CRYOLIVE FLARELESS SLEEVE/COUPLING NUT/PLASTIC CAP COMBINATIONS. USE ONLY THE COUPLING NUT PROVIDED WITH THE ASSEMBLY.

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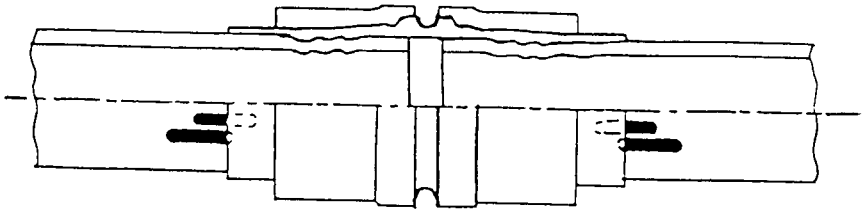

RYNGLOK Tube to Tube Union
Figure 834

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APPROVED FITTING/TUBE MATERIAL COMBINATIONS FOR REPAIR WITH RYNGLOC UNIONS								
AEROQUIP PART NO.	FOR USE WITH TUBE MATERIAL	APPROVED TUBE SIZES OD/WALL						
		04	06	08	10	12	16	20
R80101T(-) (TITANIUM MAT'L)	21-6-9 CRES	0.016	0.020	0.026	0.033	0.039	0.052	0.052
	3AL-2.5V TI	0.016	0.019	0.026	0.032	0.039	0.051	N/A
	304 1/8 HARD CRES (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065	N/A
	6061-T6 AL (MIL-T-7081)	0.035	0.035	0.035	0.035	0.035	0.035	0.035

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Splice Repair with More Than One Rynglok Tube-to-Tube Union - Minimum Removed Tube Section		
TUBE DASH NUMBER	TUBE OUTER DIAMETER (IN)	MAXIMUM REMOVED TUBE SECTION (IN)
04	0.250	0.300
06	0.375	0.300
08	0.500	0.350
10	0.625	0.350
12	0.750	0.350
16	1.000	0.400
20	1.250	0.400
04	0.250	2.38
06	0.375	2.64
08	0.500	2.92
10	0.625	3.18
12	0.750	3.56
16	1.000	4.15
20	1.250	4.81

13. Aeroquip Tool Kit Number
    A. RTSK8-02-006 (cover Tube Sizes 04 through 20)

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Rynglok Repair Fittings Swage and Inspection Tool Part Numbers		
TUBE SIZE	TOOL NUMBER FOR EACH TUBE SIZE	INSP. GAGE P/N
04	RTST8-02-04	RTSG-051-04
06	RTST8-02-06	RTSG-051-06
08	RTST8-02-08	RTSG-051-08
10	RTST8-02-10	RTSG-051-10
12	RTST8-02-12	RTSG-051-12
16	RTST5-02-16	RTSG-051-16
20	RTST4-02-20	RTSG-051-20

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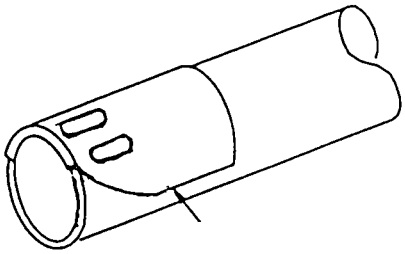
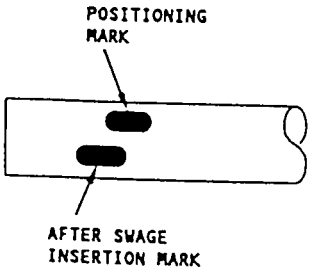


RTSGO-01-SIZE
MARKING TOOL
(AEROQUIP)



Witness Mark Location During Rynglok Fitting Installation
Figure 835

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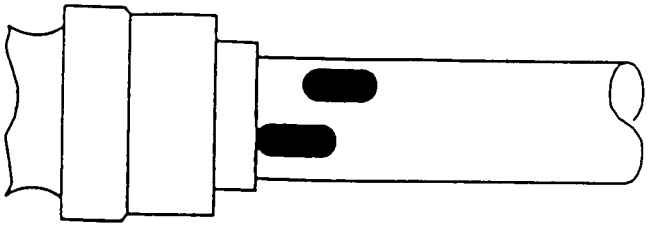
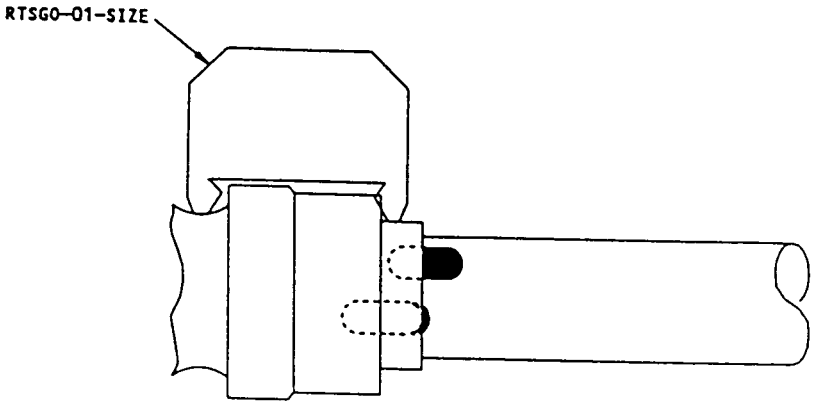


INSPECTION MARK AT MINIMUM TUBE INSERTION



INSPECTION MARK AT MAXIMUM TUBE INSERTION

Use of Inspection Gage After Swage of Rynglok Fittings
Figure 836

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FLEXIBLE HOSE - REMOVAL/INSTALLATION

1. General
   A. This section provides instructions for the installation of flexible hoses in general. Specific instructions for any particular system supersede these general instructions.
   B. Prior to performing any maintenance on oxygen system flexible hoses, review oxygen system safety precautions and general maintenance instructions outlined in 35-00, Maintenance Practices.
   C. Hydraulic hose assemblies and mating connections must be capped with protective closures to prevent entry of moisture, dirt or other contaminants until hose is reconnected to the airplane system.

      CAUTION: DO NOT LEAVE HOSES AND FITTINGS UNCAPPED. DIRT OR DEBRIS COULD ENTER. CONTAMINATION OF HOSES, DAMAGE TO SYSTEM COMPONENTS AND LEAKAGE OF HYDRAULIC FLUID COULD OCCUR.

      DO NOT ALLOW HYDRAULIC FLUID SPILLAGE OR LEAKAGE TO ACCUMULATE WITHOUT WIPING UP. DAMAGE COULD RESULT FROM CORROSIVE OR DEGRADING ACTION OF HYDRAULIC FLUID.

2. Install Flexible Hose
   A. Prior to hose installation, visually check hose assembly to determine condition. Check hose end fittings, sealing surfaces, hose surface for damage. On wire braid for broken wires or hoses and other damage.

      NOTE: If broken wires:

      Isolated or random, tag for future checks

      If two or more wires in one plait or several broken wires in a concentrated area, replace hose assembly.

   B. Lubricate male threads as required. Refer to 20-10-51 for approved thread lubricants.
   C. Position hose and tighten fittings hand-tight. Check installation for proper alignment and length.

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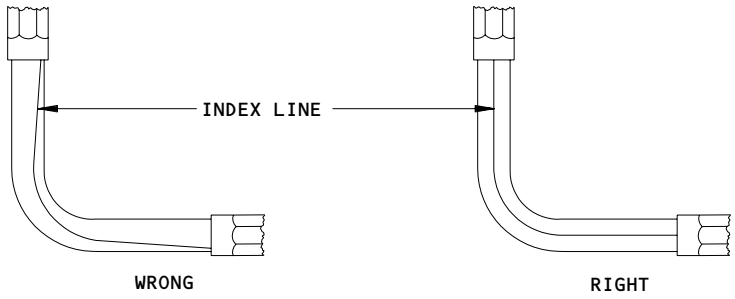
D. Tighten fittings, tightening pipe fitting ends before coupling-type ends. Refer to 20-50-11 for proper torque values. Use two wrenches on coupling-type fittings to prevent flexible tubing from twisting while tightening. On hoses with index lines, check that index lines are not twisted.

CAUTION: USE INDEX LINE ON SIDE OF HOSE TO DETERMINE INDICATIONS OR TWISTING. IF HOSE IS TWISTED, PREMATURE FAILURE OF HOSE OR HOSE COUPLING LEAKS MAY OCCUR.

E. Clamp hose as required. Check and flex installed hose under normal operating pressure to ensure clamps are properly positioned and aligned to allow hose to work and no chafing under clamps will occur.



Flexible Hose Installation
Figure 401

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FLEXIBLE HOSE - APPROVED REPAIRS

1. General
   A. This section provides approved repair procedures for hydraulic, pneumatic, oxygen, water, and other hose assemblies. Repairs includes replacement of defective rigid tubes where flexible hose may be used for temporary repair.
   B. Specific instructions for any particular system supersedes.
   C. Prior to performing any maintenance on oxygen system flexible hoses, review oxygen system safety precautions and general maintenance instructions outlined in AMM 35-00/201.
   D. Hydraulic hose assemblies and mating connections must be capped with protective closures to prevent entry of moisture, dirt or other contaminants until hose is reconnected to the airplane system.

      CAUTION: DO NOT LEAVE HOSES AND FITTINGS UNCAPPED. DIRT OR DEBRIS COULD ENTER. CONTAMINATION OF HOSES, DAMAGE TO SYSTEM COMPONENTS AND LEAKAGE OF HYDRAULIC FLUID COULD OCCUR.

      CAUTION: DO NOT ALLOW HYDRAULIC FLUID SPILLAGE OR LEAKAGE TO ACCUMULATE WITHOUT WIPING UP. DAMAGE COULD RESULT FROM CORROSIVE OR DEGRADING ACTION OF HYDRAULIC FLUID.

2. Hydraulic Tubing Repair (Fig. 801)

   NOTE: The Boeing Company recommends that the operator make these procedures: Make a record of flexible hoses that are installed as temporary repairs for rigid lines. Make a schedule for regular inspections of the flexible hose installation to make sure the installation stays an airworthy repair until the system is put back to its original configuration. Make a procedure to make sure that flexible hoses, installed as temporary repairs, are replaced as soon as possible, but not later than an operator scheduled time check which has been approved by the assigned principal maintenance inspector. A variety of possible repair techniques can be used, and the conditions of their use are beyond the knowledge and control of The Boeing Company. Therefore, final determination as to the suitability for use of this procedure in any particular application is the sole responsibility of the airline. This procedure is not applicable for engine hydraulic tube repair or for replacement of coiled flexible tubing.

   A. Equipment and Materials
      (1) Hydraulic Tubing Repair Kit - P/N 65-92528-1
   B. Install Flexible Hose
      (1) Select a flexible hose that will meet the following requirements:
         (a) Rated for at least the same operating pressure and fluid type as the system in which the flexible hose will be installed.

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(b) At least the same inside diameter as the damaged tube.
(c) Sufficient length to replace the damaged tube, or span the damaged section of tube, and meet the criteria of acceptable slack, flex, twisting, bending, clearance, and support requirements.
    1) Slack:
        a) Hose assemblies must not be installed in a manner that will cause a mechanical load on the hose. Hoses will change length from +2 to -4 percent when pressurized. Provide adequate slack or bend to compensate for change in length and expected length tolerances.
    2) Flex:
        a) When hose assemblies are subject to considerable vibration or flexing, sufficient slack must be left between rigid fittings. Install the hose so that flexure does not occur at the end fitting(s). The hose must remain straight for at least two hose diameters from the end fitting(s). Avoid clamp locations that will restrict or prevent hose flexure.
    3) Twisting:
        a) Hoses must be installed without twisting to avoid possible rupture of the hose or loosening of the attaching nuts. Use of swivel connections at one or both ends will relieve twist stresses.
    4) Bending:
        a) To avoid sharp bends in the hose assembly, use elbow fittings, hose with elbow type end fittings, or the appropriate bend radii per Table I.

TABLE I

AS 115 HOSE	HOSE INSIDE DIAMETER (INCH)	MINIMUM HOSE BEND RADIUS MEASURED AT INSIDE OF BEND (INCH)
-04	1/4	1.50
-06	3/8	2.50
-08	1/2	1.88
-10	5/8	3.25
-12	3/4	4.00

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5) Clearance:
   a) The hose assembly must clear all other lines, equipment, and adjacent structure under every operating condition. Specifically, hoses must meet the minimum clearance requirements shown in Table II.

TABLE II

HOSE CLEARANCE TO	MINIMUM CLEARANCE (INCH)
CONTROL CABLES AND LINKAGES	1.0 *[1]
CABLE AT PULLEYS	0.5
CABLE AT MID-SPAN	2.0
ELECTRICAL WIRING	0.5
HYDRAULIC TUBES OR HOSES	0.2

*[1] Measure at a relative position where the hose is closest closest to the cable or linkage.

6) Support:
   a) The hose assembly must be supported in a manner that will not introduce deflection of rigid lines due to any possible relative motion that may occur. Use sufficient clamps to follow the contour of the structure to prevent hose abrasive wear, kinking, and entanglement during flexure. Clamp placement should, at a minimum, be at locations where the tube clamps were. The hose must not be rigidly supported by tight, rigid clamps about its outside diameter. If hose between rigid connections must move longitudinally, clamps must be of a type that will not cause wear on the hose casing. The connections must be supported at the tube, not the hose.

(2) Depressurize appropriate hydraulic system where repair is to be made (AMM Chapter 29).
(3) If the damaged tube can be replaced in its entirety by a flexible hose, process as follows:
   (a) Remove the damaged tube.
   (b) If necessary, prepare the ends of the tubes, to which the flexible hose will be installed, with the appropriate fittings per the Tubing Repair paragraph (AMM 20-10-5/801).
(4) If the damaged tube is too long to be replaced by a flexible hose, proceed as follows:
   (a) Cut out the damaged tube section as required to accept the selected flexible hose.

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(b) Prepare the end(s) of the cut tube with the appropriate fittings per the Tubing Repair paragraph (AMM 20-10-5/801).

(5) Install the flexible hose.

(6) Supply normal operating pressure to the repaired line.

(7) Check the hose and connections for leaks, and that all requirements for slack, flex, twisting, bending, clearance, and support remain valid.

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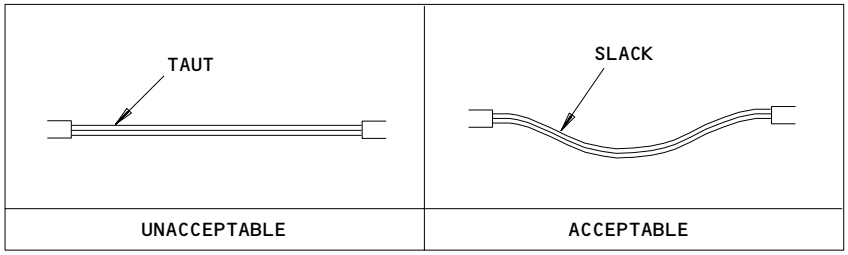
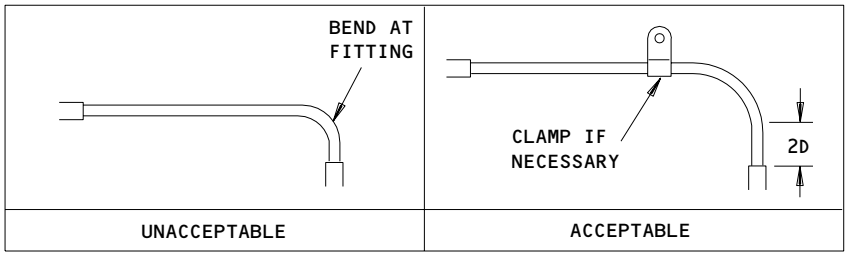
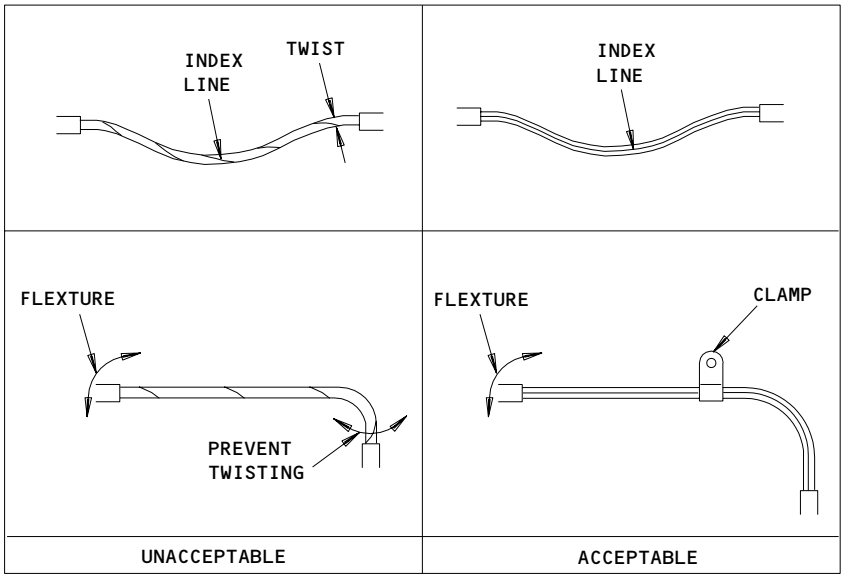


SLACK



FLEX



TWISTING

Hydraulic Tubing Repair
Figure 801 (Sheet 1)

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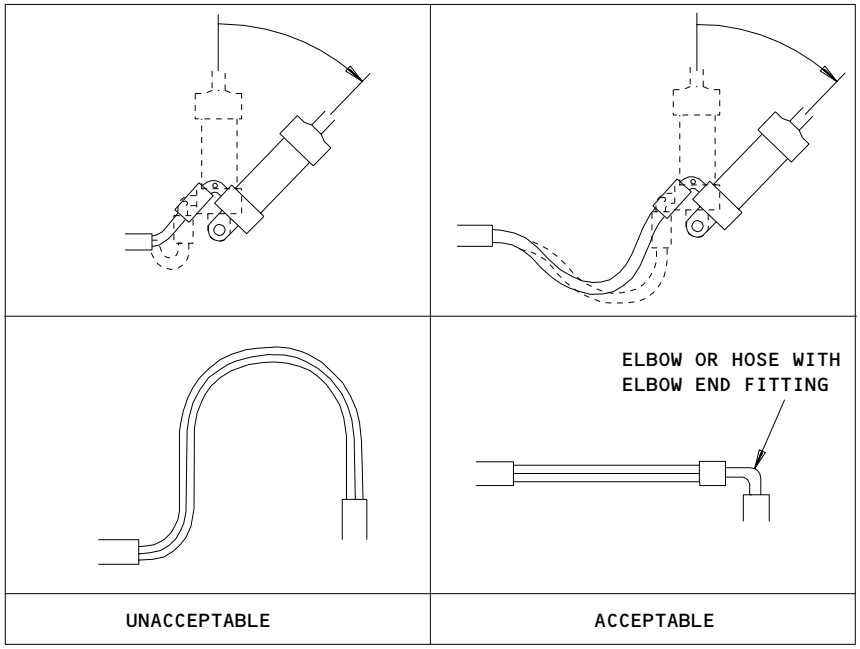
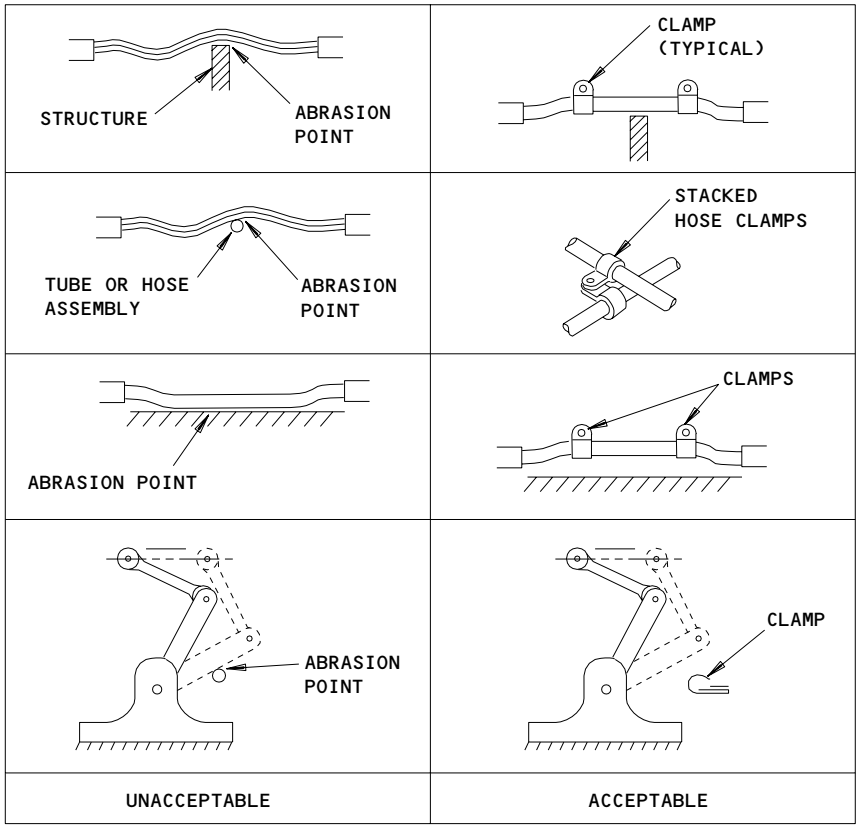


BENDING



CLEARANCE

Hydraulic Tubing Repair
Figure 801 (Sheet 2)

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AIR CONDITIONING DUCTS

1. General
   A. This procedure contains these tasks to repair air conditioning ducts made of either Kevlar/Epoxy, Graphite/Epoxy, Polycarbonate, Polyurethane and Polyisocyanurate ducts.
   B. If there are other instructions given in other procedures or manuals for a specified system, obey those instructions.

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TASK 20-10-55-308-001

2. Kevlar/Epoxy and Graphite/Epoxy Ducts

A. Materials

(1) Abrasive cloth -- 150-grit or finer
(2) Thinner -- TL-52
(3) Epoxy Resin -- BMS 8-201
(4) Epoxy preimpregnated Kevlar fabric -- BMS 8-264
(5) Epoxy preimpregnated graphite fabric -- BMS 8-258
(6) Parting film
(7) Glass fabric -- BMS 9-3 class 7, types H thru H-4, E thru E-2
(8) Methyl Ethyl Ketone (MEK) thinner -- TT-M-261
(9) QCI-130 resin and additive, Parts A and B -- Quantum Composites, 4702 James Savage Rd., Midland, Michigan 48640
(10) Hetron 92 -- Ashland Chemical Company, Ashland, Ohio
(11) Benzoyl Peroxide in Tricresyl Phosphate Paste such as Luperco ATC or AFR Paste Catalyst -- Lucidol Division, Pennwalt Corp, 1740 Military Rd, Buffalo, New York 14240, or
Garox BZP -- Ram Chemicals, Division of The Whittaker Corp, 210 East Alondra Blvd, Gardena, California
(12) 60 percent Methyl Ethyl Ketone Peroxide in Dimethyl Phthalate liquid such as Lupersol DDM-9 -- Lucidol Division, Pennwalt Corp, Buffalo, New York
(13) Styrene Monomer resin mix such as Styrene Monomer 120 -- Monsanto Co., St. Louis, Missouri, or Styrene 12T -- Dow Chemical Co., Bennington, VT, or oe Styrene Monomer-Rubber Grade -- Dexter Corp, Pittsburgh, California

B. Procedure - Repair of Typical Defects or Damages

S 108-002

(1) Surface Preparation
(a) Sand area to be repaired using 150-grit or finer abrasive cloth.
(b) Wipe off sanding residue with a clean cloth moistened with TL-52 thinner.

S 218-003

(2) Resin-starved areas, exposed fibers, or impact-damaged soft spots, oe delaminations, or internal voids.
(a) Sand surfaces to remove gloss.
(b) Use brush, squeegee, or hypodermic to work BMS 8-201 epoxy resin into defective area.
(c) Cure in accordance with Fig. 601 or 602.

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S 218-004

(3) Small bruises, punctures, and holes less than 0.25 inch diameter, or surface voids.
   (a) Sand surface surrounding defect to remove gloss.
   (b) Use same fabric thickness as original duct.
      1) Hot Patch - Use BMS 8-264 for Type I ducts and BMS 8-258 for Type III ducts.
      2) Cold Patch - Use glass fabric (BMS 9-3 class 7, types H, H-2, oe H-3, E, E-1, E-2) with BMS 8-201 resin mix.
   (c) Cut patches to fit defective area, extending a minimum of 0.50 inch (12.7 mm), past the damaged area. All patch corners must be rounded.
   (d) Place one or more plies on detail covering damaged area and cover with parting film.
   (e) Secure layer of parting film over patch area with tape. Apply a vacuum bag layup for applying pressure to the repair. Use of other pressure application methods, such as clamps or weights, is acceptable provided they do not distort the part or the repair.
   (f) Cure patch in accordance with the applicable method in Fig. 601 or 602. Use of vacuum bags is preferred.

S 218-005

(4) Holes, cuts, fractures, or punctures 0.25 inch (6.35 mm) diameter or larger.
   (a) Cut back material as required to ascertain extent of damage.
   (b) Trim or scarf back plies to a smooth oval.
   (c) Replace on a ply for ply plus one basis using procedures outlined in paragraph 4.B., overlapping 0.50 inch (12.7 mm) minimum on each succeeding ply.

S 358-006

(5) Gel coat repair.
   (a) Abrade surface to remove cracked or damaged gel coat.
   (b) Prepare the QCI 130 gel coat mixture as follows or prepare the oe alternative material, BMS 8-201, Type 1 or 2 resin as indicated by oe the vendor:
   (c) Prepare the QCI 130 gel coat mixture as follows or prepare the oe alternative material, BMS 8-201, Type 1 or 2 resin as indicated by oe the vendor:

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INGREDIENT	PARTS BY WEIGHT
QCI 130A Resin	2000
MEK Thinner	1500
QCI 130B Hardener	300

1) Add thinner to Part A, stir to dissolve and strain two times. Weigh Part B hardener in separate can and add just prior to use. Shake well and strain.

(d) Spray or spread over surface, fairing edges.

(e) Cure gel coat correction as follows:

1) For QCI 130, cure for four hours at room temperature.
2) For BMS 8-201, Type 1 resin, cure for 16 to 24 hours at 70 to 80 degrees Fahrenheit (21 to 27 degrees Centigrade).
3) For BMS 8-201, Type 2 resin, cure for 16 to 24 hours at 70 to 80 degrees Fahrenheit (21 to 27 degrees Centigrade).

(f) Sand to smooth patched surface.

S 218-007

(6) Surface resin ridges and edges.

(a) Sand ridges and edges until excess is removed.

(b) If fabric is removed during sanding, replace on a ply for ply plus oe one basis using procedures outlined in Repair 4.B.

S 218-008

(7) Lamination of Kevlar plies to duct ends.

(a) If required to improve the fit, extra Kevlar plies (2 inches wide) may be laminated to the duct ends.

1) Sand and clean duct ends.
2) Wrap extra Kevlar plies to duct ends.
3) Process using the procedures outlined in paragraph 4.C.(2) and 4.C.(3).
4) Cure at 260 degrees Fahrenheit (127 degrees Centigrade), for approximately 90 minutes.

S 398-009

(8) Sealing

(a) Type I, Grades A, B, C, and D ducts may be sealed internally by oe sloshing, using sloshing resin mix prepared as follows:

1) Prepare resin mix R109 in the following proportions:

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MATERIAL	PARTS BY WEIGHT
Hetron 92	100 ±2
Benzoyl Peroxide	2.0 ±0.2

2) Prepare sloshing resin mix by combining the R109 resin mix with the following materials in the proportions indicated:

NOTE: Only one sloshing seal treatment per duct is allowed.

MATERIAL	PARTS BY WEIGHT
Resin Mix R109	50 ±2.0
MEK Peroxide	1.0 ±0.2
Styrene Monomer	49 ±2.0

(b) Cure sloshed parts in accordance with Fig. 603.

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TASK 20-10-55-308-010

3. Polycarbonate Ducts

A. Materials

(1) Solvent -- Methyl or Isopropyl Alcohol

(2) Solvent -- BMS 3-2, Type 2; TT-N-95 Type 2; Aliphatic naphtha; or denaturated alcohol

(3) Ethylene Dichloride

(4) Methylene Chloride

(5) Lexan 9600 or scraps of polycarbonate to be repaired

(6) Aluminum Oxide abrasive cloth, 180 grit or finer

(7) Fiberglass fabric -- BMS 9-3, Type D

(8) Urethane adhesive -- BMS 5-105, Type II

B. Procedure

S 108-011

(1) Cleaning

(a) Clean damaged area of loose material and dirt by brushing with a stiff-bristle brush and blowing with compressed air.

(b) Wipe surface with methyl or isopropyl alcohol using clean, lint-free wiping material.

(c) Protect cleaned part from recontamination.

S 348-012

(2) Bonding

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WARNING: AVOID BREATHING VAPOR OR PROLONGED SKIN CONTACT OF METHYLENE CHLORIDE AND ETHYLENE DICHLORIDE. USE ADEQUATE VENTILATION AND, WHEN NECESSARY, RESPIRATOR PROTECTION.

(a) Prepare bonding solution by one of the following methods:
1) Mix ethylene dichloride (maximum 40% by weight) and methylene chloride to adjust the evaporation rate.
2) Chop clean polycarbonate of the same grade and color into small pieces and make a 1 to 5% (by weight) solution in methylene chloride or a mixture of methylene chloride and ethylene dichloride.

NOTE: Scraps of equal material or Lexan 9600 can be used is an alternate to original polycarbonate material A higher concentration solution increases the allowable working time, but may increase irregularities and squeeze out.

A higher concentration solution increases the allowable working time, but may increase irregularities and squeeze out.

(b) Apply bonding solution to cracks using clean brush. Allow sufficient time for solution to dry.
(c) Check filled cracks to ensure proper bonding.

S 348-013

(3) Laminating
(a) Solvent clean surface to be laminated using either BMS 3-2, Type 2 cleaning solvent; TT-N-95, Type 2 aliphatic naphtha; or denaturated alcohol. Remove solvent by wiping dry. Do not permit solvent to dry by evaporation.
(b) Remove gloss by sanding with aluminum oxide abrasive cloth, 180 grit or finer.
(c) Remove dust with a clean, dry cloth and repeat step (a).

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WARNING: URETHANE ADHESIVE CONTAINS ISOCYANATES. AVOID BREATHING VAPOR OR SKIN CONTACT. BLEND AND USE ONLY IN WELL VENTILATED AREAS.

(d) Thoroughly blend base resin and catalyst parts of liquid urethane adhesive EC3532A and EC3532B, or EC3549A and EC3549B (BMS 5-105, Type II) in accordance with manufacturer's instructions.

NOTE: Useful work life of blended urethane adhesive at 70-80 degrees fahrenheit (21 to 27 degrees Centigrade) is approximately 5-15 minutes for EC3532, and 30-70 minutes for EC3549.

(e) Apply a thin continuous coat of blended adhesive to fiberglass fabric, BMS 9-3, Type D and to repair surface using brush, spatula, or suitable dispensing gun.

(f) Bring surfaces together and apply pressure to ensure contact of faying surfaces.

(g) Cure at temperature above 65 degrees Fahrenheit (18 degrees Centigrade) according to the following schedule.

NOTE: Laminated part may be removed from adhesive application position after "handling time", provided that removal does not stress the bond during the cure time period.

ADHESIVE	CURE TIME	HANDLING TIME
EC3532A & EC3532B	12 HOURS	20 MINUTES
EC3549A & EC3549B	48 HOURS	90 MINUTES

TASK 20-10-55-308-014

4. Polyurethane ducts and Polyisocyanuate ducts
   A. Materials
      (1) Abrasive Paper -- Grits 80, 100, 150, 220, 240, 320, 400, 600
      (2) Adhesives -- Types 38, 77, 98
      (3) Catalysts
         (a) Benzoyl peroxide in tricresyl phosphate base
            1) Garox BZP
            2) Luperco ATC or AFR paste

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(b) Methyl ethyl ketone peroxide, 60 percent in dimethyl phthalate liquid
1) Luperson DDM-9

(4) Cheesecloth, lint free -- BMS 15-5
(5) Glass Fabric -- BMS 9-3, Type D
(6) Glass Fibers, milled, 1/32 inch (0.79 mm) length
(7) Mylar Film -- 0.001-0.010 inch (0.025-0.254 mm) thick
(8) Resin -- Hetron 92
(9) Solvents
(a) Butyl carbitol
(b) Solvents of cleaners per D6-7127 for interior painted and plastic oe surfaces
(c) Series 91 solvent

B. Resin Preparation

NOTE: Resin mixes R109 and R109A are optional to each other. R109 is cured with heat. R109A is cured at room temperature.

S 828-015

(1) Resin Mix R109

WARNING: COBALT NAPHTENATE MUST NOT BE MIXED WITH BENZOYL PEROXIDE OR METHYL ETHYL KETONE PEROXIDE. SUCH A MIXTURE IS EXPLOSIVELY REACTIVE.

(a) Add 1.8-2.2 parts by weight of Benzoyl Peroxide catalyst to 98 parts Hetron 92 resin.
(b) If the mixture becomes a gel before you can use it, discard the mixture and make some more.
(c) Apply the mixture as specified in the repair procedure.
(d) Cure this mixture 30 minutes at 250-280 degrees Fahrenheit (121-138 degrees Centigrade).
(e) To fill voids, mix catalyzed resins with the milled glass fibers to make a paste.

S 828-016

(2) Resin Mix R109A
(a) Add 0.2 weight percent cobalt naphthenate to 49-51 grams Hetron 92.
(b) Add 0.625 weight percent MEK peroxide.
(c) Pot life of this mixture is 60 minutes at 70-80 degrees Fahrenheit (21-27 degrees Cenitgrade).
(d) Apply the mixture as specified in the repair procedure.

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(e) Cure this mixture 60 minutes at 85-95 degrees Fahrenheit (29-35 degrees Centigrade).

NOTE: Titanium dioxide can be added to the resin mixture to make it opaque.

(f) To fill voids, mix catalyzed resins with the milled glass fibers to make a paste.

C. Procedures - Grade 1300 Dents/Scratches

S 328-017
(1) Sand the damaged area lightly with 180-grit of finer abrasive paper.

S 118-018
(2) Wipe the surface with butyl carbitol.

S 348-019
(3) Fill the dents with BMS 5-28 material.

S 348-020
(4) Cut a patch from fiberglass material to be 3/8 inch larger than the damaged area.

S 358-021
(5) Soak the patch with Type 38 adhesive.

S 848-022
(6) Put the patch over the damaged area.

S 358-023
(7) Cure the repair.

D. Procedure - Grade 1301 cuts

S 108-024
(1) Clean the area of the cut with butyl carbitol.

S 848-025
(2) Mix some prepared resin with milled glass fibers to make a paste.

S 358-026
(3) Apply a layer of the resin mixture to the area of the cut.

S 358-027
(4) Cure the resin.

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E. Procedure - Grade 1302 cuts

S 108-028
(1) a Clean the area of the cut and adjacent area a minimum of one inch around the cut with butyl carbitol.

S 348-029
(2) Cut a patch from fiberglass material to be larger than the damaged area.

S 848-030
(3) Put the cut patch on a clean work surface or on a piece of mylar.

S 358-031
(4) Pour resin on the patch. Cover with more mylar and wipe off unwanted resin.

S 358-032
(5) Put the patch over the damaged area.

S 358-033
(6) Rub the patch smooth over the surface and wipe off unwanted resin.

S 358-034
(7) Cure the resin.

S 848-035
(8) Remove the Mylar.

F. Procedure - Grade 1303 Cuts

S 168-036
(1) Cut away loose glass.

S 108-037
(2) Clean the area of the cut with butyl carbitol.

S 348-038
(3) Cut a patch from fiberglass material to be larger than the damaged area.

S 848-039
(4) Put the cut patch on a clean work surface or on a piece of Mylar.

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S 358-040
(5) Pour the resin on the patch. Cover this with more Mylar and wipe off the unwanted resin.

S 358-041
(6) Put the patch over the damaged area.

S 358-042
(7) Rub the patch smooth over the surface and wipe off unwanted resin.

S 358-043
(8) Cure the resin.

S 848-044
(9) Remove the Mylar.

G. Procedure - Grade 1304 Cuts

S 218-045
(1) Generally, cuts on the inside surface of a duct cannot be repaired.

H. Procedure - Grade 1305 Gouges

S 168-046
(1) Cut away loose glass.

S 108-047
(2) Clean the area around the damage with butyl carbitol.

S 348-048
(3) Mix some prepared resin with milled glass fibers to make a paste.

S 358-049
(4) Fill the gouge with the resin mixture.

S 348-050
(5) Cut a patch from fiberglass material to be larger than the damaged area.

S 848-051
(6) Put the cut patch on a clean work surface or on a piece of Mylar.

S 358-052
(7) Pour resin on the patch. Cover this with more Mylar and wipe off unwanted resin.

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S 848-053
(8) Put the patch over the damaged area.

S 348-054
(9) Rub the patch down over the surface and wipe off unwanted resin.

S 348-055
(10) Cure the resin.

S 848-056
(11) Remove the Mylar.

I. Procedure - Grade 1306 Gouges

S 108-057
(1) Clean the area around the damage with butyl carbitol.
(2) Cut away damaged foam down to, but not through, the opposite layer of glass.

S 358-058
(3) Get an old scrap duct and cut a plug from it to fit the hole in the good duct within 0.125 inch (3 mm).

S 348-059
(4) Mix some prepared resin with milled glass fibers to make a paste.
(5) Bond the plug in position and fill gaps around it with the resin mixture.

S 348-060
(6) Cut a patch from fiberglass material to be larger than the damaged area.

S 348-061
(7) Put the cut patch on a clean work surface or on a piece of Mylar.

S 348-062
(8) Pour resin on the patch. Cover this with more Mylar and wipe off unwanted resin.

S 848-063
(9) Put the patch over the damaged area.

S 348-064
(10) Rub the patch smooth over the surface and wipe off unwanted resin.

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S 348-065
(11) Cure the resin.

S 848-066
(12) Remove the Mylar.

J. Procedure - Grade 1307 Cuts

S 168-067
(1) Clean the area around the damage with butyl carbitol.
(2) Cut away the foam and the outside layer glass to make a slot 0.125 inch (3 mm) wide.

S 348-068
(3) Mix some prepared resin with milled glass fibers to make a paste.

S 348-069
(4) Fill the slot with the resin mixture.

S 348-070
(5) Cover this with Mylar to keep the resin smooth.

S 348-071
(6) Cure the resin.

S 848-072
(7) Remove the Mylar.

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STENCIL MARKINGS - MAINTENANCE PRACTICES

1. Equipment and Materials
   A. Turco 3420
   B. Cheesecloth
   C. Aliphatic Naphtha, TT-N-95
   D. Water
2. Prepare Surface for Stencil Markings
   A. Rinse the receiving surface with clean water.
   B. Brush a solution of 3 to 6 ounces of Turco 3420 per gallon of water on the receiving surface.
   C. Do not allow solution to dry. Keep solution off unpainted magnesium.
   D. After 2 to 15 minutes, rinse with warm running water.
3. Install (apply) Stencil Markings
   A. All cuts of the stencil shall be sharp and free from burrs.
   B. Select the required paint. Refer to Chapter 51, Protective Finishes.
   C. Apply the stencil by spray to the cleaned surface.
   D. The thickness of the stencil marking shall be kept to a minimum and should not exceed one mil.
   E. Smooth the stencil by rubbing briskly with a rag dampened with aliphatic naphtha after the marking has dried.

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BEARINGS AND BUSHINGS - REMOVAL/INSTALLATION

1. General
   A. Removal and installation of bearings and bushings shall be accomplished per instructions contained in 20-50-03 of 737 Overhaul Manual.

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CABLE TURNBUCKLE LOCKING CLIPS - REMOVAL/INSTALLATION

1. General
   A. The 737 airplane utilizes turnbuckles which may be safetied by a lock clip or lockwire. The following procedure covers lock clip removal and installation.
2. Equipment and Materials
   A. Corrosion Preventive Compound, MIL-C-16173, Grade 2, or equivalent
3. Remove Cable Turnbuckle Locking Clips
   A. Turnbuckle locking clips are removed by exerting a twisting force upon the clip forcing it out of the hole in the center of the turnbuckle barrel and extracting the clip from the turnbuckle slot. Discard turnbuckle locking clip after removal from airplane. Turn turnbuckle barrel until the cables become disengaged.
4. Install Cable Turnbuckle Locking Clips

   CAUTION: DO NOT REUSE LOCKING CLIPS.

   A. Apply a thin coat of corrosion preventive compound to threads of turnbuckle barrel and cable terminals.
   B. Engage turnbuckle barrel with both threaded cable terminals and turn barrel until not more than three threads are exposed outside the barrel and proper cable tension is reached. (See figure 401.)
   C. Align the slot in the barrel with the slot in the cable terminal.
   D. Insert the straight end of the locking clip into the aperture formed by the aligned slots.
   E. Place the hooked end of the locking clip over the hole in the center of the turnbuckle barrel and seat the hook loop into the hole.
   F. Application of pressure to the hook shoulder will engage the hook lip in the turnbuckle barrel and complete locking one terminal.
   G. Repeat steps (C) thru (F) to lock the other terminal.

      NOTE: Both locking clips may be inserted in the same turnbuckle barrel hole.

   H. Check both turnbuckle locking clips for proper engagement of the hook lip in the turnbuckle barrel hole by applying slight pressure in the disengaging direction.

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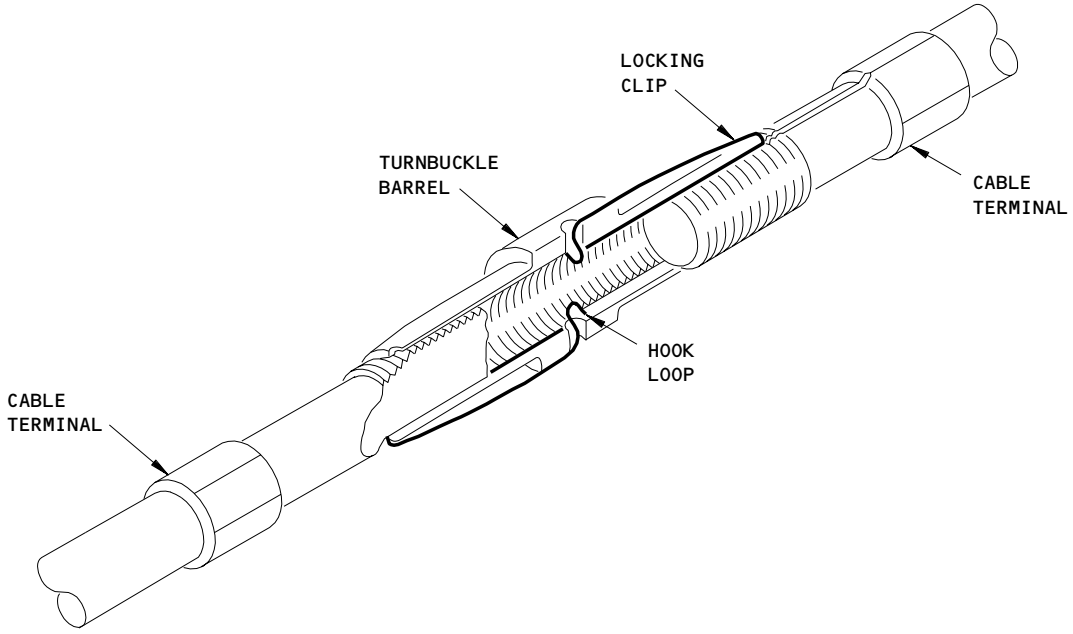

Turnbuckle Locking Clip Installation
Figure 401

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CONTROL CABLES - REMOVAL/INSTALLATION

1. General
   A. This procedure covers the removal and installation of cables. Procedures for installing both prefabricated and nonprefabricated cables are included to facilitate installation of cables when portable swaging machines are available.
   B. When it is necessary to replace a 0.75, 1.00, or 1.25-inch nylon flip-type grommet without removing the control cable, a BACG20H cable grommet of the proper size may be used. For installation of nylon flip-type grommets, see Nylon Flip-Type Grommet - Removal/Installation.
   C. Cable Lubrication (Ref 12-26-0)
2. Equipment and Materials
   A. Cable Clamps Part Number A20005-9
   B. Tensiometer
   C. BMS 3-33 Grease (Preferred)
   D. BMS 3-24 Grease (Alternate) (Ref 20-30-21)
   E. Cable Pull Tester Kit - 520CTK Preferred. ATI Industries, 2425 West Vinyard Ave., Escondido, CA 97025
   F. Model A Cable Tester - Mine Safety Appliances, Pittsburg, Pennsylvania, or equivalent
   G. Cable Swager Kit 520 JK - ATI Industries, 2425 West Vinyard Ave., Escondido, CA 97025
3. Remove Control Cables
   A. Mark cable end fittings with masking tape or paint so that original rigged position may be used as reference when rigging.
   B. Loosen turnbuckles to release tension.
   C. Install cable clamps on affected cable not being removed such that slight tension is maintained on cables. If cable can be isolated between rigging pin locations, install rigging pins through appropriate drum or quadrant.

      NOTE: Slight tension on affected cables which are not being removed will prevent unwrapping on cable drums and prevent cables from jumping pulley guards.

   D. New cables are installed at the same time the old cable is removed. The old cable is used to guide and pull the new cable into position.
4. Install Control Cables
   A. If installing a prefabricated cable, proceed as follows:
      (1) Remove necessary pulleys and pressure seals. See applicable chapter for cable locations.
      (2) Attach the new cable to the old cable and pull the old cable out threading the new cable through simultaneously. A slight tension should be maintained on the new cable.
      (3) Reinstall pulleys and pressure seals.

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B. If installing nonprefabricated cable, proceed as follows:
   (1) Identify cable being removed.
   (2) Prepare new cable per applicable system. See applicable chapter for cable lengths.
   (3) Install only those fittings that will permit cable installation.
   (4) Wipe full length of cable, except clad area with a dry, lint-free cloth and apply a light even coat of grease.
   (5) Apply proof load per following table to cable and installed fittings to check swaging and to prestretch cable.

       NOTE: If prestretched cable is used, entire cable length does not require proof loading.

   (6) Wipe full length of cable with a dry, lint-free cloth.
   (7) Apply grease.
       (a) Cres cable; apply no grease.
       (b) Carbon steel cable; coat full length of cable, except clad areas, with a minimum quantity of BMS 3-33 grease sufficient only to produce a continuous, thin visible fillet of grease in cable grooves.
   (8) Mark positions of fittings not installed on cable prior to installation.
   (9) Wrap old cable so it will not unravel.
   (10) Cut off cable end fitting of old cable and splice old cable to new cable.

       NOTE: Splice must be a minimum diameter and strong enough not to break when pulled through.

   (11) Pull old cable out maintaining slight tension on new cable.
   (12) Install remaining fittings and apply proof load to fittings per table following step (5).

       NOTE: You must apply the full proof load gradually. You must apply full proof load in more than 3 seconds. You must hold the full proof load for at least 5 seconds.

C. If required, remove any foreign matter from the surface of the control cable for the full length of travel through fairleads, air pressure seals, over pulleys, quadrants, and drums with a dry cloth.
   (1) Apply grease.
       (a) Cres cable; apply no grease.
       (b) Carbon steel cable; coat full length of cable, except clad areas, with a minimum quantity of MS 3-33 grease sufficient only to produce a continuous, thin, visible fillet of grease in grooves.

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PROOF LOADS FOR CABLE ASSEMBLIES											
		CABLE DIAMETER (INCHES) 1									
		1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	3/8
WIRE ROPE TYPE		PROOF LOAD (POUNDS)									
BMS 7-265 OR MIL-W-83420 COMP. "A" (CARBON STEEL)	7 x 7	288 +25 -0	552 +25 0	---	---	---	---	---	---	---	---
	7 x 19	---	600 +25 -0	1200 +60 -0	1680 +85 -0	2520 +125 -0	3360 +170 -0	4200 +210 -0	4800 +240 -0	5880 +295 -0	8640 +435 -0
BMS 7-265 OR MIL-W-83420 COMP. "B" (CRES)	7 x 7	288 +25 -0	552 +25 -0	---	---	---	---	---	---	---	---
	7 x 19	---	552 +25 -0	1056 +50 -0	1440 +70 -0	2220 +110 -0	3000 +150 -0	3840 +190 -0	4680 +230 -0	5400 +270 -0	7200 +360 -0

MATERIAL:

CABLE - CARBON STEEL PER BMS 7-265, TYPE I, COMPOSITION A (TZ) (PREFERRED)
- CARBON STEEL PER BMS 7-265, TYPE I, COMPOSITION A (FIRST OPTION)
- CARBON STEEL PER MIL-W-83420, TYPE I, COMPOSITION A (SECOND OPTION)
- CARBON STEEL PER MIL-W-1511 (THIRD OPTION)

INTERCHANGABILITY INFORMATION:

ZINC-ONLY AND TIN-OVER-ZINC COATED CABLES ARE INTERCHANGABLE AND CAN BE INTERMIXED WITHIN A SYSTEM (SUCH AS THE AILERON, SPOILER, OR STABILIZER SYSTEMS). OPPOSITE CABLES WITHIN A GIVEN CABLE LOOP ARE REPLACED WITH CABLES OF THE SAME TYPE. THIS WILL PREVENT ASYMMETRIC CABLE STRETCH THAT CAN DEGRADE THE SYSTEN RIGGING.

1 THE DIAMETER OF THE WIRE ROPE TELLS YOU THE PROOF LOAD TO USE ON NYLON JACKETED CABLE. DO NOT INCLUDE THE JACKET IN THE DIAMETER.

Control Cables Installation
Figure 401

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D. Install turnbuckle barrel an equal distance onto both threaded terminals until no more than three threads show outside the barrel.
E. Remove clamps and rig pins from cable and drums.
F. Tighten cable according to applicable system temperature-tension chart. If new cable is installed the affected system must be cycled a specified number of test cycles, with cables tightened to twice the working tension. Make final rigging adjustments. Refer to applicable chapter for rigging load test cycle tables.

NOTE: Use tensiometer to check cable tension. Apply tensiometer to cable at least 6 inches from turnbuckle terminal or other fittings. To ensure that proper cable tension is obtained, allow a minimum of one hour at constant ambient temperature for airframe temperature to stabilize.

G. Install turnbuckle locking clips on all turnbuckles disturbed.
H. Check that cable pressure seals are correctly adjusted after rigging to eliminate any binding or deflection of cables.

NOTE: Correctly adjusted seals stop deflection of the cable and make sure the cable is free to move.

I. The minimum clearance from the adjacent structure shall be as follows.

NOTE: The clearances that follow are general guidelines only. Refer to the applicable chapter to find any special conditions for a specific system.

(1) Between different cable systems - 0.50 inch

NOTE: A clearance of 2.00 inches is recommended.

(2) Between structure, wiring, tubing and fixed equipment:

NOTE: A clearance of 1.50 inches is recommended below the cable, and 1.00 inch is recommended in the other directions.

(a) At a fairlead - 0.50 inch
(b) At a rubstrip - 0.10 inch

(3) Between doors, landing gear, and components that move - 2.00 inches

NOTE: A clearance of 4.00 inches is recommended.

J. Operate controls through full travel and check for no binding or excessive force.

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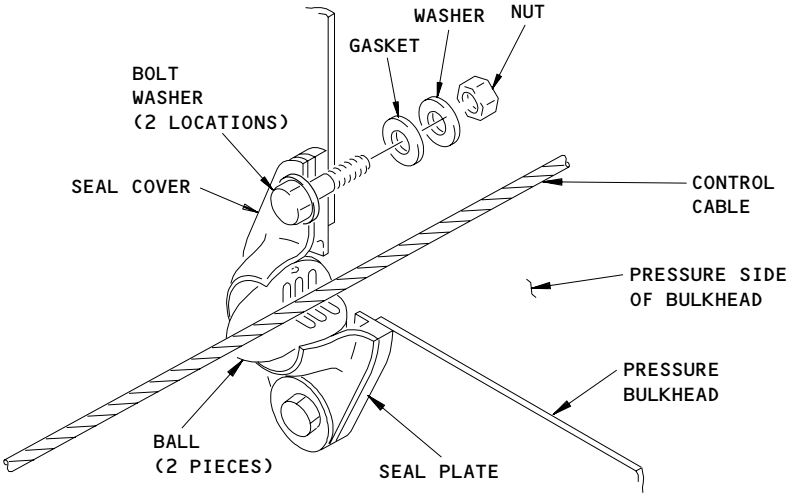
CONTROL CABLE AIR PRESSURE SEAL - REMOVAL/INSTALLATION

1. Equipment and Materials
   A. Ball and Roller Bearing Grease MIL-G-25760
2. Remove Control Cable Air Pressure Seal
   A. Remove two seal retaining bolts (Fig. 401).
   B. Remove ball (2 pieces) from seal cover.
   C. If seal plate requires replacement, disconnect turnbuckle adjacent to pressure bulkhead and remove seal cover and seal plate from control cable.
3. Install Control Cabin Air Pressure Seal
   A. If seal plate (Fig. 401) or seal cover are removed, replace on control cable and rig control cable according to system rigging instructions.
   B. Lubricate cable for full length of travel within seal with grease.

      NOTE: Do not fill seal with grease.

   C. Join the two ball halves on cable between seal cover and seal plate.
   D. Install seal retaining bolts with washers. Prior to tightening bolts, adjust seal to provide minimum cable deflection. Tighten seal retaining bolts.
   E. Check that cable pressure seals are correctly adjusted after rigging to eliminate any binding or deflection of cable.



Installation of Control Cable Air Pressure Seal
Figure 401

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ELECTRICAL/ELECTRONIC BLACK BOX - MAINTENANCE PRACTICES

1. General
   A. The following procedures assure proper mating of electrical connectors while removing and installing black box units. Units which have pigtail type connectors or no provisions for a mechanical extractor/insertion method are not covered within this procedure.
   B. Lever latches are used for movement and retention of electronic units mounted on racks. This unit consists mainly of a handle and trigger (Fig. 201). Electronic units are held in position by engagement of a hook on the lever latch handle with a fork-type catch on the rack. Correct adjustment of the lever latch fork is necessary to assure proper connector engagement.

      CAUTION: IMPROPER ADJUSTMENT OF ASSEMBLIES ON EQUIPMENT SHELVES MAY CAUSE CIRCUIT MALFUNCTION OR EQUIPMENT DAMAGE.

2. Removal of Black Box Units
   A. Remove electrical power by pulling the applicable circuit breakers.
   B. On units with cam-lock handles (Fig. 201):
      (1) Depress the latch allowing the lever to move away from the handle.
      (2) Move the lever in an opening direction forcing the unit away from the shelf-mounted connector.
      (3) Remove the unit from the shelf.
   C. On units with hold-down screws:
      (1) Loosen the retainer nuts until the retainer cups may be released from the hold-down hooks.
      (2) Position the extractor tool under the front lip of the unit with the slots in the extractor's legs in the projecting studs on the shelf. The extractor's carriage should be positioned so that it will exert an outward force on the projecting lip of the unit's front panel.
      (3) Turn the torque knob allowing the extractor to eject the unit from the connector.
      (4) Remove the unit from the shelf.

         NOTE: To prevent foreign object contamination or damage cover all ports, openings and electrical connectors of the unit or shelf with plastic caps or bags.

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3. Installation of Black Box Units
   A. On units with lever latch handles (Fig. 201):
      (1) Slide the unit into the shelf with the cam-lock lever in the open position until the lever engages the shelf-mounted fork.

          NOTE: Remove any protective caps or bags from the unit or shelf prior to installation.

      (2) Move the lever latch to its locked position.
          (a) The connector shall mate to the dimensional requirements of view 1 of Fig. 201.
          (b) The fork should be adjusted so that with the connector properly mated and the lever open 0.50 to 0.60 inch or 0.25 to 0.35 inch as applicable from the locked position, it just exerts pressure on the lever.
   B. On units with hold-down screws:
      (1) Slide the unit into the shelf until resistance from the mating connectors is noticed.
      (2) Position the extractor tool under the front lip of the unit with the slots in the extractor's legs in the projecting studs on the shelf. The extractor's carriage should be positioned so that it will exert an inward force on the projecting lip of the unit's front panel.
      (3) Insert the unit into the shelf by turning the torque limiting knob until additional knob rotation has no effect on the unit.
          (a) The connector shall mate to the dimensional requirements of view 1.
      (4) Place the retainer cups over the hold-down hooks, tighten and safety the retainer nuts.
   C. Test the unit per the applicable system test.
4. Lever Latch Fork Adjustment
   A. Adjustment of the lever latch fork must be made with the electronic unit in position and the mating electrical connectors engaged. Two types of latching mechanisms are identified on Fig. 201 and the required adjustment tolerances are shown.
   B. Prepare for Adjustment
      (1) Open circuit breaker of unit to be adjusted.
      (2) Press trigger and pull lever latch to open position.
      (3) Remove unit by handle.
      (4) If installed, loosen jamnut on fork assembly.
      (5) Examine all parts of latching mechanism for serviceability.
   C. Adjust Lever Latch Fork
      (1) Slide unit back on shelf until connectors are partially engaged.
      (2) Engage lever latch hook with fork assembly pin.

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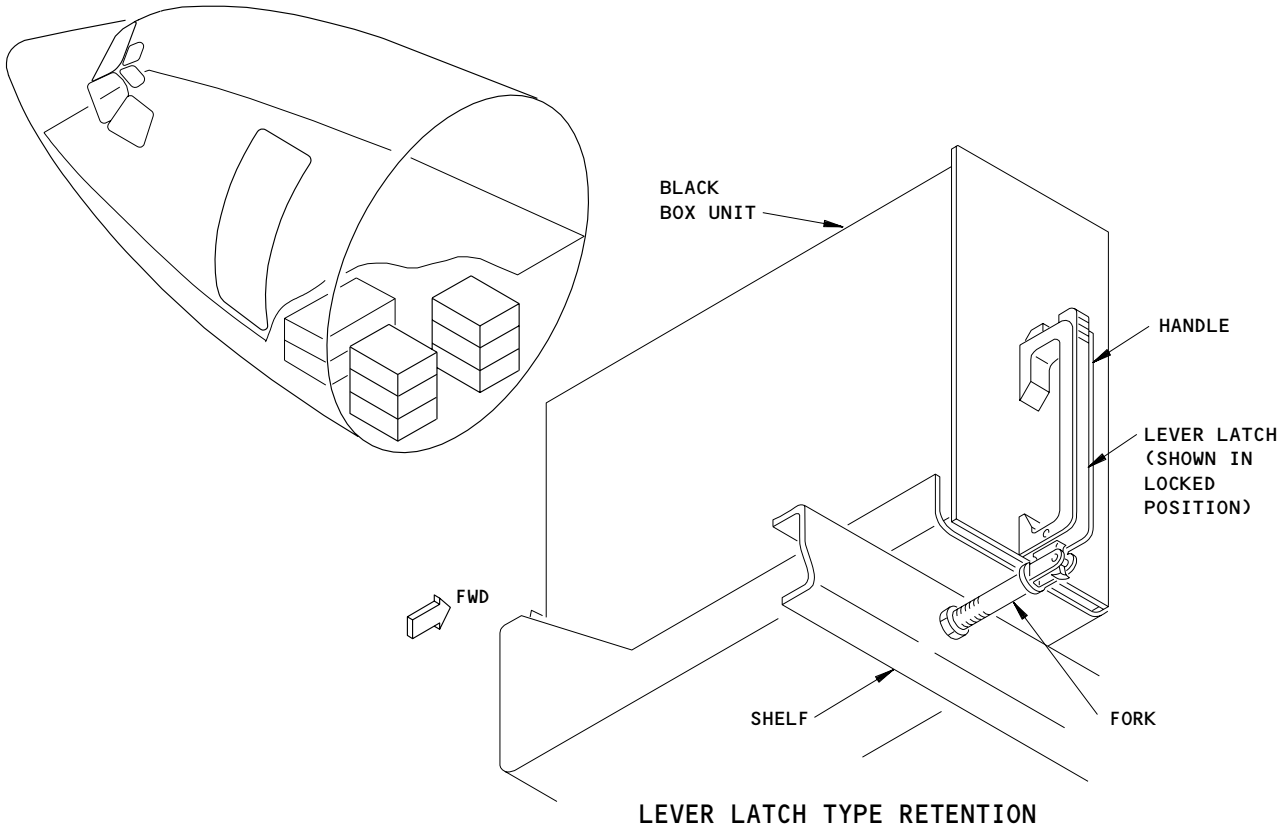
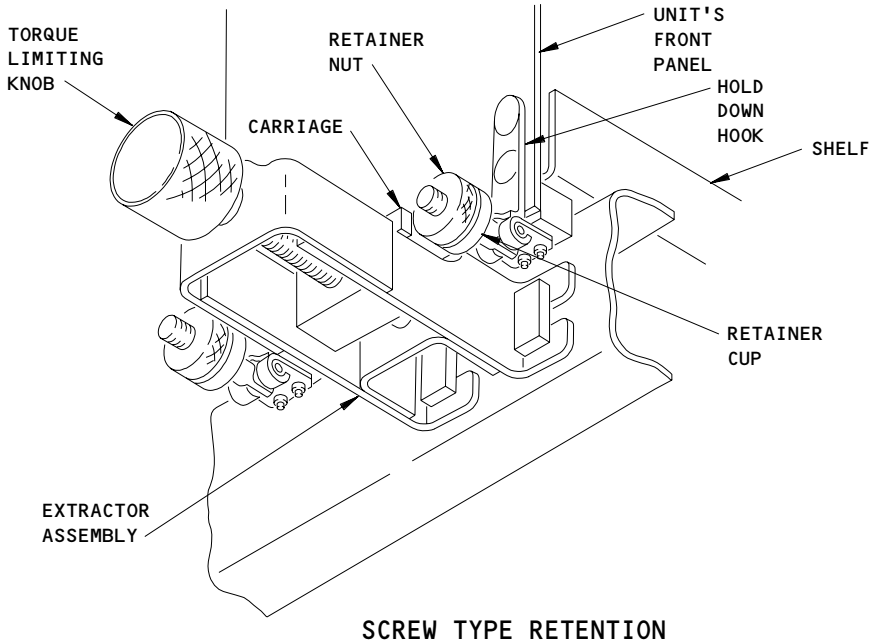


LEVER LATCH TYPE RETENTION
(TYPICAL)



SCREW TYPE RETENTION
(TYPICAL)

Electrical/Electronic Black Box Installation
Figure 201 (Sheet 1)

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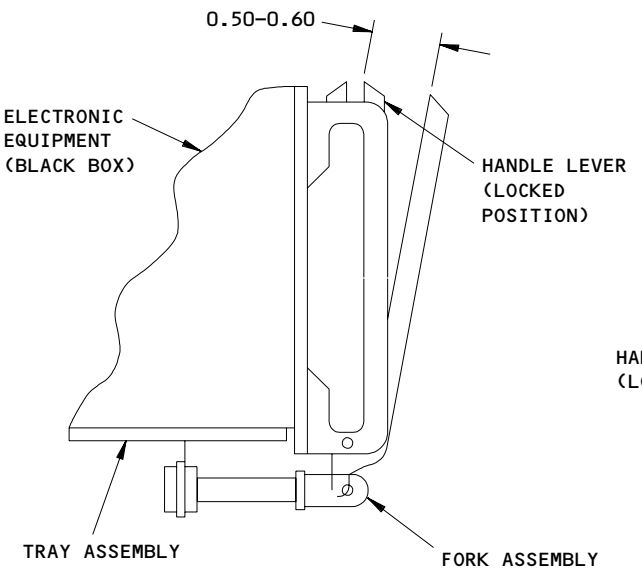
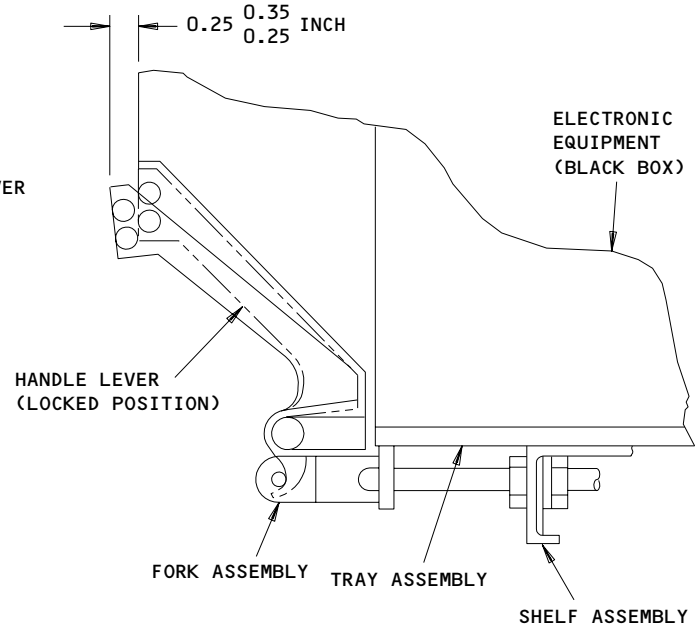


TYPE I



ADJUST FRONT HOLD DOWNS AS FOLLOWS:

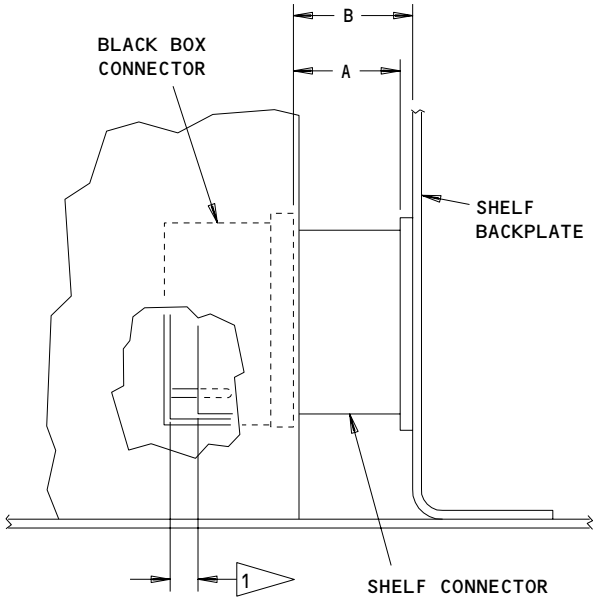
WITH PLUG ON THE REAR OF UNIT FULLY ENGAGED AND THE HANDLE LEVER ON THE FRONT OF THE UNIT AT THE DIMENSION SHOWN, ADJUST FORKS BY ROTATING TO A POSITION WHERE THEY START TO EXERT PRESSURE ON THE LOCKING LEVER.

DETAIL A

	A	B
CONNECTOR TYPE	INCH MAX	INCH MAX
AD2		0.297 MAX
AMP		0.297 MAX
DPA	0.157 MAX	
DPD	0.138 MAX	
DPE	UNKNOWN	UNKNOWN
DPDMA	0.138 MAX	
DPD2	0.138 MAX	
DPXA		0.297 MAX
DPXB		0.297 MAX
DPX2		0.297 MAX
SR-RAI		0.581 MAX

1 0.09 INCH MAXIMUM FOR ANY CONNECTOR FULLY MATED (ALTERNATE METHOD)

NOTE: DIMENSIONS CAN BE MEASURED WITH PUTTY OR A PAPER SLEEVE OR RING OF A SUITABLE LENGTH THAT WILL BE CRUSHED WHEN THE CONNECTOR IS MATED PROPERLY.



TYPICAL MATED ELECTRICAL CONNECTORS
VIEW 1

Electrical/Electronic Black Box Installation
Figure 201 (Sheet 2)

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(3) Start closing lever latch handle.

NOTE: It is possible to determine full connector engagement by feel. A sudden increase in handle pressure, resistance to handle movement, indicates that the connectors are fully engaged.

(4) Adjust fork assembly until resistance to handle movement occurs at gap tolerance as shown in Fig. 201.
(5) Close handle until latched.
(6) Tighten jamnut to snug fit.

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PRESSURE-SENSITIVE PLACARDS - REMOVAL/INSTALLATION

1. General
   A. The following procedure is used for the installation of interior vinyl placards and is optional for installation of foil markers and pressure-sensitive decals.

      NOTE: Vinyl placards are prepared on a material that will not readily follow the contour of rough or textured surface of the substrate and will contact only the high spots, producing a poor bond. An adhesive is used with vinyl placards to provide a smooth surface for placard contact, thus assuring a firm bond. Foil markers are made on a soft metal that, when applied and pressed into place, will assume that contour of the substrate and make a good bond. However, if the substrate is textured, the surface may also be coated with adhesive when applying a foil marker to provide a smoother surface, making more satisfactory installation.

2. Equipment and Materials
   A. Detergent cleaner - any commercially available detergent
   B. Cleaners
      (1) Aliphatic Naphtha - TT-N-95. Refer to 20-30-31.
   C. Adhesive - BMS 5-55. Refer to 20-30-51.
   D. Adhesive Film - BMS 5-91. Refer to 20-30-51.
   E. Sandpaper, medium grit - commercially available
   F. Masking tape. Refer to 20-30-51.
3. Remove Placard

   NOTE: If the existing placard is adhering firmly and the new placard is the same size, the new placard may be installed on the existing placard.

   A. Insert sharp knife, or similar object, under edge of placard and peel placard from adhesive area.
   B. Remove adhesive film that may remain with cured adhesive or substrate, using either cleaner.
4. Prepare Placard for Installation
   A. If placard is stamped to indicate BMS 5-91 adhesive is used, no special placard preparation is required and placard is ready for installation.
   B. If placard has no backing adhesive, prepare placard as follows:
      (1) Clean placard with naphtha cleaner.
      (2) Remove release paper from one side of BMS 5-91 adhesive film and apply to back of placard. Trim excess film.
      (3) Laminate adhesive film to placard by either of the following:
         (a) Roll placard on hot roll laminator heated to 140°F.

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(b) Heat placard to not more than 140°F with dry air blast or some other suitable medium and rub release paper side with cheesecloth.

CAUTION: ADHESIVE TO RELEASE PAPER BOND HAS BEEN SOFTENED. USE CARE SO RELEASE PAPER WILL NOT BE MOVED.

NOTE: Step (4) is not a specific requirement but it does assure adhesive film is firmly bonded to placard.

(c) If placard has an adhesive backing other than BMS 5-91, prepare placard as follows:
1) Remove release paper from back of placard.
2) Remove release paper from one side of BMS 5-91 adhesive film and apply adhesive film to back of placard. Trim excess film.
3) Laminate adhesive film to placard as noted in step 3.B.(4) above.

5. Install Placard

NOTE: If placard is being installed over an existing placard or on the cured adhesive from a previously installed placard, steps B thru D and G are eliminated.

A. Clean substrate with detergent. Dry thoroughly.
B. Mask area approximately 1/16 inch smaller than placard with masking tape or use mask of required size securely positioned.

CAUTION: BE CERTAIN MASKED AREA IS PROPERLY LOCATED. DRY ADHESIVE CAN BE REMOVED USING NAPHTHA CLEANER. CURED ADHESIVE CANNOT BE REMOVED WITHOUT DAMAGING SUBSTRATE.

C. Brush apply one coat BMS 5-55 of adhesive to prime contact area. Allow adhesive to dry thoroughly (approximately 15 minutes).
D. Remove masking tape or mask.
E. Remove release paper from placard, center on area, and apply to primed substrate taking care to eliminate air pockets.
F. Rub down placard thoroughly using firm hand pressure and cheesecloth pad.
G. If primed surface shows around placard, remove excess adhesive with naphtha cleaner.

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O-RINGS - INSTALLATION

1. General
   A. The following procedure is used for the installation of O-rings over sharp edges such as threaded fasteners, keyways, slots, splines and ports.
   B. Prior to installation, check O-rings for cuts, abrasions, deformities, and surface irregularities.
2. Equipment and Materials
   A. Cleaner and lubricant - the fluid used within the components and system.
   B. O-Ring Installation Tool - ST848
3. Installation of O-Rings
   A. Choose appropriate ST848 series O-ring installation tools. (See figure 201).

      CAUTION: ELASTOMERIC O-RING INNER DIAMETERS SHALL NOT BE STRETCHED MORE THAN 50% DURING INSTALLATION. TEFLON AND PLASTIC O-RING INNER DIAMETERS SHALL NOT BE STRETCHED MORE THAN 5% DURING INSTALLATION.

   B. Place thimble over fitting.
   C. Slip O-ring onto thimble.
   D. Guide expanding body over thimble and against O-ring into groove.
   E. Use extracting rod to remove expanding body from thimble.
   F. Remove thimble.
   G. Check O-ring for twisting due to installation. Realign O-ring with no twists prior to closing gland.

      CAUTION: O-RINGS MUST NOT BE PINCHED, AND ANY ATTACHING BOLTS MUST BE PROPERLY TIGHTENED.

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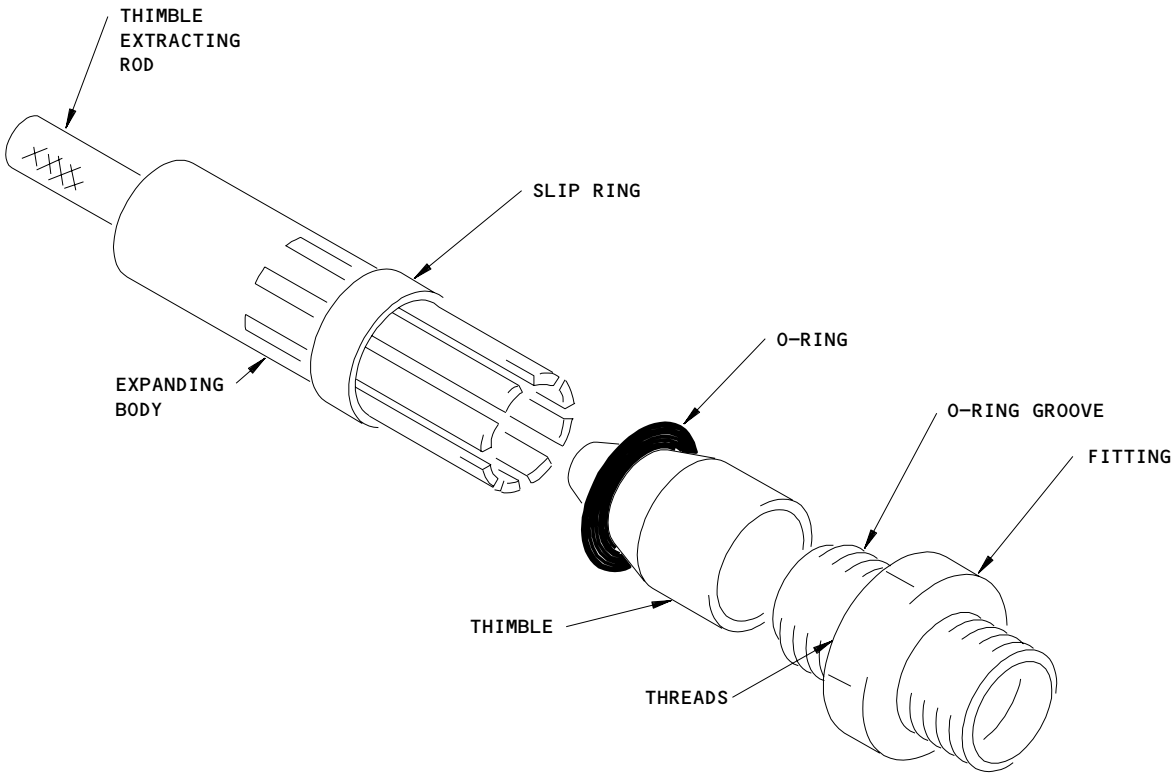

TOOL NO.	FLARED TUBE OR HOSE FITTING SIZE
ST848-187	1/16
-250	1/4
-312	5/16
-375	3/8
-500	1/2
-625	5/8
-750	3/4
-1000	1
-1250	1-1/4
-1500	1-1/2
-1750	1-3/4

Typical O-ring Installation Tool
Figure 201

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LUBRICATION FITTINGS - REMOVAL/INSTALLATION

1. General
   A. This procedure provides instructions for installation of press-in type lubrication fittings in mating parts from which such fittings have been removed.
   B. This procedure gives the temporary instructions to lubricate a part that has a broken or blown out lubrication fitting.
   C. Procedures are typical for all parts. For repair instructions for lubrication fittings on landing gear components, refer to Overhaul Maintenance Manual.
2. Tools and Test Equipment
   A. Drive Tool - 5253-1 (for Alemite Type 1728B lubrication fittings)
   B. Drive Tool - 5254-1 (for Alemite 1646B and 1992B lubrication angle fittings)
3. Materials
   A. Solvent - P-D-680 (Ref 20-30-31)
   B. Adhesive - Loctite RC/680 or MIL-R-46082 (Ref 20-30-11)
   C. Compound - Loctite 675, 290 (Ref 20-30-11)
   D. Cleaner - Freon MIL-C-81302 (Rep 20-30-11)
   E. Primer - Loctite Grade T (Ref 20-30-11)
   F. Nitrogen - Liquid, MIL-P-2740 (Ref 20-30-51)
4. Install Lubrication Fittings

   CAUTION: BE SURE TO USE PROPER TOOL AND TO DRIVE LUBRICATION FITTING IN STRAIGHT, TO PREVENT DAMAGE TO THE MATING PART.

   A. Install new fitting.
      (1) Obtain specified standard fitting for installation in the applicable hole.
      (2) Cleaning:
         (a) Remove as much grease as possible from the bore of the lube fitting hole with Q-Tips or equivalent from the entire depth of hole.
         (b) Using Freon on a clean Q-Tip or equivalent, clean hole to a depth of 0.5 inches minimum. Repeat until no more visible grease or dirt is removed.
      (3) Using proper drive tool, insert fitting into hole in mating part.
   B. Install blown-out fitting (Fig. 401).
      (1) Obtain specified standard or modified size fitting for installation in the applicable hole.
      (2) Cleaning:
         (a) Remove as much grease as possible from the bore of the lube fitting hole with Q-Tips or equivalent from the entire depth of hole.
         (b) Using Freon on a clean Q-Tip or equivalent, clean hole to a depth of 0.5 inches minimum. Repeat until no more visible grease or dirt is removed.

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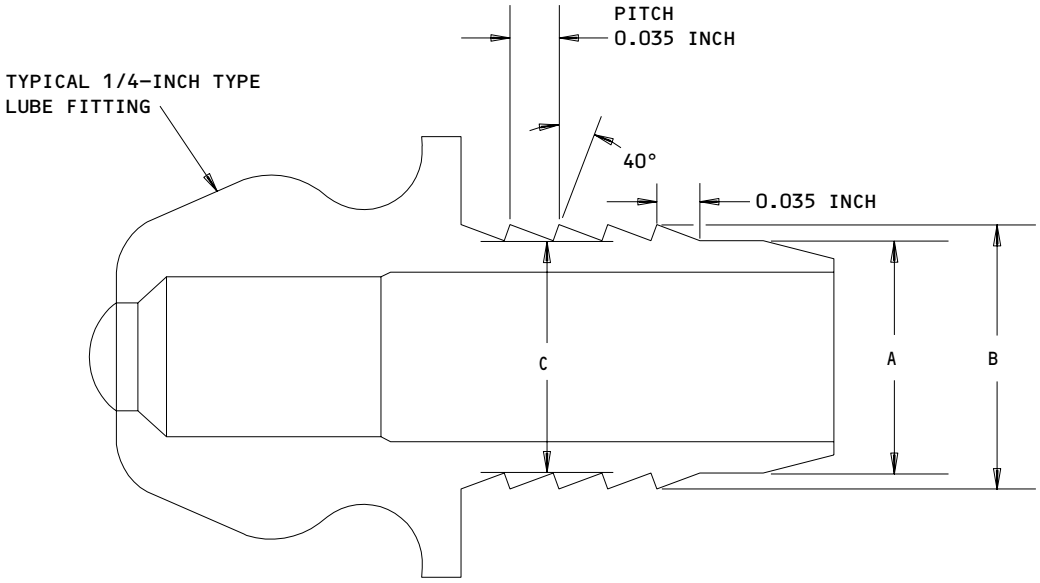
DESIGN LUBE HOLE DIA IS .188/.189 INCHES

LUBE HOLE DIA (X) (INCHES)	LUBE FITTING DIA (INCHES)
0.194 MAX	3/16 1
0.195–0.247	1/4 MODIFIED 1
0.248–0.249	1/4 2
0.250–0.254	1/4 1

1 INSTALL WITH ADHESIVE
2 INSTALLATION WITH ADHESIVE OPTIONAL



ALL DIMENSIONS ARE IN INCHES
X (NOT SHOWN) = HOLE DIA IN MATING COMPONENT
A = SHANK DIA (X MINUS 0.007/0.012)
B = SERRATION OD (X PLUS 0.005/0.010)
C = SERRATION ROOT OD (X MINUS 0.003/0.010)

Lubrication Fitting Modification and Installation
Figure 401

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(3) Primer Application:
(a) After hole is thoroughly clean, use a Q-Tip or equivalent to apply a thin coat of Loctite Primer-T to the bore of the hole.
(b) Allow primer to air dry at room temperature a minimum of five minutes prior to application of retainer compound.
(4) Retainer Compound:
(a) Using a Q-Tip or equivalent, apply a thin coat of Loctite Compound: Compound 290 or RC/680, to the bore of the hole, to a depth of 0.25 to 0.40 inches.

CAUTION: AVOID EXCESSIVE AMOUNT OF ADHESIVE ON FITTING AND MATING PART, TO PREVENT OBSTRUCTION OF LUBRICATION PASSAGES.

NOTE: After adhesive is applied, fitting must be inserted into hole immediately - adhesive begins to set after one minute.

(5) Shrink Fit Process
(a) Dip lube fitting into liquid nitrogen for at least one minute to assure even and adequate cooling.
(b) Install lube fitting in the hole, with a minimum lapse of time, using the manufacturer's recommended grease fitting drive tool.
(c) Allow to cure for 12 hours at room temperature before use.

5. Temporary Lubrication for Blown-out Lubrication Fittings
A. General
(1) This task contains the instructions to lubricate a component using a blown-out lubrication fitting when replacement of the lubrication fitting replacement is inconvenient.
(2) This procedure is only to be used in the event that a grease fitting has been blown out and the maintenance to repair the fitting is inconvenient, but lubrication is necessary to continue service.
B. Equipment
(1) Rubber-Tipped Grease Gun Adapter - B411 (Alemite P/N)

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C. References
(1) AMM 20-30-21/201, Lubricants
D. Lubricate the Component with the Blown-out Fitting
(1) Gain access to the blown-out lubrication fitting.
(2) Using the applicable grease gun and grease required for the location with the blown-out lubrication fitting, attach the rubber-tipped grease adapter to the grease gun.
(a) Refer to AMM 20-30-21/2 for the proper lubricants.
(3) Press the rubber-tipped adapter firmly against the opening where the lubrication fitting was blown out.
(4) Gently pump the grease into the fitting opening, making sure that the rubber tip remains firmly seated against the opening.
(5) Clean up any excess grease.
(6) Close any panels opened for access.
(7) Return the aircraft to normal.

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HEAT GUNS, SOLDERING GUNS AND/OR SOLDERING IRONS - MAINTENANCE PRACTICES

1. Use of heat guns, soldering, guns and/or soldering irons
   A. Heat guns, soldering guns and soldering irons are not considered to be explosionproof. Elements in all of these devices may operate at temperatures in excess of the fuel vapor flashpoint (450°F). In addition, heat guns and soldering guns may contain electrical switches which can produce sparks capable of igniting fuel vapors.
   B. The following paragraphs define the minimum recommended safety practices to be observed when using heat guns, soldering guns and/or soldering irons on or near in-service airplanes. It should be noted that these procedures are written for use throughout the world and, of necessity, are general. Regulations established by local agencies and/or airline generated procedures may take precedence. Boeing can neither conceive nor document all potential sets of conditions which the airlines may encounter.
   C. Assessment of existing conditions, good judgement and common sense must be exercised by airline personnel. Consequently, customer airlines are responsible for the use of any or all of the aforementioned heating devices.
   D. It is not recommended that any heating device ever be used in fuel tanks. It is recognized that fuel tanks could be purged and inserted with nitrogen. However, it is recommended that procedures utilizing crimped splices and sleeving with nylon ties, as defined in Document D6-5456 Electrical and Electronics Assembly and installation notes, be used for fuel gage wiring repair.
   E. Heat guns, soldering guns or soldering irons should not be; used within 100 feet of an airplane during refueling, defueling, or when fuel tanks are open. This distance must further be maintained from all fuel vents, fuel spills and other flammable liquids.
   F. Heat guns, soldering guns and soldering irons can be used when and where smoking is allowed on, or in the vicinity of, the airplane. If these devices are to be used where smoking is not allowed, it will be necessary to determine that unsafe quantities of fuel vapors are not present in the intended work area.

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G. The vapor level considered safe for use of ignition-producing devices is essentially zero. Vapor level measurement may be accomplished by use of calibrated measuring equipment such as Mine Safety Appliances, model 2A, 40 or Davis (Scott), model D-16, which read in "PERCENT LOWER EXPLOSIVE LIMIT" or "PERCENT EXPLOSIVE". Any fuel vapor level readable on these instruments is an indication of a liquid fuel or vapor source near by and local higher vapor concentrations, or of insufficient ventilation. These instruments should be used to establish that initial vapor levels are sufficiently low and also to monitor the level during repairs. Under no conditions should any potential ignition source be used in the vicinity of open fuel tanks, fuel vents or spilled fuel where vapor concentrations are unpredictable or cannot be controlled.

H. If ignition producing equipment is to be used anywhere on or near an airplane where smoking is not allowed, it is essential that a member of the local fire fighting crew or a person responsible for airplane fire safety stand by to observe the work and other nearby activities. Work should never begin, nor be continued, on any fuel system component while ignition producing equipment is present. Also, the number of maintenance and safety personnel involved should be kept to a minimum. The amount of emergency or fire fighting equipment which should be at the scene of repair must be determined by local fire fighting personnel or other authorities, responsible for fire safety and who are capable of judging the degree of risk associated with the repair work being contemplated.

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METAL SURFACES - CLEANING/PAINTING

1. General
   A. This section provides cleaning procedures to be used for faying surfaces bonds and bonding jumper installation. The procedures include hand cleaning with abrasives, wire brush and disk spot cleaning, removal of paint, and solvent cleaning. Abrasives or wire brushes are not to be used on plated surfaces, unpainted alclad aluminum or CRES.
2. Hand Cleaning with Abrasives
   A. General
      (1) Do not apply abrasives to plated surface, alclad aluminum or CRES. However, this is the only method to be used on titanium.
   B. Equipment and Materials
      (1) Abrasive paper or cloth, 180 grit
         (a) Garnet Paper - Federal Spec P-P-121 (AMM 20-30-04, Miscellaneous Materials)
         (b) Aluminum Oxide Cloth, closed coat - Federal Spec P-C-451 (AMM 20-30-04, Miscellaneous Materials)
   C. Clean with Abrasive
      (1) If possible, use a circular or elliptical motion of abrasive to provide a uniformly smooth surface.

         CAUTION: DO NOT ALLOW PARTICLES FROM ABRASIVE TO CONTAMINATE MECHANISMS OR ELECTRICAL EQUIPMENT.

3. Spot Cleaning with Rotary Bonding Brush
   A. General
      (1) This method is effective in removing paint from any metal or for removal of alodine, irridite, or light anodize from aluminum. Bonding brush cleaning is not to be applied to plated surfaces, nor to metals left unpainted such as CRES or alclad aluminum. For these surfaces use solvent cleaning.
   B. Equipment and Materials
      (1) Drill motor or other suitable drive
      (2) Bonding brush, stainless steel, of proper size (Fig. 701)

         CAUTION: DO NOT USE CARBON STEEL BONDING BRUSHES. EMBEDMENT OF STEEL PARTICLES INTO METAL SURFACES COULD CAUSE SERIOUS CORROSION.

         DO NOT USE ROTARY WIRE BRUSHES OR ABRASIVE DISKS ON TITANIUM. REFER TO TITANIUM CLEANING.

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C. Clean with Bonding Brush

NOTE: Color-code bonding brush assembly housing.

(1) Using a drill motor or other suitable drive, clean required spot diameter with a stainless steel bonding brush of proper size.
(a) Apply brush intermittently, keeping cutting face parallel with surface.
(b) Inspect results after each application and continue operation until required area is clean.

NOTE: Hold surface loss of metal to an absolute minimum.

(c) If difficulty is experienced getting through an anodic film, use abrasive disk cleaning.

4. Spot Cleaning with Rotary Abrasive Disk

A. General
(1) This method is effective for removal of unpainted anodize, iridite, alodine, Skydrol resistant finish, or similar hard finishes. Paint must also be remove by this method but expect rapid plugging of disk. Do not use this method on plated surfaces, nor to metals left unpainted such as CRES or alclad aluminum. For these surfaces use solvent cleaning.

B. Equipment and Materials
(1) Drill motor or other suitable drive
(2) Abrasive disk, cloth, open coat, 150 grit
(a) Garnet Cloth - Federal Spec P-C-451 (AMM 20-30-04, Miscellaneous Materials)
(b) Aluminum Oxide Cloth - Federal Spec P-C-451 (AMM 20-30-04, Miscellaneous Materials)
(c) Disk mandrel of proper size (Fig. 701)

C. Clean with Abrasive Disk

CAUTION: DO NOT ALLOW PARTICLES FROM ABRASIVE TO CONTAMINATE MECHANISMS OR ELECTRICAL EQUIPMENT.

(1) Using a drill motor or other suitable drive, clean required spot diameter with an abrasive disk of proper size.
(a) Apply disk intermittently, with light pressure, keeping face of disk parallel to metal surface.
(b) Inspect results after each application and continue operation until required area is clean.

NOTE: Hold surface loss of metal to an absolute minimum.

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BRUSH OR DISK DIA.	PILOT DIA.	SHANK DIA.	WIRE SIZE (IN.) MAX	WIRE SIZE (IN.) MIN	BONDING BRUSHES OSBORN NO.	BONDING BRUSHES MORRIS NO.	BONDING BRUSHES MANUFACTURERS BRUSH CO.	BONDING BRUSHES BOEING ST NO.	DISK MANDRELS BOEING ST NO.
11/32	1/4	1/4	0.005	0.004				ST913K-34-24	ST913M-34-24
1/2	3/32	1/4	0.005	0.004	94-SV-37	P-31-SS	220-NN	ST913K-50-09	ST913M-50-09
1/2	1/8	1/4	0.005	0.004	94-SV-47	P-32-SS	221-NN	ST913K-50-12	ST913M-50-12
1/2	5/32	1/4	0.005	0.004	94-SV-48	P-33-SS	222-NN	ST913M-50-16	ST913M-50-16
1/2	3/16	1/4	0.005	0.004	94-SV-36	P-34-SS	223-NN	ST913M-50-19	ST913M-50-19
3/4	3/16	1/4	0.006	0.005		P-31-516-SS	224-NN	ST913M-75-19	ST913M-75-19
3/4	1/4	1/4	0.006	0.005		P-31-517-SS	225-NN	ST913K-75-25	ST913M-75-25
3/4	5/16	1/4	0.006	0.005		P-31-53-SS	226-NN	ST913K-75-31	ST913M-75-31
1.0	3/16	1/4	0.008	0.006		P-36-SS	227-NN	ST913K-100-19	ST913M-100-19
1.0	1/4	1/4	0.008	0.006		P-36-S1-SS	228-NN	ST913K-100-25	ST913M-100-25
1.0	5/16	1/4	0.008	0.006		P-36-S5-SS	229-NN	ST913K-100-31	ST913M-100-31

Rotary Bonding Brushes and Abrasive Disk Mandrels
Figure 701

EFFECTIVITY
ALL

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5. Removal of Paint with Lacquer Thinner

A. General

(1) This method is effective in removing primer or lacquer-based paint or enamel from clad aluminum or other metal surfaces. Do not use lye, alkaline paint remover or hydroxides for cleaning surfaces.

BONDING BRUSH COLOR CODE		
METAL	COLOR CODING	COLOR IDENTIFICATION
Aluminum	None	None
Ferritic	Blue	J7-42-5200
Magnesium	Green	J7-42-5700
Beryllium	Brown	J7-42-5400

B. Equipment and Materials

WARNING: SOLVENT MAY AFFECT SKIN, EYES AND RESPIRATORY TRACT. USE IN A WELL VENTILATED AREA. AVOID PROLONGED BREATHING OF VAPORS. AVOID EYE AND REPEATED SKIN CONTACT. KEEP AWAY FROM SPARKS AND FLAMES.

(1) Lacquer Thinner - Federal Spec TT-T-266 (AMM 20-30-41, Finishing Materials)
(2) Lint-free gauze sponges or clean cotton or linen cloth

C. Remove Paint with Lacquer Thinner

(1) Apply lacquer thinner to specified area using a clean cotton, linen or gauze applicator.
(2) Use an uncontaminated portion of applicator for each application, taking care to avoid overrun or spillage beyond desired limits of bond.

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(3) When designated area is completely clean, immediately wipe dry with clean cloth or gauze.

6. Solvent Cleaning of Bare, Clad or Plated Metal

A. General

(1) This method is effective for cleaning plated surfaces and unpainted CRES or alclad aluminum.

B. Equipment and Materials

(1) Nonmetallic brush or cloth applicator

(2) Lint-free gauze or cloth

(3) Solvent - BMS 3-2, type 1 (AMM 20-30-31)

C. Clean bare, clad or plated metal.

(1) Apply solvent to bonding surfaces with a nonmetallic brush or cloth applicator.

(2) Scrub as necessary to remove visible contamination.

(3) Immediately dry surfaces with a suitable lint-free gauze or cloth.

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BONDING JUMPERS AND GROUND LEADS - REMOVAL/INSTALLATION

1. General
   A. Refer to 20-20-00 Electrical Bonding and Grounding in the Standard Wiring Practice Manual; D6-54446.

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LOCKWIRE - REMOVAL/INSTALLATION

1. General
   A. This procedure describes the installation of safetying devices.
   B. In case of conflict between this procedure and specific maintenance procedures, the information in the specific procedure shall have precedence.
   C. Safety wire shall not be reused.
   D. Safety wire shall be applied in such a manner that the wire is put in tension when the parts tend to loosen.
   E. A 3 to 6 twist pigtail shall be made at the end of the wiring. Bend the pigtail back or under such that the wire ends are shielded and does not constitute a snag.
   F. Double-twist safety wire method is required for all safety wiring except as follows:
      (1) Single wire method is specified.
      (2) Single wire may be used for small screws in a closely spaced, closed pattern, such as a square or triangle.
      (3) Single wire may be used for parts in electrical systems where accessibility or frequent removal make the double-twist method impractical.
   G. Install and twist the safety wire so the loop around the head stays down (if loop tended to come up over the bolt head there would be a slack loop).
   H. For multiple fasteners spaced less than four inches apart, the maximum number which can be safety wired together shall be the number than can be wired with a 24-inch length of wire.
   I. For fasteners four to 6 inches apart, wire together in series no more than three fasteners.
   J. Where fasteners are more than 6 inches apart, do not tie them in series unless the tie points are provided on adjacent parts to shorten the wire span to less than 6 inches.
   K. Use a right-handed twist for all double-twist installations.
   L. Safety-wire diameter shall be between 1/3 and 3/4 of the hole diameter, 0.032-inch diameter minimum.
   M. Safety-wire 0.020 inch in diameter may be used if:
      (1) The safety-wire hole is 0.045 inch diameter or smaller, or
      (2) The spacing between parts is less than two inches and the safety-wire hole diameter is between 0.045 and 0.062 inch diameter.

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TWIST PER INCH					
Safety Wire Dia. Inch	Less Than 0.019	0.019 To 0.026	0.023 To 0.042	0.043 To 0.065	More Than 0.065
Twists/Inch	11 to 14	9 to 12	7 to 10	5 to 8	4 to 7

2. Equipment and Materials
   A. Safety Wire Material
      (1) Monel, inconel, or corrosion resistant safety wire shall be used in elevated temperature areas and on all fasteners except as noted in (2) and (3).
      (2) Annealed copper wire, 0.020 in. diameter, shall be used on emergency equipment.
      (3) Clad 5056 aluminum alloy wire shall be used for safety wire contacting magnesium to prevent galvanic corrosion.
   B. Safety Wire Size
      (1) Wire diameter shall be between 1/3 and 3/4 of hole diameter, except when using the single wire method. For single wire method, use the largest standard wire size which will fit in the hole.
      (2) The following table shows BAC standard wire sizes.

MATERIAL	SIZE (INCHES)				
Monel or Inconel	.020	.032	.040	.051	.091
Corrosion Resistant Steel	.020	.032	.041	.047	.091
Aluminum Alloy	.020	.032	.041	.047	.091
Copper, Annealed	.020				

3. Remove Safety Wire
   A. Cut and remove lockwire or remove pin.
4. Install Safety Wire
   A. Install lockwires on bolts and screws (Fig. 402).
      (1) Safety wiring for right-hand threads shall be installed as shown. Safety wiring for left-hand threads shall be opposite.
      (2) The loop of double wire shall pass around, not over, the head of the bolt or screw.

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(3) When safetying nuts and bolts, tighten to the low side of the selected torque range, and if necessary, continue tightening until a slot aligns with the safety hole.
(4) All fittings which require safety wiring shall be wired to the mating part or an adjacent member.

B. Install lockwire on emergency equipment (guarded switches, fire extinguishers, oxygen regulators, etc.).
(1) Use annealed copper wire.

CAUTION: THE USE OF ANY OTHER TYPE OF WIRE COULD INHIBIT USE OF THE EMERGENCY EQUIPMENT.

NOTE: The wire is intended to break readily when the emergency equipment is activated.

C. Install Cotter Pins (Fig. 402)
(1) For installation of cotter pins in castellated nuts, the pin shall be installed with the head parallel to the slot in the nut. Bend cotter pin ends to either bolt end or castellated nuts slit next to the pin end.
(2) Cotter pins and washers shall be installed on clevis pins by inserting the pin thru the hole on the bolt and bending the pin ends around the side of the bolt.
(3) For installation of cotter pins in non-castellated nuts, the pin shall be installed thru the hole on the bolt and bending the pin ends back on each side of the bolt approximately 90°.

D. Install Lockwire on Electrical Connectors (Fig. 403)

NOTE: The specification for the installation of lockwires to bolts and screws is also applicable to electrical connectors.

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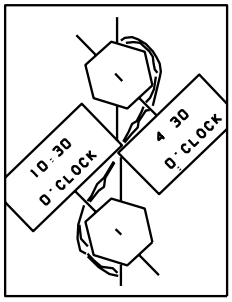
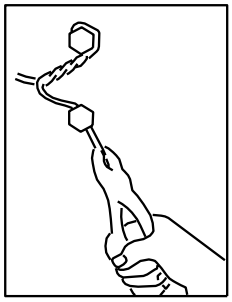
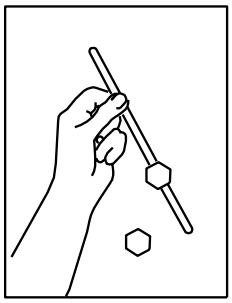


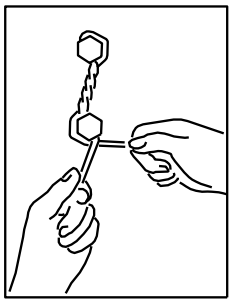
POSITION THE HOLES.



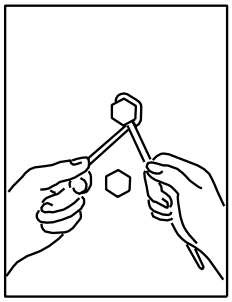
INSERT THE UPPERMOST LOCKWIRE, WHICH POINTS TOWARDS THE SECOND BOLT, THROUGH THE HOLE WHICH LIES BETWEEN THE NINE AND TWELVE O'CLOCK POSITIONS. GRASP THE END OF THE LOCKWIRE WITH A PAIR OF PLIERS AND PULL THE LOCKWIRE TIGHT.



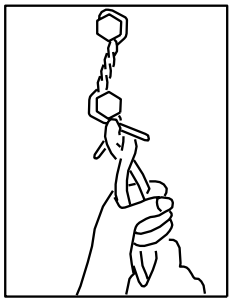
INSERT PROPER GAGE LOCKWIRE.



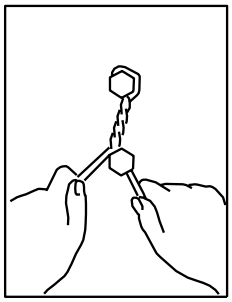
BRING THE FREE END OF THE LOCKWIRE AROUND THE BOLTHEAD IN A COUNTERCLOCKWISE DIRECTION AND UNDER THE END PROTRUDING FROM THE BOLT HOLE. TWIST THE LOCKWIRE IN A COUNTERCLOCKWISE DIRECTION.



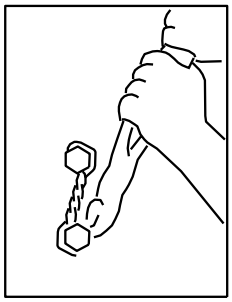
GRASP UPPER END OF THE LOCKWIRE AND BEND IT AROUND THE HEAD OF THE BOLT, THEN UNDER THE OTHER END OF THE LOCKWIRE. BE SURE LOCKWIRE IS TIGHT AROUND HEAD.



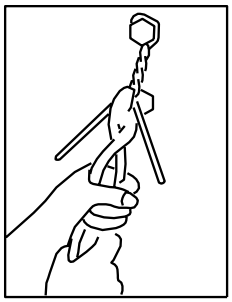
GRASP THE LOCKWIRE BEYOND THE TWISTED PORTION AND TWIST THE LOCKWIRE ENDS COUNTER-CLOCKWISE UNTIL TIGHT.



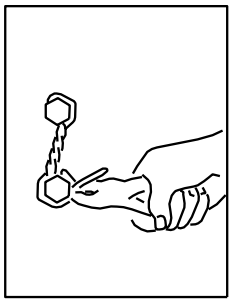
TWIST LOCKWIRE UNTIL LOCKWIRE IS JUST SHORT OF HOLE IN THE SECOND BOLT.



DURING THE FINAL TWISTING MOTION OF THE PLIERS, BEND THE LOCKWIRE DOWN AND UNDER THE HEAD OF THE BOLT.



KEEPING LOCKWIRE UNDER TENSION, TWIST IN A CLOCKWISE DIRECTION UNTIL THE LOCKWIRE IS TIGHT. WHEN TIGHTENED THE WIRE SHALL HAVE APPROXIMATELY 7-10 TWISTS PER INCH.



CUT OFF EXCESS LOCKWIRE WITH DIAGONAL CUTTERS.

Basic Lockwiring Procedure
Figure 401

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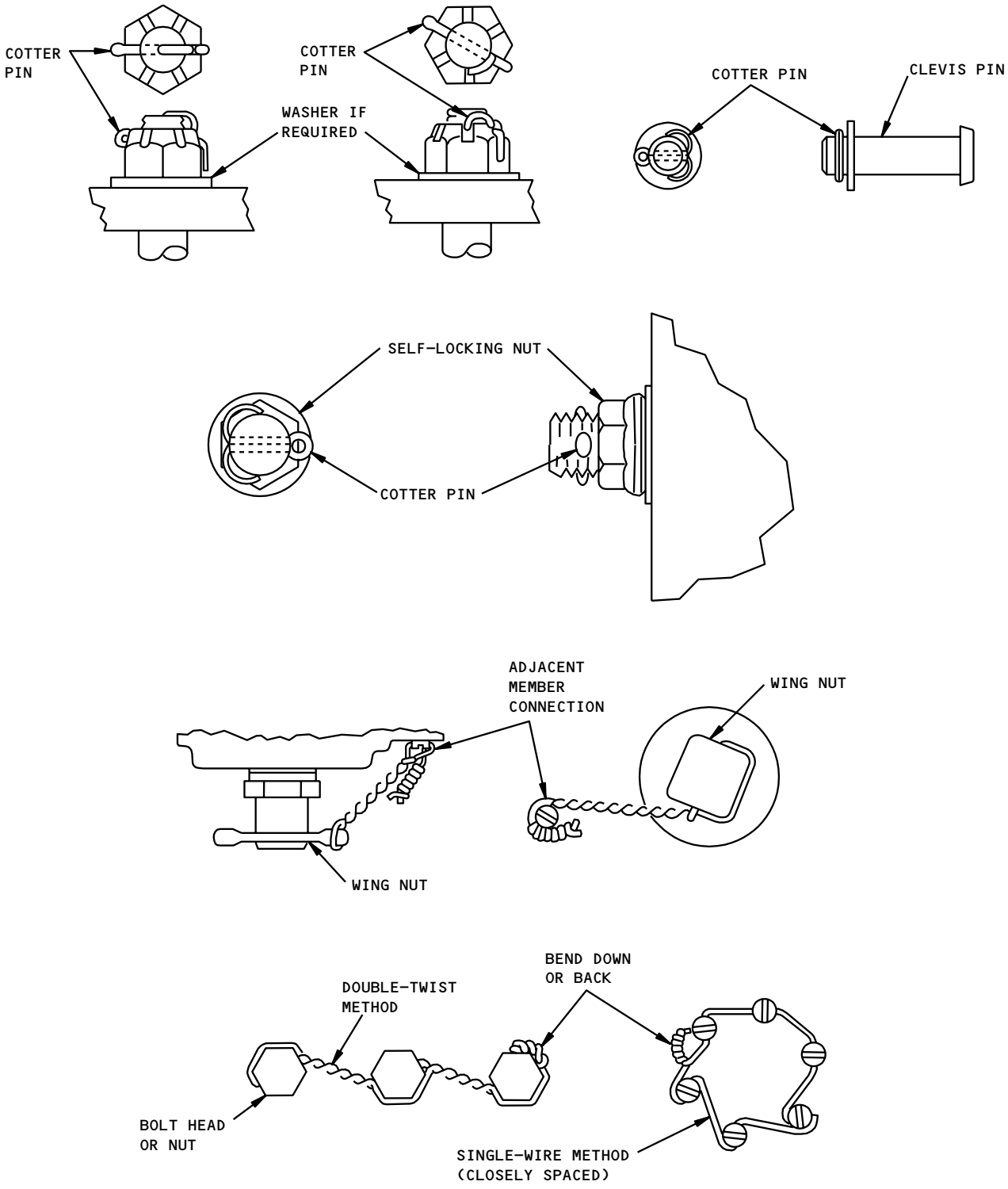

Lockwire/Pin - Installation
Figure 402

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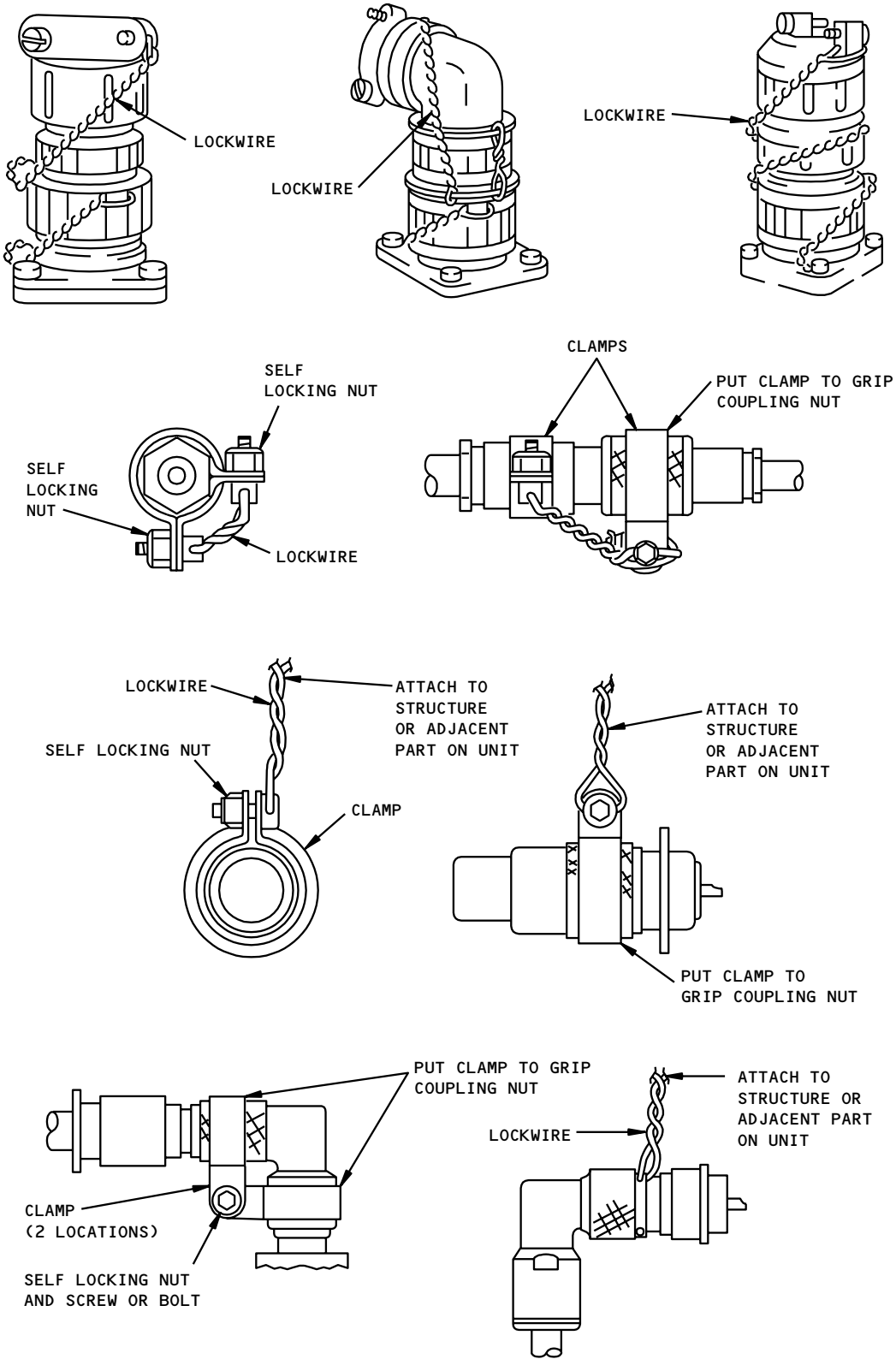

Connector Lockwire - Installation
Figure 403

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SELF-LUBRICATED BEARINGS AND BUSHINGS - INSPECTION/CHECK

1. General
   A. The examination of self-lubricated (teflon - cloth lined) bearings and bushings may be made while either installed on the airplane or removed for bench check. The preferred method is the bench check, since this would include a thorough examination to determine if the bearing shows signs of damage due to corrosion or cracks and also allows for torque measurement of the bearing inner race. The inspection/check procedure of self-lubricated bearings and bushings has been divided into three areas. The first, is inspection/check methods applicable to bearings and bushings. The second, covers inspection/check of special bearing and bushing configurations. The third, is bench check methods of inspection/check procedures applicable to all self-lubricated bearings and bushings.
2. Inspection/Check Self-Lubricated Bearings and Bushings
   A. Check Self-Lubricated Bearings and Bushings (Installed on Airplane).
      (1) Bearings or bushings should be checked for wear and excessive looseness by rocking the installation and observing and feeling the amount of looseness, security of bearing retention in its housing, signs of rotation in its housing, signs or corrosion, cracks or physical damage on either bearing or housing.

          NOTE: 0.010 inch internal diametrical play is cause for close visual inspection of bearings or bushings. Any evidence of galling of bearing surfaces or extrusion of liner or backing from bearing surfaces is cause for rejection. If play exists, but the above conditions are not found, then the item should be inspected for the adverse condition as outlined at each maintenance inspection. Unlike an all-metal bearing a knocking noise will not accompany bearing internal looseness.

      (2) In installations where bearing rotation is possible, or in instances where bolts are removed to permit rotation, bearings should be rotated manually, first unloaded, then with a manual load, for signs of roughness, abnormal looseness, abnormal drag (over and above normal preload drag), or nonuniform drag.

          NOTE: If the liner is accessible for examination after bolt removal, refer to bench check procedures for examining the liner material.

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(3) Bearings or bushings should be visually examined for signs of extruding liner material.

CAUTION: DO NOT LUBRICATE TEFLON BEARINGS. THEY ARE SELF-LUBRICATED AND USE OF GREASE OR OTHER LUBRICANTS MAY RESULT IN LINER DETERIORATION.

NOTE: Extruded material should not be confused with the ragged edge which may exist and is normal on bearings and bushings of certain manufacture.

B. Check Self-Lubricated Bearings and Bushings (Bench Check)

(1) Examine bearing or bushing for physical damage, cracks, corrosion, and for signs of rotation or fretting on both the bearing bore and outside diameter.

NOTE: If signs of rotation exist, the physical dimensions of the bearing or bushing should be measured to ensure that wear is not beyond tolerances.

(2) Manually rotate bearings and check for signs of roughness, abnormal looseness, abnormal drag (over and above normal preload drag), or nonuniform drag.

CAUTION: DO NOT LUBRICATE TEFLON BEARINGS. THEY ARE SELF-LUBRICATED AND USE OF GREASE OR OTHER LUBRICANTS MAY RESULT IN LINER DETERIORATION.

(3) Check condition of bearing liner.

(a) Examine liner for wear.

1) Normally, wear which results in an internal diametrical looseness of 0.010 inch is sufficient reason to reject the bearing for reuse. However, service experience coupled with allowable wear limits for specific applications should be used to establish reusability criteria.

NOTE: Inspection can be made of most spherical bearing configurations by rotating the ball to expose the liner for observation through the bearing bore.

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(b) Examine liner load pattern.
1) Examine liner and ball contact for uniform load distribution. Improper swaging during manufacture or installation can result in localized wear at the edges of liner. Bearings exhibiting this condition should normally be rejected for reuse.
(c) Examine liner for foreign material.
1) Examine liner to make sure that no foreign material has become embedded in it.
(d) Examine liner for chemical deterioration.
1) Examine liner and liner bond for any signs of chemical attack which might result from inadvertent exposure to some noncompatible chemical compound.
(4) Examine and check bearings and bushings.

3. Inspection/Check Special Bearing and Bushing Configurations
A. Check Special Bearing and Bushing Configurations
(1) Aluminum bearing races should be examined for integrity of surface treatment or plating, corrosion, and for cracks.
(2) Special configuration bearings having threads, holes, keyways, flanges, or similar items which might act as local stress risers should receive careful examination for cracks in these areas.
(3) Examine and check bearings and bushings.

4. Inspection/Check Bushings and Bearings (Bench Check)
A. General
(1) Before the following inspection/check procedures are accomplished, the procedures outlined above should be accomplished.
B. Check Bearing for Wear
(1) To determine the amount of bearing wear manually apply a reversing load to the bearing in a simple holding fixture and measure play with a dial indicator. First radial wear should be measured by applying a reversing radial load of ten to fifteen pounds and total diametrical play measured. A reversing load of the same magnitude should then be applied in an axial (thrust) direction and axial play measured.

NOTE: When measuring play in the radial direction, several points should be checked by rotating the outer race relative to the inner race to establish the point where maximum play exists before attempting to make an accurate wear reading.

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C. Check Bearing Breakaway Torque

(1) Breakaway preload torque checks are made by measuring the torque required to rotate one race with the other race fixed. The bearing must be free of lubricants or any other contaminants. Breakaway torque shall not exceed twice the allowable rotational preload torque (Table 601).

NOTE: Breakaway torque must be measured prior to conducting rotational torque checks. Test should be done at room temperature.

D. Check Bearing Rotational Torque

(1) Rotational preload torque checks are made by measuring the torque required to rotate one race with the other race fixed. The bearing must be free of lubricants or any other contaminants. See Table 601 for allowable rotational preload torque values.

NOTE: Breakaway torque must be measured prior to conducting rotational torque checks. For rotational torque tests the bearing must be oscillated through two or three revolutions immediately prior to measuring the torque. Tests should be done at room temperature.

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Bearing Allowable Limits for Rotationl Preload Torque Table 601					
SELF-LUBRICATED SPHERICAL BEARINGS					
Part Number	Bearing ID	Torque Lb-In.	Part Number	Bearing ID	Torque Lb-In.
10-60545-1000	.2500	1 to 5	10-60545-125	2.0000	20 to 60
10-60545-101	0.3125	1 to 5	10-60545-126	3.0000	20 to 60
10-60545-102	0.3750	1 to 5	10-60545-127	1.0000	2 to 6
10-60545-103	0.4375	1 to 5	10-60545-128	1.7190	20 to 60
10-60545-104	0.5000	1 to 5	10-60545-129	1.7190	20 to 60
10-60545-105	0.5625	1 to 5	10-60545-130	0.7500	2 to 6
10-60545-106	0.6250	1 to 5	10-60545-134	1.3765	20 to 60
10-60545-107	0.7500	1 to 5	10-60545	-1.3745	
10-60545-108	0.8750	2 to 6	10-60545-135	0.7500	1 to 5
10-60545-109	1.0000	2 to 6	10-60545-136	0.2500	1 to 8
10-60545-110	0.1900	5 to 15	10-60545-137	1.2500	20 to 60
10-60545-122	0.2500	3 to 9	10-60545-138	2.5003	40 to 80
10-60545-123	0.7500	40 to 80	10-60545	2.4994	
10-60545-124	1.2500	20 to 60	10-60545-143	3.5000	20 to 60
	1.2508		10-60545-144	0.5000	1 to 5

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Bearing Allowable Limits for Rotationl Preload Torque
Table 601

SELF-LUBRICATED SPHERICAL BEARINGS					
Part Number	Bearing ID	Torque Lb-In.	Part Number	Bearing ID	Torque Lb-In.
SELF-LUBRICATED SPHERICAL BEARINGS (EXTERNAL STAKING)					
Part Number	Bearing ID	Torque Lb-In.	Part Number	Bearing ID	Torque Lb-In.
10-60545-111S	0.2500	1 to 3	10-60545-119S	0.8750	1 to 5
10-60545-112S	0.3125	1 to 3	10-60545-120S	1.0000	2 to 10
10-60545-113S	0.3750	1 to 3	10-60545-121S	2.5000	20 to 60
10-60545-114S	0.4375	1 to 3	10-60545-140S	0.5000	1 to 7
10-60545-115S	0.5000	1 to 5	10-60545-141S	0.5625	1 to 7
10-60545-116S	0.5625	1 to 5	10-60545-142S	0.3125	1 to 7
10-60545-117S	0.6250	1 to 5	10-60545-200S	0.5000	1 to 5
10-60545-118S	0.7500	1 to 5	10-60545-201S	0.6250	1 to 5
			10-60545-202S	0.2500	1 to 5
			10-60545-203S	0.3750	1 to 3
SELF-LUBRICATED ROD END BEARINGS					
Part Number	Bearing ID	Torque Lb-In.	Part Number	Bearing ID	Torque Lb-In.

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Bearing Allowable Limits for Rotationl Preload Torque Table 601					
SELF-LUBRICATED SPHERICAL BEARINGS					
Part Number	Bearing ID	Torque Lb-In.	Part Number	Bearing ID	Torque Lb-In.
10-60779-1	0.2500	1 to 8	10-60779-160	0.4375	1 to 8
10-60779-2	0.3125	1 to 8	10-60779-161	0.5000	1 to 8
10-60779-3	0.2500	1 to 7	10-60779-162	0.6250	1 to 8
10-60779-100	0.1230	1 to 8	10-60779-163	0.7500	1 to 8
10-60779-101	0.1900	1 to 8	10-60779-164	0.3140	1 to 8
10-60779-102	0.2500	1 to 8		0.3120	
10-60779-103	0.3125	1 to 8	10-60779-165	0.6250	1 to 8
10-60779-104	0.3750	1 to 8	10-60779-166	0.3125	1 to 8
10-60779-105	0.4375	1 to 8	10-60779-167	0.3750	3 to 13
10-60779-106	0.5000	1 to 8	10-60779-168	0.5000	1 to 8
10-60779-107	0.6250	1 to 8	10-60779-169	0.2500	1 MAX
10-60779-108	0.7500	1 to 8	10-60779-170	0.2500	1 MAX
10-60779-109	0.8750	1 to 8	10-60779-171	0.3750	1 to 8
10-60779-110	1.0000	1 to 8	10-60779-172	0.3125	1 to 8
10-60779-111	1.2500	1 to 8	10-60779-200	0.1900	1 to 8
10-60779-112	0.3125	1 to 6	10-60779-201	0.2500	1 to 8
10-60779-113	0.1900	1 to 8	10-60779-202	0.3125	1 to 8
10-60779-117	0.5000	1 to 8	10-60779-203	0.3750	1 to 8
10-60779-118	0.2500	1 to 8	10-60779-204	0.4375	1 to 8

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Bearing Allowable Limits for Rotationl Preload Torque Table 601					
SELF-LUBRICATED SPHERICAL BEARINGS					
Part Number	Bearing ID	Torque Lb-In.	Part Number	Bearing ID	Torque Lb-In.
10-60779-119	0.2500	1 to 8	10-60779-205	0.5000	1 to 8
10-60779-120	0.3125	1 to 8	10-60779-206	0.6250	1 to 8
10-60779-121	0.3715	1 to 8	10-60779-207	0.7500	1 to 8
10-60779-122	0.2500	1 to 7	10-60779-208	0.1900	1 to 7
10-60779-150	0.2500	1 to 9	10-60779-209	0.2500	1 to 7
10-60779-151	0.2500	1 to 9	10-60779-210	0.3125	2 to 10
10-60779-152	0.3750	3 to 13	10-60779-211	0.3150	2 to 10
10-60779-153	0.4375	3 to 13	10-60779-212	0.4375	3 to 13
10-60779-154	0.4375	3 to 13	10-60779-213	0.5000	3 to 13
10-60779-155	0.6250	4 to 16	10-60779-214	0.6250	3 to 13
10-60779-156	0.7500	5 to 19	10-60779-215	0.7500	4 to 16
10-60779-157	0.2500	1 to 8	10-60779-216	0.3120	1 to 8
10-60779-158	0.3125	1 to 8	10-60779-217	0.2500	1 to 7
10-60779-159	0.3750	1 to 8	10-60779-301	0.2500	1 to 6

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CONTROL CABLES - INSPECTION/CHECK

1. General
   A. There are two procedures given for the inspection of a control cable. The procedure to "Examine the Control Cable for Broken Wires" is recommended. The procedure to "Examine the Control Cable for Wear" is optional.
   B. Control cables are made from strands of wire. Wires are twisted into strands, and the strands are twisted into cables.
   C. Control cables are identified by a two-number code. The first number is the number of strands of wires in the cable. The second number is the number of wires in each strand. For example, a 7X19 cable has 7 strands, and each strand has 19 wires. The more strands a cable has, the more flexible it is.
   D. The cables that follow have special procedures for inspection. Examine these cables with the referenced procedure.
      (1) Engine Thrust Cables (Ref 76-11-21 I/C)
2. Clean the Control Cable

   CAUTION: DO NOT USE SOLVENTS (FOR EXAMPLE, VAPOR DEGREASING SOLVENT, STEAM CLEANING SOLVENT, AND METHYL ETHYL KETONE) TO CLEAN THE CABLE. SOLVENTS WILL REMOVE THE CABLE INTERNAL LUBRICANT, WHICH WILL CAUSE CORROSION AND RAPID WEAR.

   A. Clean the airplane control cable with a dry, clean cloth. Do not use solvents or abrasive materials to clean the control cable.
   B. If necessary, apply applicable grease to carbon steel cables per Chapter 12, Servicing.

      NOTE: Do not put grease on corrosion resistant steel cables.

3. Examine the Control Cable for Broken Wires
   A. To examine a control cable for broken wires, rub a cloth along the length of the cable. Broken wires are indicated where the cloth gets caught on the cable.

      NOTE: Wires usually break where cables go through fairleads or around pulleys. Examine these areas carefully paying special attention to cable runs outside the pressurized areas. Use a flashlight and mirror to aid inspection in hard to see places. Replace cables with evidence of corrosion.

   B. Replace a 7X7 control cable when one of these conditions is found:
      (1) Two wires are broken in 12 continuous inches of cable.
      (2) More than three wires are broken in the total cable length between the two cable terminals.

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(3) One wire is broken on a corroded cable.

C. Replace a 7X19 control cable when one of these conditions is found.
(1) Four wires are broken in 12 continuous inches of cable.
(2) More than six wires are broken in the total cable length between the two cable terminals.
(3) One wire is broken on a corroded cable.

4. Examine the Control Cable for Wear (Fig. 601)
A. External Wear
(1) For cables in the pressurized area (fuselage cables), replace a cable if one strand has worn wires where one wire cross section is decreased by 40 percent or more.
(2) For cables not in the pressurized area, replace a worn cable where you cannot identify the wire strands on the worn side.
(3) Replace all cable assemblies which have damage caused by rust or corrosion.
(4) It is necessary at all times to clean/lubricate control cables at pressure seals fairleads, pulleys and drums.

5. Lubricate the Cables
A. If you removed the lubricant, lubricate the cables per Chapter 12, Servicing.

6. Examine the Pulleys (Fig. 602)
A. Visually examine the pulley for sharp edges and unwanted material in the grooves.
B. Visually examine the pulley wear pattern.
C. Check the pulley for wobble. Push on the outer edge of the pulley with a two-pound force. Make sure the movement of the outer edge is not more than the movement that follows:
(1) 0.10 inch for 8-inch diameter pulleys
(2) 0.09 inch for 6-inch diameter pulleys
(3) 0.08 inch for 5-inch diameter pulleys
(4) 0.07 inch for 4-inch diameter pulleys
(5) 0.06 inch for 3-inch diameter pulleys
D. Make sure the pulley bearings are correctly lubricated, turn smoothly, and do not have flat spots.
E. Examine the pulley bolts for wear.
F. Replace the pulley when one of these conditions is found:
(1) Unusual wear pattern
(2) Too much wobble
(3) Failure to turn freely and smoothly

7. Examine the Pulley Bracket
A. Look for cracks and other damage on the pulley bracket and on the support structure near the bracket.
B. Replace the damaged bracket on repair structure as needed.

8. Cable Travel Inspection
A. Make sure the cable guides and fairleads are clean and correctly aligned.

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B. Make sure the cable guides, fairleads, rubstrips, and grommets are not worn or broken.
C. The minimum cable clearance from other parts is 0.20 inches, except 0.10 inches within 10.00 inches of a pulley or quadrant
D. Make sure the control cables are not held away from the correct position by cable guides, fairleads, rub strips, or grommets.

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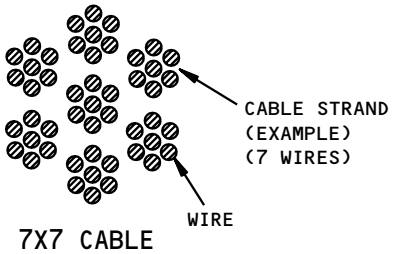
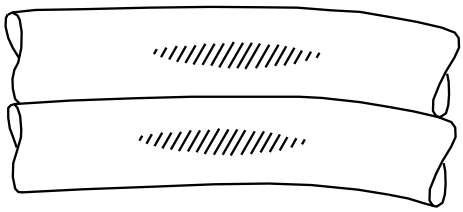
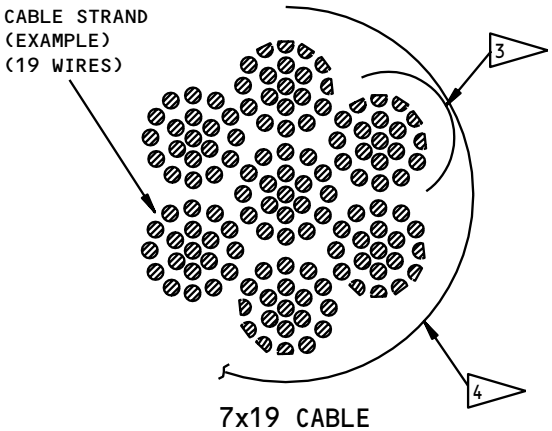


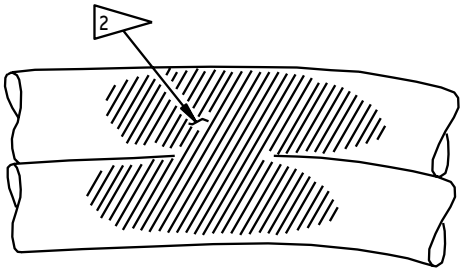
7X7 CABLE



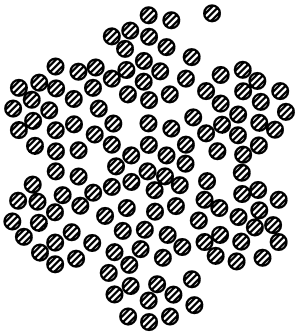
EACH OUTER WIRE WORN
LESS THAN 40%
(WORN AREAS NOT BLENDED)



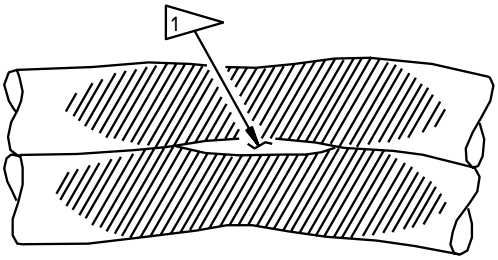
7x19 CABLE



EACH OUTER WIRE WORN 40–50%
(WORN AREAS ARE BLENDED)



EXAMPLE OF INTERNAL WEAR



EACH WIRE IS WORN MORE THAN 50%

1. VISIBLE SPACE BETWEEN WIRES.
2. WEAR CONDITION RESULTING IN BLENDED SURFACES BETWEEN WIRES.
3. THE OUTER WIRE WEAR AREA ON CABLE STRAND. A VISIBLE SPACE BETWEEN WIRES 1 OR A FULLY BLENDED SURFACE 2 SURFACE OVER APPROXIMATELY SIX WIRES INDICATES 50 PERCENT WIRE WEAR.
4. CABLE WEAR MAY OCCUR ON ONE SIDE ONLY OR ON FULL CIRCUMFERENCE. CABLE WEAR CAN EXTEND ALONG THE CABLE FOR A DISTANCE EQUAL TO USUAL CABLE TRAVEL.

Cable Wear Patterns
Figure 601

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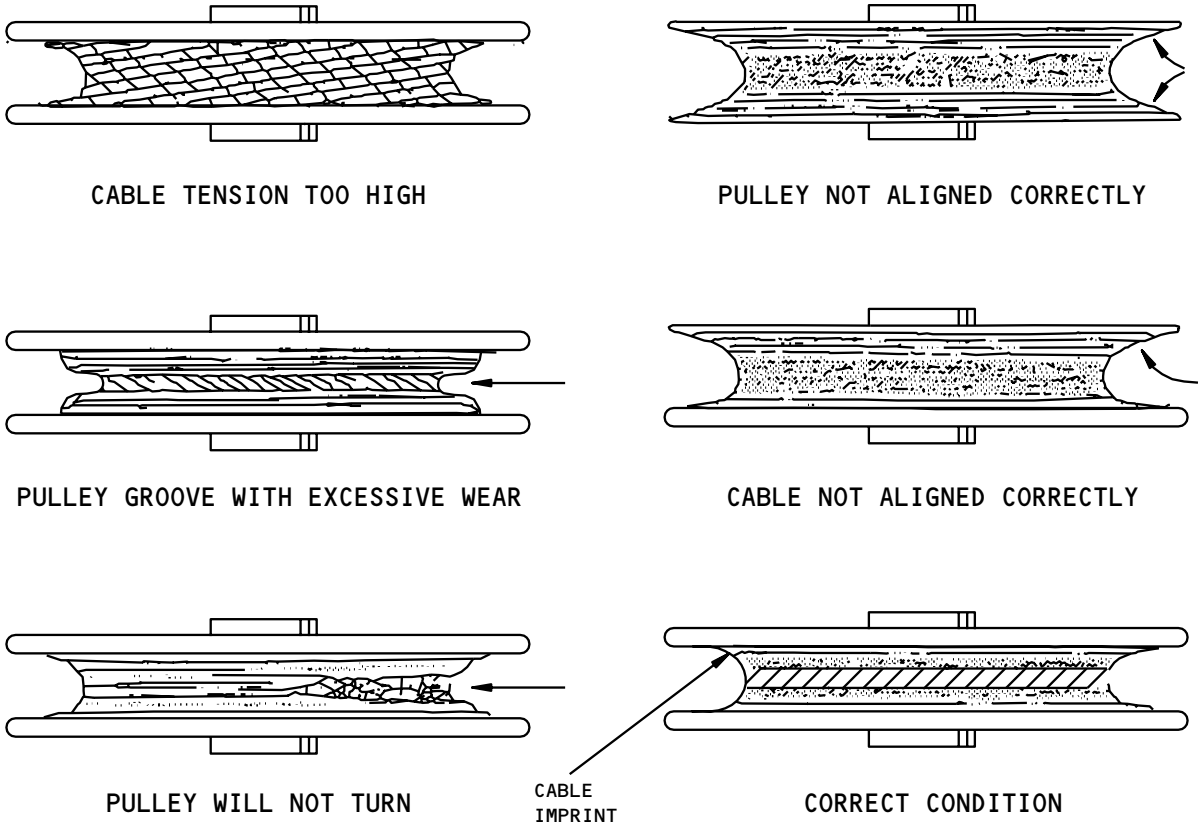

Pulley Wear Patterns
Figure 602

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ELECTRICAL BONDING - INSPECTION/CHECK

1. General
   A. Refer to 20-20-00 Electrical Bonding and Grounding in the Standard Wiring Practice Manual; D6-54446.

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SEALANTS AND SEALING MATERIALS

1. General
   A. The following is a list of adhesives, cements, and sealants that could be required during regular maintenance of the airplane. Listing is by material and grouped according to type and/or use. Acceptable vendors and/or material specifications and/or Boeing process specifications are included as an aid in obtaining the required material.
   B. The specific usage and/or alternatives of any material are controlled by the applicable maintenance procedure. This listing provides a convenient list of materials listed in the maintenance procedures and does not provide authorization for material substitution. Refer to the applicable maintenance procedure for the proper material to be used.
   C. Materials other than those listed can be tested using the procedures in Boeing document D6-17487, Evaluation of Airplane Maintenance Materials to verify that any substitute material will not be injurious to airplane surfaces when used as specified by the manufacturer.
   D. D6-7127, Cleaning Interiors of Commercial Transport Aircraft, outlines methods of evaluation for materials to be used in cleaning of Boeing commercial aircraft interiors. It contains materials and processes as a guideline for cleaning during general maintenance.
   E. Using the vendor code, determine the vendor by using one of the following sources:
      (1) The introduction of the Illustrated Parts Catalog which lists vendor codes, company names, and addresses. The vendor codes are listed in alphabetical order and also in numerical order.
      (2) U.S. government catalog and handbook number H4/H8.

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
ADHESIVES				
		A-4000 with Catalyst Y-27 Primer A4014, 1200 RTV, S-2260	71984	
Adhesive, Bearings and Bushings	BMS 5-92 Types I,III	Adhesive, Modified Epoxy for Rigid PVC Foam Cored Sandwiches		
Adhesive, Door Seal Installation		EC-4475	76381	
Adhesive, Epoxy	BMS 5-123	ATACS 4103 EPOXY-PATCH 608	61426 04347	
	BMS 5-125	Self Leveling Compound for Fluid Drainage		
	Type II	PR 1440 L/S A/B Compounds	0NYS9	
	Type III	PL 422 FR Compound	03481	
Adhesive		Dow Corning FS3452 DC 340 DC 3145 DC Silastic 732 Loctite 675 Loctite 290 Loctite Rc/680 Loctite Grade T RTV 3145 RTV 133 RTV 162 RTV109	71984 71984 71984 71984 2A052 2A052 2A052 2A052 71984 01139 01139	
	MIL-R-46082	Retaining Compound		

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Adhesive, Epoxy Polymide	BMS 5-126 Types 2,3, 5,6	Adhesive, Epoxy Polyamide (2 component)	*[1]	
	BMS 5-127	Interior Decorative Laminate Bonding		
	Type I Type II	3M EC4927	76381	
	Class I	Bostik 74764 Boscodur 24 Catalyst	13932 13932	
	Class II Class II	Bostik 7132 Boscudor 24 Catalyst	13932 13932	
Adhesive, Film (Placards)	BMS 5-91 (MIL-P-19834)	Pressure Sensitive File Adhesive for Interior Non-Structured Bonding	*[1]	
Adhesive, Bearings and Bushings		Epon 913 or 913-1 R/B Preferred EA913 or EA913.1	22893 12405	
Adhesive (Floor Mat)		EP45 Girder Process Division United Shoe Machinery Corp. Carlton Hill, NJ		
Adhesive, General		DC 93-007		
		Silastic 140 with Primer 1200 RTV, S-2260	71984	
		Silastic 731 RTV with Primer 1200 RTV, S-2260	71984	
		SR 529 with Catalyst SRC-18 Primer 1200 RTV, S-2260	01139 71984	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Adhesive, General		Magna 8-W-C- Surfacer Magna 50-C-3 Hardener Magna 10-C-32 Hardener Magna 66-C-28 Reducer	98795	
		D-253	03938	
		Churchill 3C-90	04011	
Adhesive, General		Permabond 910	61078	
		Epocast 502 with Hardener HN 951	99384	
		Epocast 571 with Hardener 973	99384	
		Epocast 8543	99384	
		Epon 901, 933	22893	
Adhesive, General		H-1070-3-1		
		GACO N-15	09463	
		RTV 109	24451	
		RTV 3145	71984	
Adhesive, General		Pro-Seal 501, 898	83527	
		DC30-121 (Superseded by RTV 174)		
		RTV 102,108,157,174	24451	
	BAC5010 Type 60	DC Q3-7063	71984	
	BAC5010 Type 60	RTV 174 RTV 102 DCQ3-7063	01139 01139 71984	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
	BAC5010 Type 68	93-076 Base 93-076-2 Catalyst DC 1204 Primer	71984 71984 71984	
	Type 72	Bostik 7132 Adhesive Boscodur 24T Catalyst	70707 70707	
Adhesive, General	MIL-A-25457	Adhesive, Air Drying, Silicone Rubber	*[2]	
	BAC5010 Type 77	GE SR-529/SR-18	89954	
		PS-18	95696	
		3M No. 77	76381	
		Scotchcast No. 7126	76381	
	BAC5010 Type 84	RTV 730, D.D. Rubber Cement	71984	
	BMS 592 Type 1	Adhesive Epoxy	*[1]	
	BMS 5-92 Type I or Type III	EC2216 Gray (Part A) EC2216 White (Part B) EA9330 (Part A) EA9330 (Part B)		
	BAC5010 Type 98	RTV 133		
Adhesive, Lightning Strips	BMS 5-19 Class B	Pressure, Weather and Fuel Clarity Sealant	*[1]	
		Bostik 1074 (Replaced by BMS 5-7)	10932	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Adhesive, Neoprene Base	BMS 5-7	Deicing Boot Adhesive, Neoprene Base	*[1]	
Adhesive, Mylar and Nylon	BMS 5-31	Adhesive for Mylar and Nylon	*[1]	
CEMENTS				
Cements, General		EC-873	76381	
		Bostik 4040	21361	
		A-56-B and #4	25472	
		A-68-B with Accelerator A-53-B	25472	
		EC-2126B (Base) EC-2116A (Accelerator)	04963	
	MIL-A-5092 (Superceded by MM-A-1617)	Adhesive, Rubber Base, General Purpose	*[2]	
Cement, Synthetic	BMS 5-14	Cement - Synthetic Rubber Buna N	*[1]	
Rubber Cement, Synthetic Rubber (Low Odor)	BMS 5-30	ED-1458	76381	
		Bostik 4145	70707	
Cement, Synthetic Rubber (Naphtha Soluble)	BMS 5-55	Cement - Synthetic Rubber Naphtha Soluble	*[1]	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
COMPOUNDS				
Compound, Conductive (Window Heat Switches		Marco Resin MR28C Accelerator "E" Catalyst MCI	90614	
		Albron 408 Aluminum Powder, Alcoa Aluminum, Pittsburgh, PA		
Compound, Electrical Insulating	BMS 5-37 (MIL-S-8784)	Coating Compound, Electrical Insulating	*[1]	
Compound, Fairing		Tereco 151.175	17359	
Compound Window Fairing		EC-3587-1/4 and EC-3587-1	55203	
Compound, Filler		8-W-5	98795	
Compound, Hole Filling (two part)	BMS 5-16 (MIL-S-8802 or MIL-S-81733)	Two Part Hole Filling Compound	*[1]	
Compound, Leveling		EPON 815 (Adhesive) use with Curing Agent "T"	22893	
	BMS 5-28 (Superseded by BMS 5-95) (Ref SEALANTS)		*[1]	
Compound, Pin Hole Filling		28-C-1	98795	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Compound, Silicone		DC 5	71984	
Electrical Insulating		GE 162	24451	
SEALANTS				
Sealant - Pressure and Environmental	GMS 5-12 (Superseded by BMS 5-95)	Pro-Seal 860, 870	83574	
		PR 1436G	83574	
		GC-414	04011 *[1]	
Sealant - Polysulfide		PR1425	83574	
Sealant (Electrical Wiring Repair Fuel Cells)		Nycote	05803	
		PR9021, B-4	83574	
Sealant - Pressure and Environmental Chromate Type	BMS 5-95	PR1432GP, PR1436G E-2, Pro-Seal 870 B-2, 870 B-1/2, 870 C-20, 870 C-20, 870 C-80, 870 C-168, 870 C-336, 870 Sprayable-168	83574 83574 83574 83574 83574 83574	
Sealant - Locking	MIL-S-22473	Sealing, Locking and Retaining		
Sealant		Flexane-80 R.S. Huges Co. Inc. 6530 5th Pl. So. Seattle, WA 98108		

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Sealant - Conductive	BMS 5-35	Electrical Conductive Sealant	*[1]	
Sealant, Firewall	BMS 5-22 (MIL-S-38249)	Firewall Sealant	*[1]	
Sealant, Skydrol Resistant	BMS 5-63 Class B (MIL-S-38249)	Firewall Sealant - Hydraulic Fluid Resistant	*[1]	
Sealant, Quick Repair		DC 30-079 DC 93-076-1/2 DC 93-076-2 Primer 1204	71984	
	MIL-A-46106	Adhesive-Sealant, Silicone, Room Temperature Vulcanizing	*[2]	
Sealant, Topcoat	MIL-S-4383	Sealing compound, Topcoat, Fuel Tank, Buna-N Type	*[2]	
Sealant, (Thrust Reverser Proximity Switches)		90-006-2	71984	
Sealant, Pressure, Weather and Fuel Cavity	BMS 5-19 (MIL-S-8802) Superseded by BMS 5-26	Pressure, Weather and Fuel Cavity Sealant	*[1]	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Sealant, Pressure and Weather	BMS 5-32 (MIL-S-8802) Superseded by BMS 5-26 and BMS 5-95	Pressure, Weather and Fuel Cavity Sealant, Low Density	*[1]	
Sealant, Fuel, Pressure and Temp Resistant	BMS 5-44 (MIL-S-8802)	Temperature Resistant, Fuel Pressure and Weather Sealant	*[1]	
Sealant, Integral Fuel Tank	BMS 5-26 Type II	Integral Fuel Tank Sealant	*[1]	
		PR 1440	99891	
		Pro-Seal 890	99891	
Sealant, High Temp	BMS 5-18 (MIL-S-8802)	High Temperature Sealant	*[1]	
Sealant, Secondary Fuel Barrier	BMS 5-81	Sealant, Secondary Fuel Barrier	*[1]	
Sealant	BMS 5-26 Type I	PR1422	99891	
Sealant, Temperature Resistant	MIL-S-8802 or MIL-S-81733	PR1422-B2	99891	

*[1] Refer to Boeing Material Specification manuals for approved material part numbers and vendors.
*[2] Refer to the applicable Qualified Procurement List for the military specification listed for the approved material part number and vendors.

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LUBRICANTS - MAINTENANCE PRACTICES

1. General
   A. The following is a list of lubricants that could be required during regular maintenance of the airplane. Listing is by material and grouped according to type and/or use. Acceptable vendors and/or material specifications and/or Boeing process specifications are included as an aid in obtaining the required material.
   B. The specific usage and/or alternatives of any material are controlled by the applicable maintenance procedure. This listing provides a convenient list of materials listed in the maintenance procedures and does not provide authorization for material substitution. Refer to the applicable maintenance procedure for the proper material to be used.
   C. Materials other than those listed can be tested using the procedures in Boeing document D6-17487, Evaluation of Airplane Maintenance Materials to verify that any substitute material will not be injurious to airplane surfaces when used as specified by the manufacturer.
   D. D6-7127, Cleaning Interiors of Commercial Transport Aircraft, outlines methods of evaluation for materials to be used in cleaning of Boeing commercial aircraft interiors. It contains materials and processes as a guideline for cleaning during general maintenance.
   E. Using the vendor code, determine the vendor by using one of the following sources:
      (1) The introduction of the Illustrated Parts Catalog which lists vendor codes, company names, and addresses. The vendor codes are listed in alphabetical order and also in numerical order.
      (2) U.S. government catalog and handbook number H4/H8.

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
ANTICORROSION				
Corrosion Preventive Compound	MIL-C-8188 Grade A	Corrosion Preventive Oil Gas Turbine Engine, Synthetic Base	*[2]	
	MIL-C-11796 (Class 2 & 3) or MIL-C-16173 (Grade 2 & 3)	Corrosion Preventive Compound Petroleum Corrosion Preventive Compound Solvent Cutback	*[2] *[2]	
Corrosion Inhibiting Compound	BMS 3-23	Corrosion Inhibiting Compound-Organic	*[1]	
	MIL-G-25537 or BMS 3-38	Corrosion Preventive Compound Solvent		
Corrosion Inhibiting Compound	BMS 3-29	Advanced Organic Corrosion Inhibiting Compound	*[1]	
Corrosion Inhibiting Nondrying Resin Mix	BMS 3-27	Mastinnox 6856K	F1419	
ANTISEIZE				
Antiseize Compound		G-661	01139	
Antiseize Compound	TT-A-580/ AMS 3080	Packaging Commodities, 1214 Poplar Place S., Seattle, Wash., 98144	*[2]	
Antiseize Compound, High Temperature	PWA581-8 Superceded by PWA586	EASE-OFF 990 Superseded by Fel-PRO C-200	87889 73165 73165	
	MIL-A-907	Fel-Pro C-5A		
Antiseize Compound	BMS 3-28	Antiseize Compound General Purpose	*[1]	
	MIL-T-5544	Thread Compound Antiseize, Graphite - Petrolatum	*[2]	
Antiseize Compound (Thrust reverser threads)	MIL-L-25681		*[2]	

Lubricants
Figure 201 (Sheet 1)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Antifretting Compound		Sundstrand 730691 (Preferred) 718050 (Alternate) 688272 (Alternate)		
GREASE				
Grease, General Use	MIL-G-21164 Supersedes MIL-G-7187	Grease, Molybdenum Disulphide	*[2]	
Airplane Ball and Roller Bearing Grease, Wide Temperature Range	BMS 3-24 (FORMERLY MIL-G-25760)	Aeroshell No. 16	54527	
General Purpose Aircraft Grease	BMS 3-33 Preferred to MIL-PRF-23827	Aeroshell Grease 33	54527	
Grease (Instrument, Gears, and Gear Actuator Screws)	MIL-PRF-23827 Supersedes MIL-G-7421	Grease, Lubrication Gear and Actuator Screw	*[2]	
Grease, Fuel Tank Access Doors		Aeroshell No. 14 (per MIL-G-25537)	54527	
		Low Temperature Lubriplate	73219	
Grease AC Generator and CSD splines, CSD QAD ring		Mix equal parts of MIL-M-7866, Molybdenum Disulfide and Unitemp 500, of Rheotemp 500 Sundstrand 688272 718050,73069	59595 85932 99167 99167	
Grease, Pneumatic System Thread Lubricant	MIL-G-4343	Grease, Pneumatic System	*[2]	
Grease, Silicone Base		DC33, Extreme Low Temp	71984	
		FS 1281	71984	
		DC-4	71984	
Grease, Skydrol Assembly Lubricant	MIL-S-8660	Grease, Silicone MCS-352B	*[2] 76541	

Lubricants
Figure 201 (Sheet 2)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Grease		Petrolatum, Braycote 248	98308	
		Aeroshell 5	54527	
	MIL-G-81322 Supersedes MIL-G-3545	Grease, Aircraft, General Purpose, Wide Temp. Range	*[2]	
		Mobilegrease 28	77988	
Grease, Gasoline and Oil Resistant	MIL-G-6032	Grease, Plug and Valve, Gasoline and Oil Resistant		
Grease Cleaning		Aero Lubriplate 105	73219	
Grease		Rheotemp 500	98354	
LUBRICANT				
Lubricant (TFE Spray)		MS 122	18598	
Lubricant, Anti-scoring, Extreme Pressure		Lubricant CMD #3	11957	
Lubricant, Dry Film (Fuel Sump Drain Valve)		SFL 4396	82829	
Lubricant, Dry Film (Air Drying)	MIL-L-23398	Lubribond A	85932	
Lubricant (Thrust Reverser Linkage)	MIL-A-907	Antiseize Compound, High Temperature	*[2]	
Lubricant, Dry	MIL-M-7866	Molybdenum Disulphide, Powdered	*[2]	
Lubricant		Molykote M-30 Ace Lube Oil Co. 2500 Minnehaha Ave. Minneapolis, MN 55404		
		Zip ZC-330 Zip Aerosol Products 21320 Deering Court Canoga Park, CA 91304		

Lubricants
Figure 201 (Sheet 3)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
		Nyco International, Inc. U.S.A. 2020 North Loop West, Suite 210 Houston, TX 77018		
		Nyco S.A. (France) 66 Champs Elysees 51 Rue D'Ponthieu 75008 Paris, France		
Lubricant, Landing Gear Strut Additive		Lubrizol #1395 Lubrizol Incorporated 15111 Whittier Ave., Whittier, CA 90603		
		Molykote "M" Gearguard (Optional)	71984	
		Houston Lubricant Co.	ODHK6	
		Nyco S.A. (France)	F4101	
Fully Formulated Shock Strut Fluid	BMS 3-32 Type I and II	Castrol Aero 35,40 Castro Incorporated Speciality Products Division 16715 Von Karman Ave. Suite 230 Irvine, California 92714-9855		
		Royco SSF/LGF Royal Lubricants Company P.O. Box 298 River Road East Hanover, New Jersey 07936 United States of America Tele: (800) 989-7692		
		Shell SSF/LGF Shell Oil Products Corporation P.O. Box 4303 Houston, Texas 77210 United States of America Tele: (800) 745-2469		
Lubricant Thread		Krytox 240 AC	18873	
Lubricant, Packing Lubricant	VV-P 236	Petrolatum Royco 80827 Braycote 236 Bray Oil Company	07950 33032	

Lubricants
Figure 201 (Sheet 4)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Oil, Hydraulic	BMS 3-11 Type IV	Hydraulic Fluid, Fire Resistant	*[1]	
	BMS 3-11 Type V	Type V, Class 1, Grade B Skydrol 5	76541	
	MIL-H-5606	Hydraulic Fluid, Petroleum Base	*[2]	
Full Formulated Shock Strut Fluids (SSF/LGF)		Royco SSF	07950	
		Shell SSF and LGF Shell International		
		Trading Co. Shell Centre London, England SE1 7NA		
		Castrol Aero 25,30,35, and		
		Bray Products Division of Burmah Castrol Company 16815 Von Karman Ave, Suite 202 Irvine, CA 92714		
SSF/LGF	MIL-H-6083	Hydraulic Fluid		
Oil, Lubricating	MIL-L-23699 or PWA 521 (SB 238)	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base	*[2] *[2]	
		Castrol 5000	K0132	
	MIL-L-6085	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base	*[2]	
	MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base	*[2] 54527	
	MIL-L-7870	Lubricating Oil, General Purpose, Low Temperature		
Oil, Lubricating (Air Cycle Machine), Engine and Accessories, and APU	PWA 521 (SB 238)	Aeroshell Turbine Oils 300, 390 and 500 *[3]		
		Aeroshell Turbine Oil 555	54527	
		BP Aero Turbine Oil 15 BP Trading Limited London, E.C. 2, England		
		Castrol 5000	K0132 29700 72190	

Lubricants
Figure 201 (Sheet 5)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
		ESSO/EXXON Turbo Oil 2380	29700	
		Mobile Jet Oil 254	77988	
		Mobile Jet Oil II	77988	
		Royco Oil 500,555	07950	
Oil, Lubricating (Air Cycle Machine), Engine and Accessories, and APU (Cont)		Castrol 3C and 205 *[3] Castrol Limited London, NWI, England		
		ESSO/ENCO Turbo Oils 15, TJ-15, 2380 *[3], and 5251 *[3]		
		Hancock Air Turbine Synthetic Lubricant and Astro Turbine 25 *[3]		
		Hatcol 3211 *[3]		
		L-245X	70575	
		Chevron Jet Engine Oil 5	77988	
		Turbo Oil 15	55029	
		Stauffer Jet I and Jet II *[3]	97854	
		Sato 15, 5180 *[3], 6256 *[3], 7388 *[3] and Synthetic Jet Accessory Oil *[3]*[4]	59595	
Oil, Lubricating		Mobil Jet Oil II	77988	
Oil (Antiskid Transducer Dust Seal)		V79 TERESSO	72190	
Lubricant O-Ring (CSD)		Acryloid HF825 Acryloid HF866	77902	
Lubricant		Acryloid HF866	77902	

*[1] Refer to Boeing Material Specification manuals for approved material part numbers and vendors.

*[2] Refer to the applicable Qualified Procurement List for the military specification listed for the approved material part number and vendors.

*[3] These type II oils are -40°F minimum temperature oils rather than -65°F lower limit type I oils.

*[4] Also marked under Caltex and Regent brand names.

Lubricants
Figure 201 (Sheet 6)

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CLEANERS AND POLISHES

1. General
   A. The following is a list of cleaners and polishes that could be required during regular maintenance of the airplane. Listing is by material and grouped according to type and/or use. Acceptable vendors and/or material specifications and/or Boeing process specifications are included as an aid in obtaining the required material.
   B. The specific usage and/or alternatives of any material are controlled by the applicable maintenance procedure. This listing provides a convenient list of materials listed in the maintenance procedures and does not provide authorization for material substitution. Refer to the applicable maintenance procedure for the proper material to be used.
   C. Materials other than those listed can be tested using the procedures in Boeing document D6-17487, Evaluation of Airplane Maintenance Material to verify that any substitute material will not be injurious to airplane surfaces when used as specified by the manufacturer.
   D. D6-7127, Cleaning Interiors of Commercial Transport Aircraft, outlines methods of evaluation for materials to be used in cleaning of Boeing commercial aircraft interiors. It contains materials and proceses as a guideline for cleaning during general maintenance.
   E. Using the vendor code, determine the vendor by using one of the following sources:
      (1) The introduction of the Illustrated Parts Catalog which lists vendor codes, company names, and addresses. The vendor codes are listed in alphabetical order and also in numerical order.
      (2) U.S. government catalog and handbook number H4/H8.

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
CLEANERS				
Alkaline		Altrex	83339	
Antistatic Agent (Carpets)		Stat-eze 5	05867	
Antistatic Agent (Windows)		Static Stop	28014	
		Activol 1390-M	07648	
Cleaners, General		Bon Ami (without bleach or silicones)	85452	
		Clean Quick Orvus Wa Paste	74188	
Cleaner	MIL-C-25769 Type I or II Superseded by MIL-C-78936	Cleaning Compound, Aircraft Surfaces, Alkaline Water Base	*[2]	
Glass and Mirror		Glyst Concentrated Glass Cleaner Glass Wax Gold Seal Co., Bismark, N.C.	61102	
Heavy Duty Cleaners (Suitable for Carbon Deposit Removal)		Bruin W	94058	
		Novee 427	86440	
		Greasolve	83339	
		T-776	72008	
		Major Clean	71361	
		Jet-Mulso No. 2	61102	
Detergent/ Disinfectant		Lysol	94192	
		Ogee 350	81205	
		Calla 7127	1KQX9	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Cleaner		Altrex B Novamax Technologies 1615 Johnson Rd NW Atlanta, Georgia 30318		
Alkaline Cleaners, Manual, General Cleaning		Allied-Kelite 28	89138	
		Calla 301, 301A	19457	
		Cee Bee 280, A410B	71361	
		Dubois C-1102	72008	
		GMC 528B	09402	
		Metaclean AC	98364	
		Oakite 204	44389	
		Pacific Chemical B-82	93965	
		Penwalt (Delchem) 2271R	86460 or 99987	
		Tec Formula No. 1	25227	
		Tec 86-2	25227	
		Turco Jet Clean C	61102	
		Turco Jet Clean E	61102	
		Ridolene No. 53	27056	
		Wyanndotte Aerowash A	83339	
		Winter Clean	0192B	
Alkaline Cleaners, Manual, Heavy Duty		Airshow W	94058	
		Greasesolve	83339	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Brightener and Rust Preventer		Everite	04442	
Buffing Compound		Learock S-30, 888	75554	
Car Shampoo		Turco	98138	
Cleaner (Acid-Solvent Solution)		Process K	89138	
Cleaner, Hand (Adhesive and Epoxy Remover)		Epocleanse	17433	
Cleaner - Engine		Turco 4848-92	61120	
Cleaner - Interior		Freon 113, Freon TF	18873	
Cleaner, Disinfectant (for toilets		Boulin CDQ	94058	
Cleaner, Polish		Plex-I-Glow	93920	
Liquid Cleaners (Acrylic Windows)	P-P-560 (MIL-C-18767)	Polish, Plastic	*[2]	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Cleaner, Window		Dustless Aerylic Window	28104	
		Micro-Glass Mirror Cleaner	81205	
Cleaner (Outflow Valve)		Decarb Concentrate 1031 National Colloid Co. P.O. Box 293 Garden Grove, CA 92642		
		Formula 815MX or 815 NP	94058	
Royalite		Teracote No. 60, Solutions 1 and 2	17359	
Cleaner (Zone Temperature Assy)		NRG Pluss No. 678 National Colloid Corp. P.O. Box 293 Garden Grove, CA 92642		
		Formula 815MX or 815NP	94058	
Deodorants, Toilet Flushing		Chemical - Toilet Flushing Deodorant		
		Elkee Formula-1	04421	
		NFC A/C Toilet Deodorant	0401B	
		Timson 101	4J644	
		Aerofresh	15108	
		Sanitex QC	86938	
		Sani-Pack 41-100	18195	
		Sani-Pack 41-008 (Procedure II) Headomatic Alex Milne Ass Orenda Rd E., Unit 2 Brampton, Ontario Canada 26T1G1		

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
CORROSION REMOVER				
Acid Brighteners (for aluminum)		3002	61002	
		Kelite L-20	89138	
		FO 204	05867	
		Delchem 782	86460	
		Clarco 2100A	91608	
Phosphoric Acid Corrosion Remover (for aluminum)	MIL-C-38334 (Liquid)	Corrosion Removing Compound Prepaint, for Aircraft Aluminum Surfaces	*[2]	
Phosphoric Acid Corrosion Remover (for Ferrous)	(Paste)	Corrosion Removing Compound Paste (Phosphoric Acid Base)	*[2]	
Phosphoric Acid Corrosion Remover (for steel)	MIL-M-10578	Corrosion Removing and Metal Conditioning Compound (Phosphoric Acid Base)	*[2]	
General Purpose Initiator Presealing Strippers (Paint)	BMS 3-2 Type 1, 2 MIL-M-81351 BMS 11-7	Methyl Ethyl Ketone Peroxide	*[2]	
		Cleaning Solvent, Presealing	*[1]	
		Cee Bee A292	71371	
		Turco 5351	61102	
Compound Citric-Acid	MIL-C-11029	Compound Citric-Acid	*[2]	
POLISHES				
Polish - Metal	MIL-P-6888	Polish, Metal, Aluminum Aircraft	*[2]	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Polish		Meguire Mirror Glaze MGH10, MGH17	14088	
Polish-Paint or Heavy-Duty Metal		Wadpol K2 Super Shine	K0402	
Polish, Wax		Simonize	Commercial	
SOAPS				
Detergent, Airplane Interior		Spray White E	89138	
		High Concentrate 40.1	16634	
		Quadra Kleen	26106	
Detergent		Glo Do-All, Formula 1B or 3B	34364	
General Purpose		Castile	Commercial	
Liquid Soap		Turco 1526	61102	
		Spray White	89138	
Rug Shampoo		Do-All	34364	
Soapless Base, Rug, Carpet, and Upholstery Shampoo		High-Concentrate 40-1	16634	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Soap Solution (non-corrosive)		Tereco 201 (thin), 211	17359	
Cleaning of Toilet Filter	P-D-619		94192	
SOLVENTS				
	O-A-51	Acetone	Commercial	
	O-A-396 or O-E-760	Ethyl Alcohol	Commercial	
	AMS3002	Ethyl Alcohol	Commercial	
	AMD3004	Methyl Alcohol	Commercial	
	O-M-232	Methyl Alcohol (Methonal)	Commercial	
	TT-B-838	Butyl Acetate, Normal	Commercial	
	TT-B-846	Butyl Alcohol	Commercial	
		Chlorathene	71984	
		Chloroathene VG	96717	
		Cyclo Hexanone	87664	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
	TT-E-776	Ethyl Glycol Monobutyl Ether (Butyl Cellosolve)	Commercial	
		Freon Precision Cleaning Agent	18873	
	TT-I-735	Isopropyl Alcohol	Commercial	
	VV-K-211	Kerosene	Commercial	
	MIL-T-6094	Lacquer Thinner	*[2]	
	MIL-D-6998	Methylene Chloride (Dichlormethane)	*[2]	
	TT-M-261	Methyl Ethyl Ketone	Commercial	
	TT-M-268	Methyl Isobutyl Ketone Solvent 3 Vulcan Chemical Div of Vulcan Materials Co. P.O. Box 7689 Birmingham AL	Commercial	
	JAN-T-171	Toluene, Grade A	Commercial	
	TT-N-95	Aliphatic Naphtha	Commercial	
	MIL-C-38736	Solvent-Cleaning Mixture	*[2]	
	JAN-A-465	Solvent-Acetic-Acid	*[2]	
SOLVENTS				
	P-D-680	Stoddard Solvent, Types 1, 2	Commercial	
		Thinner No. 2911	76381	
		TEC 902		
		TL-58		

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
	MIL-T-81533	Trichloroethane 1, 1, 1	Commercial	
	O-T-236	Tetrachlorethylene (perochlorethylene) (Tech.)	Commercial	
	O-T-634		Commercial	
		Transpo XH315W	61102	
		Tri-Ethane	47695	
	BMS 11-6	Trichlor	*[1] Commercial	
	BMS 11-6	Trichlor	01988	
		Permachlor NA	17125	
		Triclean D	18873	
		Blascosolv	07581	
		Nialk MD	09287	
		Trichlor	093915	
	MIL-O-T-620	Trichlorothane, Technical Inhibited (Methyl Chloroform)	Commercial	
	TT-M-261	Methyl Ethyl Ketone	Commercial	
	TT-T-528	Toluene	Commercial	
	ASTM845 or 846	Xylene	Commercial	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
	TT-X-916	Xylene	Commercial	
		Activator A-2	76381	
	P-S-661	Dry Cleaning Solvent	Commercial	
	VV-G-109	Gasoline, Unleaded	Commercial	
	TT-T-548	Toluene	Commercial	
General Purpose	GMS 3-2, Replaced by TT-N-95	Cleaning Solvent, General Purpose	*[1]	
	BMS 3-2, Type 1	Skellysolve-S	01983	
		Union No. 5 thinner	79003	
		Varsol No. 1	29700	
		Shell-Sol 345	54527	
		Chevron 325	81230	
		S-76 Cleaning Solvent	79003	
		Atlantic-Richfield Klezine	92788	
	BMS 3-2, Type 2	Skellysolve-V	01988	
		Super Naphtholite	94684	
		Standard (Chevron) 265 Thinner	81230	
		Cyclohexanone	Commercial	
	Kerosine	RD2494	Commercial	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Initiator	MIL-M-81351	Methyl Ethyl Ketone Peroxide	*[2]	
Presealing Cleaning Solvents	BMS 11-7	Cleaning Solvent, Presealing	*[1]	
		Turco 4460	61102	
		TT-2279		
		PFL-307-56		
		Sikkens 96.130	H5036	
		Turco 4460	61102	
		T-2279A	09869	
		PFL-307-56	94684	
		TL-4119	72556	
		M-189	01630	
		Pro-Seal T-825	71191	
STRIPPERS				
Cloth		Lint-Free, Clean, Wiping	Commercial	
Remover, Alkaline Removable Coating		TEC 243 or TEC 243F (water (water base)	25227	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
Scraper		Plastic *[3]	Commercial	
Stripper Inorganic		Chromic Acid	Commercial	
		Sodium Dichromate - Sulphuric Acid	Commercial	
Strippers, Organic		Cee Bee A-228-D, Cee Bee A292	71361	
		Fiber Resin E5-1	26348	
Strippers		Cee Bee A-228-D, Cee Bee A292,	8U841	
		Cee Bee E-1058	8U841	
		Eldorado PR-5044	6K478	
		Elixair - Skyrestore (Thick)	KA861	
		Fiber Resin E5-1	26348	
	TT-M-268	Methyl Isobutyl Ketone	Commercial	
		Naftosolv FN	D1940	
		SkyKleen 2000 Aviation Cleaner	1CHP6	
	TT-T548 or JAN-T-171, Grade A	Toluene	Commercial	
		Turco 800	61102	
		Turco 5351	61102	
	ASTM 845 or 846	Xylene	Commercial	
		Pennwalt AZ Strip 19E	86460	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
	TT-E-776	Ethylene Glycol Monobutyl Ether (Butyl Cellosolve)	Commercial	
		Turco 5873	61102	
		Cee Bee A-306B	71361	
		Cee Bee R256B	71361	
WAXES		Turco 5351	61102	
		Kwykwax	64807	
		Simonize	778304 81238	
		Duco #7	18873	
		Franklin-s Plexiglas Wax	72490	

*[1] Refer to Boeing Material Specification manuals for approved material part numbers and vendors.
*[2] Refer to the applicable Qualified Procurement List for the military specification listed for the approved material part number and vendors.
*[3] Refer to AMM 51-31-0/201 for the list of approved plastic scrapers.

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FINISHING MATERIALS - MAINTENANCE PRACTICES

1. General
   A. The following is a list of finishing materials that could be required during regular maintenance of the airplane. Listing is by material and grouped according to type and/or use. Acceptable vendors and/or material specifications and/or Boeing process specifications are included as an aid in obtaining the required material.
   B. The specific usage and/or alternatives of any material are controlled by the applicable maintenance procedure. This listing provides a convenient list of materials listed in the maintenance procedures and does not provide authorization for material substitution. Refer to the applicable maintenance procedure for the proper material to be used.
   C. Materials other than those listed can be tested using the procedures in Boeing document D6-17487, Evaluation of Airplane Maintenance Materials to verify that any substitute material will not be injurious to airplane surfaces when used as specified by the manufacturer.
   D. D6-7127, Cleaning Interiors of Commercial Transport Aircraft, outlines methods of evaluation for materials to be used in cleaning of Boeing commercial aircraft interiors. It contains materials and processes as a guideline for cleaning during general maintenance.
   E. Using the vendor code, determine the vendor by using one of the following sources:
      (1) The introduction of the Illustrated Parts Catalog which lists vendor codes, company names, and addresses. The vendor codes are listed in alphabetical order and also in numerical order.
      (2) U.S. government catalog and handbook number H4/H8.

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
COATING				
Abrasion Resistant		Tereco 155	17359	
Abrasion Resistant Teflon (Spray or Brush)		Laminar X-500 Kit	98795	
Coating, Special Purpose Coating	BAC 5710 Type 41	683-3-2 Base Protective Coating	98502	
		X-310 Catalyst	98502	
Antistatic (Nose Radome)	BMS 10-21 Type II	Antistatic Coatings	*[1]	
Clear, Skydrol Resistant		Coating 683-3-2 Catalyst X-310 Accelerator CA108	98502	
Conductive Coating (Fuel Cells)		998 x 300 (Carbon Black)	95570	
Conversion Coating (Magnesium)	MIL-M-3171	Magnesium Alloy, Processes for Treatment and Prevention of Corrosion	*[2]	
Corrosion Resistant Finish (Integral Fuel Cells)	MIL-C-27725	Coating, Corrosion Preventive for Aircraft Integral Fuel Tanks	*[1]	
	BMS 10-20 Type II	Corrosion Resistant Finish for Integral Fuel Tanks		
Corrosion Prevention Wing Tanks		Zinc Rich Epoxy Primer a) Base, 463-6-28 Bostik b) Catalyst, X-344 Bostik c) Thinner TL-52 Bostik	 70707 70707 70707	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
Coating-Removable		Coating ARDROX 306N	K 6858	
		Removable ADROX 7050-W	K 6858	
Coating-Exterior Decorative	BMS 10-72	Coating, Exterior Decorative Paint	*[1]	
	MIL-C-16173, Grade 2	Valvoline Tectyl 502C	81355	
		Braycote 137	81355	
		Braycote 137E	86549	
		502C-BC	81355	
		Veedol Anorustol 280	86549	
		Rust Preventive 1612A	84591	
		Steelguard MS10	81355	
		Nox-Rust 207	02847	
		Petrotect 2	86459	
		Royco 137R	86459	
		ST 1502	81355	
		No-rust 27	02847	
		P2A	86459	
		Visconorust No. 1602	86459	
	MIL-C-16173, Grade 3	Valvoline	81355	
		Braycote 153E	86459	
		894 BC	81355	
		Veedol Anorustol 270	86459	
		Rust-Foil 161-3	81355	
		Steel Gard MS-12	81355	
		Nox-Rust 208	02847	
		Oakite Special Protective Oil Q	44389	
		Petrotect 3	86459	
		Ferrocote 364-BL	77490	
		Ferrocote 367-BL	77490	
		Royco 153R	86459	
		St 1894	81355	
		No Rust 28	02847	
		P3A	86459	
		Visconorust No. 1603	86459	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
	MIL-C-166173, Grade 4	Valvoline Tectyl 846	81355	
		Braycote 194	81355	
		Braycote 194E	86549	
		846-BC	81355	
		Veedol Anorustol 275	86459	
		P4A	86459	
	MIL-C-16173, Grade 5	Valvoline Tectyl 511M	81355	
		Braycote 198E	86459	
		511M-BC	81355	
		Petrotect 5	86459	
		Royco 195	86459	
		St 511	81355	
		P5A	86459	
Compound, Corrosion Preventive	MIL-C-11796, Class I	Braycote 202	98308	
		H-2	84591	
		H-10	84591	
		Cosmoline 1060	73277	
		Kendex 7010	75273	
		Nox Rust 507	02847	
		Tectyl 435	72527	
	MIL-C-11796, Class II	No. 1882	70878	
		Braycote 265	98308	
		LH-4	84591	
		Cosmoline 1061	73277	
		Kendex 7011	75273	
		Petrotect P-150	86459	
		Tectyl 436	72527	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
	MIL-C-11796, Class III	Code 312D	70878	
		Braycote 248	98308	
		No. 903, MP-3	71881	
		L-23B	84591	
		Gulf No-Rust 7	89857	
		Gulf No-Rust 7	34252	
		Cosmoline 1062	73277	
		Kendex 7012	75273	
		Nokorode 963A	96581	
		Nox-Rust 509	02847	
		Petrotect P-250	86459	
		Roycote 248	07950	
		Royco 248R	07950	
		Trio Compound	87951	
		Tectyl 437	72527	
Enamel	BMS 10-60, Type I	Gloss 643-3 Base	98502	
		Semi-Gloss	98502	
		653-3 Base		
		Flat	98502	
		663-3-1 Base		
		Clear	98502	
		683-3-1		
		Catalyst	98502	
		X-310A		
		Thinner	98502	
		TL-59		
		Color Tints	98502	
		Tint Base BTC-X		
		Reducer TL-62		
		Catalyst X-310A		

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
	BMS 10-60, Type II	Gloss-Series 800 Catalyst 910X331A Gloss-Series 800 Catalyst 910-1521 Thinner 020X310 Semi Gloss-Series 800 Catalyst 910X331 Flat-Series 800 Catalyst 910X331 Tints Tint Base DSE-X Catalyst 910X331A Thinner 020X325 Gloss 643-32 Catalyst X365 Thinner TL-102	85570 85570 85570 85570 85570 85570	
	BMS 3-11 Resistant	Hydraulic Fluid Resistant Finch 68303-2 Base Finch X-310 Catalyst		
	BMS 10-83, Type II	Polane L., Semi-gloss Base F63 Series Catalyst V66V29 Reducer R7KB29 Reducer R7K84	86972	
		653-28-1	70707	
		Andrew Brown System	71191	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
Titanium		Finch System	98502	
		Corogard	04963	
		Aeroflex paint G-12-E-25	H0951	
Erosion Coating (Nose Radome)	MIL-B-83231	Coatings, Polyurethane, Rain Erosion Resistant	*[2]	
		Prestec Paint No. 2381 Simtec Coatings 1188 N. Grove St. Anaheim, California 92806		
	BMS 10-60 Type II	or use	coml	
Gold Coating, High Temp.	BMS 10-82	Low Emissivity Gold Coating	*[1]	
High Temperature Coating for Titanium		B2000	71191	
Repair Coating (Ldg Gr Axle, High Temp Finish)	MIL-C-81751	Coating, Metallic Ceramic	*[2]	
Walkway Coating, Nonslip	MIL-W-5044, Type I, 37875 White	Griptread 589-000-015 White Type I Smooth (optional)	*[2] 73842	
	MIL-W-5044, Type I, 37038 Black	Griptread 589-000-025 Black, Type I Smooth (optional)	*[2] 73842	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
Coating, Nonreflective Finish	BAC5710 Type 35	Nextel Suede 3101		
	BAC5710, Type 51	Polyurethane, DeSoto Hi-Temperature	85570	
COMPOUNDS				
Water Displacing (for Controlling Corrosion)	MIL-C-23411	Corrosion Preventive Compound, Clear	*[2]	
FINISHES				
Films and Materials for Aluminum	MIL-C-81706 (Class 3) or MIL-C-5541 (Class 3)	Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys Chemical Conversion Coatings on Aluminum and Aluminum Alloys	*[2] *[2]	
Chemical and Solvent Resistant	MIL-P-23377 MIL-C-22750	Primer Coating, Epoxy Polyamide, Chemical and Solvent Resistant Coating, Epoxy Polyamide	*[2] *[2]	
Chemical and Solvent Resistant	BMS 10-11 (Types 1 & 2)	Chemical and Solvent Resistant Finish	*[1]	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
Enamel, Exterior Decorator	BMS 10-60	Exterior Decorative Enamel System	*[1]	
Enamel, Polyurethane	MIL-C-83286	Coating, Urethane Aliphatic Isocyanate, for Aerospace Application	*[2]	
Ink	BMS 10-73 Types I, II	Silk Screen Ink Finish	*[1]	
Paint	BMS 10-55, Types I, II	Internal Decorative Water Emulsion	*[1]	
Paint, Aluminized Coating		EC-843 or EC-843S (Corogard) Optional Aeroflex-G-12-E-25 Skkins Co. 20846 So Normandy Ave Torrance, CA 90502	76381	
Paint, Vinyl	MIL-P-8793	Paint, Gloss (for use on Elastomenic Pigmented Film)	*[2]	
Corrosion Resistant	BMS 10-20	Corrosion Resistant Finish for Integral Fuel Tanks	*[1]	
PRIMERS				
Primer		Bostik 1007 DC 1200 EC-776 or EC-776R (Also called EC1309 or EC-77655)	70707 71984 76381	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
Primer, Spray, Yellow	BMS 10-11 Type I, II	Chemical and Solvent Resistant Finish	*[1]	
Teflon Filled Coating White, Gray	BMS 10-86 Type I, II	Teflon filled, abrasion resistant urethane coating Hysol AC5365	*[1] 04347	
Aluminized Epoxy		463-4-4 Base X-301 Catalyst TL-52 Thinner	98502	
Primer, Zinc Chromate	TT-P-1757 Replaces MIL-P-8585	Primer Coating, Zinc Chromate Low Moisture Sensitivity	Coml	
Primer, Corrosion Resistant Urethane Compatible	BMS 10-79 Type II Class A BMS 10-79 Type III Class A	513 x 329 Base 910 x 456 Curing Solution 515 x 336 Base 910 x 458 Curing Solution	85570 85570	
	BMS 10-79 Type II Class B	513 x 377 Base 910 x 482 Curing Solution 920 x 364 Thinner 010 x 317 Thinner	85570	
	BMS 10-79 Type II Rule 1124	513 c 384 Base 910 x 456 Curing Solution	85570	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
	BMS 10-79 Type III Rule 1124	515 x 349 Base 910 x 533 Curing Solution	85570	
Corrosion Inhibiting	BMS 5-89	Urethane Compatible, Corrosion Resistant Primer	*[1]	
Wash	MIL-C-8514	Corrosion Inhibiting Adhesive Primer	*[1]	
Zinc Chromate	MIL-P-8585 (Color Y)	Coating Compound, Metal Pretreatment, Resin Acid Primer Coating, Zinc Chromate, Low Moisture Sensitivity	*[2]	
SEALER				
Edge		BASE 683-3-2 Catalyst X-310	98502	
Decal Edge	BAC 5312	#4150	76381	
STRIPPERS				
Paint		Turco 5351, 5292, 4338	95479 95510 61102	
SURFACE CONDITION				
Static Conditioner		Surface Conditioner 28-C-1 Surface 8-W-5	98795	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	CODE	MISC
THINNERS				
Epoxy Thinner		TL-52 TL-29	98502	
Lacquer Thinner		TT-T-266	Commercial	

*[1] Refer to Boeing Material Specification manuals for approved material part numbers and vendors.
*[2] Refer to the applicable Qualified Procurement List for the military specification listed for the approved material part number and vendors.

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MISCELLANEOUS MATERIALS - MAINTENANCE PRACTICES

1. General
   A. The following is a list of miscellaneous materials that could be required during regular maintenance of the airplane. Listing is by material and grouped according to type and/or use. Acceptable vendors and/or material specifications and/or Boeing process specifications are included as an aid in obtaining the required material.
   B. The specific usage and/or alternatives of any material are controlled by the applicable maintenance procedure. This listing provides a convenient list of materials listed in the maintenance procedures and does not provide authorization for material substitution. Refer to the applicable maintenance procedure for the proper material to be used.
   C. Materials other than those listed can be tested using the procedures in Boeing document D6-17487, Evaluation of Airplane Maintenance Materials to verify that any substitute material will not be injurious to airplane surfaces when used as specified by the manufacturer.
   D. D6-7127, Cleaning Interiors of Commercial Transport Aircraft, outlines methods of evaluation for materials to be used in cleaning of Boeing commercial aircraft interiors. It contains materials and processes as a guideline for cleaning during general maintenance.
   E. Using the vendor code, determine the vendor by using one of the following sources:
      (1) The introduction of the Illustrated Parts Catalog which lists vendor codes, company names, and addresses. The vendor codes are listed in alphabetical order and also in numerical order.
      (2) U.S. government catalog and handbook number H4/H8.

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
ABRASIVES				
Abrasive Disc		Scotch Brite Pad, Type A	76381	
		Aluminum Oxide Abrasive Nylon Pad, Type F	06565	
		Bear-Tex, Aluminum Oxide Abrasive Pad	21270	
		Microlon, Aluminum Oxide Abrasive Pad	70614	
Abrasive Paper		240,320,400,600 Grit	Commercial	
Buffing Compound		Dupont #7	18873	
		Polysand Polysand Division Fredrick B Athon Enterprises 628 S. Orange Drive Los Angeles, CA 90036		
		Learock S-30 or 888	75554	
		962 Matchless Grey	76236	
		Grey #4M-30, Red #B-7	27201	
ANTI-ICING/DE-ICING				
Antifreeze Anti-icing/De-icing	O-A-548	Ethylene Glycol	Commercial	
		800341, 213923	33525	
		Union Carbide Fluid UCAR ADF II	80524	
		Dow Chemical Fluid 146AR	71983	
	MIL-A-8243	Anti-icing/deicing fluids	*[2]	
	DOD-U-10866 Class 2	Urea	*[2]	

Miscellaneous Materials
Figure 201 (Sheet 1)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
BRAID OR CORD				
Braid, Flat Woven (Tying Material)		#17-D	00768	
Cord, Nylon (Fuel Cell Lacing)	MIL-C-5040	Cord, Nylon	*[2]	
Cord, Shock Absorber (Bungee)	MIL-C-5651 Type I	Cord, Elastic, Exercise and Shock Absorber, for Aeronautical use	*[2]	
Cord, Silicone Sponge Rubber (Door Seal Filler)	BMS 1-45 (Superceded by BMS 1-57)	Silicone Rubber, Skydrol 500 Resistant, High Physical Properties	*[1]	
CHEMICALS				
Cerium Oxide Powder		Cerium Oxide Powder Somaca Western Co. 852 Aldo Avenue Santa Clara, CA 95050		
Nitrogen, Gaseous (Oxygen System Testing)	BB-N-411 Type I, Class I, Grade A	Nitrogen, Tech	*[2]	
Oxygen, Breathing (Aviation Grade)	MIL-O-27210	Oxygen, Aviation & Breathing, Liquid or Gas	*[2]	
Toilet Flushing		Turco Deodair	61102	
		Jet Degerm	15108	
		West Sanitor Fluid	64807	
		Dess-Air Dessair Ltd London Wal London, E.C.2		
		Monogram DG-19	29780	
CREAMS				
			64807	

Miscellaneous Materials
Figure 201 (Sheet 2)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
FABRIC				
Cargo Lining and Insulation Repair	BMS 8-100	700 SI Stratoglas	01413	
Cheese Cloth			Commercial	
Dacron (Door Seal Repair)		D-117, D-118 Mohawk Fabrics Co., Inc. 96 Guypark Amsterdam, NY 12010		
Fabric	BMS 8-143, Type 100	Glass	08928	
	BMS 8-64	Flow Resistant	71562	
Fabricglass	BMS 8-118, Type II,III,IV	Glass Fabric Preimpregnated	26663	
Fiberglass Cloth (With Volan "A" Finish)		#120,128,181	88088	
Foam	BMS 8-133, Type I, Grade 20, Form A	Urethane	28014	
Flame Resistant (Insulation Blanket)	BMS 8-95 Type I	Fabric, Hypolon Coated, Flame Resistant	*[1]	
	Replaced by BMS 8-142	Insulation Covering, Self-Extinguishing	*[1]	

Miscellaneous Materials
Figure 201 (Sheet 3)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
FABRIC (Cont)				
Gauze Laminate	BMS 8-98	Decorative Tedlar, Type IIA, Grade A, Class 1, Gloss G	0888B 0889B 0890B	
		Decorative Tedlar, Type IIA, Grade A, Class 1, Gloss M	0888B 0889B 0890B	
		Decorative Tedlar, Type IIA, Grade B, Class 1.5, Gloss G	0888B 0889B 0890B	
		Decorative Tedlar, Type IIB, Grade A, Class 1, Gloss M	0888B	
		Decorative Tedlar, Type IIB, Grade A, Class 1, Gloss G	0888B	
		Decorative Tedlar, Type III, Class 1, Gloss S	18873	
		Decorative Tedlar, Type III, Grade A, Class 2, Gloss M	18873	
		Decorative Tedlar, Type III, Grade A, Class 2, Gloss L	18873	
		Decorative Tedlar, Type III, Grade B, Class 2, Gloss L	18873	
		Decorative Tedlar, Type III, Grade B, Class 4, Gloss L	18873	
	BMS 8-254	Textured Decorative, Type I	01666 0891B	
		Textured Decorative, Type II	13932	
		Textured Decorative, Type III	13932	
Lead Coated	BMS 8-47 Type I,III,IV	Fabric, Lead Coated	*[1]	
Insulation Blanket (Filling)	BMS 8-48 Type III, Class III	Thermal-Acoustical Fiberglass Insulation	*[1]	
Insulation Covering (Self-Extinguishing)	BMS 8-142 Type I	Insulation Covering, Self-Extinguishing	*[1]	
Osnaburg Cloth	CCC-C-429 (Any Class)	Cloth, Osnaburg	*[2]	
Foam	BMS 8-300 Type I	Foam, Flexible Polyimide	61969	

Miscellaneous Materials
Figure 201 (Sheet 4)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
FLUIDS				
Fuel Additive		Biobor JF	24611	
LEAK DETECTION				
Leak Detection Solutions	BMS 10-34 (Systems 1 thru 5 and 7)	Leak Detection System	*[1]	
Leak Detection Compound, Oxygen System		Snoop Leak Detector Sherlock CG Type I Leak Detector O	18034 23316 93965	
Leak Detection, Fuel Tanks		Automate Red BSF	32063	
		Automate Blue SF	32063	
		Intense Green Fluorescent Dye Pigment OS-31	83328	
		Bluish White Fluorescent Dye Pigment OS-80	83328	
PAD				
Felt Pad		Belgian Hare Felt Pad Somaca Western Co. 852 Aldo Avenue Santa Clara, CA 95050		
Nonslip		Safety Walk, Type B, Medium, Aluminum Color	76381	
Polyurethane	BMS 8-39	Flexible Urethane Foam	73842	
Paper, Moisture-proof		Polyethylene Material or Canvas	Commercial 81205	
Rain Repellent		RainBoe Type III Fluid (65-38196-2)		
Rain Repellent Remover Pad		Ardrox 275-G	K6858	

Miscellaneous Materials
Figure 201 (Sheet 5)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
PARTING AGENT				
Parting Agent		Del Chem X-769	99987	
PASTE				
		Resto-Part	71425	
Paste, Vinyl Ink Process		3900 Series	76381	
		Flourocarbon MS122	18598	
SHEETING				
Plastic Sheeting		0.0075-inch Aluminized Mylar C.P. Waggoner Co. Grand Prairie, TX		
		0.0075 and 0.010 inch Mylar Plastic Sheet	31708	
Protective Coating (Strippable, Water Based)		SPRAY LAT SC-1071	87354	
Sheeting, Plastic	BMS 8-86	Plastic, ABS Sheet, Flame Resistant	*[1]	
Plastic, Laminate Glass Fiber (Cargo Lining Repair)		700 SI Stratoglass	Commercial	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
SLEEVE				
Sleeve, Braided Shield		GS080, GS149	59730	
Sleeve, Insulating		Insutube 681	22180	
TAPE				
Aluminum Foil Tape		Permacel P112	99742	
Conductive Tape		3MX-1170	76381	
Double Back		#400	76381	
		Permacel 94, 96, 306, 603L, ED812, ED8117 or ST8117	99742	
		3M Scotch Y-9024	76381	
Duct Sealing		#474, Vinyl Plastic, 1 and 2 inches wide Permacel-29, 1 and 2 inches wide	26066 99742	
Sound Damping and Sealing Tape	BMS 8-283A Type I	Rubatex tape 36V with X601D Adhesive	*[1]	
Sealing Tape, Moisture Inhibitor		3M 866DL, Polyurethane Tape 0.018 inch thick, 36 inches wide, 3M Industrial Specialties Division 3M Center Building 220-7E-01 St. Paul, MN., 55144-1000		

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
		PATCO 809U, Polyurethane Tape 0.009 inch thick, 4 inches wide. PATCO Corporation 51 Ballou Blvd. Bristol, RI, 02809-0995		
Flame Resistant		3M No. 474 Permacel P-29 Silver or P-621, P212HD Permacel-29	76381 99742 99742	
		Polyken 292		
Fuel Resistant Tape		SJ8566X Polyurethane Film Tape, Replaced by Y-8544	76381	
Teflon Tape		P-424	99742	
General		3M No. 61, 202, 214, 221, 425, 474, 475, 600, 639, 670, X-1155, and Y-9044, Y-9017, Y-9201, Y-9202, Y-9204 Permacel-29	76381 99742	
		Protex 20V, 28V	06929	
		Permacel 29, 32, 68, 70, 76, 85, 212HD, 255, 295, 306, 421, 422, 621, 705, 718, and 2650	99742	
		Tuck 210	83334	
		CD Mold Release	93648 or 16059	
		FASCAL 440	04271	

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
TAPE (Cont)				
General Glass Cloth,		361	76381	
Pressure Sensitive,		7000G	88301	
Thermo Setting (Duct Repair)		P212	99742	
Insulation	MIL-I-23594 Superseding MIL-T-23594	Insulation Tape, Electrical high temperature, Polytetrafluoroethylene Pressure-Sensitive		
		No. 7904	32975	
		3m No. 60, 61, 62	76381	
		P421, P423	99742	
Cargo Lining Repair		Permacel P621, P212HD, P626 (Preferred)	99742	
		3M 367-FR, 398-FR	76381	
Insulation Covering (Self-Extinguishing)	BMS 8-142 Type I	Insulation Covering, Self-Extinguishing	*[1]	
Fiberglass Reinforced Heat Resistant		Orcon Film Part No. AN4C	60815	
Labeling		Dymo Labeling Tape #158 (Color optional)	11244	
Masking	UU-T-106	Tape, Pressure Sensitive Adhesive, Masking Repair	*[2]	
Silicon, Heat		Heat Tape Part No. OT-6C	60815	
Nylon Lacing	MIL-T-43435	Tape, Lacing and Tying	*[2]	
Patching		OT-5, -6, -7	60815	
Plastic Film (Pipe Thread Sealing)	MIL-T-27730	Tape, Antiseize, Tetrafluorine (with Dispenser)	*[2]	
Preservation and Sealing		Mystic 7300	32975	
		Replaced by 3M 8402	76381	
		Mystic 7452, 7453	32975	
		Replaced by 3M-425	76381	

Miscellaneous Materials
Figure 201 (Sheet 6)

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MATERIALS AND USAGE	SPECIFICATION	PART NUMBER AND/OR NOMENCLATURE	VENDOR CODE	MISC
TAPE (Cont)				
Pressure Sensitive		3M No. 250	76381	
Transparent Polyester		Speed Tape #850	76381	
HiSpeed		428B (6" wide) Y9162B (11" wide)	76381 76381	
Mylar Tape		Gizard Protex 20V	06929	
Tapes	BMS8-256	Graphite Fiber, Unidirectional, Non Self-Adhesive, Epoxy Resin-Impregnated 350°F Cure Masking		
Tape	BMS5-157 Type I	Tape, Advanced Insulation Blanket Tape	1EHQ7	
THREAD				
Cotton	V-T-276 Type 1B3 Ticket No. 16, 24	Thread, Cotton	*[2]	
Nylon	V-T-295 Type I Class 9 No. 2	Thread, Nylon	*[2]	
Twine	MIL-T-713 Type N Class II	Twine, Fibre Impregnated Lacing and Tying		
WINDOW SHADES				
Window Shade Material		Vinyl Laminate Mylar Aluminum Foil Color: Vinyl Side - BAC White No. 744, Mylar Side - Silver No. 111 (0.007 + 0.007 inch)	73808	
		Vinyl Laminate Mylar Aluminum Foil (Same Color as above) 0.014 inch	73808	

*[1] Refer to Boeing Material Specification manuals for approved material part numbers and vendors.

*[2] Refer to the applicable Qualified Procurement List for the military

Miscellaneous Materials
Figure 201 (Sheet 7)

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AIRPLANE CLEANING TABLES - MAINTENANCE PRACTICES

1. Environmental Requirements

A. In an effort to meet the various air quality environmental regulations, a specific series of solvents, based on process and material, have been provided. This table is derived from the corresponding BAC specifications and is intended to better provide the flexibility needed to meet local environmental requirements. The following table is located in both the AMM and Standard Overhaul Practices Manual to provide continuity across all models and all manuals:

LIST OF CLEANING TABLES
TABLE 201

Description	Series	BAC Specifications
General Cleaning of Metal	80	BAC 5750
General Cleaning of all Organic Coatings	81	BAC 5750
General Cleaning of Solvent Resistant Organic Coatings	82	BAC 5750
General Cleaning of Composites	83	BAC 5750
Final Cleaning of Metal Prior to Painting	84	BAC 5750
Final Cleaning of All Organic Coatings Prior to Painting	85	BAC 5750
Final Cleaning of Solvent Resistant Organic Coatings Prior to Painting	86	BAC 5750
Final Cleaning of Composites Prior to Painting	87	BAC 5750

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LIST OF CLEANING TABLES TABLE 201		
Description	Series	BAC Specifications
Final Cleaning of All Organic Coatings Prior to Non-Structural Bonding	89	BAC 5750
Final Cleaning of Solvent Resistant Coatings Prior to Non-Structural Bonding	90	BAC 5750
Final Cleaning of Composites Prior to Non-Structural Bonding	91	BAC 5750
Final Cleaning Prior to General Sealing	92	BAC 5000
Final Cleaning Prior to Fuel Tank Sealing	93	BAC 5504
Final Cleaning Prior to Application of Rain Erosion Resistant Coating	94	BAC 5880
Final Cleaning Prior to Aerodynamic Smoothing and Fairing	95	BAC 5030
Final Cleaning of Oxygen Components Exposed to Oxygen	96	BAC 5402
Final Cleaning Prior to Structural Bonding	97	BAC 5514
Cleaning of Specific Polymersics	98	BAC 5750
Cleaning of Phenolics or Nylon	98-1	BAC 5750

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LIST OF CLEANING TABLES TABLE 201		
Description	Series	BAC Specifications
Final Cleaning of Composites Prior to Structural Bonding	99	BAC 5578

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 80) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for general cleaning of metals as listed in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. General Cleaning of Metal (Series 80)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01000, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

GENERAL CLEANING OF METAL (SERIES 80)
TABLE 201

Material Name	Material Bulk Code	Specifications
1,1,1-Trichloroethane	B00090	
Acetone	B00062	JIS-K-1503
Aerfluor 343		
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		

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GENERAL CLEANING OF METAL (SERIES 80) TABLE 201		
Material Name	Material Bulk Code	Specifications
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	B00647	
EP-921		
Ethyl alcohol, denatured	B00068	
Ethyl-3-Ethoxy propionate (EEP)		
Extra Solv		
FCC-55		
Freon TES or Genesolve DES		
Freon TF or Genesolve D	B00143	
Glidsafe Prepsolv		
Isopropyl alcohol (IPA)	B00130	
MEK: 1,1,1-Trichloroethane 1:1		

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GENERAL CLEANING OF METAL (SERIES 80) TABLE 201		
Material Name	Material Bulk Code	Specifications
MEK: sec-Butyl alcohol 42:58 percent		
MEK: Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl isobutyl ketone (MIBK)	B00151	JIS-K-8903
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
M0K OR M0K*		
P-D-680, Type I, II, or III	B00074	
Shopmaster RTU		
Toluene	B00094	
TT-N-95, Type II	B00083	
TT-T-291, Type I, II, or III	B00762	
Turco 4460 BK		
Turco 6226		
Turco 6709		
Wedco 3500		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (SERIES 81) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for general cleaning of all organic coatings as listed in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. General Cleaning of All Organic Coatings (Series 81)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01001, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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GENERAL CLEANING OF ALL ORGANIC COATINGS (SERIES 81) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Aerfluor 343		
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
Extra Solv		
Freon TES or Genesolve DES		
Freon TF or Genesolve D	B00143	
Isopropyl alcohol (IPA)	B00130	
MIL-C-81302, Type I	B00143	
P-D-680, Type I, II, or III	B00074	
Shopmaster RTU		
TT-N-95, Type II	B00083	
TT-T-291, Type I, II, or III	B00762	
Turco 6226		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (SERIES 82) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for general cleaning of solvent resistant organic coatings as listed in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. General Cleaning of Solvent Resistant Organic Coatings (Series 82)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01002, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

GENERAL CLEANING OF SOLVENT RESISTANT ORGANIC COATINGS (SERIES 82)
TABLE 201

Material Name	Material Bulk Code	Other Specifications
1, 1, 1-Trichloroethane	B00090	
Acetone	B00062	JIS-K-1503
Aerfluor 343		
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		

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GENERAL CLEANING OF SOLVENT RESISTANT ORGANIC COATINGS (SERIES 82) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	B00647	
EP-921		
Ethyl alcohol, denatured	B00068	
Ethyl-3-Ethoxy propionate (EEP)		
Extra Solv		
FCC-55		
Freon TES or Genesolve DES		
Freon TF or Genesolve D	B00143	
Glidsafe Prepsolv		
Isopropyl alcohol (IPA)	B00130	
MEK: 1,1,1-Trichloroethane 1:1		

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GENERAL CLEANING OF SOLVENT RESISTANT ORGANIC COATINGS (SERIES 82) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
MEK: sec-Butyl alcohol 42:58 percent		
MEK: Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl isobutyl ketone (MIBK)	B00151	JIS-K-8903
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
MOK OR MOK*		
P-D-680, Type I, II, or III	B00074	
Shopmaster RTU		
Toluene	B00094	
TT-N-95, Type II	B00083	
TT-T-291, Type I, II, or III	B00762	
Turco 4460 BK		
Turco 6226		
Turco 6709		
Wedco 3500		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (SERIES 83) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for general cleaning of composites as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. General Cleaning of Composites (Series 83)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01003, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

GENERAL CLEANING OF SOLVENT RESISTANT ORGANIC COATINGS (SERIES 83)
TABLE 201

Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
Aerfluor 343		
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		

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GENERAL CLEANING OF SOLVENT RESISTANT ORGANIC COATINGS (SERIES 83) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
Ethyl alcohol, denatured	B00068	
FCC-55		
Glidsafe Prepsolv		
Isopropyl alcohol (IPA)	B00130	
MEK: 1,1,1-Trichloroethane 1:1		
MEK: sec-Butyl alcohol 42:58 percent		
MEK: Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
TT-N-95, Type II	B00083	

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GENERAL CLEANING OF SOLVENT RESISTANT ORGANIC COATINGS (SERIES 83) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Turco 4460 BK		
Turco 6709		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 84) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning of metal before painting as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning of Metal Prior to Painting (Series 84)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01004, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANIING OF METAL PRIOR TO PAINTING (SERIES 84) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	B00647	
FCC-55		
Glidsafe Prepsolv		
Isopropyl alcohol (IPA)	B00130	
MEK: 1,1,1-Trichloroethane 1:1		
MEK: sec-Butyl alcohol 42:58 percent		
MEK: Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
Toluene	B00094	

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FINAL CLEANIING OF METAL PRIOR TO PAINTING (SERIES 84) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Turco 4460 BK		
Turco 6709		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 85) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning of all organic coatings before painting as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning of All Organic Coatings Prior to Painting (Series 85)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01005, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANING OF ALL ORGANIC COATINGS PRIOR TO PAINTING (SERIES 85) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
FCC-55		
Isopropyl alcohol (IPA)	B00130	
MEK: sec-Butyl alcohol 42:58 percent		
MEK: Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
Toluene	B00094	
Turco 4460 BK		
Turco 6709		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 86) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning of solvent resistant organic coatings before painting as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning of Solvent Resistant Coatings Prior to Painting (Series 86)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01006, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANING OF SOLVENT RESISTANT ORGANIC COATINGS
PRIOR TO PAINTING (SERIES 86)
TABLE 201

Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	B00647	
FCC-55		
Glidsafe Prepsolv		
Isopropyl alcohol (IPA)	B00130	
MEK: 1,1,1-Trichloroethane 1:1		
MEK: sec-Butyl alcohol 42:58 percent		
MEK: Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK: MEK 3:2		
MIL-C-81302, Type I	B00143	

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FINAL CLEANING OF SOLVENT RESISTANT ORGANIC COATINGS
PRIOR TO PAINTING (SERIES 86)
TABLE 201

Material Name	Material Bulk Code	Other Specifications
Toluene	B00094	
Turco 4460 BK		
Turco 6709		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 87) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning of composites before painting as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning of Composites Prior to Painting (Series 87)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01007, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANING OF COMPOSITES PRIOR TO PAINTING (SERIES 87) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
FCC-55		
Glidsafe Prepsolv		
MEK: 1,1,1-Trichloroethane 1:1		
MEK: sec-Butyl alcohol 42:58 percent		
MEK: Toluene 1:1		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)		
MIBK:MEK 3:2		
Turco 4460 BK		
Turco 6709		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 88) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning of metal before non-structural bonding as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning of Metal Prior to Non-Structural Bonding (Series 88)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01008, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANING OF METAL PIROR TO NON-STRUCTURAL BONDING (SERIES 88) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
FCC-55		
Isopropyl alcohol (IPA)	B00130	
MEK: 1,1,1-Trichloroethane 1:1		
MEK: sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
Turco 6709		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 89) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning of all organic coatings before non-structural bonding as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning of All Organic Coatings Prior to Non-Structural Bonding (Series 89)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01009, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANING OF ALL ORGANIC COATINGS PIROR TO NON-STRUCTURAL BONDING (SERIES 89) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
Isopropyl alcohol (IPA)	B00130	
MIL-C-81302, Type I	B00143	

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 90) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning of solvent resistant organic coatings before non-structural bonding as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning of Solvent Resistant Organic Coatings Prior to Non-Structural Bonding (Series 90)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01010, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANING OF SOLVENT RESISTANT ORGANIC COATINGS PRIOR TO NON-STRUCTURAL BONDING (SERIES 90)
TABLE 201

Material Name	Material Bulk Code	Other Specifications
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
FCC-55		
Isopropyl alcohol (IPA)	B00130	
MEK: 1,1,1-Trichloroethane 1:1		
MEK: sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
Turco 6709		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 91) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning of composites before non-structural bonding as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning of Composites Prior to Non-Structural Bonding (Series 91)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This list of solvents has the Series Bulk Code of B01011, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANING OF COMPOSITES PRIOR TO NON-STRUCTURAL BONDING (SERIES 91) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
FCC-55		
Isopropyl alcohol (IPA)	B00130	
MEK: 1,1,1-Trichloroethane 1:1		
MEK: sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
Turco 6709		
B01011		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 92) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning before general sealing as given in BAC5000. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning Prior to General Sealing (Series 92)
   A. General
      (1) This selection of solvents uses BAC5000 as a guide and may be used on all surfaces except unpainted composite laminated surfaces. This list of solvents has the Series Bulk Code of B01012, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANING PRIOR TO GENERAL SEALING (SERIES 92) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
1,1,1-Trichloroethane	B00090	
Aliphatic Naphtha (for acrylic surfaces only)	B00083	TT-N-95(TyII)
BMS11-7	B00184	
Citra Safe	B00634	
Dowclene DC		
FCC-55		
MEK: sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone	B00148	ASTM D740 JIS-K-1524
Methyl propyl ketone (MPK)	B00666	

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 93) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning before fuel tank sealing as given in BAC5504. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning Prior to Fuel Tank Sealing (Series 93)
   A. General
      (1) This selection of solvents uses BAC5504 as a guide. This list of solvents has the Series Bulk Code of B01013, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANING PRIOR TO FUEL TANK SEALING (SERIES 93) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
1,1,1-Trichloroethane	B00090	O-T-620
BMS11-7	B00184	
Citra Safe	B00634	
Dowclene EC		
FCC-55		
MEK: sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	ASTM D740 JIS-K-1524
Methyl propyl ketone (MPK)	B00666	

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 94) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning before application of rain erosion coating before painting as given in BAC5880. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning Prior to Application of Rain Erosion Resistant Coating (Series 94)
   A. General
      (1) This selection of solvents uses BAC5880 as a guide. This list of solvents has the Series Bulk Code of B01014, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

FINAL CLEANING PRIOR TO APPLICATION OF RAIN EROSION RESISTANT COATING (SERIES 94)
TABLE 201

Material Name	Material Bulk Code	Other Specifications
Methyl ethyl ketone (MEK)	B00148	TT-M-261

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 95) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning before aerodynamic smoothing and fairing as given in BAC5030. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning Prior to Aerodynamic Smoothing and Fairing (Series 95)
   A. General
      (1) This selection of solvents uses BAC5030 as a guide. This list of solvents has the Series Bulk Code of B01015, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANING PRIOR TO AERODYNAMIC SMOOTHING AND FAIRING (SERIES 95) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
1,1,1-Trichloroethane	B00090	O-T-620
Aliphatic naphtha (for acrylic surfaces only)	B00083	TT-N-95, TyII
BMS11-7	B00184	MIL-C-38736B
Citra Safe	B00634	
FCC-55		
Methyl ethyl ketone (MEK)	B00148	ASTM D740
Methyl propyl ketone (MPK)	B00666	

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 96) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning of oxygen components exposed to oxygen as given in BAC5402. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning of Oxygen Components Exposed to Oxygen (Series 96)
   A. General
      (1) This selection of solvents uses BAC5402 as a guide. This list of solvents has the Series Bulk Code of B01016, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANIING OF OXYGEN COMPONENTS EXPOSED TO OXYGEN (SERIES 96) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Freon TF	B00143	
Isopropyl Alcohol	B00130	TT-I-735

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 97) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning prior to structural bonding as given in BAC5514. There are no procedural steps in this procedure.
2. Final Cleaning Prior to Structural Bonding (Series 97)
   A. General
      (1) This selection of solvents uses BAC5514 as a guide. This list of solvents has the Series Bulk Code of B01017, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANIING PRIOR TO STRUCTURAL BONDING (SERIES 97) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
MEK: sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	ASTM D740
Methyl isobutyl ketone (MIBK)	B00151	ASTM D1153
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
Sec-Butyl alcohol		ASTM D1007

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 98, 98-1) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for general cleaning of various polymerics as given in BAC5750. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents. This procedure contains two tasks:
      (1) Cleaning of specific polymerics (Series 98).
      (2) Cleaning of phenolics or nylon (Series 98-1).
2. Cleaning of Specific Polymerics (Series 98)
   A. General
      (1) This selection of solvents uses BAC5750 as a guide. This procedure contains a list of solvents for general cleaning of specific polymerics as given in BAC5750. This list of solvents has the Series Bulk Code of B01018, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
      (2) The solvents in this list may be used for:
         (a) The general cleaning of:
            1) Polyester (Vibrin, Mylar, Dacron)
            2) Polytetrafluoroethylene (Teflon)
            3) Polyvinyl fluoride (Tedlar)
         (b) OR, the final cleaning of the following prior to painting:
            1) Polyester (Vibrin, Mylar, Dacron)
            2) Polytetrafluoroethylene (Teflon)
            3) Polyvinyl fluoride (Tedlar)
         (c) OR, the final cleaning of the following prior to non-structural bonding:
            1) Polyester (Vibrin, Mylar, Dacron)
            2) Polytetrafluoroethylene (Teflon)
            3) Polyvinyl fluoride (Tedlar)
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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CLEANIING OF SPECIFIC POLYMERICS (SERIES 98) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
Ethyl-3-Ethoxy propionate (EEP)		
FCC-55		
Isopropyl alcohol (IPA)	B00130	
MEK: sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	
Methyl isobutyl ketone (MIBK)	B00151	JIS-K-8903
Methyl propyl ketone (MPK)	B00666	
MOK OR MOK*		
TT-N-95, Type II	B00083	
Turco 6709		

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3. Cleaning of Phenolics or Nylon (Series 98-1)

A. General

(1) This selection of solvents uses BAC5750 as a guide. This procedure contains a list of solvents for general cleaning of specific phenolics or nylon as given in BAC5750. This list of solvents has the Series Bulk Code of B01051, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.

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B. Procedure

(1) When your procedure refers to this subject (Table 202), use a solvent from this list.

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CLEANIING OF PHENOLICS OR NYLON (SERIES 98-1) TABLE 202		
Material Name	Material Bulk Code	Other Specifications
Acetone (Nylon only)	B00062	JIS-K-1503
CDG-110		
CDG-211		
Ethyl alcohol, denatured	B00068	
FCC-55		
Isopropyl alcohol (IPA)	B00130	
MEK: sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK) (Nylon only)	B00148	
Methyl isobutyl ketone (MIBK) (Nylon only)	B00151	JIS-K-8903
Methyl propyl ketone (MPK) (Nylon only)	B00666	
Toluene (Nylon only)	B00094	
TT-N-95, Type II	B00083	
Turco 6709		

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AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 99) - MAINTENANCE PRACTICES

1. General
   A. This procedure contains a list of solvents for final cleaning of composites prior to structural bonding as listed in BAC5578. This procedure gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.
2. Final Cleaning of Composites Prior to Structural Bonding (Series 99)
   A. General
      (1) This selection of solvents uses BAC5578 and D6-53900 as a guide. This list of solvents has the Series Bulk Code of B01019, but this code is only for reference to identify this complete group. In your orders to get the solvents of this list, you must identify each individual solvent by its name, bulk code, or other specification, as shown. Do not use the Series Bulk Code.
   B. Procedure
      (1) When your procedure refers to this subject (Table 201), use a solvent from this list.

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FINAL CLEANIING OF COMPOSITES PRIOR TO STRUCTURAL BONDING (SERIES 99) TABLE 201		
Material Name	Material Bulk Code	Other Specifications
1,1,1-Trichloroethane (Non-metallic core only)	B00090	
Acetone	B00062	O-A-51
BMS11-7 (Non-metallic core only)	B00184	
MEK: Toluene 1:1		ASTM D740 TT-T-548
Methyl ethyl ketone (MEK)	B00148	ASTM D780
Methyl propyl ketone (MPK) (High purity)	B00666	
Naphtha (Non-metallic core only)	B00083	TT-N-95

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STATIC GROUNDING - MAINTENANCE PRACTICES

1. General
   A. This procedure contains these tasks:
      (1) Static ground procedure
      (2) Bonding procedure
      (3) Measure airplane electrical resistance to ground
      (4) Grounding (Static Grounding) is the process of connecting one or more metal objects and ground conductors to ground electrodes (an electrical path to earth).
         (a) A positive ground is the same as a static ground.
      (5) Bonding is the process of connecting two or more metal objects together with a conductor.
   B. If airplane is parked for turnaround flight, static electrical grounding is not necessary if no maintenance is to be done on the airplane.
   C. During pressure refueling the airplane, do the following:
      (1) Static grounding is not necessary.
      (2) Electrical bond between the airplane and the refueling vehicle is recommended.
   D. Positive grounding of the airplane during over wing refueling is recommended.
   E. Statically ground the airplane when performing maintenance task using following devices:
      (1) Power tools
      (2) Electrical power sources
      (3) Lights
      (4) Powered instruments
   F. When static grounding is recommended in a detailed procedure, the airplane must be statically grounded to a common, approved, identified ground. Where a grid system is used, any number of individual grounds will provide a common ground, since all grounds are interconnected. If an area does not have a grid system, a single approved and identified ground must be used as the common ground for all grounding cables used.

      WARNING: DO NOT WEAR HEADSET OR HANDLE ANY UMBILICAL CONNECTIONS TO AIRPLANE DURING ATMOSPHERIC ELECTRICAL DISTURBANCES. LIGHTNING STRIKE CAN CAUSE SEVERE INJURY.

   G. Stop ground servicing operations, external to the airplane, during electrical storms.
   H. Electrostatic Grounding - Parked Airplane
      (1) The airplane is normally electrostatically grounded through conductive tires. (AMM Procedure for measuring electrical resistance to ground.)

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(2) If needed to prevent static electrical discharge shocks to attending personnel or passengers.
(a) Airplanes having inadequate conductivity to ground through the tires and
(b) Airplanes parked on a surface where the parking site conductivity is inadequate to carry away static electrical charge, should be electrostatically grounded to an identified grounding point.

NOTE: The operator should assure the adequacy of airplane and parking area conductivity and may need to establish local procedures in areas where inadequate parking site conductivity is seasonal or permanent. Parking site conductivity may be inadequate on dry snow, dry sand or in areas of low moisture.

I. Should operators elect not to follow this recommended procedure, they should develop alternate procedures or establish conditions adequately protecting the personnel and equipment involved. Local fire codes and customs may require alternative or additional procedures to those defined here.

2. Static Ground Procedure (Fig. 201)

A. Access

(1) Location Zones

204	Nose Landing Gear
310	Left Main Landing Gear
410	Right Main Landing Gear

B. Grounding procedure:

WARNING: DO NOT CONNECT A HEADSET AND DO NOT TOUCH CONNECTIONS TO THE AIRPLANE DURING ATMOSPHERIC ELECTRICAL ACTIVITY OR IN STRONG RADIOACTIVE FIELDS. LIGHTNING STRIKE AND HIGH DISCHARGE CURRENTS CAN CAUSE SEVERE INJURY.
ALWAYS ATTACH THE GROUNDING CABLE TO THE GROUND CONNECTION FIRST. NEVER ATTACH THE CABLE TO THE AIRPLANE AND THEN TO THE GROUND CONNECTION.

CAUTION: ATTACH GROUNDING CABLES ONLY TO SPECIFIED POINTS ON THE AIRPLANE. INCORRECTLY ATTACHED GROUNDING CABLES CAN CAUSE SCRATCHES WHICH CAN CAUSE CORROSION AND CRACKS ON STRESSED PARTS. GROUND WIRES ATTACHED TO DOORS OR FAIRINGS MADE FROM COMPOSITE MATERIALS DO NOT PROVIDE A GROUND.

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(1) Attach grounding cable to a static ground and to the airplane in the following sequence:
(a) Connect the grounding cable to an approved, identified static ground point. These points may be located in the parking surface or in another fixed location.
(b) Connect the grounding cable to approved grounding attach point on the airplane. These points are identified in Fig. 201.
(c) During landing gear retraction test, attach grounding clamps to radial stud at locking collar on the jack when the airplane is jacked up.
(2) Before the airplane is moved, remove the ground cables from the approved grounding attach point on the airplane.

3. Bonding Procedure
A. Procedure

WARNING: DO NOT CONNECT A HEADSET AND DO NOT TOUCH CONNECTIONS TO THE AIRPLANE DURING ATMOSPHERIC ELECTRICAL ACTIVITY OR IN STRONG RADIOACTIVE FIELDS. LIGHTNING STRIKE AND HIGH DISCHARGE CURRENTS CAN CAUSE SEVERE INJURY.

CAUTION: ATTACH BONDING CABLES ONLY TO SPECIFIED POINTS ON THE AIRPLANE. INCORRECTLY ATTACHED BONDING CABLES CAN CAUSE SCRATCHES WHICH CAN CAUSE CORROSION AND CRACKS ON STRESSED PARTS. BOND WIRES ATTACHED TO DOORS OR FAIRINGS MADE FROM COMPOSITE MATERIALS DO NOT PROVIDE A BOND.

(1) Connect a bonding cable to a recognized bonding or grounding point on the airplane and a recognized grounding or bonding point on the support equipment is use.
(2) Before the airplane is moved, remove the ground cables in the opposite sequence that you attached them.

4. Measure Airplane Electrical Resistance to Ground
A. Special Tool and Equipment
(1) Multimeter - COM-0591
B. References
(1) AMM 24-44-11/201
(2) AMM 24-41-03/601
C. Prepare to Check
(1) Remove electrical power from the airplane (AMM 24-41-11/201).
(2) Do a continuity check from the neutral pin of the external power receptacle to the grounding stud with an ohmmeter (AMM 24-41-03/601).

NOTE: The value should be less than 0.1 ohms.

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(3) Remove or de-energize any external powered devices.
(4) Disconnect airplane static ground cables if connected.
(5) Connect an ohmmeter between the recognized bonding/grounding point on the airplane and the nearest identified ground point on the ramp.
(6) Measure the resistance to ground and record in the maintenance log. Resistance should be less than 1.0 megaohms.
(7) If the resistance exceeds 1.0 megaohms this may be the result of inadequate grounding point or exceptional high surface resistance. Do the following:

NOTE: If the resistance to ground is greater than 1.0 megaohms, record this fact in the airplane log book and advise the flight crews of subsequent flights of this airplane that insufficient conductivity to ground is established through the tires to electrostatically ground this airplane on a parking surface and that static ground procedures may apply.

(a) Ensure the airplane is not parked over painted surfaces and that the tires provide adequate conductivity.
(b) Repeat the measurement at other parking site locations where successful measurement has been made to verify inadequate airplane conductivity.

(8) Connect airplane static ground cables if required.
(9) Put the airplane back to its usual condition.

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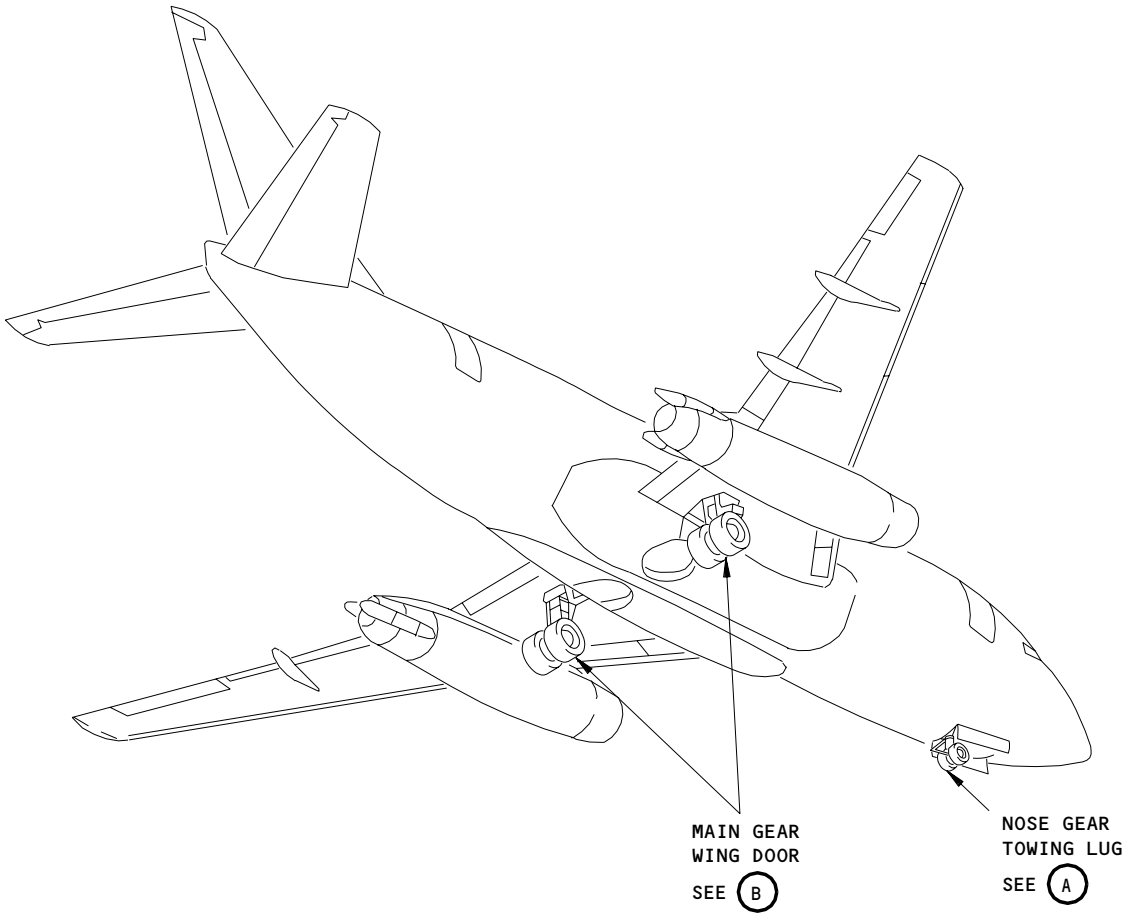

Static Grounding Point Locations
Figure 201 (Sheet 1)

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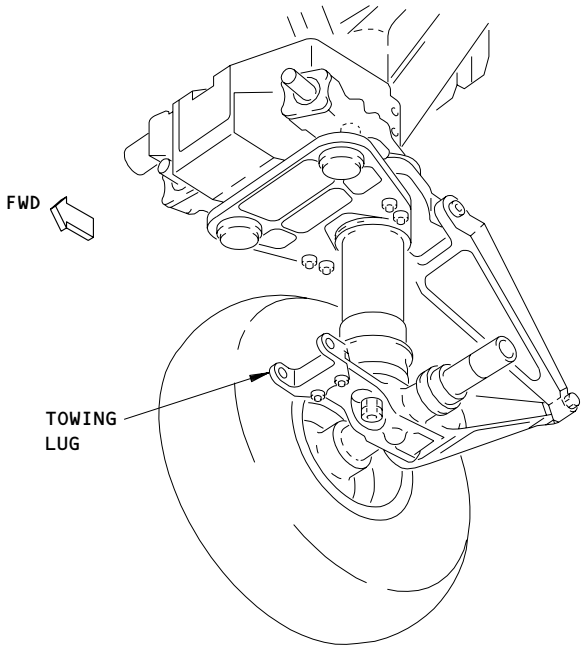
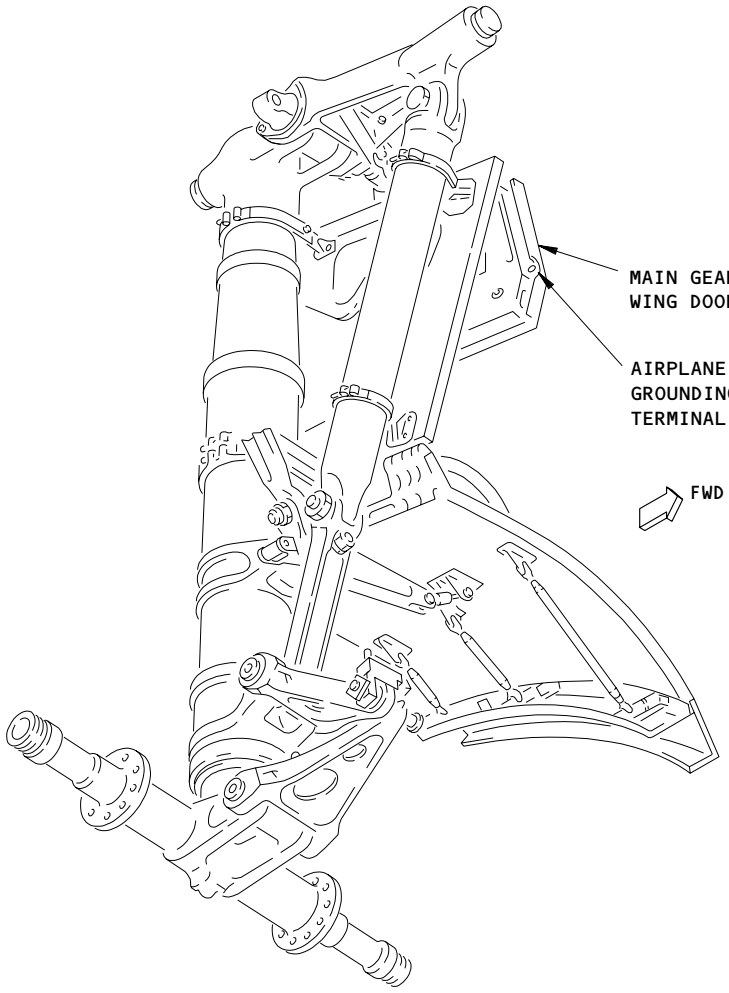


NOSE GEAR TOWING LUG LOCATION

A



LEFT MAIN GEAR SHOWN
RIGHT MAIN GEAR OPPOSITE

MAIN GEAR GROUNDING STUD LOCATION

B

Static Grounding Point Locations
Figure 201 (Sheet 2)

441353

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ELECTROSTATIC DISCHARGE SENSITIVE DEVICES - MAINTENANCE PRACTICES

1. General
   A. Many electronic line replaceable units (LRU's) contain microcircuit components that are susceptible to damage from electrostatic charges. Such components are referred to as electrostatic discharge sensitive (ESDS) devices. Decals (Fig 201) installed on ESDS (LRU's) indicate that special handling is required. Personnel who remove, install, and transport ESDS Units should have an understanding of static electricity, including generation of static charge and protection from electrostatic discharge.
   B. Electrostatic charges can be generated and stored in a variety of ways on the surfaces of all bodies. Electrostatic discharges are generated when materials of different electrical potentials come into close proximity. Discharges from materials such as nylon or your skin can cause discharge currents capable of damaging unprotected ESDS components. ESDS damage may cause catastrophic failures, characteristic changes and/or performance degradation.
   C. The purpose of the following procedures is to assist personnel to recognize which are ESDS LRU's and the precautions necessary for handling the units which contain ESDS components identified by a special decal (Fig. 201). Three basic types of ESDS symbols are in common usage. These include military, commercial and an international symbol. The international symbol is used on Boeing designed equipment but the other symbols may be used on some LRU's.
2. Removal and Installation of ESDS Printed Circuit Boards
   A. Equipment and Material
      (1) Conductive bags - 3M 2100 series
      (2) Wrist straps - 3M 2066, 2067, 2211, 2212, 2213, or 2214
      (3) 100% cotton twine - commercially available
      (4) ESDS Labels (Fig. 201)
         (a) JEDIC international label - multisource
         (b) 3M P/N 7102
   B. Remove printed circuit boards with ESDS decals.
      (1) Remove system electrical power.

         WARNING: USE ONLY WRIST STRAPS WITH A GROUNDING LEAD RESISTANCE OF GREATER THAN 1 MEGOHM. INADVERTENT CONTACT BETWEEN A LOW RESISTANCE WRIST STRAP AND A HIGH VOLTAGE IS A SHOCK HAZARD TO PERSONNEL.

      (2) Connect wrist strap assembly to a convenient ground on component containing PC board and to skin of person removing PC board.
      (3) Gain access to printed circuit board.
      (4) Remove printed circuit board using extractors provided.

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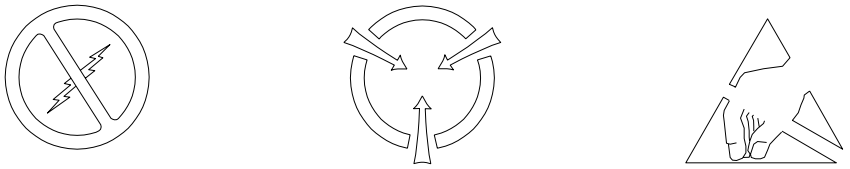

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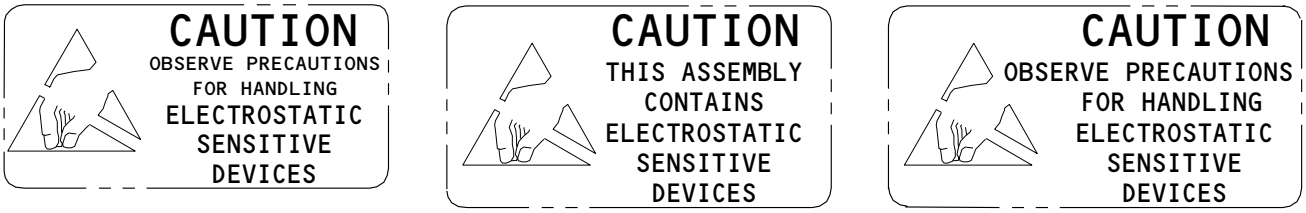
TYPES OF ESDS SYMBOLS



TYPICAL BOEING ESDS DECALS

Static Discharge Sensitive Devices Identifiers
Figure 201

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(5) Immediately insert static sensitive board into a conductive bag and identify with an ESD label. Use an ESDS label or 100% cotton twine to close conductive bag.

CAUTION: DO NOT USE STAPLES OR ADHESIVE TAPE TO CLOSE CONDUCTIVE BAG. DAMAGE TO BAG WILL EXPOSE CONTENTS TO ELECTROSTATIC DISCHARGE.

(6) Close and secure unit unless replacement card is to be installed immediately.
(7) Disconnect wrist strap from ground and operator.
(8) Place bagged printed circuit card in a rigid container to maintain integrity of conductive bag during transportation.

C. Install printed circuit board with ESDS decals.
(1) Check that system electrical power is off.

WARNING: USE ONLY WRIST STRAPS WITH A GROUNDING LEAD RESISTANCE GREATER THAN 1 MEGOHM INADVERTENT CONTACT BETWEEN A LOW RESISTANCE WRIST STRAP AND A HIGH VOLTAGE IS A SHOCK HAZARD TO PERSONNEL.

(2) Connect wrist strap assembly to a convenient ground on unit where the printed circuit board is to be installed and to skin of person installing PC board.
(3) Gain access to receptacle that PC board is to be installed into.
(4) Remove static sensitive PC board from conductive bag.

CAUTION: DO NOT TOUCH CONNECTOR PINS OR OTHER EXPOSED CONDUCTORS. DAMAGE TO COMPONENTS CAN RESULT.

(5) Install PC card in position using extractors provided. Lock extractors.
(6) Close and secure unit
(7) Disconnect wrist strap.

3. Removal and Installation of Metal-Encased ESDS LRU's

A. General
(1) Metal-encased ESDS units can be either rack mounted, panel mounted or bolted on.

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B. Equipment and Material
(1) Dust caps.

NOTE: Conductive or antistatic-dust caps should be used when available. If conductive or antistatic dust caps are not available, nonconductive dust caps may be used but with caution since they do not provide complete ESDS protection during handling.

C. Remove metal encased LRU's with ESDS labels
(1) Remove system electrical power.
(2) Remove ESDS labeled unit from rack, panel, or mounted position.

CAUTION: DO NOT TOUCH CONNECTOR PINS OR OTHER EXPOSED CONDUCTORS. DAMAGE TO COMPONENTS CAN RESULT.

(3) Install dust caps on all connectors. Do not touch electrical pins in connectors.

NOTE: Dust caps from unit being installed may be used on the unit being removed.

(4) Transport unit per standard practices with dust caps installed.
D. Install metal encased LRU's with ESDS labels.
(1) Check that system electrical power is off.

CAUTION: DO NOT TOUCH CONNECTOR PINS OR OTHER EXPOSED CONDUCTORS. DAMAGE TO COMPONENTS CAN RESULT.

(2) Remove all dust caps from connectors of unit being installed. Do not touch electrical pins in connectors.
(3) Place unit in position and secure.

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STANDARD TORQUE VALUES - MAINTENANCE PRACTICES

1. General
   A. The torque values listed in Fig. 202 provide data for tightening all types of threaded fasteners, both lubricated and nonlubricated, and the values required when tightening the fastener either by the nut or the bolt. Restricted access often requires the use of an adapter having a torque length "B". This condition requires a corrected torque wrench reading "T1". Follow the examples in Fig. 201 to determine the corrected torque wrench reading when using an adapter. All special torque values required for specific installations are given in the applicable text covering those items.
   B. The self-locking mechanism of nuts and nutplates shall develop the minimum locking torque at room temperature (Fig. 203). Where there is an apparent easy turning or excessive drag when installing the nut on the bolt, the nut should be removed and tested (Fig. 203).
   C. Torque values are given in Fig. 202 for bolts and nuts.
   D. Torque values are given in Fig. 204 for reduced head bolts.
   E. Torque values are given in Fig. 205 for rigid tube coupling connector.
   F. Torque values are given in Fig. 206 for pipe thread fittings.
   G. Torque values are given in Fig. 207 for low pressure and return line fittings.
   H. Torque values are given in Fig. 208 for high pressure line flareless fittings with lubricated threads.
   I. Torque values are given in Fig. 209 for hose and duct clamps.

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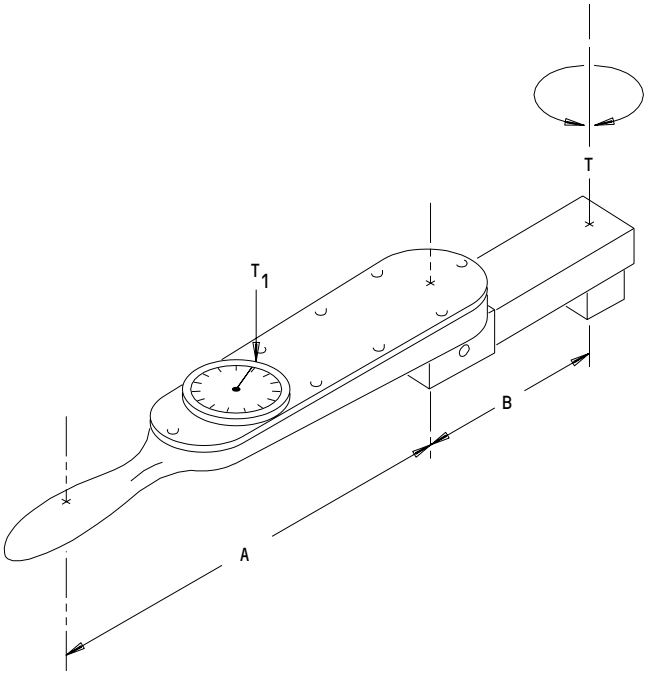
$$T_1 = \frac{TA}{A+B}$$

A = TORQUE LENGTH OF TORQUE WRENCH
B = TORQUE LENGTH OF ADAPTER
T = ACTUAL TORQUE OF NUT
T_1 = INDICATED TORQUE OF WRENCH (CORRECTED TORQUE)

EXAMPLE A = 12 IN.
B = 3 IN.
T = 160 POUND-INCHES

$$T_1 = \frac{160 \times 12}{12+3}$$

T_1 = 128 POUND-INCHES



METHOD I

Torque Wrench Adapter
Figure 201 (Sheet 1)

441360

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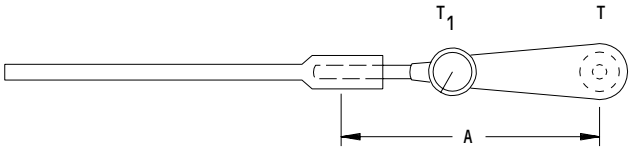
USING HANDLE EXTENSION ONLY.
NO CORRECTION NECESSARY.

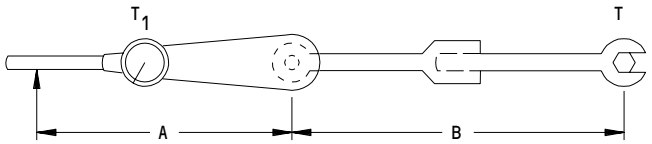
$T_1 = T$



METHOD II

USING ADAPTER WITH EXTENSION BETWEEN ADAPTER AND WRENCH BOTH IN LINE WITH WRENCH. INDICATED TORQUE T_1:

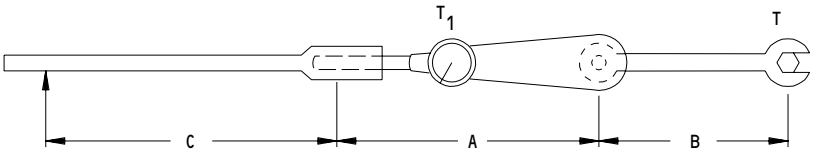
$$T_1 = \frac{TA}{A+B}$$



METHOD III

USING BOTH HANDLE EXTENSION AND ADAPTER, INDICATED TORQUE T_1:

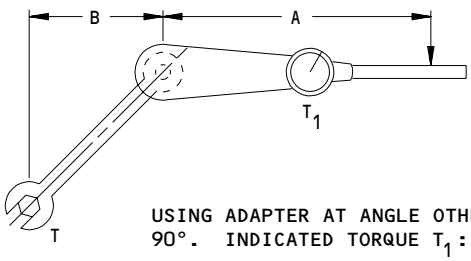
$$T_1 = \frac{T(A+C)}{A+B+C}$$



METHOD IV

METHODS V AND VI SHOULD BE AVOIDED. WHEN NECESSARY TO USE EITHER OF THESE METHODS, THE FOLLOWING RESTRICTIONS MUST BE MET:

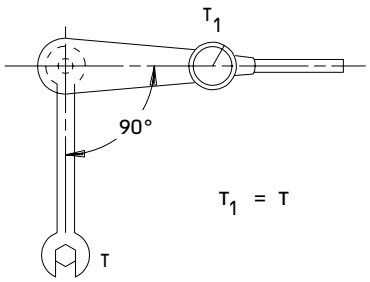
1. THE ADAPTER PLUS ANY EXTENSIONS USED BETWEEN THE WRENCH AND ADAPTER MUST NOT EXCEED THE LENGTH OF THE WRENCH.
2. WHEN A FORCE IS APPLIED AT 90 ±3 DEGREES TO THE HANDLE OF THE WRENCH, IT IS RECOMMENDED THAT A STIRRUP-TYPE HANDLE WITH A POINTER (INDICATING ANGLE OF LOADING) BE USED TO ENSURE LOADING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



USING ADAPTER AT ANGLE OTHER THAN 90°. INDICATED TORQUE T_1:

$$T_1 = \frac{TA}{A+B}$$

METHOD V



USING ADAPTER AT RIGHT ANGLE TO THE WRENCH. NO CORRECTION NECESSARY.

METHOD VI

Torque Wrench Adapter
Figure 201 (Sheet 2)

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NUT	PART NUMBER AND STYLE	N10HR (12-POINT), N10JG (12-POINT), N10HC (BARREL NUT)		NAS1804-1805 (12-POINT), N10GW (12-POINT), N10JA (PLATE-NUT), N10B (12-POINT), N10JB (PLATE-NUT), N10RM (PLATE-NUT), NAS577 (BARREL-NUT), N10JD (CASTELLATED NUT THICK STYLE 7/16 THRU 1-1/4 ONLY) 4			N10JC (SHEET METAL HEX-SIZES #4 THRU 7/16 ONLY), ALL PLATE-NUTS EXCEPT N10JA, N10JB, AND N10RM, ALL CLIP-NUTS, INSERTS, AND TAPPED HOLES, MS21042 HEX, MS21043, N10JD (CASTELLATED-THICK STYLE ALL SIZES 3/16 THRU 1-1/4), MS14144 (CASTELLATED-THICK STYLE) 4			AN316, AN316C, (JAMNUTS), N10JC, MS21245 (HEX SIZES 1/2 THRU 1-1/2) N10JD, MS14145 (CASTELLATED-THIN STYLE ALL SIZES -103 THRU -120) 4		BACN10YJ NYLON NUT
	STYLE	12-POINT		12-POINT	HEX HEAD	PAN HEAD	100° HEAD	12-POINT	HEX HEAD	PAN HEAD	100° HEAD	SOCKET HEAD	ALL	ALL
BOLT	PART NUMBER	B30NG B30NH B30US B30TR		B30FD B30MR B30LE B30PN 2	B30NE B30LM B30NM NAS6603 THRU NAS6620 NAS6703 THRU NAS6720	B30LN B30NS B30EM	B30LP B30EM B30LU B30LR B30MS B30NN	B30LT B30NL B30NJ B30NK B30UU	B30LJ B30NR B30NF B30PF B30PU B30PW S12CB NAS563 THRU 572 NAS1801 NAS1802 NAS6203 THRU NAS6220	B30LK B30NT B30BE B30BG NAS1217 NAS1218 NAS600 THRU NAS606 NAS623	B30PC B30LH B30RF B30SW B30UW	MS21262 MS24678 NAS1351 NAS1352	ALL	ALL
		TORQUE RANGE (POUNDS-INCH)												
	THREAD SIZE	DRY BOLT	LUBED BOLT 3	DRY BOLT	LUBED BOLT 3			DRY BOLT	LUBED BOLT 3				DRY OR LUBED BOLT 3	DRY OR LUBED BOLT 3
	2-56 OR 2-64	---	---	---	---			3.4-4.5	3.4-4.5				3.4-4.5	---
	4-40 OR 4-48	---	---	---	---			6-8	6-8				6-8	---
	6-32 OR 6-40	---	---	---	---			12-15	12-15				12-15	---
	8-32 OR 8-36	---	---	---	---			15-20	15-20				15-17	5-6
	10-32	---	---	30-35	20-25			25-35	20-25				18-25	6-8
	1/4-28	90-125	70-80	65-100	50-75			50-80	50-75				30-50	---
	5/16-24	180-250	145-180	130-200	90-125			100-150	90-125				60-95	---
	3/8-24	300-500	275-330	220-410	150-250			160-240	150-200				95-160	---
	7/16-20	510-840	370-440	370-690	260-425			250-350	240-300				220-280	---
	1/2-20	870-1300	500-575	630-1070	440-650			480-790	440-650				290-510	---
	9/16-18	1300-1800	800-1000	1000-1470	700-920			800-1150	700-920				480-850	---
	5/8-18	1900-2300	1350-1650	1400-1900	1000-1200			1100-1500	1000-1200				660-980	---
	3/4-16	3300-4300	2800-3300	2400-3500	1700-2150			2300-3000	1700-2150				1300-2000	---
	7/8-14	5100-6700	2900-4500	3700-5500	2600-3400			2500-4500	2600-3400				1500-3300	---
	1-12 OR 1-14	7000-10,900	6200-7000	5100-8900	3600-5500			3700-7500	3600-5500				2200-5300	---
	1-1/8-12	9500-13,000	8300-9400	6900-10,700	4900-6700			5000-9000	4900-6700				3000-6200	---
	1-1/4-12	15,800-19,200	11,000-12,000	11,500-15,700	7500-9700			9000-13,000	7500-9700				5400-8600	---
	1-3/8-12	20,000-24,000	16,000-17,000	---	---			---	---				7000-9000	---
	1-1/2-12	---	---	---	---			---	---				10,000-12,000	---

1 WHEN ANY BOLT IS TO BE INSTALLED BY WRENCHING THE HEAD, SUCH AS WHEN YOU INSTALL BOLTS INTO PLATE-NUTS, CLIP-NUTS, BARREL-NUTS, INSERTS, OR TAPPED HOLES, THE INSTALLATION TORQUE MUST BE THE MAXIMUM TORQUE SHOWN IN THE TABLE FOR THE NUT ± 10%.

2 WHEN B3OLE OR PN BOLTS ARE INSTALLED WITH N10HR NUTS, USE THE INSTALLATION TORQUE SHOWN FOR N10GW NUTS.

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

4 WHEN SAFETYING FINE CASTELLATED NUTS, TIGHTEN THE NUT TO THE LOW SIDE OF THE SELECTED TORQUE RANGE, AND IF NECESSARY, CONTINUE TO TIGHTEN IT UNTIL A SLOT ALIGNS WITH THE SAFETY HOLE.

Standard Torque Values for Bolts and Nuts
Figure 202 (Sheet 1)

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NUT TIGHTENING TORQUE 1			
NUT	PART NUMBER AND STYLE	COARSE THREADED NUTS, INSERTS AND TAPPED HOLES	
BOLT	STYLE	ALL	
	PART NUMBER	ALL	
THREAD SIZE		TORQUE (POUND-INCHES)	
		DRY BOLT	MAXIMUM 5
---		---	---
---		---	---
---		---	---
---		---	---
10-24		12-15	21
1/4-20		25-30	45
5/16-18		48-55	100
3/8-16		95-110	170
7/16-14		140-155	280
1/2-13		240-290	520
9/16-12		300-420	650
5/8-11		420-540	900
3/4-10		700-950	1500
7/8-9		1300-1800	2700
1-8		2200-3000	4500
1-1/8-7		3300-4000	7200
1-1/4-7		4000-5000	10,000
---		---	---
---		---	---

5 THE MAXIMUM TORQUE ALLOWABLE FOR THE ALIGNMENT OF THE CASTELLATED NUT AND HOLE TO PUT IN A COTTER PIN OR OTHER SAFETY DEVICE.

Standard Torque Values for Bolts and Nuts
Figure 202 (Sheet 2)

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THREAD SIZE	DIAMETER DASH NO.	NAS1423 AND NAS509 JAMNUTS 6			ALL OTHER NONSELF-LOCKING JAMNUTS 7		
		TORQUE (INCH-POUNDS)			TORQUE (INCH-POUNDS)		
		MINIMUM	TARGET	MAXIMUM	MINIMUM	TARGET	MAXIMUM
0.1900-32	-3	10	13	16	16	19	22
0.2500-28	-4	15	18	21	24	27	30
0.3125-24	-5	30	33	36	46	49	52
0.3750-24	-6	40	43	46	60	65	70
0.4375-20	-7	60	65	70	93	98	103
0.5000-20	-8	75	80	85	109	116	124
0.5625-18	-9	85	90	95	128	135	143
0.6250-18	-10	96	101	106	144	151	159
0.7500-16	-12	150	158	165	227	237	247
0.8750-14	-14	210	220	230	315	330	345
1.0000-12	-16	270	280	290	400	420	440
1.1250-12	-18	350	365	380	523	548	573
1.2500-12	-20	430	450	470	645	675	705

JAMNUTS

6 LOCKWIRED JAMNUTS
7 NON-LOCKWIRED JAMNUTS

Standard Torque Values for Bolts and Nuts
Figure 202 (Sheet 3)

1412361

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TORQUE - SELF-LOCKING NUTS 1

FINE THREADS (REF BPS-N-70)				COARSE THREADS (REF MIL-N-25027)		
TORQUE (POUND-INCHES)				TORQUE (POUND-INCHES)		
	USED NUT		NEW NUT			
SIZE	MINIMUM BREAKAWAY	MAXIMUM LOCKING	MINIMUM 1ST CYCLE BREAKAWAY	SIZE	MINIMUM LOCKING	MAXIMUM LOCKING
4-48		3	-	2-56	0.2	2.5
6-40	1.0	6	-	4-40	0.5	5
8-36	1.5	9	-	6-32	1.0	10
10-32	2.0	13	-	8-32	1.5	15
1/4-28	3.5	30	7	10-24	2.0	18
5/16-24	6.5	60	12	1/4-20	4.5	30
3/8-24	9.5	80	18	5/16-18	7.5	60
7/16-20	14.0	100	26	3/8-16	12.0	80
1/2-20	18.0	150	34	7/16-14	16.5	100
9/16-18	24.0	200	46	1/2-13	24.0	150
5/8-18	32.0	300	60	9/16-12	30.0	200
3/4-16	50.0	400	90	5/8-11	40.0	300
7/8-14	70.0		135	3/4-10	60.0	400
1-14	90.0	800	180	7/8-9	82.0	600
1-12	90.0	800	180	1-8	110.0	800
1-1/8-12	117.0	900	234	1-1/8-7	137.0	900
1-1/4-12	143.0	1000	285	1-1/4-7	165.0	1000
1-3/8-12	165.0	1100	330	1-3/8-6	200.0	1200
1-1/2-12	195.0	1250	386	1-1/2-6	230.0	1400
1-3/4-12	245.0	1450	490	1-3/4-5	300.0	1800
2-12	300.0	1700	600	2-4.5	360.0	2200
				2-1/4-4.5	430.0	2600
				2-1/2-4.5	500.0	3000

1 THE FOLLOWING CONDITIONS MUST BE USED FOR TORQUES (REF BPS-N-70):

A. THE MINIMUM-TO-MAXIMUM TORQUE RANGE IS USED TO FIND THE CONDITION OF A USED SELF-LOCKING NUT AND BOLT SET.

B. ALL NUT THREADS SHALL BE NEW OR UNDAMAGED. A NUT IS CONSIDERED INSTALLED WHEN A MINIMUM OF ONE THREAD PLUS THE CHAMFER OF THE MALE THREAD EXTENDS BEYOND THE TOP OF THE NUT. IF THE MALE THREAD DOES NOT HAVE A CHAMFER, THE MALE THREAD MUST EXTEND ONE AND ONE-HALF THREADS (MINIMUM) ABOVE THE TOP OF THE NUT.

C. THE REMOVAL WILL BE COMPLETE WHEN THE LOCKING DEVICE IS DISENGAGED.

D. THE MINIMUM BREAKAWAY TORQUE IS THE TORQUE REQUIRED TO TURN A NUT OR BOLT FROM AN INSTALLED POSITION. THIS CONDITION IS FOR BOLT THREADS WITH NO LOAD ON THE BASE OF THE NUT.

E. THE MAXIMUM LOCKING TORQUE IS THE MAXIMUM TORQUE DURING THE INSTALLATION OR REMOVAL OF NUTS WITH NO LOAD ON THE BASE OF NUT.

Standard Torque Values for Self-Locking Nuts
Figure 203

1412364
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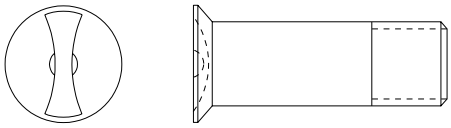
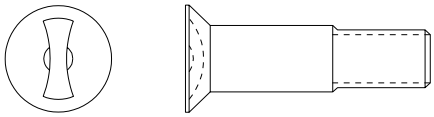
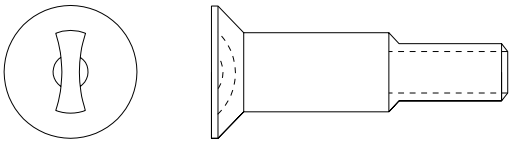


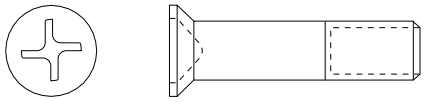
BACB30DP (CRES)
BACB30EL (STEEL)



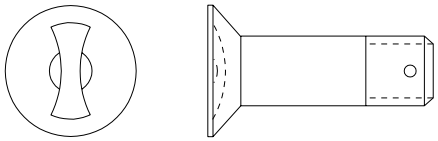
BAC30RF (STEEL)



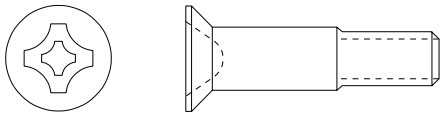
BACB30NU (TITANIUM)



BACB30UR (TITANIUM)



BACB30LL (CRES)



BACB30VF (TITANIUM)

BACB30DP,BACB30EL,BACB30LL,BACB30NU,BACB30RF,BACB30UR,BACB30VF	
BOLT SIZE	TORQUE RANGE POUND-INCHES (Nm)
8-32	10-13 (1.13-2.03)
10-32	15-18 (2.03-2.82)
1/4-28	26-30 (3.39-4.52)
5/16-24	60-65 (10.17-11.30)
3/8-24	95-105 (10.73-11.86)
7/16-20	150-170 (16.95-19.21)
1/2-20	220-245 (24.86-27.68)
9/16-18	290-325 (32.76-36.72)
5/8-18	395-435 (44.63-49.15)
3/4-16	645-720 (72.87-81.35)
7/8-14	1040-1150 (117.50-129.93)
1-12 OR 1-14	1560-1730 (176.26-195.46)

Standard Torque Values for Reduced Head Bolts
Figure 204

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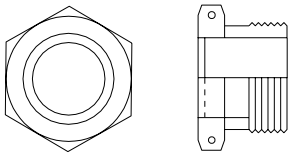
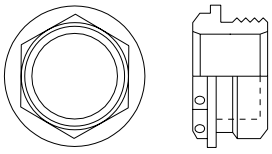
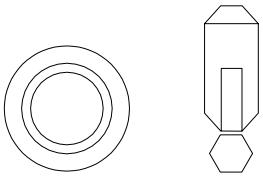


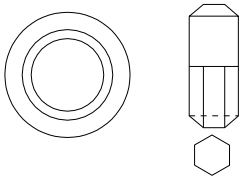
NAS591



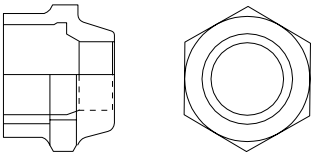
NAS594



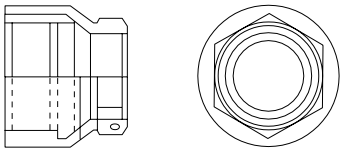
NAS592



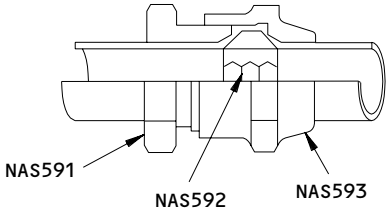
NAS595



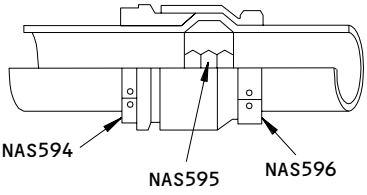
NAS593



NAS596



CONNECTION ASSEMBLY (REF)



CONNECTION ASSEMBLY (REF)

TUBE OD (INCHES)	ALUMINUM ALLOY FITTINGS NAS591-593		STAINLESS STEEL FITTINGS NAS594-596	
	TORQUE (POUND-INCHES)		TORQUE (POUND-INCHES)	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
1	480	720	480	720
1-1/4	600	900	600	900
1-1/2	600	900	600	900
2	900	1200	900	1200
2-1/2	1500	1800	1800	2100
3			1800	2100
4			2400	2700

Standard Torque Values For Rigid Tube Coupling Connectors
Figure 205

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PIPE THREAD SIZE (INCHES)	ALL PIPE EXCEPT STAINLESS STEEL TO STAINLESS STEEL		STAINLESS STEEL TO STAINLESS STEEL PIPE FITTINGS	
	TORQUE (POUND-INCHES)		TORQUE (POUND-INCHES)	
	WORKING	MAXIMUM	MINIMUM	MAXIMUM
1/8	100	175	100	150
1/4	150	300	100	275
3/8	225	450	100	400
1/2			100	500
3/4			150	600
1			200	800

Standard Torque Values for Pipe Thread Fittings
Figure 206

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TUBE OUTSIDE DIAMETER (INCHES)	FITTING NUT SIZE	TORQUE 1 (POUND-INCHES)	TORQUE 2 (POUND-INCHES)
1/4	-4	110	65
5/16	-5	140	90
3/8	-6	170	130
1/2	-8	280	260
5/8	-10	360	360
3/4	-12	450	500
1	-16	750	700
1-1/4	-20	900	900
1-1/2	-24	900	900
2	-32		2000

1 TORQUE VALUES ARE APPLICABLE TO:

(1) FLARED ALUMINUM TUBE ENDS
(2) FLARELESS ALUMINUM TUBE ENDS WITH BACS13BD OR BACS13BX SWAGED SLEEVES
(3) FLARELESS TYPE HOSE END FITTINGS WITH ALUMINUM INSERTS
(4) STANDARD MS FLARELESS TUBE ENDS ON 6061-T6 ALUMINUM TUBING AND ANNEALED CRES TUBING. ANNEALED CRES TUBING IS IDENTIFIED BY A WIDE YELLOW BAND ADJACENT TO TUBING-USE IDENTIFICATION CODE MARKINGS

2 TORQUE VALUES ARE APPLICABLE TO FLARED HOSE END FITTINGS WITH ALUMINUM INSERTS

NOTE: TORQUE VALUES ARE APPLICABLE TO ALL WALL THICKNESSES FOR A GIVEN DIAMETER TUBE AND HAVE A ±5% TOLERANCE.

Standard Torque Values for Low Pressure and Return Line Fittings
Figure 207

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TUBING SIZE (INCHES)		INSTALLATION TORQUE ON FLARELESS TUBING FITTINGS/BOSSES 3 4 (POUND-INCHES, ±5%) NOTE: YOU MUST USE CARE WHEN YOU SELECT THE CORRECT TORQUE FOR REDUCER FITTINGS. YOU MUST FIND THE CORRECT FITTINGS INSTALLATION TORQUE FOR THE SIZE OF THE BOSS OR BULKHEAD.	
OD	TUBE DASH NO.	STEEL AND TITANIUM TUBES 1	ALUMINUM AND ANNEALED CRES TUBES 2
3/16	-3	100	80
1/4	-4	140	110
5/16	-5	190	140
3/8	-6	270	170
1/2	-8	500	280
5/8	-10	700	360
3/4	-12	900	450
1	-16	1200	750
1-1/4	-20	1600	900
1-1/2	-24	2000	900
2	-32	2000	---

NOTE: 1. USE ALUMINUM TUBE TORQUE VALUES FOR ALUMINUM, STEEL, OR TITANIUM FITTINGS IN ALUMINUM BOSSES.
2. USE STEEL TUBE TORQUE VALUE FOR STEEL OR TITANIUM FITTINGS INSTALLED IN STEEL OR TITANIUM BOSSES.

1 THESE TORQUE VALUES ARE APPLICABLE TO THESE TUBE ENDS:
A. 21-6-9 STEEL WITH BACS13BD OR BACS13BX SWAGED SLEEVE
B. CRES STEEL WITH BACS13BD OR BACS13BX SWAGED SLEEVE
C. MIL-T-6845 CRES WITH BACS13AP PRESET SLEEVE 5
D. HOSE END FITTINGS WITH STEEL INSERTS (NIPPLES)
E. ALL TITANIUM TUBE ENDS.

2 THESE TORQUE VALUES ARE APPLICABLE TO THESE TUBE ENDS:
A. ALUMINUM WITH BACS13BD & BACS13BX SWAGED SLEEVES
B. 6061-T6 ALUMINUM WITH PRESET BACS13AP SLEEVES 6
C. ANNEALED CRES WITH PRESET BACS13AP SLEEVES 6
D. HOSE END FITTINGS WITH ALUMINUM INSERTS (NIPPLES).

Installation Torque For Flareless Tubing Fittings
Figure 208 (Sheet 1)

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3> YOU MUST USE CARE WHEN YOU SELECT THE CORRECT TORQUE FOR REDUCER FITTINGS. YOU MUST FIND THE CORRECT FITTINGS INSTALLATION TORQUE FOR THE SIZE OF THE BOSS OR BULKHEAD.

4> TUBE MATERIAL SPECIFICATIONS:
A. 6061-T6 ALUMINUM - MIL-T-7081, WW-T-700/6
B. ANNEALED CRES - MIL-T-8504, MIL-T-8606, MIL-T-8808
C. 1/8 HARD CRES - MIL-T-6845
D 21-6-9 CRES - BMS 7-185
E. TI-3AL-2.5V - BMS 7-234

5> USE THESE TORQUE VALUES FOR STANDARD MS FLARELESS TUBE ENDS (BACS13AP SLEEVES) ON MIL-T-6845 (304-1/8h) TUBING WITH THE MINIMUM WALL THICKNESS GIVEN BELOW:

SIZE	-4	-5	-6	-8	-10	-12
WALL THICKNESS	0.020	0.020	0.028	0.034	0.049	0.049

USE THESE TORQUE VALUES FOR SPECIAL THIN WALL MIL-T-6845 (304-1/8h) TUBING:

SIZE	-8	-10	-12
WALL THICKNESS	0.028	0.035	0.042
TORQUE (LB-IN)	375	575	725

6> USE THESE TORQUE VALUES FOR STANDARD MS FLARELESS TUBE ENDS (BACS13AP SLEEVES) ON 6061-T6 ALUMINUM AND ANNEALED CRES TUBING WITH THE MINIMUM WALL THICKNESS BELOW:

SIZE	-3	-4	-5	-6	-8	-10	-12	-16
WALL THICKNESS	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.035

USE THESE TORQUE VALUES FOR SPECIAL THIN WALL ANNEALED CRES TUBING:

SIZE	-6	-10	-12
WALL THICKNESS	0.020	0.020	0.020
TORQUE (LB-IN)	160	250	325

Installation Torque for Flareless Tubing Fittings
Figure 208 (Sheet 2)

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BOEING PART NUMBER (BAC5001-9, TABLE VII)	DASH NUMBER ( )	TORQUE (POUND-INCHES) +5 -0
BACC10AUU()	250-275	70
	300-500 550-600	100
BACC10BR8()	100-900	100
BACC10CT2()	100-600	
BACC10DP()A	150-250	50
BACC10DP()B	300	
BACC10DP()AB	350-400	
	450-600	70
BACC10DU()AB	100-175	50
	200-275	55
	300-450	60
	500-600	65
	700-1000	75
BACC10EY()B	150-800 425-800	105
	150-400	75
BACC10EZ()B	125-275	
	300	105
	125-300	
BACC10GY()	150-175	50
	200-275	55
	300-450	60
	475-600	65
	650-900	85
BACC10HX()	100-300	10
	325-500	15
	550-800	20

BOEING PART NUMBER (BAC5001-9, TABLE VII)	DASH NUMBER ( )	TORQUE (POUND-INCHES) +5 -0
NUCO (U430453)	125	55-65
BACC10KH	200-275	45
	300-475	55
	500-550	60
	600-650	65
	700	70
BACC10AC	150-200	40-50
	225-300	60-70
	315-550	120-140

COUPLING CLAMPS, V-BAND, AND CHANNEL-BAND 1

1 THE RECOMMENDED TIGHTENING PROCEDURE IS AS FOLLOWS:
1. APPLY THE INSTALLATION TORQUE AS GIVEN IN THE TABLE.
2. HIT THE ENTIRE CIRCUMFERENCE OF THE CLAMP LIGHTLY WITH A WOOD, LEATHER, OR SOFT PLASTIC MALLET.
3. DO STEPS 1 AND 2 UNTIL THE TORQUE WILL STAY CONSTANT.

Standard Torque Values for Clamps
Figure 209 (Sheet 1)

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CHANNEL BAND CLAMPS		
TYPE	DUCT OD (INCHES)	TORQUE (POUND-INCHES)
BACC10CT	1.00-6.00	100-105 2

DUCT-SUPPORT CLAMPS		
TYPE	DUCT OD (INCHES)	TORQUE (POUND-INCHES)
BACC10AD	2.00-8.00	20-25

HOSE CLAMPS		
TYPE	HOSE OD (INCHES)	TORQUE (POUND-INCHES)
BACC10BN	1.75-20.00	20

ROYLYN COUPLING		
TYPE	DUCT OD INCHES/MATERIAL	TORQUE (POUND-INCHES)
BACR12H	1.50/5052-0 1.50/STAINLESS 1.75/5052-0 2.00/5052-0 2.50/5052-0	600-1000 900-1200 900-1200 1300-2500 2000-3000

2 INSIDE OF COUPLING IS NOT LUBRICATED.

Standard Torque Values for Clamps
Figure 209 (Sheet 2)

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HIRF/LIGHTNING PROTECTION - FQIS WIRING AND BONDING - INSPECTION/CHECK

1. General
   A. This procedure contains a task that inspects the bonding of the Fuel Quantity Indicating System (FQIS) wiring shields at the fuel tank receptacles, at the pressure seal connectors, and along the length of the wire bundle between those points.
   B. The Boeing portable Loop Resistance Tester (LRT) is used to do these inspections.

TASK 20-55-54-286-001

2. FQIS Connectors - Inspection/Check
   A. General
      (1) ALI - Refer to the task: Airworthiness Limitation Precautions (AMM 28-00-00/201), for important information on airworthiness limitation instructions (ALIs).
   B. Reference
      (1) AMM 20-56-02/201, HIRF/Lightning - Loop Resistance Measurement
      (2) AMM 20-56-03/201, HIRF/Lightning - Joint Resistance Measurement
      (3) AMM 24-22-00/401, Manual Control
      (4) AMM 25-52-65/401, Cargo Compartment Ceiling Lining
   C. Access
      (1) Location Zones
          221 Center Tank
          300 Left Wing
          400 Right Wing

      (2) Access Panels
          3378 Left Feed Thru Panel
          3478 Right Feed Thru Panel

   D. Prepare for the Inspection Procedure

      S 846-002
      (1) Remove electrical power from the airplane (AMM 24-22-00/401).

      S 016-003
      (2) Remove forward cargo compartment ceiling liners from LH Sta 380 to Sta 540 (AMM 25-52-65/401).

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S 846-004

(3) Make sure the connectors at both ends of the wire bundles shown on the wire diagram indicated in Table 601 for the selected connectors are tight.

NOTE: This includes connector plugs and backshells.

(a) If any connectors or wiring were found to be loose or broken, make a note of that condition for future reference and tighten the connector or repair the wiring.

E. FQIS Connectors, Tank End - Inspection

S 286-005

(1) Loop Resistance Measurement Procedure

(a) At the point where the out-tank wire bundle enters the fuel tank, do a a loop resistance measurement on each connector listed in Table 601 (AMM 20-56-02/201).

NOTE: The loop resistance measurement is done to set up the correct conditions for a joint resistance measurement, and to make sure that the joint resistance measurement will not be influenced by parallel electrical paths as the installation ages over time.

1) If the loop resistance value measured is less than 13 milliohms (Left or Right Main Tank wire bundle) or 15 milliohms (Center Tank bundle), then perform the joint resistance measurement below on the connector.
2) If the loop resistance value measured is more than specified above, refer to the applicable wiring diagram indicated in Table 601 and troubleshoot the installed shielding system in accordance with the Standard Wiring Practices Manual (SWPM 20-20-00) and re-test the connector.

NOTE: CDCCL - Refer to the task for Airworthiness Limitation Precautions for information on Critical Design Configuration Control Limitations (CDCCL).

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S 286-006

(2) Joint Resistance Measurement Procedure

(a) Do a Joint Resistance measurement (AMM 20-56-03/201) on the connector end of the bundle from the overbraid exposed at the end of the backshell forward of the cable clamp, to the front spar (left or right main tanks) or airplane structure (center tank) within 0.5 inch of the tank penetration.

NOTE: Use care when measuring from the exposed shield at the backshell to make sure that you do not push the probe tip through to the inner shield. If possible, lay the probe tip against the shield to make this measurement.

1) If the measured value is less than 5.5 millohms, do a loop resistance measurement on the next remaining connector listed in Table 601.
   a) If the measured value was more than 5.5 milliohms, troubleshoot and repair the joint (SWPM 20-20-00) and retest the joint by doing the Joint Measurement test above.
2) If all connectors listed in Table 601 have been tested, do the FQIS Connectors, Pressure Seal End task below.

FQIS CONNECTORS AT TANK END
TABLE 601

	CONN	LOCATION	WDM
	D00884	Left Main Tank	28-41-01
	D00888	Right Main Tank	28-41-01
	D00886	Center Tank	28-41-01

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F. FQIS Connectors, Pressure Seal End - Inspection

S 286-007

(1) Loop Resistance Measurement Procedure

(a) Move the Loop Resistance Tester and couplers to the connectors at the pressure seal end of the wire bundles shown in Table 601.

(b) Perform a loop resistance measurement at the pressure seal end of the wire bundle from the tank connectors listed in Table 601 and measured above (AMM 20-56-02/201).

NOTE: The loop resistance measurement is done to set up the correct conditions for a joint resistance measurement, and to make sure that the joint resistance measurement will not be influenced by parallel electrical paths as the installation ages over time.

1) If the loop resistance measured is less than 15 milliohms, then perform the joint resistance measurement below on the connector.

2) If the loop resistance value measured is more than 15 milliohms, refer to the applicable wiring diagram indicated in Table 601 and troubleshoot the installed shielding system in accordance with the Standard Wiring Practices Manual (SWPM 20-20-00) or BF Goodrich Service Bulletin T3031-0008-0101 and re-test the connector.

S 286-008

(2) Joint Resistance Measurement Test Procedure

(a) Do a Joint Resistance measurement (AMM 20-56-03/201) on the connector end of the bundle from the overbraid exposed at the end of the backshell forward of the cable clamp, to primary structure within 0.5 inch of the body penetration.

NOTE: Use care when measuring from the exposed shield at the backshell to make sure that you do not push the probe tip through to the inner shield. If psossible, lay the probe tip against the shield to make this measurement.

1) If the measured value is less than 3.5 millohms, perform a loop resistance measurement on the next remaining connector listed in Table 601.

a) If the measured value was greater than 3.5 milliohms, troubleshoot and repair the joint (SWPM 20-20-00) and retest the joint by doing the Joint Measurement test above.

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2) If all the connectors have been tested, do the visual check of the wire bundles below.

S 286-009

(3) Wire Bundle Visual Inspection

(a) Do a detailed visual inspection of each wire bundle connected to the tank end connectors listed in Table 601, along the entire length of the bundle.

1) Check for evidence of corrosion, chaffing, shielding degradation, or other damage to the outside wire bundle shield.

2) If damage or severe corosion is noted, replace the wire bundle (SWPM 20-20-00).

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HIRF/LIGHTNING - LOOP RESISTANCE TESTER (LRT) - MAINTENANCE PRACTICES

1. General
   A. The Loop Resistance Tester (LRT) is a specialized piece of test equipment which is used to make non-intrusive wire bundle and coax cable shield resistance measurements. The LRT can also be used to make resistance measurements across a built-up joint or individual electrical connections/joints.
      (1) This task contains the procedure for performing a Lid Standard Measurement with the LRT. The Lid Standard Measurement is a check of the Loop Resistance Tester (LRT) that should be performed whenever the LRT does not appear to be operating correctly. Measurement of the standard resistances on the LRT storage lid provides a quick indication of proper LRT operation. The Lid Standard Measurement consists of the following two parts:
         (a) Loop Mode, which makes a check of the loop resistance measurement function.
         (b) Joint Mode, which makes a check of the joint resistance measurement function.
2. LRT Lid Standard Measurement
   A. Procedure
      (1) Loop Mode
         (a) The various components of the LRT are illustrated in Fig. 201.
         (b) Open the LRT assembly and slide the lid aside to separate it from the base.
         (c) Open the lid and remove the Sense/Drive couplers and the Joint Probe assembly.
         (d) Connect the blue-coded Sense coupler cable to the blue-coded Sense Coupler connector on the LRT.
         (e) Connect the red-coded Drive coupler cable to the red-coded Drive Coupler connector on the LRT.
         (f) Connect the Joint Probe assembly to the Joint Probe connector on the LRT.
         (g) Lift the safety cover and set the RUN-OFF/CHARGE switch to the RUN position.
         (h) Set the MODE switch to the LOOP position.
         (i) Push and hold the ON/OFF pushbutton switch on the BITE module until "Testing Hardware" shows on the BITE display, then release the ON/OFF switch. A four-character symbol will move around the BITE display during the hardware self-test.

             NOTE: To conserve the battery, the LRT will automatically power down after 10 minutes of inactivity. To re-apply power, do the above steps again.

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(j) When the "Press Start" indication shows on the BITE display, make sure the LED on each Sense/Drive coupler control box is red.

(k) Connect the Sense/Drive couplers to the cutout in the Reference Standard, built into the storage lid of the LRT.
   1) Position the couplers at each end of the cutout, near the Sense/Drive coupler alignment marks (Fig. 201).

(l) Begin the Lid Standard Test by pushing the START pushbutton switch on either of the Sense/Drive coupler control boxes.

(m) Make sure the LED on each of the Sense/Drive coupler control boxes is green.
   1) If either LED is red and a "DRV Coup is Open" or "SNS Coup Is Open" message shows on the BITE display, then the couplers should be checked for proper connection.
      a) Gently squeeze and release the coupler handles to improve the connection of the couplers to the Lid Standard. If adjusting the couplers does not change the LEDs to green, replace the LRT.
      b) If "Press Start" shows on the BITE display, then push the START pushbutton on either of the Sense/Drive coupler control boxes and begin the Lid Standard Test again.
   2) If either LED is red and a "DRV Coup Is Open" or "SNS Coup Is Open" message does not show on the BITE display, replace the LRT.
   3) If the LED on one or both couplers flashes red, then re-connect the couplers to the lid after the "Press Start" message shows on the BITE display.
      a) Push the START pushbutton on either of the Sense/Drive coupler control boxes and begin the Lid Standard Test again.
   4) If the message "UNSTABLE" shows on the BITE display and does not clear, set the MODE switch to the JOINT position.
      a) When the message "CONNECT PROBES" shows on the BITE display, set the MODE switch back to the LOOP position.
      b) Push the START pushbutton on either of the Sense/Drive coupler control boxes and begin the Lid Standard Test again.
      c) If the "UNSTABLE" message continues to show, replace the LRT.

(n) When the Sense/Drive coupler control box LEDs flash green, note the measured resistance value which shows on the BITE display.
   1) Make sure the displayed resistance value is 0.5 - 1.0 milliohm.
   2) If the displayed resistance value is not 0.5 - 1.0 milliohm, replace the LRT.

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(2) Joint Mode

(a) With the Sense/Drive couplers still connected to the Lid Reference Standard, change the MODE switch to the JOINT position.

(b) Make sure the Joint Probe LEDs are red (Fig. 201).

(c) Place the tip of one Joint Probe on the first Joint Probe reference mark on the Lid Reference Standard (Fig. 201).

(d) Place the tip of the other Joint Probe on the second Joint Probe reference mark.

NOTE: The LRT will start the Joint Test when the LEDs on both Joint Probes are green.

(e) When the LED on either Joint Probe flashes green, the measurement shows, in milliohms, on the bottom line of the BITE display.

NOTE: The loop resistance from the previous loop measurement is displayed on the top line of the BITE display during a joint mode measurement.

(f) Note the joint resistance value.

(g) Keep the first Joint Probe in place on the first Joint Probe reference mark and move the second Joint Probe to the next Joint Probe reference mark.

(h) Repeat the above steps until a resistance value has been measured for each Joint Probe reference mark, 2 through 6.

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(i) Compare the measured resistance values with the acceptable resistance values listed below:

TABLE 201	
MEASUREMENT POINTS (REFERENCED TO FIRST JOINT PROBE MARK)	RESISTANCE MEASUREMENT ACCEPTABLE VALUES
Second Joint Probe Reference Mark	0.01 - 0.06 milliohms
Third Joint Probe Reference Mark	0.04 - 0.11 milliohms
Fourth Joint Probe Reference Mark	0.07 - 0.16 milliohms
Fifth Joint Probe Reference Mark	0.10 - 0.21 milliohms
Sixth Joint Probe Reference Mark	0.12 - 0.26 milliohms

1) If all five resistance measurements taken above are within the range of Acceptable Values from Table 201, then this task is complete and the LRT is operational.
2) If any of the five resistance measurements taken above are outside the range of Acceptable Values from Table 201, then replace the LRT.

(j) Change the MODE switch to LOOP.
(k) Disconnect the Sense/Drive couplers from the Lid Reference Standard.
(l) This completes the LRT Lid Standard Measurement.

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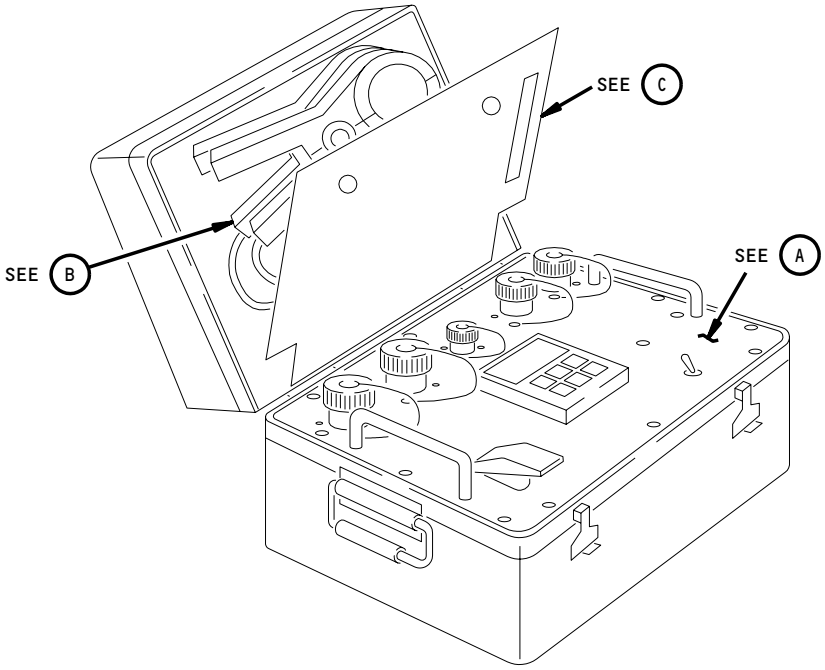

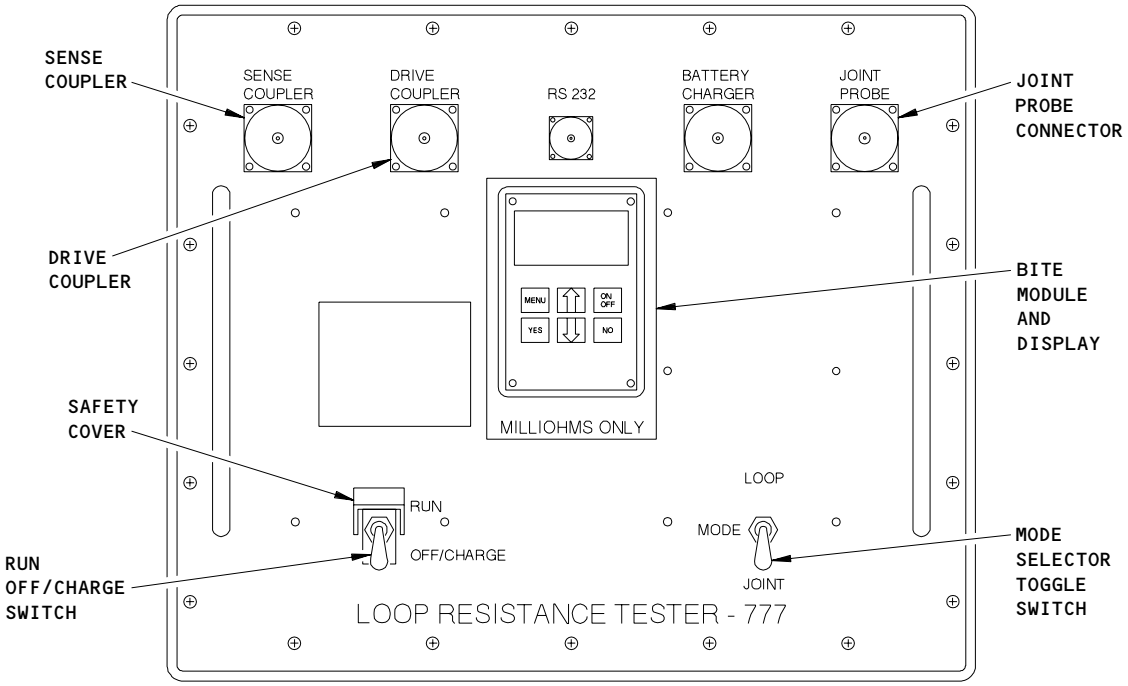

A

High Intensity Radiated Fields (HIRF) Inspection
Loop Resistance Tester Maintenance Practices
Figure 201 (Sheet 1)

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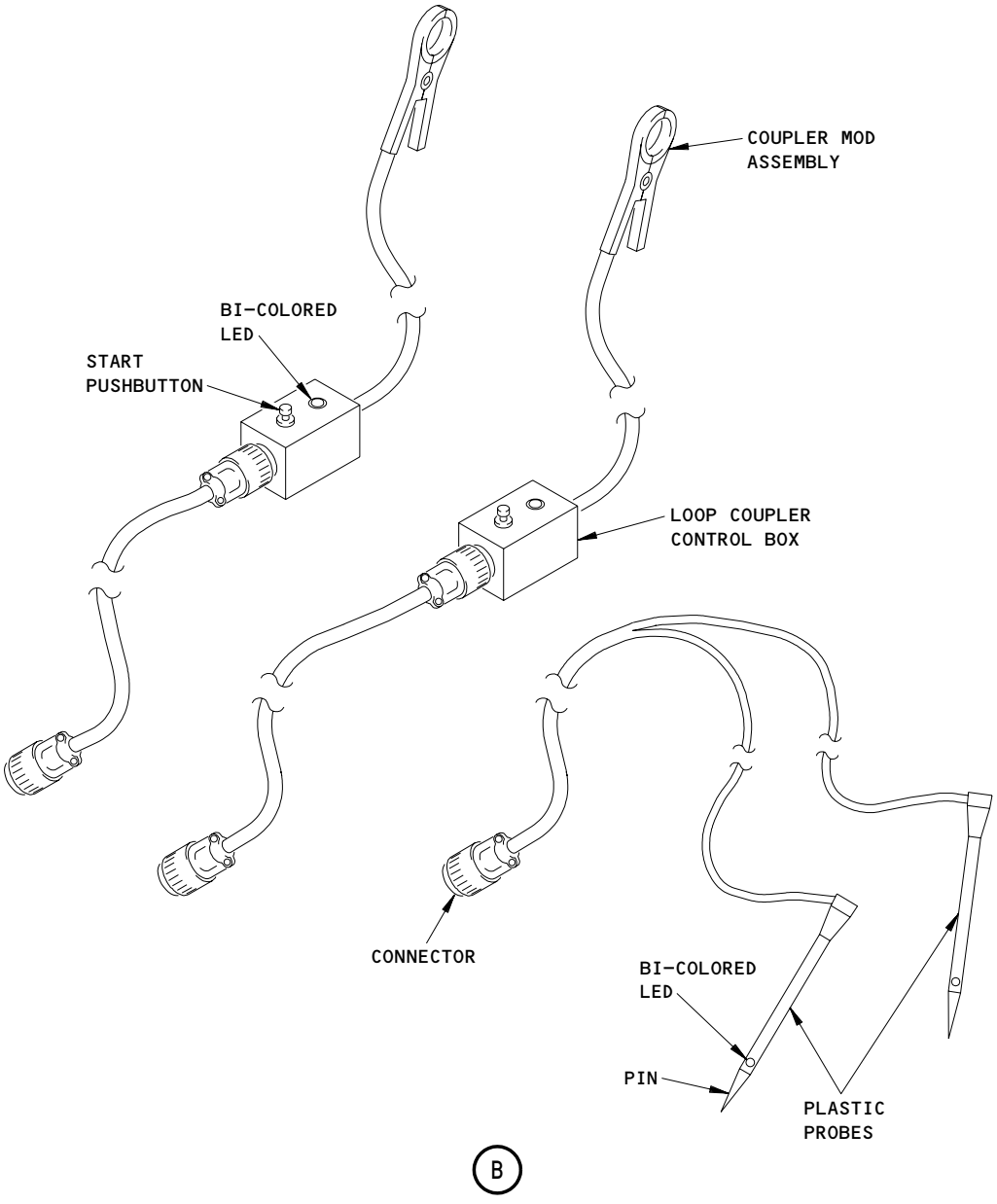

High Intensity Radiated Fields (HIRF) Inspection Loop Resistance Tester Maintenance Practices
Figure 201 (Sheet 2)

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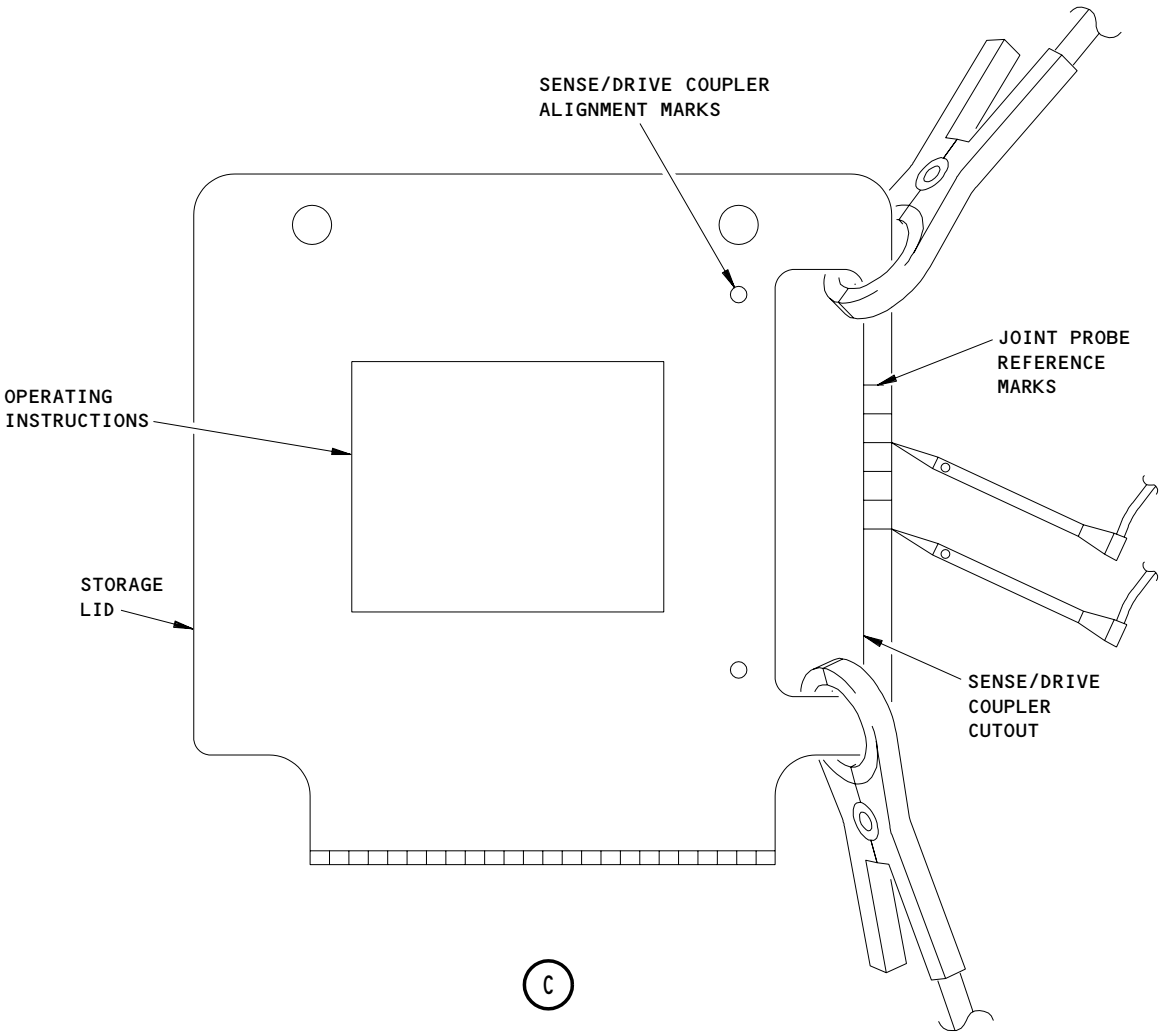

High Intensity Radiated Fields (HIRF) Inspection
Loop Resistance Tester Maintenance Practices
Figure 201 (Sheet 3)

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HIRF/LIGHTNING - LOOP RESISTANCE MEASUREMENT - MAINTENANCE PRACTICES

1. General
   A. The comments and instructions contained herein apply to the Loop Resistance Tester (LRT), Boeing P/N 906-10246-X.
   B. The LRT is used to make non-intrusive wire bundle and coax cable shield resistance measurements by inductively coupling a low voltage into the shield and measuring the current flowing through the shield. The LRT can also be used to make resistance measurements across a built-up joint or individual electrical connections/joints after an electrical loop is first established.
   C. This procedure does the Loop Resistance Measurement task.
      (1) The Loop Resistance Measurement Task contains instructions on how to use the LRT to measure the shield resistance of a wire bundle or coaxial cable. The shield must be electrically connected to airplane structure at both ends in order to form an electrical loop for current to flow. In certain cases, a ground return jumper cable must be used to provide a ground return path because the wire bundle is not specifically connected to airplane structure at one end.
2. Loop Resistance Measurement
   A. References
      (1) AMM 20-56-01/201, LRT Lid Standard Measurement
      (2) AMM 20-56-03/201, Joint Resistance Measurement
   B. Preliminary
      (1) Prepare the LRT for use (Fig. 201).
         (a) Open the LRT assembly and slide the lid aside to remove it from the base.
         (b) Open the lid and remove the Sense/Drive couplers and the joint probe assembly.
         (c) Connect the blue-coded Sense coupler cable to the blue-coded Sense Coupler connector on the LRT.
         (d) Connect the red-coded Drive coupler cable to the red-coded Drive Coupler connector on the LRT.
         (e) Connect the Joint Probe assembly to the Joint Probe connector on the LRT.
         (f) Lift the safety cover and set the RUN-OFF/CHARGE switch to the RUN position.
         (g) Set the LRT MODE switch to the LOOP position.

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(h) Push and hold the ON/OFF pushbutton switch on the BITE module until "Testing Hardware" shows on the BITE display, then release the ON/OFF switch. A four-character symbol will move around the BITE display during the hardware self-test.

NOTE: To conserve the battery, the LRT will automatically power down after 10 minutes of inactivity. To re-apply power, do the above steps again.

(i) When the "Press Start" indication shows on the BITE display, make sure the LED on each Sense/Drive coupler control box is red.

C. Procedure

(1) Connect the couplers.

(a) For a normal Loop Resistance Measurement (Fig. 202):

1) Clamp both of the LRT couplers around the wire bundle to be measured.

a) If there are ground wires, such as shield pigtail connections, at the point of measurement on the measured bundle, make sure that such wiring is NOT included within either coupler.

b) Make sure there is at least 4 inches separation between the two couplers. If such separation is impossible to maintain, use the Mu-Metal shields (P/N 906-10249-9) provided with the LRT to obtain the necessary isolation.

NOTE: In the case of multiple wire bundles going to/from a connector, make sure the coupler is only around the desired bundle. This may require removing (and replacing) wire ties to separate the bundles enough for coupler connection.

(b) If a Modified Loop Resistance Measurement is required, (Fig. 203):

1) Clamp the Drive coupler around the ground return jumper cable.

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2) Clamp the Sense coupler around the bundle to be tested.

NOTE: A minimum separation of 4 inches between the couplers should still be maintained.

a) If there are ground wires, such as shield pigtail connections, at the point of measurement on the bundle, make sure that such wiring is NOT included within the Sense coupler.

(2) Initiate a Loop Resistance Measurement by pushing the START pushbutton on either of the Sense/Drive Coupler Control boxes, causing the LEDs on both boxes to turn green.
(a) When the LEDs flash green, note the loop resistance value shown on the LRT BITE display.
(b) This completes the Loop Resistance Measurement.
(3) If you are unable to complete the Loop Resistance Measurement, do the following fault isolation steps:
(a) If either LED is red and a "DRV Coup Is Open" or "SNS Coup Is Open" message shows on the BITE display, then the couplers should be checked for proper connection.
1) Gently squeeze and release the coupler handles to improve the connection of the couplers around the wire bundle being measured.
a) If adjusting the couplers does not change the LEDs to green, replace the LRT.
2) If "Press Start" shows on the BITE display, then push the START pushbutton on either of the Sense/Drive coupler control boxes and begin the Loop Resistance Measurement again.
(b) If either LED is red and a "DRV Coup Is Open" or "SNS Coup Is Open" message does not show on the BITE display, replace the LRT.
(c) If the LED on one or both couplers flashes red, then re-connect the couplers to the wire bundle being measured after the "Press Start" message shows on the BITE display.
1) Push the START pushbutton on either coupler control box and begin the Loop Resistance Measurement again.
(d) If the message "UNSTABLE" is displayed and does not clear, set the MODE switch to the JOINT position.
1) When the message "Connect Probes" shows on the BITE display, set the MODE switch back to the LOOP position.
2) When the "Press Start" message appears, push the Start pushbutton on either of the coupler control boxes and begin the Loop Resistance Measurement again.

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3) If this fails to clear the "UNSTABLE" message, then there is a problem with the wire bundle being measured or with the LRT.

NOTE: The "UNSTABLE" message is caused by the LRT detecting a varying resistance. This varying resistance can be caused by a loose connection, a corroded or intermittent electrical joint, a faulty Transorb adapter, or a faulty LRT.

a) Make sure the LRT is operating correctly (AMM 20-56-01/201).
b) If the LRT is operating correctly, then the wire bundle or a connection/joint is faulty and must be repaired or replaced before continuing the measurement. Check each electrical connection in the circuit being measured to isolate the faulty connection/joint. Check the electrical joint (AMM 20-56-03/201).

(e) If the BITE display shows "Joint V TooBig" (Dash-2 LRT only), "Loop I TooBig" or "Loop V TooBig", then stray currents may be circulating through the shield of the wire bundle being measured.
1) If power is applied to any of the equipment attached to this bundle, remove power from the equipment.
2) Any on-board electrical equipment that does not need to be ON should be turned OFF.
3) Make sure no other sources of current or voltage are connected on or near the bundle being tested.
4) In extreme cases, all power may need to be removed from the airplane.

(4) For a Dash-2 LRT, the following BITE display messages may also appear:
(a) Joint TooSmall:
1) This indication is displayed when the Joint Value is too small compared to the Loop Value to give an accurate Joint reading. This condition exceeds the operating capabilities of the LRT.
(b) LNoise V TooBig:
1) This indication is displayed when excessive noise voltage on the wire bundle shield interferes with the LRTs ability to read accurately during Loop Mode. Stray signals on the wire shield may be produced by motors, electronic equipment, or adjacent electronic circuits. This condition can be alleviated by de-energizing equipment in the vicinity of the circuit being tested.

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(c) LNoise I TooBig:

1) This indication is displayed when excessive noise current on the wire bundle shield interferes with the LRTs ability to read accurately during Loop Mode. Stray signals on the wire shield may be produced by motors, electronic equipment, or adjacent electronic circuits. This condition can be alleviated by de-energizing equipment in the vicinity of the circuit being tested.

(d) JNoise V TooBig:

1) This indication is displayed when excessive noise voltage on the wire bundle shield interferes with the LRTs ability to read accurately during Joint Mode. Stray signals on the wire shield may be produced by motors, electronic equipment, or adjacent electronic circuits. This condition can be alleviated by de-energizing equipment in the vicinity of the circuit being tested.

(e) JNoise I TooBig:

1) This indication is displayed when excessive noise current on the wire bundle shield interferes with the LRTs ability to read accurately during Joint Mode. Stray signals on the wire shield may be produced by motors, electronic equipment, or adjacent electronic circuits. This condition can be alleviated by de-energizing equipment in the vicinity of the circuit being tested.

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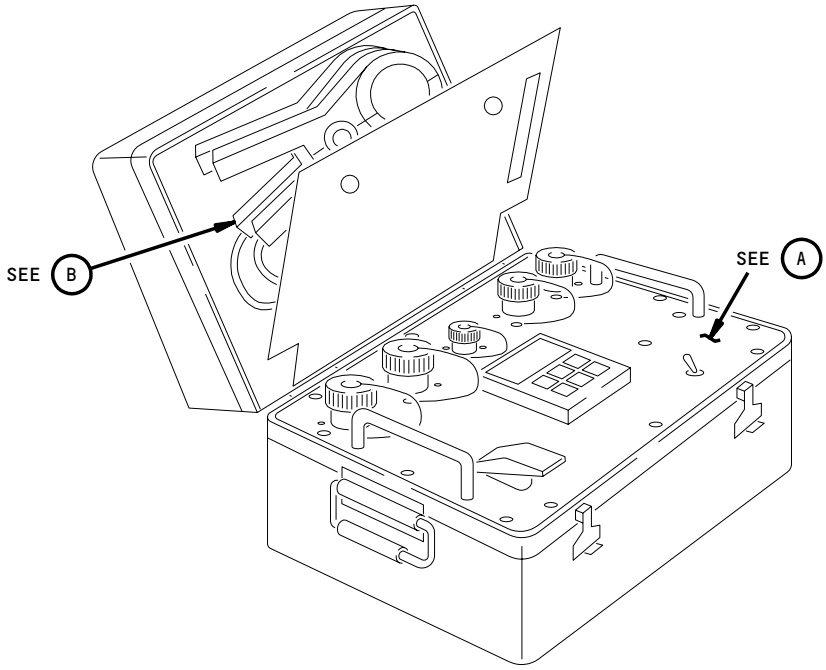

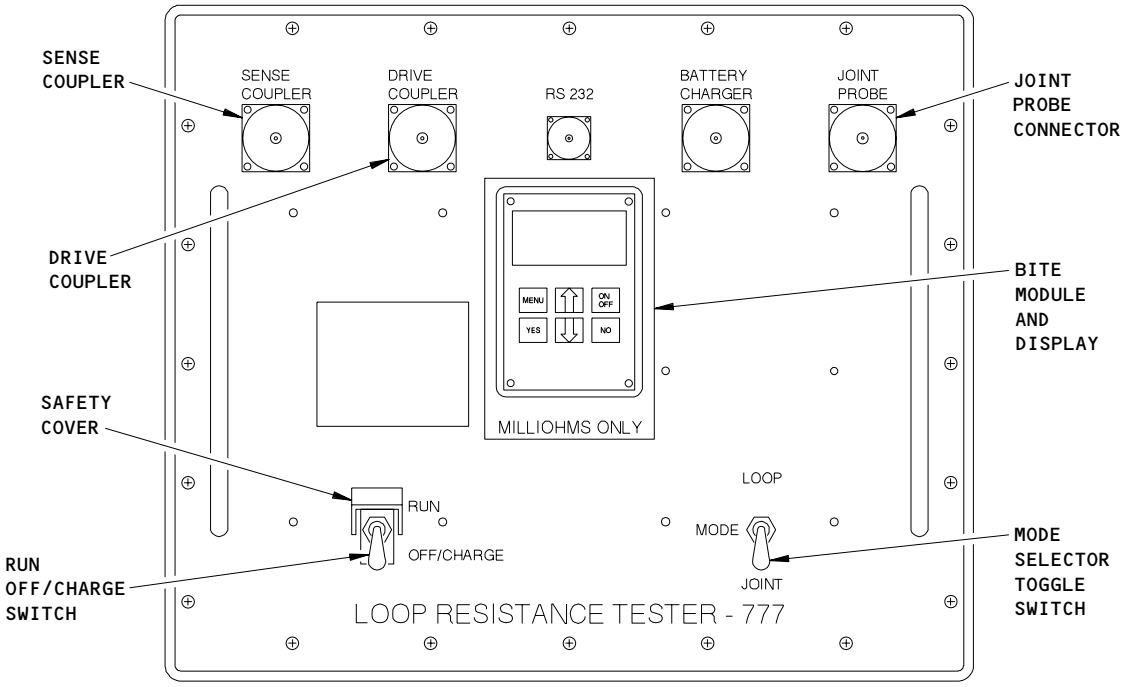

A

High Intensity Radiated Fields (HIRF) Inspection
Loop Resistance Tester Maintenance Practices
Figure 201 (Sheet 1)

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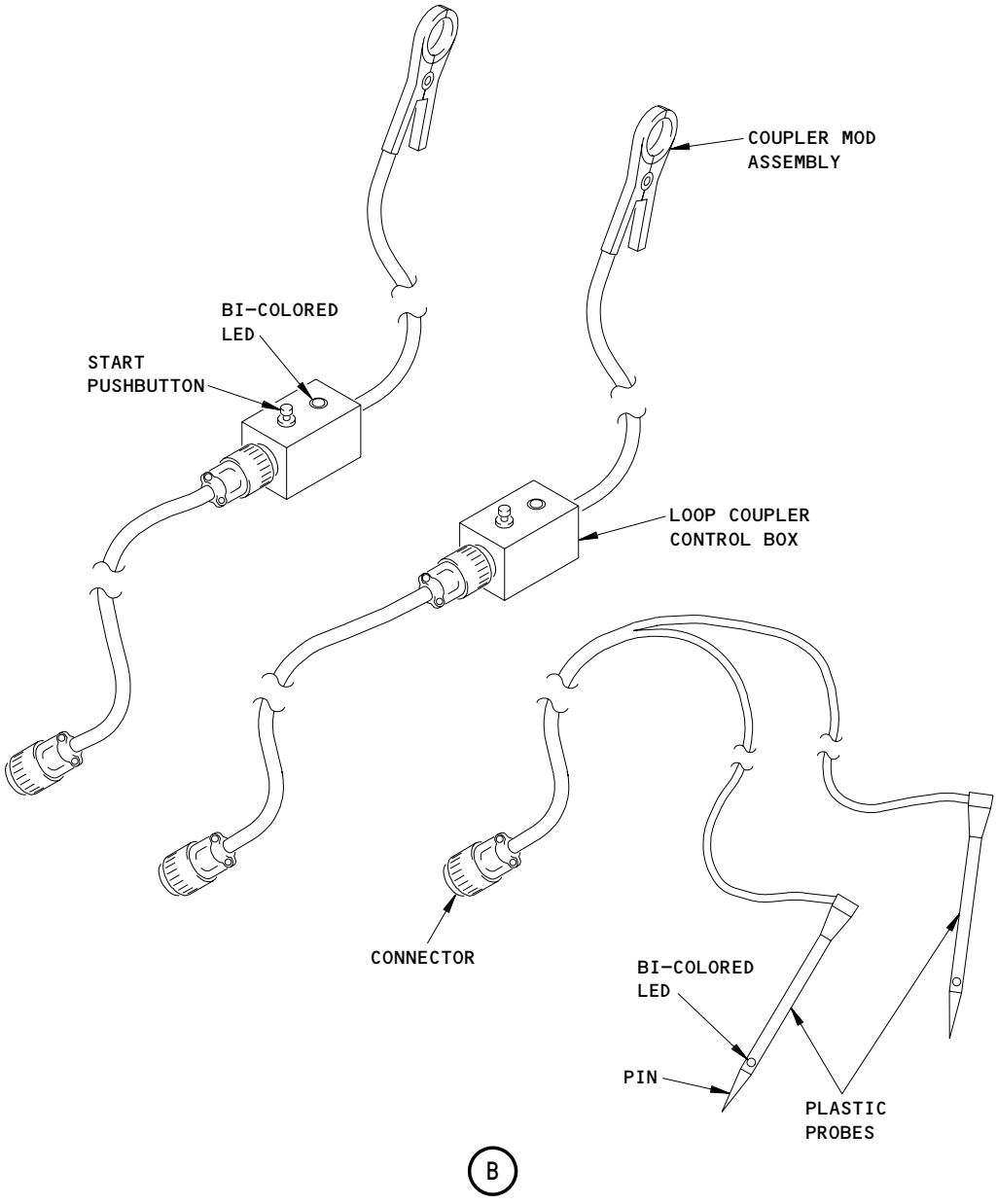

High Intensity Radiated Fields (HIRF) Inspection
Loop Resistance Tester Maintenance Practices
Figure 201 (Sheet 2)

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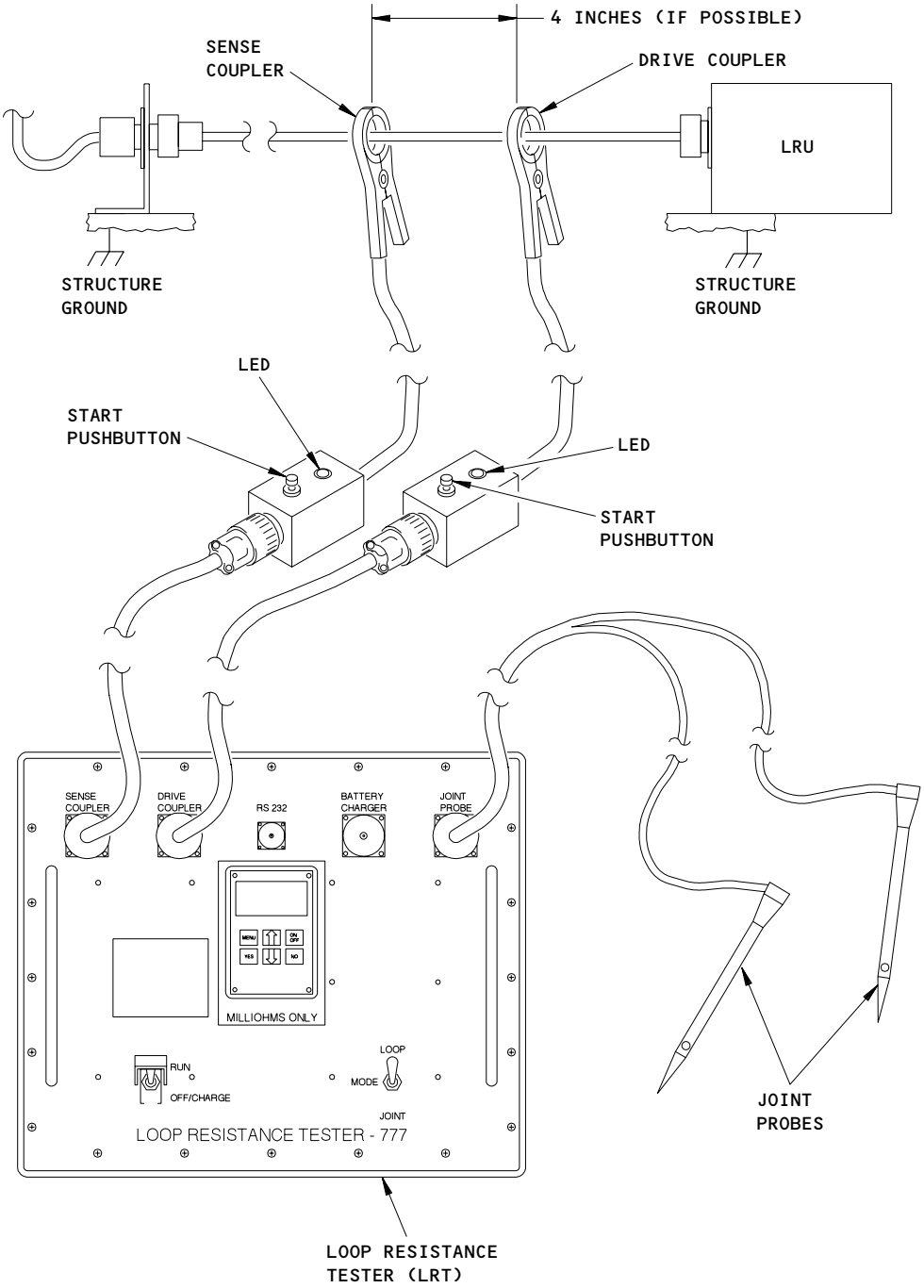

Typical Loop Resistance Tester (LRT)
Hookup for Loop Resistance Measurement
Figure 202

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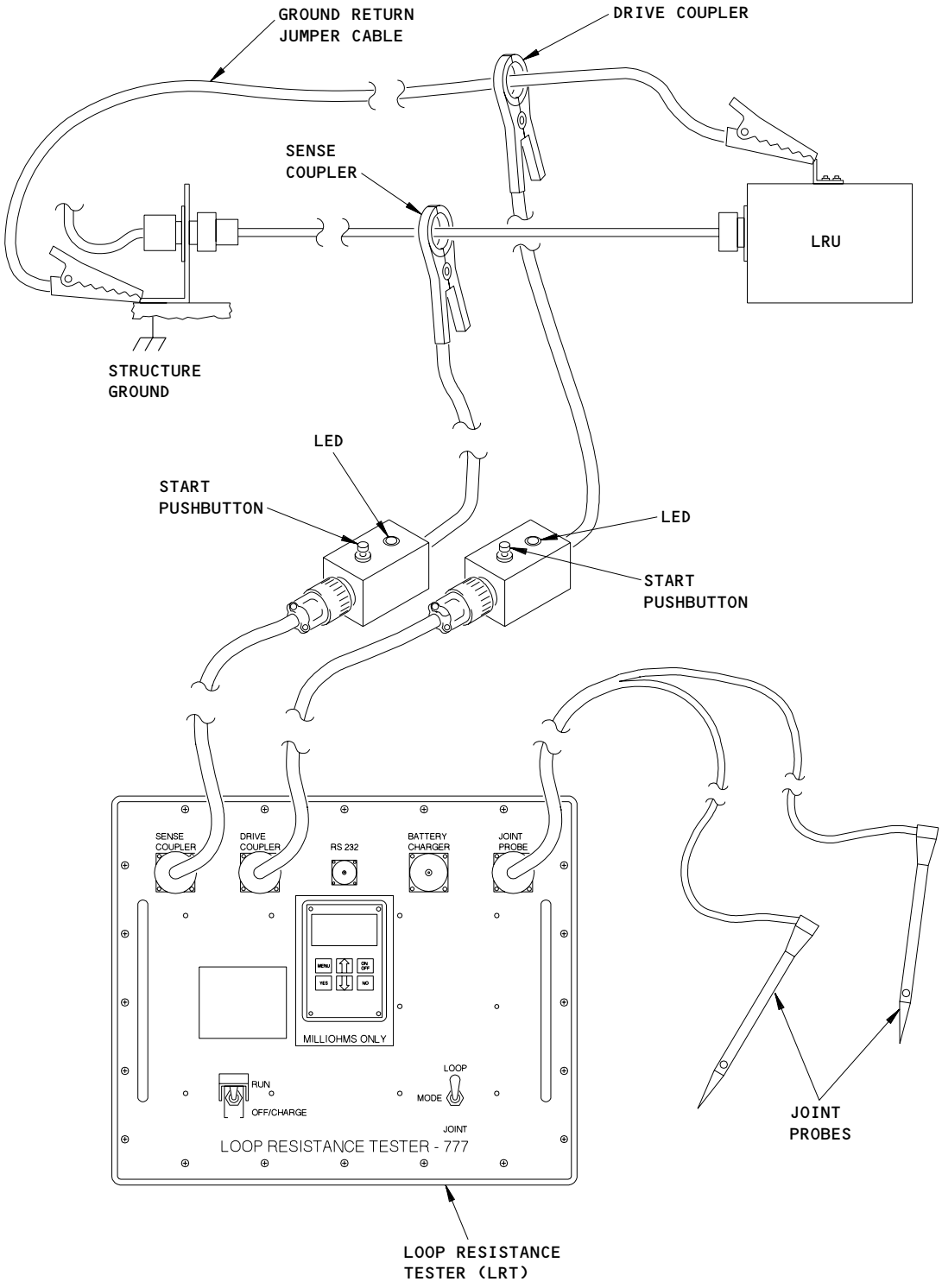

Typical Loop Resistance Tester (LRT)
Hookup for Modified Loop Resistance Measurement
Figure 203

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HIRF/LIGHTNING - JOINT RESISTANCE MEASUREMENT - MAINTENANCE PRACTICES

1. General
   A. This task contains instructions on how to use the Loop Resistance Tester (LRT) to measure the resistance across a built-up joint or individual electrical connections/joints.
      (1) The direct contact voltage and current measurement capabilities of the LRT Joint Probes are used to perform a Joint Resistance Measurement.
      (2) The connections/joints to be measured must be contained within the shielding system being measured in the Loop Resistance Mode (the loop current must flow through these joints/connections).
   B. In some cases, the current path to structure may include a subassembly. An example would be one of the connectors mounted to an FSEU Gearbox. In such a case, the bonding of the subassembly-to-structure may also need to be measured. If an out-of-spec joint reading is found, refer to the AMM chapter associated with that particular subsystem for component bonding requirements.
2. Joint Resistance Measurement
   A. References
      (1) AMM 20-56-01/201, LRT Lid Standard Measurement
      (2) AMM 20-56-02/201, Loop Resistance Measurement
      (3) SWPM 20-20-00, Standard Wiring Practices Manual
      (4) SWPM 20-25-11, Standard Wiring Practices Manual
   B. Procedure
      (1) To establish an electrical current flow in the wire bundle, joints/connections and bonding straps being measured, do a Loop Resistance Measurement (AMM 20-56-02/201) before starting the Joint Resistance Measurement.

          NOTE: Before a Joint Resistance Measurement can be performed, a Loop Measurement must have been completed on the wire bundle associated with the joint being measured. If this is a modified loop formed with a ground return jumper cable, then the LRT Sense/Drive couplers must be connected as shown for a modified loop resistance measurement. The LRT continues to monitor the loop resistance of the wire bundle while the joint measurement is being made. If the loop resistance changed by too large an amount, the LEDs on both joint probes will blink red and the message "REDO LOOP" will appear on the BITE display. This message cannot be erased without switching the LRT back to the loop mode and doing a loop resistance measurement again.

      (2) Set the Mode Selector switch on the LRT to the joint position.
      (3) Make sure the LEDs on both Joint Probes are red.

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(4) Connect one joint probe to one side of a complex joint buildup (structure, LRU, receptacle, bracket, or connector backshell for example) within 1 inch of the joint being measured (Fig. 201 or 202).

NOTE: A joint may have several electrical connections. For example, a connector mounted on a bracket which is mounted to structure can provide five connections between the bundle shield and "ground". The shield is (1) connected to the connector backshell which is (2) connected to the connector itself which (3) connects to the receptacle which (4) is mounted on the bracket which is (5) connected to structure.

(5) Connect the second joint probe to the other side of the joint being measured, within 1 inch of the joint/connector.

NOTE: The LRT will start the Joint Resistance Measurement when the LEDs on both Joint Probes are green. The LEDs change from red to green when electrical continuity is established between the probes. It may be necessary to wiggle the probes in order to make electrical contact through surface coatings.

(a) If the Joint Probes appear to be making good electrical contact and the Joint Probe LEDs do not change to green and no error messages are displayed on the LRT, then, do LRT Lid Standard Measurement (AMM 20-56-01/201).

(b) If the BITE display shows "Joint V TooBig", then stray currents may be circulating through the shield of the wire bundle being measured.

1) If power is applied to any of the equipment attached to this bundle, remove power from the equipment.
2) Any on-board electrical equipment that does not need to be ON should be turned OFF.
3) Make sure no other sources of current or voltage are connected on or near the bundle being tested.
4) In extreme cases, all power may need to be removed from the airplane.

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(6) When the LEDs on the probes flash green, record the resistance value of this joint from the bottom line of the BITE display.
(a) The following resistance values (Table 201) are maximum joint resistance values for common electrical connections/joints.

TABLE 201

TYPE OF JOINT	MAXIMUM ALLOWABLE RESISTANCE (ALUMINUM CONNECTORS) IN MILLIOHMS	MAXIMUM ALLOWABLE RESISTANCE (STAINLESS/STEEL) IN MILLIOHMS
Backshell-To-Receptacle	2.5	5.0
Backshell-To-Plug Body	2.5	5.0
Plug-To-Receptacle	5.0	12.5
Receptacle-To-Bracket	2.5	5.0
Bracket-To-Bond Strap	1.0	1.0
Bond Strap-To-Structure	1.0	1.0
Bracket-To-Structure	1.0	1.0
Ground Stud-To-Structure	1.0	1.0
Riveted Bracket-To-Structure	1.0	1.0
Other Fay Surface Bonds	1.0	1.0

(b) To calculate the maximum allowable resistance for a built-up joint, do the following:
1) Determine what type of electrical connections/joints and how many of each are contained within the built-up joint.
2) Find the maximum allowable resistance for each type of electrical connection/joint (Table 201) contained within the built-up joint.
3) Sum the individual maximum allowable resistances for each electrical connection/joint contained within the built-up joint. This sum is the calculated maximum allowable resistance for the built-up joint.

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(c) If the measured built-up joint resistance is higher than the calculated maximum allowable resistance, then do a joint resistance measurement across each individual connection/joint to isolate the specific high resistance connection/joint.
1) If an individual connection/joint resistance exceeds the maximum allowable resistance (Table 201) for that type of connection/joint, then repair the faulty connection/joint.

NOTE: Loose connectors and backshells or pigtails can cause an out-of-tolerance resistance reading.

a) Do the following SWPM 20-20-00 or SWPM 20-25-11.
2) After you complete the joint repair, repeat the Joint Buildup Resistance Measurement to verify the repair.

(d) If the measured joint resistance is less than the calculated maximum allowable resistance for the built-up joint, then do the Joint Buildup Resistance Measurement on the next joint in the wire bundle.

(e) If all of the built-up joints/connections for a particular wire bundle have been measured and joint resistances are less than the calculated maximum allowable resistance for the built-up joints, then the Joint Buildup Resistance Measurement Task is complete.

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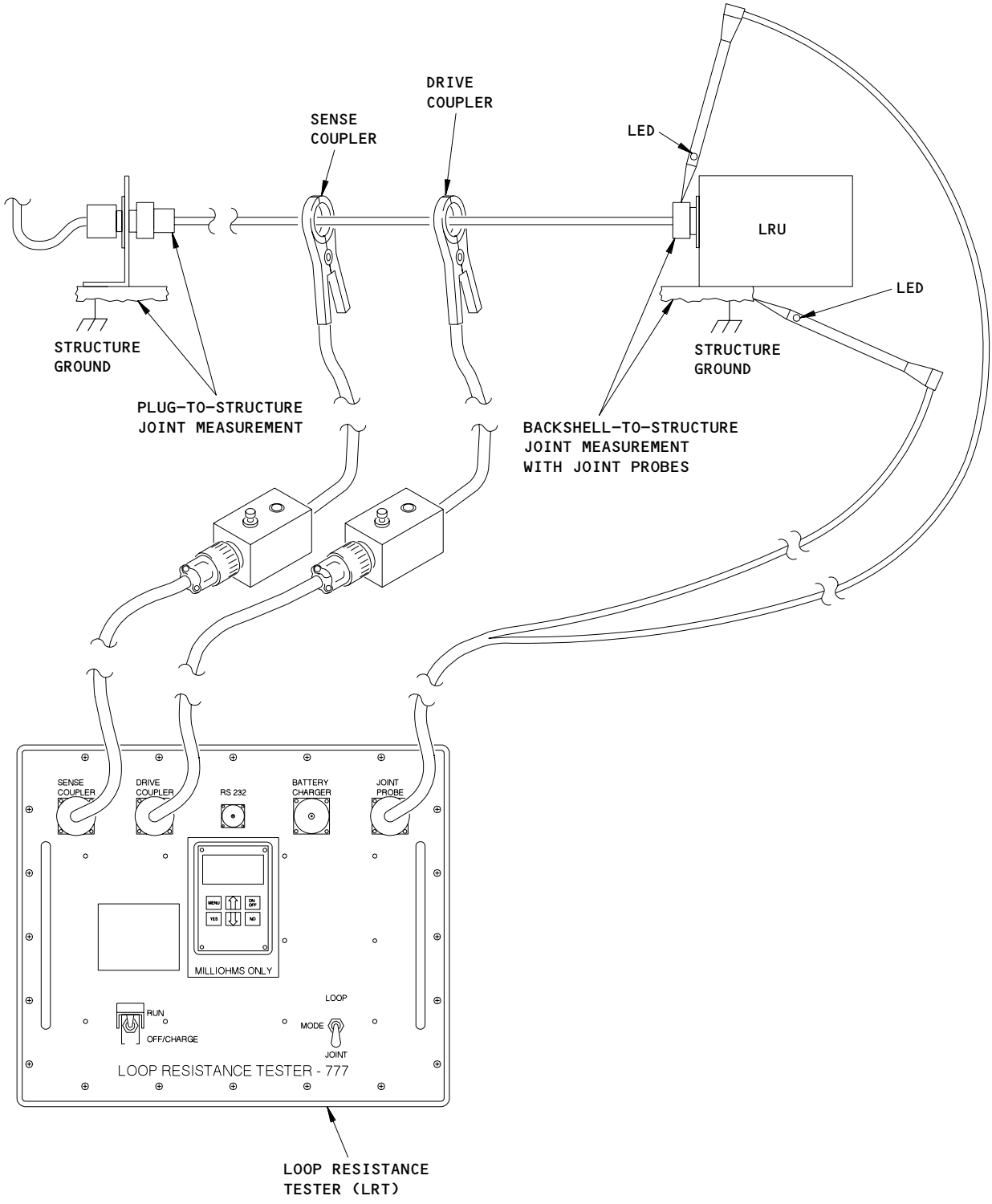

Typical Loop Resistance Tester (LRT)
Hookup for Joint Buildup Test
Figure 201

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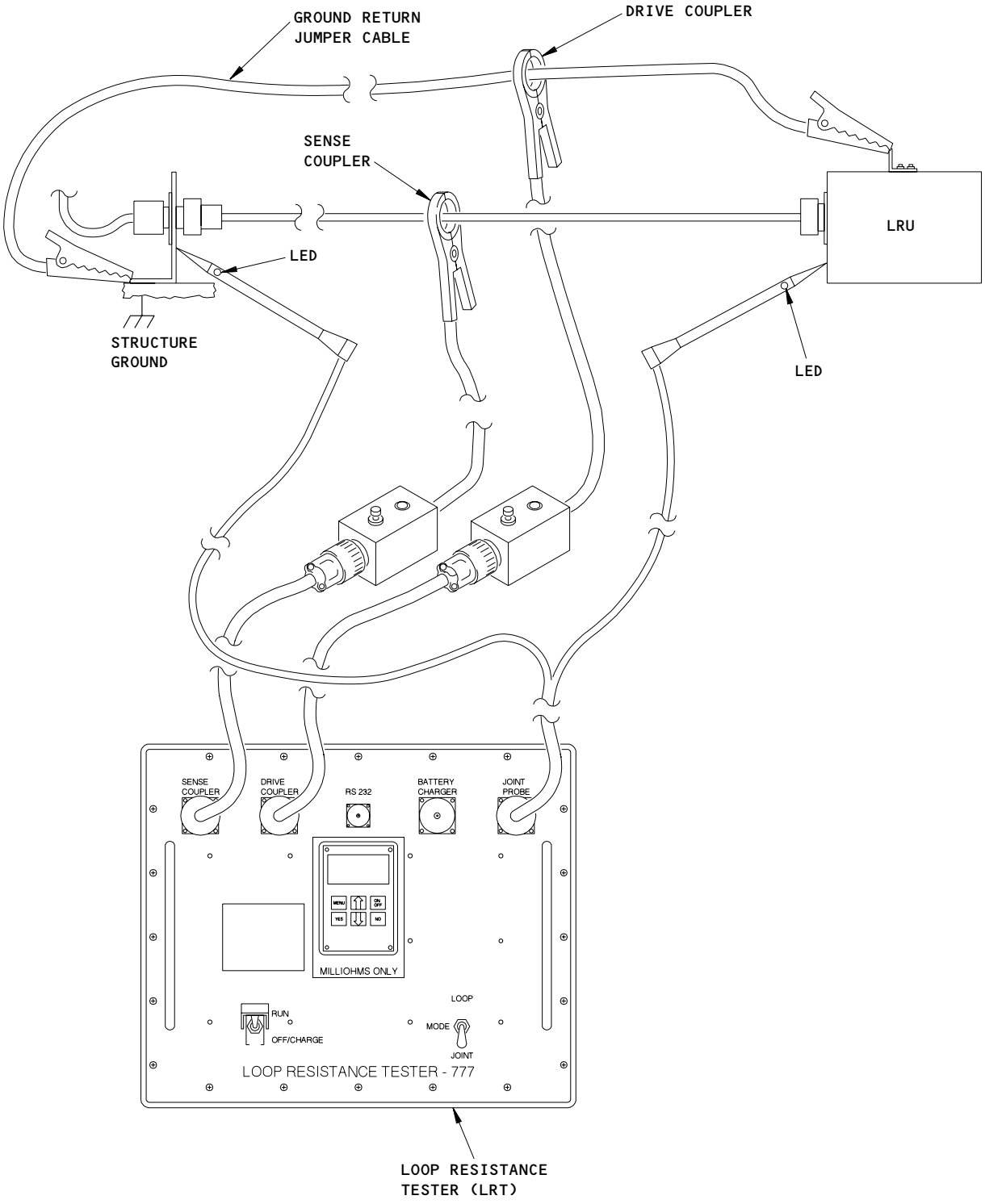

Typical Loop Resistance Tester (LRT)
Hookup for Modified Joint Buildup Test
Figure 202

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CIRCUIT BREAKER RESET - MAINTENANCE PRACTICES

1. General
   A. This procedure is for on the ground maintenance.
   B. Circuit breakers open when there is an electrical overload in the airplane system. A circuit breaker that opens because of an electrical overload is known as a "tripped" circuit breaker.
   C. If there are currently specific instructions for the reset of a tripped circuit breaker in maintenance and troubleshooting procedures, follow those instructions.
   D. A defective circuit breaker can cause the circuit breaker to open. Make sure the circuit breaker is serviceable.
   E. Use your judgment and airline policy to reset a tripped circuit breaker.
   F. Monitor the airplane to see if a tripped circuit breaker occurs again on subsequent flights.
   G. Do not reset a tripped circuit breaker until you know the cause for the tripped circuit breaker and that the circuit breaker can be safely reset. Fires have occurred in which the tripped circuit breakers were reset without an examination of the cause.
   H. Use this procedure to reset a tripped circuit breaker:
      (1) If you know the circuit breaker is serviceable
      (2) If this procedure is in agreement with your airline policy
      (3) If you cannot determine the cause for the tripped circuit breaker
      (4) If you cannot determine whether it is safe to reset the circuit breaker
2. Procedure
   A. Attach a DO-NOT-CLOSE tag to the tripped circuit breaker.
   B. Install a circuit breaker lock on the tripped circuit breaker.
   C. If the tripped circuit breaker is one of three circuit breakers protecting a 3-phase circuit:
      (1) Open the other two circuit breakers
      (2) Attach DO-NOT-CLOSE tags
      (3) Install circuit breaker locks
   D. Look in the aircraft logbook to find if there is recorded data about a "tripped" circuit breaker, such as:
      (1) The condition existing when the circuit breaker trip occurred
      (2) The conditions existing when the circuit breaker was reset
      (3) The results of resetting the circuit breaker
   E. Do a visual check for damage to electrical wiring and system components related to the tripped circuit breaker. If necessary, refer to the Wiring Diagram Manual. Look for these types of damage:
      (1) Electrical shorting
      (2) Electrical arcing
      (3) Corrosion on the contacts of the electrical wiring and system components
      (4) Abrasion of the electrical wiring and system components

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(5) Cracks on the insulation of the electrical wiring
(6) Split wires

NOTE: A split wire is identified when the conductor is visible through a crack in an electrical wire insulation.

(7) Wires
(8) Discoloration of the insulation of the electrical wiring
(9) Fluid or dust contamination of electrical wiring and system components

NOTE: Contamination can be a fuel source during electrical arcing.

(10) Metal shavings

NOTE: Metal shavings can cause electrical shorting.

F. Make sure there are no loose terminal connections.

NOTE: Loose terminal connections can be a source of electrical arcing. (If you find damage to the electrical wiring, refer to the Standard Wiring Practices Manual and repair the electrical wiring.

G. If you find damage to a system component, refer to the applicable Aircraft Maintenance Manual procedure and replace the component.
H. If you find damage to the electrical wiring, refer to the Standard Wiring Practices Manual and repair the electrical wiring.
I. Remove contamination and metal shavings if necessary.
J. Remove the DO-NOT-CLOSE tag(s).
K. Remove the circuit breaker lock(s).

WARNING: KEEP PERSONS AND EQUIPMENT CLEAR OF THE SYSTEM RELATED TO THE TRIPPED CIRCUIT BREAKER. MAKE SURE THERE IS NO DAMAGE TO THE ELECTRICAL WIRING AND SYSTEM COMPONENTS. MAKE SURE ALL TERMINAL CONNECTIONS ARE TIGHT. DAMAGED ELECTRICAL WIRING, DAMAGED SYSTEM COMPONENTS AND LOOSE TERMINAL CONNECTIONS CAN CAUSE ELECTRICAL ARCING AND A FIRE WHEN THE CIRCUIT BREAKER IS CLOSED.

WARNING: DO NOT RESET (CLOSE) A FUEL PUMP CIRCUIT BREAKER THAT HAS OPENED (TRIPPED) UNTIL YOU CORRECT THE PROBLEM. REFER TO AMM 28-22-0/101. THIS CONDITION CAN CAUSE A FIRE OR EXPLOSION.

WARNING: MAKE SURE THROUGH THE BOEING COMPANY 737-200 SPM 20-02-10, AIRFRAME FLAMMABLE LEAKAGE ZONES THAT THE OPEN CIRCUIT BREAKER DOES NOT HAVE AN EFFECT ON FLAMMABLE LEAKAGE ZONES. IF THE CIRCUIT BREAKER IS CLOSED WITHOUT FLAMMABLE LEAKAGE ZONE VERIFICATION, SPARKS CAN CAUSE A FIRE OR EXPLOSION.

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L. Close the circuit breaker(s).
M. After you close the circuit breaker(s), make sure there is no electrical arcing or other damage to the system.
N. To make sure the airplane system operates correctly, refer to the applicable procedure in the Aircraft Maintenance Manual.

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CIRCUIT BREAKER CYCLING - MAINTENANCE PRACTICES

1. Circuit Breaker Cycling
   A. General
      (1) This procedure is for on-the-ground maintenance and is preventative maintenance for those circuit breakers that are less frequently used.
         (a) It is not necessary to do this procedure for frequently used circuit breakers.
         (b) Because each airline operates differently, it is an airline decision as to which circuit breakers are frequently used and which circuit breakers are less frequently used.
      (2) Research has shown that the cycling of less frequently used circuit breakers can help to improve operational system reliability.
         (a) If a circuit breaker is not operated for a long time, it is possible that the circuit breaker will not open when an electrical problem occurs.
      (3) Too much use of a circuit breaker can cause a circuit breaker to malfunction.
      (4) Circuit breakers are located in all areas of the airplane such as the flight compartment, electrical equipment bays, cargo compartments, passenger compartment, and other areas.
   B. References
      (1) AMM 24-22-00/201
   C. Procedure
      (1) Remove electrical power (AMM 24-22-00/201).

         NOTE: Electrical power must be off to decrease the number of fault indications and nuisance messages.

      (2) Do these steps to check a circuit breaker on the airplane:
         (a) Open the circuit breaker.
         (b) Do a visual check of the circuit breaker area for damage. Look for these types of damage:
            1) Electrical shorting
            2) Electrical arcing
            3) Discoloration of the circuit breaker
            4) Contamination of the circuit breaker

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(c) If you find damage to the circuit breaker, replace the circuit breaker.
(d) Close the circuit breaker.
1) Look for contamination.
(e) Remove contamination, if necessary.
(f) If you find that the circuit breaker is unserviceable After you open and close it, replace the circuit breaker.

(3) If necessary, do this procedure again to cycle another circuit breaker.

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