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## FLOOR PANEL PROTECTION - MAINTENANCE PRACTICES

#### 1. General

- A. This procedure has this task:
  - (1) Floor panel damage prevention during maintenance.

TASK 20-09-01-612-001

- 2. Floor Panel Damage Prevention During Maintenance
  - A. To prevent possible damage to floor panels during maintenance, do these steps:

s 982-002

(1) Let only one person at a time use the ladder, stand, or scaffolding.

s 822-003

- (2) Use plywood bearing pads that are a minimum of 1/2 inch thick and 1 foot square under each leg, if you have these conditions:
  - (a) You use ladders, stands, or scaffolding with leg-bearing surfaces. Leg-bearing surfaces include rollers, screws, and sharp edges.
  - (b) You have a leg-bearing surface of less than 8 square inches for each leg.

 20-09-01



## BEARINGS AND BUSHINGS - REMOVAL/INSTALLATION

TASK 20-11-01-914-001

- 1. Bearings and Bushings Removal/Installation
  - A. Procedure

s 914-002

(1) Use the instructions in SOPM 20-50-03, Standard Overhaul Practices Manual, to remove and install the bearings and bushings.

 20-11-01

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### CABLE TURNBUCKLE LOCKING CLIPS - REMOVAL/INSTALLATION

#### 1. General

A. This procedure contains two tasks. The first task is the replacement of the turnbuckle locking clips. The second task is an alternative installation procedure for the turnbuckle assembly.

TASK 20-11-02-024-008

- 2. Replacement of Turnbuckle Locking Clips
  - A. Remove the Turnbuckle Locking Clips (Fig. 401)

s 034-002

(1) Twist the turnbuckle locking clip and push the locking hook out of the hole in the center of the turnbuckle barrel.

s 024-003

- (2) Move the turnbuckle locking clip out from the turnbuckle slot.
- B. Install the Turnbuckle Locking Clips (Fig. 401)

s 434-004

<u>CAUTION</u>: DO NOT USE THE TURNBUCKLE LOCKING CLIPS AGAIN. THEY CAN BE DEFECTIVE IF USED AGAIN.

(1) Tighten the turnbuckle until not more than three threads are out of the barrel and until you have correct cable tension.

s 824-005

(2) Align the slot in the barrel and the cable terminal.

s 434-006

(3) Put the straight end of the locking clip into the aligned slot.

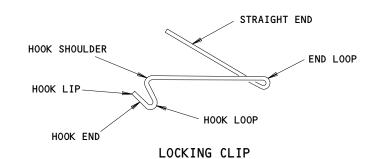
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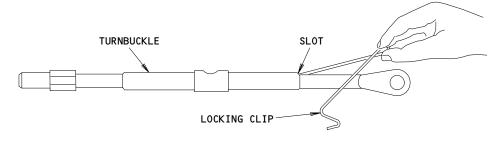
(4) Put the locking clip hook over the hole in the center of the turnbuckle. Engage the hook into the hole.

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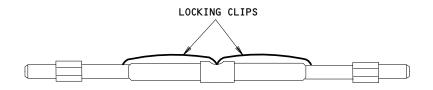
20-11-02



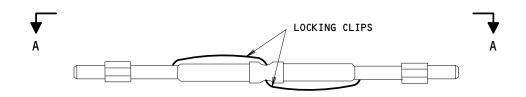




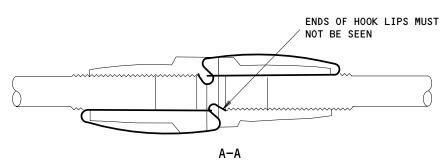
INSERT CLIP IN SLOT



## LOCKING CLIP INSERTED IN SAME TURNBUCKLE BARREL HOLE



## LOCKING CLIP INSERTED IN OPPOSITE TURNBUCKLE BARREL HOLE



Turnbuckle Locking Clip Figure 401

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s 424-008

(5) Push the hook shoulder to engage the hook in the turnbuckle.

s 424-009

(6) Do the last four steps again to lock the second terminal.

<u>NOTE</u>: You can put the locking clips in the same side or in the opposite side of the turnbuckle holes.

s 824-010

(7) To make sure the two turnbuckle locking clips are correctly installed, turn the turnbuckle slightly.

s 214-011

(8) Visually examine the turnbuckle locking clip to make sure the hook is engaged in the turnbuckle.

TASK 20-11-02-404-010

- 3. <u>Alternate Method to Install Turnbuckle Assembly</u> (Safetied with lockwire) (If clips not available)
  - A. Consumable Materials
    - (1) C00308 Cable Corrosion Preventative Compound MIL-C-11796B Class 3
  - B. Procedure

s 644-011

(1) Apply a thin layer of corrosion preventative compound to the barrel and cable terminals (Fig. 402).

s 434-012

ALL

(2) Engage the turnbuckle barrel equally with the cable terminals. Turn the barrel until not more than three threads are out of the barrel and until you have the correct cable tension.

EFFECTIVITY-

20-11-02



s 434-013

(3) Put a soft annealed wire of stainless steel and of the correct diameter into the holes.

NOTE: Use .024 for 1/16" cable, .031 for 3/32" or 1/8" cable, .043 for 5/32" thru 5/16" cable.

s 434-014

(4) Twist the wire. Do not use a tool for this operation that can cause damage to the wire.

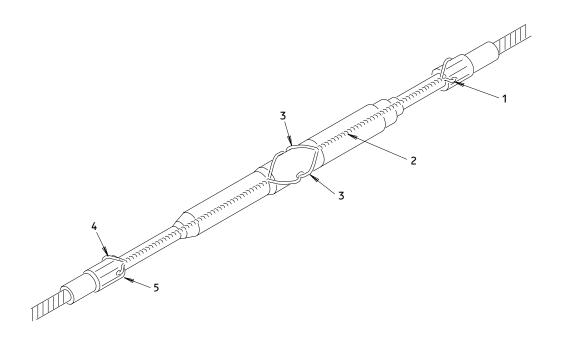
s 434-015

(5) Put the ends of the wire through the opposite holes in the barrel. Pull the wire through.

NOTE: If you use a tool, use it only on the ends of the wire.

s 434-016

(6) Twist the wire down to the hole in the terminal. Put the end of one wire in the hole, pull through, and twist the ends together. Cut off the length of twisted ends that is more than 5/8".



Turnbuckle Installation Figure 402

EFFECTIVITY-ALL 20-11-02



S 434-017
(7) Push the twisted ends flat against the terminal.

ALL ALL

20-11-02

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### CONTROL CABLES - REMOVAL/INSTALLATION

#### 1. General

- A. This procedure contains two tasks. The first task is the removal of control cables. The second task is the installation of control cables.
- B. This procedure includes prefabricated and not prefabricated cables to make installation easier when portable swaging machines are available.
- C. If this procedure does not agree with specified maintenance procedures, use the specified maintenance procedure.
- D. The maintenance manual location for control cable fabrication data is found in Table I

TABLE I	
CABLE	MM LOCATION
FLIGHT CONTROLS  - AILERON & AILERON TRIM - SPOILER - SPEED BRAKE - RUDDER	27-00-01-0 27-00-01-0 27-00-01-0 27-00-01-0
LANDING GEAR - ALTERNATE EXTENSION - BRAKES - DOOR GROUND RELEASE - EXTENSION/RETRACTION - NOSE WHEEL STEERING	32-00-40-0 32-00-40-0 32-00-40-0 32-00-40-0 32-00-40-0

#### TASK 20-11-03-004-031

#### 2. Remove Control Cables

- A. Equipment
  - (1) Cable Clamps A20005-9
- B. Consumable Materials
  - (1) G00270 Masking Tape
- C. Procedure

s 934-003

(1) Use masking tape to make a mark on the cable and fittings.

NOTE: The masking tape lets you refer to the initial position when you install the new cable.

s 034-004

(2) Loosen the turnbuckles to release the tension (Ref 20-11-02/401).

20-11-03



s 034-005

(3) If you remove the applicable engine control cable section, remove the cable stops (Ref 20-11-17/401).

s 034-006

(4) If applicable, remove the control cable air seal (Ref 20-11-04/401).

s 434-007

(5) Install cable clamps on the cable you do not remove to keep light tension on the cable. If you can isolate the cable between the rigging pin locations, install the rigging pins through the applicable drum or quadrant.

NOTE: Light tension on the cable that you do not remove will prevent wind off on the cable drums. Light tension will also make sure the cables do not move out of the pulley guides.

s 834-008

(6) Install the new cable at the same time you remove the old cable. Use the old cable to pull the new cable into position.

NOTE: If you do not attach the new cable to the old cable before you remove the old cable, you will have a problem routing the new cable.

#### TASK 20-11-03-404-032

- 3. <u>Install Control Cables</u>
  - A. Equipment
    - (1) Tensiometer Commercially available.
    - (2) Cable Clamps A20005-9
  - B. Consumable Materials
    - (1) D00015 Grease Airplane ball and roller bearings, cables, corrosion preventive, BMS 3-24
    - (2) G00034 Cloth Lint-free, dry
    - (3) G00270 Masking Tape
    - (4) C00308 Cable Corrosion Prevention Material
  - C. Install Prefabricated Cable

NOTE: You may wish to replace zinc-only coated cables with tin-over-zinc coated cables to minimize the amount of initial cable stretch.

s 014-009

(1) Remove the necessary pulleys and control cable air seals (Ref 20-11-04/401). See the applicable chapter for cable location.

EFFECTIVITY-

20-11-03

ALL



s 834-010

(2) Attach the new cable to the old cable. Pull the old cable out, which pulls the new cable through at the same time. Keep light tension on the new cable.

NOTE: If you do not attach the new cable to the old cable, you will have a problem in routing the new cable.

s 414-011

(3) Install the pulleys and control cable air seals (Ref 20-11-04/401).

s 434-035

- (4) Finish installation according to procedures given in Section E.
- D. Install Nonprefabricated Cable

NOTE: You may wish to replace zinc-only coated cables with tin-over-zinc coated cables to minimize the amount of initial cable stretch.

s 834-012

(1) Identify the cable you remove. Prepare a new cable as told in the applicable system chapter.

s 434-013

(2) Install only those fittings that will permit cable installation.(a) You can use a portable swager to install the fittings.

s 834-014

(3) Apply proof load (Fig. 401) to the cable and installed fittings to do a check on the swaging and to make the cable longer initially.

s 164-015

(4) Rub the full length of the cable with a dry, lint-free cloth.

NOTE: Do not use solvents to clean cable assemblies.

s 644-016

(5) Apply a light thin layer of BMS 3-24 grease to carbon steel cables, then wipe the cable with a clean rag to leave a thin film of grease between the wires on the cable. Do not grease cres cables. They may only be cleaned with a clean rag.

s 934-018

ALL

(6) Make marks on the positions of the fittings not installed on the cable before installation.

EFFECTIVITY-

20-11-03



		CABLE DIAMETER (INCHES) 1										
WIRE ROPE	TYPE	1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16	3/8	
		PROOF LOAD (POUNDS)										
BMS 7-265 COMP. "A" (TZ) (CARBON STEEL)	7 x 7	288 +25 -0	552 +25 0									
	7 x 19			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 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	

PROOF LOADS FOR CABLE ASSEMBLIES

#### 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:

YOU SHOULD REPLACE CABLES FOR BOTH SIDES OF A SYSTEM IF ONE OR BOTH SIDES HAS A BAD CABLE. USE CABLES OF THE SAME TYPE FOR BOTH SIDES. THIS WILL PREVENT UNEVEN CABLE STRETCH THAT CAN CAUSE PROBLEMS WITH THE RIGGING OF THE SYSTEM.

1>>	PROOF-	-LOADING	OF	NYLON	JACKETED	CABLE	SHALL	ВЕ	BASED	UPON	THE	DIAMETER	OF	THE	WIRE	ROPE	ONLY.
	DO NO	T INCLUD	E TH	IE JACK	CET AS PA	RT OF	THE DI	AME	TER.								

Control Cable Installation Figure 401

EFFECTIVITY-ALL 20-11-03



s 834-019

(7) Put tape on the old cable so it will not unravel.

s 834-001

(8) Cut off the cable end fitting of the old cable and make a splice to attach the old cable to the new cable.

NOTE: If you do not attach the new cable to the old cable, you will have a problem in routing the new cable. Make the splice of minimum diameter and sufficiently strong not to break when you pull the cable through. Make the splice on only the center strands of the cable. Put tape on the loose outer strands.

s 834-020

(9) Pull the old cable out with light tension on the new cable.

s 434-021

(10) Install the remaining fittings and apply a proof load to fittings (Fig. 401).

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

s 434-033

(11) Finish installation according to procedures given in Section E.E. Finish Installation (general)

s 164-022

(1) If necessary, remove unwanted material from the surface of the control cable with a dry, lint-free cloth. Clean the full length of travel through the fairleads, air seals, over the pulleys, quadrants, and drums.

s 644-023

(2) Apply a light thin layer of BMS 3-24 grease to carbon steel cables, then wipe the cable with a clean rag to leave a thin film of grease between the wires on the cable. Do not grease cres cables. They may only be cleaned with a clean rag.

S 434-024

(3) Install the turnbuckles with the turnbuckle barrel installed an equal distance on the two threaded terminals. Do not let more than three threads show out of the barrel.

EFFECTIVITY-

20-11-03

ALL



S 034-025

(4) Remove the cable clamps and rigging pins from the control cable and drums.

s 434-026

(5) Tighten the cable as told in the temperature - tension chart in the system chapter.

Use a tensiometer to do a check on the cable tension. Apply the tensiometer to the cable at least six inches from the turnbuckle terminal or other fittings. To make sure you have the correct cable tension, permit a minimum of one hour at constant ambient temperature (±5°F) for airplane temperature to become stable.

s 714-027

(6) If a new cable is installed, operate the system for a number of test cycles, with cables tightened to two times the working tension. See the applicable chapter for tension specifications.

s 834-028

(7) Make the last rigging adjustments. Refer to the applicable chapter for rigging load and test cycle tables.

s 214-029

(8) Make sure the air seals are correctly adjusted after installation (Ref 20-11-04).

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

S 244-036

ALL

(9) 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.

(a) Between different cable systems - 0.50 inch

NOTE: A clearance of 2.00 inches is recommended.

EFFECTIVITY-

20-11-03



(b) Between structure, wiring, tubing and fixed equipment: At a fairlead - 0.50 inch At a rubstrip - 0.10 inch

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

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

NOTE: A clearance of 4.00 inches is recommended.

(d) Cables my sag to the lower surface of grommets at RBL 103.7 and RBL 106.25, WL 197.5, between STA 660 and 1250.

s 434-030

(10) Install the turnbuckle locking clips on all the turnbuckles adjusted (Ref 20-11-02).

s 434-031

(11) Install the cable stop if applicable (Ref 20-11-17).

s 714-032

(12) Operate controls through full travel to make sure that they move freely and that too much force is not necessary.

EFFECTIVITY-

ALL

20-11-03



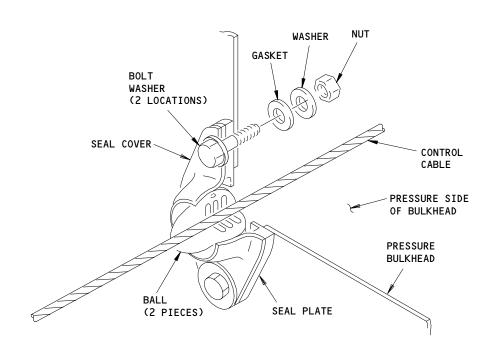
#### CONTROL CABLE AIR PRESSURE SEAL - REMOVAL/INSTALLATION

## 1. General

- A. Six tasks are provided in this subject. The first is removal of control cable air pressure seal. The second is installation of control cable air pressure seal. The third is removal of engine throttle control cable air pressure seal. The fourth is installation of engine throttle control cable air pressure seal. The fifth is removal of aileron, flap, or speed brakes control cable raised seal. The sixth is installation of aileron, flap, or speed brake control cable raised seal.
- B. Paragraphs 2 and 3 provide removal and installation for pressure bulkhead control cabin air pressure seals.
- C. Raised or half tube pressure seals are installed to prevent water from freezing around cables. For throttle control cables (Ref par. 4, 5). For aileron, flaps and speed brake control cables air pressure seal (Ref par. 6 and 7).

TASK 20-11-04-004-001

2. Remove Control Cable Air Pressure Seal (Fig. 401)



Control Cable Air Seal Installation Figure 401

ALL

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#### A. Procedure

s 034-002

(1) Remove two seal retaining bolts.

s 034-003

(2) Remove ball (2 pieces) from seal cover.

s 024-004

- (3) If it is necessary to replace the seal plate or seal cover, do these steps:
  - (a) Disconnect the turnbuckle adjacent to the pressure bulkhead.
  - Remove the seal cover and the seal plate from the control cable.

TASK 20-11-04-404-005

- Install Control Cable Air Pressure Seal (Fig. 401)
  - A. Consumable Materials
    - (1) D00015 Grease BMS 3-24
  - B. Procedure

s 434-006

- (1) If you remove the seal plate or seal cover, do these steps:
  - (a) Replace them on the control cable.
  - (b) Adjust the control cable as told in the system rigging instructions.

s 644-008

(2) Apply grease to the cable for full length of travel within seal.

NOTE: Do not fill seal with grease. Do not apply cleaning solvents or grease to stainless steel cables (CRES).

s 434-034

(3) Install the gasket to the pressure bulkhead.

s 434-009

ALL

(4) Connect the two ball halves on cable between seal cover and seal plate.

EFFECTIVITY-

20-11-04



s 424-035

(5) Loosely install the seal retaining bolts and washer.

s 434-036

(6) Adjust the seal to give minimum cable deflection and tighten the seal retaining bolts.

s 214-037

- (7) Make sure the cable pressure seals are correctly adjusted after installation.
  - (a) Make sure there is no cable deflection.
  - (b) Make sure the cable moves freely.

TASK 20-11-04-004-012

Remove Engine Throttle Control Cable Air Pressure Seal (Fig. 402)

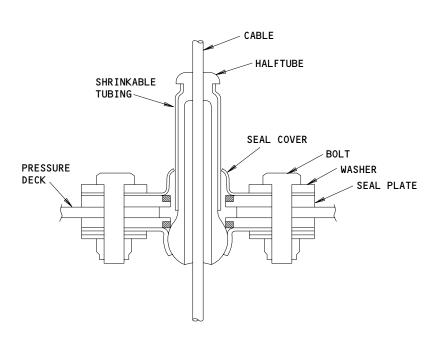
Procedure

s 034-013

(1) Disconnect throttle control cable at turnbuckle.

s 034-014

(2) Remove pulley.



Installation of Engine Thottle Control Cable Air Pressure Seal Figure 402

EFFECTIVITY-ALL 20-11-04

01

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s 024-015

- (3) Remove engine throttle air pressure seal.
  - (a) Remove two seal retainer bolts and pulley shield.
  - (b) Remove seal cover.
  - (c) Remove shrunk sleeving.
  - (d) Remove two half tubes.

TASK 20-11-04-404-016

- Install Engine Throttle Control Cable Air Pressure Seal (Fig. 402)
  - A. Consumable Materials
    - (1) B00015 Grease BMS 3-24
    - (2) G00973 Tubing Heat shrinkable, TFE-4
  - B. Procedure

s 424-017

- (1) Install engine throttle air pressure seal.
  - (a) Slide 5-inch piece of shrinkable tubing over turnbuckle and on cable.
  - (b) Place two half tubes over cable.
  - (c) Slide shrinkable tubing over half tubes.
  - (d) Use a suitable heat source and shrink tubing over half tubes.

NOTE: Seal plates installed on rib at BBL 140.00 will require removal to allow for installation of shrinkable tubing.

(e) Slide seal cover back on cable. Align pulley shield, shield plate, half tubes, seal cover and reinstall retainer bolts. Leave bolts slightly loose.

s 434-018

(2) Install pulley.

s 644-019

(3) Apply grease to the cable for full length of travel within seal.

NOTE: Do not fill seal with grease.

s 834-020

(4) Rig control cable according to system rigging instructions.

s 434-021

(5) Tighten retainer bolts.

TASK 20-11-04-004-022

6. Remove Aileron, Flap or Speed Brakes Control Cable Raised Seal (Fig. 403)

A. Procedure

s 014-023

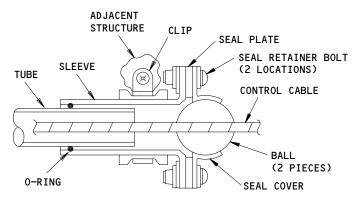
(1) Gain access to seal.

 20-11-04

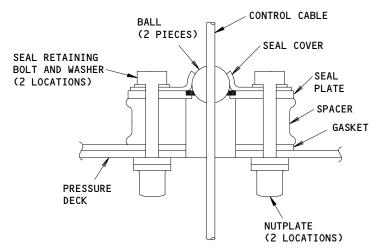
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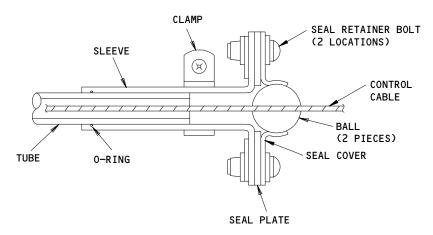




# AILERON CONTROL CABLE RAISED SEAL (SECTION VIEW THRU TUBE)



# TE FLAP CONTROL CABLE RAISED SEAL (SECTION VIEW THRU SPACER)



# SPEED BRAKE CONTROL CABLE RAISED SEAL (SECTION VIEW THRU TUBE)

Installation of Aileron Flaps Speedbrake Control Cable - Raised Seal Figure 403

304400

20-11-04

01

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s 034-024

(2) Remove seal retaining bolts.

S 024-025

(3) Remove seal ball from seal cover.

TASK 20-11-04-404-026

- 7. Install Aileron, Flap or Speed Brake Control Cable Raised Seal (Fig. 403)
  - Consumable Materials
    - (1) B00015 Grease BMS 3-24
  - B. Procedure

s 644-027

Apply grease to the cable with grease for full length of travel. (1) Wipe off excess grease.

NOTE: Do not fill seal with grease.

s 424-028

(2) Install seal ball halves.

s 434-029

(3) Install seal retaining bolts. Leave bolts slightly loose.

(4) Adjust seal to provide minimum cable deflection.

s 434-031

(5) Tighten seal retaining bolts.

s 714-032

(6) Operate control levers and check that cables move freely through seals without evidence of binding.

s 434-033

(7) Tighten retainer bolts.

ALL

EFFECTIVITY-

20-11-04

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## FLARELESS TUBING ASSEMBLY - REMOVAL/INSTALLATION

#### 1. General

- A. This procedure these tasks:
  - (1) The removal of the flareless tubing assembly
  - (2) The installation of the flareless tubing assembly
  - (3) The specifications for electrical resistance in the fuel tank
  - (4) The installation of flareless fittings in pressurized areas, fuel tanks, or cargo areas
  - (5) Tubing clearances
  - (6) Tubing clamp spacing.
- B. Remove and install all flareless tubing as told in this procedure. Identify the system, the tubing assembly configuration, and the tubing material before removal.
- C. When you disconnect tubing, always obey necessary precautions to prevent leakage of fluids. If fluid falls on the airplane, identify the fluid and clean the area as applicable (Ref Chapter 12, Cleaning and Washing).
- D. When you remove, install, or do work with hydraulic tube assemblies, obey the quidelines that follow:
  - (1) When you remove tubes make sure the tubes and port fittings have tags that identify the correct connection locations.
  - (2) Do not move or change the tube bends. If you move or change a 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 a bend in the tube, it can be possible that the tube will have too much stress when it is connected. Stress can cause cracks in the tubes.

WARNING: DO NOT USE TITANIUM FITTINGS IN THE OXYGEN SYSTEM TUBING. TITANIUM FITTINGS CAN CAUSE A FIRE OR INJURY TO PERSONS.

- E. You can use nuts and fittings again if the seal areas give a good seal on the assembly. Also make sure the threads turn smoothly and the hex corners are not worn.
  - NOTE: It is recommended that titanium or steel fittings be use 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.
- F. Incorrectly preset flareless BACS13AP sleeves can cause leaks. We recommend that you preset flareless sleeves by machine. Preset by hand only where you cannot preset by machine because of the tube configuration or because you cannot get access to the flareless sleeves.

ALL ALL

20-11-05



When you install tubing, align the fittings and tubing to permit you to hand tighten the B-nuts before you wrench tighten them. Do not use fitting nuts to align tubing and connections.

NOTE: If you use the nut to "stretch" or align the tubing to make the sleeve touch the mating surface, you will put too much force on the preset, swaged, or welded sleeve and tube end. This force adds to the risk of leakage, blowoff, and other failures.

TASK 20-11-05-054-021

- Flareless Tubing Assembly Removal
  - References
    - (1) 35-00-00/201, 0xygen
  - Procedure В.

s 804-038

s 014-039

REFER TO 35-00-00 FOR OXYGEN MAINTENANCE PROCEDURES. INCORRECT MAINTENANCE CAN CAUSE INJURY OR DAMAGE.

(1) Refer to 35-00-00 before you do work on the oxygen system.

REMOVE ALL PRESSURE FROM THE SYSTEM AS SPECIFIED IN THE WARNING: APPLICABLE MAINTENANCE INSTRUCTIONS BEFORE YOU START REMOVAL OF THE FLARELESS TUBING ASSEMBLY. A PRESSURIZED SYSTEM CAN CAUSE

INJURY.

(2) Get access to the tube assembly fittings.

s 034-003

ALL

(3) Remove the support clamps on the tubing you will remove and on the adjacent tubing assemblies as necessary.

EFFECTIVITY-

20-11-05



s 934-041

MAKE SURE EACH TUBE AND THE PORT FITTING HAVE TAGS TO IDENTIFY WARNING: 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 THIS OCCURS, UNINTENTED OPERATION OR MALFUNCTION OF AIRPLANE SYSTEMS CAN RESULT AND CAUSE INJJURY TO PERSONS AND DAMAGE TO EQUIPMENT.

(4) Install tags on the tubes and on the port fittings to clearly identify the correct connection locations.

s 034-004

(5) Loosen the adjacent tubing assemblies and clamps if necessary.

s 024-005

(6) Remove the tubing assembly from airplane.

s 434-006

CAUTION: PUT CAPS ON THE HYDRAULIC LINES AND FITTINGS. UNWANTED MATERIAL CAN CAUSE CONTAMINATION OF HYDRAULIC LINES, DAMAGE TO SYSTEM COMPONENENTS, AND LEAKAGE OF HYDRAULIC FLUID.

(7) Install protective caps on the tube assemblies and mating connections. Remove hydraulic fluid leakage.

s 684-027

CAUTION: DO NOT LET HYDRAULIC FLUID LEAKAGE COLLECT. REMOVE IT IMMEDIATELY. HYDRAULIC FLUID CAN CAUSE DAMAGE.

(8) Remove hydraulic fluid leakage.

TASK 20-11-05-054-022

- 3. Flareless Tubing Assembly Installation
  - A. Consumable Materials

TABLE 1 FLARELESS TUBING ASSEMBLY THREAD COMPOUNDS	
TYPE OF SYSTEM	APPROVED THREAD COMPOUNDS (STRAIGHT THREAD FITTINGS)
Compressed Gas	Antiseize Compound BMS 3-28
Deicing or (Anti-icing)	

EFFECTIVITY-

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ALL



Instrument Air	Antiseize Compound BMS 3-28
Pneumatic  Air Conditioning	Antiseize Compound BMS 3-28 DOOO62 Pneumatic Gease MIL-G-4343
ATT CONDITIONING	
Fire Protection	Antiseize Compound BMS 3-28 or D00053 Grease MIL-G-6032
Coolant	poods di case mil d'oosi
Water Injection	Antiseize Compound BMS 3-28
Fuel	D00070 Hydraulic Fluid MIL-H-5606
Lubrication	
Hydraulic MIL-H-5606	DOOO7O Hydraulic Fluid MIL-H-5606
Hydraulic BMS 3-11	D00054 Skydrol Assy Lube MCS 352
Hydraulic MIL-H-6083	D00070 Hydraulic Fluids MIL-H-5606 or D00106 Hydraulic Fluids MIL-H-6083
Misc Tubing	Antiseize Compound BMS 3-28 or DO0053 Grease MIL-G-6032

## B. Procedure

s 214-008

(1) Examine the tube ends and fittings for defects or contamination that can have a bad effect on the seal of the installation.

s 214-037

(2) Look for wear or dents on the tube.

EFFECTIVITY—\_\_\_\_\_

20-11-05



s 644-028

CAUTION: DO NOT USE TITANIUM FITTINGS IN OXYGEN SYSTEM TUBING. TITANIUM AND TITANIUM ALLOYS ARE OXYGEN REACTIVE. IF A NEW TITANIUM SURFACE IS OPENED TO GASEOUS OXYGEN, SPONTANEOUS COMBUSTION CAN OCCUR AT LOW PRESSURES.

(3) Apply the thread compound applicable to your system (Table 1) (Fig. 401). Apply the thread compound immediately before installation. Apply to the circumference of the external threads, shoulder, and conical seal surface of the flareless sleeve.

NOTE: Do not get the thread compound in the interior of the tube or the bore of the fitting. Do not apply thread compound when you assemble dri-lubed B-nuts.

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.

s 424-010

(4) Put the tubing assembly in the airplane and keep the tube clamps loose to permit you to align the tube in the fitting.

s 214-042

(5) Look at the tags to make sure the tubes are aligned with the correct port fittings.

s 824-011

(6) Align the tube and fitting by hand and make the tube end touch the bottom of the fitting.

s 434-012

(7) Keep the tube end at the bottom and aligned in the fitting. Turn the B-nut by hand until the B-nut touches bottom on the sleeve shoulder.

s 434-013

(8) To tighten the assembly, hold the union with a wrench and torque tighten the B-nut to the recommended value (Fig. 403).

NOTE: Do not use the B-nut to align the tube. Do not let the B-nut touch the bottom.

EFFECTIVITY-

20-11-05



s 434-014

ALWAYS KEEP THE CLAMPS TIGHT. TIGHT CLAMPS KEEP THE AREA CAUTION: BETWEEN THE TUBE AND THE CLAMP SURFACES FREE OF UNWANTED MATERIALS AND CONTAMINATION. IF SURFACES ARE NOT CLEAN, ABRASION CAN OCCUR.

(9) Tighten by hand the nuts which you cannot get access to torque tighten. Hand tighten until a clear increase in torque occurs, then tighten 1/6 to 1/3 (one or two hex flats) turn more.

The maximum tube collapse permitted after you torque the NOTE: BACS13AP sleeves is 0.015 inch less than the tube diameter (Fig. 402).

s 434-015

(10) Tighten all the tube clamps.

s 714-043

(11) 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.

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

s 714-044

(12) If you disconnected electrical wires to get access to the tubes and you think there is a possibility you connected the wires incorrectly or cross-connected the wires, do an operational check:

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

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

s 794-031

(13) Do a leak test:

ALL

(a) Pressurize the system for 5 minutes minimum.

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With the system pressurized, rub the tube and fitting with a clean white cloth to find leakage.

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

TASK 20-11-05-054-023

- Electrical Resistance Specifications in the Fuel Tank
  - Equipment
    - (1) Bonding meter Model T477W Microhm Bridge, Type W Bonding Meter, Avtron Manufacturing, Inc., Cleveland, Ohio
  - В. Procedure

s 764-017

WARNING: MAKE SURE THE BOND RESISTANCE IS NOT MORE THAN THE VALUES SHOWN. BOND RESISTANCE IS VERY IMPORTANT IF A LIGHTNING STRIKE OCCURS.

> IF POSSIBLE, USE A METER THAT IS RESISTANT TO EXPLOSION. IF NOT, MAKE SURE THE DANGEROUS GAS CONTENT OF THE ATMOSPHERE MEASURED BY A COMBUSTIBLE GAS DETECTOR IS LESS THAN 10 PERCENT OF THE LOWER EXPLOSIVE LIMIT.

- Install again or replace the fittings which have resistances more than the values in Fig. 404 and 405.
  - (a) Again do a check on resistance. Do not use bonding jumpers to bridge high-resistance hydraulic installations.

s 764-018

(2) Measure the resistance between the bulkhead fittings and hydraulic tubes (Fig. 407). Make sure the resistance is less than the value in Fig. 404.

s 764-019

ALL

(3) Measure the resistance across the in-line union/tee fittings (tube-to-tube) (Fig. 408). Make sure the resistance is less than the value in Fig. 405.

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TASK 20-11-05-054-024

- 5. Installation of Flareless Fittings in Pressurized Areas, Fuel Tanks, or Cargo
  - A. Procedure

s 434-021

(1) Tighten flareless fittings with BACS13AP sleeves two times (tighten, loosen, and tighten again).

NOTE: Be careful to make sure that the fittings will not have leaks after you tighten the fittings.

s 434-022

- Tighten flareless fittings with BACS13BX, BACS13BD, welded-on or (2) NAS1760-type sleeves as follows:
  - (a) Tighten the fitting to the torque specified in Fig. 403.
  - Loosen the fitting to release the torque.
  - (c) Tighten the fitting to the torque specified in Fig. 403.

NOTE: Be careful to make sure the fittings will not have leaks after you tighten the fittings.

s 764-023

(3) WING FUEL TANK INSTALLATIONS; Do the paragraph, Electrical Resistance Specifications in the Fuel Tank.

s 304-024

(4) Make necessary repairs. Refer to 20-11-05/801.

s 794-025

(5) Do a leak test:

ALL

- (a) Pressurize the system for a minimum of 5 minutes.
- With the system pressurized, rub the tube and fitting with a clean white cloth to find leakage.

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

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s 714-045

(6) 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.

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

s 714-046

(7) If you disconnected electrical wires to get access to the tubes and you think there is a possibility you connected the wires incorrectly or cross-connected the wires, do an operational check:

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

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

TASK 20-11-05-054-025

### 6. <u>Tubing Clearances</u>

- A. General
  - (1) This task gives you the minimum clearances necessary between tubes and all other components (hoses, fittings, structure, and other tubes). These clearances prevent tube damage in all operating positions.
- B. Clearances

s 974-029

- (1) The minimum clearance for all mechanical systems except hydraulic tubing will be from adjacant structure, fixed structure, fixed and moving equipments 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.

s 974-030

ALL

- (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.

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- (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 between electrical wiring installations.

s 434-027

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

s 224-028

(4) At supported locations, make sure the tubes are clear of the adjacent structure by a minimum of 0.10 inch. Where the tubes are attached directly with clamps to the supporting structure, the clearance can be the thickness of the supporting clamps.

s 224-029

(5) At not supported locations, make sure all rigid lines are clear of the adjacent structure, equipment installations, and other items by a minimum of 0.25 inch.

s 224-030

(6) Make sure the tubes are clear of all operating mechanisms by not less than 0.38 inch. This clearance can be 0.25 inch at supported locations where tubes will not rub or touch the operating mechanism.

s 224-031

(7) If tubes go through or across each other or are parallel, make sure there are sufficient clamps attached. Clearance must be 0.25 inch minimum or the thickness caused by back-to-back clamping.

<u>NOTE</u>: You can use more back-to-back clamping than that on the supplied airplane to get the necessary clearance.

s 434-032

ALL

(8) To get the necessary clearances with the loop-type clamps, use BAC S18AF3 or BAC S18AF4 spacers to make the necessary height. On the U-type clamps, use BAC 8SIAN spacers. Do not use NAS42 or NAS43 on hydraulic tubes.

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

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s 224-033

(9) Make sure the tubes are clear of the control cables between the break points or fairleads and the control linkage by a minimum of 0.625 inch.

s 224-034

(10) Make sure the minimum clearance between the tubes in the clampblocks (65B80254) and the channels on the clampblocks is 0.060 inch. If this clearance is less, correct the spacer tube length (NAS43003-) and/or correct the force of the tubes in the clampblock.

TASK 20-11-05-054-026

- 7. Tubing Clamp Spacing
  - A. Procedure

S 224-036

(1) Keep the tube clamp spacing in the limits shown in Table 2 unless specified differently.

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TABLE 2 NORMAL TUBE CLAMP MAXIMUM SPACING						
Tubing OD (Inches)	Material	Clamp Spacing — Usual (Inches)	Clamp Spacing - Special *[1]			
1/4	Steel, Titanium	16.0	12.0			
3/8	Steel, Titanium	20.0	15.0			
3/8	Aluminum	16.5	12.0			
1/2	Steel, Titanium	23.0	17.0			
1/2	Aluminum	19.0	14.0			
5/8	Steel, Titanium	22.0	18.5			
5/8	Aluminum	22.0	16.5			
3/4	Steel, Titanium	27.5	20.5			
3/4	Aluminum	24.0	18.0			
1.0	Steel, Titanium	30.0	22.5			
1.0	Aluminum	26.5	19.5			
1 1/4	Steel, Titanium	31.5	23.5			
1 1/4	Aluminum	28.5	21.0			

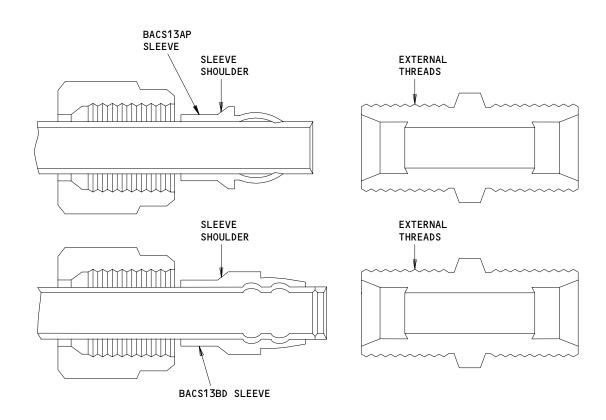
\*[1] Special: Wing Rear Spar, Engine Strut, Engine Aft Fairing

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# LUBRICATION POINTS

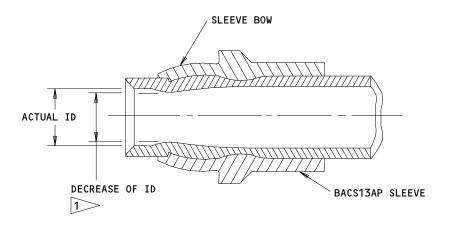
# Flareless Tubing Assembly Lubrication Points Figure 401

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1 MAKE SURE THE DECREASE OF ID IS NOT MORE THAN 0.005 INCH AFTER PRESET OR 0.015 INCH AFTER MANY TIGHTENINGS

Maximum Collapse of Preset Flareless Sleeve Figure 402

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INSTALLATION TORQUE ON FLARELESS TUBING FITTINGS 3>4> (POUND-INCHES, ±5%)					
TUBING SIZE (INCHES)		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 & 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			

1 TORQUE VALUES APPLICABLE TO THE FOLLOWING TUBE ENDS:

- A. 21-6-9 CRES AND ALL OTHER CRES TUBE ENDS WITH BACS13BD OR BACS13BX SWAGED SLEEVES
- B. MIL-T-6845, MIL-T-8504 AND MIL-T-8808 CRES FLARED TUBE ENDS
- C. MIL-T-6845 CRES WITH BACS13AP PRESET SLEEVE 5
- D. HOSE END FITTINGS WITH STEEL INSERTS (NIPPLES)
- E. ALL TITANIUM TUBE ENDS

2 TORQUE VALUES APPLICABLE TO THE FOLLOWING 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. FLARELESS TYPE HOSE END FITTINGS WITH ALUMINUM INSERTS (NIPPLES)
- E. ALUMINUM FLARED TUBE ENDS

Installation Torque for Flareless Fittings Figure 403 (Sheet 1)

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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 TORQUE VALUES ARE APPLICABLE TO STANDARD MS FLARELESS TUBE ENDS (BACS13AP SLEEVES) ON MIL-T-6845 (304-1/8 HARD) 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 (POUND-INCHES)	375	575	725

TORQUE VALUES ARE APPLICABLE TO STANDARD MS FLARELESS TUBE ENDS (BACS13AP SLEEVES) ON 6061-T6 ALUMINUM AND 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 (POUND-INCHES)	160	250	325

Installation Torque for Flareless Fittings Figure 403 (Sheet 2)

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## RESISTANCE BETWEEN BULKHEAD FITTINGS AND HYDRAULIC TUBE

	MAXIMUM RESISTANCE (MILLIOHM)					
TUDE		TITANIUM				
TUBE SIZE	ALUMINUM	PERMASWAGE	WELD-ON			
-04		6	12			
-06	0.70	4	8			
-08		2.5	5			
-10	0.41	1.5	3			

Resistance Between Bulkhead Fittings and Hydraulic Tubing Figure 404

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### RESISTANCE ACROSS UNION/TEE FITTINGS (TUBE-TO-TUBE)

TUDE	MAXIMUM RESISTANCE (MILLIOHM)				
TUBE SIZE	ALUMINUM	TITANIUM			
-04		12			
-06	1.30	8			
-08		5			
-10	0.75	3			

Resistance Across Union/Tee Fittings (Tube-To-Tube)
Figure 405

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### INSTALLATION TORQUE

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

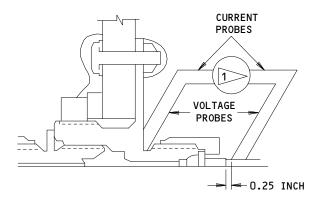
Installation Torques for Flareless Fittings in Pressurized Areas Figure 406

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## SCREW TOGETHER WELD-ON BULKHEAD FITTING

1 MICRO-OHMMETER

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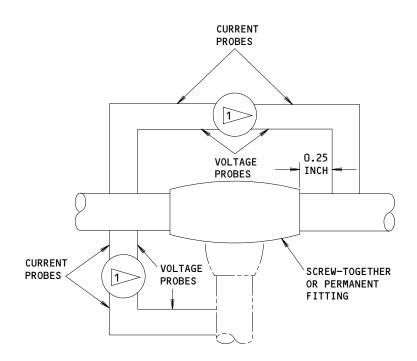
Bulkhead Fittings Figure 407

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1 MICRO-OHMMETER

Union/Tee Fittings Figure 408

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### FLARELESS TUBING ASSEMBLY - APPROVED REPAIRS

#### 1. General

- A. This procedure contains these tasks:
  - (1) Tube Repair.
  - (2) Swage BACS13BX Flareless Sleeves with the Harrison Elastomer Swagers 5175, 5570, and 5720.
  - (3) Swage BACS13BX Flareless Sleeves with the 6633KO1 Harrison Roller Swaging Kit.
  - (4) Preset BACS13AP Flareless Sleeves.
  - (5) Install the 921721 Cryolive Flareless Sleeve Assembly.
  - (6) Install the BACC42W H-Coupling.
  - (7) Install the 3PO2111 or 3PHS111 Cryofit Coupling.
  - (8) Install Permaswage Fittings.
  - (9) Install the Rynglok 8010T permanent tube to tube union.
  - (10) Repair Hydraulic Tubing with Flexible Hoses.
  - (11) Repair 6061-T4 Aluminum Hydraulic Tubing.
  - (12) Aluminum Fuel Tubes, temporary weld repair method.
- B. This procedure gives the approved repairs for hydraulic, pneumatic, water, fire extinguisher, and other tube assemblies. Repair procedures include the replacement of damaged tube ends or the replacement of small damaged tube parts. You can use flareless tubes and sleeves, H-Coupling assemblies, Cryofit couplings, Permaswage fittings, Cryolive assemblies, or Rynglok unions.
- C. For the approved repair of fuel system aluminum tubes, refer to CMM 28-00-12.
- D. You can repair 6061-T4 aluminum tubes using 6061-T6 aluminum tube and flareless fittings. It is not acceptable to repair 6061-T6 aluminum tube with 6061-T4 aluminum tube or use 6061-T4 aluminum tube in place of 6061-T6 aluminum tube.
- E. You can use approved 304-1/8 Hard or 21-6-9 corrosion-resistant steel tube assemblies to replace titanium tube assemblies. You can also use approved 304-1/8 Hard corrosion-resistant steel tube assemblies to replace 21-6-9 corrosion-resistant steel tube assemblies.

CAUTION: USE CADMIUM PLATED STEEL FITTINGS WHEN REPLACING ALUMINUM LINES WITH CORROSION RESISTANT STEEL LINES. GALVANIC CORROSION MAY OCCUR IF CADMIUM PLATED STEEL IS NOT USED.

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- F. Replacements for aluminum lines may be made from Corrosion Resistant Steel (CRES) material.
- G. When you do repairs, the type of flareless tube sleeves will tell you the installation method to use.
  - (1) Use approved power swaging equipment, or roller swaging, to do all swaged—on sleeves and fittings.
  - (2) You can preset BACS13AP flareless sleeves by machine. Preset by hand only when a hydraulic or pneumatic-operated presetting tool is not available. If you must preset by hand, we recommend that you preset some samples. Cut the samples into sections longitudinally and make an inspection of the ring cut depth before you preset the part to be repaired.
  - (3) You can install the CRYOLIVE sleeve assembly, consisting of CRYOLIVE sleeve, coupling nut and protective cover/inspection tool, by removing the assembly from liquid nitrogen and sliding it on to the tube end. Note that 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.
- H. The H-coupling assembly is a repair coupling which has a union coupling, a slide, and a nut. You can install the H-coupling assembly in straight sections of the tube. Use two end wrenches of applicable size. This assembly is approved for fuel and hydraulic high pressure lines of 21-6-9, titanium 3AL-2.5V, and 304-1/8 hard CRES tubing. The H-coupling assembly is also approved for the repair of 304 CRES annealed and 6061-T6 aluminum tubing lines of 1500 psi or less.
- I. You can use a Cryofit coupling for the inline repair of 3AL-2.5V titanium tubing. To install the Cryofit coupling in a straight tube section, shrink fit the coupling in its position.
- J. You can use the Permaswage coupling for inline repair of 6061-T6 aluminum, 21-6-9 CRES or 304-1/8 hard CRES, and 3AL-2.5V titanium tubing.
- K. 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 or in fuel cells.
- L. When you repair 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. Fitting nuts used to align fittings during the tube installation will increase the risk of leakage, blowoff, or other failure.
- M. Do a leak check on all hydraulic tubes disconnected during the repair procedure.
  - (1) Pressurize the hydraulic tubes for a mimimum of 5 minutes.
  - (2) Rub all the fittings with a clean white cloth.
  - (3) Look for hydraulic fluid on the cloth to find leakage.
- N. 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 locations.

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- (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. Stress can cause cracks in the tubes.
- (3) 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.

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

NOTE: Use your own judgement 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.
- 0. 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.
- P. 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 grey drilube coating, a color-coded ring is applied to the back side of the B-nut.

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TUBE MATERIAL	TUBE FINISH/COLOR	B-NUT (MAY BE COVERED WITH DRILUBE)
ALUMINUM	STANDARD 767 - GREEN PRIME	GOLD OR BROWN
CRES	STANDARD 767 - NO FINISH	SILVER, BRIGHT
TITANIUM	NO FINISH	DULL GRAY

(3) If a steel or titanium B-nut connects to an aluminum tube or fitting, use the lower torque value (aluminum).

WARNING: DO NOT USE TITANIUM FITTINGS WHEN YOU REPAIR THE OXYGEN SYSTEM TUBES. TITANIUM FITTINGS CAN CAUSE A FIRE OR INJURY TO PERSONS.

- Q. To install oxygen system tube assemblies, refer to Chapter 35, Oxygen. You can use this procedure to preset or swage flareless sleeves for oxygen system tube assemblies. You must make sure the oxygen tube assemblies are clean and free of oil (refer to the Component Maintenance Manual Instructions).
- R. Use the tube materials as shown in Table I. Use the approved tube materials/tube sizes/tube wall thicknesses as shown in Table IA for 3000 psi hydraulic systems.

TABLE I CROSS REFERENCE OF TUBING TO BMS/MIL SPECIFICATION						
TUBING MATERIAL	BMS	MIL	OTHER			
ALUMINUM 6061-T4, 6061-T6		WW-T-700/6 *[1] T-7081	 AMS 4083			
CRES 21-6-9	7–185					
1/8 HARD CRES 304-1/8h		T-6845	AMS 5566			
ANNEALED CRES 304		T-8504	AMS 5567			
ANNEALED CRES 321		т-8808	AMS 5556 AMS 5557			
TITANIUM 3AL-2.5V	7–234		AMS 4945			

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

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Table IA 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 AMS 4083 (MIL-T-7081) 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

TASK 20-11-05-308-286

# 2. <u>Tube Repair</u>

## A. General

(1) 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

<u>CAUTION</u>: DO NOT REPAIR COIL TUBES. NORMAL MOVEMENT OF COIL MAY BE RESTRICTED BY A REPAIR.

- (2) You can repair tubes if you obey the permitted repair limits. When it is possible do the following:
  - replace the damaged tube
  - replace the damaged part with a tube splice
  - repair the damaged tube with a fitting (if the damaged are is sufficiently small).
  - completely remove all corrosion and treat affected surface area as described in the Corrosion Prevention Manual.
- (3) When you remove, install, or do work with hydraulic tube assemblies, obey the guidelines that follow:
  - (a) When you remove tubes, you must make sure the tubes and port fitings have tags that identify the correct connection location.

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- (b) Do not move or change the tube bends. If you move or change the bend in the tube, these bad effects can occur:
  - 1) 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-correction of the tubes can become possible.
  - 2) 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. Stress can cause cracks in the tubes.
- (c) If you must bend the tube assemblies to fit the installation, do not bend more than permitted by the ovality limits in Fig. 801. We recommend that you use a bend block or tool equivalent to the Parker G-824 hand bender. Make sure the bend block supports the tube bend beyond the neutral axis of the bend, as shown in Fig. 801, and that bend-ovality allowables are not exceeded.
- (d) Do not repair dents or chafed areas. Replace the tube or tube section if the defect depth is more than the values in Fig. 803. It is not necessary for you to repair or replace tubes with defect depth less than these values.
- (4) To repair a damaged tube section, cut out the damaged tube section and replace it with a fitting or with an assembled tube and fitting assembly.
- (5) To replace a BACA14BP fitting you must use another BACA14BP fitting.
- (6) To install the new BACA14BP or D10203 fitting on the new tube section, use TASK 20-11-05-408-363. Refer to TASK 20-11-05-054-023 to verify electrical resistance where required.
  - NOTE: Use BACA14BP fittings only for replacement of other BACA14BP fittings unless approved by The Boeing Company on a case-by-case basis. The MS screw-together ends on this fitting are prone to deformation and galling from repeated assembly and disassembly and my leak.
- (7) To replace a BACU24AB swage union, cut out the damaged fitting and replace it with a B-nut, BACS13AP sleeve or BACS13BX sleeve or a CRYOLIVE flareless sleeve assembly and an MS21924 bulkhead union, using the procedures of Fig. 807.
- (8) To make tube repairs, use tube sections of the same material and use the fittings as shown in Fig. 802. You can make splice a repair of 21-6-9 and Ti-3AL-2.5V tube with 304-1/8h tube of the wall thickness shown in Fig. 821 or 824.
- (9) The permitted limits of hydraulic line damage caused by dents, chafes, or the corrosion removal process per the Corrosion Prevention Manual, are shown in Fig. 803.
- (10) 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 you can move apart, with an assembled tube and fitting assembly (Fig. 806).

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02.1



- (b) Replace a tube center section that has a short damaged segment with a single union (Fig. 805).
- (c) Replace a tube center section that has very much damage with an assembled tube and fitting assembly (Fig. 809).
- (11) 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.

- (a) Do the post-installation test of one of more components to which the tubes are connected as a check.
- (12) If you disconnected electrical wires to get access to the tubes and you think there is a possibility you connected the wires incorrectly or cross-connected the wires, do an operational check:

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

- (a) Do the post-installation test of one of more components to which the wires are connected as a check.
- B. Repair of a Tube (Make a Splice)

S 948-287

(1) Make a decision about the type of repair necessary. Use Fig. 802 to make a decision about the group the repair is in.

S 948-288

(2) Refer to Fig. 805 to find the necessary tube cutout length when you use a single union to replace a damaged tube area.

s 438-289

- (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 (see Fig. 806 & 809).
  - (b) Cut and trim the repair tube as follows: (see Fig. 804)
    - 1) Use the correct size ratchet chipless cutter.
    - 2) Turn the cutter drive screw counter clockwise 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. To assemble the tool refer to Fig. 804.
    - 8) Push down on the plunger and install the tool into the end of the tube.

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02.101



- 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.

<u>NOTE</u>: Make sure you do not drop metal particles in the area of the repair.

- (c) Swage the necessary flareless sleeves to the repair tube as told in the applicable section:
  - Swage BACS13BX Flareless Sleeves with the Harrison Elastomer Swagers 5175, 5570, and 5720.
  - Swage BACS13BX Flareless Sleeves with the 6633K01 Harrison Roller Swaging Kit.
  - Preset BACS13AP Flareless Sleeves.
  - 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 (Ref 20-10-09 Removal/Installation).
- (e) Measure all of the tube assembly length (L1) (see Fig. 806 and 809).
- (f) To find the necessary cutout length (L2) as shown on Fig. 806 and 809, use the procedure given in Fig. 810.
- (g) Remove the pressure from the systems where you will do the repairs.
- (h) Cut out the damaged tube (L2). Trim the tube ends as shown in Fig. 804.
- (i) When you make the installation, refer to the applicable section as follows:
  - 1) To use the Harrison elastomer swager to install BACS13BX flareless sleeves, refer to "Swage the BACS13BX flareless sleeves with the Harrison elastomer swagers 5175, 5570 and 5720".
  - 2) To use the 6633KO1 Harrison roller swaging kit to install BACS13BX flareless sleeves, refer to "Swage the BACS13BX Flareless Sleeves with the 6633KO1 Harrison Roller Swaging Kit."

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- 3) To use the Harrison 6777 Roller Swage Machine for installing 35211 sleeves or 35212 unions, refer to "Swage Harrison 35211 sleeves and 35212 unions with the Harrison 6777 Roller Swage Machine.
- 4) To install BACS13AP flareless sleeves, refer to "Preset the BACS13AP Flareless Sleeves".
- 5) If you use H-couplings (BACC42W) for repair, refer to "Install the BACC42W H-coupling".
- 6) If you use Cryofit unions (3P02111 or 3PHS111) for repair, refer to "Install the 3P02111 or 3PHS111 Cryofit Coupling".
- 7) If you use Permaswage unions (D10283) for repair, refer to "Install the Permaswage Fittings".
- 8) To install Cryolive flareless sleeve assembly, refer to "Install the Cryolive Flareless Sleeve Assemblies".

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 BACN10- and MS21921 coupling nuts.

- 9) If you use Rynglok tube to tube unions for repair, refer to "Rynglok Union Installation".
- (j) Install the repair section and tighten the nuts (AMM 20-11-00/201).
- (k) When you use a Cryofit Union or H-Coupling in the repair section, install it after you tighten the flareless fittings in their positions.
- (l) When you use a Permaswage union in the repair section, you must make allowance for swage growth. Tighten the repair section in position after installation of the Permaswage union.
- (m) When you replace a tube bend section, make sure you keep the minimum straight length specifications for all fittings (Fig. 812).
- (n) When you use 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.

TASK 20-11-05-308-290

- Swage the BACS13BX Flareless Sleeve with the Harrison Elastomer Swagers 5175, 5570 and 5720 (Fig. 813)
  - A. Equipment
    - (1) Harrison Portable Swagers 5175 and 5720 Harrison Stationary Swager - 5570 (Sierracin-Harrison - 3020 Empire Ave. -Burbank, California 91504)

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- (2) "Tiplar" bore gauge or "Mueller" bore gage or equivalent
- (3) Regulated air pressure (0 100 psi)
- B. Consumable Materials
  - (1) D00324 Lubricant Extreme Pressure, Anti-Scoring No. 3
- C. Procedure

S 948-291

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

(1) Get the necessary tools as shown in the instruction manual supplied with the Harrison elastomer swager.

S 648-292

(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.

NOTE: Do not let the lubricant go into the grooves of the sleeve.

Lubricant in the grooves will prevent correct swaging.

s 348-293

(3) Apply the specified swage pressure and hold the pressure for a minimum of two seconds. See Fig. 814 for specified pressure.

s 228-294

(4) Do a check of the groove depth with a Tiplar or Mueller bore gage. See Fig. 816 for groove dimensions.

S 228-295

(5) Do a check on the external dimensions of the swaged fitting. See Fig. 815.

s 228-296

(6) Make sure the tooling die marks on the tube 0.D. do not have a height or depth larger than 10% of the tube wall specified thickness. Other permitted defects include marks or scratches on the outer tube which are less than 0.20 inch in length and 0.002 inch in depth.

s 218-297

(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.

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s 228-298

(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 in height. Also, these marks must not touch the nut.

TASK 20-11-05-308-299

- 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

s 948-300

(1) Get the necessary tools as listed in the operating instruction manual supplied with the Harrison Roller Swage Tube Repair Kit.

s 358-301

(2) Apply the specified torque to the expander mandrel (Fig. 817).

s 228-302

(3) After you swage, make sure the BACS13BX sleeve and tube agree with the specifications of Fig. 817

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

s 218-303

(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.

s 228-304

(5) Make sure the die marks on the external skirt and shoulder areas of the sleeves are not more than 0.002 inch in height. Also, make sure the die marks to not touch the nut.

s 218-305

ALL

(6) Make sure the tube inner surfaces at the swage area do not have scratches or marks caused by defective rollers.

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TASK 20-11-05-308-426

5. Titanium Hydraulic Tubing, 3000 psi - Roll Swaging Harrison 35211 Sleeves and 35212 Unions using the Harrison 6777 Swage Machine.

NOTE: This procedure does not apply to repair of aluminum and cres tubing.

- A. General
  - (1) The sleeves, unions, and nuts used for this procedure are listed in (Fig. 802 and Fig. 805).
- B. Do the procedure:

s 308-425

(1) Cut and chamfer tubes as shown in (Fig. 804) and to length requirements in (Figures: 805-810) as applicable. Correct for swage growth according to data provided in the manufacturer's operating manual.

s 118-427

(2) Clean the tube with Methyl Ethyl Ketone or an equivalent cleaning agent and blow air through the tube to remove particles.

s 328-430

(3) Use swage dies as illustrated in (Fig. 813).

s 828-431

(4) Use Swage Torques as shown in (Fig. 817).

s 218-429

(5) Make sure that there are no scratches or other damage on the seal areas of the sleeve and union.

s 788-428

- (6) Conduct a Proof Pressure Test of the tube assembly:
  - (a) Connect the Harrison sleeve and union of the tube assembly and torque it to the specified value.
  - (b) Pressurize the tube to 6000psi pressure.
  - (c) There shall be no leakage in proof testing.
  - (d) If there is leakage, loosen and retighten the fitting. If leakage persists remove the tube and inspect tube end and test fittings for defects.

TASK 20-11-05-308-306

- 6. Preset the BACS13AP Flareless Sleeves
  - A. General
    - (1) We recommend you pressure preset and do not preset by hand. If you must preset by hand, we recommend you preset some samples first. Then you can preset the section to repair. On samples, cut away the sleeve to make sure the ring cut on the tube makes a circle around the tube circumference and has a depth of 0.002 inch.

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#### B. Equipment

- (1) Cherry Lockbolt Gun used with hand presetting tool - Model G87D is the preferred tool and Model G85D is optional (Textron Aerospace Fasteners, Cherry Div., 1224 East Warner Ave, Box 2157, Santa Ana, California 92707)
- (2) Presetting tool used with Cherry Lockbolt gun -ST878D
- (3) Hand Presetting tool and holding fixture ST879A and ST879AF
- C. Consumable Materials
  - (1) D00324 Lubricant Extreme Pressure, Anti-Scoring No. 3
- D. Procedure

#### s 358-307

- (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 (see Fig. 818) in the Cherry Lockbolt Gun.
  - (c) Connect the air pressure line and use the correct pressure (Fig. 818). 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.

#### s 358-308

ALL

- (2) To preset the sleeve by hand do the following:
  - (a) Use the correct mandrel for the preset tool ST879A (Fig. 819).
  - (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 as shown in Fig. 821.
  - (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. 821.

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s 228-309

- (3) After you preset, make sure the BACS13AP sleeve and tube joint have the following properties (Fig. 820):
  - (a) Corrosion resistant steel tubing (MIL-T-6845):

Make sure the sleeves have a maximum of 0.005 inch 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 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 (Fig. 820).
  - Make sure the sealing surface of the sleeve bow is free of scratches, marks, or other defects.
  - 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.

TASK 20-11-05-408-310

- 7. Install the CRYOLIVE Flareless Sleeve Assembly (Fig. 832)
  - 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. DAMAGE TO EQUIPMENT OR INJURY TO PERSONS CAN OCCUR. THE CRYOLIVE FLARELESS SLEEVE ASSEMBLY IS NOT QUALIFIED FOR THESE APPLICATIONS.

WARNING: USE EXTREME CAUTION WHEN USING LIQUID NITROGEN. THE TEMPERATURE OF LIQUID NITROGEN IS 320 DEGREES BELOW ZERO. PROVIDE PROPER VENTILATION AS LIQUID NITROGEN VAPORS CAN DISPLACE OXYGEN IN CONFINED AREAS. USE SAFETY GLASSES, A FACE SHIELD, AND INSULATED GLOVES WHEN USING LIQUID NITROGEN. MISSUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.##

WARNING: SLOWLY AND CAREFULLY SUBMERGE WARM ITEMS IN LIQUID NITROGEN TO PREVENT RAPID BOILING OFF AND SPLASHING. MISSUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

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- (1) The Cryolive flareless sleeve, shown in Figure 832 and Figure 802, 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 to the tube end and allowed to warm to room temperature. The sleeve shrink fits into position at the correct distance from the the tube end as it warms to room temperature.
- (2) The Cryolive flareless sleeve assembly can be used, as shown in Figure 833 and Figure 802, with 304 1/8 hard CRES, Ti-3Al-2.5V 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, Ti-3Al-2.5V 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 <u>not</u> 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 Components 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).
- (5) Safety Glasses (commercially available).
- (6) Face Shield (commercially available).
- C. Consumable Materials
  - (1) G00262 Liquid Nitrogen
  - (2) B01000 Solvent General Cleaning of Metal (Series 80)
- D. Procedure

s 868-311

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

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S 218-312

(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.

s 118-313

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

(3) Use solvent, Series 80 (AMM 20-30-80/201) to clean the tube in the area where you will install the Cryolive flareless sleeve.

s 948-314

WARNING: USE EXTREME CAUTION WHEN USING LIQUID NITROGEN. THE TEMPERATURE OF LIQUID NITROGEN IS 320 DEGREES BELOW ZERO. PROVIDE PROPER VENTILATION AS LIQUID NITROGEN VAPORS CAN DISPLACE OXYGEN IN CONFINED AREAS. USE SAFETY GLASSES, A FACE SHIELD, AND INSULATED GLOVES WHEN USING LIQUID NITROGEN. MISSUSE OF LQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

(4) Put on insulated gloves, safety glasses, and face shield.

S 948-315

(5) Put liquid nitrogen BB-N-411, Type II, MIL-P-27401, Type II (-320 °F), into a small, insulated container.

s 948-316

WARNING: SLOWLY AND CAREFULLY SUBMERGE WARM ITEMS IN LIQUID NITROGEN TO PREVENT RAPID BOILING OFF AND SPLASHING. MISSUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

(6) 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.

s 948-317

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

s 948-318

(8) Put the tongs into the liquid nitrogen.

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s 038-319

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

s 438-320

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

(10) Hold 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.

s 438-321

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.

(11) Allow the Cryolive flareless sleeve to warm and shrink on to the tube.

S 438-322

(12) 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 (see Fig. 833).

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

TASK 20-11-05-408-323

8. Install the BACC42W H-Coupling (Fig. 822)

ALL

A. General

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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.

- 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 1500 psi or lower pressure applications. You can use this repair on tubing that is installed and in use.
- (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 (Fig. 809).

#### 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 superceded 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.

- Consumable Materials
  - G00270 Masking Tape
  - B01000 Solvent General Cleaning of Metal (Series 80)
- C. Procedure

S 868-324

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 THAN ONE THREAD ENGAGED. YOU CAN COMPRESS THE UNION AND MAKE THE COUPLING ASSEMBLY DIFFICULT TO PUT IN POSITION.

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

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S 118-325

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

(2) Use solvent, Series 80 (AMM 20-30-80/201) to clean the tube in the area where you will install the H-coupling.

s 358-326

(3) Cut the tube.

s 118-327

(4) Chamfer and remove burrs from the ID and OD edges. Clean the edges with solvent, Series 80 (AMM 20-30-80/201).

s 948-328

(5) Install tape on the nut side of the clearance with a minimum of 0.56 inch from the tube end and a maximum of 0.675 inch from the center of the clearance (Fig. 822).

s 948-329

(6) Use the same measurements to make a mark (index line) on the coupling side of the tube.

s 948-330

(7) Find and make a mark (marking dots) on the nut and coupling side of the tube (Fig. 822).

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

s 428-331

(8) Install the coupling assembly over the coupling side of the tube.

s 218-332

(9) Make sure the large radius and the large diameter end of the sleeve are toward the center of the union.

S 438-333

(10) Install the nut and sleeve over the tape on the nut side of the tube.

s 218-334

(11) Make sure the sleeve large bore is toward the clearence.

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S 828-335

(12) Align the tubes and move the union until it touches the tape on the nut side on the tube.

s 218-336

(13) Make sure the union meets or covers the index line on the coupling side of the tube.

s 948-337

(14) Install tape on the coupling side of the tube, with the tape edge even with the end of the union.

s 438-338

(15) Push the sleeve and coupling body on the ends of the union.

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

s 838-339

(16) Engage the threads of the nut with the coupling body and tighten the nut handtight.

s 438-340

(17) Hold the coupling body with a wrench and tighten the coupling assembly nut to the stop.

s 218-341

(18) Examine the completed repair to make sure you can see the two marking dots (Fig. 822). If you cannot see the two dots, this shows that the sleeve and coupling are not fully seated against the center land of the union.

s 218-342

(19) Make sure dimension "C" did not increase.

s 208-343

- (20) 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.
  - (d) If the clearance between the slide or coupling and the union is more than 0.015 inch, install the nut and tighten it until you get the necessary clearance (Fig. 822).
  - (e) Install the nut again and tighten the nut. (See BACC42W Standard).
  - (f) If the union does not touch the tape, you must remove the coupling and a sufficient tube length. Install a new repair section.

EFFECTIVITY-

20-11-05

ALL



TASK 20-11-05-408-344

9. Install the 3PO2111 or 3PHS111 Cryofit Couplings (Fig. 823)

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. THE CRYOFIT COUPLING

IS NOT QUALIFIED FOR THESE APPLICATIONS.

WARNING: USE EXTREME CAUTION WHEN USING LIQUID NITROGEN. THE

TEMPERATURE OF LIQUID NITROGEN IS 320 DEGREES BELOW ZERO. PROVIDE PROPER VENTILATION AS LIQUID NITROGEN VAPORS CAN DISPLACE OXYGEN IN CONFINED AREAS. USE SAFETY GLASSES, A FACE

SHIELD, AND INSULATED GLOVES WHEN USING LIQUID NITROGEN. MISSUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

WARNING: SLOWLY AND CAREFULLY SUBMERGE WARM ITEMS IN LIQUID NITROGEN TO

PREVENT RAPID BOILING OFF AND SPLASHING. MISSUSE OF LIQUID

NITROGEN CAN CAUSE INJURY TO PERSONS.

(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 TS3PO2111 (Aerofit Products, Inc. 6460 Dale Street, Buena Park, California 90621).
- (2) Tongs (any suitable), (available from Aerofit Products, Inc. 6460 Dale Street, Buena Park, California 90621) (P/N AT911067-01).
- (3) Insulated Gloves (available from Aerofit Products, Inc. 6460 Dale Street, Buena Park, California 90621 by P/N 0E-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 Aerofit Products, Inc., 6460 Buena Park, California 90621 by P/N WB910825-01).

NOTE: AEROFIT PRODUCTS, INC. CRYOFIT COUPLINGS AND EQUIPMENT ARE AVAILABLE FROM T.W. METALS, INC.

- (5) (commercially available) Safety Glasses
- (6) (commercially available) Face Shield
- C. Consumable Materials
  - (1) G00262 Liquid nitrogen
  - (2) B01000 Solvent General Cleaning of Metal (Series 80)
  - (3) A00558 Loctite 290

20-11-05



- (4) G00270 Masking Tape
- D. Procedure

S 868-345

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

s 118-346

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

(2) Use solvent, Series 80 (AMM 20-30-80/201) to clean the tube in the area where you will install the Cryofit coupling.

s 438-347

(3) Use tape to make a mark on the tube to make sure you put the Cryofit coupling over the center of the tube repair.

s 328-348

(4) Cut the tube.

s 118-349

(5) Chamfer and remove burrs from the ID and OD edges. Clean the edges with solvent, Series 80 (AMM 20-30-80/201).

s 948-350

WARNING: USE EXTREME CARE WHEN USING LIQUID NITROGEN. THE TEMPERATURE OF LIQUID NITROGEN IS 320 DEGREES BELOW ZERO. PROVIDE PROPER VENTILATION AS LIQUID NITROGEN VAPORS CAN DISPLACE OXYGEN IN CONFINED AREAS. USE SAFETY GLASSES, A FACE SHIELD, AND INSULATED GLOVES WHEN USING LIQUID NITROGEN. MISSUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

(6) Put on the insulated gloves, the safety glasses, and the face shield.

s 948-351

(7) Put liquid nitrogen (-320°F) into a small, insulated container.

EFFECTIVITY-

20-11-05



S 948-352

WARNING: SLOWLY AND CAREFULLY SUBMERGE WARM ITEMS IN LIQUID NITROGEN TO PREVENT RAPID BOILING OFF AND SPLASHING. MISSUSE OF LIQUID NITROGEN CAN CAUSE INJURY TO PERSONS.

(8) Remove the Cryofit coupling from the main storage container and put it into the small container of liquid nitrogen. Make sure the coupling is fully covered by theliquid nitrogen.

s 948-353

(9) Move the Cryofit coupling in the liquid nitrogen (-320°F) to the repair location.

S 948-354

(10) Put the tongs and the tube chiller into the small container of liquid nitrogen.

s 438-355

(11) 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.

S 438-356

(12) Position the test coupling so that both tubes are visible in the coupling window. For 3PO2111 couplings, ensure that a gap of less than 0.120 inch exists between the tube ends. For 3PHS111 couplings, ensure that the gap is less than 0.300 inch.

s 438-357

(13) Remove the test coupling and place the marking gauge over one of the tube ends. Using the marking pen, color in the rectangular slot in the gauge to provide an installation mark on the tube. Follow the same procedure to mark the remaining tube end.

S 438-358

ALL

(14) Place an installation stop ("0" ring), or snap-on coupling 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.

EFFECTIVITY-

20-11-05



s 438-359

(15) 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.

s 038-360

(16) For 3P02111, remove a Cryofit coupling from the liquid nitrogen and immediately place it into a pre-chilled extended time tool. Close the tool and immediately return the coupling/tool to liquid nitrogen. This step is omitted for 3PHS111 couplings since they are pre-assembled in the tool and furnished in Lexan plastic packaging from the manufacturer.

s 438-361

(17) 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.

S 438-362

- (18) Install the coupling by following the steps below in rapid sequence:
  - (a) Remove the tube chiller from the tubes.
  - (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.
  - (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.

EFFECTIVITY-

20-11-05

ALL



#### TASK 20-11-05-408-363

#### 10. Install the Permaswage Fittings

#### A. General

- (1) To do the Permaswage repair procedure, use the D12000 or DLT series swaging tool and the BACU24BS or D10282 in-line tube unions (sizes 04, 06, 08, 10, 12, and 16). You can use CRES Permaswage fittings, as shown in Fig. 824 and Fig. 802, with 304-1/8 hard CRES tube to repair Ti-3AL-2.5V and 21-6-9 CRES. Repair 6061T6 aluminum tubing with aluminum Permaswage fittings with D suffix in the basic part number.
- (2) When you do a repair, remove the part of the tube with the defect. Put in a tube splice and install the splice with two fittings. Fittings and tubing material sizes are shown in Fig. 824.
- (3) When you remove tubes, make sure the tubes and port fittings have tags that identify the correct connection locations.
- (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 shown in Fig. 827 (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 less than the cut-out. This permits tube gaps (not more than 0.150 inch) as shown in Fig. 827.

<u>NOTE</u>: 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 - #D12102C03-01A00 for sizes 04 & 06 (1/4" & 3/8"), #D12102C06-26A00 for sizes 08, 10 & 12 (1/2", 5/8" & 3/4"), #D12102C11-04 for size 16 (1"). One pump, part #D12025-001, is required for swaging with the tool kits listed. (Deutsch Metal Components, P.O. Box 61188, 14800 S. Figueroa St., Los Angeles, California 90061)

EFFECTIVITY-

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(2) Deutsch Permaswage Lightweight series (DLT Series) - Tool numbers are listed in Fig. 825. You can get tool kits 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:

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

One pump is required to actuate the power units, as shown in Fig. 825. (Deutsch Metal Components, P.O. Box 61188, 14800 S. Figueroa St., Los Angeles, CA 90061)

- C. Consumable Materials
  - (1) C00064 Alodine 1200 or 1200S
  - (2) C00259 Primer BMS 10-11, Type 1
  - (3) B00010 Solvent General Cleaning of Metal (Series 80)
  - (4) B00138 Abrasive cloth 240-grit, P-C-451
- D. Prepare Tube for Installation

S 948-364

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 EQUIPEMENT OR INJURY TO PERSONS CAN OCCUR.

(1) Use the tools shown in Fig. 825.

s 948-365

- (2) Cut out the damaged section of the tube:
  - (a) Make sure the section you cut out of the tube is a straight section with a minimum straight length as shown in Fig. 826. This will make sure the fitting and swage tool will fit.
  - (b) Use one Permaswage fitting for the repair if the damaged section is no more than 0.150 inch long. In this case, the cut can be through the center of the damaged section.
  - (c) If the damage is too near to a bend (less than 1/2 "A", Fig. 826) or longer than 0.150 inch, use a tube splice and two fittings to make the repair.

S 948-366

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

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

EFFECTIVITY-

20-11-05

ALL



s 118-367

- (4) Clean the tube in the swage area:
  - (a) Clean the not painted tube sections that you will repair with solvent, Series 80 (AMM 20-30-80/201).
  - (b) Make sure the sections are free of dirt, grease, and other unwanted material for a distance equal to the values shown in Fig. 826.
  - (c) Remove paint and anodize from the tubes in an area equal to the values shown in Fig. 826. Use the methods shown in Fig. 828.
  - (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.

#### S 948-368

- (5) 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. Refer to Fig. 804 for the correct 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.

s 948-369

- (6) Use one of these steps to apply witness marks:
  - (a) Use a felt pen or equivalent to apply witness marks as shown in Fig. 829. Use Deutsch tools D12580-1, -2, -3 only or equivalent.
  - (b) Make marks directly on the tube to show the minimum insertion depths as shown in Fig. 829. Swage fittings to the marks.

s 378-370

(7) Apply paint to bare areas. For example, tool marks and areas where you removed paint (fittings and painted tubes).

s 378-371

- (8) Apply alodine 1200 to open areas of aluminum and BMS 10-11 primer to all other tubes and fittings.
- E. Procedure

s 868-372

(1) Remove pressure from the systems where you will do the repair.

ALL

20-11-05



s 948-373

(2) Use a union and a tube as shown in Fig. 824.

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

s 358-374

(3) Make sure the tube is sufficiently long to do the repair (Fig. 826).

s 118-375

(4) Clean the tube as shown in Fig. 828, then cut the tube.

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

s 218-376

(5) Examine the unions for silicone seals (see NOTES, Fig. 824).

s 428-377

(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.

s 358-378

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

(7) Swage the union to the tube as shown in the manufacturer's recommended procedures.

s 358-379

(8) Swage each end three times.

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

s 118-380

(9) Clean the die blocks regularly.

s 218-381

(10) Examine the end plates for loose retaining screws.

EFFECTIVITY-

20-11-05

ALL



S 228-382

(11) Examine the finished swage as shown in the manufacturer's recommended procedure or measure with Vernier caliper for dimensions as shown in Fig. 830.

s 768-383

(12) In the fuel tanks and vapor areas, do a check of the electrical resistance specifications across each tube/fitting interface (Ref 20-10-09).

s 768-384

(13) Make resistance measurements for all Permaswage repair installations in wing tanks and fuel vapor areas (Ref 20-10-09).

s 798-385

- (14) For Permaswage fitting repairs in general areas, do a leak test as follows:
  - (a) Pressurize the system for a minimum of 5 minutes.
  - (b) Rub the tube and fittings with a clean white cloth to find leakage.

s 218-386

(15) Examine the tube-to-fitting interface for hydraulic leaks you can see.

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

s 378-387

(16) Apply BMS 10-11 primer to the Alodine areas of the finished tube joint where the bare metal is open.

TASK 20-11-05-408-388

11. Rynglok Union Installation (Fig. 834)

ALL

A. General

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

(1) Rynglok tube to tube fittings are not to be used on fluid lines inside airplane fuel tanks. The rynglok tube to tube fitting is not qualified for these applications.

EFFECTIVITY-

20-11-05



- (2) The Rynglok in-line tube unions (Fig. 834), sizes 04, 06, 08, 10, 12, and 16 are used with 304 1/8 hard CRES to repair Ti-3AL-2.5 and 21-6-9 CRES. The same unions plus a size 20 are used with 6061-T6 aluminum tube to repair 6061-T6 aluminum tu be, provided the bare areas of the tubing are painted after swaging to limit the possibility of galvanic corrosion ocurring.
- (3) When you do a repair, remove the part of the tube with the damage. If the area of the tube damage is less than the value listed in (Fig. 805), use one Rynglok union for repair.
- (4) If the tube damage is longer than the value listed in (Fig. 805), put in a tube splice and install the splice with two fittings. The splice must be equal to or slightly shorter than the removed tube section. The minimum length of tubing to be removed is shown in (Fig. 836). Fittings and tubing material sizes are shown in (Fig. 835).
- B. Equipment
  - (1) Swager Hydraulic Fitting RTSK8-02-006 (Aeroquip Corporation, Jackson Plant, 300 S. East Ave., Jackson, MI 49203-1972)
- C. Consumables
  - (1) B00068 Alcohol, ethyl (denatured) MIL-E-51454, Type II
  - (2) COOO64 Coating, Surface Treatment (Alodine) MIL-C-81706, MIL-C-5541, Type II MIL-C-5541, Type II
  - (3) COO259 Primer, chemical and solvent resistant finish, epoxy resin primer BMS10-11, Type I
- D. Procedure

948-389

(1) Remove pressure from the system where you will do the repair.

s 358-390

(2) Use the tools (Fig. 837) contained in swager, RTSK8-02-006.

s 358-391

- (3) Cut out the damaged section of the tube using a chipless tube cutter (Fig. 804) and the following:
  - (a) Make sure the section you cut out of the tube is a straight section with a minimum straight length as shown in (Fig. 812). This will make sure the fitting and the swage tool will fit.
  - (b) Use one Rynglok union for the repair if the damaged section is not longer than the dimensions listed in (Fig. 805). If the damage is within the dimensions, the cut can be through the center of the damaged section.

s 158-392

(4) Remove the paint and the anodize from the tubes to the dimensions shown in (Fig. 812).

s 118-393

(5) Clean the non-painted tube sections that you will repair with alcohol, MIL-E-51454, Type II.

EFFECTIVITY-

20-11-05

ALL



s 398-394

(6) Use a brush to apply coating, MIL-C-81706, MIL-C-5541, Type II to the cut ends of the tube.

s 628-395

(7) Seal the tube ends with a cap if you do not join the tubing immediately.

s 948-396

(8) Apply positioning and inspection marks on the tube to be repaired using the appropriate gage from the swager, RTSK8-02-006 and a Sanford Sharpie (or equivalent) felt tip pen with a fine or extra fine point (Fig. 837,838). Bottom the gage on the cut edge of the tube before making the marks.

s 948-397

(9) Move the Rynglok union over the tube ends.

s 948-398

(10) Put the edge of the fitting ring over the center of the positioning mark (nominal tube insertion) as shown in (Fig. 839). The edge of the fitting ring may be anywhere along the length of the positioning mark but the nominal position is recommended.

s 368-399

WARNING: MAKE SURE YOU MAKE NO PUMP ADJUSTMENT THAT CAN CAUSE THE SWAGE TOOL HYDRAULIC PRESSURE TO BE OUTSIDE THE MANUFACTURER'S 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.

(11) Swage the union to the tube as shown in the Aeroquip Installation Guide supplied with the swager, RTSK8-02-006.

<u>NOTE</u>: The fitting must always be fully installed in the tool to maximize tool life.

s 368-400

(12) Examine the finished installation for correct ring advancement using the appropriate size inspection gage from the swager, RTSK8-02-006. The inspection gage should fit over the ring area as shown in (Fig. 841) so that the ring is flush with the center portion of the union.

s 948-401

(13) Pressurize the hydraulic system to operating pressure for the system which was repaired.

EFFECTIVITY-

20-11-05

ALL



s 368-402

(14) Examine the tube-to-union interface for hydraulic leakage. If leakage is found, the union must be cut out and a tube repair by section replacement must be done.

s 378-403

(15) Apply coating, MIL-C-81706, MIL-C-5541, Type II to bare areas of the aluminum tubing where paint was removed, followed by a coat of primer, BMS10-11, Type I.

TASK 20-11-05-358-404

- 12. 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 the flexible hoses that are 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 rigid or flexible coiled tubing. Engine hydraulic tubes are those tubes below or forward of the firewall, and within the engine cowls. Consult Boeing when considering a repair to any Engine Hydraulic or coiled tube.
  - B. References
    - (1) 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

s 228-405

- (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.

EFFECTIVITY-

20-11-05

ALL



- (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 as shown below and on Fig. 831.
  - Slack 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 percent when pressurized. Supply sufficient slack or bend to make the allowance for a change in length and length tolerances.
  - 2) Flex 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.
  - 3) Twisting 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 To prevent sharp bends in the hose assembly, use elbow fittings, hose with elbow type end fittings, or the applicable bend radii, as shown in Table 1.

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

EFFECTIVITY-

ALL

20-11-05



5) Clearance - 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 2.

TABLE 2	
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 - 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.

#### s 868-406

(2) Remove pressure from the hydraulic system where you will do the repair. (Ref 29-11-00).

#### s 968-407

ALL

- (3) If you can replace all of the damaged tube with a flexible hose, 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.

EFFECTIVITY-

20-11-05



s 968-408

- (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.

s 428-409

(5) Install the flexible hose (Ref 20-10-10).

s 868-410

(6) Supply the usual operating pressure to the repaired tube.

s 218-411

(7) Examine the hose and connections for leaks.

s 228-412

(8) Make sure the repair agrees with all specifications for slack, flex, twisting, bending, clearance, and support.

TASK 20-11-05-308-432

#### 13. Repair 6061-T4 Aluminum Hydraulic Tubing

- A. General
  - (1) This is a repair method that applies only to 6061-T4 aluminum hydraulic tubes in Sizes 16 (1 inch) and 20 (1-1/4 inch) and uses 6061-T4 aluminum tube material. 6061-T6 material may be used as as alternate material for repair of 6061-T4 aluminum hydraulic tubes but 6061-T4 aluminum tube material may NOT be used to repair 6061-T6 aluminum hydraulic tubes.
  - (2) Repair is accomplished using only the BACS13BX sleeve, the elastomer swaging process and other applicable methods specified in this MM for flareless tube repairs. No tube-to-tube fitting repairs are approved for 6061-T4 aluminum hydraulic tube.
- B. Repair 6061-T4 Aluminum Hydraulic Tubing

s 308-423

- (1) Do the repair:
  - (a) Decide if a tube splice is necessary or if the damage is small enough to repair by installing a flareless MS21902 union between two BACS13BX sleeves.
  - (b) Refer to (Fig. 805) to find the necessary tube cutout length when you use a single flareless MS21902 union to replace a damaged tube area.
  - (c) To use assembled tube ends or a center section to do a repair, find the cutout length and install as follows:
    - 1) Make an estimate of the total length (L1) of the repair section necessary to replace the damaged tube (Figs. 806,809).
    - 2) Cut and trim the repair tube as follows: (Fig. 804)

a) Use the correct size ratchet chipless cutter.

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- b) Turn the cutter drive screw counter clockwise to retract the cutter wheel.
- c) Put the cutter over the tube.
- d) Turn the screw clockwise until the cutter touches the tube at the necessary cut location.
- e) Turn the cutter screw 1/8 to 1/4 turn and rotate the cutter until the cutter is easy to rotate. The tube should now be cut.
- f) Remove the tool.
- g) To deburr the tube, use the correct stem subassembly and deburring tool. To assemble the tool refer to (Fig. 804).
- h) Push down on the plunger and install the tool into the end of the tube.
- i) Release the plunger. Let the plug fill the inside of the tube.
- Rotate the deburring tool until the inside burr is removed.
- k) Remove the tool with the plug expanded. The expanded plug should remove particles from the inside of the tube.

<u>NOTE</u>: Make sure you do not drop metal particles in area of the repair.

- 3) Swage the necessary flareless BACS13BX sleeves to the repair tube using the applicable section: Swage BACS13BX Flareless Sleeves with the Harrison Elastomer Swagers 5175, 5570, 5720.
- 4) Assemble and tighten the flareless fittings which are part of the repair section (AMM 20-10-09) Removal/Installation.
- 5) Measure all of the tube assembly length with BACS13BX sleeves (L1) (Figs. 806, 809).
- 6) To find the necessary cutout length (L2) as shown in (Figs. 806, 809), use the procedure given in (Fig. 810) for BACS13BX sleeves and Harrison Portable Swagers with MS21902 unions.
- 7) Remove the pressure from the systems where you will do the repairs.
- 8) Cut out the damaged tube (L2). Trim the tube ends as shown in (Fig. 804).
- 9) When you make the installation, refer to the section: "Swage the BACS13BX Flareless Sleeves with the Harrison Elastomer Swagers 5175, 5570, 5720".
- 10) Install the repair section and tighten the nuts (AMM 20-11-00/201).

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14. <u>Aluminum Fuel Tubes - Temporary Weld Repair Method</u>
A. General

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CAUTION: REPLACE THE TUBE WITH A TEMPORARY REPAIR WITH A NEW SECTION OF TUBE WITHIN A MAXIMUM OF 250 FLIGHT HOURS. IF YOU DO NOT REPLACE THE TUBE, DAMAGE COULD OCCUR.

- (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.
- (2) Repair is accomplished with tubing removed from airplane.
- B. Consumable Materials
  - (1) B00148 Solvent, Methyl Ethyl Ketone (MEK), TT-M-261 or JIS-K-1524
  - (2) B00818 Solvent, TT-N-295
- C. Aluminum Fuel Tube Repair

s 018-414

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

s 118-415

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

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

s 358-416

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

s 128-417

(4) Clean tubing use wire brush to descale and remove all protective coatings and oxides from area to be welded.

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

s 118-418

(5) Rub or rinse the tubing with solvent, Series 88 (AMM 20-30-88/201) to remove all the residue.

s 318-419

<u>CAUTION</u>: 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) Fusion weld the damaged area by a gas tungsten arc process.

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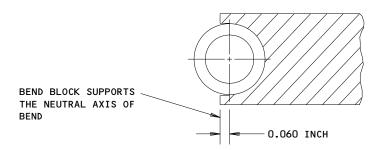
- (7) Hydrostatically test required tube to 240 psig per BAC5001-2. There shall be no leakage.
  - s 378-421
- (8) Finish repaired area with appropriate protective coatings BMS 10-11 Type I Primer required to meet original tube finish requirements.
  - S 438-422
- (9) Install the repaired fuel tube per applicable maintenance manual procedure.

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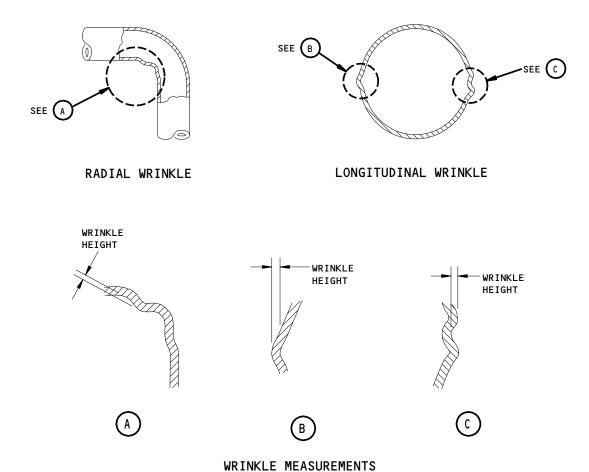
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NOTE: IF THE OVALITY OF ANY PART OF THE BEND IS MORE THAN THE MAXIMUM PERMITTED OVALITY, DISCARD THE TUBE.

#### TUBE BEND BLOCK



Permitted Ovality and Wrinkle of Hydraulic and Fire Extinguishing Tube Bends Figure 801 (Sheet 1)

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SYSTEM OPERATING PRESSURE	TUBE OD	TUBE MATERIAL	ALLOWABLE WRINKLE HEIGHT (Inches)	ALLOWABLE OVALITY (Percent of Specified OD)*
Liquid:		Stainless Steel	0.010	5
1000 PSI To 3000 PSI (Including Return Lines)	All Sizes	Aluminum	0.010	5
		3AL-2.5V Titanium	None Visible	3
Pneumatic And Oxygen: Pressure Above 1500 PSI or Temperature Above 160F	All Sizes	Stainless Steel	0.010	5
Other Liquid Systems:	Less Than 1.0	Stainless Steel	0.040	10
Pressure Less Than 1000 PSI		Aluminum Alloy & Copper	0.020	10
Pneumatic and Oxygen Systems:	1.0 Or Over,	Stainless Steel	0.060	10
Pressure Less Than 1500 PSI  or  Temperature Less Than 160F	Less Than 2.0	Aluminum Alloy & Copper	0.030	10
	2.0 Or Over,	Stainless Steel	0.080	5
	Less Than 3.0	Aluminum Alloy & Copper	0.040	5
	3.0 Or Over	Stainless Steel	0.100	5
		Aluminum Alloy & Copper	0.050	5

<sup>\*</sup> Specified Diameter= = Drawing Specified Tube Diameter

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

(NOTE: OD MEASURED IN SAME PLANE).

NOTE: FOR ADDITIONAL INFORMATION ON TUBE BENDING, SEE SAE AIR 5378 "AIRCRAFT TYBE BENDING METHODS, TECHNIQUES AND TOOLING."

Permitted Ovality and Wrinkle of Hydraulic and Fire Extinguishing Tube Bends Figure 801 (Sheet 2)

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CAUTION: DO NOT USE CADMIUM PARTS ON TITANIUM TUBES. CORROSION WILL OCCUR IF YOU USE CADMIUM PARTS ON TITANIUM TUBES.								
TUBE JOINING	TUBE MATERIAL	TABLE C TOOLS IRED	APPROVED SIZES					
ILLUSTRATION	PART NUMBER*	8	REF TABLE FOR TOOLS REQUIRED	31223				
	BACS13AP (BITE-Type)	6061T6	B,C	04, 06, 08, 10, 12				
		304 ANN.	B,C	04, 06, 08, 10, 12				
		304 1/8 Hard	В,С	04, 06, 08, 10, 12				
	BACS13BX (Elastomer Swage)	6061T6	A	06, 08, 10, 12, 16, 20 4, 24 4				
		304 ANN.	A	16, 20				
		304 1/8 Hard	A	06, 08, 10, 12, 16, 20 4, 24 4				
		21-6-9	A	04, 06, 08, 10, 12, 16				
	BACS13BX (Roller Swage)	21-6-9	D	04, 06, 08, 10, 12, 16				
	Swage/	Ti-3Al-2.5V	D	04, 06, 08, 10, 12, 16				
 I			+					

## REPAIR METHOD - RECONNECTABLE WITH FLARELESS FITTING SLEEVES TABLE A

Tube Material and Fitting Selection Tables Figure 802 (Sheet 1)

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CAUTION: DO NOT USE CADMIUM PARTS ON TITANIUM TUBES. CORROSION WILL OCCUR IF YOU USE CADMIUM PARTS ON TITANIUM TUBES.							
TUBE JOINING	TUBE MATERIAL	REF TABLE C FOR TOOLS REQUIRED	APPROVED SIZES				
ILLUSTRATION	PART NUMBER*	8 8	REF FOR REQUI	312E3			
	35211 SLEEVE (Roller Swage)	Ti-3AL-2.5V	D(1)	04, 06, 08, 10, 12, 16			
	35212 UNION (Roller Swage)	Ti-3Al-2.5V	D(1)	04, 06, 08, 10, 12, 16			
	CRYOLIVE Assembly 921721	6061T6	G	04, 06, 08, 10, 12, 16			
		21-6-9	G	04, 06, 08, 10, 12, 16			
		Ti-3Al-2.5V	G	04, 06, 08, 10, 12, 16			
		304 1/8 Hard	G	04, 06, 08, 10, 12, 16			

<sup>\*</sup> SEE TABLE D FOR ASSOCIATED APPROVED FITTINGS.

## REPAIR METHOD - RECONNECTABLE WITH FLARELESS FITTING SLEEVES TABLE A

Tube Material and Fitting Selection Tables Figure 802 (Sheet 2)

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TUBE JOINING					
ILLUSTRATION	PART NUMBER	MATERIAL 8	REF TABLE FOR TOOLS REQUIRED	SIZES	
	BACC42W Repair H-Coupling	6061T6	G	04, 06, 08, 10	
	BACC42W-T	304 ANN.	G	04, 06, 08, 10	
		304 1/8 Hard	G	04, 06, 08, 10, 12, 16	
		21-6-9	G	04, 06, 08, 10, 12, 16	
		Ti-3Al-2.5V	G	04, 06, 08, 10, 12, 16	
	3P02111 or 3PHS111 Cryofit	Ti-3Al-2.5V	F	04, 06, 08, 10, 12, 16	
	Permaswage D10282-D (Al)	6061T6	E	04, 06, 08, 10, 12, 16	
	Permaswage D10282 - (Cres)	Ti-3Al-2.5V	E	04, 06, 08, 10, 12, 16	
		304 1/8 Hard	E	04, 06, 08, 10, 12, 16	
		21-6-9	E	04, 06, 08, 10, 12, 16	
		6061T6	Н	04, 06, 08, 10, 12, 16	
	Rynglok 80101T -	Ti-3Al-2.5V	Н	04, 06, 08, 10, 12, 16	
	(TITANIUM)	304 1/8 Hard	Н	04, 06, 08, 10, 12, 16	
		21-6-9	Н	04, 06, 08, 10, 12, 16	

## REPAIR METHOD - PERMANENT UNIONS, TUBE-TO-TUBE TABLE B

Tube Material and Fitting Selection Tables Figure 802 (Sheet 3)

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REF LETTER FOR TABLES A AND B	TOOL REQUIRED
A	Harrison Portable Swagers No. 5175 and 5720 or equivalent stationary Swager No. 5570
В	Pressure Presetting Tools ST878D
С	Hand Presetting Tools ST879A
D	Harrison Roller Swage Tool Kit 6633KO1
D (1)	Harrison Roller Swaging Machine 6777
E	Deutsch Permaswage Kits:  D12000 Series  No. D12102C03-01A00 for sizes 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 unit, Part No. D12025-001, is necessary for swaging with the tool kits shown.  DLT Series  Refer to Fig. 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	AMCI: • TS3P02111
G	None necessary - hand tools only.
Н	Aeroquip Rynglok Kit RTS8-02-006 for sizes 04, 06, 08, 10, 12, 16, 20.

TOOL REQUIRED FOR REPAIR METHOD TABLE C

Tube Material and Fitting Selection Tables Figure 802 (Sheet 4)

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PART	ASSOCIATED APP	ASSOCIATED APPROVED FITTINGS					
NUMBER	FITTING NUTS 5 7	UNIONS 6					
BACS13AP (BITE-Type) BACS13BX (Elastomer Swage) BACS13BX (Roller Swage)	For Aluminum tubes less than size 20, use:  BACN10YL-Alum  MS21921-Alum or Steel  BACN10CS-Alum or Steel  For size 20 and 24 Aluminum tubes used with short flareless fittings, use:  AS4660-Alum	For Aluminum tubes less than size 20, use:  • Ms21902-Alum or Steel  • M21924-Alum or Steel For size 20 and 24 Aluminum tubes used with short flareless fittings, use:  • AS4663-Alum					
	For <u>Cres</u> tubes, use:  BACN10YE-Cres  MS21921-Cres, Steel or Ti  BACN10CS-Cres, Steel  BACN10YA-Ti	For <u>Cres</u> tubes, use: • MS21902-Cres, Steel or Ti • MS21924-Cres, Steel or Ti					
	For <u>Ti</u> tubes, use:  • BACN10YA-Ti  • BACN10YE-Cres  • MS21921-Ti, Cres  • AS4660-Ti (sizes 20 and 24 only)	For <u>Ti</u> tubes, use:  • Ms21902-Cres or Ti  • Ms21924-Cres or Ti  • As4660-Ti (sizes 20 and 24 only)  • 35212 swaged union					
35211 Sleeve (Roller Swage)	For <u>Ti</u> tubes, use:  • BACN10YA-Ti  • BACN10YE-Cres  • MS21921-Ti, Cres  • AS4660-Ti (sizes 20 and 24 only)	For <u>Ti</u> tubes, use:  • MS21902-Cres or Ti  • MS21924-Cres or Ti  • AS4660-Ti (sizes 20 and 24 only)  • 35212 swaged union					
35212 Union (Roller Swage)	N/A	N/A					
CRYOLIVE Assembly 921721	For Aluminum tubes, use: • 921721W- (sizes 04 thru 12 only For Cres tubes, use: • 921721J- For Ti tubes, use: • 921721T-	For <u>Ti</u> tubes, use: • MS21902-Cres or Ti • MS21924-Cres or Ti					

ASSOCIATED APPROVED FITTINGS
TABLE D

Tube Material and Fitting Selection Tables Figure 802 (Sheet 5)

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	TUBE SIZES								
MATERIAL	04	05	06	08	10	12	16	20	24
	0.250	0.312	0.375	0.500	0.625	0.750	1.000	1.250	1.500
21-6-9	0.016	0.020	0.020	0.026	0.033	0.039	0.052		
3A1-2.5V	0.016		0.019	0.026	0.032	0.039	0.052	0.070	
6061-T6	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.049	0.049
304 1/8 н	0.020	0.020	0.028	0.035	0.049	0.058	0.065*	0.035*	0.049*

<sup>\*</sup> NOT QUALIFIED FOR 3000 PSI SYSTEMS, LOWER PRESSURES ONLY.

NOTE: ALTERNATIVE WALL THICKNESSES FOR TUBE REPAIRS OF 3000 PSI AND LOWER SYSTEM PRESSURE APPLICATIONS PER FLAGNOTE 8.

CRES 321 TUBING PER MIL-T-8808 MAY BE USED AS A SUBSTITUTE FOR 304 TUBING PER MIL-T-8504, 6061-T6 ALUMINUM TUBING PER MIL-T-7081 OR AMS 4083. 6061-T6 ALUMINUM PER MIL-T-7081 OR AMS 4083 MAY BE USED AS A SUBSTITUTE FOR 6061-T6 ALUMINUM TUBING PER 22-T-700/6. CONTACT THE BOEING COMPANY WHEN CONSIDERING USE OF TUBE MATERIALS OTHER THAN THOSE SPECIFIED.

TABLE E

Tube Material and Fitting Selection Tables Figure 802 (Sheet 6)

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TUBING MATERIAL	LOCATION ON AIRPLANE	TUBING SURFACE	FINISH RECOMMENDATION AND OPTIONS	FINISH CODE FOR COMMERCIAL AIRPLANES	
Titoui	A.I.I.	Inside	None	F-25.01	
Iltanium	Titanium All		None	F-25.01	
		Inside	None	F-25.01	
CRES			None Optional:	F-25.01	
CKES	All	Outside	Passivate + Primer (Green) Passivate + Primer + Paint (White)	F-17.09 + F-20.02 F-17.09 + F-20.02 + F-21.03	
	Fuel Tanks	Inside	None	F-25.01	
		Outside	Alodine (Transparent Gold)	F-17.08	
		Inside	None	F-25.01	
Aluminum	All Other		Outside	Anodize plus Primer (Green) Optional: Anodize + Primer + Paint (White)	F-17.19 and F-20.02 F-17.19 + F-20.02 + F-21.03

# TYPICAL FINISHES FOR HYDRAULIC TUBING TABLE F

Tube Material and Fitting Selection Tables Figure 802 (Sheet 7)

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NOTE: REFER TO FIG. 824 TO MAKE AN ORDER FOR PARTS. 1>> STANDARD CADMIUM-PLATED SLEEVE BACS13AP (SIZE) > STANDARD CADMIUM-PLATED SLEEVE: • BACS13BX (SIZE) HP > BACS13BD2OH.HP AND BACS13BD24H.HP HAVE BEEN SUPERSEDED BY BAC13BX2OH.HP AND BAC13BX24H.HP. 4 THE BACSBBX SLEEVE CAN BE USED TO REPAIR SIZE 20 AND 24 ALUMINUM TUBES WITH SHORT FLARELESS FITTINGS. IT CAN ALSO BE USED TO REPAIR SIZE 20 ALUMINUM TUBES AND SIZE 20 AND 24 CRES TUBES WITH STANDARD FLARELESS FITTINGS. MAKE SURE YOU DETERMINE THE APPLICATION BEFORE SWAGGING. SHORT FLARELESS FITTINGS REQUIRE A SHORTER "Z<sub>1</sub>" DIMENSION (FIG. 811). > DO NOT USE ALUMINUM NUTS OR UNIONS ON TUBE MATERIALS OTHER THAN ALUMINUM. ASSOCIATED APPROVED FITTINGS FOR OTHER UNIONS, REDUCERS, ELBOWS, AND TEES WITH MS33514 OR MS33515 FITTING ENDS; AND FOR SHORT FLARELESS FITTING APPLICATIONS, OTHER UNIONS, REDUCERS, ELBOWS AND TEES WITH AS4658 OR AS4659 FITTING ENDS. 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/N 9211699 (MATERIAL CODE)(SIZE) N COUPLING NUT. THE LONGER LENGTH COUPLING NUTS ARE NOT INTERCHANGEABLE WITH STANDARD BACN10- AND MS21921 COUPLING NUTS. 8 WHEN PERFORMING A HYDRAULIC TUBE REPAIR WITH THE SAME TUBE MATERIAL, THE ALTERNATE TUBE WALL THICKNESSES LISTED IN FIG. 802 (SHEET 6) MAY BE USED IN PLACE OF WALL THICKNESSES DELIVERED WITH THE AIRPLANE WHEN PERFORMING A REPAIR ON TUBES IN SYSTEMS WITH 3000 PSI OR LESS OPERATING PRESSURE.

Tube Material and Fitting Selection Tables Figure 802 (Sheet 8)

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TUBE MATERIAL		TUBE OUTER DIAMETER						
(PRESSURE)	PROBLEM TYPE	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	0.030 (Ti)
	dent	0.005	0.007	0.010	0.015	0.018	0.020	0.030 (Ti)
304 1/8 Hard	chafed	0.006	0.007	0.008	0.010	0.011	0.012	N/A
(3000 psi)	dent	0.005	0.010	0.020	0.030	0.040	0.040	N/A
6061T6 (1500 psi except*)	chafed	0.015	0.015	0.010	0.005	0.004 0.015*	0.003 0.015*	0.003 0.015*
	dent	0.015	0.015	0.010	0.005	0.005	0.005	0.005

<sup>\*</sup>Suction Line, 150 psi

ALL DIMENSIONS ARE IN INCHES.

NOTE: THE ABOVE LIMITS WERE VERIFIED BY HYDRAULIC IMPULSE FATIGUE AND BURST TESTING (FOR ADDITIONAL INFORMATION SEE SAE-AIR 1388).

Permitted Tube Problem Depth Hydraulic Pressure (3000 PSI), Return Lines (1500 PSI),
and Fire Extinguishing Pressure (1000 PSI)
Figure 803

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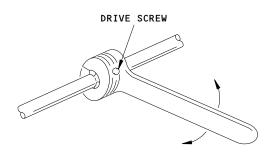
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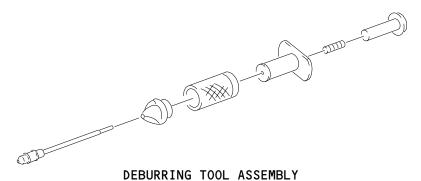
TUBE SIZE	CHIPLESS CUTTER PART NUMBER	CUTTER WHEEL PART NUMBER
04	D9872	D9872-114
06	D9872	D9872-114
08	D9853	D9853-214
10	D9853	D9853-214
12	D9853	D9853-214

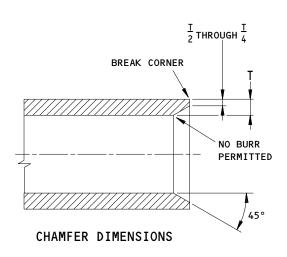
DEUTSCH CHIPLESS CUTTERS AND CUTTER WHEELS TABLE A

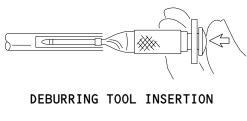
Deutsch Tools Figure 804 (Sheet 1)

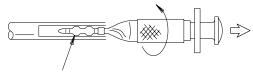
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PLUG EXPANDED

DEBURRING TOOL EXTRACTION

TUBE SIZE	TUBE WALL THICKESS (INCHES)	STEM SUBASSEMBLY PART NUMBER	DEBURRING TOOL 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	D9850-13-08	D9850		
10	0.016-0.058	D9850-13-10	D9850		
12	0.016-0.058	D9850-13-12	D9850		
16	0.016-0.058	D9849-13-16	D9849		
20	0.016-0.058	D9849-13-20	D9849		

### DEUTSCH STEM SUBASSEMBLIES, DEBURRING TOOLS, AND REQUIRED CHAMFER DIMENSIONS TABLE B

Deutsch Tools FIgure 804 (Sheet 2)

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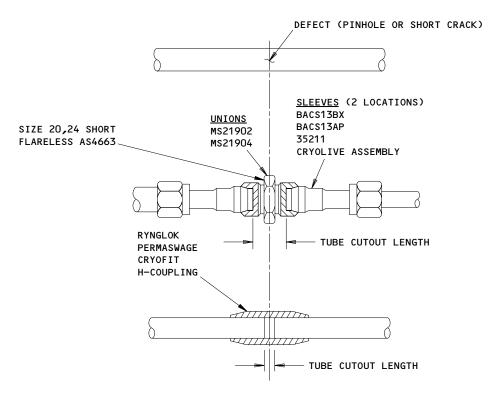
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NOTE: FITTING NUTS NOT SHOWN.

Tubing Repair with Unions - Short Damage Figure 805 (Sheet 1)

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UNION PART NO.	SLEEVE PART NO.	TUBE SIZE									
		04	05	06	08	10	12	16	20	24	
MS21902	BACS13AP	0.59	0.56	0.68	0.76	0.86	1.05	N/A	N/A	N/A	
	BACS13BX (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) 35211 (Harrison Roller Swager 6777)	0.82	N/A	0.95	1.03	1.21	1.40	1.40	N/A	N/A	
MS21924	BACS13AP	1.18	1.18	1.29	1.42	1.55	1.78	N/A	N/A	N/A	
	BACS13BX (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) 35211 (Harrison Roller Swager 6777)	1.41	N/A	1.56	1.69	1.90	2.13	2.13	N/A	N/A	
Rynglok		0.300	N/A	0.300	0.350	0.350	0.350	0.400	0.400	N/A	
Permaswage Cryofit H-Coupling	None Necessary	0.150 INCH MAXIMUM									

TUBE CUTOUT LENGTHS IN INCHES

Tubing Repair with Unions - Short Damage Figure 805 (Sheet 2)

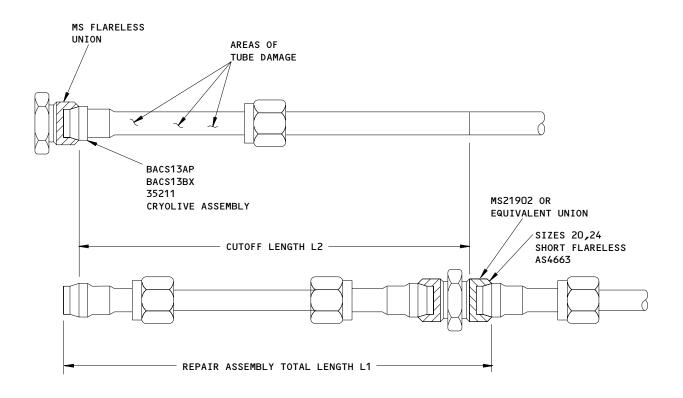
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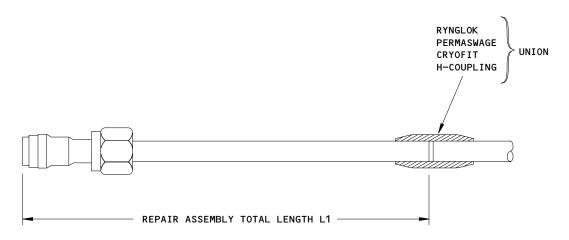
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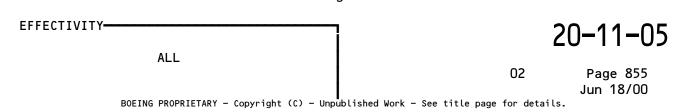




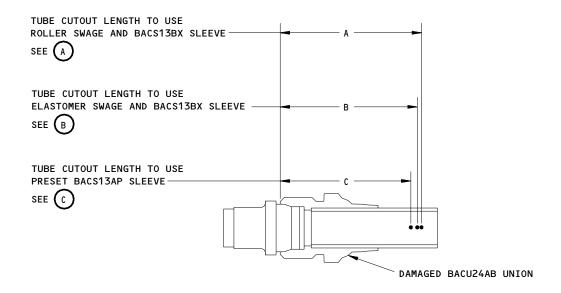


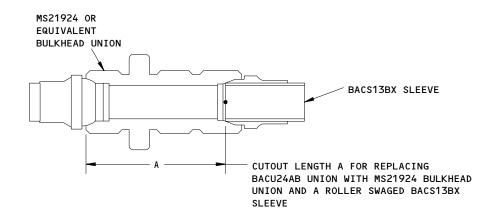
NOTE: REFER TO FIG. 810 (SHEET 1) FOR THE LENGTHS L1 AND L2.

Tubing Repair by End Replacement Figure 806











NOTE: REFER TO FIG. 808 FOR THE LENGTHS A,B AND C. COUPLING NUTS NOT SHOWN.

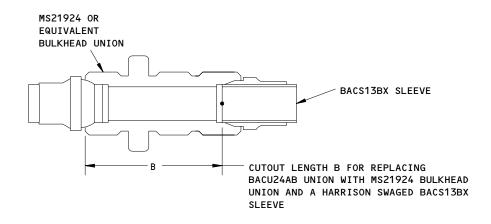
### Tube Cutout Lengths for Replacement of Damaged BACU24AB Swage Unions Figure 807 (Sheet 1)

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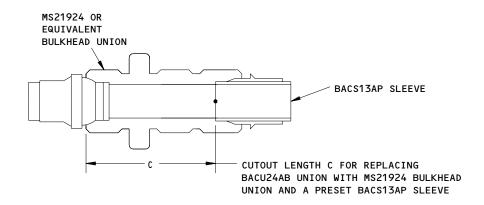
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### Tube Cutout Lengths for Replacement of Damaged BACU24AB Swage Unions Figure 807 (Sheet 2)

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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										
35211	Harrison Roller Swage Machine 6777	MS21924	A (Fig. 807)	1.562	1.705	1.886	2.100	2.334	2.319	N/A	N/A
BACS13BX	Harrison Portable Swagers 5175, 5720 or Equiv. Statnry. 5570	MS21924	B (Fig. 807)	1.487	1.612	1.791	1.965	2.199	2.122	2.119	2.049
BACS13AP	Hand or Machine Preset	MS21924	C (Fig. 807)	1.422	1.547	1.726	1.900	2.134	N/A	N/A	N/A
CRYOLIVE Assembly	N/A	MS21924	B (Fig. 807)	1.487	1.612	1.791	1.965	2.199	2.122	N/A	N/A

Repair Method: You need to replace a damqged 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 equivalent material as the union you are replacing.

Check Fig. 802 for sleeve/tube material limitations.

To make the repair (Refer to Fig. 807):

- 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 plane to use.
- Step 2: Slide a flareless coupling nut on the tube. Follow the procedures for presetting a BACS13AP sleeve or swaging a BSCS13BX 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 808

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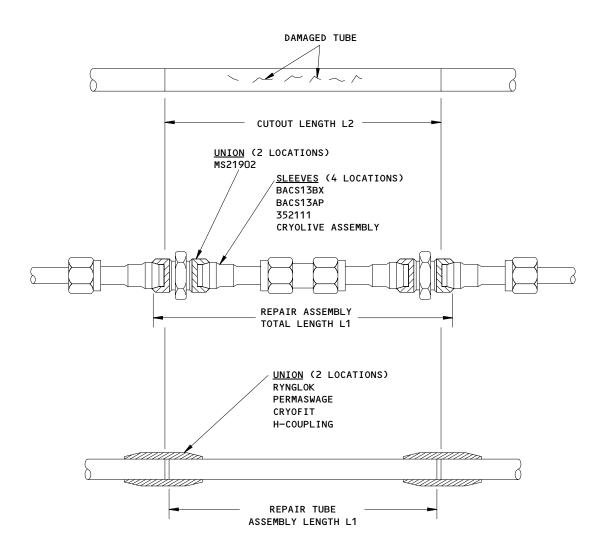
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NOTE: REFER TO FIG. 810 FOR THE LENGTHS L1 AND L2.

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Tubing Repair by Section Replacement Straight or Bend - Extensive Damage Figure 809

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FITTING	S USED FOR REPAIR T	UBE ASSEMBLY	L2 CUTOUT LENG	TH FORMULA 1	
FLARE	SWAGE METHOD	UNION PART NO.	FOR TUBE END SECTION	FOR TUBE CENTER SECTION	
BACS13BX	Harrison Portable Swagers 5175 and 5720 or Equivalent Stationary Swager 5570	MS21902	L1 Minus 2P	L1 Minus 2P	
BACS13BX	Harrison Roller Swage Kit 6633K01	or Equivalent	L1 Minus 2Z <sub>1</sub>	L1 Minus 2Z <sub>1</sub>	
BACS13AP	Hand or Machine Preset		L1 Minus 2H	L1 Minus 2H	
CRYOLIVE Assembly 921721	N/A		L1 Minus 2P	L1 Minus 2P	
35211	Harrison Roller Swage Machine 6777		L1 Minus 2Z <sub>2</sub>	L1 Minus 2Z <sub>2</sub>	
BACS13BX	Harrison Portable Swagers 5175 and 5720 or Equivalent Stationary Swager 5570		L1 Minus (P+0.10)		
BACS13BX	Harrison Roller Swage Kit 6633K01	Permaswage Cryofit H-Fitting	L1 Minus (Z <sub>1</sub> +0.10)	N/A	
BACS13AP	Hand or Machine Preset		L1 Minus (H+0.10)		
CRYOLIVE Assembly 921721	N/A		L1 Minus (P+0.10)		
35211	Harrison Roller Swage Machine 6777		L1 Minus 2Z <sub>2</sub>	L1 Minus 2Z <sub>2</sub>	
N/A	N/A	Rynglok Permaswage Cryofit H-Coupling		L1 Minus 0.20	

Procedure to Find the Tube Cutout Length L2 Figure 810 (Sheet 1)

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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 Fig. 806.

To make the repair tube end section, you roller swaged BACS13BX flareless sleeves to the tube ends and tightened then to one end of a MS21902 flareless union.

- Step 1: Measure the repair tube assembly total length L1 (Fig. 806).
- Step 2: Observe the cutout length L2 formula (L1 minus 2Z<sub>1</sub>) in above table.
- Step 3: find the  $\rm Z_1$  value for tube size in Fig. 811.
- Step 4: Subtract ( $Z_1$  times 2) from the measured L1 for cutout length L2.

1 REFER TO FIG. 811 FOR VALUES FOR H, P,  $Z_1$  AND  $Z_2$ .

Procedure to Find the Tube Cutout Length L2 Figure 810 (Sheet 2)

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FLARELESS SLEEVE				Tl	JBE SIZ	ES			
JOINT TYPE	04	05	06	08	10	12	16	20	24
BACS13BX (Roller Swaged)	0.140	N/A	0.137	0.190	0.195	0.195	0.195	N/A	N/A
35211 (Harrison Roller Swaged)	0.210	N/A	0.207	0.250	0.255	0.255	0.255	N/A	N/A
BACS13BX (Elastomer Swaged)	0.214	0.230	0.230	0.285	0.330	0.330	0.392	0.395 1 0.355 2	0.465 1 0.350 2
BACS13AP (Preset)	0.234	0.250	0.250	0.305	0.350	0.350	N/A	N/A	N/A

1 ALL EXCEPT SHORT FLARELESS
2 SHORT FLARELESS

Flareless Sleeve Tube End Values Figure 811

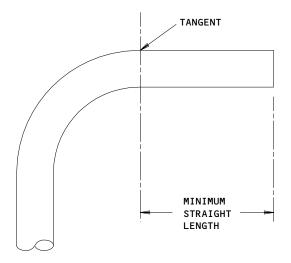
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EITTING TYPE		TUBE	END M	INIMUM	STRAIGH	HT LENG	TH - II	NCHES	
FITTING TYPE	04	05	06	08	10	12	16	20	24
BACS13BX (Harrison Elastomer Swager) and CRYOLIVE Flareless Sleeve Assembly	1.23	1.25	1.28	1.39	1.48	1.51	1.47	1.46	1.46
BACS13BX (Harrison Roller Swager)	2.25	2.25	2.25	2.25	2.25	2.25	2.25	N/A	N/A
BACS13AP (BITE Type)	0.80	0.90	1.00	1.10	1.15	1.15	N/A	N/A	N/A
D10282 * (Permaswage)	1.07	N/A	1.15	1.65	1.70	1.80	1.90	2.15	N/A
BACC42W * (H-Coupling)	2.80	2.80	2.80	2.80	2.80	2.80	2.80	N/A	N/A
3p02111 * (Cryofit)	0.71	0.81	0.90	0.98	1.17	1.35	1.76	N/A	N/A
35211 Sleeve (Harrison Roller Swager)	1.30	N/A	1.30	1.38	1.42	1.40	1.40	N/A	N/A
35212 Union (Harrison Roller Swager)	1.22	N/A	1.30	1.48	1.46	1.50	1.50	N/A	N/A
80101T (Rynglok)	1.236	N/A	1.362	1.480	1.628	1.777	2.109	2.143	N/A

<sup>\*</sup> Based on 1/2 fitting length

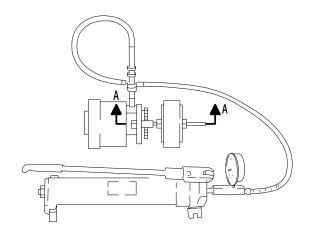
Minimum Straight Length Specifications for Repair Fitting Installations Adjacent to Tube Bends Figure 812

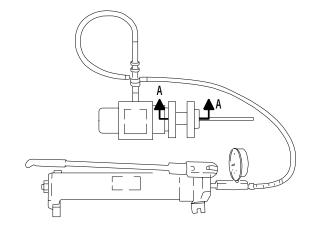
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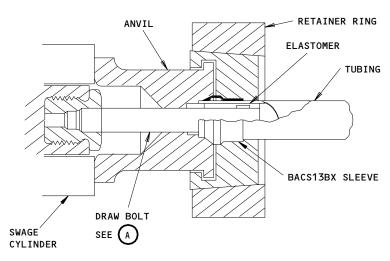




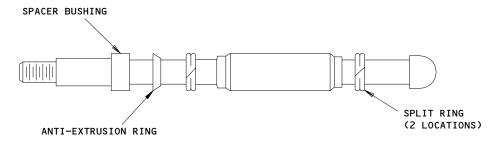


HARRISON MODEL 5720

HARRISON MODEL 5175



A-A



DRAW BOLT ASSEMBLY (SHOWN EXTENDED)



Harrison Portable Swagers for BACS13BX Sleeves Figure 813 (Sheet 1)

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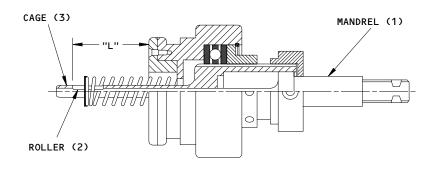
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SIZE	EXPANDER ASSEMBLY	MANDREL (1)	ROLLERS (2)	CAGE (3)
-04	7320-04016	7321-04016	7322-04016	7323-04016
-06	7320-06019	7321-06019	7322-06019	7323-06019
-08	7320-08026	7321-08026	7322-08026	7323-08026
-10	7320-10032	7321-10032	7322-10032	7323-10032
-12	7320-12039	7321-12039	7322-12039	7323-12039
-16	7320-16051	7321-16051	7322-16051	7323-16051

## EXPANDERS P/N AND SPARE PARTS P/N REQUIRED TO ROLLER SWAGE 35211 AND 35212 TO 3AI-2.5V TITANIUM TUBING

TUBE O.D.	SET LENGTH "L" (INCHES) ±0.005
-04 -06 -08 -10 -12	1.010 1.205 1.310 1.382 1.474 1.600

TOOL ADJUSTMENT

#### HARRISON 6777 MACHINE

Harrison Portable Swagers for BACS13BX Sleeves Figure 813 (Sheet 2)

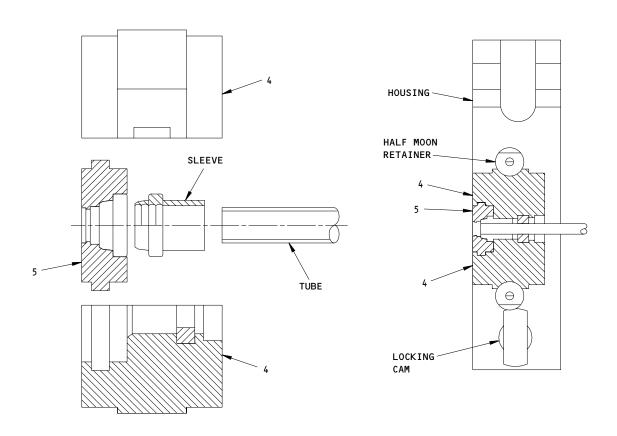
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TUBE AND SLEEVE DIA. INCHES	TWO HALF JAWS (4)	RETAINER (5)
1/4	6884-04	6885-104
3/8	6884-06	6885-106
1/2	6884-08	6885-108
5/8	6884-10	6885-110
3/4	6884-12	6885-112
1	6884–16	6885-116

#### HARRISON 6777 MACHINE

Harrison Portable Swagers for BACS13BX Sleeves Figure 813 (Sheet 3)

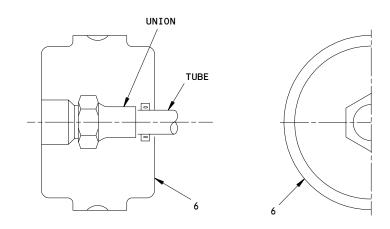
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TUBE AND UNION DIA.  INCHES	TWO HALF JAWS (6)
1/4 3/8 1/2 5/8 3/4	6886-04 6886-06 6886-08 6886-10 6886-12 6886-16

#### EXTERNAL ROLLER SWAGE TOOLS FOR UNIONS

Harrison Portable Swagers for BACS13BX Sleeves Figure 813 (Sheet 4)

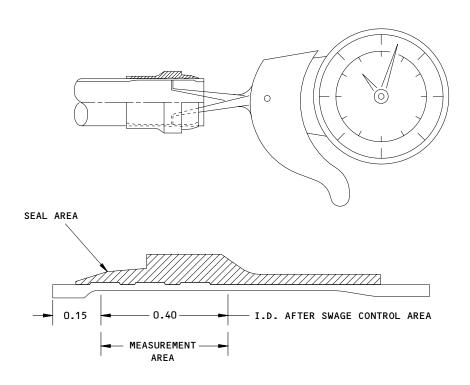
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NOTE: I.D. AFTER SWAGE REQUIREMENTS-MEASURING METHOD FOR 35211 SLEEVE AND 35212 UNION.

TUBE O.D./DASH NO.	TUBE WALL	TORQUE	I.D. AFTER SWAGE
Т	UBE MATERIAL: 3AI-	2.5V TITANIUM PER A	MS4945
0.250/-04 0.375/-06 0.500/-08 0.625/-10 0.750/-12 1.000/-16	0.016 0.019 0.026 0.032 0.039 0.051	6-7 11-12 20-22 40-43 40-43 65-68	0.225-0.232 0.347-0.354 0.458-0.465 0.575-0.587 0.684-0.695 0.913-0.919

## SWAGING TORQUE AND I.D. AFTER SWAGE REQUIREMENTS FOR 35211 SLEEVE AND 35212 UNIONS

Harrison Portable Swagers for BACS13BX Sleeves Figure 813 (Sheet 5)

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		_					
304, 321, AND 347 CRES	SWAGE PRESSURE (PSI) 3> BACS13BX	475* [2>>	N/A	940 1	1150* [2>>	2000* [2>>	
304, 33	WALL (IN.)	0.020	N/A	0.035	0.035	0.035 2>>	
6061-T4AL PER MIL-T-7081 OR AMS 4083	SWAGE PRESSURE (PSI) ±5% BACS13BX	N/A	N/A		N/A	N/A	
09 M	WALL (IN.)	N/A	N/A		N/A	N/A	
6061-T6 AL PER WW-T-700/6 OR MIL-T-7081 OR AMS 4083	SWAGE PRESSURE (PSI) ±5% BACS13BX	N/A	450		200	950	
606 WW MI	WALL (IN.)	N/A	0.035	0.028	0.035	0.035	
-6-9 CRES AS N IN BMS 7-185	SWAGE PRESSURE (PSI) 3> BACS13BX	475	1000		1150	2000	
21-6-9 SHOWN IN	WALL IN.)	0.016	0.020		0.020	0.026	
SWAGER	0N	5175				-	_
TUBE	SIZE	70	05		90	80	==

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

304 CRES (MIL-T-8504), 321 AND 347 CRES (MIL-T-8808) 1/8 HARD CRES (MIL-T-6845) MINIMUM SWAGE PRESSURE - IF YOU MUST SWAGE AGAIN, INCREASE IN 5% INCREMENTS.

Swage Pressures for Elastomer Swaging Flareless Sleeves Figure 814 (Sheet 1)

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	Ä.											Т		
304, 321, AND 347 CRES	SWAGE PRESSURE (PSI) 3	BACS13BX		450		850 <b>*</b>	1300 2	1350 2	1600* [2>>	3050* [2>>	1650 [2>>		N/A	N/A
304, 35	WALL	( * NT )		0.035		0.049	0.035	0.049	0.058 2>>	0.065 2>>	0.035 2		0.035	950.0
6061-T4AL PER MIL-T-7081 OR AMS 4083	SWAGE PRESSURE (PSI) ±5%	BACS13BX	N/A				N/A				750		750	N/A
09 W	WALL	( TN - )	N/A				N/A				0.035		0.035	N/A
6061-T6 AL PER WW-T-700/6 OR MIL-T-7081 OR AMS 4083	SWAGE PRESSURE (PSI) ±5%	BACS13BX	250		325	375	009				950		N/A	N/A
606 WW	WALL	( TN - )	0.020		0.028	0.035	0.035				0.035		0.035	N/A
-6-9 CRES AS I IN BMS 7-185	SWAGE PRESSURE (PSI) 3	BACS13BX	C	068			1600				3050		N/A	N/A
21-6-9 SHOWN IN	WALL	\.	0	0.033			0.039				0.052		N/A	N/A
SWAGER	0N		5570	0276										-
TUBE	SIZE		10				12				16		20	54

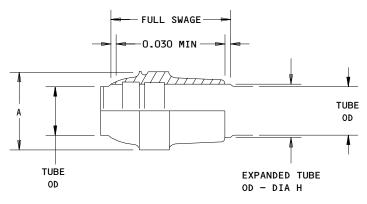
Swage Pressures for Elastomer Swaging Flareless Sleeves Figure 814 (Sheet 2)

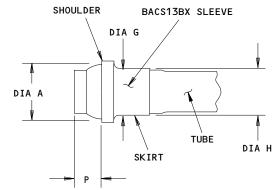
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DIMENSION		SIZE										
DIMENSION	04	05	06	08	10	12	16	20	24			
P ±0.010	0.214	0.230	0.230	0.285	0.330	0.330	0.392	0.395 1 0.355 2	0.465 1 0.350 2			
A max	0.374	0.437	0.493	0.673	0.789	0.964	1.214	1.474	1.723			
G max	0.298	0.364	0.423	0.550	0.686	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			

NOTE: ALL DIMENSIONS ARE IN INCHES.

### DIMENSIONS OF FLARELESS TUBE ENDS AND BACS13BX SLEEVES AFTER ELASTOMERIC SWAGING

1 ALL EXCEPT SHORT FLARELESS
2 SHORT FLARELESS

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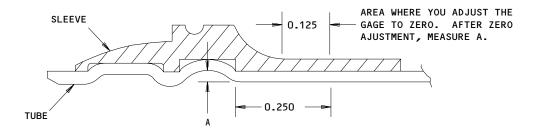
## BACS13BX Flareless Sleeve Dimensions After Elastomeric Swaging Figure 815

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BACS13BX (TWO GROOVES)

TUBE	DEPTH 2A	- INCHES		
SIZE	MINIMUM	MAXIMUM		
04	0.020	0.032		
05	0.020	0.032		
06	0.020	0.032		
08	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		

BACS13BX SWAGE GROOVE DEPTH LIMITS

NOTE: ALL DIMENSIONS ARE IN INCHES.

Groove Depth Measurement for BACS13BX Sleeves Figure 816

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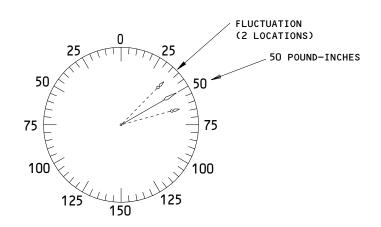
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#### TORQUE WRENCH DIAL - PROCEDURE TO READ TORQUE

TUBE	MATE WALL THICKNI		SWAGE TORQUE (POUNDS-INCH)		
SIZE	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	

SWAGER TORQUES NECESSARY TO ROLLER SWAGE BACS13BX SLEEVES
TO Ti-3AL-2.5V CWSR OR 21-6-9 CRES TUBE USING HARRISON 6633K01
ROLLER SWAGING KIT

1 AS SPECIFIED IN SPECIFICATION AMS 4945/BMS 7-234

AS SPECIFIED IN SPECIFICATION BMS 7-185

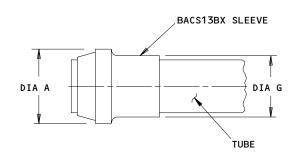
Swage Torques, Sleeve Dimensions, and Wall Thicknesses for Roller Swaging Figure 817 (Sheet 1)

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DIAMETER		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					

MAXIMUM PERMITTED SHOULDER AND SKIRT DIAMETERS (INCH)

Swage Torques, Sleeve Dimensions, and Wall Thicknesses for Roller Swaging Figure 817 (Sheet 2)

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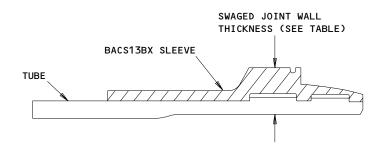
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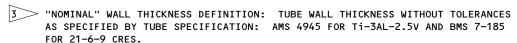




#### SECTION OF ROLLER SWAGED JOINT

	TUBE DI	MENSIONS				
TUBE SIZE		AL" WALL S - INCHES 4	SWAGED JOINT WALL THICKNESS FOR "NOMINAL" TUBE WALLS - INCHES			
	Ti-3AL-2.5V	21-6-9 CRES		>		
04	0.016	0.016	0.068	<b>A</b>		
06	0.019	0.020	0.066			
08	0.026	0.026	0.100	TOLERANCE		
10	0.032	0.033	0.101	+0.002 -0.003		
12	0.039	0.039	0.132			
16	0.051	0.052	0.143	•		

SWAGED JOINT WALL THICKNESS SPECIFICATION 3 4



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

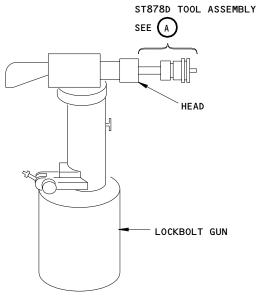
Swage Torques, Sleeve Dimensions, and Wall Thicknesses for Roller Swaging Figure 817 (Sheet 3)

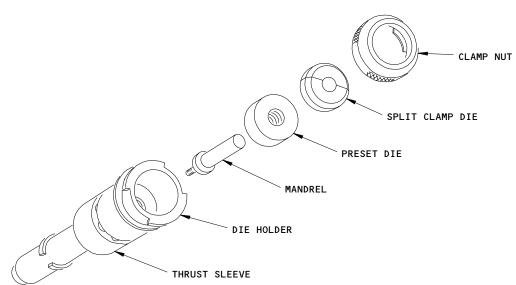
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ST878D TOOL ASSEMBLY



Preset Pressures (PSI) for the Cherry G-85 Lockbolt Gun with ST878D Presetting Tool Assembly (BACS13AP Sleeves) Figure 818 (Sheet 1)

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			RECOMMENDED AIR PRESSURE (PSI)				
TUBE SIZE	WALL THICKNESS	TOOL NO.	ALUMINUM	STEEL			
0122	mionico		6061-T6	AISI 304-1/8 HARD			
3/16	0.020-0.035	ST878D-3-020 ST878D-3-035	22.5	30.0			
1/4	0.020-0.035	ST878D-4-020 ST878D-4-035	27.5	40.0			
5/16	0.020-0.035	ST878D-5-020 ST878D-5-035	30.0	40.0			
3/8	0.020-0.035	ST878D-6-020 ST878D-6-035	70 0 52				
1/2	0.028-0.035	ST878D-8-028 ST878D-8-035	42.5	75.0			
5/8	0.028-0.083	ST878D-10-028 ST878D-10-083	50.0 80.0				
3/4	0.020-0.049	ST878D-12-020 ST878D-12-049	E2 E 01				

NOTE: ALL DIMENSIONS ARE IN INCHES.

Preset Pressures (PSI) for the Cherry G-85 Lockbolt Gun with ST878D Presetting Tool Assembly (BACS13AP Sleeves) Figure 818 (Sheet 2)

EFFECTIVITY-

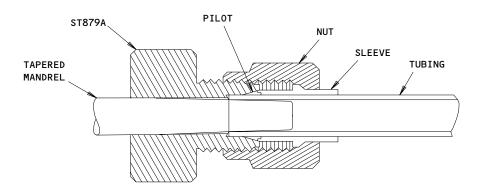
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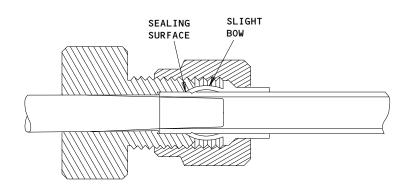
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BEFORE PRESET BY HAND



AFTER PRESET BY HAND

Preset by Hand with Preset Tool ST879A Figure 819

EFFECTIVITY ALL

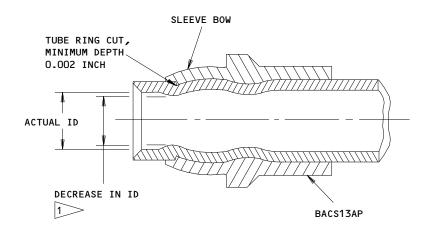
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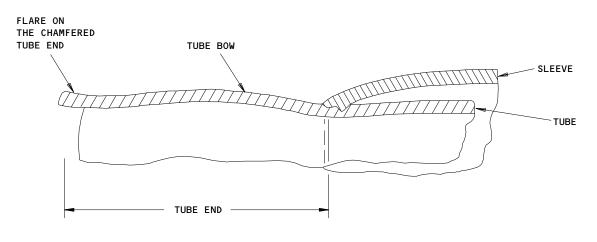
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#### ASSEMBLED AND PRESET SLEEVE



TUBE END DEFORMATION

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

## Properties of Preset BACS13AP Flareless Sleeve/Tube End Figure 820

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TUBE OD		1/4	5/16	3/8	1/2	5/8	3/4	1	1-1/4
	304	0.020	0.020	0.028	0.035	0.049	0.058	N/A	N/A
Wall Thickness	21-6-9	0.016	0.020	0.020	0.026	0.033	0.039	N/A	N/A
Procedure A 2 (Displacement, Turns)		1-1/6	1-1/6	1-1/6	1-1/6	1-1/6	1-1/6	N/A	N/A
Procedure B	304	145	200	290	545	780	900	N/A	N/A
(Torque) Pound-Inches 3	21-6-9	145	200	290	545	780	1200	N/A	N/A

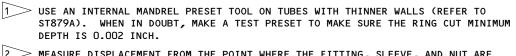
NOTE: ALL DIMENSIONS ARE IN INCHES.

# HAND PRESETTING FLARELESS FITTINGS - NO MANDREL 1 (STEEL TUBING) TABLE A

TUBE OD		1/4	5/16	3/8	1/2	5/8	3/4	1	1-1/4
Wall Thickness	6061-T6	0.035	0.035	0.035	0.035	0.035	0.035	N/A	N/A
Procedure A 2 (Displacement, Turns)		1-1/6	1-1/6	1-1/6	1	1	1	N/A	N/A
Procedure B (Torque) Pound-Inches 3	6061-T6	110	140	170	280	360	450	N/A	N/A

NOTE: ALL DIMENSIONS ARE IN INCHES.

# HAND PRESETTING FLARELESS FITTINGS - NO MANDREL 1 (ALUMINUM TUBING) TABLE B



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 821

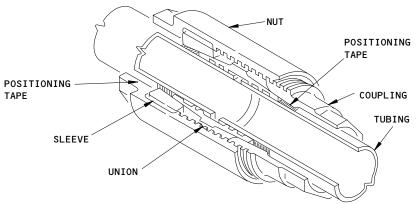
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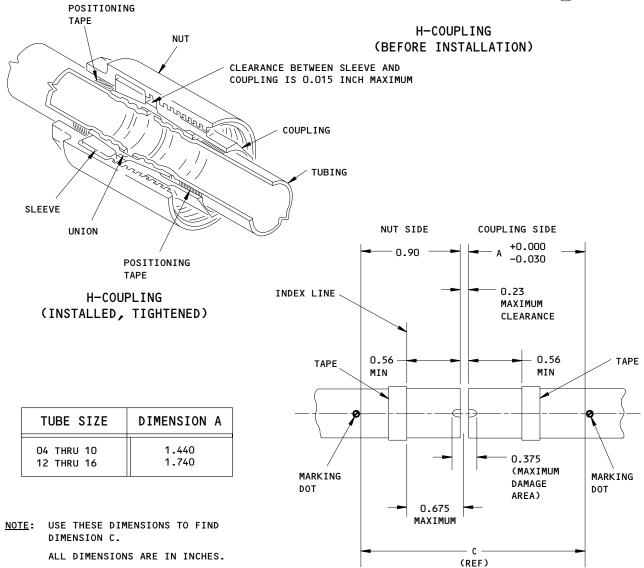
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H-Coupling Installation Figure 822

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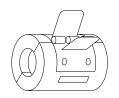
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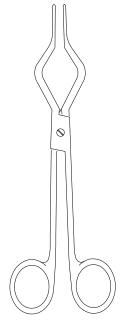




SNAP-ON INTALLATION STOP



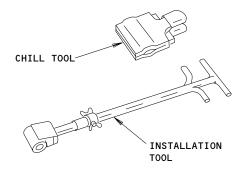
EXTENDED TIME TOOL

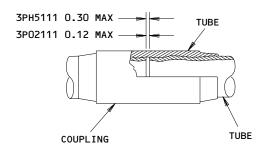


**TONGS** 



#### O-RINGS INSTALLATION STOP





CRYOFIT COUPLING INSTALLATION

NOTE: CRYOFIT KITS INCLUDE ADDITIONAL ITEMS.

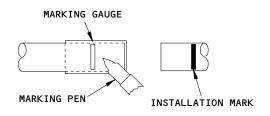
Cryofit Coupling 3P02111 and 3PH5111 Repair Figure 823 (Sheet 1)

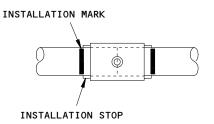
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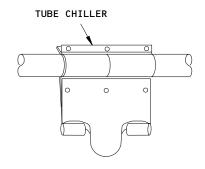




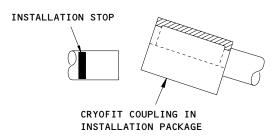


APPLICATION OF INSTALLATION MARK

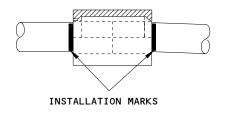
**INSTALLATION STOP** 



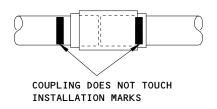
TUBE CHILLER APPLICATION



CORRECT POSITIONING OF CROFIT FITTING ON TUBE



**ACCEPTABLE** 



UNACCEPTABLE

POSITION OF INSTALLED FITTING ON TUBE

NOTE: CRYOFIT KITS INCLUDE ADDITIONAL ITEMS.

Cryofit Coupling 3P02111 and 3PH5111 Repair Figure 823 (Sheet 2)

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DEUTSCH FITTING	FITTING	FOR USE WITH	APPROVED TUBE SIZES OD/WALL						
PART NO.	PART NO. MATERIAL	TUBE MATERIAL	04	06	08	10	12	16	20
	21-6-9 Cres	0.016	0.020	0.026	0.033	0.039	0.052		
D10282-()	21-6-9 Cres	3AL-2.5V Ti	0.016	0.019	0.026	0.032	0.039	0.051	0.070
		304-1/8 Hard Cres (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065	
D10282D()	6061T6 Al	6061T6 AL (MIL-T-7081)	0.035	0.035	0.035	0.035	0.035	0.035	0.040

TABLE A

BOEING	FITTING	FOR USE WITH TUBE MATERIAL	APPROVED TUBE SIZES OD/WALL						
PART NO.	MATERIAL		04	06	08	10	12	16	20
		21-6-9 Cres	0.016	0.020	0.026	0.033	0.039	0.052	
BACU24BS (SIZE) (SIZE) J	21-6-9 Cres	3AL-2.5V Ti	0.016	0.019	0.026	0.032	0.039	0.051	0.070
		304-1/8 Hard Cres (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065	
BACU24BS (SIZE) (SIZE) D	6061T6 AL	6061T6 AL (MIL-T-7081)	0.035	0.035	0.035	0.035	0.035	0.035	0.040

TABLE B

Approved Fitting/Tube Material Combinations for Repair with Permaswage Unions Figure 824 (Sheet 1)

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NOTE: Material code (J) with the Boeing part number or no material code (-) with the Deutsch part number indicates 21-6-9 cres fitting with two internal grooves on each end, one each filled with silicone. Material code D on either the Boeing or Deutsch part number indicates 6061T6 aluminum fitting with two internal groves on each end, all filled with silicone.

Aluminum unions without all grooves filled with the silicone sealant are not approved for Boeing airplanes.

1 > A BOEING STANDARD FOR AN EXTERNALLY SWAGED UNION - BACU24BS (SIZE)(SIZE) MATERIAL) - BASED ON THE DEUTSCH PERMASWAGE D10282 UNION HAS BEEN DEVELOPED BY BOEING FOR USE ON THE 777 AIRPLANE. THE BACU24BS (SIZE)(SIZE) J UNION (BOTH SIZES THE SAME) AND THE D10282-(SIZE) UNION ARE INTERCHANGEABLE. IN ADDITION, THE BACU24BS (SIZE)(SIZE) D UNION (BOTH SIZES THE SAME) AND D10282D (SIZE) D UNION ARE INTERCHANGEABLE.

THE CORROSION RESISTANT STEEL D10282-(SIZE) AND ALUMINUM D10282D(SIZE) PER-MASWAGE UNIONS ARE IMPROVED REPLACEMENTS FOR THE STANDARD CORROSION RESISTANT STEEL D10036D (SIZE) AND ALUMINUM D10036D (SIZE) UNIONS, RESPECTIVELY. THE D10036 UNIONS ARE FUNCTIONALLY INTERCHANGEABLE WITH THE D10282 UNIONS BUT ARE MORE LIKELY TO DEVELOP LEAKS DURING USE. BOEING DOES NOT RECOMMEND USE OF THE D10036 UNION.

BACU24BS (SIZE)(SIZE) J - (BOTH SIZES THE SAME), BACU24BS (SIZE)(SIZE) D -(BOTH SIZES THE SAME), 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 SOUTH FIGUEROA ST., P.O. BOX 61188, LOS ANGELES, CA 90061.

Approved Fitting/Tube Material Combinations for Repair with Permaswage Unions Figure 824 (Sheet 2)

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TUBE SIZE	SWAGE TOOL ASSEMBLY	SWAGE HEAD	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 TABLE A

TUBE	SWAGE TOOL ASSEMBLY	SWAGE HEAD ASSEMBLY	POWER UNIT	INSPECTION GAGE	
04	DLT05PSKT3000	DLT05PSHA3004	DLT05MAPW0000	D12-9892-04	
06	DLT10PSKT3000	DLTO5PSHA3006	DLT10MAPW0000	D12-9892-06	
08	N. T2000//T7000	DLTO5PSHA3008		D12-9892-08	
10	DLT20PSKT3000	DLTO5PSHA3010	DLT20MAPW0000	D12-9892-10	
12	DLT30PSKT3000	DLT30PSHA3012	DLT30MAPW0000	D12-9892-12	
16	DLT40PSKT3002	DLT40PSHA4016	DLT40MAPW0000	D12-9892-16	
20	DLT40PSKT3003	DLT40PSHA3020	DLT40MAPW0000	D12-9892-20	

 $\underline{\mbox{NOTE}} \colon$  One of the following pumps is necessary to actuate the power units:

- DTLO2MAPP1000 pneumatic pump 10,000 psi
- DLT01MAPM1000 manual pump 10,000 psi

#### DEUTSCH LIGHTWEIGHT TOOLS TABLE B

 $\underline{\text{NOTE}} \colon$  The -12 size swage die is different in outer diameter than the swage dies used before.

Swage and Inspection Tool Part Numbers Figure 825

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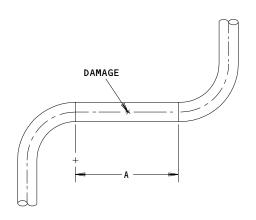
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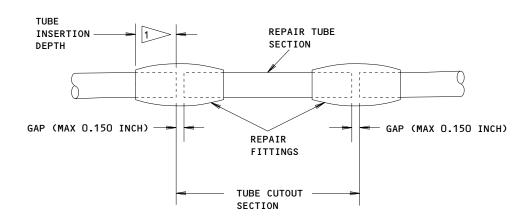
SIZE	TUBE SIZE								
	04	06	08	10	12	16	20		
Fitting length	1.540/ 1.530	1.690/ 1.680	2.700/	2.780/ 2.766	2.920/ 3.906	3.209/ 3.195	3.664/ 3.650		
A tube length (min)	2.15	2.30	3.30	3.40	3.55	3.80	4.30		

NOTE: ALL DIMENSIONS ARE IN INCHES.

Minimum Straight Length for Permaswage Fitting Installation Figure 826

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MATERIAL	TUBE SIZE								
	04	06	80	10	12	16	20		
Cres/Ti	0.02	0.02	0.03	0.04	0.057	0.049	0.05		
AL	None	0.04	0.06	0.06	0.061	0.048	0.06		

SWAGE GROWTH VALUES (INCH)

1 THE A DIMENSION IS SHOWN IN FIG. 829.

Tube Splice Repair Figure 827

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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	<ol> <li>Hand apply abrasive material, 240-grit or finer</li> <li>Lacquer thinner (refer to TT-T-266)         (flammable) MEK (refer to TT-T-261)         (flammable) for primed surfaces (MIL-P-6889) and         lacquer base paint/enamel</li> </ol>		

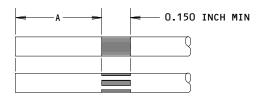
Cleaning and Paint Removal Procedures for Aluminum Tubes FIgure 828

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DIMENSION	TUBE S	BE SIZE AND INSERTION DEPTH - INCHES				
(FIG. 827)	04	06	08	10	12	16
A	0.69	0.77	1.27	1.31	1.38	1.52

MARK FOR THE MINIMUM TUBE INSERTION DEPTHS

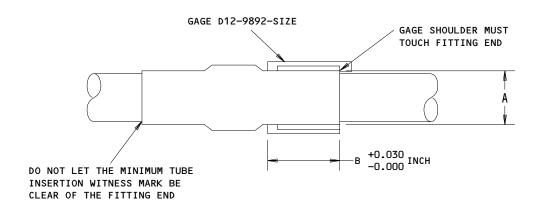
Witness Mark Location and Usual Marking Procedures Figure 829

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TUBE DIAMETER (INCHES)	SWAGED DIAMETER MAX A DIMENSIONS (INCHES)	SWAGED LENGTH MIN B DIMENSIONS (INCHES)
1/4 (04)	0.315	0.46
3/8 (06)	0.447	0.53
1/2 (08)	0.606	1.02
5/8 (10)	0.735	1.02
3/4 (12)	0.863	1.02
1 (16)	1.181	1.406
1-1/4 (20)	1.390	1.406

AFTER SWAGE DIMENSIONS (INCH)

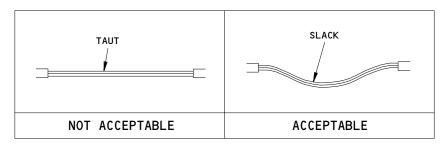
Final Swage Dimensions Figure 830

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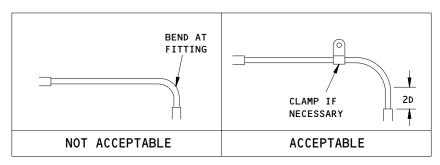
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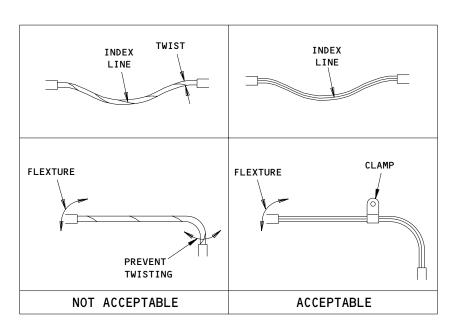




**SLACK** 



**FLEX** 



**TWISTING** 

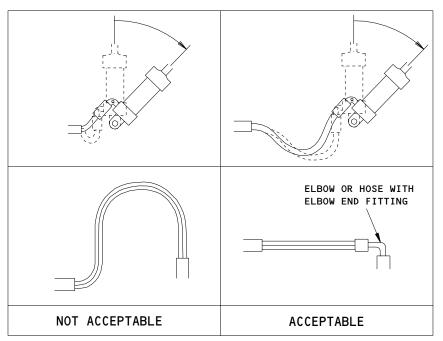
Hydraulic Tubing Repair with Flexible Hose Figure 831 (Sheet 1)

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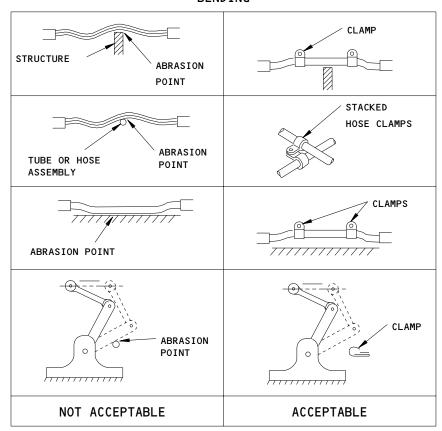
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#### **BENDING**



**CLEARANCE** 

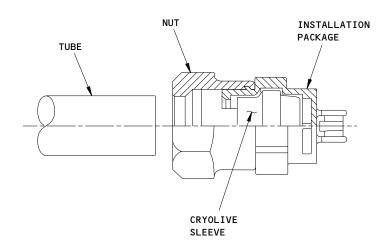
Hydraulic Tubing Repair with Flexible Hose Figure 831 (Sheet 2)

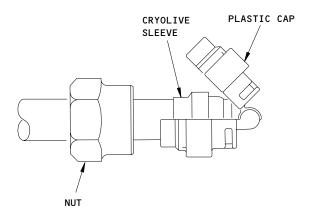
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NOTE: REMOVAL OF PLASTIC CAP AFTER INSTALLATION.

## CRYOLIVE Flareless Sleeve Assembly Figure 832

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TUBE SIZE	COUPLING NUT MATERIAL	COMBINATION - SLEEVE/COUPLING NUT/PLASTIC CAP PART NO. *			
04	304 Cres 7075-T73 Al 6Al-4V Ti	921721J04 921721W04 921721T04			
06	304 Cres 7075-T73 Al 6Al-4V Ti	921721J06 921721W06 921721T06			
08	304 Cres 7075-T73 Al 6Al-4V Ti	921721J08 921721W08 921721T08			
10	304 Cres 7075-T73 Al 6Al-4V Ti	921721J10 921721w10 921721T10			
12	304 Cres 7075-T73 Al 6Al-4V Ti	921721J12 921721W12 921721T12			
16	304 Cres 7075-T73 Al 6Al-4V Ti	921721J16 (Combination Not Approved) 921721T16			

Approved CRYOLIVE Flareless Sleeve/Coupling Nut/Plastic Cap Combinations Figure 833

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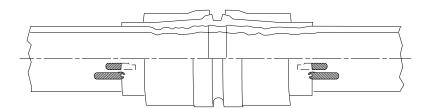
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<sup>\*</sup> DO NOT REPLACE COUPLING NUTS INCLUDED WITH THE CRYOLIVE FLARELESS SLEEVE/COUPLING NUT/PLASTIC CAP COMBINATIONS. USE ONLY THE COUPLING NUT PROVIDED WITH THE ASSEMBLY.





Rynglok Tube to Tube Union Figure 834

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AEROQUIP PART NUMBER	FOR USE WITH TUBE	APPROVED TUBE SIZES OD/WALL						
	MATERIALS	04	06	08	10	12	16	20
R80101T(-) (TITANIUM MATERIAL)	21-6-9 CRES	0.016	0.020	0.026	0.033	0.039	0.052	N/A
	304 1/8 HARD CRESS (MIL-T-6845)	0.020	0.028	0.035	0.049	0.058	0.065	N/A
	6061-T6 AL (MIL-T-7081) or AMS 4083	0.035	0.035	0.035	0.035	0.035	0.035	0.035
	3AL-2.5V TITANIUM	0.016	0.019	0.026	0.032	0.039	0.051	N/A

Approved Fitting/Tube Material Combinations for Repair with Rynglok Unions Figure 835

EFFECTIVITY----

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TUBE DASH NUMBER	TUBE OUTER DIAMETER (IN)	MINIMUM REMOVED TUBE SECTION (IN)		
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		

Splice Repair with More Than One Rynglok Tube to Tube Union-Minimum Removed Tube Section Figure 836

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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	RTST8-02-16	RTSG-051-16		
20	RTST8-02-20	RTSG-051-20		

AEROQUIP TOOL KIT NUMBER
RTSK8-02-006 (COVERS TUBE SIZES 04 THROUGH 20)

Rynglok Repair Fittings Swage and Inspection Tool Part Numbers Figure 837

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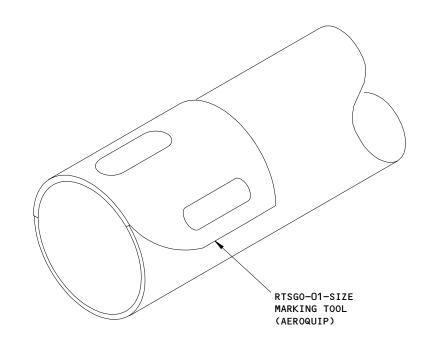
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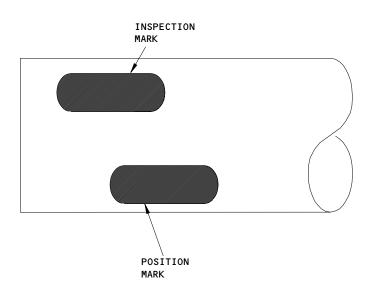
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# Mark Location During Rynglok Fitting Installation Figure 838

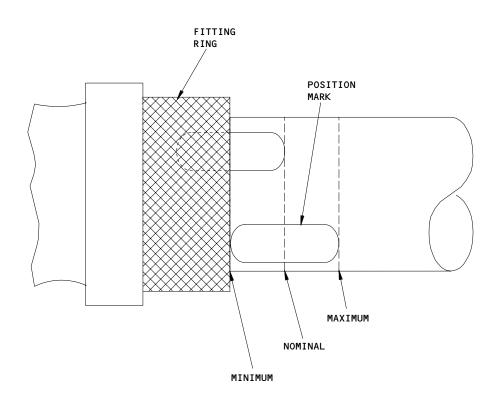
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# Fitting Position for Tube Insertion Figure 839

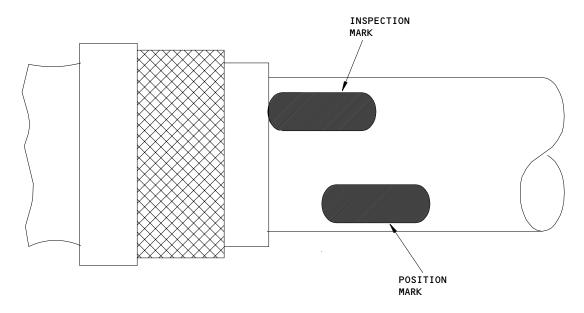
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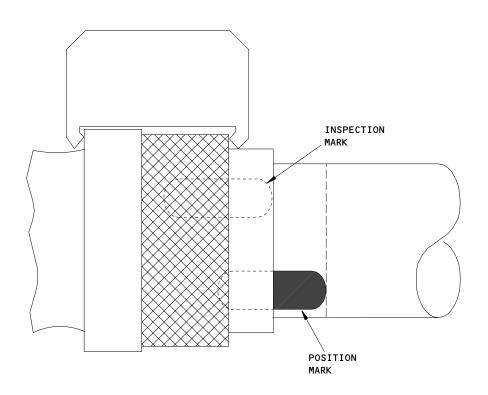
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## MINIMUM INSPECTION MARK AFTER SWAGING



## MAXIMUM INSPECTION MARK AFTER SWAGING

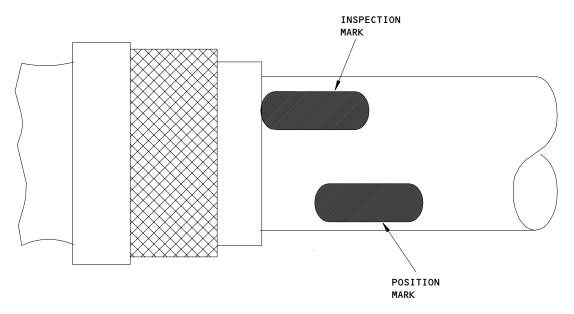
Use of Inspection Gage After Swage of Rynglok Fittings Figure 840

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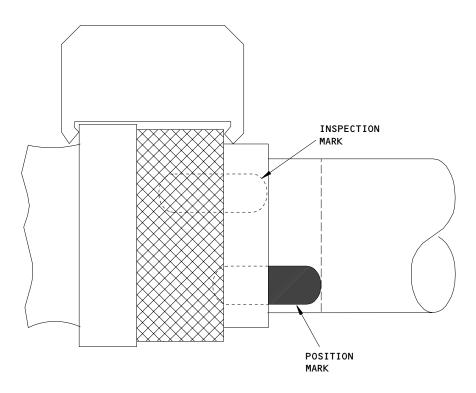
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## MINIMUM INSPECTION MARK AFTER SWAGING



## MAXIMUM INSPECTION MARK AFTER SWAGING

Use of Inspection Gage After Swage of Rynglok Fittings Figure 841

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## ALUMINUM FOIL MARKERS - REMOVAL/INSTALLATION

## 1. General

- A. This procedure contains two tasks. The first task is the removal of aluminum foil markers. The second task is the installation of aluminum foil markers.
- B. Replace aluminum foil markers that have creases, torn edges, or words you cannot read.
- C. Replace aluminum foil markers that have a poor bond on external primed or painted surfaces.
- D. Remove and replace aluminum foil markers that have a poor bond on internal primed or painted surfaces.
- E. Remove and replace aluminum foil markers that have a poor bond on bare metal surfaces.

NOTE: For aluminum foil markers that you install over textured surfaces or that have a poor bond, you can use the procedure for pressure-sensitive placards. This gives a better installation (AMM 20-11-16/401).

F. Do not install new aluminum foil markers on used aluminum foil markers. Remove the used aluminum foil marker and install the new aluminum foil marker.

TASK 20-11-06-004-018

## 2. Aluminum Foil Marker Removal

- A. Consumable Materials
  - (1) B01000 General Cleaning of Metal (Series 80) (AMM 20-30-80)
  - (2) B00084 Xylene ASTM 845 or 846
- B. Procedure

s 024-019

(1) Put a sharp knife, or an equivalent tool under the edge of the placard and lift the placard.

s 114-020

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(2) For primed, painted, or plastic interior surfaces, use xylene to remove all the adhesive from the surfaces and markers.

EFFECTIVITY-

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s 114-021

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(3) For metal surfaces, remove all the adhesive from the surfaces and markers with solvent, Series 80 (AMM 20-30-80).

TASK 20-11-06-404-012

- 3. Aluminum Foil Marker Installation
  - A. Equipment
    - (1) Model C, IBM typewriter with Pica type and with a medium dark opaque, or blueprint black ribbon
  - B. Consumable Materials
    - (1) A00134 Adhesive BMS 5-14
    - (2) A00119 Adhesive RUBBER CEMENT BMS 5-55
    - (3) B01000 Solvent General Cleaning of Metal (Series 80) (AMM 20-30-80)
    - (4) B00084 Solvent Xylene ASTM 845 or 846
    - (5) B00046 Phosphoric Acid Metal Conditioner and Corrosion Remover MIL-M-10578 Type II
    - (6) B00192 Cleaning Solvent BMS 3-2
    - (7) B00137 Abrasive Paper 150- and 180- grit aluminum oxide
    - (8) G00033 Cheesecloth BMS 15-5B
    - (9) COOO34 Bostik Clear Base 683-3-2 with Catalyst X-310A
  - C. References
    - (1) AMM 51-24-02/701, Hydraulic Fluid Resistant Finish
  - D. Prepare for Installation

s 804-023

(1) If necessary, add information to the aluminum foil marker with a typewriter. Set the impression controls on the typewriter to the highest value that will not cut through the aluminum foil marker.

s 804-001

(2) When necessary, cut the aluminum foil marker to the necessary size before you remove the protective backing.

s 104-002

ALL

- (3) Clean the receiving surface immediately before you apply the aluminum foil marker.
  - (a) To clean aluminum surfaces, do these steps:
    - 1) Clean heavily corroded aluminum surfaces with a wire brush. Clean heavily greased surfaces with BMS 3-2 solvent.

EFFECTIVITY-

20-11-06



- 2) Apply a solution of one-fourth phosphoric acid metal conditioner and three-fourths water, by volume, with a brush, rag, or sponge to the surface.
- 3) Let the solution stay on the metal approximately 1/2 minute.
- 4) Rub off the solution fully, first with moist rags, then with a clean, dry cheesecloth.
- (b) Use xylene to clean polyester, epoxy, phenolic or polyurethane surfaces that are not painted.
- (c) To clean aluminized paint EC-843 coated surfaces, do these steps:
  - 1) Sand with 180-grit abrasive paper.
  - 2) Clean with BMS 3-2 solvent.
- (d) To clean cork surfaces, do these steps:
  - 1) Lightly sand with 150-grit aluminum oxide abrasive paper until you get a clean cork surface.
  - 2) Remove sanding dust with a vacuum or a clean, dry cloth.
- (e) Clean all other surfaces with BMS 3-2 solvent.

#### s 804-003

- (4) On cadmium-plated surfaces, laminated polyester materials that are not painted, and rough surfaces that are not painted, do these steps:
  - (a) Apply a light layer of BMS 5-14 adhesive to the cleaned surface.
  - (b) Let the adhesive dry for 5 to 20 minutes until surface is tacky but adhesive does not stay on you clean finger when you lightly touch it.
  - (c) Continue to the applicable aluminum foil marker installation procedure.

## s 804-004

(5) On primed or painted rough internal surfaces, do these steps:

<u>NOTE</u>: Do not use this procedure on external surfaces open to weathering.

- (a) Apply a light layer of BMS 5-55 adhesive to the cleaned surface.
- (b) Let adhesive dry for 5 to 20 minutes until the surface is tacky but adhesive does not stay on your clean finger when you lightly touch it.

### s 804-013

(6) Support surfaces of thin panels while you apply aluminum foil markers.

#### s 804-017

(7) Do not use a wrinkled, torn, or curled aluminum foil marker.

EFFECTIVITY-

20-11-06

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s 804-014

(8) Do not touch or contaminate adhesive on aluminum foil marker after you remove protective backing.

s 804-015

(9) The aluminum foil marker and receiving surface must be free of moisture when you apply the aluminum foil marker.

s 804-016

(10) When you apply a large or complicated aluminum foil marker, leave a small section of backing attached to help in handling and to give protection during application.

s 424-006

- (11) To install cellophane-backed aluminum foil marker, do these steps:
  - (a) Put the aluminum foil marker in 50 to 120°F water for 30 to 120 seconds.
  - (b) Remove aluminum foil marker from water and remove unwanted water with a clean, dry cloth.
  - (c) With dry hands, rub a finger across one edge of the aluminum foil marker to move back the edge of the cellophane backing.
  - (d) Carefully remove the backing from the aluminum foil marker.

s 424-007

- (12) To install paper-backed aluminum foil marker, do these steps:
  - (a) Remove paper backing from the aluminum foil marker.
    - If the paper backing is cut, bend lightly along the cut line. Hold backing and remove it slowly from aluminum foil marker to prevent wrinkling.
    - 2) If the paper backing is not cut, rub a finger across the edge of the aluminum foil marker to move back one edge of the paper backing.

NOTE: The backing possibly has a tab to help you remove the backing.

s 424-008

- (13) To install aluminum foil markers without self-contained adhesive, do the applicable steps:
  - (a) On primed, painted, or plastic interior airplane surfaces not open to weathering, do these steps:
    - 1) Apply a light layer of BMS 5-55 adhesive to the back of the aluminum foil marker.
    - Let the adhesive dry until it is tacky but does not stay on your clean finger when you lightly touch it.
  - (b) On bare metal surfaces, do these steps:
    - 1) Apply a light layer of BMS 5-14 adhesive to the back of aluminum foil marker.

20-11-06



2) Let adhesive dry until it is tacky but does not stay on your clean finger when you lightly touch it.

s 424-009

(14) Put the aluminum foil marker in position and push down lightly to attach it.

s 424-010

(15) Start at one end and roll the aluminum foil marker firmly down. Be careful to prevent air bubbles. To prevent roll marks, do not let the edge of the roller touch the aluminum foil marker.

To prevent marring, give protection to the face of aluminum foil marker when you push it into position.

s 804-022

(16) To remove air bubbles, make a small hole with a pin and make smooth with a roller.

s 114-012

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(17) If necessary, remove unwanted adhesive. Use a solvent, Series 80 (AMM 20-30-80) for BMS 5-14 adhesive or BMS 3-2 solvent for BMS 5-55 adhesive.

s 034-013

(18) To remove protective paper facing, strip it parallel to the aluminum foil marker surface.

S 214-014

(19) To make sure the edge is bonded, rub a fingernail along the edge of the aluminum foil marker. Be careful not to lift the edge.

s 394-015

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(20) In areas of possible BMS 3-11 fire-resistant hydraulic fluid contamination, apply coating Bostik 683-3-2 clear base with X-310A Catalyst (edge sealer) (AMM 51-24-02/701).

EFFECTIVITY-

20-11-06



## CONTROL CABLE GROMMET - REMOVAL/INSTALLATION

### 1. General

- A. This procedure contains one task. The task is the replacement of the grommets on the control cable.
- B. You can replace the control cable grommets in the 3/4, 1, and 1-1/4 inch holes with the control cable removed or installed. You have two alternatives for the replacement of an NAS1368 plastic grommet with the control cable installed:
  - You can use a replacement NAS1368 grommet and cut one side of the grommet for installation
  - You can use a BACG2OH nylon grommet, which is a divided grommet.

TASK 20-11-07-074-016

- 2. Replacement of the Grommets
  - A. Equipment
    - (1) Sharp Knife, Razor Blade, or Suitable Cutting Equipment.
    - (2) Grommet Installation Set A20006-32
  - B. Consumable Materials
    - (1) A00273 Adhesive, BMS 5-126 Type 2 Class 1 or Type 3 Class 1
    - (2) A00119 Adhesive, BMS 5-55
    - (3) B01051 Solvent Cleaning of Phenolics or Nylon (Series 98-1) (AMM 20-30-98 or SOPM 20-30-98)
  - C. Remove the Grommet

s 024-002

- (1) Cut as necessary to remove the grommet from the bulkhead.
- D. Install the Grommet with the Control Cable Removed (Fig. 401).

s 114-003

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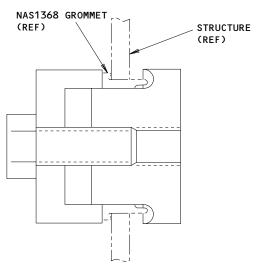
(1) Clean the contact area with solvent , Series 98-1 (AMM 20-30-98 or SOPM 20-30-98) .

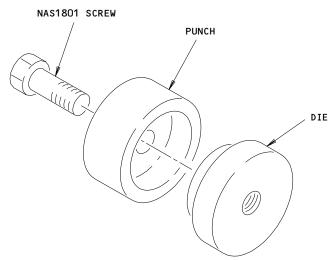
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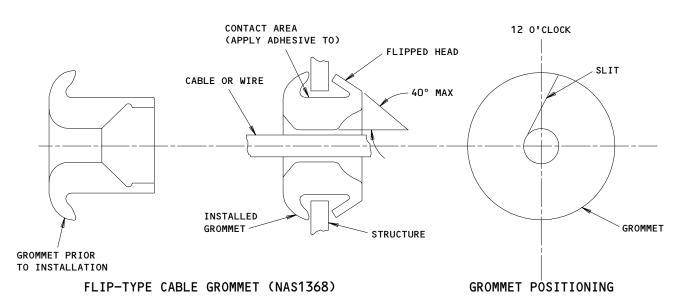


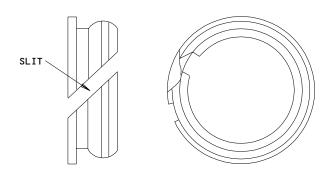




GROMMET BEFORE INSTALLATION

A20006-32 GROMMET INSTALLATION SET





NYLON CABLE GROMMET (BACG20H)

Control Cable Grommets Installation Figure 401

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s 644-004

(2) Apply BMS 5-126 adhesive to the contact area on the NAS1368 grommet.

s 424-005

(3) Put the grommet in the bulkhead hole.

s 824-011

(4) Put in the Grommet Installation set tool and turn the grommet.

NOTE: The grommet can be loose in the bulkhead hole, but you must cut to remove the grommet.

s 094-018

- (5) Remove the grommet installation set.
- E. Install the Grommet with the Control Cable Installed (Fig. 401).

s 114-017

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(1) Clean the contact area with solvent , Series 98-1 (AMM 20-30-98 or SOPM 20-30-98) .

s 424-007

- (2) Use these steps to install the NAS1368 grommet:
  - (a) Put in the grommet in the grommet installation set and flip the grommet.
  - (b) Remove the grommet from grommet installation set.
  - (c) Split the NAS1368 grommet with a slant cut.
  - (d) Place the grommet over the control cable.
  - (e) Apply BMS 5-126 adhesive on the grommet contact area.

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- (f) Insert the grommet into the bulkhead hole.
- (g) Align the slit part of the grommet at the 12 o'clock position.

## s 424-008

- (3) Use this step to install the BACG2OH grommet:
  - (a) Apply BMS 5-55 adhesive on the grommet contact area.
  - (b) Install the grommet into the bulkhead hole.
  - (c) Align the slit part of the grommet at the 12 o'clock position.

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#### PRESSURE-SENSITIVE DECALS - REMOVAL/INSTALLATION

## 1. General

- A. This procedure contains two tasks. The first task is the removal of pressure-sensitive plastic film decals. The second task is the installation of pressure-sensitive plastic film decals.
- B. Apply external decal sections in a sequence where the ends make an overlap downstream from the line of flight.
- C. Apply activator to pressure-sensitive adhesives when you apply decals at ambient temperatures below 60°F.
- D. Clean plastic film decals with naphtha. Do not use adhesive activator.
- E. You can remove air bubbles in the eight hours after you apply the decal. Make a small hole in the decal film with a sharp pointed instrument, at the edge of bubble, and push air out through the hole.
- F. You can also install interior decals with the same procedure you use for pressure-sensitive placards (Ref 20-11-16).

TASK 20-11-08-004-000

#### 2. Remove Pressure-Sensitive Decals

- A. Equipment
  - (1) Plastic Scraper or Spatula
- B. Consumable Materials
  - (1) B00083 Solvent Aliphatic Naphtha TT-N-95
  - (2) G00033 Cheesecloth BMS 15-5
- C. References
  - (1) 51-21-01/701, Interior and Exterior Finishes (Paint Stripping)
- D. Procedure

s 024-002

(1) To remove external decals, paint strip (Ref 51-21-01).

s 024-003

ALL

- (2) To remove internal decals, use heat or use solvent.
  - (a) To remove decals with heat, do these steps:
    - 1) Heat the decal to approximately 120°F until the adhesive becomes soft.

NOTE: If you use too much heat, the decal will melt. If the decal melts, remove it with solvent.

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- 2) Lift the corner of the decal with a sharp spatula or knife blade and remove the decal from the surface.
- 3) If necessary, clean the surface. Use a cheesecloth pad that is moist with a solution of one-half cleaner and one-half water.
- (b) To remove decals with solvent, do these steps:
  - 1) Apply Aliphatic Naphtha to the decal with a brush or cloth.
  - 2) When the decal has wrinkles (after approximately two minutes), apply solvent again.
  - 3) After approximately two minutes, move the soft decal off of the surface or remove with a spatula.
  - 4) If necessary, clean the surface with a cheesecloth pad that is moist with Aliphatic Naphtha.

### TASK 20-11-08-404-004

- 3. <u>Install Pressure-Sensitive Decals</u>
  - A. Equipment
    - (1) Scotchcal Cutter ST732
    - (2) Felt Squeegee
  - B. Consumable Materials
    - (1) B00083 Solvent Aliphatic Naphtha TT-N-95
    - (2) B00151 Solvent Methyl Isobutyl Ketone TT-M-268
    - (3) Activator Solvents
      - (a) B00092 A-2 and A-3 Activators JAN-T-171, Grade A
      - (b) B00089 Solvent Activator, Cyclohexanone
    - (4) C00260 Paint Enamel, BMS 10-11, Type 2
    - (5) A00559 Edge Sealer No. RFE96J
    - (6) C00034 Sealer Bostik 683-3-2 Base with X-310A Catalyst (Edge Sealer)
    - (7) G00270 Masking Tape
    - (8) G00033 Cheesecloth BMS 15-5
    - (9) B00137 Abrasive Paper 150-Grit
  - C. References
    - (1) 12-25-01/301, Airplane Servicing (Exterior Cleaning)
    - (2) 51-21-03/701, Corrosion Removal and Control
    - (3) 51-24-02/701, Hydraulic Fluid Resistant Finish
  - D. Prepare the Surfaces for Installation

s 114-005

(1) Clean corroded aluminum surfaces (Ref 51-21-03).

s 114-006

(2) Clean wax-coated aluminum surfaces until area shows a water-break-free surface (Ref 12-25-01).

s 114-007

- (3) Use methyl isobutyl ketone cleaner and a clean cloth to clean polyester plastic that is not painted.
  - (a) Dry surface with a clean cloth. Do not let air dry.

EFFECTIVITY-

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s 114-019

- (4) Use naphtha cleaner and a clean cloth to clean phenolic plastic that is not painted.
  - (a) Dry surface with a clean cloth. Do not let air dry.

s 114-008

- (5) Lightly sand cork surfaces with 150-grit abrasive paper until you get a clean cork surface.
  - (a) Remove sanding dust with a clean, dry cloth.

s 114-021

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(6) Clean all other surfaces thoroughly with naphtha cleaner and a clean dry cloth, except in preparation for application of the Refuel Panel Placard (BAC27NFS223) which requires the use of solvent, Series 89 (AMM 20-30-89/201) and a clean dry cloth in place of naphtha.

<u>NOTE</u>: Verify that no grease is present on the surface prior to the application of the Refuel Panel Placard.

- (a) Dry the surface with a clean cloth. Do not let air dry.
- E. Prepare the Decal for Installation

s 804-010

(1) On decals with an area less than one square foot, remove the backing and put the decal face down on a smooth surface.

s 424-011

- (2) On decals with an area more than one square foot, use masking tape to put the decal on the receiving surface.
  - (a) Cut a sheet of carrier tape approximately four inches longer than the decal and approximately the same width. When you use premasked decals, you can use the premask as a carrier.
  - (b) Put the carrier over the decal, with the edge you will hang two to three inches beyond the decal edge.
  - (c) Hang the carrier on the receiving surface with masking tape.
  - (d) Rub the carrier on with a plastic scraper. Use short strokes and work from the middle of the joint to the edges. Be sure to remove all wrinkles and air bubbles.
  - (e) Fold the carrier and decal back at the joint, along the surface with the backing up. Use masking tape to hold in this position.
  - (f) Remove the decal backing.

EFFECTIVITY-

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s 804-012

(3) On strip decals, remove about one foot of backing and put the decal face down on a smooth surface.

s 804-013

WARNING: USE A-2 AND A-3 ACTIVATORS AND CYCLOHEXANONE IN WELL-VENTILATED AREAS AND DO NOT BREATHE THE FUMES FOR A LONG TIME. A-2 AND A-3 ACTIVATORS AND CYCLOHEXANONE ARE TOXIC AND FLAMMABLE.

- (4) Apply activator or cyclohexanone to the adhesive surface of solvent-activated decals. If ambient temperature is less than 60°F, use A-3 activator.
  - (a) Put a felt squeegee into the activator solvent momentarily. Remove unwanted solvent with an absorbent cloth.
  - (b) Move the felt squeegee evenly across the adhesive side of the decal. Do not let the activator touch the film face.
    - Apply activator to strip decals for approximately six inches.
    - 2) Apply activator to the full surface of all other decals with strokes that overlap.

#### F. Procedure

s 424-014

- (1) To apply decal to a regular surface, do these steps:
  - (a) Put the decals with areas less than one square foot in position and bond one edge to the surface. Hold the remainder of decal taut and a small distance from the receiving surface with a piece of backing on the adhesive side.
  - (b) For decals with an area greater than one square foot, move the carrier into position. Hold the free end taut and a small distance from the receiving surface with a piece of backing on the adhesive.
  - (c) Align and bond approximately three inches of strip decals to the receiving surface.
    - Use the applied section as a joint and strip up to three feet of the backing. If necessary, apply activator to the adhesive.
    - 2) Align the stripping and hold it taut and a small distance away from the receiving surface.
  - (d) Start at the joint and rub the decal on the surface with the plastic scraper with short fan-like strokes. Do not let the adhesive touch the receiving surface until the plastic scraper pushes it down.
  - (e) Continue to strip, apply activator, and apply strip decals until you apply all of the decal.
  - (f) When you apply strip decals around a corner and a splice occurs, overlap decal a minimum of two inches.

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#### s 424-015

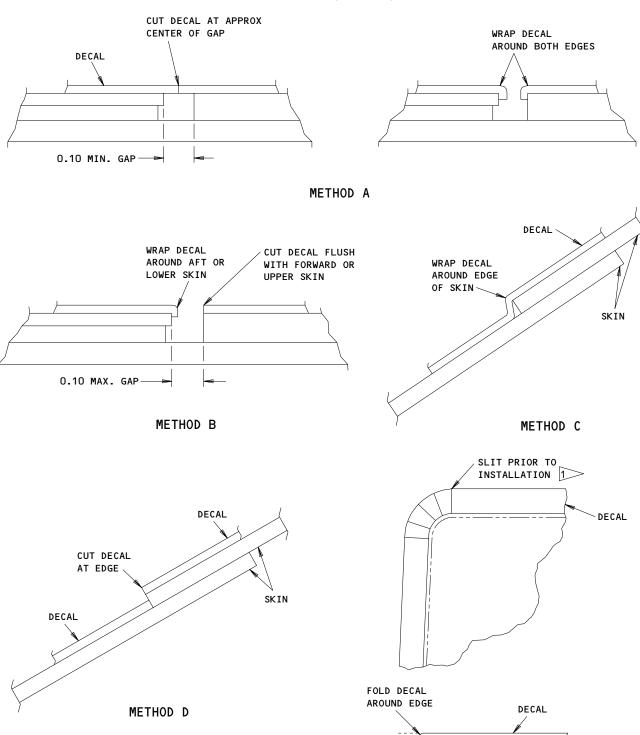
- (2) To apply decals to irregular surfaces, do these steps:
  - (a) To apply decals on a joint between two surfaces which move with respect to each other, do one of these steps:
    - 1) For distances of 0.100 inch and more, cut the decal at the approximate center of the distance. Wind the decal around the two edges. See Procedure A (Fig. 401).
    - 2) For distances of less than 0.100 inch, cut the decal aligned with the forward or top skin edge. Wind the decal around the aft or bottom skin edge. See Procedure B.
  - (b) To apply decals across lap joints, do one of these steps:
    - 1) Wind the decal smoothly and continuously around the edge of the lap joint. See procedure C (recommended procedure).
    - 2) You can use this alternative where the decal extends along the lap joint for a long distance. Cut the decal aligned with the overlap edge and touch the remainder of the decal to the overlap edge. See Procedure D.
  - (c) To apply decals to external emergency exit handles, see Procedure E.
    - Before you remove the backing paper, put the decal on the handle and cut the decal overlap around each rounded corner.
    - 2) Remove the backing paper and apply the decal. Push the overlap around the edges of the handle.
  - (d) Use tool ST732 to cut decals, except pressure-sensitive Polyester, around the heads of fasteners on removable panels. Push the decal into the recessed slot.
  - (e) Cut and remove an area of film, of pressure-sensitive polyester decals, and approximate size of a nonflush rivet or fastener, with a Scotchcal cutter. Push the decal film firmly in position around the rivet or fastener.
  - (f) Let the adhesive cure for 1/2 hour before you seal the edges.
  - (g) Make a small hole in the decal film, with a sharp pointed instrument, at each rivet on decals applied over pressurized areas.

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Decal Application Over Irregular Surfaces
Figure 401

SKIN PANEL OR HANDLE

METHOD E

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>SLITTING DECAL ENSURES
CONFORMATION TO CORNER RADII



s 804-016

(3) To remove carrier, or premask and masking tape, pull back parallel to the decal surface. If you will paint the adjacent area, leave the premask in position.

s 394-017

- (4) Seal the edges.
  - (a) If you painted up to the edges of decals, seal the edges of the decal with paint.
    - If the decal has a premask, remove the premask only after you apply the last layer of paint up to the decal. The paint will flow sufficiently well to seal the edges. If this condition does not occur, seal the edges by the recommended procedure.
  - (b) Use a brush to apply clear base 683-3-2 with X-310A catalyst (edge sealer) to the edges of the decals that follow. Make sure you have a dry film thickness of 0.0015 to 0.0020 inch (Ref 51-24-01).
    - 1) Solvent-activated vinyl decals
    - 2) BMS 10-26, Type 1 and 3 pressure-sensitive elastomeric vinyl decals
    - 3) Solvent-activated reflective decals
    - 4) Pressure-sensitive reflective decals
    - 5) Pressure-sensitive aluminized, mylar decals
  - (c) Let adhesive cure for a minimum of 1/2 hour, then seal the edges of pressure-sensitive polyester decals with clear base 683-3-2 and X-310A catalyst (edge sealer) (Ref 51-24-02).
  - (d) Use a brush to apply the applicable color of BMS 10-11, Type 2 enamel on all open exposed rivet or fastener heads on pressure-sensitive polyester decals. Make an overlap on the edge of the decal of 1/4 inch.
  - (e) Use a brush to apply RFE96J edge sealer to the edges of the reflective (fluorescent) vinyl decals. Make sure you have a dry film thickness of 0.0015 to 0.0020 inch.

EFFECTIVITY-

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20-11-08



### PRESSURE-SENSITIVE DECALS - REPAIRS

### 1. General

- A. This procedure contains one task. THe task is to repair external decals.
- B. To repair damaged external decals, apply patches of equivalent decals. Replace damaged internal decals.

TASK 20-11-08-358-006

- 2. Repair External Decals
  - A. Consumable Materials
    - (1) A00000 Sealer Edge, 4150, 3M Company
    - (2) A00000 Sealer Edge, Koppers Vinyl 401, Koppers Co., Inc.
    - (3) A00000 Sealer Edge, 683-3-2, Sikkens
    - (4) A00000 Catalyst Sealer, Edge, X-310, Sikkens
  - B. References
    - (1) 20-11-08/401, Pressure-Sensitive Decals
  - C. Procedure

s 038-002

(1) Cut away all loose decal film but be careful not to cut the airplane skin.

s 808-003

(2) Cut a patch of decal film of the same type and color as the initial decal. Make sure it is of sufficient size to make an overlap of 1/4 inch on the part of the decal that is not damaged.

s 438-004

(3) Apply the patch (Ref 20-11-08, R/I).

EFFECTIVITY-

20-11-08



## TEFLON BACKUP RINGS - REMOVAL/INSTALLATION

### 1. General

A. This procedure contains one task. The task is the installation of the teflon backup ring.

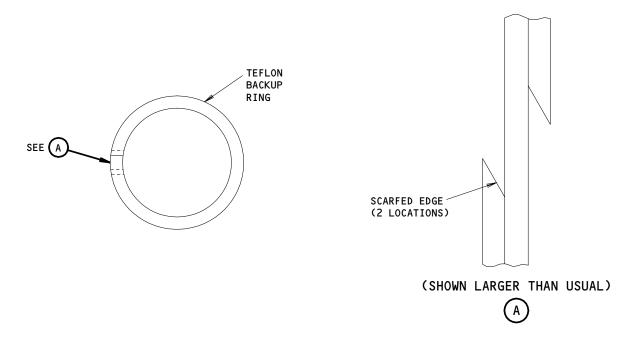
TASK 20-11-09-094-003

## 2. Install the Teflon Backup Ring

A. Procedure

s 424-002

(1) Install split-teflon backup rings with the direction of the spiral clockwise. Make sure the scarfed ends face as shown in Fig. 401.



Teflon Backup Ring Installation Figure 401

ALL

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## STENCIL MARKINGS - CLEANING/PAINTING

## 1. General

- A. This procedure contains one task. The task is the installation of stencil markings.
- B. For decorative finishes used on airplane external surfaces, refer to "Decorative Exterior Finishes" (AMM 51-21-02/701).
- C. Paint used for markings is specified by the surface you will paint and the type of finish necessary. Paint must agree with the initial surface finish.
- D. In areas where an hydraulic fluid-resistant finish is necessary, apply BMS 10-11, Type II enamel.
- E. Areas where no finish is required, apply BMS 10-60 enamel.
- F. When letter sizes are less than two inches in height and width, use BMS 10-60 enamel for the letters.

NOTE: When you use BMS 10-60, Type II on painted or not painted surfaces, use BMS 10-79, Type II primer.

G. For markings applied directly on corogard EC 843 or EC 843S, use EC 942 black.

TASK 20-11-10-207-013

## 2. <u>Install Stencil Markings</u>

- A. General
  - (1) Make sure clean surfaces do not become dirty when you clean adjacent surfaces.
  - (2) Use a polyethylene wash bottle to apply solvents. Identify contents.
  - (3) Do not cause contamination to adjacent areas when you spray.
  - (4) Make sure all coatings or finishes are uniform, homogeneous, and free from gelled particles.
  - (5) Apply primer and stencil paint with spray equipment only.
  - (6) Make sure all coating or finish materials are correctly mixed and labeled. Discard materials with expired pot life.

ALL ALL

20-11-10



- (7) Make sure painted markings are well made and have a solid, homogeneous color.
- B. Equipment
  - (1) Bottles, Polyethylene size as necessary, with nozzle
  - (2) Brush, Fiber soft bristle
  - (3) Burnishing Tool plastic or wood
  - (4) Gloves, Knitted Cotton lightweight, white
  - (5) Spray Equipment
- C. Consumable Materials
  - (1) Solvents
    - (a) B00192 or B00193 Solvents BMS 3-2, Type I or Type II
    - (b) B01018 Solvent Cleaning of Specific Polymerics (Series 98) (AMM 20-30-98)
    - (c) B00083 Solvent Aliphatic Naphtha, TT-N-95, Type II
  - (2) G00117 Tape, Masking Permacel P112
  - (3) G00033 Wipers, BMS 15-15, Classes A and B
  - (4) G00251 Abrasive Paper 280-grit or finer
  - (5) Finishes
    - (a) COO319 Primer BMS 10-79, Type II Primer
    - (b) COOO32 Enamel BMS 10-60, Type II Enamel
    - (c) COOO35 EC 942 Black (Corogard)
  - (6) B00151 Solvent Methyl Isobutyl Ketone (MIBK)
  - (7) B00079 Solvent Butyl Acetate
  - (8) C00259 Enamel Primer, Green Spray BMS 10-11, Type I
  - (9) C00260 Enamel BMS 10-11, Type II
- D. References
  - (1) 51-21-01/701, Paint Stripping
  - (2) 51-21-02/701, Prepaint Cleaning and Treatment
  - (3) 51-21-02/701, Decorative Exterior Finishes
- E. Prepare Surface for Stencil Markings

s 957-014

(1) Mask or put a protective cover on all adjacent surfaces which you will not clean, treat, or coat.

s 027-002

- (2) Remove old markings if necessary:
  - (a) Strip the markings (Ref 51-24-11).
  - (b) Prepare the surface for the coating (Ref 51-21-02).
  - (c) Apply a layer of material that is equivalent to the initial material (Ref 51-24-11).

s 117-003

(3) Clean the surface:

ALL

(a) Remove loose soil and unwanted grease or oil. Be careful not to get dirt on a larger area than necessary.

EFFECTIVITY-

20-11-10



WARNING: DO NOT SPRAY SOLVENTS OR KEEP THEM IN OPEN CONTAINERS. DO NOT USE FLAMMABLE SOLVENTS IN THE AIRPLANE. SOLVENTS AND CLEANERS CONTAIN TOXIC INGREDIENTS. WEAR PROTECTIVE GLOVES WHEN YOU USE THEM, AND DO NOT GET SOLVENT OR CLEANER ON SKIN OR EYES. MAKE SURE YOU HAVE SUFFICIENT VENTILATION OR USE RESPIRATOR MASKS. INJURY OR DAMAGE CAN OCCUR.

<u>CAUTION</u>: DO NOT USE SOLVENTS OTHER THAN THOSE SPECIFIED. THEY CAN CAUSE DAMAGE TO THE FINISH.

(b) Use the applicable solvent:

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

- 1) For tedlar, teflon, and solvent resistant finishes, use a solvent, Series 98 (AMM 20-30-98).
- 2) For acrylic surfaces, use naphtha, TT-N-95, Type II.
- 3) For all other surfaces and for hydraulic fluid contamination, use BMS 3-2.
- (c) Use a polyethylene bottle to apply solvent to the work surface or to a clean wiper.

NOTE: Do not put the wiper into the solvent container.

- (d) Rub the surface with a wiper or a soft brush.
- (e) Rinse the surface with clean solvent. Use clean wipers.
- (f) Remove unwanted solvent. Let the surface drain, then rub dry.

s 117-004

- (4) Clean the surface again:
  - (a) Put solvent on a clean wiper.

NOTE: Do not put the wiper into the solvent container.

(b) Rub the surface with a solvent-soaked wiper. Immediately rub dry with a clean, dry wiper.

NOTE: Do not let the solvent air dry.

- (c) Replace the dirty wipers frequently with clean ones.
- (d) Do the last three steps until the wiper shows no dirt.

NOTE: If a clean surface becomes dirty, clean it again.

EFFECTIVITY-

20-11-10

ALL



s 127-005

(5) For plastic laminates and painted surfaces, do these steps:(a) If necessary, clean the surface.

CAUTION: DO NOT SAND THE PAINTED SURFACE AROUND THE DECAL EDGE IF CLEAR HYDRAULIC FLUID RESISTANT COATING WAS USED AS AN EDGE SEALER FOR THE DECAL. DAMAGE TO THE SEAL CAN OCCUR.

- (b) Lightly sand the surface with 280-grit or finer abrasive paper.
- (c) Do again the two steps to clean the surface.
- F. Install Stencil Markings

s 427-006

- (1) Install the stencil.
  - (a) Make sure all stencil cuts are sharp and clear of burrs.
  - (b) Attach stencil tightly so paint does not go under the edges.

s 377-015

- (2) Use a marking enamel or lacquer that agrees with the surface finish.
  - (a) In areas requiring a hydraulic fluid resistance finish, apply BMS 10-11, Type II enamel.
    - (b) Where no special finish is required, apply BMS 10-60 enamel.

s 377-007

- (3) Prepare the stencil paint.
  - (a) To prepare BMS 10-79, Type II or BMS 10-60, Type II, refer to 51-24-11/701.

WARNING: KEEP MATERIAL IN AN OPEN CONTAINER TO PREVENT CONCENTRATION OF HYDROGEN GAS. EC 942 REACTS CHEMICALLY WITH METAL AND RELEASES FLAMMABLE HYDROGEN GAS.

- (b) To prepare EC 942 Black (Corogard 12), do these steps:
  - 1) Shake base mixture immediately before you make it thin.

<u>CAUTION</u>: DO NOT ADD A VOLUME OF THINNER THAT IS MORE THAN ONE-FIFTH THE VOLUME OF THE BASE MATERIAL.

2) Make the base material thin with a mixture (by volume) of 5/8 methyl isobutyl ketone and 3/8 butyl acetate.

NOTE: You can use the material for as much as 16 hours after you mix it (pot life is 16 hours). Do not use the material after 16 hours.

EFFECTIVITY-

20-11-10

ALL



s 387-016

WARNING: DO NOT BREATHE THE FUMES OF FINISHES AND SOLVENTS. DO WORK IN A WELL-VENTILATED AREA. USE APPROVED RESPIRATORY PROTECTION AS NECESSARY. DO NOT GET FINISHES AND SOLVENTS IN EYES OR ON SKIN AND CLOTHING. KEEP MATERIALS AWAY FROM SOURCE OF IGNITION. FINISHES AND SOLVENTS ARE TOXIC AND FLAMMABLE. THEY CAN CAUSE INJURY OR DAMAGE.

CAUTION: DO NOT APPLY FINISHES WHEN AMBIENT TEMPERATURE IS LESS THAN 50 DEGREES FAHRENHEIT OR RELATIVE HUMIDITY IS MORE THAN 85 PERCENT.

(4) Apply enamel or lacquer with spray equipment. Make sure there is a sufficiently wet layer to give uniform flowout but not to cause runs and sags.

s 117-009

(5) Remove rough edges from the markings with BMS 3-2 solvent or burnishing tool after the marking cures.

NOTE: An alternative procedure to remove rough edges is to remove masking tape while paint film is still wet. This permits paint to flow out.

EFFECTIVITY-

ALL

20-11-10



#### HARTWELL TYPE LATCHES - ADJUSTMENT/TEST

## 1. General

- A. This procedure contains two tasks. The first is testing Hartwell latches. The second is adjusting Hartwell latches.
- B. Hartwell type latches are used on small flush-fitting service access doors such as those for the potable water and lavatory service panels and the forward and mid drain mast access doors.

TASK 20-11-11-705-001

- 2. Test Hartwell Latches, Series 5100
  - A. Procedure

s 725-002

- (1) Test Hartwell series 5100 latches.
  - (a) Check that door turns freely to within +0.100 or −0.030 inch of contour at latch position.
  - (b) The latch you want to check, press door to fit and come in line at door edge as shown in Fig. 501. Lock latch and check that preload is there by pushing latch bolt at location mentioned in Fig. 501. There must be 0.010 to 0.030 inch depression free play at this point. Adjust per par. 3 if you do not get free play.
  - (c) Check that door latch bolt overlap on structure to be 0.25 inch as shown in Fig. 501.

TASK 20-11-11-825-003

- 3. Adjust Latches (Fig. 501.)
  - A. Procedure

s 825-004

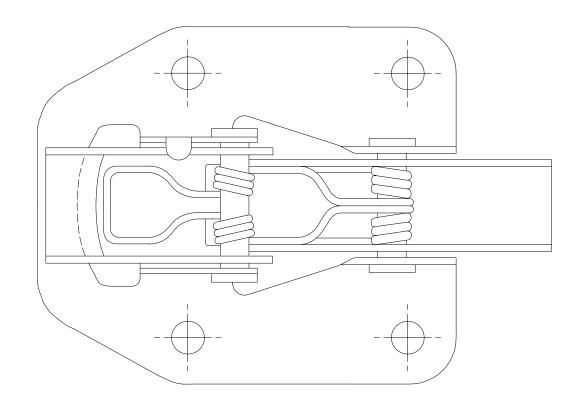
(1) If you cannot get 0.010 to 0.030 inch depression free play, add or subtract phenolic shims.

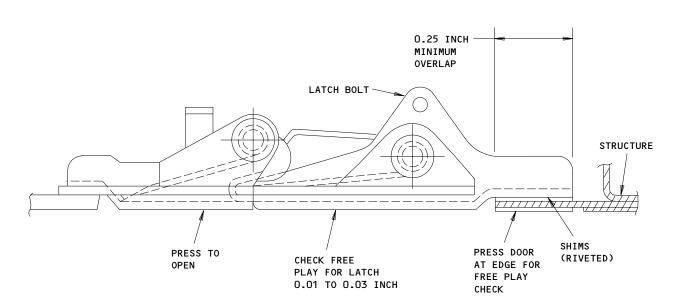
NOTE: Nominal 0.030 and 0.040 inch shims are installed to get dimensional condition shown in Fig. 501. Shim thickness may be different.

EFFECTIVITY-

20-11-11







Hartwell Latches, Series 5100, Adjustment Figure 501

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### METAL SURFACES - CLEANING/PAINTING

#### 1. General

- A. This procedure contains five tasks. The first task is to hand clean metal surfaces with abrasives. The second task is to clean metal surfaces with a rotary banding brush. The third task is to clean metal surfaces with a rotary abrasive disk. The fourth task is to remove paint from metal surfaces. The fifth task is to clean bare, clad, or plated metal with solvent.
- B. Use this procedure for faying surface bonds and bonding jumper installation. Do not use abrasives or wire brushes on CRES, plated surfaces, or alclad aluminum that is not painted.

TASK 20-11-14-147-009

- 2. Hand Clean Metal Surfaces with Abrasives
  - A. General
    - (1) Do not use abrasives on plated surfaces, alclad aluminum, or CRES.
    - (2) This is the only procedure you can use to clean titanium.
  - B. Consumable Materials
    - (1) Abrasive paper or cloth, 180-grit
      - (a) B00137 Abrasive Paper Federal Spec P-P-121
      - (b) B00138 Abrasive Cloth Federal Spec P-C-451
  - C. Procedure

s 127-014

CAUTION: DO NOT LET PARTICLES FROM THE ABRASIVE CAUSE CONTAMINATION OF OF THE MECHANISMS OR ELECTRICAL EQUIPMENT. DAMAGE CAN OCCUR.

(1) Use a circular or elliptical movement of the abrasive to get an equally smooth surface.

TASK 20-11-14-147-010

- 3. Clean Metal Surface with a Rotary Bonding Brush
  - A. General
    - (1) Use this procedure to remove paint from metal or to remove Alodine, Iridite, or light anodize from aluminum. Do not use a bonding brush on plated surfaces or on metals that are not painted, for example, CRES, titanium, or alclad aluminum. Clean these surfaces with solvent.

EFFECTIVITY-

20-11-14

ALL



- B. Equipment
  - (1) Drill motor or other applicable drive
  - (2) Bonding brush, stainless steel, of correct size (Fig. 701).
- C. Procedure

NOTE: Identify the bonding brush housings with color as shown in the task, Remove Paint from Metal Surfaces with Lacquer Thinner or Methyl Ethyl Ketone. The colors show which bonding brush housings you will use on which metal.

s 147-015

<u>CAUTION</u>: DO NOT USE CARBON STEEL BONDING BRUSHES. STEEL PARTICLES IN METAL SURFACES COULD CAUSE DANGEROUS CORROSION.

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

DAMAGE CAN OCCUR. HAND CLEAN TITANIUM WITH ABRASIVES OR CLEAN WITH A SOLVENT.

(1) Use a drill motor or other applicable drive to apply a stainless steel bonding brush of the correct size to clean the necessary diameter (Fig. 701).

DISK DIA DIA. (IN.)			BONDING BRUSHES						DISK MANDRELS	
	SHANK DIA (IN.)	WIRE SIZE (IN.)		OSBORN NO.	MORRIS NO.	MANUFACTURERS BRUSH CO	BOEING ST NO.	BOEING		
(IN.)		MAX MIN	DRUSH CU	31 NO.	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	ST913K-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-

20-11-14



- (a) Apply brush intermittently and keep the cutting face parallel with the surface.
- (b) Examine results after each time you apply the brush and continue operation until necessary area is clean.

NOTE: Keep the decrease in surface metal to a minimum.

(c) If it is a problem to get through an anodic film, clean it with a rotary abrasive disk.

TASK 20-11-14-147-013

- 4. Clean with a Rotary Abrasive Disk
  - A. General
    - (1) Use this procedure to remove anodize, Iridite, Alodine, BMS 3-11 resistant finish, or equivalent hard finishes that are not painted. You can also remove paint by this procedure but the disk will become quickly clogged. Do not use this procedure on plated surfaces or metals that are not painted, for example, CRES, titanium, or alclad aluminum. Clean CRES or alclad aluminum surfaces with solvent. Hand clean titanium with abrasives or clean with solvent.
  - B. Consumable Materials
    - (1) B00109 Abrasive disk, cloth, open coat, 150-grit
  - C. Equipment
    - (1) Disc Mandrel of Applicable Size (Fig. 701)
  - D. Procedure

s 127-016

<u>CAUTION</u>: DO NOT LET PARTICLES FROM THE ABRASIVE CAUSE CONTAMINATION OF THE MECHANISMS OR ELECTRICAL EQUIPMENT. DAMAGE CAN OCCUR.

- (1) Use a drill motor or other applicable drive to apply an abrasive disk of correct size to clean the necessary diameter.
  - (a) Apply disk intermittently with light pressure and keep the face of the disk parallel to the metal surface.
  - (b) Examine results after each time you apply the disk and continue operation until necessary area is clean.

NOTE: Keep the decrease in surface metal to minimum.

TASK 20-11-14-147-012

- 5. Remove Paint from Metal Surfaces With Lacquer Thinner or Series 84 Solvent
  - A. General
    - (1) Use this procedure to remove primer or lacquer-based paint or enamel from clad aluminum or other metal surfaces. Do not use lye, alkaline paint remover, or hydroxides to clean surfaces.
    - (2) This chart gives color codes for identification of bonding brushes for individual metals.

EFFECTIVITY-

20-11-14



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

- B. Consumable Materials
  - (1) B00139 Lacquer Thinner Federal Spec TT-T-266, or equivalent
  - (2) B01004 Solvent Final Cleaning of Metal Prior to Painting (Series 84) (AMM 20-30-84)
  - (3) G00033 Lint-free cheesecloth
- C. Remove Paint

s 117-017

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

(1) Apply lacquer thinner or a solvent, Series 84 (AMM 20-30-84) to the specified area with a clean cheesecloth.

s 117-009

(2) Use a clean part of the cheesecloth each time you apply solvent to the surface. Make sure you do not get solvent on adjacent surfaces.

s 117-010

(3) When the specified area is fully clean, immediately rub dry with clean cheesecloth.

TASK 20-11-14-117-011

- 6. Clean Bare, Clad, or Plated Metal with Solvent
  - A. General
    - (1) Use this procedure to clean plated surfaces and CRES, titanium, or alclad aluminum that is not painted.
  - B. Consumable Materials
    - (1) G00033 Lint-free cheesecloth
    - (2) B00192 Solvent BMS 3-2, type 1
  - C. Procedure

s 117-012

(1) Apply solvent to bonding surfaces with a cheesecloth.

 20-11-14



s 117-013

(2) Rub with the necessary force to remove contamination you can see.

s 117-014

(3) Immediately dry surfaces with a lint-free cheesecloth.

EFFECTIVITY-

ALL

20-11-14

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# BONDING JUMPERS AND GROUND LEADS - REMOVAL/INSTALLATION

TASK 20-11-15-004-016

- 1. <u>Electrical Bonding Jumpers and Ground Leads</u>
  - A. General
    - (1) Refer to SWP 20-20-00 Electrical Bonding and Grounding in the Standard Wiring Practice Manual D6-54446.
    - (2) Calibration Box Electrcial Bonding Meter

20-11-15



## PRESSURE SENSITIVE VINYL PLACARDS - REMOVAL/INSTALLATION

#### 1. General

A. This procedure contains one task. The task is the replacement of internal vinyl placards.

NOTE: Vinyl placards are prepared on a material that will not easily follow the contour of rough or textured surfaces. The placard will touch only the high spots and have a poor bond. Use an adhesive with vinyl placards to get a smooth surface and a firm bond for the placard. Foil markers are made on a soft metal that, when applied, will have the contour of the surface and make a good bond. If the surface is textured, you can apply adhesive to get a smoother surface and more satisfactory installation of foil markers.

TASK 20-11-16-204-008

## 2. Replace the Placard

WARNING: THE USE OF FLAMMABLE SOLVENTS IN THE INTERIOR OF THE AIRPLANE CAN LEAD TO A FIRE HAZARD. THEIR USE SHOULD BE AVOIDED IF POSSIBLE. IF FLAMMABLE SOLVENTS MUST BE USED, THEY ARE TO BE TRANSFERRED TO SMALL WASH BOTTLES OUTSIDE THE AIRPLANE, AND BROUGHT INTO THE AIRPLANE IN ONLY SMALL PLASTIC WASH BOTTLES. ATTACH A METAL OR PLASTIC TAG TO EACH BOTTLE IDENTIFYING THE SOLVENT. PROVIDE FOR ADEQUATE VENTILATION DURING SOLVENT CLEANING.

#### A. Consumable Materials

- (1) B00048 Detergent Cleaner Spraywhite E
- (2) B00083 Solvent Aliphatic Naphtha TT-N-95
- (3) A00119 Adhesive BMS 5-55
- (4) A00016 Adhesive Film BMS 5-91
- (5) B000137 Sandpaper, medium grit
- (6) G00270 Masking tape

EFFECTIVITY-

20-11-16



(7) G00033 Cheese Cloth - Woven BMS 15-5

B. Remove the Placard

NOTE: If the placard is bonded firmly and the new placard is the same size, you can install the new placard on the used placard.

s 024-002

(1) Put a sharp knife or similar object under the edge of the placard and remove the placard from the adhesive area.

s 114-003

- (2) Remove remaining adhesive film with Freon TF , Isopropyl Alcohol, Ethyl Alcohol, or naphtha cleaner.
- C. Prepare the Placard for Installation

s 804-015

WARNING: THE USE OF FLAMMABLE SOLVENTS IN THE INTERIOR OF THE AIRPLANE CAN LEAD TO A FIRE HAZARD. THEIR USE SHOULD BE AVOIDED IF POSSIBLE. IF FLAMMABLE SOLVENTS MUST BE USED, THEY ARE TO BE TRANSFERRED TO SMALL WASH BOTTLES OUTSIDE THE AIRPLANE, AND BROUGHT INTO THE AIRPLANE IN ONLY SMALL PLASTIC WASH BOTTLES. ATTACH A METAL OR PLASTIC TAG TO EACH BOTTLE IDENTIFYING THE SOLVENT. PROVIDE FOR ADEQUATE VENTILATION DURING SOLVENT CLEANING.

(1) If the placard has an indication that BMS 5-91 adhesive is used, no special placard preparation is necessary. Continue to the installation.

s 844-005

ALL

- (2) If the placard has no backing adhesive, prepare placard as follows:
  - (a) Make the rear surface of the placard rough with sandpaper.
  - (b) Clean the placard with naphtha cleaner.
  - (c) Remove release paper from one side of the BMS 5-91 adhesive film and apply to rear of placard. Remove unwanted film.
  - (d) Laminate adhesive film to the placard with one of these steps:
    - 1) Roll placard on hot roll laminator heated to 140°F.
    - Heat the placard to not more than 140°F with a dry air blast or other applicable source and rub release paper with a cheesecloth.

NOTE: Heat makes the adhesive to release paper bond soft. Be careful not to move the release paper.

EFFECTIVITY-

20-11-16



s 844-006

(3) If the placard has an adhesive backing other than BMS 5-91, prepare placard as follows:

NOTE: This step is not necessary but it does make sure the adhesive film is firmly bonded to the placard.

- (a) Remove the release paper from the rear of the placard.
- (b) Remove the release paper from one side of the BMS 5-91 adhesive film and apply adhesive film to the rear of the placard. Remove unwanted film.
- (c) Laminate adhesive film to the placard with one of these steps:
  - 1) Roll placard on hot roll laminater heated to 140°F.
  - 2) Heat placard to not more than 140°F with a dry air blast or other applicable source and rub release paper with a cheesecloth.

NOTE: Be careful not to move the release paper.

D. Install the Placard

NOTE: If you install the new placard over a placard or on cured adhesive, do not do steps 2-4 and 7.

s 114-007

(1) Clean the surface with cleaner or detergent. Dry fully.

s 954-008

CAUTION: MAKE SURE THE MASKED AREA IS IN THE CORRECT POSITION. YOU CAN REMOVE DRY ADHESIVE WITH NAPHTHA CLEANER. IF YOU TRY TO REMOVE CURED ADHESIVE, YOU WILL CAUSE DAMAGE TO THE SURFACE.

(2) Mask an area approximately 1/16 inch smaller than placard with masking tape or attach a mask of necessary size.

s 804-014

(3) Use a brush to apply one layer of adhesive to the prime contact area. Let adhesive dry fully (approximately 15 minutes).

s 954-010

(4) Remove masking tape or mask.

s 424-011

(5) Remove release paper from the placard. Put the placard on the center of the primed surface. Apply to the surface but be careful to prevent air pockets.

EFFECTIVITY-

20-11-16

ALL



s 424-012

(6) To attach the placard fully, rub with firm hand pressure and a cheesecloth pad.

s 114-013

(7) If the primed surface shows around the placard, remove unwanted adhesive with naphtha cleaner.

EFFECTIVITY-

ALL

20-11-16

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## CONTROL CABLE QUICK STOPS - REMOVAL/INSTALLATION

#### 1. General

- A. This procedure contains one task. The task is the replacement of the control cable stops.
- B. Control cable stops are for the protection of the control stand cable drums if an engine separation occurs.

TASK 20-11-17-964-008

- 2. Replacement of the Control Cable Stop
  - A. References
    - (1) 20-11-28/401, Lockwires
  - B. Remove the Control Cable Stop (Fig. 401).

s 034-001

(1) Remove the lockwire that attaches the control cable stop to the swaged cable terminal stud.

s 024-002

- (2) Move the control cable stop longitudinally away from the swaged cable terminal stud until the control cable stop disengages. Then move the control cable stop laterally to let the cable go through the slot in the control cable stop.
- C. Install the Control Cable Stop (Fig. 401).

s 434-003

(1) Put the large center hole of the control cable stop near the swaged cable terminal stud. Move the slot of the control cable stop along the cable.

s 424-004

(2) Push the control cable stop on the end of the swaged cable terminal stud until the control cable stop fully engages.

s 824-005

(3) To adjust the control cable stop, twist the swaged cable terminal stud to get the dimension shown.

s 434-006

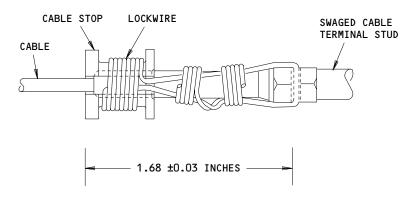
(4) Install a lockwire from the control cable stop to the swaged cable terminal stud (Ref 20-11-28).

EFFECTIVITY-

20-11-17

ALL





Control Cable Stops Installation Figure 401

857707

20-11-17

01

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## FLEXIBLE HOSE - REMOVAL/INSTALLATION

### 1. General

- A. This procedure contains one task. The task is the installation of flexible hoses.
- B. This procedure gives general instructions for the installation of flexible hoses. If there is a special procedure for a specified system, use the special procedure. For example, there is a special procedure for 71-00-02, Power Plant Removal/Installation.
- C. Flexible hoses do not have a specified life limit. Inspect flexible hoses to the applicable operators standard.
- D. Before you do maintenance on oxygen system flexible hoses, refer to safety precautions and general maintenance instructions in 35-11-00 Crew Oxygen System or 35-21-00 Passenger Oxygen System - Maintenance Practices.

TASK 20-11-18-204-008

- 2. Install the Flexible Hose (Fig. 401)
  - A. References
    - (1) 35-11-00/201, Crew Oxygen System
    - (2) 35-21-00/201, Passenger Oxygen System
    - (3) 20-11-05/401, Flareless Tubing Assembly
    - (4) 20-51-01/201, Standard Torque Valves
  - B. Procedure

s 214-011

- (1) Prior to hose installation do a visual check of the hose assembly to determine its condition.
  - (a) Look at the hose, fittings, sealing surfaces and outer covering for damage.
  - (b) Do the following if you find broken wires in the outer covering:
    - Put a tag on the hoses that have isolated or random broken wires.

NOTE: This is to identify the hose for future inspections.

EFFECTIVITY-

20-11-18



2) Do not use the hose if two or more wires in one plate are broken, or if several wires are broken in a concentrated area.

s 434-008

CAUTION: PUT CAPS ON THE HOSES AND FITTINGS. UNWANTED MATERIAL CAN CAUSE CONTAMINATION OF HOSES, DAMAGE TO SYSTEM COMPONENTS, AND LEAKAGE OF HYDRAULIC FLUID.

REMOVE ALL HYDRAULIC FLUID LEAKAGE. HYDRAULIC FLUID CAN CAUSE CORROSION OR OTHER DAMAGE.

(2) Use caps on the hose assemblies and mating connections.

<u>NOTE</u>: Caps keep out moisture and unwanted material until the hose is again connected to its system.

s 214-003

(3) Make sure all fittings are clean and free of defects.

s 644-004

(4) Lubricate external threads as necessary. Refer to 20-11-05 for approved thread lubricants.

s 424-005

(5) Put the hose in position and tighten the fitting by hand.

s 214-010

(6) Examine the installation for correct alignment and length.

s 434-006

CAUTION: USE THE INDEX LINE ON THE SIDE OF THE HOSE TO MAKE SURE
THE HOSE IS NOT TWISTED. IF THE HOSE IS TWISTED, HOSE FAILURE
OR HOSE COUPLING LEAKAGE CAN OCCUR BEFORE THE USUAL TIME.

(7) Tighten the pipe fitting ends. Refer to 20-51-01 for the correct torque values.

s 434-001

(8) Tighten the coupling-type ends. Refer to 20-51-01 for correct torque valves. Use two wrenches to prevent twisted flexible tubing.

s 434-007

ALL

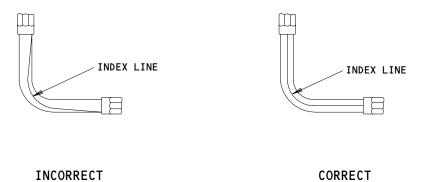
(9) Clamp hose as necessary.

EFFECTIVITY-

20-11-18

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Flexible Hose Installation Figure 401

ALL

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## O-RINGS - REMOVAL/INSTALLATION

### 1. General

- A. This procedure contains one task. The task is the installation of O-rings over sharp edges. Sharp edges include threaded fasteners, keyways, slots, splines, and ports.
- B. Before installation, examine the 0-rings for cuts, abrasions, deformities, and surface defects.

TASK 20-11-19-404-010

- 2. <u>Installation of 0-rings</u> (Fig. 401)
  - A. Equipment
    - (1) O-Ring Installation Tool ST848
  - B. Consumable Material
    - (1) Fluid used with component or system
  - C. Procedure

s 804-002

(1) Use the applicable ST848 series O-Ring installation tools.

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

EFFECTIVITY-

20-11-19

ALL

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s 644-003

REPLACE USED O-RINGS WITH NEW O-RINGS. USED O-RINGS CAN CAUTION: CAUSE LEAKAGE.

(2) Lubricate the 0-ring with a thin layer of the fluid used with the component or system.

s 434-004

DO NOT MAKE THE ELASTOMERIC O-RING INNER DIAMETERS LARGER BY CAUTION: MORE THAN 50% DURING INSTALLATION. DO NOT MAKE THE TEFLON AND PLASTIC O-RING INNER DIAMETERS LARGER BY MORE THAN 5% DURING INSTALLATION. FAILURE CAN OCCUR.

(3) Put the thimble over the fitting.

s 424-005

(4) Put the 0-ring on the thimble.

s 424-006

(5) Move the expanding body over the thimble and against the O-ring, then push the 0-ring into the groove.

s 034-007

(6) Use the extracting rod to remove the expanding body from the thimble.

s 034-008

(7) Remove the thimble.

ALL

s 214-009

CAUTION: DO NOT PINCH THE O-RINGS. MAKE SURE ATTACHED BOLTS ARE CORRECTLY TIGHTENED. FAILURE CAN OCCUR.

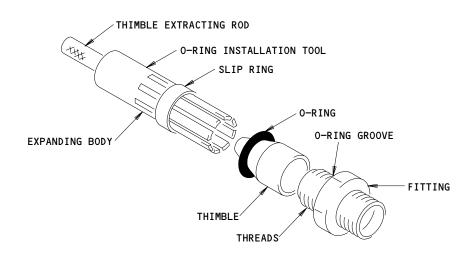
Examine the 0-ring for twists and pinches caused by installation.

Make sure you align the O-ring with no twists before you close the gland.

EFFECTIVITY-

20-11-19





O-Ring Installation Tool Figure 401

20-11-19

01

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## RECESSED BOSS SEAL FITTINGS - REMOVAL/INSTALLATION

#### 1. General

A. This procedure contains three tasks.

The first task is the removal of the fittings.

The second task is installation of straight (style E) fittings.

The third task is installation of elbow (style S) fittings.

TASK 20-11-21-004-001

2. Recessed Boss Seal Fittings - Removal (Fig. 401)

A. Procedure

s 034-002

(1) Disconnect the hose or the tube from the fitting.

s 034-003

(2) Loosen the jamnut if it is installed.

s 024-004

(3) Remove the fitting from the boss.

TASK 20-11-21-404-005

- 3. Recessed Boss Seal Fittings-Straight (Style E) Installation (Fig. 401)
  - A. References
    - (1) 20-51-01/201, Standard Torque Values
  - B. Procedure

<u>NOTE</u>: Use a lubricant on the 0-ring which is applicable for the 0-ring material.

s 434-006

(1) Lubricate the new NAS1611 0-ring and backup ring.

s 424-017

(2) Install the 0-ring and backup ring in the fitting grooves.

s 434-007

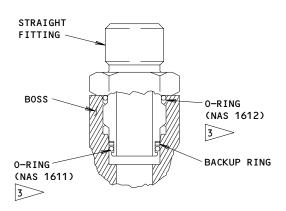
(3) Lubricate the new NAS1612 0-ring.

EFFECTIVITY-

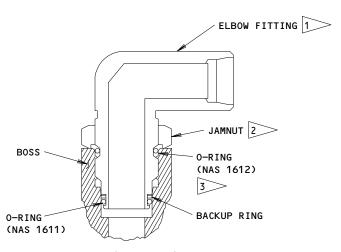
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STRAIGHT (STYLE E) FITTINGS



ELBOW (STYLE S) FITTINGS

>> YOU CAN USE A 45° OR 90° ELBOW JAMNUTS NAS 1410 DD, OR AN6298 WITH BACKUP RING MS28773 ARE OPTIONAL USE ONLY PHOSPHATE ESTER FLUIDS WITH NAS 1611 AND NAS 1612 O-RINGS

Recessed Boss Seal Fitting Installation Figure 401

EFFECTIVITY-ALL

302897

20-11-21

01

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s 424-018

(4) Put the 0-ring in its position in the groove below the nut hex.

s 424-008

(5) Turn the fitting into the boss and tighten it to the correct torque for the fitting dimensions (Ref 20-51-01/201).

s 434-009

(6) Connect the hose or the tube to the fitting.

TASK 20-11-21-404-010

- 4. Recessed Boss Seal Fittings-Elbow (Style S) Installation (Fig. 401)
  - A. References
    - (1) 20-51-01/201, Standard Torque Values
  - B. Procedure

NOTE: Use a lubricant on the O-ring which is applicable for the O-ring material.

s 434-011

(1) Install the jamnut on the threaded end of the fitting and turn it to the stop.

s 434-012

(2) Lubricate the new NAS1612 0-ring.

s 424-019

(3) Install the 0-ring in the groove between the two sets of threads.

s 434-013

(4) Lubricate the new NAS1611 0-ring and the backup ring.

s 424-020

(5) Install the 0-ring and backup ring in the fitting grooves.

s 424-014

(6) Trun the fitting into the boss until it touches the bottom. Then loosen it until the fitting aligns with the hose or tube (one turn maximum).

s 434-015

(7) Hold the fitting and tighten the jamnut to the correct torque for the fitting dimesions (Ref 20-51-01/201).

s 434-016

ALL

(8) Connect the hose or tube to the fitting.

EFFECTIVITY-

20-11-21

l .



## E/E RACK MOUNTED COMPONENTS - REMOVAL/INSTALLATION

#### 1. General

- A. This procedure contains these tasks.
  - (1) The first task removes the electrical/electronic (E/E) box from the rack.
  - (2) The second task installs the E/E box.
  - (3) Adjust lever latch forks.
  - (4) The third task removes the circuit card assembly from the rack.
  - (5) The fourth task installs the circuit card assembly.
- B. Lever latches are used for movement and retention of black boxes mounted on racks. Adjustment of the lever latch fork is necessary to assure proper connector engagement: If a box has two lever latches, both should be adjusted together.
- C. Connector engagement for all type boxes must be as shown in Fig. 401.

TASK 20-11-22-004-033

- 2. Remove the E/E Box (Fig. 401)
  - A. References
    - (1) 20-41-02/201, Electro-Static Sensitive Devices
  - B. AIRPLANES WITH TRIDAIR EXTRACTOR;

Remove the E/E Box

s 864-110

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

(1) Open the applicable circuit breakers to remove electrical power.

s 034-035

(2) Remove the connections from the front of the E/E box, if applicable.

s 914-036

CAUTION: DO NOT TOUCH THE E/E BOXES BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (REF 20-41-01). SOME E/E BOXES ARE ELECTROSTATIC SENSITIVE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO DEVICES IN THE E/E BOX.

(3) Do the procedure for devices that are sensitive to electrostatic discharge (Ref 20-41-02).

s 034-083

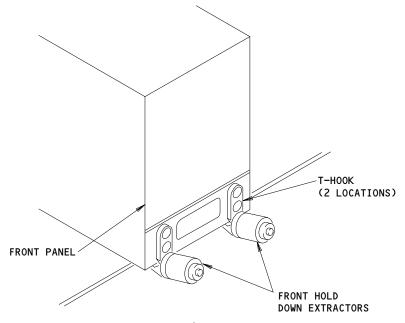
(4) Turn the knob on the front hold-down extractor counterclockwise to disengage the clutch.

EFFECTIVITY-

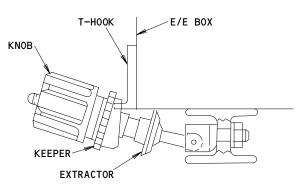
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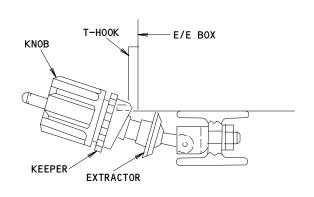


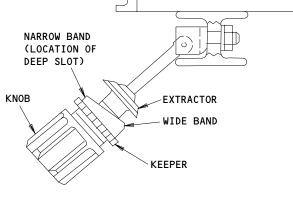


INSTALLED E/E BOX









T-HOOK

EXTRACTOR FREE POSITION

E/E BOX

INSTALLED E/E BOX WITH THE EXTRACTOR TIGHTENED

## TRIDAIR EXTRACTOR

E/E Box Installation Figure 401 (Sheet 1)

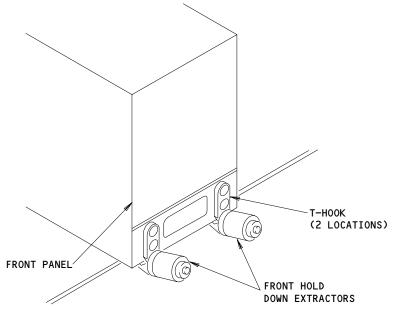
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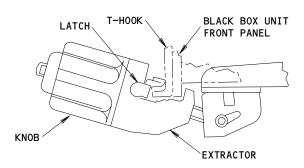
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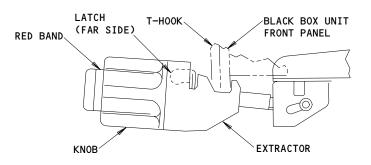




INSTALLED E/E BOX



## TIGHTENED EXTRACTOR WITH THE E/E BOX FULLY ENGAGED



LOOSENED EXTRACTOR ON THE T-HOOK WITH THE E/E BOX LOOSENED

## HOLLINGSEAD EXTRACTOR

E/E Box Installation Figure 401 (Sheet 2)

EFFECTIVITY ALL

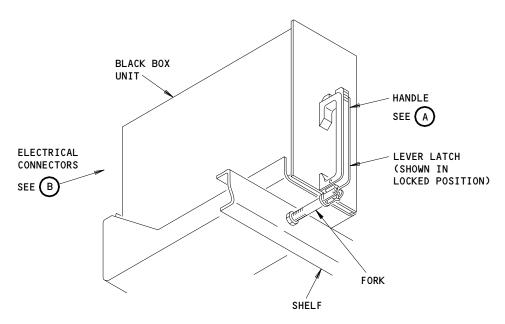
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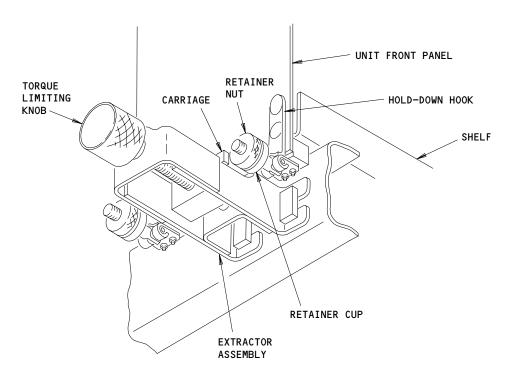
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# LEVER LATCH TYPE RETENTION (EXAMPLE)



SCREW TYPE RETENTION (EXAMPLE)

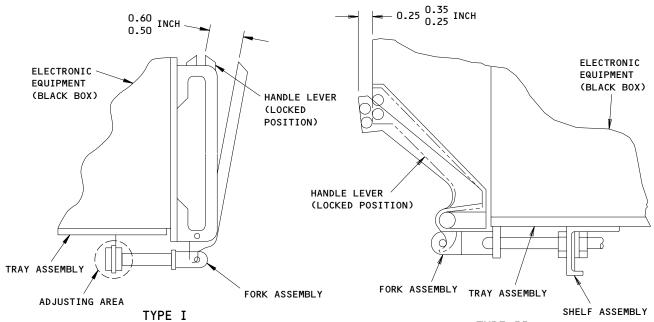
E/E Box Installation Figure 401 (Sheet 3)

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ADJUST FRONT HOLD DOWNS AS FOLLOWS:

TYPE II

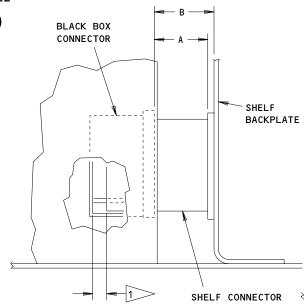
WITH PLUG ON THE REAR OF UNIT FULLY ENGAGED AND THE HANDLE LEVER ON THE THE FRONT OF THE UNIT AT THE DIMENSION SHOWN, ADJUST FORKS BY ROTATING TO A POSITION WHERE THEY START TO EXERT PRESSURE ON THE LOCKING LEVER.

#### **HANDLE**

	Α	В
CONNECTOR	INCH	INCH
TYPE	MAX	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 O.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 IS MATED PROPERLY.



MATED ELECTRICAL CONNECTORS (EXAMPLE)

E/E Box Installation Figure 401 (Sheet 4)

EFFECTIVITY ALL

20-11-22

01

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S 864-038

(5) Turn the keeper to align the deep slot with the T-hook. Lower the front hold-down extractor to be clear of the T-hook.

NOTE: Apply light pressure down on the E/E box handle while you disconnect the front hold-down extractor.

s 024-039

(6) Carefully move the E/E box out from the tray and remove the E/E box.

NOTE: Shake the front of the E/E box from right to left for approximately 1/8 inch to help disconnect the E/E box from the electrical connector.

s 434-040

- (7) Install the dust cap on the E/E box electrical connector and the tray electrical connector.
- C. AIRPLANES WITH HOLLINGSEAD EXTRACTOR; Remove the E/E Box

S 864-041

(1) Open the applicable circuit breakers to remove electrical power.

s 034-042

(2) Remove the connections from the front of the E/E box, if applicable.

s 914-043

ALL

CAUTION: DO NOT TOUCH THE E/E BOXES BEFORE YOU SO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (REF 20-41-02). SOME E/E BOXES ARE ELECTROSTATIC SENSITIVE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO DEVICES IN THE E/E BOX.

(3) Do the procedure for devices that are sensitive to electrostatic discharge (Ref 20-41-02).

EFFECTIVITY-

20-11-22



S 864-044

(4) Turn the knob on the front hold-down extractor counterclockwise until you can see the red band.

S 864-045

(5) Turn the latch counterclockwise to disengage the front hold-down extractor from the T-hook. Lower the front hold-down extractor to be clear of the T-hook.

NOTE: Apply light pressure down on the E/E box handle while you disconnect the front hold-down extractor.

s 024-046

(6) Carefully move the E/E box out from tray and remove the E/E box.

NOTE: Shake the front of the E/E box from right to left for approximately 1/8 inch to help disconnect the E/E box from the electrical connector.

s 434-047

(7) Install the dust cap on the E/E box electrical connector and the tray electrical connector.

s 034-048

(8) Remove and discard the 0-rings from the electrical connectors on the rack, if installed.

s 034-094

(9) AIRPLANES WITH LEVER LATCH HANDLES;

Do these steps:

ALL

- (a) Depress the lever latch allowing the lever to move away from the handle.
- (b) Move the lever in an opening direction forcing the unit away from the shelf-mounted connector.

EFFECTIVITY-

20-11-22



(c) Remove the unit from the shelf.

TASK 20-11-22-404-049

- 3. <u>Install the E/E Box</u>
  - A. References
    - (1) 20-41-02/201, Electro-Static Sensitive Devices
  - B. AIRPLANES WITH TRIDAIR EXTRACTOR;

Install the E/E Box

s 214-050

(1) Make sure the rubber plugs are installed in the metering tray at the correct locations. Compare the orifice configuration on the metering tray with the one shown on the decal.

s 344-051

(2) Remove the dust caps from the electrical connectors.

S 214-052

(3) Make sure the tray gasket and restrictor plugs (variable number) are in the correct positions. Install if necessary.

S 214-053

(4) Visually make sure the guide pins on the tray will connect with the E/E box.

S 214-054

CAUTION: MAKE SURE THE ELECTRICAL PINS ON THE E/E BOX CONNECTOR AND TRAY CONNECTOR ARE NOT BENT OR DAMAGED. INSTALLATION OF THE E/E BOX WITH DAMAGED PINS CAN CAUSE DAMAGE TO THE E/E BOX, THE TRAY ELECTRICAL CONNECTOR, OR THE SYSTEM COMPONENTS.

(5) Visually make sure the electrical pins of the E/E box and tray connector are not bent or damaged. Replace damaged components.

s 914-055

CAUTION: DO NOT TOUCH THE E/E BOXES BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (REF 20-41-02). SOME E/E BOXES ARE ELECTROSTATIC SENSITIVE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO DEVICES IN THE E/E BOX.

(6) Do the procedure for devices that are sensitive to electrostatic discharge (Ref 20-41-02).

EFFECTIVITY-

20-11-22

ALL



s 424-056

(7) Carefully start to install the E/E box into the tray.

NOTE: For easier installation of the E/E box, lift the front of the E/E box approximately 1/8 inch above the tray surface.

s 424-057

(8) Continue to move the E/E box into the tray and engage the electrical connector.

NOTE: The E/E box will engage with the electrical connector easier if you shake the front of the E/E box from right to left for approximately 1/8 inch. While you shake the box, apply a light horizontal force to the front of the E/E box.

s 824-058

(9) Turn the keeper to put the deep slot near to and aligned with the T-hook.

s 434-059

(10) Put the extractor on the T-hook and turn the keeper 180 degrees.

s 434-060

(11) To tighten the front hold-down extractor, turn the knob clockwise until the clutch engages fully.

NOTE: You will feel clicks while you turn the knob.

s 214-061

(12) Shake the E/E box to make sure of a tight fit. Tighten the extractor.

S 214-062

ALL

(13) Make sure the electrical connector is engaged.

EFFECTIVITY-

20-11-22



S 434-063

(14) Install the connections to the front of the E/E box, if applicable.

s 864-064

(15) Close all applicable circuit breakers.

C. AIRPLANES WITH HOLLINGSEAD EXTRACTOR; Install the E/E Box

S 914-065

CAUTION: DO NOT TOUCH THE E/E BOXES BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE (REF 20-41-01). SOME E/E BOXES ARE ELECTROSTATIC SENSITIVE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO DEVICES IN THE E/E BOX.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (Ref 20-41-02/201).

s 214-109

CAUTION: MAKE SURE THE ELECTRICAL PINS ON THE E/E BOX CONNECTOR AND TRAY CONNECTOR ARE NOT BENT OR DAMAGED. INSTALLATION OF E/E BOX WITH DAMAGED PINS CAN CAUSE DAMAGE TO THE E/E BOX, TRAY ELECTRICAL CONNECTOR, OR SYSTEM COMPONENTS.

(2) Make sure the rubber plugs are installed in the metering tray at the correct locations. Compare the orifice configuration of the metering tray with that shown on decal.

s 344-067

(3) Remove the dust caps from the electrical connectors.

s 214-069

(4) Make sure the tray gasket and restrictor plugs (variable number) are in the correct positions. Install if necessary.

s 424-070

(5) Carefully start to install the box into the tray.

NOTE: For easier installation of the E/E box, lift the front of the E/E box approximately about 1/8 inch above the tray surface.

s 424-071

ALL

(6) Continue to move the box into the tray and engage the electrical connector.

EFFECTIVITY-

20-11-22



s 824-072

(7) Align the front hold-down extractor with the T-hook. Put the extractor on the T-hook and turn the latch clockwise.

s 434-073

(8) Turn the knob on the front hold-down extractor clockwise until you cannot see the red band and the clutch engages.

S 214-074

(9) Shake the E/E box to make sure of a tight fit. Tighten the extractor.

s 214-075

(10) Make sure the electrical connector is engaged.

S 434-076

(11) Install the connections to the front of the E/E box, if applicable.

s 864-077

(12) Close all applicable circuit breakers.

D. AIRPLANES WITH LEVER LATCH HANDLES; Do these steps:

s 434-095

(1) Slide the unit into the shelf with the lever in the open position until the lever engages the shelf-mounted fork.

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

s 434-096

(2) Move the lever latch to its locked position and verify proper adjustment.

TASK 20-11-22-004-097

- 4. Adjust Lever Latch Fork (Fig. 401)
  - A. Prepare For Adjustment

s 014-098

(1) Open circuit breaker of unit to be adjusted.

EFFECTIVITY-

20-11-22

ALL



s 034-099

(2) Press trigger and pull lever latch to open position.

s 024-100

(3) Remove unit by handle.

s 434-101

(4) If installed, loosen jamnut on fork assembly.

s 014-102

- (5) Examine all parts of latching mechanism for serviceability.
- B. Adjust Lever Latch Fork

s 434-103

(1) Slide unit back on shelf until connectors are partially engaged.

s 434-104

(2) Engage lever latch hook with fork assembly pin.

S 864-105

(3) Start closing lever latch handle.

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

s 824-106

Adjust fork assembly until resistance to handle movement occurs within required gap tolerance (Fig. 401).

NOTE: Loosen the nut at the shelf area for fork adjustment.

s 824-107

(5) Close handle until latched.

s 434-108

ALL

(6) Tighten jamnut to snug fit.

EFFECTIVITY-

20-11-22



TASK 20-11-22-004-078

- 5. Remove the Circuit Card Assembly (Fig. 402)
  - A. References
    - (1) 20-41-02/201, Electrostatic Sensitive Devices
  - B. Procedure

s 864-079

(1) Open applicable circuit breakers to remove electrical power.

s 014-080

(2) Open the card file door.

s 914-081

CAUTION: DO NOT TOUCH THE CARD ASSEMBLIES BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE.

CARD ASSEMBLIES ARE ELECTROSTATIC SENSITIVE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO DEVICES IN THE CARD ASSEMBLIES.

(3) Do the procedure for devices that are sensitive to electrostatic discharge (Ref 20-41-02/201).

s 034-082

(4) Turn the ejectors on the card assembly until the card is loose in the guide.

S 024-084

(5) Carefully move the card out along the guide.

s 024-085

(6) Remove the card assembly.

TASK 20-11-22-404-086

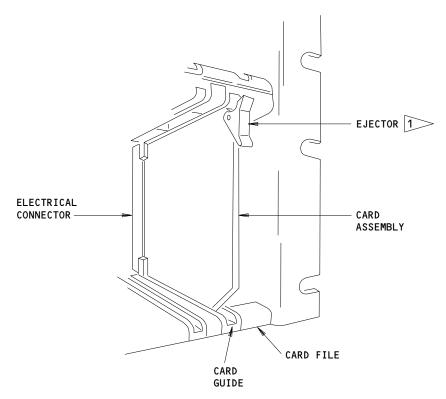
- 6. <u>Install the Card Assembly</u>
  - A. References
    - (1) 20-41-02/201, Electrostatic Sensitive Devices

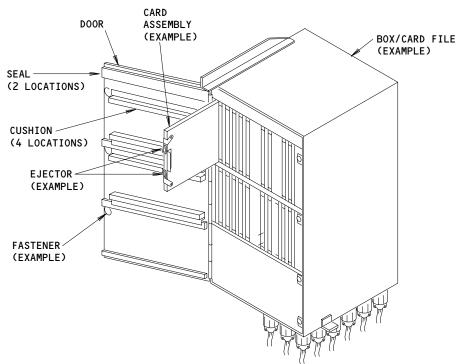
EFFECTIVITY-

20-11-22

ALL







SOME CARD FILES CAN HAVE EJECTORS INSTALLED ON THE TOP AND BOTTOM

E/E Card Assembly Installation Figure 402

ALL

20-11-22

01

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#### B. Procedure

s 914-087

CAUTION: DO NOT TOUCH THE CARD ASSEMBLIES BEFORE YOU DO THE PROCEDURE FOR DEVICES THAT ARE SENSITIVE TO ELECTROSTATIC DISCHARGE.

CARD ASSEMBLIES ARE ELECTROSTATIC SENSITIVE. ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO DEVICES IN THE CARD ASSEMBLIES.

(1) Do the procedure for devices that are sensitive to electrostatic discharge (Ref 20-41-02/201).

s 424-088

(2) Put the card assembly into the guide. Carefully push the card in until it correctly engages with the electrical connector.

s 214-089

(3) Make sure the ejectors touch the card.

s 864-090

(4) Close the applicable circuit breakers.

s 414-091

(5) Close the card file door.

EFFECTIVITY-

ALL

20-11-22



## FLUID LINE TUBING CLAMPS - REMOVAL/INSTALLATION

#### 1. General

- A. This procedure contains these tasks:
  - (1) The removal of tubing clamps.
  - (2) The installation of tubing clamps.
  - (3) The installation of protective lacing.
- B. Different types of clamps hold the fluid system tubing:
  - (1) Block clamps are used to hold a number of fluid lines at a specified locations.
  - (2) Loop-type cushioned tube clamps are used in fluid line installations to reduce vibration and wear of lines.
- C. Before you install a nylon loop-type clamp,
  - do a test of the clamp as follows:
  - (1) Open the clamp to approximately 1.5 times the tube diameter.

NOTE: Do this 3 or 4 times to make sure the clamp is flexible. If the clamp cracks, do not use the clamp.

- D. For torque data for clamps, refer to 20-51-01/201.
- E. Clampshell clamp assemblies are made of three parts:
  - two identical clampshells
  - a cushioned or an uncushioned loop-type clamp as applicable for the installation.
- F. If there is too much wear, replace the clamp. Replace the entire clamp assembly, even though only one component part has too much wear.
- G. There are two types of clampshell clamps.
  - (1) Unplated shells: These are for high vibration and high temperature (up to 800°F) areas.
  - (2) Cadmium plated shells: These are for aluminum tubing only and are limited to temperature of 400°F.

TASK 20-11-24-004-001

# 2. <u>Tubing Clamp - Removal</u>

A. Procedure - Remove Clampshell Type Clamps (Fig. 401)

s 024-002

- (1) Remove the clamp and the clampshell halves.
- B. Procedure Remove Block Type Clamps

s 034-003

(1) Remove the nuts, bolts, and washers that hold the clamp block assemblies together.

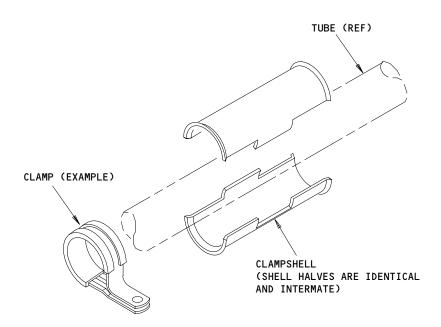
s 024-004

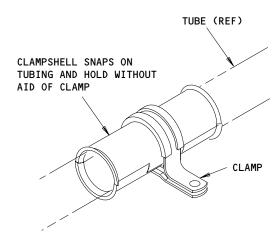
(2) Remove the block assemblies.

EFFECTIVITY-

20-11-24







Clampshell Type Clamp Installation Figure 401

20-11-24

01

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TASK 20-11-24-404-005

- 3. <u>Tubing Clamp Installation</u>
  - A. Consumable Materials
    - (1) G00145 Tape Permacel P421
  - B. Procedure Install Clampshell Type Clamps (Fig. 401)

s 424-006

- (1) Hold the clampshell halves in their positions and install the clamp.
- C. Procedure Install the Block Clamp Assembly

s 214-003

(1) Make sure each tube is wound three times with P421 Tape, approximately 0.25 inch from the edge of the block.

NOTE: This tape is used to prevent too much clearance between the tube and the clamp. Airplanes may not have this tape because the tube has not been in service long enough to be worn.

s 434-004

(2) Put the tubes in the applicable notches in the block clamp assembly.

s 424-005

(3) Put the other half of the block clamp assembly in its position.

s 434-006

(4) Put the channel on the half of the block clamp assembly that the bolt head will touch.

s 434-007

(5) Install the bolts through the holes in the block clamp assembly.

NOTE: Make sure the washers are on the bolts.

s 434-008

(6) Install the washer and nut on the bolt.

NOTE: Make sure the washers are below the bolt head and the nut.

EFFECTIVITY-

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## TASK 20-11-24-404-010

- 4. Protective Lacing Installation
  - A. Consumables
    - (1) A00027 Adhesive RTV 108 (used on nose landing gear only)
    - (2) G00057 Tape Scotch, 3M #63 (used on nose landing gear only)
    - (3) GO2503 Lace Black Nylon Untreated Sleaving (1/8")
  - B. Procedure Install the Protective Lacing (Fig 402)

s 404-011

(1) Install the lacing per Figure 402 , steps 1 through 3 , except nose landing gear.

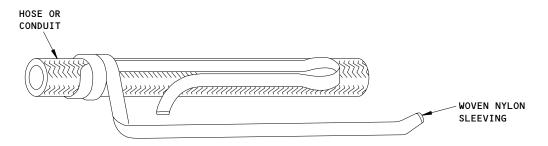
s 404-012

- (2) Install the lacing on nose landing gear per Figure 402.
  - (a) Prior to pulling locking lace through, before Step 3, apply adhesive to the laces.
  - (b) Pull the laces into place, (Step 3), this will bond the laces in place.
  - (c) Apply two layers of tape over the lacing.
    - 1) Spirally wrap each layer with a 50% overlap and reverse the direction of the spiral with each layer.
    - 2) Extend the tape 1.0 inch to 1.5 inch beyond each end of the lacing.

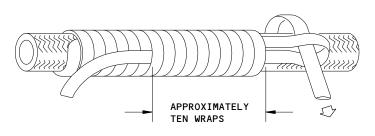
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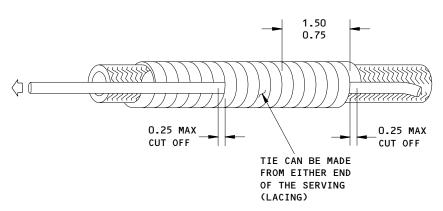




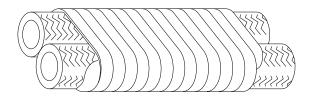
STEP 1



STEP 2







FOR TWO OR MORE HOSES

NOTE: ALL DIMENSIONS ARE IN INCHES.

Protective Lacing Installation Figure 402

ALL

O1 Page 405
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## HEAT GUNS, SOLDERING GUNS, AND/OR SOLDERING IRONS - MAINTENANCE PRACTICES

TASK 20-11-25-912-001

## 1. Use of Heat Guns, Soldering Guns, and Soldering Irons

### A. General

- (1) This procedure gives the minimum recommended safety procedures for heat guns, soldering guns, and soldering irons used near airplanes. These are general procedures. If regulations made by local agencies or procedures made by the airline are more applicable, use them. Boeing cannot know or write about all possible conditions which the airlines can have.
- (2) You must examine the conditions and be careful. Customer airlines must know how heat guns, soldering guns, and soldering irons are used.
- (3) Heat guns, soldering guns, and soldering irons can cause an explosion. Components in all of these devices can operate at temperatures higher than the fuel ignition temperature (450°F). Heat guns and soldering guns also can contain electrical switches which can cause sparks. These sparks can cause the fuel to burn.
- (4) We do not recommend you use a device to supply heat in the fuel tanks. You must have a good flow of air in the fuel tanks. You can make them safe when you fill the fuel tanks with nitrogen. For the repair of the wires in the fuel tanks, we recommend you use procedures that use crimped splices and sleeves with nylon ties. These procedures are specified in WDM Chapter 20.
- (5) Do not use heat guns, soldering guns, or soldering irons less than 100 feet from an airplane during these operations:
  - When you fuel
  - When you defuel
  - When the fuel tanks are open.
- (6) You can use heat guns, soldering guns, and soldering irons when and where smoking is permitted. If you use these devices where smoking is not permitted, you must first make sure there are not dangerous levels of fuel fumes in the work area.

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- (7) Zero is the safe fuel fume level at which to use devices that can cause ignition.
- (8) Measure the fuel fume level with a combustible gas indicator that reads in "PERCENT LOWER EXPLOSIVE LIMIT" or "PERCENT EXPLOSIVE". For example, you can use Mine Safety Appliances, Model 2A or Davis, Model D-16. If you can read a fuel fume level on this equipment, two conditions occurred:
  - A liquid fuel or fume source is near
  - The local fuel fume levels are high or the ventilation is not sufficient.

Use the equipment to measure the initial fuel fume levels. Make sure the fuel fume levels are sufficiently low. Continue to monitor the fuel fume levels during the repair.

- (9) Do not use a possible ignition source near open fuel tanks, fuel vents, or fuel leaks where fume concentrations cannot be known or controlled.
- (10) If you use a possible ignition source near an airplane where smoking is not permitted, make sure a person monitors the work and any other work in the area. The person must be authorized to monitor airplane fire safety.
- (11) A person who can measure the risk of the repair to be done must identify the emergency or fire fighting equipment necessary at the work area of the repair. The person must be authorized to monitor airplane fire safety.
- (12) Do not start or continue to do work on a fuel system component while equipment that can cause the fuel to burn is near.
- (13) Keep the number of maintenance and safety persons included to a minimum.

EFFECTIVITY-

ALL

20-11-25



## LUBRICATION FITTINGS - REMOVAL/INSTALLATION

## 1. General

A. This procedure contains the installation instructions for a lubrication fitting (press-in type). Refer to Airplane Maintenance Manual 32-00-50 Page 801 for repair of lubrication retainers for the landing gear.

TASK 20-11-27-424-010

- 2. <u>Install the Lubrication Fittings</u> (Fig. 401)
  - A. General
    - (1) This task contains instructions for the installation of new lubrication fittings and lubrication fittings that were blown out.
  - B. Equipment
    - (1) Drive Tool 5253-3 (for Alemite Type 1728B lubrication fittings)
    - (2) Drive Tool 5254-1 (for Alemite 1646B and 1992B lubrication angle fittings)
  - C. Consumable Materials
    - (1) B00722 Solvent P-D-680
    - (2) B00083 Solvent Aliphatic Naphta TT-N-95
    - (3) G00262 Nitrogen Liquid, MIL-P-27401
    - (4) COO316 Primer Loctite Grade T (747I)
    - (5) Adhesive:
      - (a) G00106 Retaining Loctite 675 or MIL-R-46082
      - (b) G00106 Loctite RC/680 or MIL-R-46082
    - (6) Cotton Swab (Commercially Available)
  - D. References
    - (1) CMM 32-00-03, Landing Gear Parts
  - E. Install a New Lubrication Fitting

s 844-012

(1) Get an applicable standard fitting to install in the hole.

s 164-003

- (2) Do these steps to clean the lubrication fitting hole:
  - (a) Use a cotton swab to remove as much grease as possible from the inner surface of the lubrication fitting hole.

EFFECTIVITY-

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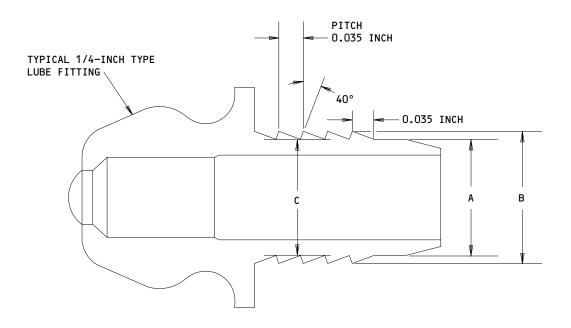


## DESIGN LUBE HOLE DIA IS 0.188/0.189 INCHES

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

> 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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20-11-27

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- (b) Clean the hole to a depth of at least 0.5 inch with solvent or detergent on a clean cotton swab.
- (c) Clean the hole until you can see no more grease or dirt removed from the hole.

s 424-011

<u>CAUTION</u>: MAKE SURE YOU USE THE CORRECT TOOL TO INSTALL THE LUBRICATION FITTING. MOVE THE FITTING IN A STRAIGHT LINE TO PREVENT DAMAGE TO THE MATING PART.

- (3) Use the correct drive tool to install the fitting into the hole in the part the fitting connects to.
- F. Install a Lubrication Fitting to Replace a Fitting that was Blown Out

s 844-013

(1) Get a special approved or an oversized fitting to install in the hole.

s 164-006

- (2) Do these steps to clean the lubrication fitting hole:
  - (a) Use a cotton swab to remove as much grease as possible from the inner surface of the lubrication fitting hole.
  - (b) Clean the hole to a depth of at least 0.5 inch with solvent or detergent on a clean cotton swab.
  - (c) Clean the hole until you can see no more grease or dirt removed from the hole.

s 394-009

- (3) Do these steps to apply the primer:
  - (a) Use a cotton swab to apply a thin layer of primer to the inner diameter of the hole.
  - (b) Let the primer air dry at approximately 68°F for at least five minutes before you apply the retainer compound.

s 424-015

CAUTION: DO NOT APPLY TOO MUCH ADHESIVE ON THE FITTING AND THE PART IT CONNECTS TO. TOO MUCH ADHESIVE ON THE FITTING WILL CAUSE A BLOCKAGE TO THE LUBRICATION PASSAGES AND CAUSE DAMAGE TO EQUIPMENT.

- (4) Do these steps to install the lubrication fitting:
  - (a) Use a cotton swab to apply a thin layer of adhesive to the inner diameter of the hole (between 0.25 and 0.40 inch in depth).

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(b) Put the lubrication fitting into liquid nitrogen for at least one minute to make sure the fitting is fully cool.

**CAUTION:** MAKE SURE YOU USE THE CORRECT TOOL TO INSTALL THE LUBRICATION FITTING. MOVE THE FITTING IN A STRAIGHT LINE TO PREVENT DAMAGE TO THE MATING PART.

Use the correct drive tool to install the lubrication fitting into the hole in the part the fitting connects to.

Install the lubrication fitting into the hole in the NOTE: mating part immediately . If you do not install the fitting immediately it will become too warm.

(d) Let the lubrication fitting cure for 12 hours at approximately 68°F before you use it.

EFFECTIVITY-

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## LOCKWIRE - REMOVAL/INSTALLATION

## 1. General

- A. This procedure contains one task. The task is the replacement of lockwires.
- B. If this procedure does not agree with specified maintenance procedures, use the specified maintenance procedure.
- C. Do not use lockwire more than once.
- D. Install the lockwire to put tension on the wire when the parts become loose.
- E. Make three to six twists at the end of the wire. Bend the twists back or under to give the wire ends protection so they will not catch something.
- F. Use the double twist procedure for all lockwire unless a single wire procedure is specified.
- G. Install and twist the safety wire so the loop around the head stays down. (If the 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 six inches apart, wire together in series no more than three fasteners.
- J. Where fasteners are more than six inches apart, do not tie them in series unless tie points are provided on adjacent parts to shorten the wire span to less than six 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.

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

TASK 20-11-28-964-010

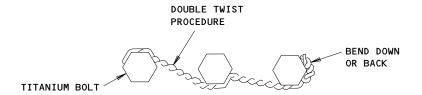
- Lockwire Replacement (Fig. 401)
  - A. Procedure Remove the Lockwire

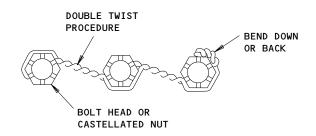
s 024-002

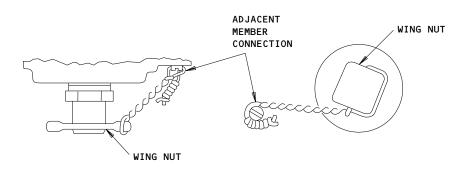
(1) Cut and remove the lockwire.

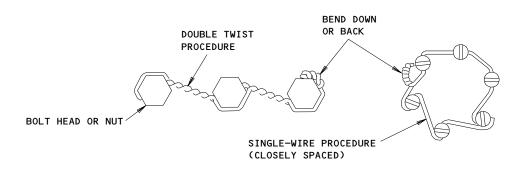
20-11-28











Lockwire Installation Figure 401

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#### B. Procedure - Install the Lockwire

#### s 804-007

- (1) Use these types of wires for lockwire:
  - (a) Use monel, inconel, or corrosion-resistant lockwire in high temperature areas.
  - (b) Use 0.020-inch diameter copper wire on emergency equipment only. Use it where a seal is necessary on emergency equipment to show no person has used the equipment. Emergency equipment includes portable fire extinguishers, first aid kits, emergency valve, and oxygen regulators.
  - (c) Use Clad 5056 aluminum alloy wire for lockwire that touches magnesium to prevent galvanic corrosion.
  - (d) This table shows BAC standard wire sizes.

MATERIAL	SIZE (INCH)				
Monel or Inconel	.020	.032	.040	.051	.091
Corrosion Resistant Steel	.020	.032	.040	.051	.091
Aluminum Alloy	.020	.032	.040	.051	.091

#### s 424-003

- (2) Use these steps to install lockwire to bolts and screws (Fig. 401):
  - (a) On all fittings where you install lockwire, attach the fitting to the mating part or an adjacent part.
  - (b) Install the lockwire for right threads as shown in the figures for this procedure. Install the lockwire for left threads opposite to that shown.
  - (c) Make sure the loop of double wire goes around the head of the bolt or screw.

NOTE: The wire must not go above the head.

CAUTION: DO NOT LOOSEN OR TIGHTEN A NUT OR BOLT OUT OF ITS SPECIFIED TORQUE RANGE. DAMAGE CAN OCCUR.

(d) When you install lockwires on nuts and bolts, tighten to the low values of the torque range. If it is necessary, continue to tighten until a slot aligns with the safety hole.

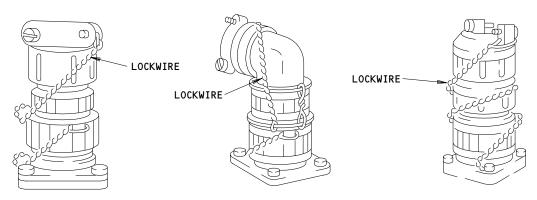
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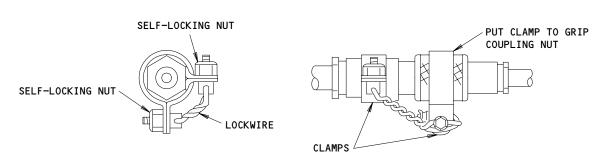
- (3) To install lockwire on electrical connectors, see Fig. 402.
  - (a) Use the instructions for the installation of lockwires to bolt and screws when you install lockwires on electrical connectors.

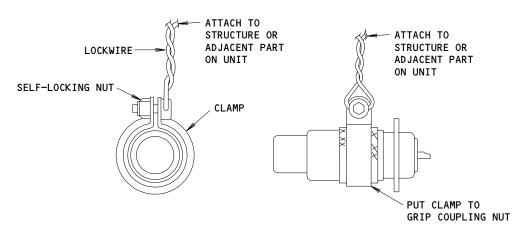
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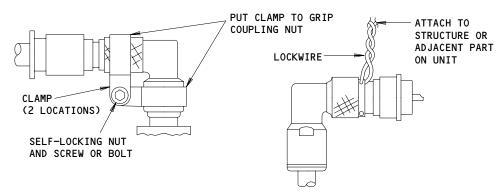
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Connector Lockwire - Installation Figure 402

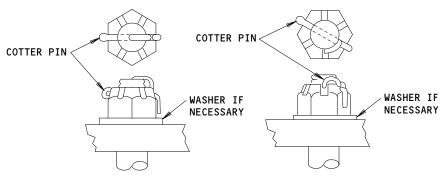
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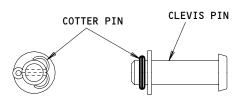
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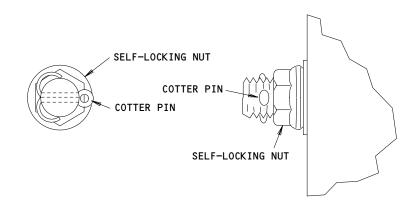
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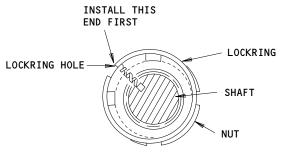
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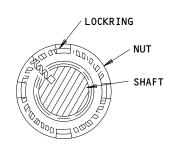












AFTER INSTALLATION

Locking Pins - Installation Figure 403

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## s 424-005

- (4) To install cotter pins (Fig. 403), do the applicable step:
  - (a) For castellated nuts, install the pin with the head parallel to the slot in the nut. Bend cotter pin ends to the bolt end or to the castellated nuts slit adjacent to the pin end.
  - (b) For clevis pins, put the pin through the hole on the bolt. Bend the pin ends around the side of the bolt.
  - For non-castellated nuts, install the pin through the hole on the bolt. Bend the pin ends back on each side of the bolt approximately 90 degrees.

## s 424-006

- (5) To install lock rings (Fig. 403), do these steps:
  - (a) Put the bent hook of the lock ring into an aligned locking hole in the shaft and nut but do not spring the ring.
  - Move the lockring above the flange into the groove with minimum expansion of the lockring.

EFFECTIVITY-

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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:
  - Lamp terminals
  - Terminal strips
  - Circuit breakers
  - Transformers
  - Switches
  - Hardwire
  - Wire junctions.

Lamp terminals with a rubber sleeve are open.

- C. Do not seal the dual grounds in fuel vapor areas or the wire junctions in fuel tanks.
- D. Do not seal the generator terminals on the engines or APU.
- E. Install wire and protectors on all secondary switch leads and seal all secondary switch terminals in the fuel vapor areas. Insulated splices are not open.
- F. To identify fuel vapor areas, see Fig. 201.

## TASK 20-11-29-202-007

- 2. Seal the Open Terminals
  - A. Equipment
    - (1) Paint brush, 1-inch wide Commercially Available
  - B. Consumable Materials
    - (1) B00083 Aliphatic Naphtha TT-N-95
    - (2) Use a sealant and the primer that goes with that sealant from Table 1.

SEALANT	
BMS 5-26 TYPE II	
BMS 5-37	
BMS 5-95	
BMS 5-142	

TABLE 1

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### C. Procedure

s 112-002

(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.

s 872-003

(2) Apply primer to the area you will seal. Use the primer specified in Table 1 for the sealant you will use.

s 392-004

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.

(3) Use a brush to apply one layer of sealant to the open areas. Make sure you seal all the open areas.

s 392-005

- (4) 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. 202).

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.

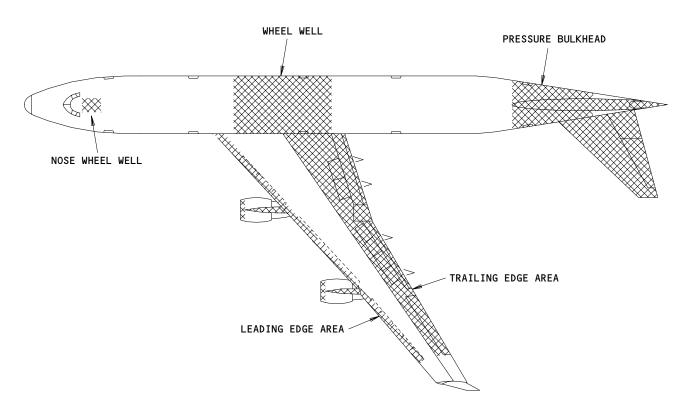
(b) If the edges of the terminals are less than 0.5 inch from each other, apply sealant to the edges.

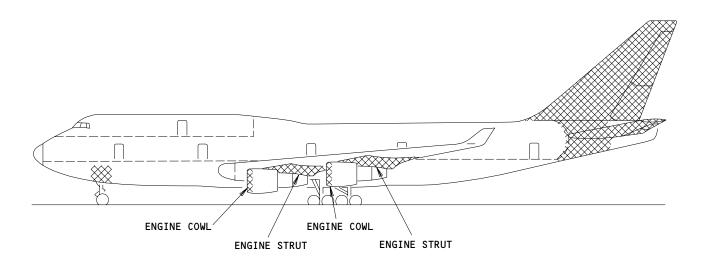
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FUEL VAPOR AREAS:

Fuel Vapor Areas Figure 201

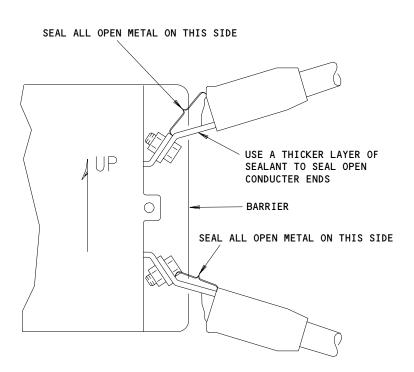
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## Sealant Installation on Ring Tongue Terminals Figure 202

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## COAXIAL CABLE - MAINTENANCE PRACTICES

## 1. General

- A. The subject that follows describes how to use a time domain reflectometer (TDR; Tektronix Model 1502B) to do a check of coaxial cables. The TDR is used to locate opens, shorts, crimps and other defects in coax cables up to 2,000 feet long. The TDR can also be used on twisted pair or parallel wires which are the same length.
- B. The TDR transmits pulses of energy down the cable. The TDR then monitors the impedance changes in the pulse energy that is reflected back. You can see these reflections on the liquid crystal display (LCD). You then find failures in the cable from the properties of the waveform shown on the LCD.
- C. The TDR has displays to help you. Push the MENU button to get access to these displays. To get out of the MENU function, continue to push MENU until it goes back to the "Normal Operation" mode.
- D. The TDR can be operated from a 115-volt ac or 230-volt ac (45 to 440Hz) power source or an optional internal battery pack. A minimum of 5 hours of operation time is available from the battery pack if it is fully charged.
- E. To do a check of a cable, you must disconnect the cable at each end. Connect the TDR to one end of the cable. Adapter cables to connect the TDR to the cable must be assembled locally. Use the applicable system wiring diagram to help isolate the failure to a specified connector, cable segment or black box.
- F. To find the distance in feet from one end of the cable to a failure, move the cursor on the LCD to the first impedance change. You will see the distance to the failure in the top right corner of the LCD.
- G. Refer to the Tektronix Operators Manual, part number 070-6266-00 for more data.

## TASK 20-11-31-212-001

## 2. Coaxial Cable Inspection

- A. General
  - (1) The TDR front panel has these controls:
    - (a) NOISE FILTER uses noise-averaging to decrease the quantity of noise on the waveform.
    - (b) VERT SCALE sets the vertical sensitivity (millirho per division) or vertical gain (dB).
    - (c) DIST/DIV sets the number of feet (meters) for each division across the LCD.
    - (d) Vp velocity of propagation. You set these controls to the propagation velocity value of the cable.
    - (e) POWER pull for power on, push for power off.
    - (f) ΔPOSITION moves the waveform up or down on the LCD.

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- (g) <>POSITION moves the vertical cursor across the LCD. The waveform is also moved when the cursor gets to the far right or left side of the LCD.
- (h) MENU gives access to the menu.
- (i) VIEW INPUT permits you to view or remove the waveform shown on the LCD.
- (j) VIEW STORE shows the waveform that is kept in memory.
- (k) VIEW DIFF shows the result of the waveform shown minus the waveform in memory.
- (l) STORE puts the waveform into memory.
- (2) Vp is the speed of a signal down the cable. This value is different for different types of cables. If you do not know the Vp, refer to Table 1 for approximate values.

NOTE: If the Vp is set incorrectly, the failure will show but the distance will possibly not be accurate.

TYPE OF CABLE	PROBABLE Vp
Jelly Filled	.64
Polyethylene (PIC, PE, or SPE)	.66
PTFE (Teflon) or TFE	.70
Pulp Insulation	.72
Foam or Cellular PE (FPE)	.78
Semi—solid PE (SSPE)	.84
Air (Helical spacers)	.98

## TABLE 1

- (3) Bleed a cable before you attach it to the TDR to remove static from the cable. You can use a 50 ohm terminator and a BNC adapter to bleed a cable.
- (4) You will always see a rising pulse at the start of the waveform. This is the test pulse from the TDR.
- (5) During this procedure the cable that you do a check of will be referred to as the applicable cable.

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- B. Special Tools and Equipment
  - (1) Tektronix 1502B Time Domain Reflectometer
- C. References
  - (1) Wiring Diagram Manual
  - (2) 20-11-22/401, Rack-Mounted Electrical/Electronic Module
- D. Access
  - (1) Location Zone

117/118 Electrical and Electronics Compartment

#### E. Procedure

s 862-002

- (1) Prepare the applicable cable and the TDR (Fig. 201):
  - (a) Pull the POWER button to the ON position.
  - (b) Connect an adapter cable to the BNC on the front panel of the TDR.
  - (c) Remove the black box at one end of the applicable cable (Ref 20-11-22/401).
  - (d) Disconnect the applicable cable at the other end.

CAUTION: DO NOT DIRECTLY TOUCH THE RACK CONNECTORS. THIS CAN CAUSE DAMAGE. USE A BREAKOUT BOX.

(e) Attach a breakout box to the rack connector where the black box was installed.

CAUTION: DO NOT ATTACH LIVE CIRCUIT CABLES TO THE INPUT OF THE TDR.
VOLTAGES MORE THAN 5 VOLTS CAN CAUSE DAMAGE TO THE
SAMPLING GATE OR TUNNEL DIODE.

- (f) Connect the adapter cable from the TDR to the applicable test points on the breakout box.
- (g) Connect a 50 ohm terminator to the open end of the applicable cable.
- (h) Set the NOISE FILTER on the TDR to 1 avg.
- (i) Set the VERT SCALE to 500 mp.
- (j) Set the DIST/DIV switch to show the full cable length.

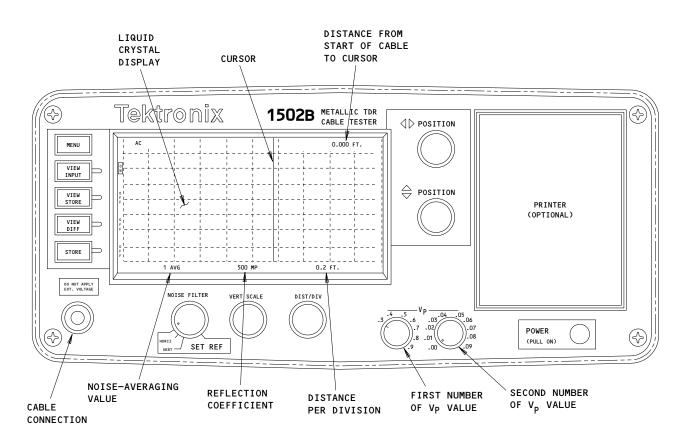
NOTE: For example, for a 20 foot cable it will be necessary to have 4 divisions on the display if you use 5 ft/DIV. If you do not know the cable length, set the DIST/DIV to 200 ft/DIV and continue to decrease the DIST/DIV until you see the full waveform. With a 50 ohm terminator attached, the applicable cable will show as a length of no limit.

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TDR FRONT PANEL

# Time Domain Reflectometer Controls Figure 201

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(k) Set the Vp controls for the applicable cable.

NOTE: The left control is the first number and the right control is the second number of the Vp value.

- (1) Make allowance for the adapter cable and breakout box.
  - 1) Measure the distance from the BNC on the TDR to the start of the applicable cable.

NOTE: This is the length of the adapter cable.

- 2) Turn the NOISE FILTER control to HORZ SET REF.
- 3) Turn the <>POSITION control to move the cursor until the distance shown is equal to the adapter cable length.
- 4) Push STORE.
- 5) Turn the NOISE FILTER control to 1 avg.
- 6) Make sure you see 0.000ft∆ on the LCD.

NOTE: This is the start of the applicable cable.

## s 282-003

- (2) Examine the applicable cable (Fig. 202):
  - (a) Examine the waveform shown on the LCD.
  - (b) Make sure you have a straight line waveform equal to the length of the applicable cable (if known).
  - (c) If it is necessary, turn the NOISE FILTER clockwise to average-out some of the noise.

<u>NOTE</u>: This will increase the time necessary for the TDR to give a waveform output.

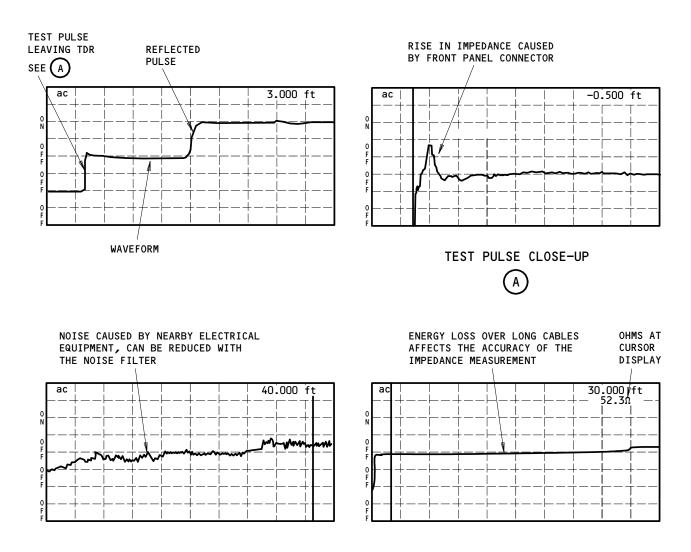
- (d) Make sure these failure conditions do not show.
  - A drop in the waveform, this shows a short circuit in the applicable cable.
  - 2) A rise in the waveform, this shows an open circuit in the appplicable cable.
  - 3) Hills and valleys in the waveform, these can show bends, kinks, frays and water in the applicable cable.
- (e) If you see a failure condition in the applicable cable, turn the <>POSITION control.
- (f) Put the cursor on the leading edge of the rising or falling pulse.

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USUAL CABLE CONDITIONS

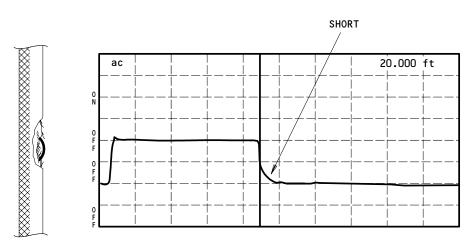
Time Domain Reflectometer Displays
Figure 202 (Sheet 1)

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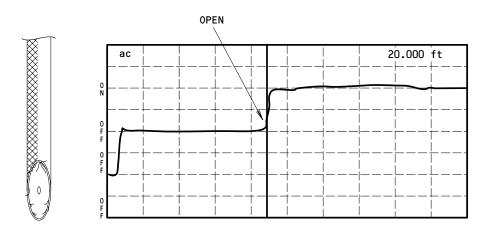
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SHORTED CABLE



CUT CABLE EXAMPLES OF CABLE FAILURE CONDITIONS

Time Domain Reflectometer Displays Figure 202 (Sheet 2)

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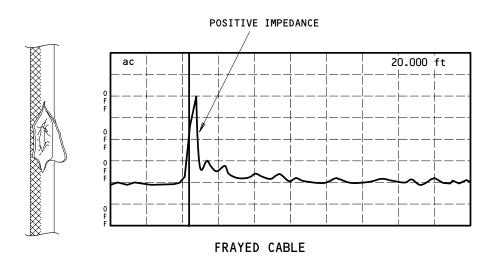
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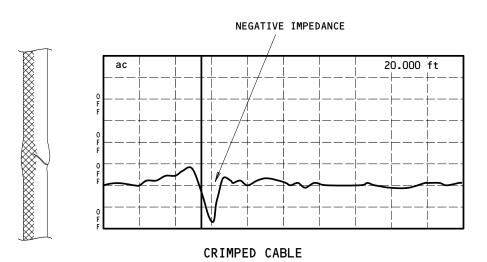
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EXAMPLES OF CABLE FAILURE CONDITIONS

Time Domain Reflectometer Displays Figure 202 (Sheet 3)

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(g) Read the distance in the top right corner of the LCD.

NOTE: This value is the distance from the start of the applicable cable to the cause of the failure.

- (h) If you do not use a 50 ohm terminator, you will see an open circuit at the end of the applicable cable.
- (i) Make a note of the distance to the open circuit.
  - 1) Use a jumper to cause a short circuit on the other end of the applicable cable.
  - 2) Examine the waveform shown on the LCD.
  - 3) Make sure the waveform now shows a short circuit where the open circuit was.

NOTE: The length of the applicable cable is the distance shown on the LCD.

4) If the waveform continues to show an open circuit at the same distance from the TDR, this is a failure.

<u>NOTE</u>: The distance to the open is the distance to the failure.

s 972-004

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(3) Measure the reflection coefficient:

NOTE: The reflection coefficient (p) is a measure of the impedance change at a point in the applicable cable. It is used to find if the failure condition is important or not.

- (a) Adjust the VERT SCALE to make the waveform one division high.
- (b) Turn the <>POSITION control until the line-cursor is on the failure condition.
- (c) Read the reflection coefficient directly off the LCD above the VERT SCALE control.
  - A good waveform with no failure conditions (flat) will have a reflection coefficient of zero.
  - 2) Small impedance changes from 10mp to 100mp can possibly be a cable connector and are usually not important.

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3) Large impedance changes of +/- 1000mp show an open or a short circuit in the applicable cable.

NOTE: A positive value shows an increase in impedance and will be a hill on the waveform. A negative value shows a decrease in impedance and will be a valley on the waveform.

- The TDR can also calculate and show the impedance, in ohms, at the cursor position on the applicable cable.
  - This function is available from the SETUP MENU.
  - The value will show under the 'distance to cursor' value on the LCD.
  - 3) Most 50 ohm coaxial cable is manufactured to an impedance of 50+/-2 ohms.
- F. Put the Cable Back to its usual Condition

s 082-005

(1) Disconnect the TDR adapter cable from the breakout box.

s 092-006

(2) Remove the breakout box.

s 082-007

Remove the 50 ohm terminator (or jumper) from the other end of the applicable cable.

s 412-008

(4) Install the applicable black box (Ref 20-11-22/401).

s 432-009

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(5) Connect the applicable cable at the two ends.

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## FLIGHT CONTROL SURFACES SAFETY HARNESS RECEPTACLE - MAINTENANCE PRACTICES

## 1. General

- A. This procedure contains one task. The task is to attach the safety harness to the flight control surfaces.
- B. Receptacles for the safety harness are on the top surfaces of the wing and horizontal stabilizer. Maintenance persons who work high above the ground will attach their safety harnesses to these receptacles.

## TASK 20-11-33-402-001

## 2. Attach the Safety Harness

- A. General
  - (1) There are four receptacles on the wing upper surface and four receptacles on the horizontal stabilizer upper surface.
  - (2) The safety harness attach lanyard uses a lock assembly.
- B. Equipment
  - (1) Attach Lanyard Wing/Horizontal Stabilizer Safety Harness, B20001-5
- C. Procedure

s 422-003

WARNING: DO NOT WALK ON THE WINGS OR THE HORIZONTAL STABILIZER.

ICE OR SNOW ON THESE SURFACES IS NOT SAFE. MAINTENANCE
PERSONS CAN FALL WHICH MAY CAUSE INJURY TO PERSONS OR
DAMAGE TO EQUIPMENT.

WARNING: USE A MAN LIFT TO ATTACH THE SAFETY HARNESS FITTINGS TO THE RECEPTACLES. MAINTENANCE PERSONS CAN FALL WHICH MAY CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

(1) Set up the safety equipment.

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- (a) Put on the full body safety harness.
- (b) Attach the hook end of the lanyard to the body harness.

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- (c) Attach the opposite end of the lanyard to the anchor fitting in the attachment receptacle on the surface you are working.
- (d) Adjust the lock assembly until it is aligned with the airplane skin.

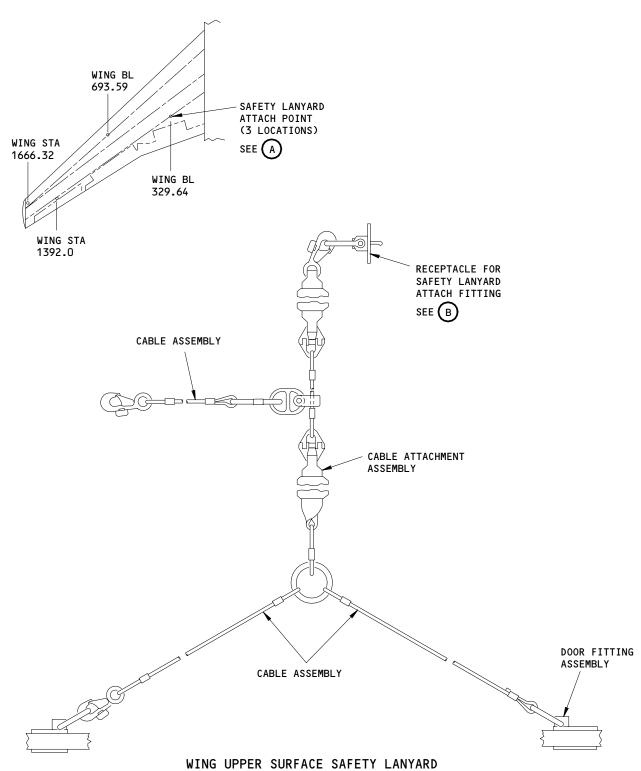
NOTE: If not aligned, there is a risk the lock assembly will not engage correctly.

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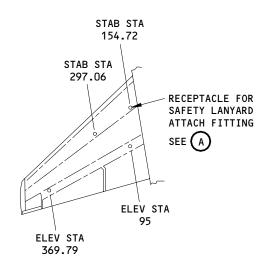
Flight Control Surfaces Safety Lanyard Attach Points
Figure 201 (Sheet 1)

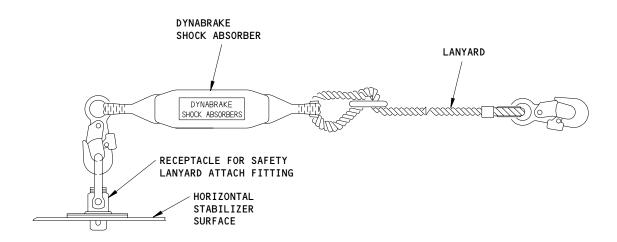
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## HORIZONTAL STABILIZER ATTACH LANYARD

Flight Control Surfaces Safety Lanyard Attach Points Figure 201 (Sheet 2)

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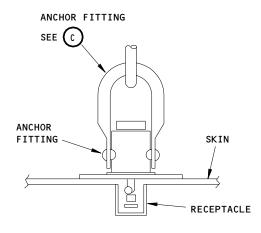




RECEPTACLE FOR SAFETY LANYARD ANCHOR FITTING SEE B

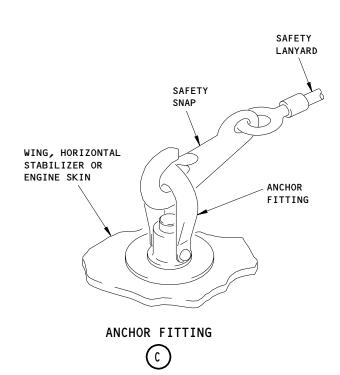
SAFETY LANYARD ATTACH POINT

(A)



RECEPTACLE FOR SAFETY LANYARD ANCHOR FITTING





Flight Control Surfaces Safety Lanyard Attach Points Figure 201 (Sheet 3)

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## OFF-AIRPLANE DATA LOADING - MAINTENANCE PRACTICES

## 1. General

A. On-board software loadable LRUs can be loaded with software on the airplane using the AMM Software Installation procedures for each software loadable LRU or off the airplane using these off-airplane loading procedures. The AMM on-airplane Software Installation procedure for each software loadable LRU is contained within the respective ATA chapter for the LRU. This procedure provides details for the software loading of an LRU off the airplane.

TASK 20-15-01-472-001

## 2. Off-Airplane Software Installation

- A. Equipment
  - (1) Off-airplane data loading equipment may have the capability to support various interfaces: i.e., ARINC 429, ARINC 629, RS232, and PC cards. Off-airplane data loading equipment may be used to load several software loadable LRUs. Reference the airlines off-airplane data loading policy to determine which LRUs can be off-airplane loaded with the following equipment. For off-airplane data loading equipment information contact an off-airplane data loading equipment vendor directly.
    - (a) PAC-429S-DLS, ARINC 615 Data Load Simulator Pacific Avionics Corporation 8640-154th Avenue NE Redmond, Washington 98052-3556

Telephone: (425) 883-1811 Fax: (425) 861-9898

(b) 777 Shop Loader
Pacific Avionics Corporation
8640 154th Avenue NE
Redmond, Washington 98052-3556
Telephone: (425) 883-1811
Fax: (425) 861-9898

(c) 615 FDS, Flightline Dataload Station Qualtair, Incorporated 2100 196th Street SW, Suite 125 Lynwood, Washington 98036 Telephone: (425) 672-8786 Fax: (425) 672-8849

(d) QSL7X7, Shop Data Loader Qualtair, Incorporated 2100 196th Street SW, Suite 125 Lynwood, Washington 98036

Telephone: (425) 672-8786 Fax: (425) 672-8849

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(e) or equivalent.

#### B. Procedures

s 022-002

(1) Off-airplane data loading is accomplished on software loadable LRUs that are removed from the airplane or are taken out of stores.

s 422-003

(2) An LRU which is removed from the airplane for the purpose of off-airplane loading must be installed using the AMM Removal and Installation procedures. The R & I procedures will require that you make sure that the correct software is installed in the LRU.

s 942-004

(3) Refer to the appropriate airline's documentation for the correct software part number or numbers for each software loadable LRU prior to performing this software loading procedure.

s 942-005

(4) The procedures for software loading using off-airplane data loading equipment are documented in the respective supplier's off-airplane data loading equipment user's manual.

s 942-006

(5) Refer to the airline's off-airplane data loading policy for additional off-airplane loading equipment and procedures information.

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### ON-AIRPLANE SOFTWARE INSTALLATION - MAINTENANCE PRACTICES

### TASK 20-15-11-402-001

# 1. On-Airplane Software Installation

- A. General
  - (1) Software Installation Times
    - (a) The time required to install software in a component is variable and is dependent on several factors that include:
      - 1) Retrieval of the correct software media, applicable equipment and Maintenance Manual procedure.
      - 2) Setup procedures.
      - 3) Data transfer time.
      - 4) Software configuration check.
      - 5) Return to usual airplane configuration.
      - 6) Airline completion procedures.
  - (2) Data Transfer Times
    - (a) The data transfer time is the actual time from disk or disks insertion into the data loader until the data transfer is complete.
    - (b) The data transfer time depends on:
      - 1) The number of disks.
      - The type and size of software files on each disk.
      - 3) The unique protocols and processors of the data loader.
      - 4) The unique internal protocols and processors of the component.
      - 5) Disks inserted in a timely manner.
    - (c) Typical data transfer times are:
      - 1) Operational Program Software (OPS): approximately 5 to 16 minutes per disk; for example, if the OPS has four disks, then the complete installation can take as long as 64 minutes.
      - 2) Operational Program Configuration (OPC): approximately 1 to 3 minutes per disk.
      - 3) Databases: approximately 3 to 15 minutes per disk.

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- (3) Table 201 Data Transfer Times
  - (a) Table 201 shows data transfer times for components that are approved for on-airplane software installation. Not all components are installed on all airplanes. If a component is installed on an airplane, then there is a software installation procedure applicable to that airplane. The software installation procedure is in the AMM chapter-section given in the table.
  - (b) The types of software installed in a component on one airplane can be different than the types of software installed in the component on a different airplane. For example, some ACARS management units have an OPS and database, but other ACARS management units only have an OPS.
    - A component on the list can have some hardware part numbers that are approved for software installation and other hardware part numbers that are not approved for software installation. An example of this is the ACARS management unit.
    - 2) Refer to airline part number records to find software part numbers for applicable components.
  - (c) Data transfer times are approximate times in minutes for software installed from disks with a data loader. Data transfers can fail, and failure of the data transfer will increase the total time necessary for software installation. Data transfer times are supplied only as an aid to help you schedule work.
  - (d) The times given are for the installation of one piece of software into one component.
    - If a component has more than one piece of software, then you must add the time for each piece to find the total data transfer time for the component.
    - 2) If a system has more than one of a given component, and software is to be installed in each one, you must multiply the time given in the table by the total number of components to find the total data transfer time for the system.
      - a) For example, if a left and a right component are installed on the airplane, you must multiply the time given in the table by two to find the total data transfer time for the two components.

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b) Some systems can cross-load software between components. Usually it is faster to cross-load software than to install software with a data loader. The Flight Management Computer System (FMCS) is an example of a system that can cross-load.

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Table 201			
AMM Chapter Section	Component	Software	Data Transfer Time (in Minutes)
22-11	Flight Control Computer (FCC) (-150 Series with on-airplane software installation configur- ation)	OPS OPC	3 to 5 1
23–15	Satellite Data Unit (SDU) (Rockwell Collins)	OPS ORT (DB)	15 to 48 1 to 5
23–15	Satellite Data Unit (SDU) (Honeywell)	USER ORT (DB) SECURED ORT (DB)	1 to 5 1 to 5
23–27	ACARS Management Unit (MU/CMU) (some Allied Signal units)	CORE & Application (OPS) Airplane Database (DB)	5 to 16 1 to 15
23–27	ACARS Management Unit (MU/CMU) (some Rockwell Collins units)	CORE (OPS) AOC (DB)	2 to 16 3 to 15
23–27	ACARS Management Unit (MU/CMU) (some Teledyne units)	Application (OPS)	5 to 16
23–30	ACESS Central Management Unit (CMU)	OPS Configuration Database	10 to 15 3 to 15
23–30	ACESS Cabin Interphone Controller (CIC)	OPS *[1] OPS *[2] Configuration DB *[1] Configuration DB *[2]	10 to 15 35 to 45 3 to 15 5 to 15
23–30	ACESS Entertainment Service Controller (ESC)	OPS *[1] OPS *[2] Configuration DB *[1] Configuration DB *[2]	10 to 15 25 to 35 3 to 15 5 to 15

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	Table 201			
	AMM Chapter Section	Component	Software	Data Transfer Time (in Minutes)
I	23-30	ACESS Local Area Controller (LAC)	OPS *[1] OPS *[2] Configuration DB *[1] Configuration DB *[2]	7 to 15 30 to 40 3 to 15 5 to 15
I	23–30	ACESS Passenger Address Controller (PAC)	OPS *[1] OPS *[2] Configuration DB *[1] Configuration DB *[2]	9 to 15 20 to 30 3 to 15 5 to 15
I	23-30	CSS Passenger Service Controller (PSC)	OPS *[3] OPS *[4] Configuration DB *[3] Configuration DB *[4]	6 to 10 12 to 18 1 to 2 6 to 12
I	23-30	CSS Cabin Interphone Controller (CIC)	OPS *[3] OPS *[4] Configuration DB *[3] Configuration DB *[4]	3 to 4 50 to 60 1 to 2 6 to 12
I	23-30	CSS Local Area Controller (LAC)	OPS *[3] OPS *[4] Configuration DB *[3] Configuration DB *[4]	4 to 5 5 to 15 1 to 2 6 to 12
I	23-30	CSS Passenger Address Controller (PAC)	OPS *[3] OPS *[4] Configuration DB *[3] Configuration DB *[4]	2 to 3 20 to 25 1 to 2 6 to 12

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Table 201			
AMM Chapter Section	Component	Software	Data Transfer Time (in Minutes)
23–38	Digital Interface Unit (Passenger Flight Information Display System)	Airshow DB *[5]	3 to 15
31–35	Optical Quick Access Recorder (Teledyne)	OPS *[6]	30
31-35	Data Management Unit (DMU)	ACMS OPS	5 to 16
31–61	IDS EFIS/EICAS Interface Unit (EIU)	OPS	12 to 16
31–61	IDS Integrated Display Unit (IDU)	OPS	8 to 10
34-46	Enhanced Ground Proximity Warning Computer (EGPWC)	DB *[7]	7
34-61	Flight Management Computer (FMC)	OPS Nav DB	6 to 7 24 to 30
45-10	Central Maintenance Computer (CMC)	OPS Airline Data Base	15 to 20 1 to 3

- \*[1] From data loader to cabin management unit (CMU).
- \*[2] From CMU to component.
- \*[3] From data loader to passenger service controller (PSC).
- \*[4] From PSC to component.
- \*[5] Software is installed from disk or CD-ROM.
- \*[6] Software is installed from disk drive at component front panel.
- \*[7] Software is installed from PCMCIA card at component front panel.

# (4) Data Loaders

- (a) This procedure supplies general information about data load equipment. You can find the data load equipment for the airplane configuration in the Flight Management Computer System (34-61).
- (b) A data loader is a disk drive that connects to a component through interface wiring. Software disks are inserted into the disk drive and the data is transferred to the component.

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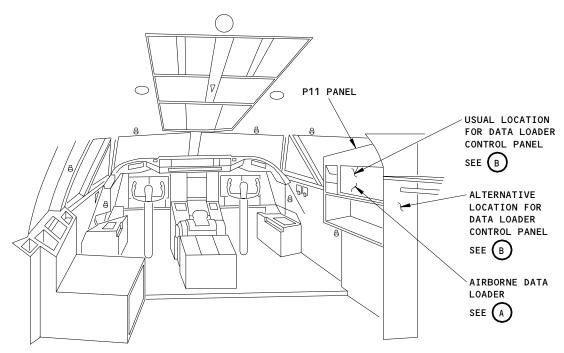
- (c) There are two types of data loaders: airborne data loaders and portable data loaders.
- (d) An airborne data loader is a data loader that is installed in the flight compartment on the P11 panel.
- (e) A portable data loader (PDL) is equipment that is moved to the airplane to install software. The PDL is removed from the airplane when the task is complete.
- (f) The data loader control panel is installed on the first observer's console panel, P11. Sometimes the data loader control panel is installed on the aft end of the P11 panel in the coat stowage area.
  - 1) There is interface wiring between the data loader control panel and the components that can receive software installations from the flight compartment. The data loader control panel has a switch position for each component that can receive software. INOP labels are attached on switch positions that are not available for software installation.
- (g) Figure 201 shows examples of data loader control panels and airborne data loaders.
- (5) Alternative Software Installation
  - (a) Usually software is installed with a data loader in the flight compartment. But some components have a disk drive, CD-ROM drive, PDL connector, or PCMCIA (personal computer memory card international association) interface for software installation at the front of the component.
- (6) Airborne Data Loaders (ADL)
  - (a) This procedure supplies examples for operation of these ADLs:
    - Allied Signal (Sundstrand)
    - 2) Teledyne
- (7) Portable Data Loaders (PDL)
  - (a) Somes airplanes do not have an airborne data loader. If there is no airborne data loader, then there is an interface connector for a portable data loader. The connector will be near the data loader control panel. The circuit breaker that supplies power for the PDL must be open when a PDL is connected or disconnected.

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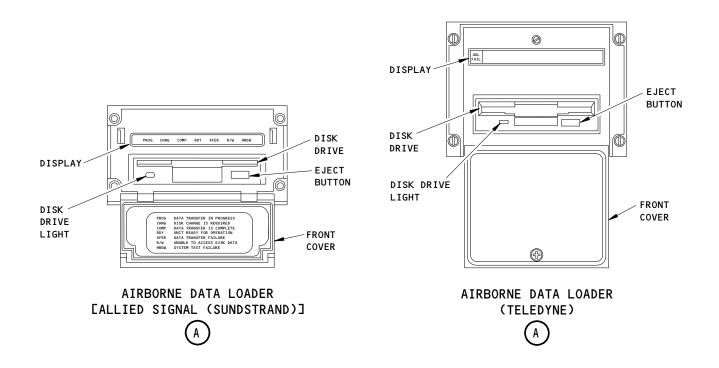
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FLIGHT COMPARTMENT



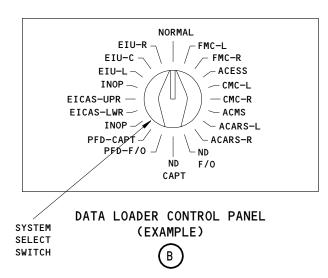
On-Airplane Software Installation Figure 201 (Sheet 1)

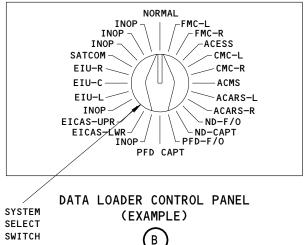
ALL

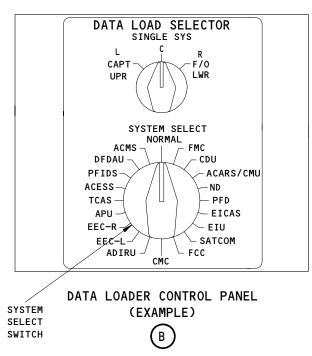
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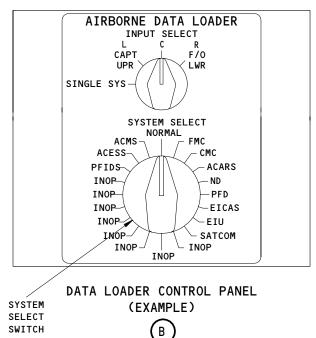
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On-Airplane Software Installation Figure 201 (Sheet 2)

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01

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- (b) PDLs are not Boeing supplied parts. Refer to the data loader supplier for instructions for PDL operation.
- B. References
  - (1) AMM 24-22-00/201, Control
- C. Access
- D. Allied Signal (Sundstrand) Airborne Data Loader Procedure

s 862-003

- (1) The Allied Signal ADL has these status lights:
  - (a) PROG (In Progress) shows as software installation occurs.
  - (b) CHNG (Change) shows when it is time to install the next disk.
  - (c) COMP (Complete) shows when the software installation is completed.
  - (d) RDY (Ready) shows when the disk is in the disk drive and the ADL is ready to install the software in the component.
    - 1) If the RDY indication flashes, then the data loader is in standby mode while it waits for the component to validate the data.
  - (e) XFER (Transfer Fail) shows when the software installation is not completed. Open and close the circuit breaker for the component, and start the installation again.
  - (f) R/W (Read/Write) shows when the ADL cannot read or write the data on the disk. Open and close the circuit breaker for the component, and start the installation again. If the problem continues, then replace the disk.
  - (g) HRDW (Hardware) shows when the ADL fails the self test.

s 862-004

- (2) Supply electrical power (AMM 24-22-00/201).
  - (a) Make sure that the power is not removed while you install software.

<u>NOTE</u>: A power interruption will cause a failure of the software installation.

s 862-005

ALL

(3) Make sure that the system select switch on the data loader control panel (P11) is set to NORMAL.

EFFECTIVITY-

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01.1



s 862-006

(4) Open this circuit breaker:

(a) On the main power distribution panel, P6:

1) 6L35 FMC DATA BASE

s 012-007

(5) To open the ADL front cover, pull at the top edge.

s 862-008

(6) Push the eject button on the ADL.

(a) If a plastic protective disk is ejected from the disk drive, then remove it.

s 862-009

(7) Close this circuit breaker:

(a) On the P6 panel:

1) 6L35 FMC DATA BASE

s 862-010

(8) Wait until all the status lights are off.

NOTE: The status lights will flash on and off while the ADL does a self test.

s 862-011

(9) Make sure that the circuit breakers are closed for the applicable component or system that will receive the new software.

s 422-012

(10) Do these steps at the ADL to install the software:

<u>NOTE</u>: You must know the correct software part numbers for the component. For the component to be an approved installation, software with the correct part numbers must be installed.

<u>NOTE</u>: This is a general procedure for software installation. Some components have other steps that are necessary. The software installation task for the component will include all necessary steps.

(a) Set the switch or switches on the data loader control panel to the applicable position for your component or system.

EFFECTIVITY-

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(b) Carefully push the first disk (label up) into the disk drive.

If the destination component is active, the installation sequence will begin and the RDY light will come on. When the data transfer begins, the PROG light will come on. The RDY light can flash when the component validates the data. If the software is on more than one disk, the CHNG light will come on when it is time to put in the subsequent disk.

If the CHNG light comes on, wait approximately 10 seconds and then push the eject button.

NOTE: The installation can fail if you wait too long before you remove and install disks.

- 1) Remove the disk from the disk drive.
- 2) Put the subsequent disk into the disk drive.
- 3) If there are more than two disks for the software installation, then remove and install disks until the COMP light shows.
- When the COMP light comes on, wait approximately 10 seconds and then push the eject button.
- Remove the disk from the disk drive. (e)
- (f) If there was a plastic protective disk in the disk drive before you installed software, then put it back into the disk drive.

s 862-013

(11) Set the system select switch on the data loader control panel to NORMAL.

s 412-014

(12) Close the front cover on the ADL.

s 742-015

(13) Make sure that the correct software part numbers are installed in the component.

NOTE: The software installation task for the component has the steps to do a software configuration check.

s 862-016

ALL

(14) Remove electrical power (AMM 24-22-00/201).

EFFECTIVITY-

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01.1



#### E. Teledyne Airborne Data Loader Procedure

s 862-017

- (1) Supply electrical power (AMM 24-22-00/201).
  - (a) Make sure that the power is not removed while you install software.

<u>NOTE</u>: A power interruption will cause a failure of the software installation.

s 862-018

(2) Make sure that the system select switch on the data loader control panel (P11) is set to NORMAL.

s 862-019

- (3) Open this circuit breaker:
  - (a) On the main power distribution panel, P6:
    - 1) 6L35 FMC DATA BASE

s 012-020

(4) To open the ADL front cover, turn the cover knob clockwise and pull.

s 862-021

- (5) Push the eject button on the ADL.
  - (a) If a plastic protective disk is ejected from the disk drive, then remove it.

s 862-022

- (6) Close this circuit breaker:
  - (a) On the P6 panel:
    - 1) 6L35 FMC DATA BASE

s 862-023

(7) Wait until the display shows INSERT DISK #1.

NOTE: The display lights and the ADL FAIL light will go on and off while the ADL does a self test. When the self test is complete, the display will show INSERT DISK #1.

s 862-024

ALL

(8) Make sure that the circuit breakers are closed for the applicable component or system that will receive the new software.

EFFECTIVITY-

20-15-11



s 422-025

(9) Do these steps at the ADL to install the software:

NOTE: You must know the correct software part numbers for the component. For the component to be an approved installation, software with the correct part numbers must be installed.

NOTE: This is a general procedure for software installation.

Some components have other steps that are necessary. The software installation task for the component will include all necessary steps.

- (a) Set the switch or switches on the data loader control panel to the applicable position for your component or system.
- (b) Carefully push the first disk (label up) into the disk drive.

NOTE: The display will show DISK INSERTED and then VOL: followed by the disk volume label, if there is one. If the destination component is active, the display will then show the file, extension and the percent of the file transfer completed. If there is more than one file, the ADL will install the next file until all files are completed. If the software is on more than one disk, then the display will show CHANGE DISK or INSERT DISK when it is time to put in the subsequent disk.

NOTE: LOAD IN PROGRESS can show if the component puts the data loader in standby while it does a check of the data.

TRANSFERRED total number of blocks can show after a file transfer.

NOTE: If TRANSFER FAIL shows, then the installation is not completed. Open and close the circuit breaker for the component, and start the installation again.

IF READ/WRITE FAIL shows, then there is a problem with the disk. Open and close the circuit breaker for the component, and start the installation again. If the problem continues, then replace the disk.

(c) If CHANGE DISK or INSERT DISK shows on the display, wait approximately 10 seconds and then push the eject button.

<u>NOTE</u>: The installation can fail if you wait too long before you remove and install disks.

- 1) Remove the disk from the disk drive.
- 2) Put the subsequent disk into the disk drive.

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- 3) If there are more than two disks for the software installation, then remove and install disks until the display shows that the installation is completed.
- (d) When the installation is completed, wait approximately 10 seconds and then push the eject button.

NOTE: COMP, COMPLETE, or LOAD COMPLETE are examples of indications for a completed installation.

- (e) Remove the disk from the disk drive.
- (f) If there was a plastic protective disk in the disk drive before you installed software, then put it back in the disk drive.

s 862-026

(10) Set the system select switch on the data loader control panel to NORMAL.

s 412-027

(11) Close the front cover on the ADL.

s 742-028

(12) Make sure that the correct software part numbers are installed in the component.

<u>NOTE</u>: The software installation task for the component has the steps to do a software configuration check.

s 862-029

(13) Remove electrical power (AMM 24-22-00/201).

EFFECTIVITY-

20-15-11

ALL



## SELF-LUBRICATED BEARINGS AND BUSHINGS - INSPECTION/CHECK

## 1. General

- A. This procedure contains three tasks:
  - (1) The first task has two inspection/check procedures of bearings and bushings. One procedure is for bearings and bushing that are installed on the airplane. The other procedure is when the bearings and bushing are on the bench.
  - (2) The second is an inspection/check of special bushing and bearing configurations. Special bushings and bearings are those with holes, keyways, flanges, threads or other special properties.
  - (3) The third is an inspection/check of bushings and bearings (bench check). Do this task after you have done the bench test instructions from the first task. This task gives steps to do a check of the breakaway torque of spherical bearings.
- B. You can examine the self-lubricated (teflon-cloth lining) bearings and bushings on the airplane, or removed (bench check). The recommended procedure is the bench check. During the bench check you fully examine the parts for signs of damage from corrosion or cracks. Also, you can do a torque check of the bearing inner race.

TASK 20-21-02-206-001

- 2. <u>Bearings and Bushings Inspection/Check</u>
  - A. Procedure Check of Self-Lubricated Bearings and Bushings (Installed on the Airplane)

s 216-019

CAUTION: DO NOT LUBRICATE TEFLON BEARINGS. TEFLON BEARINGS ARE SELF-LUBRICATED. GREASE OR OTHER LUBRICANTS CAN CAUSE LINING DETERIORATION.

- (1) Examine the bearings or bushings to make sure they are not too worn or too loose as follows:
  - NOTE: If you find more than 0.010-inch internal diametrical play, you must carefully examine the bearings or bushings. Reject a bearing that has signs of galling of the bearing surfaces. If there is play but not galling, then examine the parts for a failure condition given at each maintenance inspection. These bearings and bushings do not always have noise when they are loose.
  - (a) Try to move and turn the assembly to make sure the bearing or bushing is not too worn.

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- (b) Make sure the bearing is not loosely held by its housing or turns in it housing.
- (c) Make sure there is not damage, cracks or too much corrosion on the bearing or housing.

#### s 216-003

(2) If you can turn the bearing, or if removal of bolts permits you to turn the bearing, do the steps that follow:

<u>NOTE</u>: If you can see the lining after bolt removal, refer to the bench check instructions and examine the lining material.

- (a) Turn the bearing without a load on the bearing.
  - Make sure it is not too worn, is rough, or has too much drag.
- (b) Turn the bearing while you apply a load.
  - 1) Make sure it is not too worn, is rough, or has too much drag.

### s 216-004

(3) Examine the bearings and bushings to make sure there is not lining material that comes out of the housing too far.

NOTE: Some bushings and bearings have some lining material that comes out a small distance when they are made. These bearings and bushings can be serviceable.

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

s 216-017

CAUTION: DO NOT LUBRICATE TEFLON BEARINGS. TEFLON BEARINGS ARE SELF-LUBRICATED. GREASE OR OTHER LUBRICANTS CAN CAUSE LINING DETERIORATION.

(1) Examine the bearing or bushing for physical damage, cracks, corrosion.

## s 216-018

(2) Examine the bearing or bushing to see if it turns in the housing or for fretting on the surfaces without the lining.

<u>NOTE</u>: If the bearing or bushing turns in the housing, you must measure the dimensions to make sure it is not too worn.

### s 216-006

(3) Manually turn the bearings and feel for signs that it is too rough, too loose, has too much drag or unusual drag.

EFFECTIVITY-

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s 216-007

(4) Do a check of the bearing lining:

NOTE: On most spherical bearings, you can turn the ball and look at the lining through the bearing bore.

- (a) Examine the lining for worn areas.
  - Usually, reject bearings and bushings that have internal diameterical play of 0.010 inch. But, use service experience and the applicable permitted wear limits to know if the part is serviceable.
- (b) Examine the lining load pattern.
  - Examine the surface where the lining and ball/pin touch.
     Make sure all of the surface has an equal load.

<u>NOTE</u>: Incorrect swaging during manufacture or installation can cause the edges of the lining to wear too much.

These bearings and bushings are not serviceable.

- (c) Examine the lining for unwanted material.
  - Examine the lining to make sure that no unwanted material became attached.
- (d) Examine the lining for chemical deterioration.
  - Examine the lining and lining bond for signs of chemical damage.

s 216-008

(5) Do the Bearing/Bushing - Inspection/Check (Bench Check) task.

TASK 20-21-02-206-009

- 3. Special Bearing and Bushing Configurations Inspection/Check
  - A. Procedure Special Bearing and Bushing Configurations Check

s 216-010

(1) Examine aluminum bearing races for serviceable surface treatment or plating, and for corrosion and cracks.

s 216-011

(2) Examine special configuration bearings with threads, holes, keyways, flanges, or equivalent properties for cracks in these areas.

<u>NOTE</u>: These special configurations can cause stress risers in these areas.

s 216-012

(3) Do the Bearing/Bushing - Inspection/Check (Bench Check) task.

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TASK 20-21-02-206-013

- Bushings and Bearings (Bench Check) Inspection/Check
  - General
    - (1) Before you do this task, do the procedure Check of Self-Lubricated Bearings and Bushings (Bench Check) in the first task.
  - B. Procedure - Wear Check

s 226-014

To determine the amount of bearing wear, manually apply a reversing load to bearing in a simple holding fixture and measure play with a dial indicator. Radial wear should be measured by applying a reversing radial load of 10 to 15 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.

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.

C. Procedure - Bearing Breakaway Torque on Spherical Bearing Check

s 226-015

(1) To do the breakaway preload torque checks, measure the torque necessary to turn one race with the other contamination race.

The bearing must not have lubricants or other contamination. NOTE: The breakaway torque must not be more than twice the permitted rotational preload torque (Table 601).

NOTE: Measure the breakaway torque before you do the rotational torque checks. Do the test at room temperature.

EFFECTIVITY-

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D. Procedure - Bearing Rotational Torque on Spherical Bearing Check

s 226-016

(1) To do the rotational preload torque checks, measure the torque necessary to turn one race with the other race held.

NOTE: The bearing must not have lubricants or other contamination.

NOTE: Measure the breakaway torque before you do the rotational torque checks. For rotational torque tests, you must turn the bearing through two or three full turns immediately before you measure the torque. Do the tests at room temperature.

<u>NOTE</u>: See Table 601 for permitted rotational preload torque values.

 $\underline{\text{NOTE}} \colon$  Some part numbers in Table 601 have more than one bearing I.D.

ALL



#### BEARING PERMITTED LIMITS FOR ROTATIONAL PRELOAD TORQUE - TABLE 601 SELF-LUBRICATED SPHERICAL BEARINGS Part Number Bearing Torque Bearing Torque Part Number ΙD Lb-In. ΙD Lb-In. 10-60545-100 0.2500 1 to 5 10-60545-130 0.7500 2 to 6 20 to 60 10-60545-101 0.3125 1 to 5 10-60545-134 1.3765 0.3750 1 to 5 10-60545-102 1.3745 10-60545-103 0.4375 1 to 5 10-60545-135 0.7500 1 to 5 0.5000 1 to 5 10-60545-136 0.2500 1 to 8 10-60545-104 10-60545-105 0.5625 1 to 5 10-60545-137 1.2500 20 to 60 0.6250 1 to 5 10-60545-138 2.5003 40 to 60 10-60545-106 0.7500 2.4994 10-60545-107 1 to 5 2 to 6 10-60545-108 0.8750 10-60545-143 3.5000 20 to 60 10-60545-109 1.0000 2 to 6 10-60545-144 0.5000 1 to 5 5 to 15 5 to 15 10-60545-110 0.1900 10-60545-145 1.5630 0.2500 3 to 9 1.0000 2 to 6 10-60545-122 10-60545-147 10-60545-123 0.7500 40 to 80 10-60545-148 0.875 1 to 8 1.2500 20 to 60 10-60545-149 0.5 to 5 10-60545-124 0.625 1.2508 10-60545-150 0.1560 0.2 to 10 1 to 20 10-60545-125 2.0000 20 to 60 10-60545-151 1.5008 10-60545-126 3.0000 20 to 60 1.5008 2.0010 1.0000 2 to 6 1 to 20 10-60545-127 10-60545-152 20 to 60 2.0000 10-60545-128 1.7190

10-60545-165

0.3750

1 to 5

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10-60545-129

1.7190

ALL

20 to 60

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#### BEARING PERMITTED LIMITS FOR ROTATIONAL PRELOAD TORQUE - TABLE 601 SELF-LUBRICATED SPHERICAL BEARINGS Part Number Bearing Torque Part Number Bearing Torque ΙD Lb-In. ΙD Lb-In. 10-60545-111s 0.2500 1 to 3 10-60545-155S 1.5008 1 to 20 10-60545-112S 0.3125 1 to 3 1.5000 10-60545-113s 0.3750 1 to 3 10-60545-156S 2.0010 1 to 20 10-60545-114S 0.4375 to 3 2.0010 10-60545-1158 0.5000 10-60545-1578 1 to 5 to 5 0.5000 10-60545-116S 0.5625 1 to 5 10-60545-1588 2.256 2 to 20 10-60545-117S 0.6250 1 to 5 2.253 10-60545-1598 1 to 15 10-60545-118s 0.7500 to 5 0.1900 10-60545-119S 0.8750 1 to 5 10-60545-160s 1.0000 2 to 12 10-60545-120s 1.0000 2 to 10 10-60545-1618 2.6255 1 to 20 10-60545-121s 2.5000 20 to 60 10-60545-163s 1.001 2 to 12 10-60545-140S 0.5000 1 to 7 1.000 10-60545-1418 0.5625 1 to 7 10-60545-1648 0.2500 0.5 max 0.2500 0.1 to 0.3 10-60545-1428 0.3125 1 to 7 10-60545-166S 10-60545-143s 0.2500 10-60545-167S 0.2500 0.1 to 0.3 1 to 8 10 to 90 1 to 5 10-60545-144S 1.500 10-60545-200s 0.5000 10-60545-1458 0.6250 1 to 7 10-60545-201s 0.6250 1 to 5 1.2500 10-60545-202S 1 to 5 10-60545-146S to 9 0.2500 10-60545-1478 0.375 1 to 7 10-60545-203s 0.3750 1 to 3 10-60545-2048 1 to 5 10-60545-148s 0.3125 1 to 7 0.562 10-60545-1498 1.2500 2 to 8 0.563 10-60545-205S 2 to 14 10-60545-150s 0.8750 2 to 6 1.5000 10-60545-1518 1 to 5 0.3750 1 to 5 10-60545-206S 0.3750 10-60545-1528 0.3750 0.5 to 3 10-60545-207S 0.6250 1 to 5 10-60545-1548 1.2507 1 to 20 10-60545-2088 0.3750 1 to 5 1.2500 10-60545-2098 0.4375 1 to 3

EFFECTIVITY-

ALL



#### BEARING PERMITTED LIMITS FOR ROTATIONAL PRELOAD TORQUE - TABLE 601 SELF-LUBRICATED SPHERICAL BEARINGS Part Number Bearing Torque Part Number Bearing Torque ΙD Lb-In. ΙD Lb-In. 10-60779-1 0.2500 1 to 8 10-60779-150 0.2500 1 to 8 10-60779-2 0.3125 1 to 8 10-60779-151 0.2500 1 to 9 1 to 7 3 to 13 10-60779-3 0.2500 10-60779-152 0.3750 10-60779-100 0.1230 1 to 8 10-60779-153 0.4375 3 to 13 0.1900 1 to 8 3 to 13 10-60779-101 10-60779-154 0.4375 10-60779-155 10-60779-102 0.2500 1 to 8 0.6250 4 to 16 0.7500 5 to 19 10-60779-103 0.3125 1 to 7 10-60779-156 10-60779-104 0.3750 1 to 8 10-60779-157 0.2500 1 to 8 10-60779-105 0.4375 1 to 8 10-60779-158 0.3125 1 to 8 10-60779-106 0.5000 1 to 8 10-60779-159 0.3750 1 to 8 10-60779-107 0.6250 to 8 10-60779-160 0.4375 1 to 8 1 to 8 0.5000 1 to 8 10-60779-108 0.7500 10-60779-161 10-60779-109 0.8750 1 to 8 10-60779-162 0.6250 1 to 8 1.0000 0.7500 1 to 8 10-60779-100 1 to 8 10-60779-163 10-60779-111 1.2500 1 to 8 10-60779-164 0.3140 1 to 8 1 to 6 0.3120 10-60779-112 0.3125 10-60779-113 0.1900 1 to 8 10-60779-165 0.6250 1 to 8 1 to 8 10-60779-117 0.5000 1 to 8 10-60779-166 0.3125 10-60779-118 0.2500 1 to 8 10-60779-167 0.3750 3 to 13 1 to 8 1 to 8 10-60779-119 0.2500 10-60779-168 0.5000 10-60779-120 0.3125 1 to 8 10-60779-169 0.2500 1 MAX 10-60779-121 0.3750 1 to 8 10-60779-170 0.2500 1 MAX 10-60779-122 0.2500 1 to 7 10-60779-171 0.3750 1 to 8 10-60779-123 0.3125 1 to 8 10-60779-172 0.3125 1 to 8 10-60779-124 0.2500 1 to 8 10-60779-173 0.6250 1 to 8 10-60779-125 0.4375 1 to 8 10-60779-174 0.2500 1 to 8 0.2500 1 to 8 1 to 8 10-60779-126 10-60779-175 0.7500 10-60779-127 0.3125 1 to 8 10-60779-176 0.3125 1 to 8 10-60779-128 0.3125 1 to 8 10-60779-177 0.2500 1 to 8

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#### BEARING PERMITTED LIMITS FOR ROTATIONAL PRELOAD TORQUE - TABLE 601 SELF-LUBRICATED SPHERICAL BEARINGS Part Number Bearing Torque Part Number Bearing Torque ΙD Lb-In. ΙD Lb-In. 10-60779-178 0.2500 1 to 8 10-60779-208 0.1900 1 to 7 10-60779-179 0.4375 1 to 8 10-60779-209 0.2500 1 to 7 0.4375 2 to 10 10-60779-180 1 to 8 10-60779-210 0.3125 10-60779-181 0.2500 to 8 10-60779-211 0.3750 2 to 10 0.7500 3 to 13 10-60779-182 to 8 10-60779-212 0.4375 10-60779-183 0.6250 1 to 8 10-60779-213 0.5000 3 to 13 3 to 13 10-60779-184 0.6250 to 8 10-60779-214 0.6250 10-60779-185 0.2500 to 8 10-60779-215 0.7500 4 to 16 10-60779-186 0.5000 to 8 10-60779-216 0.3125 1 to 8 10-60779-187 0.6250 1 to 8 10-60779-217 0.2500 1 to 7 10-60779-188 0.6250 to 8 10-60779-218 0.5000 1 to 8 10-60779-189 0.6250 to 8 10-60779-219 0.5000 1 to 8 10-60779-200 0.1900 to 8 10-60779-220 0.3125 1 to 8 10-60779-201 0.2500 1 to 8 10-60779-221 0.3125 2 to 1 10-60779-202 0.3125 to 8 10-60779-222 0.4375 1 to 8 10-60779-203 0.3750 to 8 10-60779-223 0.3125 2 to 1 10-60779-204 0.4375 to 8 10-60779-224 0.3750 1 to 8 10-60779-205 0.5000 10-60779-301 0.2500 1 to 6 to 8 10-60779-206 10-60779-302 0.6250 1 to 8 0.3125 1 to 8 10-60779-207 0.7500 1 to 8

EFFECTIVITY-

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## CONTROL CABLES - INSPECTION/CHECK

## 1. General

- A. Clean the cables, if necessary for the inspection. (Ref. 747-400 AMM 12-21-05)
- B. Use these procedures to verify the integrity of the control cable system. The procedures must be performed along the entire cable run in each system. To ensure verification of the portions of the cables that are in contact with pulleys and quadrants, the control cables must be moved by operation of the applicable system's controls, to expose those portions of the cables.
- C. The first task is an inspection of the control cable wire rope.
- D. The second task is an inspection of the control cable fittings.
- E. The third task is an inspection of the pulleys.
- F. These three tasks may be performed concurrently at one location of the cable system on the airplane if desired for convenience.

### TASK 20-21-03-216-023

- 2. Inspection of the control cable wire rope.
  - A. Examine the wire rope.

### s 216-028

(1) Perform a detailed visual inspection to make sure that the cable does not contact parts other than pulleys, quadrants, cable seals or grommets installed to control the cable routing. The minimum cable clearance from other parts is 0.20 inches, except 0.10 inches within 10 inches of a pulley or quadrant. Look for evidence of contact with other parts. Correct the condition if evidence of contact is found.

#### s 216-029

- (2) Perform a detailed visual inspection of the cable runs for incorrect routing, kinks in the wire rope, or other damage.
  - (a) Replace the cable assembly if:
    - 1) One cable strand has worn wires where one cable strand is decreased by more than 40 percent. (Refer to Fig. 601)
    - 2) If a kink is found.
    - 3) If corrosion is found.

## s 216-030

ALL

- (3) Perform a detailed visual inspection of the cable. To do a check for broken wires, rub a cloth along the cable. The cloth will identify broken wires by catching on them.
  - (a) Replace the 7 x 7 cable assembly if:
    - 1) There is two or more broken wires in 12 continuous inches of cable.
    - There is three or more broken wires anywhere in the total cable assembly.

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- Replace the 7 X 19 cable assembly if:
  - There is four or more broken wires in 12 continuous inches of cable.
  - 2) There is six or more broken wires anywhere in the total cable assembly.

TASK 20-21-03-216-024

- Inspection of the control cable fittings.
  - Examine the control cable fittings.

s 216-031

(1) Perform a detailed visual inspection to make sure that the means of locking the joints are intact, (wire locking, cotter pins, turnbuckle clips, etc.). Install any missing parts.

s 216-032

Perform a detailed visual inspection of the swaged portions of swaged end fittings for surface cracks or corrosion. Replace the cable assembly if cracks or corrosion are found.

s 216-033

(3) Perform a detailed visual inspection of the unswaged portion of the end fitting. Replace the cable assembly if a crack is visible, if corrosion is present, or if the end fitting is bent more than two degrees.

s 216-034

(4) Perform a detailed visual inspection of the turnbuckle. Replace the turnbuckle if a crack is visible or if corrosion is present.

TASK 20-21-03-216-025

- Inspection of pulleys.
  - A. Examine the pulleys.

s 216-035

(1) Perform a detailed visual inspection to make sure that pulleys are free to rotate. Replace pulleys which are not free to rotate.

s 216-036

ALL

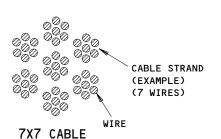
(2) Replace any pulleys that match the description in Fig. 602.

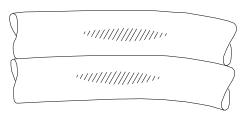
EFFECTIVITY-

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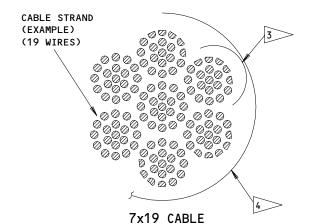
01.1

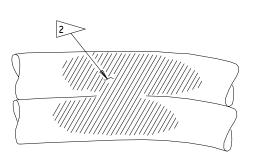




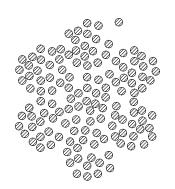


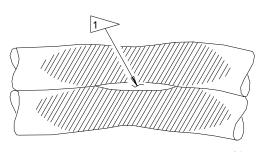
EACH OUTER WIRE WORN
LESS THAN 40%
(WORN AREAS NOT BLENDED)





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.

THE OUTER WIRE WEAR AREA ON CABLE STRAND. A VISIBLE SPACE BETWEEN WIRES OR A FULLY BLENDED SURFACE SURFACE OVER APPROXIMATELY SIX WIRES INDICATES 50 PERCENT WIRE WEAR.

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.

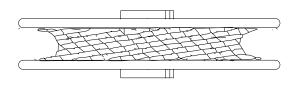
Cable Wear Patterns Figure 601

20-21-03

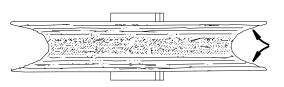
01

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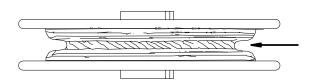




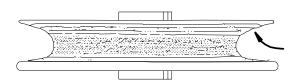
CABLE TENSION TOO HIGH



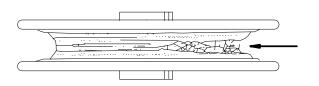
PULLEY NOT ALIGNED CORRECTLY



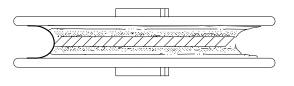
PULLEY GROOVE WITH EXCESSIVE WEAR



CABLE NOT ALIGNED CORRECTLY



PULLEY WILL NOT TURN



CORRECT CONDITION

Pulley Wear Patterns Figure 602

302902

20-21-03



# ELECTRICAL BONDING - INSPECTION/CHECK

TASK 20-22-01-766-015

- 1. <u>Electrical Bonding Inspection/Check</u>
  - A. General
    - (1) Refer to SWP 20-20-00 Electrical Bonding and Grounding in the Standard Wiring Practice Manual D6-54446.

 20-22-01



### <u>SPECIFICATIONS AND MATERIALS - MAINTENANCE PRACTICES</u>

### 1. General

- A. This procedure has one task:
  - (1) Specifications and Materials

### TASK 20-30-00-802-001

## 2. Specifications and Materials

- A. General
  - (1) Specifications and materials sections contain lists of consumable materials that can be necessary during regular maintenance of the airplane.
  - (2) Whenever possible, consumable materials will be referenced in the Maintenance Manual by a material specification.
  - (3) In the event a material is shown with no material specification, the material will be a specific vendor product or it will be commercially available.
  - (4) For specific vendor information on a product, you should refer to the U-file Bulk Materials List. Or, you should refer to the qualified products list of the applicable material specification.
- B. References
  - (1) AMM 20-30-01/201, Adhesives, Cements, and Sealants
  - (2) AMM 20-30-02/201, Cleaners and Polishes
  - (3) AMM 20-30-03/201, Finishing Materials
  - (4) AMM 20-30-04/201, Lubricants
  - (5) AMM 20-30-05/201, Welding Materials
  - (6) AMM 20-30-07/201, Miscellaneous Materials
- C. Procedure

## s 802-002

- (1) Use these tasks for information on consumable materials:
  - (a) Adhesives, Cements, and Sealers (AMM 20-30-01/201)
  - (b) Cleaners and Polishes (AMM 20-30-02/201)
  - (c) Finishing Materials (AMM 20-30-03/201)
  - (d) Lubricants (AMM 20-30-04/201)
  - (e) Welding Materials (AMM 20-30-05/201)
  - (f) Miscellaneous Materials (AMM 20-30-07/201)

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### ADHESIVES, CEMENTS, AND SEALANTS - MAINTENANCE PRACTICES

## 1. <u>General</u>

- A. This procedure has one task:
  - (1) Adhesives, Cements and Sealers

TASK 20-30-01-802-001

### 2. Adhesives, Cements, and Sealants

- A. General
  - (1) This task contains a table of adhesives, cements, and sealants for airplane maintenance.
  - (2) The table gives this information:
    - (a) bulk code
    - (b) material name
    - (c) material specification
    - (d) vendor code
  - (3) The information in the table is sorted alphanumerically by the bulk code.
    - (a) If there is more than one bulk code for a material, the table will show all applicable bulk codes.
  - (4) You can find more information on consumable materials in the U-File Bulk Materials List.
  - (5) To find information on suppliers who have materials in the table, refer to the Commercial and Government Entity Cataloging Handbook H4/H8.

<u>NOTE</u>: The handbook gives addresses for the vendor codes in the table. To get a copy of the handbook, use this address:

Commander

Defense Logistics Services Center

Attn: DLSC-WP Federal Center

Battle Creek, Michigan 49017-3084

Telephone: (616) 962-6511

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BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
A00001	Compound, Fairing	Tereco 175	17359
A00008	Reducer, Catalyst	Diethylene Triamine	61637
A00021	Adhesive, Epoxy (Parts A and B)	EA934	33564
A00055	Adhesive (With Catalyst) PSA 529 SRC-18		71984
A00062	Sealant, Thermal	DC 340	71984
A00081	Sealant, RTV	RTV 106	01139
A00084	Sealant, Electrical	RTV 3145	71984
A00091	Sealant, Silicone Rubber	93-006	71984
A00099	Sealant (With Compatible Primer)	RTV 154 S4213	17359
A00156	Adhesive, Nylon and Mylar	BMS 5-31	COML
A00160	Sealant, Firewall	BMS 5-63	COML
A00168	Adhesive (With Compatible Primer)	DC1200	71984
A00236	Sealant	PR1422A-2	83574
A00247	Sealant, Environmental	BMS 5-95 Class B	83527
A00256	Sealant, Integral Fuel Tank	BMS 5-26, Type II	COML
A01055	Sealant, Environmental	BMS 5-150 Class B-2	85570
A00260	Compound, Potting	BMS 5-28, Type 21	COML
A00305	Adhesive, Epoxy Polyamide	BMS 5-126, Type III, Class 1, Grade B	71984
A00337	Adhesive, Silicone Rubber	Silastic 140	71984
A00339	Compound, Locking	MIL-S-46163	COML
A00372	Sealant, Corrosion Inhibiting	MIL-S-81733	COML
A00440	Sealant, Integral Fuel Tank	MIL-S-8802	COML

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BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
A00456	Compound, Antigalling	PWA 550	COML
A00510	Adhesive, Silicone Rubber	RTV 731	71984
A00511	Adhesive, Silicone Rubber	RTV 108	01139
A00546	Sealant, Thermal	Wakefield No. 120	
A00588	Adhesive, RTV	RTV 103	01139
A00602	Compound, Retaining	RC 680	2A052
A00620	Sealant, RTV (White)	QQ 327	71984
A00621	Sealant, RTV (Clear)	30-79	71984
A00635	See Bulk Code A00511		
A00637	Compound, Antigalling	PWA 550-3	COML
A00640	Sealant, Pipe	PST 592	05972
A00641	Hardener	Furane 9216	99384
A00646	Compound, Sealing	Epoxylite 6203	11147
A00649	Resin, Epoxy Casting	Epocast 1310	99384
A00655	Adhesive, Epoxy Resin	Epibond 8543	99384
A00657	Adhesive, Silicone Rubber	RTV 577	01139
A00659	Adhesive, Neoprene	PWA 36027	COML
A00664	Compound, Antigalling	Lubribond HT	85932
A00666	Compound, Corrosion Inhibiting	Brayco 599	98308
A00704	Sealant, Silicone	RTV 162	01139
A00707	Sealant (With Compatible Primer)	PR 1826	83574

20-30-01



BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
A00744	Agent, Thickening	PWA 424-1	80798
A00745	Agent, Thickening PWA 424-2		80798
A00754	See Bulk Code A00511		
A00776	Compound, Potting	DC 738	71984
A00779	Sealant, Integral Fuel Tank	BMS 5-26, Type I	COML
A00906	Adhesive, Room Temperature Cure	BMS 5-128	COML
A00940	Resin, Liquid Epoxy	PWA 421-2	
A00942	Agent, Epoxy Resin Curing	PWA 422-1	COML
A00943	See Bulk Code A00508		
A00948	Adhesive, Epoxy Resin	EA 956	33564
A00950	Compound, Retaining Loctite 277		05972
A00951	See Bulk Code A00659		
A00957	Adhesive, Neoprene Base	BMS 5-7 COML	
A00958	Compound, Antiseize	Never-Seez MIL-A-907	59364
A02315	Sealant, Chromate Type	BMS 5-142	COML
4			

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01A

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## CLEANERS AND POLISHES - MAINTENANCE PRACTICES

#### 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 specification 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, Certification Testing of Aircraft Maintenenace Materials, to verify that any substitute material will not be injurious to airplane surfaces when used as specified by the maufacturer.
- D. Solvent Alternatives
  - (1) Because of new environmental protection regulations, alternatives to some solvents are now necessary. To make it easy to find applicable solvent, there are now new tables of solvent selections in the Aircraft Maintenance Manual, (AMM), and the Standard Overhaul Practices Manual, (SOPM). Refer to Subjects 20-30-80 and on for these tables which give selections fo solvents along with their material bulk code and related specifications.

Table 1 shows a list of tables of solvent selections, by the type of procedure and the surface to be cleaned, which you will find in Subjects 20-30-80 and on:

20-30-02



TABLE 1			
ATA	Table Description	Series	BAC Specification
20-30-80/201	General Cleaning of Metal	80	BAC 5750
20-30-81/201	General Cleaning of All Organic Coatings	81	BAC 5750
20-30-82/201	General Cleaning of Solvent Resistant Organic Coatings	82	BAC 5750
20-30-83/201	General Cleaning of Composites	83	BAC 5750
20-30-84/201	Final Cleaning of Metal Prior to Painting	84	BAC 5750
20-30-85/201	Final Cleaning of All Organic Coatings Prior to Painting	85	BAC 5750
20-30-86/201	Final Cleaning of Solvent Resistant Organic Coatings Prior to Painting	86	BAC 5750
20-30-87/201	Final Cleaning of Composites Prior to Painting	87	BAC 5750
20-30-88/201	Final Cleaning of Metal Prior to Non-Structural Bonding	88	BAC 5750
20-30-89/201	Final Cleaning of All Organic Coatings Prior to Non-Structural Bonding	89	BAC 5750
20-30-90/201	Final Cleaning of Solvent Resistant Coatings Prior to Non-Structural Bonding	90	BAC 5750
20-30-91/201	Final Cleaning of Composites Prior to Non-Structural Bonding	91	BAC 5750
20-30-92/201	Final Cleaning Prior to General Sealing	92	BAC 5000

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	TABLE 1			
АТА	Table Description	Series	BAC Specification	
20-30-93/201	Final Cleaning Prior to Fuel Tank Sealing	93	BAC 5504	
20-30-94/201	Final Cleaning Prior to Application of Rain Erosion Resistant Coating	94	BAC 5880	
20-30-95/201	Final Cleaning Prior to Aerodynamic Smoothing and Fairing	95	BAC 5030	
20-30-96/201	Final Cleaning of Oxygen Components Exposed to Oxygen	96	BAC 5402	
20-30-97/201	Final Cleaning Prior to Structural Bonding	97	BAC 5514	
20-30-98/201	Cleaning of Specific Polymerics	98	BAC 5750	
	Cleaning of Phenolics or Nylon	98-1	BAC 5750	
20-30-99/201	Final Cleaning of Composites Prior to Structural Bonding	99	BAC 5578	

E. Each of the individual tables has a Series Bulk Code, and each of the solvents is identified in the table by it's name, bulk code, and applicable specification. In your orders to get a solvent from the list, you must identify a solvent by it's name, bulk code, or other specification, as shown. Do not use the Series Bulk Code. Refer to the U-File for the applicable vendors.

EFFECTIVITY-



- F. This procedure has one task:
  - (1) Cleaners and Polishes

## TASK 20-30-02-992-002

- 2. <u>Cleaners and Polishes</u>
  - A. General
    - (1) This task contains a table of cleaners and polishes for airplane maintenance.
    - (2) The table gives this information:
      - (a) bulk code
      - (b) material name
      - (c) material specification
      - (d) vendor code
    - (3) The information in the table is sorted alphanumerically by the bulk code.
      - (a) If there is more than one bulk code for a material, the table will show all applicable bulk codes.
    - (4) You can find more information on consumable materials in the U-File Bulk Materials List.
    - (5) To find information on suppliers who have materials in the table, refer to the Commercial and Government Entity Cataloging Handbook H4/H8.

NOTE: The handbook gives addresses for the vendor codes in the table. To get a copy of the handbook, use this address:

Commander

Defense Logistics Services Center

Attn: DLSC-WP Federal Center

Battle Creek, Michigan 49017-3084

Telephone: (616) 962-6511

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BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
в00006	Cleaner, Alkaline	Alumiloy P	71361
в00050	Disinfectant	Lysol	COML
в00053	Polish, Aircraft Aluminum	MIL-P-6888, Type II	COML
в00071	Solvent, Trichloroethane 1,1,1	MIL-T-81533	COML
в00075	Solvent, Dry Cleaning (Stoddard)	P-D-680	COML
в00083	Solvent, Aliphatic Naphtha	TT-N-95 Type II	COML
в00097	Solvent, Trichloroethylene	BMS 11-6 MIL-T-27602 0-T-634	COML
в00099	Wax	Simoniz	81238
B00115	See Bulk Code B00071		
B00126	Cleaner	Altrex	83339
в00178	Solvent, Acetone	0-A-51	COML
в00185	Solvent, Isopropyl Alcohol	TT-I-735	COML
B00191	Solvent, Methylene Chloride (Dichloromethane)	ASTM D4701	COML



BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
в00200	Solvent, Methyl Alcohol (Methanol)	0-M-232	COML
в00230	Cleaner, Alkaline	ALTREX B	OXVDO
B00247	Cleaner, Emulsion	Can Du	0192B
B00267	Cleaner, Etch	Oakite 160	44389
B00268	Stripper, Immersion	Turco Supercarb	61102
в00279	Stripper, Brush Application	Turco 52923	61102
B00299	See Bulk Code B00075		
B00302	Polish, Plastic	Plex-T-Glow	93920
в00309	See Bulk Code B00185		
B00333	Solvent, White Spirit		COML
B00338	Solvent, Acetone	0-A-521	
B00341	See Bulk Code B00050		
B00342	See Bulk Code B00080		
B00354	Solvent, Petroleum Hydrocarbon	AMS 3160	COML
B00397	See Bulk Code B00299		
B00399	Cleaner, Aerosol	Zyglo ZC-7	37676
B00400	Cleaner, Gas Path	Ardrox 6110	A0020

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BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
B00401	Solvent, Ethyl Alcohol (Denatured Alcohol)	MIL-E-51454, Type II	COML
B00410	See Bulk Code B00200		
B00417	Cleaner, Gas Path	B and B 3100	21361
B00436	Solvent, Carbon Removing	Magnus 755	37733
B00441	Solvent, Ammonium Hydroxide	0-A-451	COML
B00447	Remover, Corrosion	GMC 801	09462
B00448	See Bulk Code B00115		
B00453	Solvent, Trichlorotrifluoroethane (Freon)	MIL-C-81302	COML
B00458	Cleaner, Aluminum	Oakite NST	44389
B00490	Cleaner, Toilet Flushing	AMS 1476D	COML
B00512	Solvent, Aliphatic Naphtha	TT-N-95	COML
B00534	See Bulk Code B00299		
B00535	Solvent, Tetrachloroethylene	0-2-236	COML
B00543	See Bulk Code B00200		
B00569	Polish, Aircraft Aluminum	Schaffner AS0410	COML
B00598	Solvent, Methyl Ethyl Ketone (MEK)	ASTM D740	COML
B00600	See Bulk Code B00185		
B00713	See Bulk Code B00075		
B00719	See Bulk Code B00071		
B00721	See Bulk Code B00598		
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BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
в00731	See Bulk Code B00598		
в00738	See Bulk Code B00191		
в00740	See Bulk Code B00185		
в00741	See Bulk Code B00598		
в00754	See Bulk Code B00071		
в00769	See Bulk Code B00185		
в00772	See Bulk Code B00453		
в00776	See Bulk Code B00075		
в00782	See Bulk Code B00453		
в00786	See Bulk Code B00401		
B50001	Cleaner, Aerospace Equipment	MIL-PRF-87937	
E00046	Solvent, Methyl Isobutyl Ketone (MIBK)	ASTM D1153	COML
E00048	Solvent, Xylene	ASTM D843	COML
E00124	Solvent, Ethylene Glycol Monobutyl Ether	ASTM 330	COML

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## FINISHING MATERIALS - MAINTENANCE PRACTICES

## 1. General

- A. This procedure has one task:
  - (1) Finishing Materials

TASK 20-30-03-992-002

# 2. <u>Finishing Materials</u>

- A. General
  - (1) This task contains a table of finishing materials for airplane maintenance.
  - (2) The table gives this information:
    - (a) bulk code
    - (b) material name
    - (c) material specification
    - (d) vendor code
  - (3) The information in the table is sorted alphanumerically by the bulk code.
    - (a) If there is more than one bulk code for a material, the table will show all applicable bulk codes.
  - (4) You can find more information on consumable materials in the U-File Bulk Materials List.
  - (5) To find information on suppliers who have materials in the table, refer to the Commercial and Government Entity Cataloging Handbook H4/H8.

NOTE: The handbook gives addresses for the vendor codes in the table. To get a copy of the handbook, use this address:

Commander

Defense Logistics Services Center

Attn: DLSC-WP Federal Center

Battle Creek, Michigan 49017-3084

Telephone: (616) 962-6511

BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
c00055	Primer, Wash	BMS 10-72, Type I	COML

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BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
C00064	Coating, Chemical Conversion	MIL-C-5541, Class 1 A	COML
c00069	Dye, Red	Automatic BSF	32063
c00148	Compound, Chromate	Iridite 18-P	99442
c00174	Compound, Corrosion Preventive	MIL-C-16173	COML
c00181	Compound, Corrosion Preventive	MIL-C-15074	COML
c00306	Thinner, Aircraft Coating	MIL-T-81772	COML
c00320	Coating, Electrical Insulation	BMS 5-37, Class B-2	COML
c00324	Coating, Chemical Conversion	MIL-C-5541, Class 3	COML
c00347	Compound, Sealing, Locking, and Retaining	MIL-S-22473	COML
c00399	Plating, Brush-On Cadmium	DC-577	99167
c00508	Ename L	BMS 10-11, Type II	COML
c00535	Primer, Corrosion Inhibiting	BMS 10-11, Type I	COML
c00580	Primer, Sealant Adhesion Promoting	DC1200 (MIL-A-46146)	71984
c00621	Primer, Epoxy	BMS 10-11, Type I	COML
c00664	Coating, Chemical Conversion	Iridite 14-2	85665
c00668	Reducer, Solvent	Thinning Agent 020-034	85670
c00672	Coating, Polyurethane	PWA 36013	COML
c00691	Agent, Epoxy Resin Curing	PWA 422-1	COML
c00755	Compound, Corrosion Inhibiting	BMS 5-26	COML
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BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
c00767	Coating, Conductive	BMS 10-21, Type 3	COML
c00839	Coating, Polyurethane	BMS 5-108	COML
c00855	See Bulk Code C00064		
c00913	Compound, Corrosion Inhibiting	BMS 3-27	COML
c00915	Compound, Corrosion Inhibiting	BMS 3-29	COML

ALL



## LUBRICANTS - MAINTENANCE PRACTICES

## 1. General

- A. This procedure has one task:
  - (1) Lubricants

TASK 20-30-04-802-002

# 2. <u>Lubricants</u>

- A. General
  - (1) This task contains a table of lubricants for airplane maintenance.
  - (2) The table gives this information:
    - (a) bulk code
    - (b) material name
    - (c) material specification
    - (d) vendor code
  - (3) The information in the table is sorted alphanumerically by the bulk code.
    - (a) If there is more than one bulk code for a material, the table will show all applicable bulk codes.
  - (4) You can find more information on consumable materials in the U-File Bulk Materials List.
  - (5) To find information on suppliers who have materials in the table, refer to the Commercial and Government Entity Cataloging Handbook H4/H8.

<u>NOTE</u>: The handbook gives addresses for the vendor codes in the table. To get a copy of the handbook, use this address:

Commander

Defense Logistics Services Center

Attn: DLSC-WP Federal Center

Battle Creek, Michigan 49017-3084

Telephone: (616) 962-6511

BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
D00005	Compound, Antiseize	Fel-Pro 200	73165

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BULK	MATERIAL	MATERIAL SPECIFICATION AND/OR	VENDOR
CODE	NAME	PRODUCT NAME	CODE
D00006	Compound, Antiseize, Pure Nickel Special	Never-Seez NSBT-8N	5W425
D00010	Compound, Antiseize	MIL-A-907 (Never-Seez NSBT-8N - Recommended)	COML
D00013	Grease, Aircraft	MIL-G-23827	COML
D00014	Grease, Molybdenum Disulfide	MIL-G-21164	COML
D00015	Grease, Corrosion Preventive	BMS 3-24	COML
D00016	Grease, Aircraft	MIL-G-81322	COML
D00017	Grease, High Vacuum	Molykote 3	71984
D00031	Lubricant	Essna 382	11770
D00036	Lubricant	Surfkote A1625	01094
D00638	Lubricant	Sandstrom 27A	34227
D00038	Lubricant	Molkote 321-R	94499
D00039	Lubricant	DC-5	71984
D00045	Lubricant	Beeswax	A0001
D00049	Lubricant	Viscasil 1000	01139
D00054	Lubricant, Assembly	MCS 352	76541
D00059	Lubricant, Paste	Molykote Type G-N	71984
D00062	Grease, Pneumatic System	MIL-G-4343	COML
D00066	Lubricant	Molykote M-30	71984
D00068	Oil, Engine	MIL-L-23699	COML
D00070	Oil, Hydraulic	MIL-H-5606	COML
	<u> </u>	1	<u> </u>

ALL



BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
D00071	Oil, Engine	MIL-L-7808	COML
D00072	Oil, Lubricating	Exxon Turbo Oil 25 GE D5OTF1 (SB 79-1)	29700
D00091	Oil, Lubricating	MIL-L-7870	COML
D00096	Oil, Lubricating	MIL-L-6081, Grade 1005	COML
D00100	Additive, Fuel	Biobor JF	24611
D00109	See Bulk Code D00071		
D00111	Lubricant, Solid Film	MIL-L-23398	COML
D00121	Grease	DC-33	71984
D00124	Oil, Lubricating	MIL-L-6081, Grade 1010	COML
D00127	Oil, Lubricating	Exxon Turbo Oil 2380	29700
D00128	See Bulk Code D00017		
D00130	See Bulk Code D00111		
D00133	Oil, Lubricating	MIL-L-6085	COML
D00148	Fluid, Hydraulic	BMS 3-11, Type IV	COML
D00155	Lubricant	Lubrizol 1395	05238
D00157	Oil, Engine	Castrol 580	01708
D00173	Lubricant, Oxygen System	Krytox 240AC	04577
D00190	See Bulk Code D00016		
D00207	Grease	MIL-G-7711	COML
D00226	See Bulk Codes D00068, D00071		
D00242	Lubricant	DC-44	71984



BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
D00244	Lubricant, Antiseize	Silver Goop	02570
D00250	Lubricant, Petrolatum Jelly	VV-P-236	COML
D00258	See Bulk Code D00242		
D00259	See Bulk Code D00054		
D00268	See Bulk Code D00250		
D00301	See Bulk Code D00250		
D00345	See Bulk Code D00071		
D00368	Grease, Silicone	DC-4	71984
D00389	Oil, Engine	GE D50TF1, Type II (SB 79-1)	COML
D00390	Oil, Engine	PWA 521, Type II (SB 238)	COML
D00398	See Bulk Code D00039		
D00399	Lubricant	DC-577	71984
D00403	Lubricant, Fluorocarbon Spray	MIL-L-60326	COML
D00405	Lubricant, Antigalling	PWA 550-3	COML
D00406	See Bulk Code D00405		
D00408	Lubricant, Dry Film	PMC 9934	
D00415	See Bulk Code D00038	DC-577	71984
D00416	Oil, High Temperature	Royco 81MS	07950

ALL



BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
D00418	See Bulk Code D00071		
D00453	Lubricant	Fel Pro C-300	73165
D00460	Compound, Antigallant	PWA 36035	COML
D00512	Oil, Engine	Aeroshell 500	86961
D00513	Oil, Engine	Aeroshell 555	86961
D00514	Oil, Engine	Royco 500	07950
D00516	See Bulk Code D00157		
D00517	Oil, Engine	Castrol 5000	01708
D00518	See Bulk Code D00072		
D00519	See Bulk Code D00127		
D00520	Oil, Engine	Mobil Jet II	77988
D00521	Oil, Engine	Mobil RM 254A	77988
D00539	Lubricant	WD-40	59364
D00633	Grease, Aircraft	BMS 3-33	COML
D00558	Compound, Antiseize	Brayco 655	07440



## WELDING MATERIALS - MAINTENANCE PRACTICES

## 1. General

- A. This procedure has one task:
  - (1) Welding Materials

TASK 20-30-05-802-002

## 2. Welding Materials

- A. General
  - (1) This task contains a table of welding materials for airplane maintenance.
  - (2) The table gives this information:
    - (a) bulk code
    - (b) material name
    - (c) material specification
    - (d) vendor code
  - (3) The information in the table is sorted alphanumerically by the bulk code.
    - (a) If there is more than one bulk code for a material, the table will show all applicable bulk codes.
  - (4) You can find more information on consumable materials in the U-File Bulk Materials List.
  - (5) To find information on suppliers who have materials in the table, refer to the Commercial and Government Entity Cataloging Handbook H4/H8.

NOTE: The handbook gives addresses for the vendor codes in the table. To get a copy of the handbook, use this address:

Commander

Defense Logistics Services Center

Attn: DLSC-WP Federal Center

Battle Creek, Michigan 49017-3084

Telephone: (616) 962-6511

BULK	MATERIAL	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR
CODE	NAME		CODE
F00005	Solder, Electronic	QQ-S-571	COML

EFFECTIVITY-

20-30-05

ALL



## MISCELLANEOUS MATERIALS - MAINTENANCE PRACTICES

## 1. General

- A. This procedure has one task:
  - (1) Miscellaneous Materials

## TASK 20-30-07-802-002

## 2. <u>Miscellaneous Materials</u>

- A. General
  - (1) This task contains a table of miscellaneous materials for airplane maintenance.
  - (2) The table gives this information:
    - (a) bulk code
    - (b) material name
    - (c) material specification
    - (d) vendor code
  - (3) The information in the table is sorted alphanumerically by the bulk code.
    - (a) If there is more than one bulk code for a material, the table will show all applicable bulk codes.
  - (4) You can find more information on consumable materials in the U-File Bulk Materials List.
  - (5) To find information on suppliers who have materials in the table, refer to the Commercial and Government Entity Cataloging Handbook H4/H8.

<u>NOTE</u>: The handbook gives addresses for the vendor codes in the table. To get a copy of the handbook, use this address:

Commander

Defense Logistics Services Center

Attn: DLSC-WP Federal Center

Battle Creek, Michigan 49017-3084

Telephone: (616) 962-6511

BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
G00019	Oxygen, Aviator's Breathing	MIL-0-27210	COML
G00022	Compound, Chlorine Dioxide		COML

EFFECTIVITY-

20-30-07

ALL



BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
G00031	Fabric, Glass	MIL-F-9084, Type 8	COML
G00032	Fabric, Glass	MIL-F-9084, Type 8A	COML
G00033	Cheesecloth - Woven, Surewipe	Lint-free, Clean	COML
G00039	Chord, Nylon	MIL-C-5040, Type 1A	
G00040	Chord, Nylon - Thread, Size 9	V-T-295, Type1, Class 2	21651
G00078	Foam, Urethane	BMS 8-39, Type IV	COML
G00083	Cork, Insulating	BMS 8-103	COML
G00095	Detector, Leak	Leak Tek 160X	03530
G00191	Coating, Protective	Spraylat SC-1071	87354
G00237	Cotton		COML
G00301	Tape, Protective	Gizzard Protex 20V	06929
G00317	Tape, Aluminum Foil	3M No. 436	20319
G00347	Tape, Doubleback	Permacel P55	99742
G00348	Tape, General Purpose	Permacel P621	99742
G00366	Tape	Permacel P705	99742
G00368	Tape, Mylar	Permacel 92	99742
G00369	Compound, Retaining	MIL-R-46082, Type I	
G00380	Paper, Abrasive		COML
G00382	Paper, Abrasive (Aluminum Oxide)	A-A-1048	COML
G00507	Cloth, Lint Free	Kimwipes No. 3425	33591
G00508	Compound, Corrosion Preventive	MIL-C-11796	COML
G00596	Penetrant, Inspection	MIL-I-25135	COML
G00601	Tape, Masking	VV-T-106	COML

ALL



BULK CODE	MATERIAL NAME	MATERIAL SPECIFICATION AND/OR PRODUCT NAME	VENDOR CODE
G00604	Solution, Sodium Hydroxide		COML
G00626	Dessicant, Dehumidifier	MIL-D-3464	COML
G00669	Nitrogen, Gaseous	MIL-P-27401	COML
G00708	Cloth, Silicone Carbide Coated	A-A-1200	COML
G00758	Marker	Carter's Marks-A-Lot	03042
G02407	Compound, Fastener Traction	E-Z Grip	COML
G00767	Wax, Paraffin	PMC 9552	COML

ALL



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 80) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for general cleaning of metals as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-80-102-001

# 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. Refer to the U-File for the applicable vendors.
- B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

General Cleaning of Metal (Series 80) Table 201				
Material Name	Material Bulk Code	Other Specifications		
1,1,1-Trichloroethane	в00090			
Acetone	в00062	JIS-K-1503		
Aerfluor 343				
BMS 11-7	B00184	MIL-C-38736B		
CDG-110				
CDG-211				
Citra Safe	B00634			
Citra Safe, Deodorized				
d-Limonene				

EFFECTIVITY——————————————————————————————————	$\neg$
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20-30-80



General Cleaning of Metal (Series 80) Table 201			
Material Name	Material Bulk Code	Other Specifications	
DeSo Clean 45	B00647		
EP-921			
Ethyl alcohol, denatured	в00068		
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)	в00130		
MEK:1,1,1-Trichloroethane 1:1			
MEK:sec-Butyl alcohol 42:58 percent			
MEK:Toluene 1:1			
Methyl ethyl ketone (MEK)	B00148		
Methyl isobutyl ketone (MIBK)	в00151	JIS-K-8903	
Methyl propyl ketone (MPK)	в00666		
MIBK:MEK 3:2			
MIL-C-81302, Type I	B00143		
MOK or MOK*			

ALL



General Cleaning of Metal (Series 80) Table 201			
Material Name	Material Bulk Code	Other Specifications	
P-D-680, Type I, II, or III	в00074		
Shopmaster RTU			
Toluene	в00094		
TT-N-95, Type II	в00083		
TT-T-291, Type I, II, or III	в00762		
Turco 4460 BK			
Turco 6226			
Turco 6709			
Wedco 3500			

ALL

20-30-80



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 81) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for general cleaning of all organic coatings as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-81-102-001

- 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. Refer to the U-File for the applicable vendors.
  - B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

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	в00068		
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			

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20-30-81



General Cleaning of All Organic Coatings (Series 81) Table 201			
Material Other Bulk Code Specifications			
TT-N-95, Type II	в00083		
TT-T-291, Type I, II, or III	в00762		
Turco 6226			

ALL

20-30-81

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## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 82) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for general cleaning of solvent resistant organic coatings as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-82-102-001

## 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. Refer to the U-File for the applicable vendors.

#### B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

	vent Resistant Series 82) Table 201	Organic Coatings
Material Name	Material Bulk Code	Other Specifications
1,1,1-Trichloroethane	B00090	
Acetone	B00062	JIS-K-1503
Aerfluor 343		
BMS 11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	в00647	

EFFECTIVITY-	$\neg$
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20-30-82



# General Cleaning of Solvent Resistant Organic Coatings (Series 82) Table 201

lable 201		
Material Name	Material Bulk Code	Other Specifications
EP-921		
Ethyl alcohol, denatured	в00068	
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		
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)	в00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
MOK or MOK*		
P-D-680, Type I, II, or III	в00074	

EFFECTIVITY-

ALL



# General Cleaning of Solvent Resistant Organic Coatings (Series 82) Table 201 Material 0ther Material Name Bulk Code Specifications Shopmaster RTU B00094 Toluene TT-N-95, Type II B00083 TT-T-291, Type I, II, or III B00762 Turco 4460 BK

EFFECTIVITY-

20-30-82

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Turco 6226

Turco 6709

Wedco 3500



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 83) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for general cleaning of composites as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-83-102-001

## 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. Refer to the U-File for the applicable vendors.
- B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

General Cleaning of Composites (Series 83) Table 201		
Material Name	Material Bulk Code	Other Specifications
Acetone	в00062	JIS-K-1503
Aerfluor 343		
BMS 11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
Ethyl alcohol, denatured	в00068	
FCC-55		
Glidsafe Prepsolv		

EFFECTIVITY-	
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20-30-83



General Cleaning of Composites (Series 83) Table 201		
Material Name	Material Bulk Code	Other Specifications
Isopropyl alcohol (IPA)	в00130	
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)	в00666	
MIBK:MEK 3:2		
TT-N-95, Type II	в00083	
Turco 4460 BK		
Turco 6709		

ALL



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 84) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning of metal prior to painting as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-84-102-001

## 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. Refer to the U-File for the applicable vendors.

#### B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning of Metal Prior to Painting (Series 84) Table 201		
Material Name	Material Bulk Code	Other Specifications
Acetone	в00062	JIS-K-1503
BMS 11-7	в00184	MIL-C-38736B
CDG-110		
CDG-211		
Citra Safe	в00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	в00647	
FCC-55		
Glidsafe Prepsolv		
Isopropyl alcohol (IPA)	B00130	

EFFECTIVITY	1
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20-30-84



Final Cleaning of Metal Prior to Painting (Series 84) Table 201		
Material Name	Material Bulk Code	Other Specifications
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	в00094	
Turco 4460 BK		
Turco 6709		

ALL



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 85) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning of all organic coatings prior to painting as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-85-102-001

- 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. Refer to the U-File for the applicable vendors.
  - B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning of All Organic Coatings Prior to Painting (Series 85) Table 201		
Material Name	Material Bulk Code	Other Specifications
BMS 11-7	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)	в00148	
Methyl propyl ketone (MPK)	в00666	
MIBK:MEK 3:2		

EFFECTIVITY	_
AI I	İ

20-30-85



# Final Cleaning of All Organic Coatings Prior to Painting (Series 85) Table 201

Material Name	Material Bulk Code	Other Specifications
MIL-C-81302, Type I	B00143	
Toluene	в00094	
Turco 4460 BK		
Turco 6709		

EFFECTIVITY-

ALL

20-30-85

01

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## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 86) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning of solvent resistant coatings prior to painting as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-86-102-001

- 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. Refer to the U-File for the applicable vendors.
  - B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

1	Resistant Org ng (Series 86 ble 201	
Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS 11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Citra Safe	B00634	
Citra Safe, Deodorized		
d-Limonene		
DeSo Clean 45	B00647	
FCC-55		
Glidsafe Prepsolv		

EFFECTIVITY	
ALL	

20-30-86



# Final Cleaning of Solvent Resistant Organic Coatings Prior to Painting (Series 86) Table 201

Material Bulk Code	Other Specifications
B00130	
B00148	
в00666	
B00143	
в00094	
	Bulk Code B00130 B00148 B00666 B00143

EFFECTIVITY-

ALL



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 87) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning prior to painting composites as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-87-102-001

- 2. Final Cleaning Prior to Painting Composites (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. Refer to the U-File for the applicable vendors.
  - B. Procedure

s 112-003

(1) In Table 201, find the applicable solvent.

Final Cleaning Prior to Painting Composites (Series 87) Table 201				
Material Name	Material Bulk Code	Other Specifications		
Acetone	в00062	JIS-K-1503		
BMS 11-7	в00184	MIL-C-38736B		
CDG-110				
CDG-211				
Citra Safe	в00634			
Citra Safe, Deodorized				
d-Limonene				
FCC-55				
Glidsafe Prepsolv				
MEK:1,1,1-Trichloroethane 1:1				

EFFECTIVITY	
ALL	

20-30-87



Final Cleaning Prior to P Ta	Painting Composi able 201	ites (Series 87)
Material Name	Material Bulk Code	Other Specifications
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		

ALL



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 88) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning of metal prior to non-structural bonding as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-88-102-001

- 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. Refer to the U-File for the applicable vendors.
  - B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning of Metal Prior to Non-structural Bonding (Series 88) Table 201		
Material Name	Material Bulk Code	Other Specifications
Acetone	B00062	JIS-K-1503
BMS 11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	в00068	
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	

EFFECTIVITY-	 	

20-30-88



# Final Cleaning of Metal Prior to Non-structural Bonding (Series 88) Table 201 Material Other Bulk Code Specifications Methyl propyl ketone (MPK) MIBK:MEK 3:2 MIL-C-81302, Type I B00143

EFFECTIVITY-

ALL

Turco 6709

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## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 89) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning of all organic coatings prior to non-structural bonding as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-89-102-001

- 2. <u>Final Cleaning of All Organic Coatings Prior to Non-structural Bonding</u> (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. Refer to the U-File for the applicable vendors.
  - B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning of All Organic Coatings Prior to Non-structural Bonding (Series 89) Table 201		
Material Name	Material Bulk Code	Other Specifications
CDG-110		
CDG-211		
Ethyl alcohol, denatured	в00068	
Isopropyl alcohol (IPA)	в00130	
MIL-C-81302, Type I	в00143	

EFFECTIVITY-

ALL

20-30-89



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 90) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning of solvent resistant organic coatings prior to non-structural bonding as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-90-102-001

- 2. <u>Final Cleaning of Solvent Resistant Organic Coatings Prior to Non-structural</u> 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. Refer to the U-File for the applicable vendors.
  - B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning of Solvent Resistant Organic Coatings Prior to Non-structural Bonding (Series 90) Table 201		
Material Name	Material Bulk Code	Other Specifications
BMS 11-7	B00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	в00068	
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	

EFFECTIVITY	٦
ALL	

20-30-90



## Final Cleaning of Solvent Resistant Organic Coatings Prior to Non-structural Bonding (Series 90) Table 201

Material Name	Material Bulk Code	Other Specifications
Methyl propyl ketone (MPK)	B00666	
MIBK:MEK 3:2		
MIL-C-81302, Type I	B00143	
Turco 6709		

EFFECTIVITY-

ALL

20-30-90

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## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 91) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning of composites prior to non-structural bonding as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-91-102-001

- 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. Refer to the U-File for the applicable vendors.
  - B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning of Composites Prior to Non-structural Bonding (Series 91) Table 201		
Material Name	Material Bulk Code	Other Specifications
Acetone	в00062	JIS-K-1503
BMS 11-7	в00184	MIL-C-38736B
CDG-110		
CDG-211		
Ethyl alcohol, denatured	в00068	
FCC-55		
Isopropyl alcohol (IPA)	в00130	
MEK:1,1,1-Trichloroethane 1:1		
MEK:sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	

EFFECTIVITY-	
	ALL

20-30-91



## Final Cleaning of Composites Prior to Non-structural Bonding (Series 91) Table 201 Material Oth

Material Name	Material Bulk Code	Other Specifications
Methyl propyl ketone (MPK)	в00666	
MIBK:MEK 3:2		
Turco 6709		

EFFECTIVITY-

ALL

20-30-91

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## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 92) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning prior to general sealing as given in BAC5000. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-92-102-001

## 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. Refer to the U-File for the applicable vendors.

## B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning Prior to General Sealing (Series 92) Table 201		
Material Name	Material Bulk Code	Other Specifications
1,1,1-Trichloroethane	в00090	
Aliphatic Naphtha (for acrylic surfaces only)	в00083	TT-N-95 (TyII)
BMS 11-7	B00184	
Citra Safe	B00634	
Dowclene DC		
FCC-55		
MEK:sec-Butyl alcohol 42:58 percent		
Methyl ethyl ketone (MEK)	B00148	ASTM D740 JIS-K-1524

EFFECTIVITY-	1
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20-30-92



Final Cleaning Prior to General Sealing (Series 92) Table 201		
Material Name	Material Bulk Code	Other Specifications
Methyl propyl ketone (MPK)	в00666	

EFFECTIVITY-

ALL

20-30-92

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## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 93) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning prior to fuel tank sealing as given in BAC5504. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-93-102-001

- 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. Refer to the U-File for the applicable vendors.
  - B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning Prior to Fuel Tank Sealing (Series 93) Table 201					
Material Name	Material Bulk Code	Other Specifications			
1,1,1-Trichloroethane	в00090	0-т-620			
BMS 11-7	в00184				
Citra Safe	в00634				
Dowclene EC					
FCC-55					
MEK:sec-Butyl alcohol 42:58 percent					
Methyl ethyl ketone (MEK)	в00148	ASTM D740 JIS-K-1524			
Methyl propyl ketone (MPK) B00666					

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20-30-93



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 94) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning prior to application of rain erosion resistant coatings as given in BAC5880. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-94-102-001

- 2. <u>Final Cleaning Prior to Application of Rain Erosion Resistant Coating</u> (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. Refer to the U-File for the applicable vendors.
  - B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning Prior to Application of Rain Erosion Resistant Coating (Series 94) Table 201				
Material Other Material Name Bulk Code Specifications				
Methyl ethyl ketone (MEK)	B00148	TT-M-261		

EFFECTIVITY-

ALL

20-30-94



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 95) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning prior to aerodynamic smoothing and fairing as given in BAC5030. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-95-102-001

## 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. Refer to the U-File for the applicable vendors.

## B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning Prior to Aerodynamic Smoothing and Fairing (Series 95) Table 201				
Material Other  Material Name Bulk Code Specification				
1,1,1-Trichloroethane	в00090	0-т-620		
Aliphatic naphtha (for acrylic surfaces only)	B00083	TT-N-95, TyII		
BMS 11-7	в00184	MIL-C-38736B		
Citra Safe	в00634			
FCC-55				
Methyl ethyl ketone (MEK)	B00148	ASTM D740		
Methyl propyl ketone (MPK)	B00666			

EFFECTIVITY-

ALL

20-30-95



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 96) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning of oxygen components exposed to oxygen as given in BAC5402. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-96-102-001

## 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. Refer to the U-File for the applicable vendors.

## B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning of Oxygen Components Exposed to Oxygen (Series 96) Table 201				
Material Other Material Name Bulk Code Specifications				
Freon TF	B00143			
Trichloroethylene	в00081	ASTM D 4080		
Tetrachloroethylene	в00093	0-T-236		

EFFECTIVITY-

ALL

20-30-96



## Final Cleaning of Oxygen Components Exposed to Oxygen (Series 96) Table 201

<del> </del>		
Material Name	Material Bulk Code	Other Specifications
HFE 7100	в50002	
HFE 71DE	в50003	
Vertrel XF	B50004	
Vertrel MCA	в50005	

EFFECTIVITY-

ALL

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## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 97) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for final cleaning prior to structural bonding as given in BAC5514. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-97-102-001

## 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. Refer to the U-File for the applicable vendors.

## B. Procedure

s 112-002

(1) In Table 201, find the applicable solvent.

Final Cleaning Prior to Structural Bonding (Series 97) Table 201				
Material Other Material Name Bulk Code Specification				
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)	в00666			
MIBK:MEK 3:2				
Sec-Butyl alcohol		ASTM D1007		

EFFECTIVITY-

ALL

20-30-97



## AIRPLANE STRUCTURE CLEANING SOLVENTS (Series 98) - MAINTENANCE PRACTICES

## 1. General

A. This subject contains a list of solvents for cleaning of specific polymerics as given in BAC5750. This subject gives only the list of solvents. It does not tell you which solvent to use or how to use the solvents.

TASK 20-30-98-102-001

## 2. Cleaning of Specific Polymerics (Series 98)

## A. General

- (1) This selection of solvents uses BAC5750 as a guide. 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. Refer to the U-File for the applicable vendors.
- (2) The solvents in this list may be used for:
  - (a) The general cleaning of:
    - Polyester (Vibrin, Mylar, Dacron)
    - 2) Polytetrafluoroethylene (Teflon)
    - 3) Polyvinyl fluoride (Tedlar)
  - (b) Or, the final cleaning of the following prior to painting:
    - 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

s 112-002

(1) In Table 201, find the applicable solvent.

Cleaning of Specific Polymerics (Series 98) Table 201				
Material Other Bulk Code Specifications				
Acetone	в00062	JIS-K-1503		
BMS 11-7	B00184	MIL-C-38736B		
CDG-110				
CDG-211				

20-30-98



Cleaning of Specific Polymerics (Series 98) Table 201			
Material Name	Material Bulk Code	Other Specifications	
Ethyl alcohol, denatured	в00068		
Ethyl-3-Ethoxy propionate (EEP)			
FCC-55			
Isopropyl alcohol (IPA)	в00130		
MEK:sec-Butyl alcohol 42:58 percent			
Methyl ethyl ketone (MEK)	в00148		
Methyl isobutyl ketone (MIBK)	в00151	JIS-K-8903	
Methyl propyl ketone (MPK)	в00666		
MOK or MOK*			
TT-N-95, Type II	в00083		
Turco 6709			

## TASK 20-30-98-102-003

## 3. Cleaning of Phenolics or Nylon (Series 98-1)

## A. General

(1) This selection of solvents uses BAC 5750 as a guide. 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. Refer to the U-File for the applicable vendors.

ALL

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## B. Procedure

s 112-004

(1) When your procedure refers to this subject (Table 201), use a solvent from this list.

EFFECTIVITY-

ALL

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Cleaning of Phenolics or Nylon (Series 98–1) Table 201			
Material Name	Material Bulk Code	Other Specifications	
Acetone (Nylon only)	в00062	JIS-K-1503	
CDG-110			
CDG-211			
Ethyl alcohol, denatured	в00068		
FCC-55			
Isopropyl alcohol (IPA)	в00130		
MEK:sec-Butyl alcohol 42:58 percent			
Methyl ethyl ketone (MEK)	B00148		
Methyl Isobutyl Ketone (MIBK) (Nylon only)	B00151	JIS-K-8903	
Methyl propyl ketone (MPK)	в00666		
Toluene (Nylon only)	в00084		
TT-N-95, Type II	в00083		
Turco 6709			

EFFECTIVITY-

ALL

20-30-98



## 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 given 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.

TASK 20-30-99-912-001

## 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. Refer to the U-File for the applicable vendors.

## B. Procedure

s 802-002

(1) When your procedure refers to this subject (Table 201), use a solvent from this list.

Final Cleaning of Composites Prior to Structural Bonding Table 201			
Material Name	Material Bulk Code	Other Specifications	
1,1,1-Trichloroethane (Non-Metallic core only)	в00090		
Acetone	в00062	0-A-51	
BMS 11-7 (non-Metallic core only)	B00184		
Isopropyl Alcohol (IPA) (Non-Metallic core only)	B00130		
MEK: Toluene 1:1		ASTM D 740 TT-T-548	
Methyl Ethyl Ketone (MEK)	B00148	ASTM D 780	

EFFECTIVITY-ALL

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Final Cleaning of Composites Prior to Structural Bonding Table 201				
Material Other Material Name Bulk Code Specifications				
Methyl Propyl Ketone (MPK) (High purity)				
Naphtha (Non-Metallic core only)	B00083	TT-N-95		

EFFECTIVITY-

ALL

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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
    (a) A positive ground is the same as a static 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).
  - (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 only when Ref Par. 4., check has been passed.
  - (2) Electrical bond between the airplane and the refueling vehicle is recommended.
- D. A static ground of the airplane when you fuel 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.)

20-41-01



- (2) If needed to prevent static electrical discharge shocks to attending personnel or passengers.
  - (a) Airplanes having inadequate conductivity to ground through the
  - Airplanes parked on a surface where the parking site (b) conductivity is inadequate to carry away static electrical charge, should be electrostatically grounded to an identified ground point.

NOTE: The operator should ensure 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
- When the airplane is on the jacks and grounding cables interfere use this location.
  - (1) A different grounding location is through the unpainted bolt head common to the jack pad fittings found at STA 995, WL 116, LBL 130 and RBL 130 (AMM 32-32-00 and 32-34-00 A/T).

TASK 20-41-01-862-021

2. <u>Static Ground Procedure</u> (Fig. 201)

ALL

- A. Access
  - (1) Location Zones
    - 711 Nose Landing Gear
    - 731 Left Main Landing Gear
    - 741 Right Main Landing Gear

EFFECTIVITY-

20-41-01



## B. Grounding procedure:

s 422-032

WARNING: DO NOT CONNECT A HEADSET AND DO NOT TOUCH CONNECTIONS TO THE AIRPLANE DURING ATMOSPHERIC ELECTRICAL ACTIVITY OR IN STRONG ELECTROMAGNETIC 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.

- (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.

s 022-023

(2) Before the airplane is moved, remove the ground cables from the approved grounding attach point on the airplane.

TASK 20-41-01-762-024

- 3. Bonding Procedure
  - A. Procedure:

s 422-033

WARNING: DO NOT CONNECT A HEADSET AND DO NOT TOUCH CONNECTIONS TO THE AIRPLANE DURING ATMOSPHERIC ELECTRICAL ACTIVITY OR IN STRONG ELECTROMAGNETIC 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 ATTACH 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 in use.

EFFECTIVITY-

20-41-01

ALL



s 022-026

(2) Before the airplane is moved, remove the bonding cables from the airplane.

TASK 20-41-01-762-027

- 4. Measure Airplane Electrical Resistance to Ground
  - A. Equipment
    - (1) Ohmmeter Multimeter
  - B. References
    - (1) AMM 24-22-00/201
    - (2) AMM 24-41-03/601
  - C. Prepare to Check

s 042-028

(1) Remove electrical power from the airplane (AMM 24-22-00/201).

s 022-039

(2) Remove or De-energize any External Powered devices.

s 762-034

(3) Do a continuity check from the neutral pin of th external power receptacle to the grounding stud (AMM 24-41-03/601).

s 022-038

(4) Disconnect airplane static ground cables if connected.

s 422-029

(5) Connect a ohmmeter between the recognized bonding/grounding point on one of the Primary Landing gear of the airplane and an identified ground point on the ramp or the surface of the ramp on which the airplane is parked.

s 762-030

(6) Measure the resistance to ground and record in the maintenance log. Resistance should be less than 1.0 megohms.

s 812-037

ALL

(7) If the resistance exceeds 1.0 megohms this may be the result of inadequate grounding point or exceptional high surface resistance. Do the followings:

NOTE: If the resistance to ground is greater than 1.0 megohms, 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 gorund procedures may apply.

(a) Ensure the airplane is not parked over painted surfaces and that the tires provide adequate conductivity.

EFFECTIVITY-

20-41-01



(b) Repeat the measurement at other parking site locations where successful measurement have been made to verify adequate airplane conductivity.

s 422-035

(8) Connect airplane static ground cables if required.

s 862-036

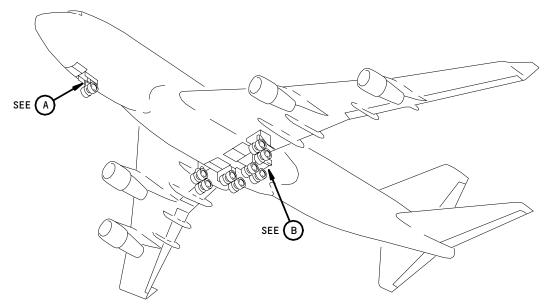
(9) Put the Airplane Back to Its Usual Condition

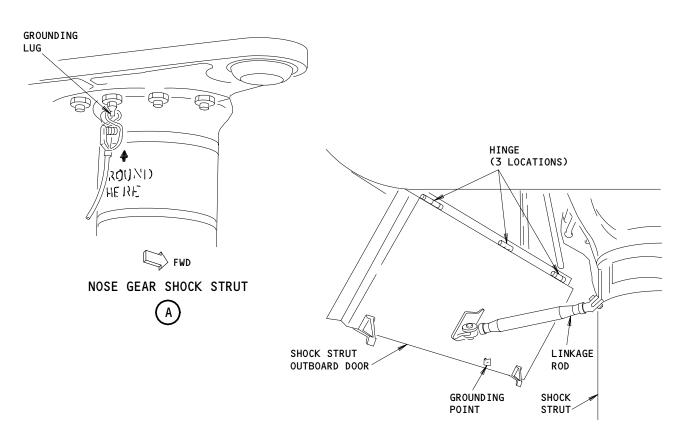
EFFECTIVITY-

ALL

20-41-01







BODY GEAR SHOCK STRUT DOOR LEFT SIDE (RIGHT SIDE IDENTICAL BUT OPPOSITE)



Static Grounding Point Location Figure 201

EFFECTIVITY-ALL

20-41-01

01

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## ELECTROSTATIC DISCHARGE SENSITIVE DEVICES - MAINTENANCE PRACTICES

- 1. <u>General</u> (Fig. 201)
  - A. This procedure contains these tasks:
    - (1) Electrostatic Discharge Sensitive (ESDS) printed circuit board removal.
    - (2) ESDS printed circuit boards installation.
    - (3) ESDS metal encased units removal handling.
    - (4) ESDS metal encased units installation handling.
    - (5) Wire Integration Unit (WIU) covers removal.
    - (6) WIU covers installation.
  - B. Many electronic line replaceable units (referred to as LRUs) contain micro-circuits and other sensitive devices which can be damaged internally by electrostatic discharges. These LRUs are identified as Electrostatic Discharge Sensitive (referred to as ESDS). The placards installed on the ESDS LRUs show that you must be careful. The persons who remove, install, and move the ESDS LRUs must know about static electricity and the protection from static discharges that is necessary.
  - C. Electrostatic charges can be caused by these: human bodies, hair, clothing, floors, equipment racks, and equipment units. An electrostatic discharge is electrostatic energy transmitted between materials of different electrical potentials. Electrostatic discharges from nylon clothing or human hair onto polyethylene or steel can cause damage to ESDS components. Damage to the internal components of an ESDS LRU can cause failure with one static discharge. System properties can change with time because of many static discharges.
  - D. The function of these procedures is to show the maintenance persons how to know and touch the ESDS LRUs. These procedures contain the precautions that are necessary to safely touch the units that are identified by the ESDS placard. Three types of decals are in used to identify the units with ESDS sensitive circuits. The military and commercial symbols are used on some units, while the international (JEDEC) symbol is used on most ESDS placard (Fig. 201). The ESDS printed circuit boards that are LRU's are identified with a "STATIC SENSITIVE" placard (Fig. 201).

TASK 20-41-02-002-053

- 2. ESDS Printed Circuit Boards Removal
  - A. Equipment
    - (1) Conductive Bags (Commercially Available)
    - (2) Conductive Plastic Carrier (Commercially Available)
    - (3) Ohmeter
    - (4) Wrist Straps, Conductive (Commercially Available)
    - (5) 100% Cotton Twine Commercially Available
    - (6) ESDS Labels
      - (a) JEDEC International Label multi-source
      - (b) 3M No. 7102

ALL

20-41-02





COMMERCIAL



GOVERNMENT

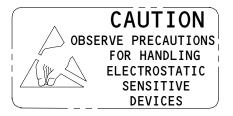


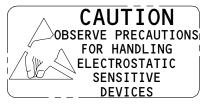
INTERNATIONAL (BOEING)

## TYPES OF ESDS SYMBOLS















TYPICAL BOEING ESDS DECALS

Static Discharge Sensitive Devices Identifiers Figure 201

 20-41-02



B. Procedure - Printed Circuit Boards with the STATIC SENSITIVE placards - Removal

NOTE: The placards on the outer area of the card files show the cards that contain the ESDS printed circuit boards that are LRU's.

s 862-060

CAUTION: MAKE SURE YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY FROM THE SENSITIVE DEVICE. CONTAMINATION OR UNWANTED MATERIAL NEAR THE SENSITIVE DEVICE CAN CAUSE A MALFUNCTION IN THE SENSITIVE DEVICE.

(1) Remove the system electrical power with the applicable Removal/Installation procedure.

s 722-056

WARNING: USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

- (2) Do these steps to do a test of the wrist strap resistance:
  - (a) Use an ohmmeter to make sure the wrist strap assembly has a minimum resistance of 250 kilohms and a maximum of 1.5 megohms.
  - (b) Put the wrist strap on your wrist.
  - (c) Use an ohmmeter to make sure the resistance is less than 10 megohm.

s 422-061

(3) Connect the wrist strap into the ELECTROSTATIC GROUND JACK of the card file.

s 862-005

CAUTION: THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS PRINTED CIRCUIT BOARDS.

(4) Attach the wrist strap correctly on the person that will remove the printed circuit board.

s 012-006

(5) Open the access door on the card file, if there is an access door.

\$ 032-007

(6) From the location decal, find the printed circuit board to be removed.

EFFECTIVITY-

20-41-02

ALL



s 022-008

(7) Use the top and bottom (or left and right) extractors on the printed circuit board to remove it from the card file.

s 862-010

(8) Put the printed circuit board in the conductive bag or the container with the ESDS placard.

s 862-009

DO NOT USE STAPLES OR ADHESIVE TAPES TO CLOSE THE CONDUCTIVE BAGS. FAILURE TO CLOSE THE CONDUCTIVE BAGS CORRECTLY CAN CAUSE DAMAGE TO THE PRINTED CIRCUIT BOARD.

(9) Use an ESDS or a 100% cotton twine to close the conductive bag.

The printed circuit boards in a conductive bag must be put in a rigid container to make sure the conductive bag stays in a satisfactory condition.

s 862-011

(10) Close the access door to the card file.

s 862-012

(11) Remove the wrist strap.

TASK 20-41-02-402-054

- 3. ESDS Printed Circuit Boards - Installation
  - A. Equipment
    - Conductive Bags (Commercially Available) (1)
    - (2) Conductive Plastic Carrier (Commercially Available)
    - (3) Ohmeter
    - Wrist Straps, Conductive (Commercailly Available)
    - (5) 100% Cotton Twine - Commercially Available
    - ESDS Labels (6)
      - (a) JEDEC International Label multi-source
      - (b) 3M No. 7102

ALL

EFFECTIVITY-

20-41-02



B. Procedure - Printed Circuit Boards with a STATIC SENSITIVE Placard - Installation

S 862-066

CAUTION: MAKE SURE YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY FROM THE SENSITIVE DEVICE. CONTAMINATION OR UNWANTED MATERIAL NEAR THE SENSITIVE DEVICE CAN CAUSE A MALFUNCTION IN THE SENSITIVE DEVICE.

(1) Remove the system electrical power with the applicable Removal/Installation procedure.

s 722-057

WARNING: USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

- (2) Do these steps to do a test of the wrist strap resistance:
  - (a) Use an ohmmeter to make sure the wrist strap assembly has a minimum resistance of 250 kilohms and a maximum of 1.5 megohms.
  - (b) Put the wrist strap on your wrist.
  - (c) Use an ohmmeter to make sure the resistance is less than 10 megohm.

s 422-062

(3) Connect the wrist strap into the ELECTROSTATIC GROUND JACK of the card file.

s 862-016

CAUTION: THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS PRINTED CIRCUIT BOARDS.

(4) Attach the wrist strap correctly on the person that will remove the printed circuit board.

s 862-017

(5) Open the access door on the card file.

s 862-018

(6) From the location decal, find the printed circuit board to be installed.

s 862-019

(7) Remove the ESDS printed circuit board from the conductive bag or the carrier.

EFFECTIVITY-

20-41-02

ALL



s 422-020

(8) With the top and bottom (or left and right) extractors, put the printed circuit board into the card file.

s 432-021

(9) Attach the printed circuit card with the extractors.

s 862-022

(10) Close the access door for the card file.

s 862-023

(11) Remove the wrist strap.

TASK 20-41-02-002-024

- ESDS Metal Encased Units Removal Handling
  - General
    - (1) The metal encased units can be put on a rack, the airplane structure, or a control panel.
  - B. Equipment
    - (1) Wrist Strap Conductive, (commercially available)
    - (2) Ohmmeter

EFFECTIVITY-

ALL

20-41-02



(3) Conductive electrical dust caps and connector covers

NOTE: Conductive dust caps and connector covers are black or grey in color.

(a) ITT Cannon - as applicable (stamped "CONDUCTIVE")

PART NUMBER	MARKING ON CAP	CONNECTOR
025-1155-001	BKAD1-A&B-R	BKAD1-A-R BKAD1-B-R
025-1156-001	BKAD1-C-R	BKAD1-C-R
025-1157-001	BKAD2&3-A&B-R	BKAD2-A-R BKAD2-B-R BKAD3-A-R BKAD3-B-R
025-1158-001	BKAD2&3-C-R	BKAD2-C-R BKAD3-C-R

(b) Souriau - as applicable

PART NUMBER	TYPE CONNECTOR	SHELL SIZE
8660-1404	Power	1
8660-1405	Signal	1
8660-1406	Power	2 & 3
8660-1407	Signal	2 & 3

- (4) Anti-static dust caps and connector covers (alternate when conductive caps and covers not available)
  - (a) Plastic dust caps and connector covers that have an anti-static solution applied and they are dated.
- C. Procedure Metal Encased Units with the ESDS Placards Removal

EFFECTIVITY-



s 862-063

CAUTION: MAKE SURE YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY FROM THE SENSITIVE DEVICE. CONTAMINATION OR UNWANTED MATERIAL NEAR THE SENSITIVE DEVICE CAN CAUSE A MALFUNCTION IN THE SENSITIVE DEVICE.

(1) Remove the system electrical power with the applicable Removal/Installation procedure.

s 722-071

WARNING: USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

(2) Do these steps to do a test of the wrist strap resistance:

(a) Use an ohmmeter to make sure the wrist strap assembly has a minimum resistance of 250 kilohms and a maximum of 1.5 megohms.

CAUTION: THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS METAL ENCASED UNIT.

- (b) Put the wrist strap on the person who will be handling the device.
- (c) Use an ohmmeter to make sure the resistance is less than 10 megohms.

s 422-077

(3) Connect the strap to an applicable electrostatic ground jack.

s 022-026

(4) Remove the unit with the ESDS placard from the equipment rack, the airframe, or the panel as shown in the applicable Removal/Installation procedure.

<u>NOTE</u>: Make sure you do not touch the pins in the electrical connector. Make sure a static sensitive placard is installed adjacent to the electrical connector(s). This static sensitive placard, or an equivalent, will be shown:

CAUTION

ELECTROSTATIC SENSITIVE DEVICE. CONDUCTIVE CONNECTOR DUST COVER REQUIRED.

This placard show that the unit can be damaged by an electrostatic discharge through the connector pins.

EFFECTIVITY-

20-41-02

ALL



s 032-027

(5) Install a conductive dust cover with a static sensitive placard on the connectors, and standard dust covers on the connectors that do not have the placard.

NOTE: The conductive dust caps and the connector covers are black

in color.

NOTE: The conductive dust caps and the connector covers from the

installed unit can be used on the removed unit.

s 862-028

(6) Move the unit, as shown in the standard practices, with the conductive dust caps and connector covers installed.

s 862-073

(7) Remove the strap.

TASK 20-41-02-402-029

- 5. ESDS Metal Encased Units Installation Handling
  - A. Equipment
    - (1) Wrist Strap Conductive (commercially available)
    - (2) Ohmmeter

EFFECTIVITY-

ALL

20-41-02

01.1

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(3) Conductive electrical dust caps and connector covers

NOTE: Conductive dust caps and connector covers are black or grey in color.

(a) ITT Cannon - as applicable (stamped "CONDUCTIVE")

PART NUMBER	MARKING ON CAP	CONNECTOR
025-1155-001	BKAD1-A&B-R	BKAD1-A-R BKAD1-B-R
025-1156-001	BKAD1-C-R	BKAD1-C-R
025-1157-001	BKAD2&3-A&B-R	BKAD2-A-R BKAD2-B-R BKAD3-A-R BKAD3-B-R
025-1158-001	BKAD2&3-C-R	BKAD2-C-R BKAD3-C-R

(b) Souriau - as applicable

PART NUMBER	TYPE CONNECTOR	SHELL SIZE
8660-1404	Power	1
8660-1405	Signal	1
8660-1406	Power	2 & 3
8660-1407	Signal	2 & 3

- (4) Anti-static dust caps and connector covers (alternate when conductive caps and covers not available)
  - (a) Plastic dust caps and connector covers that have an anti-static solution applied and are dated.
- B. Metal Encased Units with ESDS Placards-Installation Handling

EFFECTIVITY-

20-41-02



s 862-069

CAUTION: MAKE SURE YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY FROM THE SENSITIVE DEVICE. CONTAMINATION OR UNWANTED MATERIAL NEAR THE SENSITIVE DEVICE CAN CAUSE A MALFUNCTION IN THE SENSITIVE DEVICE.

(1) Remove the system electrical power with the applicable Removal/Installation procedure.

s 722-074

WARNING: USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED

(2) Do these steps to do a test of the wrist strap resistance:

(a) Use an ohmmeter to make sure the wrist strap assembly has a minimum resistance of 250 kilohms and a maximum of 1.5 megohms.

CAUTION: THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS METAL ENCASED UNIT.

- (b) Put the strap on the wrist of the person that will remove the device.
- (c) Use an ohmmeter to make sure the resistance is less than 10 megohms.

s 942-076

(3) Connect the strap to an applicable electrostatic ground jack.

s 432-031

(4) Remove all of the conductive dust caps and the connector covers from the unit to be installed.

NOTE: Make sure you do not touch the electrical pins.

s 422-032

ALL

(5) Install the ESDS unit with the applicable Removal/Installation procedure.

EFFECTIVITY-

20-41-02



s 082-078

(6) Remove the strap.

TASK 20-41-02-002-041

- 6. Wire Integration Unit (WIU) Covers Removal
  - A. Standard Tools and Equipment
    - (1) Wrist Straps (Commercially Available)
  - B. Procedure

S 862-064

CAUTION: MAKE SURE YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY FROM THE SENSITIVE DEVICE. CONTAMINATION OR UNWANTED MATERIAL NEAR THE SENSITIVE DEVICE CAN CAUSE A MALFUNCTION IN THE SENSITIVE DEVICE.

(1) Remove the system electrical power with the applicable Removal/Installation procedure.

s 012-043

(2) Remove the WIU protective cover.

s 492-044

WARNING: USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

- (3) Do these steps to do a test of the wrist strap resistance:
  - (a) Use an ohmmeter to make sure the wrist strap assembly has a minimum resistance of 250 kilohms and a maximum of 1.5 megohms.
  - (b) Put the wrist strap on your wrist.
  - (c) Use an ohmmeter to make sure the resistance is less than 10 megohm.

s 862-058

ALL

(4) Connect the wrist strap into the ELECTROSTATIC GROUND JACK of the card file.

EFFECTIVITY-

20-41-02



s 492-059

CAUTION: THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS PRINTED CIRCUIT BOARDS.

(5) Attach the wrist strap correctly on the person that will remove the printed circuit board.

s 012-055

CAUTION: DO NOT PERMIT CONTAMINATION IN THE WIU WHEN THE COVER IS OFF.
MAKE SURE THAT YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY
FROM THE WIU. MAKE SURE THAT OTHER PEOPLE THAT WORK AROUND THE
WIU AREA KEEP UNWANTED MATERIAL OR CONTAMINATION AWAY FROM THE
WIU. UNWANTED MATERIAL OR CONTAMINATION CAN CAUSE A
MALFUNCTION IN THE WIU.

(6) Remove the WIU cover.

NOTE: Observe the high voltage warnings on the WIU cover.

TASK 20-41-02-402-048

- 7. Wire Integration Unit (WIU) Cover Installation
  - A. Standard Tools and Equipment
    - (1) Wrist Straps (Commercially Availavle)
  - B. Procedure

s 492-049

ALL

WARNING: USE A WRIST STRAP WITH A MINIMUM GROUNDING LEAD RESISTANCE OF 250 KILOHMS AND A MAXIMUM OF 1.5 MEGOHMS. USE OF A LOW RESISTANCE WRIST STRAP CAN CAUSE INJURY TO PERSONS IF A HIGH VOLTAGE SOURCE IS TOUCHED.

<u>CAUTION</u>: MAKE SURE YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY FROM THE SENSITIVE DEVICE. CONTAMINATION OR UNWANTED MATERIAL NEAR THE SENSITIVE DEVICE CAN CAUSE A MALFUNCTION IN THE SENSITIVE DEVICE.

- (1) Do these steps to do a test of the wrist strap resistance:
  - (a) Use an ohmmeter to make sure the wrist strap assembly has a minimum resistance of 250 kilohms and a maximum of 1.5 megohms.

EFFECTIVITY-

20-41-02



- (b) Put the wrist strap on your wrist.
- (c) Use an ohmmeter to make sure the resistance is less than 10 megohm.

s 422-067

(2) Connect the wrist strap into the ELECTROSTATIC GROUND JACK of the card file.

s 942-065

CAUTION: THE GROUNDING LEAD ON THE WRIST STRAP MUST TOUCH THE SKIN TO GIVE THE PROTECTION THAT IS NECESSARY. FAILURE TO USE THE WRIST STRAP CORRECTLY CAN CAUSE DAMAGE TO THE ESDS PRINTED CIRCUIT BOARDS.

(3) Attach the wrist strap correctly on the person that will remove the printed circuit board.

s 412-050

(4) Install the WIU cover.

s 092-051

(5) Remove the wrist strap.

s 412-052

(6) Install the protective cover.

EFFECTIVITY-

ALL

20-41-02



## WIRE INTEGRATION UNIT (WIU) - MAINTENANCE PRACTICES

#### 1. General

- A. This procedure contains five tasks:
  - (1) The first task is the instructions to do a check at a wire wrap post for power or a signal.
  - (2) The second task is the instructions for repairs to the wires on the wire wrap post.
  - (3) The third task is a continuity check of a Wire Integration Unit (WIU).
  - (4) The fourth task is the procedure to remove a WIU.
  - (5) The fifth task is the procedure to install a WIU.
- B. The WIUs are on the aft side of E1-1 thru -6 and E2-1 thru -6 electronic shelves. There are 12 WIUs.
- C. The wires to the WIUs come from equipment which contain static sensitive devices. Do not touch the wires or equipment on the electronic shelves unless you have an ESD wrist strap on your wrist that is correctly connect to the electrostatic ground receptacle on the WIU rack (Fig. 201).
- D. You can get access to the WIUs from the cargo compartment. You must remove the cargo lining.

TASK 20-41-03-762-003

- 2. Wire Wrap Posts Power or Signals Check (Fig. 201)
  - A. Access
    - (1) Location Zones

117/118 Electronics and Electronics Compartment - Left and Right

(2) Access Panel

125B Access Door Electronics

B. Procedure - Wire Wrap Posts Power or Signals Check.

s 012-004

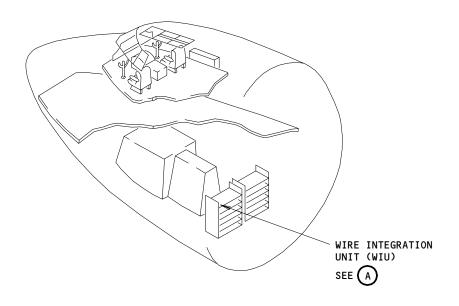
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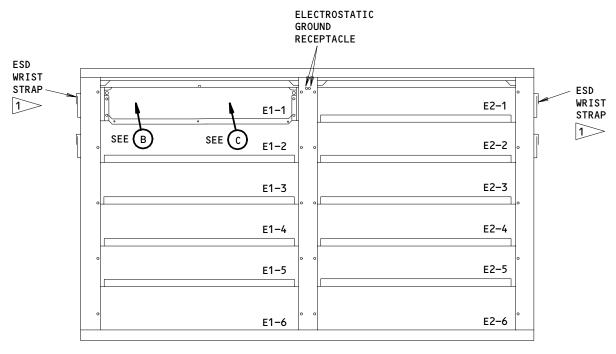
- (1) Remove the cargo lining from the aft side of the electronic rack:
  - (a) Remove the bolts.
  - (b) Remove the cargo lining.

EFFECTIVITY-

20-41-03







E1-1 SHOWN - E1-2 THRU E1-6 AND E2-1 THRU E2-6 SIMILAR (EXTERNAL COVER NOT SHOWN)



1 ELECTROSTATIC SENSITIVE DEVICE

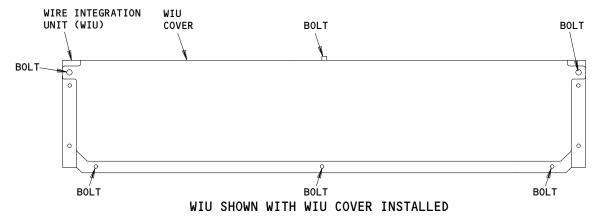
Wire Integration Unit (WUI) Figure 201 (Sheet 1)

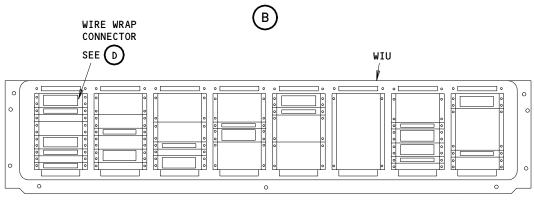
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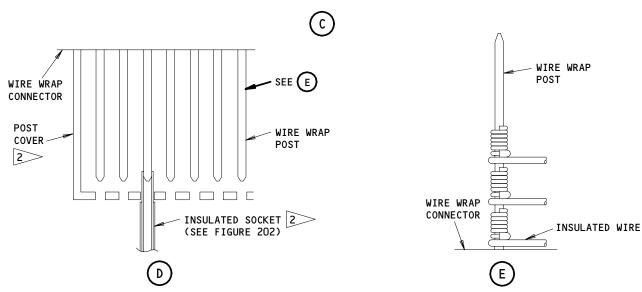
BOEING PROPRIETARY - Copyright (C) - Unpublished Work - See title page for details.







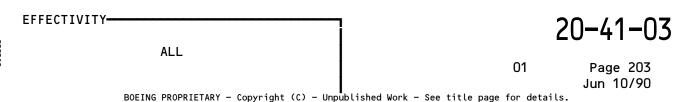
# WIU SHOWN WITH WIU COVER REMOVED



TO DO ELECTRICAL CONTINUITY CHECKS ON WIRE WRAP POSTS, KEEP THE POST COVER ON THE WIRE WRAP CONNECTOR AND INSTALL AN INSULATED SOCKET OVER THE APPROPRIATE WIRE WRAP POSTS.

CAUTION: DO NOT INSERT THE PROBE OF A TEST METER INTO THE WIRE WRAP CONNECTOR UNLESS POST COVER AND INSULATED SOCKETS ARE INSTALLED. TWO POSTS COULD BE CONTACTED AND EQUIPMENT DAMAGE COULD RESULT.

Wire Integration Unit (WIU) Figure 201 (Sheet 2)





s 492-067

CAUTION: YOU MUST PUT A ESD WRIST STRAP ON YOUR WRIST. YOU MUST CONNECT THE ESD WRIST STRAP TO THE ELECTROSTATIC GROUND RECEPTACLE ON THE WIU RACK. MAKE SURE THE ESD WRIST STRAP IS ON YOUR SKIN. IF THERE IS MATERIAL BETWEEN THE STRAP AND YOUR SKIN, THE GROUND CIRCUIT WILL NOT BE SATISFACTORY. THE ELECTRONIC SHELVES AND THE WIRES ARE CONNECTED TO ELECTROSTATIC SENSITIVE EQUIPMENT. IF YOU DO NOT CORRECTLY USE THE ESD WRIST STRAP, YOU CAN CAUSE MUCH DAMAGE TO THE EQUIPMENT.

(2) Attach a ESD wrist strap to your wrist.

NOTE: The ESD wrist straps are kept in bags at the ends of the WIU racks (Fig. 201).

s 492-005

(3) Attach a ESD wrist strap to the electrostatic ground receptacle on the WIU rack (Fig. 201).

s 012-074

CAUTION: DO NOT PERMIT CONTAMINATION IN THE WIU WHEN THE COVER IS OFF.
MAKE SURE THAT YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY
FROM THE WIU. MAKE SURE THAT OTHER PEOPLE THAT WORK AROUND THE
WIU AREA KEEP UNWANTED MATERIAL OR CONTAMINATION AWAY FROM THE
WIU. UNWANTED MATERIAL OR CONTAMINATION CAN CAUSE A
MALFUNCTION IN THE WIU.

- (4) Remove the WIU cover from the applicable shelf:
  - (a) Remove the bolts that hold the cover (View B, Fig. 201).

NOTE: Do not loosen the center bolt at the top of the cover. The bolt at this location is in a slot and does not hold the cover.

(b) Remove the cover.

ALL

EFFECTIVITY-

20-41-03



s 492-007

CAUTION: DO NOT REMOVE THE POST COVER FROM THE WIRE WRAP POSTS. IF YOU REMOVE THE POST COVER YOU CAN CAUSE SPARKS BETWEEN THE POSTS. THE SPARKS WILL CAUSE DAMAGE TO THE EQUIPMENT.

(5) Put the insulated sockets on the wire wrap posts that you will check (View D, Fig. 201).

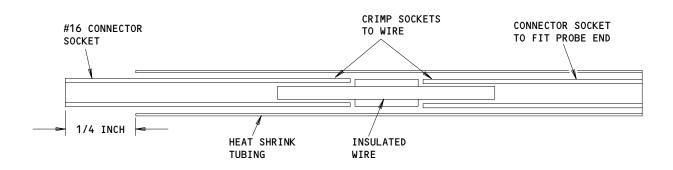
NOTE: You can make a insulated socket. Attach a No. 16 connector socket to a connector socket of the correct size to fit the probe point of the continuity checker probe point (Fig. 202).

s 762-008

658398

CAUTION: DO NOT TOUCH THE WIRE WRAP POSTS DIRECTLY WITH THE JUMPERS, WIRE CLIPS, OR INSTRUMENT PROBES. ATTACH THE INSULATED SOCKET TO THE WIRE WRAP POSTS BEFORE YOU DO THE CHECK. IF YOU TOUCH THE WIRE WRAP POSTS YOU CAN CAUSE A SHORT BETWEEN THE ADJACENT WIRE WRAP POSTS.

(6) Do the check for power or signals.



Insulated Socket Assembly Figure 202

20-41-03
ALL

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s 092-009

(7) Remove the insulated socket from the wire wrap posts.

s 412-010

- (8) Install the WIU cover on the applicable rack (View B, Fig. 201):
  - (a) Put the WIU cover on the unit.
  - (b) Install the bolts.

s 092-011

(9) Remove the ESD wrist strap from the electrostatic ground receptacle on the WIU rack (Fig. 201).

s 092-012

(10) Remove the ESD wrist strap from your wrist.

NOTE: Put the ESD wrist strap in one of the empty bags that are at the ends of the WIU rack (Fig. 201).

s 412-013

- (11) Install the cargo lining on the aft side of the electronic rack:
  - (a) Put the cargo lining in its position.
  - (b) Install the bolts.

TASK 20-41-03-352-014

- 3. Wires on Wire Wrap Posts Repair (Fig. 201)
  - A. General
    - (1) Special procedures are necessary for wire wrap repairs. The Wiring Diagram Manual, Chapter 20, gives the special procedures and tools that are necessary.
  - B. Access
    - (1) Location Zones

117/118 Electronics and Electronics Compartment - Left and Right

(2) Access Panel

125B Access Door Electronics

- C. References
  - (1) 24-22-00/201, Electrical Power
- D. Procedure Repair the wires.

s 862-015

CAUTION: REMOVE THE EXTERNAL POWER, ENGINE GENERATOR POWER, APU
GENERATOR POWER, AND ALL BATTERY POWER FROM THE AIRPLANE BEFORE
YOU DO REPAIRS TO THE WIRES. WHEN YOU DO THE REPAIRS, THE WIRE
WRAP POSTS DO NOT HAVE COVERS INSTALLED. SPARKS BETWEEN THE
WIRE WRAP POSTS CAN CAUSE DAMAGE TO THE EQUIPMENT.

(1) Remove all the electrical power (Ref 24-22-00/201).

 20-41-03



s 862-016

(2) Remove all the battery power.

s 012-017

- (3) Remove the cargo lining from the aft side of the electronic rack:
  - (a) Remove the bolts.
  - (b) Remove the cargo lining.

s 492-073

CAUTION: YOU MUST PUT A ESD WRIST STRAP ON YOUR WRIST. YOU MUST CONNECT THE ESD WRIST STRAP TO THE ELECTROSTATIC GROUND RECEPTACLE ON THE WIU RACK. MAKE SURE THE ESD WRIST STRAP IS ON YOUR SKIN. IF THERE IS MATERIAL BETWEEN THE STRAP AND YOUR SKIN, THE GROUND CIRCUIT WILL NOT BE SATISFACTORY. THE ELECTRONIC SHELVES AND THE WIRES ARE CONNECTED TO ELECTROSTATIC SENSITIVE EQUIPMENT. IF YOU DO NOT CORRECTLY USE THE ESD WRIST STRAP, YOU CAN CAUSE MUCH DAMAGE TO THE EQUIPMENT.

(4) Attach a ESD wrist strap to your wrist.

NOTE: The ESD wrist straps are kept in bags at the ends of the WIU racks (Fig. 201).

s 492-018

(5) Attach a ESD wrist strap to the electrostatic ground receptacle on the WIU rack (Fig. 201).

s 012-075

CAUTION: DO NOT PERMIT CONTAMINATION IN THE WIU WHEN THE COVER IS OFF.
MAKE SURE THAT YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY
FROM THE WIU. MAKE SURE THAT OTHER PEOPLE THAT WORK AROUND THE
WIU AREA KEEP UNWANTED MATERIAL OR CONTAMINATION AWAY FROM THE
WIU. UNWANTED MATERIAL OR CONTAMINATION CAN CAUSE A
MALFUNCTION IN THE WIU.

- (6) Remove the WIU cover from the applicable shelf:
  - (a) Remove the bolts that hold the cover (View B, Fig. 201).

NOTE: Do not loosen the center bolt at the top of the cover.

The bolt at this location is in a slot and does not hold the cover.

(b) Remove the cover.

s 012-020

(7) Remove the post cover from the wire wrap post where you will replace the wires.

EFFECTIVITY-

20-41-03

ALL



s 022-068

CAUTION: REMOVE THE WIRE FROM THE WIRE WRAP POSTS WITH THE SPECIAL TOOLS MADE FOR THAT PURPOSE AS IDENTIFIED IN CHAPTER 20 OF THE WIRING DIAGRAM MANUAL. IF YOU DO NOT USE THE CORRECT TOOLS YOU CAN CAUSE DAMAGE TO THE WIRE WRAP POSTS.

(8) Remove the wire from the wire wrap posts with the instructions in the Wiring Diagram Manual, Chapter 20.

s 422-022

(9) Install the wire on the wire wrap posts with the instructions in the Wiring Diagram Manual, Chapter 20.

s 412-023

(10) Install the post cover on the wire wrap posts.

s 412-024

- (11) Install the WIU cover on the applicable electronic shelf (View B, Fig. 201):
  - (a) Put the WIU cover on the unit.
  - (b) Install the bolts.

s 092-025

(12) Remove the ESD wrist strap from the electrostatic ground receptacle on the WIU rack (Fig. 201).

s 092-026

(13) Remove the ESD wrist strap from your wrist.

NOTE: Put the ESD wrist strap in one of the empty bags that are at the ends of the WIU rack (Fig. 201).

s 412-027

- (14) Install the cargo lining on the aft side of the electronic rack:
  - (a) Put the cargo lining in its position.
  - (b) Install the bolts.

TASK 20-41-03-762-028

- 4. Check WIUs for Continuity (Fig. 201)
  - A. General
    - (1) Do this check when there are wiring problems that you could not find with the power and signals check procedure. Or do this check after you have repair the wire wrap.
  - B. Access
    - (1) Location Zones

117/118 Electronics and Electronics Compartment - Left and Right

EFFECTIVITY-

20-41-03

ALL



(2) Access Panel
125B Access Door Electronics

C. Procedure - WIUs Continuity Check

s 012-029

- (1) Remove the cargo lining from the aft side of the electronic rack:
  - (a) Remove the bolts.
  - (b) Remove the cargo lining.

s 492-069

CAUTION: YOU MUST PUT A ESD WRIST STRAP ON YOUR WRIST. YOU MUST CONNECT THE ESD WRIST STRAP TO THE ELECTROSTATIC GROUND RECEPTACLE ON THE WIU RACK. MAKE SURE THE ESD WRIST STRAP IS ON YOUR SKIN. IF THERE IS MATERIAL BETWEEN THE STRAP AND YOUR SKIN, THE GROUND CIRCUIT WILL NOT BE SATISFACTORY. THE ELECTRONIC SHELVES AND THE WIRES ARE CONNECTED TO ELECTROSTATIC SENSITIVE EQUIPMENT. IF YOU DO NOT CORRECTLY USE THE ESD WRIST STRAP, YOU CAN CAUSE MUCH DAMAGE TO THE EQUIPMENT.

(2) Attach a ESD wrist strap to your wrist.

NOTE: The ESD wrist straps are kept in bags at the ends of the WIU racks (Fig. 201).

s 492-030

(3) Attach the ESD wrist strap to the electrostatic ground receptacle on the WIU rack (Fig. 201).

s 012-070

(4) Remove all the electronic boxes (black boxes) from the electronic shelves that are connected to system you will examine.

NOTE: Do not disconnect the wire connectors from the wire wrap plugs on the back side of the WIUs.

EFFECTIVITY-

20-41-03



s 012-002

CAUTION: BEFORE YOU DO THE CONTINUITY CHECK, YOU MUST REMOVE THE EXTERNAL POWER, ENGINE GENERATOR POWER, APU GENERATOR POWER, AND ALL BATTERY POWER. YOU MUST REMOVE THE ELECTRONIC BOXES THAT ARE CONNECTED TO THE SYSTEM YOU WILL EXAMINE. WHEN YOU DO A CONTINUITY CHECK, MORE VOLTAGE AND AMPERAGE THAN THE SYSTEM CAPACITY IS NECESSARY. DAMAGE TO THE EQUIPMENT CAN OCCUR IF YOU DO NOT OBEY THIS CAUTION.

CAUTION: DO NOT PERMIT CONTAMINATION IN THE WIU WHEN THE COVER IS OFF.
MAKE SURE THAT YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY
FROM THE WIU. MAKE SURE THAT OTHER PEOPLE THAT WORK AROUND THE
WIU AREA KEEP UNWANTED MATERIAL OR CONTAMINATION AWAY FROM THE
WIU. UNWANTED MATERIAL OR CONTAMINATION CAN CAUSE A
MALFUNCTION IN THE WIU.

- (5) Remove the WIU cover from the applicable shelf:
  - (a) Remove the bolts that hold the WIU cover (View B, Fig. 201).

NOTE: Do not loosen the center bolt at the top of the cover. The bolt at this location is a slot and does not hold the cover.

- (b) Remove the cover.
- s 762-032

<u>CAUTION</u>: DO NOT REMOVE THE POST COVER FROM THE WIRE WRAP POSTS. SPARKS BETWEEN THE POSTS CAN CAUSE DAMAGE TO THE EQUIPMENT.

- (6) Do the continuity check in this sequence:
  - (a) Put the insulated sockets on the applicable wire wrap posts (View D, Fig. 201).

NOTE: You can make a insulated socket from a No. 16 connector socket. Attached it to a connector socket of the correct size to fit the probe point of the continuity checker (Fig. 202).

(b) Do the continuity check to each wire from each electronic box connector to the opposite electronic box connector.

<u>NOTE</u>: Do this to all the wires in the system before you do the subsequent step.

EFFECTIVITY-

20-41-03

ALL



(c) Do the continuity check to each wire from each electronic box connector to the applicable wire wrap post on the WIU.

<u>NOTE</u>: Do this to all wires in the system before you do the subsequent step.

(d) Do the continuity check to each wire from each wire wrap post to the applicable wire wrap post on the WIU.

<u>NOTE</u>: Do this to all the wires in the system before you do the subsequent step.

s 842-078

(7) Repair the wires if it is necessary.

NOTE: Refer to the task Wires on Wire Wrap Posts Repairs.

s 412-033

(8) Install all the electronic boxes (black boxes) that you removed.

s 092-034

(9) Remove the insulated sockets from the wire wrap posts.

s 412-035

- (10) Install the WIU cover on the applicable rack (View B, Fig. 201):
  - (a) Put the WIU cover on the unit.
  - (b) Install the bolts.

s 092-036

(11) Remove the ESD wrist strap from the electrostatic ground receptacle on the WIU rack (Fig. 201).

s 092-037

(12) Remove the ESD wrist strap from your wrist.

NOTE: Put the ESD wrist strap in one of the empty bags that are at the ends of the WIU rack (Fig. 201).

s 412-038

ALL

- (13) Install the cargo lining on the aft side of the electronic rack:
  - (a) Put the cargo lining in its position.
  - (b) Install the bolts.

EFFECTIVITY-

20-41-03



TASK 20-41-03-002-039

- 5. Removal of a WIU from the Airplane (Fig. 203)
  - A. Access
    - (1) Location Zones

117/118 Electronics and Electronics Compartment - Left and Right

(2) Access Panel

125B Access Door Electronics

- B. References
  - (1) 24-22-00/201, Electrical Power
- C. Procedure WIU Removal

s 862-040

CAUTION: REMOVE THE EXTERNAL POWER, ENGINE GENERATOR POWER, APU
GENERATOR POWER, AND ALL BATTERY POWER FROM THE AIRPLANE BEFORE
YOU REMOVE THE WIU. IF YOU DO NOT REMOVE ELECTRICAL POWER
WIRES THAT ARE NOT CONNECTED CAN CAUSE SPARKS. SPARKS CAN
CAUSE DAMAGE TO THE EQUIPMENT.

(1) Remove all the electrical power (Ref 24-22-00/201).

S 862-041

(2) Remove all the battery power.

s 012-042

- (3) Remove the cargo lining from the aft side of the electronic rack:
  - (a) Remove the bolts.
  - (b) Remove the cargo lining.

s 492-071

CAUTION: YOU MUST PUT A ESD WRIST STRAP ON YOUR WRIST. YOU MUST CONNECT THE ESD WRIST STRAP TO THE ELECTROSTATIC GROUND RECEPTACLE ON THE WIU RACK. MAKE SURE THE ESD WRIST STRAP IS ON YOUR SKIN. IF THERE IS MATERIAL BETWEEN THE STRAP AND YOUR SKIN, THE GROUND CIRCUIT WILL NOT BE SATISFACTORY. THE ELECTRONIC SHELVES AND THE WIRES ARE CONNECTED TO ELECTROSTATIC SENSITIVE EQUIPMENT. IF YOU DO NOT CORRECTLY USE THE ESD WRIST STRAP, YOU CAN CAUSE MUCH DAMAGE TO THE EQUIPMENT.

(4) Attach a ESD wrist strap to your wrist.

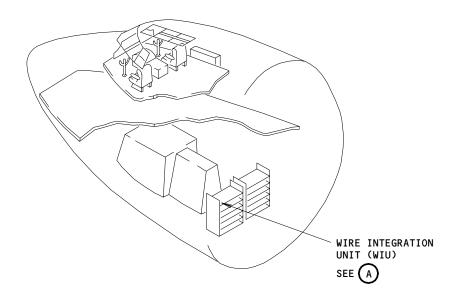
NOTE: The ESD wrist straps are kept in bags at the two ends of the WIU racks (Fig. 203).

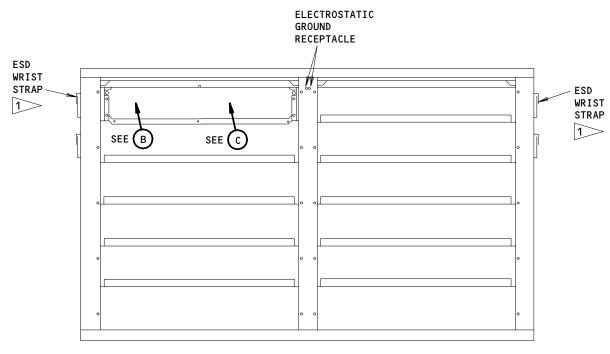
EFFECTIVITY---

20-41-03

ALL







E1-1 SHOWN - E1-2 THRU E1-6 AND E2-1 THRU E2-6 SIMILAR (CARGO LINING NOT SHOWN)

A

1 ELECTROSTATIC SENSITIVE DEVICE

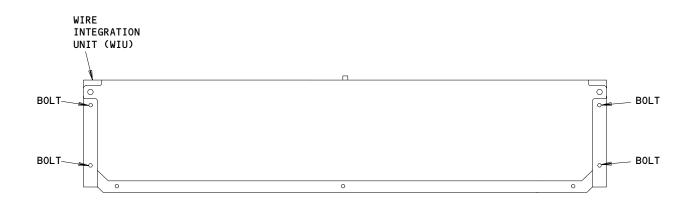
Wire Integration Unit (WIU) Installation Figure 203 (Sheet 1)

ALL

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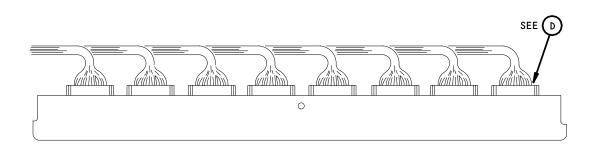
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# WIU SHOWN WITH COVER INSTALLED





# WIU SHOWN ROTATED 90°



Wire Integration Unit (WIU) Installation Figure 203 (Sheet 2)

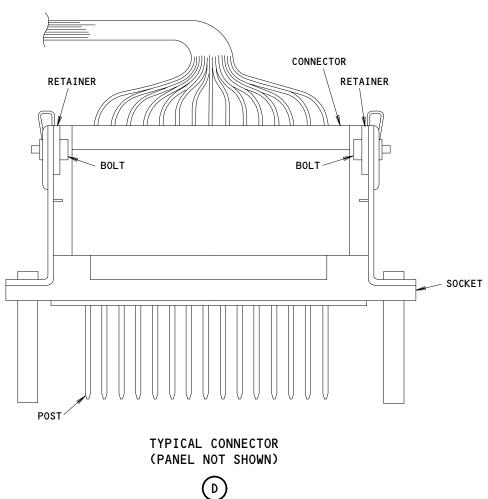
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Wire Integration Unit (WIU) Installation Figure 203 (Sheet 3)

EFFECTIVITY-ALL

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01

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s 492-043

(5) Attach the ESD wrist strap to the electronic ground receptacle on the WIU rack (Fig. 203).

S 022-044

CAUTION: DO NOT REMOVE THE WIU COVER BEFORE YOU REMOVE THE WIU FROM THE SHELF. DAMAGE TO THE WIRE WRAP POSTS AND WIRES CAN OCCUR IF YOU REMOVE THE WIU WITHOUT THE COVER. DO NOT PERMIT CONTAMINATION IN THE WIU WHEN THE COVER IS OFF. MAKE SURE THAT YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY FROM THE WIU. MAKE SURE THAT OTHER PEOPLE THAT WORK AROUND THE WIU AREA KEEP UNWANTED MATERIAL OR CONTAMINATION AWAY FROM THE WIU. UNWANTED MATERIAL OR CONTAMINATION CAN CAUSE A MALFUNCTION IN THE WIU.

(6) Remove bolts that hold the WIU panel to the shelf (View B, Fig. 203).

s 022-045

(7) Turn the top of the panel aft and down  $90^{\circ}$  to show the rear of the panel (View C, Fig. 203).

s 032-046

(8) Remove the electrical bonding jumper from the WIU panel.

s 022-047

(9) Remove the electrical connector retainer from each end of the connector at all locations (View D, Fig. 203).

s 022-048

(10) Remove each connector from the panel.

s 012-049

(11) Remove the panel.

s 092-050

CAUTION: DO NOT TOUCH THE ELECTRICAL CONNECTORS OF AIRPLANE WIRES AFTER YOU REMOVE THE ESD WRIST STRAP. AN ELECTROSTATIC DISCHARGE CAN CAUSE DAMAGE TO THE EQUIPMENT.

(12) Remove the ESD wrist strap from the electrostatic ground receptacle on the WIU rack (Fig. 203).

s 092-051

(13) Remove the ESD wrist strap from your wrist.

NOTE: Put the ESD wrist strap in one of the empty bags at the ends of the WIU rack.

EFFECTIVITY-

20-41-03

ALL



TASK 20-41-03-402-052

- Installation of the WIU on the Airplane (Fig. 203)
  - A. Access
    - (1) Location Zones

117/118 Electronics and Electronics Compartment - Left and Right

(2) Access Panel

125B Access Door Electronics

- B. References
  - (1) 24-00-00/001, Electrical Power
- C. Procedure WIU Installation

s 862-053

CAUTION: REMOVE THE EXTERNAL POWER, ENGINE GENERATOR POWER, APU
GENERATOR POWER, AND ALL BATTERY POWER FROM THE AIRPLANE BEFORE YOU
INSTALL THE WIU. REMOVE ELECTRICAL POWER, WIRES THAT ARE NOT
CONENCTED CAN CAUSE SPARKS. SPARKS CAN CAUSE DAMAGE TO THE
EQUIPMENT.

(1) Remove all the electrical power (Ref 24-00-00, MP).

s 022-077

(2) Remove all the battery power.

s 492-072

CAUTION: YOU MUST PUT A ESD WRIST STRAP ON YOUR WRIST. YOU MUST CONNECT THE ESD WRIST STRAP TO THE ELECTROSTATIC GROUND RECEPTACLE ON THE WIU RACK. MAKE SURE THE ESD WRIST STRAP IS ON YOUR SKIN. IF THERE IS MATERIAL BETWEEN THE STRAP AND YOUR SKIN, THE GROUND CIRCUIT WILL NOT BE SATISFACTORY. THE ELECTRONIC SHELVES AND THE WIRES ARE CONNECTED TO ELECTROSTATIC SENSITIVE EQUIPMENT. IF YOU DO NOT CORRECTLY USE THE ESD WRIST STRAP, YOU CAN CAUSE MUCH DAMAGE TO THE EQUIPMENT.

(3) Attach a ESD wrist strap to your wrist.

NOTE: The ESD wrist straps are kept in bags at the ends of the WIU racks (Fig. 203).

s 492-054

(4) Attach the ESD wrist strap to the electrostatic ground receptacle on the WIU rack (Fig. 203).

EFFECTIVITY-

20-41-03

ALL



S 422-055

CAUTION: MAKE SURE THE WIU COVER IS INSTALLED BEFORE YOU INSTALL THE WIU ON THE SHELF. DAMAGE TO THE WIRE WRAP POSTS AND TO THE WIRES CAN OCCUR IF YOU INSTALL THE WIU WITHOUT THE COVER. DO NOT PERMIT CONTAMINATION IN THE WIU WHEN THE COVER IS OFF. MAKE SURE THAT YOU KEEP CONTAMINATION OR UNWANTED MATERIAL AWAY FROM THE WIU. MAKE SURE THAT OTHER PEOPLE THAT WORK AROUND THE WIU AREA KEEP UNWANTED MATERIAL OR CONTAMINATION AWAY FROM THE WIU. UNWANTED MATERIAL OR CONTAMINATION CAN CAUSE A MALFUNCTION IN THE WIU.

(5) Put the WIU on the shelf with the shown connector side up (View C, Fig. 203).

s 432-056

(6) Attach the electrical bonding jumper to the panel.

s 762-057

(7) Do the electrical bond check (Ref 20-22-01,I/C). Make sure the maximum resistance is not more than 0.0025 ohm.

s 432-058

(8) Attach the electrical connectors to the panel.

s 422-059

(9) Put the retainer in its position at each end of the connector (View D, Fig. 201).

s 422-060

(10) Install the bolts through the retainers (View D, Fig. 203).

s 412-061

(11) Put the WIU panel in its position (View B, Fig. 203).

s 412-062

(12) Install the bolts.

s 712-063

(13) Do an operational test of the system associated with the WIU you installed.

S 092-064

ALL

(14) Remove the ESD wrist strap from the electrostatic ground receptacle on the WIU rack (Fig. 203).

EFFECTIVITY-

20-41-03



s 092-065

(15) Remove the ESD wrist strap from your wrist.

NOTE: Put the ESD wrist strap in an empty bag found at the ends of the WIU racks (Fig. 203).

s 412-066

- (16) Install the cargo lining on the aft side of the electronic rack:
  - (a) Put the cargo lining in its position.
  - (b) Install the bolts.

EFFECTIVITY-

20-41-03



## STANDARD TORQUE VALUES - MAINTENANCE PRACTICES

#### 1. General

- A. This procedures contains this task:
  - (1) Torque Values
- B. Refer to the figures that follow for torque data.
  - (1) The torque values shown in Fig. 202 are the correct quantity of pressure necessary to tighten fasteners. Some fasteners have threads that are lubricated. Some fasteners have threads that are not lubricated. The values which are necessary to tighten the fastener by the nut or by the bolt are also supplied.
  - (2) If it is necessary to use an adapter on the torque wrench, refer to Fig. 201 to find a corrected torque wrench value. Follow the examples in Fig. 201 to find the corrected torque wrench value T1 when you use an adapter (length B).
  - (3) Refer to Fig. 203 for the minimum permitted torque value for self-locking nuts. If you think a self-locking nut turns too easily or turns too hard on the bolt, refer to Fig. 203 for a test of the nut.

TASK 20-51-01-912-008

#### 2. Torque Values

A. Procedure

s 912-002

(1) Torque values are given in Fig. 204 for Reduced Head Bolts.

s 912-003

(2) Torque values are given in Fig. 205 for Rigid Tube Coupling Connectors.

s 912-004

(3) Torque values are given in Fig. 206 for Pipe Thread Fittings.

s 912-005

(4) Torque values are given in Fig. 207 for Low Pressure and Return Line Fittings.

s 912-006

(5) Torque values are given in Fig. 208 for Flareless Tubing Fittings with lubricated threads.

s 912-007

(6) Torque values are given in Fig. 209 for Channel Band Clamps, Duct Support Clamps, Hose Clamps, and V-Band Clamps.

EFFECTIVITY-

20-51-01

ALL



$$T_1 = \frac{TA}{A+B}$$

A = TORQUE LENGTH OF TORQUE WRENCH

B = TORQUE LENGTH OF ADAPTER

T = ACTUAL TORQUE OF NUT

 $T_1 = TORQUE OF WRENCH SHOWN (CORRECTED TORQUE)$ 

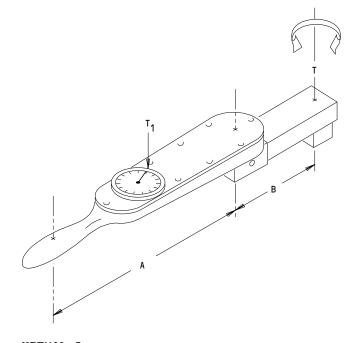
EXAMPLE A = 12 INCHES

B = 3 INCHES

T = 160 POUND-INCHES

$$T_1 = \frac{160 \times 12}{12 + 3}$$

T<sub>1</sub> = 128 POUND-INCHES



METHOD I

Torque Wrench Adapter Figure 201 (Sheet 1)

EFFECTIVITY-

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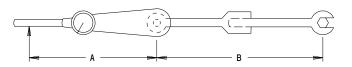
HANDLE EXTENSION ONLY.
NO CORRECTION NECESSARY.



#### METHOD II

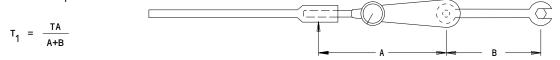
ADAPTER WITH THE EXTENSION BETWEEN THE ADAPTER AND THE WRENCH. BOTH ARE IN LINE WITH THE WRENCH. INDICATED TORQUE T:





METHOD III

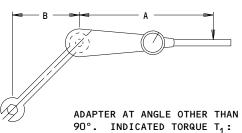
BOTH HANDLE EXTENSION AND ADAPTER, INDICATED TORQUE T<sub>1</sub>:



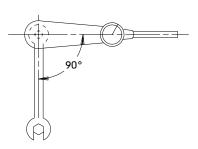
METHOD IV

NOTE: IF POSSIBLE, METHODS V AND VI SHOULD NOT BE USED. WHEN IT IS NECESSARY TO USE THESE METHODS, THE FOLLOWING CONDITIONS MUST BE APPLICABLE:

- THE ADAPTER PLUS ANY EXTENSIONS USED BETWEEN THE WRENCH AND THE ADAPTER MUST NOT BE MORE THAN 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 MAKE SURE LOADING IS AT THE CORRECT ANGLE.





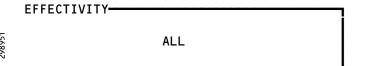


ADAPTER AT RIGHT ANGLE TO THE WRENCH. NO CORRECTION NECESSARY.

METHOD V

METHOD VI

Torque Wrench Adapter Figure 201 (Sheet 2)



20-51-01

01

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							NUT TIGHTE	NING TORQUI						
N U T	PART NUMBER AND STYLE	N10HR (12-POINT) (12-POINT), N10H		N10JA (PLATE (PLATE-NUT)	E-NUT), N1OB ( , N1ORM (PLATE (CASTELLATED	N10GW (12-P0) (12-P0INT), N1 E-NUT), NAS577 NUT THICK STY	10JB 7 (BARREL-	B ALL PLATE-NUTS EXCEPT N10JA, N10JB, AND N10RM, BARREL- ALL CLIP-NUTS, INSERTS, AND TAPPED HOLES,			AN316, AN316C, NAS509, NAS1423, (JAM NUTS), N10JC, MS21245 (HEX SIZES 1/2 THRU 1-1/2) N10JD, MS14145 (CASTELLATED-THIN STYLE ALL SIZES -103 THRU -120)	BACN1OYJ NYLON NUT		
	STYLE	12-P	POINT	12-POINT	HEX HEAD	PAN HEAD	100° HEAD	12-POINT	HEX HEAD	PAN HEAD	100° HEAD	SOCKET HEAD	ALL	ALL
B 0 L T	PART NUMBER	B30 B30	DNG DNH DUS DTR	B30FD B30MR B30LE B30PN 2	B30NE B30LM B30NM NAS6603 THRU NAS6620 NAS6703 THRU NAS6720	B3OLN B3ONS B3OEM	B30LP B30EM B30LU B30LR B30MS B30NN	B30LT B30NL B30NJ B30NK B30UU	B30LJ B30NR B30NF B30PF B30PW S12CB NAS563 THRU 572 NAS1801 NAS1802 NAS6203 THRU NAS6220	B30LK B30NT B30BE B30BG NAS1217 NAS1218 NAS600 THRU NAS606 NAS623	B3OPC B3OLH B3ORF B3OSW B3OUW	MS21262 MS24678 NAS1351 NAS1352	ALL	ALL
							TORQUE RANGE	(POUNDS-IN	CH)			•		
	THREAD SIZE	DRY BOLT	LUBED BOLT 3	DRY I	30LT	LUBED BO	OLT 3	D	RY BOLT		LUBED BOL	т [3>>	DRY OR LUBED BOLT 3	DRY OR LUBED BOLT 3
	2-56 OR 2-64 4-40 OR 4-48 6-32 OR 6-40 8-32 OR 8-36	  	  	  		  		6-	.4-4.5 -8 2-15 5-20		3.4-4. 6-8 12-15 15-17	5	3.4-4.5 6-8 12-15 15-17	  5-6
	10-32 1/4-28 5/16-24 3/8-24	90–125 180–250 300–500	 70-80 145-180 275-330	30-35 65-100 130-200 220-410		20-2! 50-7! 90-1: 150-	5 25	50	5–35 )–80 )0–150 60–240		20-25 50-75 90-125 150-20		18-25 30-50 60-95 95-160	6-8  
	7/16-20 1/2-20 9/16-18 5/8-18	510-840 870-1300 1300-1800 1900-2300	370-440 500-575 800-1000 1350-1650	370-690 630-107 1000-14 1400-19	0 70	260 440 700 1000-	650	81	50-350 80-790 00-1150 100-1500		240-30 440-65 700-92 1000-1	0 0	220-280 290-510 480-850 660-980	  
	3/4-16 7/8-14 1-12 OR 1-14 1-1/8-12	3300-4300 5100-6700 7000-10,900 9500-13,000	2800-3300 2900-4500 6200-7000 8300-9400	2400-35 3700-55 5100-89 6900-10	00	2600- 3600-	-2150 -3400 -5500 -6700	2:	300–3000 500–4500 700–7500 000–9000		1700-2 2600-3 3600-5 4900-6	400 500	1300-2000 1500-3300 2200-5300 3000-6200	  
	1-1/4-12 1-3/8-12 1-1/2-12	15,800-19,200 20,000-24,000 	11,000-12,000 16,000-17,000 	11,500-  	15,700	7500-  	-9700	-	000–13,000  		7500–9  	700	5400-8600 7000-9000 10,000-12,000	

> 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 B30LE OR PN BOLTS ARE INSTALLED WITH N10HR NUTS, USE THE INSTALLATION TORQUE SHOWN FOR N10GW NUTS.

> 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 YOU SAFETY FINE CASTELLATED NUTS, TIGHTEN THE NUT TO THE LOW SIDE OF THE SELECTED TORQUE RANGE; IF NECESSARY, CONTINUE TO TIGHTEN IT UNTIL A SLOT ALIGNS WITH THE SAFETY HOLE.

Torque Values for Bolts and Nuts Figure 202 (Sheet 1)

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	NUT TIGHTENING TORQUE 1							
N U T	PART NUMBER AND STYLE	COARSE THREADED NUTS, INS	ERTS AND TAPPED HOLES					
	STYLE	ALL						
	PART NUMBER	ALL						
B 0 L T								
		TORQUE (POUNI	D-INCHES)					
	THREAD SIZE	DRY BOLT	MAXIMUM 4					
	10-24 1/4-20 5/16-18 3/8-16	12–15 25–30 48–55 95–110	21 45 100 170					
	7/16-14 1/2-13 9/16-12 5/8-11	140-155 240-290 300-420 420-540	280 520 650 900					
	3/4-10 7/8-9 1-8 1-1/8-7	700–950 1300–1800 2200–3000 3300–4000	1500 2700 4500 7200					
1-1/4-7		4000-5000  	10,000  					

Torque Values for Bolts and Nuts Figure 202 (Sheet 2)

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LOCKING TORQUE - SELF-LOCKING NUTS 1								
		FINE THREADS (REF BPS-N-70)			COARSE THREADS (REF MIL-N-25027)			
	TORQ	UE (POUND-IN	CHES)		TORQUE (POU	UND-INCHES)		
SIZE	USED	NUT	NEW NUT	SIZE				
	MINIMUM BREAKAWAY	MAXIMUM LOCKING	MINIMUM 1ST CYCLE BREAKAWAY		MINIMUM LOCKING	MAXIMUM LOCKING		
		7		2.54		2.5		
4-48 6-40	1.0	3 6	_	2-56 4-40	0.2 0.5	2.5 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	600	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		
	H		I	2-1/4-4.5	430.0	2600		

1> THE FOLLOWING CONDITIONS MUST BE USED FOR TORQUES (REF BPS-N-70):

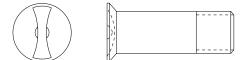
- A. THE MINIMUM-TO-MAXIMUM LOCKING TORQUE RANGE IS USED TO FIND THE CONDITION OF A USED SELF-LOCKING NUT AND BOLT SET.
- B. ALL NUT THREADS SHALL BE TOGETHER AND THE COMPLETE CHAMFER ON THE END OF THE BOLT SHALL COME OUT PASS THE NUT. UNCHAMFERED BOLTS MUST COME OUT AT LEAST 1-1/2 THREADS PASS THE NUT.
- 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 INSTALLATION OR REMOVAL OF NUTS WITH NO LOAD ON THE BASE OF THE NUT.

Locking Torque Values for Self-Locking Nuts Figure 203

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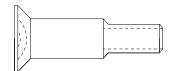




BACB3ODP (CRES)
BACB3OEL (STEEL)











BACB3ONU (TITANIUM)

BACB3OUR (TITANIUM)









BACB30LL (CRES)

BACB30VF (TITANIUM)

BACB3ODP, BACB3OEL, BACB3OLL, BACB	30NU, BACB30RF, BACB30UR, BACB30VF
BOLT SIZE	TORQUE RANGE (POUND -INCHES)
8–32	10–13
10–32	15–18
1/4-28	26-30
5/16-24	60-65
3/8-24	95–105
7/16–20	150-170
1/2-20	220-245
9/16–18	290-325
5/8-18	395-435
3/4–16	645-720
7/8–14	1040-1150
1-12 OR 1-14	1560–1730

Torque for Reduced-Head Bolts Figure 204

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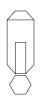




NAS591

NAS594







NAS592

NAS595



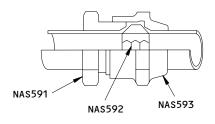


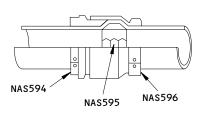




NAS593

NAS596





CONNECTION ASSEMBLY (REF)

CONNECTION ASSEMBLY (REF)

TUBE OD	NAS59	LOY FITTINGS 1-593 JND-INCHES)	STAINLESS STEEL FITTINGS NAS594-596 TORQUE (POUND-INCHES)		
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	
1 1-1/4 1-1/2 2 2-1/2 3	480 600 600 900 1500	720 900 900 1200 1800	480 600 600 900 1800 1800 2400	720 900 900 1200 2100 2100 2700	

Standard Torque Values for Rigid Tube Coupling Connectors Figure 205

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PIPE THREAD		EPT STAINLESS INLESS STEEL	STAINLESS STEEL TO STAINLESS STEEL PIPE FITTINGS TORQUE (LB-INCHES)			
SIZE (INCHES)	WORKING TORQUE	MAXIMUM TORQUE				
	(LB-INCHES)	(LB-INCHES)	MIN	MAX		
1/8 1/4 3/8 1/2 3/4	100 150 225	175 300 450	100 100 100 100 150 200	150 275 400 500 600 800		

Standard Torque Values for Pipe Thread Fittings Figure 206

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TUBE OD (INCHES)	FITTING NUT SIZE	TORQUE (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 THE 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 ON ANNEALED CRES TUBING. ANNEALED CRES TUBING IS IDENTIFIED BY A WIDE YELLOW BAND ADJACENT TO THE TUBING-USE IDENTIFICATION CODE MARKINGS.

THE TORQUE VALUES ARE APPLICABLE TO FLARED HOSE END FITTINGS WITH ALUMINUM INSERTS.

NOTE: THE 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 (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. TO USE ALUMINUM TUBE TORQUE VALUES FOR ALUMINUM, STEEL, OR TITANIUM FITTINGS IN ALUMINUM BOSSES.

2. TO 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 THESE TORQUE VALUES ARE APPLICABLE TO STANDARD MS FLARELESS TUBE ENDS (BACS13AP SLEEVES) ON MIL-T-6845 (304-1/8 HARD) TUBING WITH THE MINIMUM WALL THICKNESS 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 (POUND-INCHES)	375	575	725

 $oldsymbol{6}$  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 (POUND-INCHES)	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
	250-275	70
BACC10AUU()	300-500 550-600	100
BACC10BR8()	100-900	100
BACC10CT2()	100-600	
BACC1ODP()A	150–250	
BACC1ODP()B	300	50
BACC1ODP()AB	350-400	
	450-600	70
	100-175	50
	200-275	55
BACC1ODU()AB	300-450	60
	500-600	65
	700–1000	75
BACC10EY()B	150-800 425-800	105
BACCIOLITY B	150-400	75
	125-275	75
BACC10EZ()B	300	105
	125-300	
BACC1OGY()	150-175	40
	200-275	45
	300-450	50
	475-600	55
	650-900	65
	100–300	10
BACC10HX()	325-500	15
	550-800	20
NUCO (U430453)	125	55-65
васс10кн	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 TORQUE (INCHES) (POUND-INCHES)				
BACC10CT	1.00-6.00	100-105 2			

DUCT-SUPPORT CLAMPS						
TYPE	DUCT OD TORQUE (INCHES) (POUND-INCHES)					
BACC10AD	2.00-8.00	20–25				

HOSE CLAMPS						
TYPE	HOSE OD	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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# **LUBRICANTS - MAINTENANCE PRACTICES**

TASK 20-70-01-992-001

# 1. <u>Lubricants</u>

### A. <u>General</u>

- (1) This section gives a list of the approved oils for these parts:
  - (a) The engine
  - (b) The auxiliary power unit (APU)
  - (c) The integrated drive generator (IDG)
  - (d) The starter
  - (e) The air-driven pump (ADP) turbine drive.

CF6-80C ENGINE	APU	IDG	GARRETT STARTER	ADP TURBINE DRIVE
X X X	X X	X X X	X	X *[1] X *[1]
			X X X X	*[1]
x	X X	х	X X	*[1]
х	X X	X	X X	*[1] *[1]
Х	X X	X	X X X	*[1] *[1]
	X X X X	ENGINE  X X X X X X X X X X X X X X X X X X	ENGINE  X X X X X X X X X X X X X X X X X X	ENGINE

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	CF6-80C ENGINE	APU	IDG	GARRETT STARTER	ADP TURBINE DRIVE
Mobil RM254A Nyco Turbine Oil 525-2A Regent SATO 15 Royco Turbine Oil 500 Royco Turbine Oil 555 Royco Turbine Oil 560 Sinclair Turbo Oil 15 Stauffer Jet Oil I Stauffer Jet Oil II Texaco SATO 15 Texaco SATO 7730 Texaco Startjet 5	X X X X	x x	X X	X X X X X X	*[1] X *[1]

<sup>\*[1]</sup> Any oil of the military specification MIL-L-7808 or MIL-L-23699 is approved to use in the ADP turbine drive.

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