

CHAPTER

70

**STANDARD
PRACTICES**

(LEAP-1B ENGINES)

**737-7/8/8200/9/10
AIRCRAFT MAINTENANCE MANUAL**

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216	May 15/2023		201	Sep 15/2021		205	Sep 15/2021	
217	Sep 15/2021		202	Sep 15/2021		206	Sep 15/2021	
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212	Sep 15/2021		606	Jan 15/2023		230	Sep 15/2021	
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202	Sep 15/2021		611	Jan 15/2023		202	May 15/2022	
203	Sep 15/2021		612	BLANK		203	May 15/2022	
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201	Sep 15/2021		202	Sep 15/2021		206	May 15/2022	
202	Sep 15/2021		203	Sep 15/2021		207	May 15/2022	
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201	Sep 15/2022		201	May 15/2022		206	Sep 15/2021	
202	Jan 15/2022		202	May 15/2022		207	Sep 15/2021	
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218	May 15/2022		209	Sep 15/2021		231	Sep 15/2021	
219	May 15/2022		210	Sep 15/2021		232	Jan 15/2023	
220	May 15/2022		211	Sep 15/2021		233	Sep 15/2021	
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239	Sep 15/2021		203	May 15/2022		210	Sep 15/2021	
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241	Sep 15/2021		205	May 15/2022		212	Sep 15/2021	
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259	Sep 15/2021		206	May 15/2022		203	Sep 15/2021	
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202	Sep 15/2021		203	Jan 15/2023				
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203	Sep 15/2021							
204	Sep 15/2021							
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206	Sep 15/2021							
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ASSEMBLY AND DISASSEMBLY TECHNIQUES - MAINTENANCE PRACTICES

1. General

A. This procedure has these tasks:

- (1) Electrical bonding straps installation
- (2) Standard repair for correction of leaks
- (3) Handling for unpacking and repacking
- (4) Standard practices for the use of jackscrews
- (5) Standard practices for the use of protective covers, caps, plugs and tape
- (6) Gaskets and preformed packing seals installation
- (7) Tube installation
- (8) Metal and cushioned P clamp installation
- (9) Electrical cable installation
- (10) Standard practices for electrical connector disconnect and connect
- (11) Hose installation
- (12) V-band and V-retainer coupling installation
- (13) Pressure Sensitive Placard Removal
- (14) Pressure Sensitive Placard Installation.

TASK 70-00-01-400-801-G00

2. Electrical Bonding Straps Installation

A. General

- (1) This task provides the instructions on how to install the electrical bonding straps.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Electrical Bonding Straps Installation

SUBTASK 70-00-01-100-001-G00

- (1) Before you install an electrical bonding strap, make sure that you remove all anodic film, grease, paint, lacquer or other high-resistance material from the mating surfaces.
 - (a) The abraded area must be a minimum of one and one-half times the area of the bonding strap contact area.

SUBTASK 70-00-01-211-001-G00

- (2) Before you install the electrical bonding strap, examine the electrical bonding strap.
 - (a) Examine the braided area of the bonding strap for strands that are cut, frayed, or broken.
 - 1) Strands that are cut, frayed, or broken are not permitted.
 - a) If you find strands that are cut, frayed, or broken, replace the bonding strap.
 - (b) Examine the Viton plastic coating on the bonding strap for cuts, abrasions or other types of damage.
 - 1) Cuts, abrasions, or other types of damage are permitted only if moisture cannot enter the braid through the plastic coating.

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- a) If you find signs of moisture or corrosion, replace the bonding strap.
 - (c) Examine the terminal ends of the bonding strap terminal ends
 - 1) Scratches, nicks, dents, or abrasion on the terminal ends are permitted.
 - 2) Cracks or pieces that are broken or missing on the terminal ends are not permitted.
 - 3) Terminal ends that are loose are not permitted.
 - a) If you find a terminal end that is loose, replace the bonding strap.
 - 4) Corrosion
 - a) Corrosion on the bonding strap is not permitted.
 - <1> Use the procedures in the Standard Wiring Practices Manual (SWPM) to repair the bonding strap.
- NOTE:** Refer to the SWPM section for the repair of electrical wire and cable.
- b) Corrosion on the lug is permitted as follows:
 - <1> The corrosion is not at the interface between the lug and the grounded part.

SUBTASK 70-00-01-420-001-G00

- (3) Use the procedures in the Standard Wiring Practices Manual (SWPM) to install the bonding straps.

————— **END OF TASK** —————

TASK 70-00-01-300-801-G00**3. Correction of Leaks****A. General**

- (1) This task provides the instructions on how to repair leaks.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Correction of Leaks

SUBTASK 70-00-01-020-001-G00



DO NOT TIGHTEN THE FASTENERS TO MORE THAN THE SPECIFIED TORQUE TO TRY TO REPAIR A LEAK. DAMAGE TO COMPONENTS CAN OCCUR.

- (1) Disassemble the connection where the leak is.
 - (a) If there are seals, gaskets or preformed packing in the assembly, remove and discard them.

SUBTASK 70-00-01-210-001-G00

- (2) Examine the mating surfaces at the connection and look for these types of damage:
 - (a) Contamination
 - (b) Scratches
 - (c) Dents

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- (d) Surface defects.

SUBTASK 70-00-01-300-001-G00

- (3) Repair the problems that you find or replace the applicable parts.

SUBTASK 70-00-01-210-002-G00

- (4) Examine the fasteners as follows:
- (a) Look for damage to the threads on the fasteners.
 - (b) Make sure that the fasteners are the correct length.
 - (c) Make sure that the fasteners are not bent or damaged.

SUBTASK 70-00-01-960-001-G00

- (5) Replace the fasteners that have damage.

SUBTASK 70-00-01-420-002-G00

- (6) Assemble the connection with new seals, gaskets or preformed packing where necessary.
- (a) Make sure that the fasteners are installed correctly when you apply the specified torque value.

————— **END OF TASK** —————

TASK 70-00-01-500-801-G00

4. Unpacking and Repacking

A. General

- (1) This task provides the instructions on how to unpack and repack a part.
- (2) Follow these instructions to keep damage and contamination to a minimum.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Unpacking and Repacking

SUBTASK 70-00-01-540-001-G00

- (1) Initially, remove only the packing material that is necessary to install the part.
 - (a) Remove the remaining packing material when necessary to connect the part.
NOTE: This will help prevent damage to the new part.
 - (b) Keep the protective covers installed on the ports, openings and receptacles of the part until you make the connections.
NOTE: This will help keep contamination out of the new part.

SUBTASK 70-00-01-540-002-G00

- (2) Keep the protective covers and packing material for installation on the removed part.

SUBTASK 70-00-01-540-003-G00

- (3) Install the protective covers on the ports, openings and receptacles on the removed part.

SUBTASK 70-00-01-540-004-G00

- (4) When possible, repack the removed part in the same material and manner as the new part.

SUBTASK 70-00-01-540-005-G00

- (5) If the packing materials from the new part are not available, use locally available packing materials to pack the part.

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- (a) Make sure that all of the ports, openings, connections and mating surfaces on the replaced part have caps or covers installed.
- (b) Make sure that you use a container with sufficient protection to keep the part from damage.

————— **END OF TASK** —————

TASK 70-00-01-910-801-G00

5. Use of Jackscrews

A. General

- (1) This task provides the instructions on how to use the jackscrews.
- (2) Jackscrew holes are frequently in flanges that are only sufficiently thick to accept three or four threads. The ends of most standard bolts are chamfered and will not have full threads on the end. If you use a standard bolt as a jackscrew, the threads will not correctly engage in the flange. This will cause damage to the threads in the flange. A jackscrew will not have a chamfer and will correctly engage all the threads in the flange. Do not use standard bolts as jackscrews except in LRUs that have counterbores. The counterbores allow the use of standard screws.
- (3) If jackscrews are not available, you can make one from a standard bolt. To make a jackscrew, you must remove the chamfered section on the end of a standard bolt. This will make sure that a maximum number of threads will engage in the flange.
- (4) When you use jackscrews to remove components, do not bend the flange or cause damage to the threads in the flange.

B. Consumable Materials

Reference	Description	Specification
D00599 [CP2442]	Oil - Engine	

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Use of Jackscrews

SUBTASK 70-00-01-210-003-G00

- (1) Examine the jackscrews for burrs or rough edges.
 - (a) Remove the burrs or rough edges that you find on the jackscrews.

SUBTASK 70-00-01-420-003-G00

- (2) Install the jackscrews as follows:
 - (a) Make sure that the component has support before you tighten the jackscrews.
 - (b) Lubricate the jackscrews with engine oil, D00599 [CP2442].
 - (c) Turn the jackscrews slowly into the flange.
 - 1) Turn each jackscrew an equal number of turns to keep the component aligned correctly.

————— **END OF TASK** —————

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TASK 70-00-01-910-802-G00**6. Use of Protective Covers, Caps, Plugs and Tape****A. General**

- (1) This task provides the instructions on how to install and remove the devices that give protection to the engine and its components.
- (2) These devices include covers, caps, plugs, or tape. Use these devices to stop the entry of unwanted materials into openings on the engine or its components. These devices also give protection to surfaces on the engine and on its components.
- (3) When you remove an engine component, put the correct devices on the openings and surfaces of the part. Without a cover on the openings, unwanted objects can go into the openings and cause damage. Corrosion can also occur if you do not put a cover on the part.
- (4) Drain fluids from the components before you put the covers, caps, plugs or tape on the openings and surfaces.

B. Consumable Materials

Reference	Description	Specification
G02417 [C10-021]	Tape - Duct	

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Use of Protective Covers, Caps, Plugs and Tape**SUBTASK 70-00-01-910-001-G00**

- (1) Installation methods are as follows:
 - (a) Drain and clean all the fluid from the tubes, lines, hoses and components.

**CAUTION**

DO NOT USE TAPE ON OIL, FUEL, HYDRAULIC TUBES, AND LINES.
THE TAPE ADHESIVE CAN CAUSE DAMAGE TO THE COMPONENTS

- (b) Install the covers, caps, and plugs on the openings and machined surfaces on the part.
 - 1) Make sure that you put a cover on all of the open tubes and ports.
 - 2) Make sure that the cover, cap or plug is the correct dimension to give protection to the openings and surfaces.
- (c) When you do maintenance above the deflector panels for the bleed air, do the step that follows:
 - 1) Apply the tape, G02417 [C10-021] to seal the openings on the air deflector panels and the bleed valve areas.

SUBTASK 70-00-01-910-002-G00

- (2) Removal methods are as follows:
 - (a) Make sure that there are no loose parts or tools around the covers, caps, plugs or tape.
 - (b) Remove the covers, caps, plugs and tape from the openings, surfaces, tubes, and ports.
 - (c) If you applied the tape, G02417 [C10-021] to seal the openings on the air deflector panels and the bleed valve areas, remove the tape.

————— **END OF TASK** —————

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TASK 70-00-01-400-802-G00**7. Gaskets and Preformed Packing Seals Installation****A. General**

- (1) This task provides the instructions on how to install the gaskets and preformed packing seals.
- (2) There are always two back-up rings. They are installed with a preformed packing in between.
- (3) Use only new gaskets and preformed packings, unless differently specified in the maintenance manual.

B. Consumable Materials

Reference	Description	Specification
D00599 [CP2442]	Oil - Engine	

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Gaskets and Preformed Packing Seals Installation**SUBTASK 70-00-01-210-009-G00**

- (1) Make sure that the seal is clean.

SUBTASK 70-00-01-420-004-G00

- (2) Install the gasket or preformed packing as follows:
 - (a) Lubricate the back-up rings with clean engine oil, D00599 [CP2442].
 - (b) Lubricate the gasket or preformed packing with clean engine oil, D00599 [CP2442] unless differently specified.
 - (c) Roll the first back-up ring into the respective groove.
NOTE: Do this step if a back-up ring is installed with the preformed packing.
NOTE: Do not spread or stretch apart the back-up ring to fit the diameter of the tube to which they are mounted. This will deform the back-up ring permanently.
 - (d) Install the gasket or preformed packing.
 - 1) Make sure that the gasket or preformed packing is in the correct position.
 - 2) Make sure that the parts are correctly installed.
 - (e) Roll the second back-up ring into the respective groove.
NOTE: Do this step if a back-up ring is installed with the preformed packing.
NOTE: Do not spread or stretch apart the back-up ring to fit the diameter of the tube to which they are mounted. This will deform the back-up ring permanently.
 - (f) Use the instructions in the maintenance manual procedure to tighten the part.

————— **END OF TASK** —————

TASK 70-00-01-400-803-G00**8. Tube Installation****A. General**

- (1) This task provides the instructions on how to install the tubes on the engine.

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B. References

Reference	Title
70-51-00-800-802-G00	Wrench Arc Method (Miscellaneous) (P/B 201)

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Tube Installation

SUBTASK 70-00-01-210-010-G00

- (1) Make sure the tube is clean.

SUBTASK 70-00-01-350-001-G00

- (2) If it is necessary, bend the tube as follows:
- (a) Use a tube bending tool to bend tubes if the tool is available.
 - 1) Make sure that you use a tube bending tool on tubes with a diameter equal to or more than 1.0 in. (25.4 mm).
 - (b) If it is possible, make the bends on the straight sections of the tube.

NOTE: Do not bend the tube near a fitting or a weld.

 - 1) Bend the tube in the direction of a pre-existing bend.
 - (c) Make sure that the bend radius is not less than two times the tube diameter.

NOTE: Do not change a pre-existing bend more than 3 degrees from the initial pre-existing bend angle.
 - (d) Make sure that the tube does not have kinks or wrinkles.
 - 1) Replace the tube if it has kinks or wrinkles.

SUBTASK 70-00-01-390-001-G00

- (3) Apply a sealant if specified in the maintenance manual procedure.
- (a) If it is necessary, let the sealant dry before you install the tube.
 - (b) Make sure that there is no sealant in the tube.
 - 1) If it is necessary, clean off the sealant in the tube with a clean cloth and water.
 - (c) Make sure that the sealant does not go into the air system.

SUBTASK 70-00-01-420-005-G00

- (4) Install new preformed packings and back-up rings where required on the tubing (TASK 70-00-01-400-802-G00).

SUBTASK 70-00-01-420-006-G00

- (5) Attach the tube fittings and tighten them with your hand.
- (a) Make sure that the threads on the tube fittings engage freely and the mating flanges on the tube seat flush.

SUBTASK 70-00-01-420-007-G00

- (6) Install the tube clamps and tighten them with your hand (TASK 70-00-01-400-804-G00).

SUBTASK 70-00-01-210-004-G00

- (7) Make sure that you keep the correct clearance between the tube and each adjacent part.

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SUBTASK 70-00-01-420-008-G00

- (8) Use the wrench arc method to tighten the tube fittings (TASK 70-51-00-800-802-G00).

————— **END OF TASK** —————

TASK 70-00-01-400-804-G00**9. Metal and Cushioned P Clamp Installation**

(Figure 201)

A. General

- (1) This task provides the instructions on how to install the metal or cushioned P clamps.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Metal and Cushioned P Clamp Installation

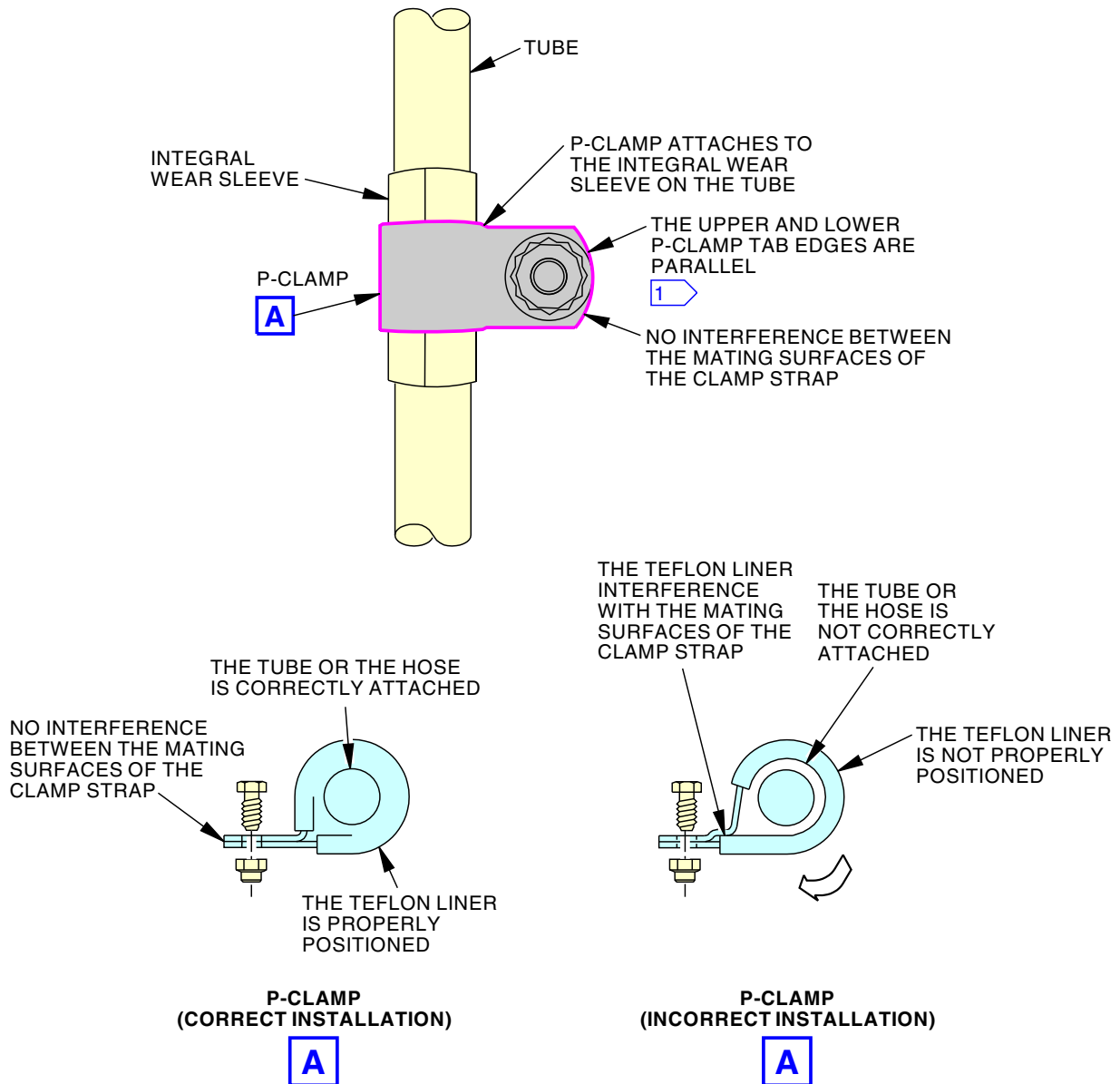
SUBTASK 70-00-01-420-009-G00

- (1) When you install a hose or tube with a clamp, install the part loosely in its position with the clamp.
- (a) Move the hose or tube to get the best clearance from adjacent parts before you tighten the clamps.
 - (b) Make sure that the clamps are the correct dimension for the hose or tube.
 - 1) Make sure that the clamps are in the correct position to keep the correct clearances when the engine becomes hot.

NOTE: The engine will change dimensions when it becomes hot.
 - (c) Make sure that the hoses and the tubes cannot rub on adjacent structures.

————— **END OF TASK** —————

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1 THE UPPER TAB MAY TWIST WHEN YOU TIGHTEN THE BOLT DURING FINAL ASSEMBLY.

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Metal and Cushioned P Clamp Installation
Figure 201/70-00-01-990-801-G00

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TASK 70-00-01-400-805-G00**10. Electrical Cable Installation****A. General**

- (1) This task provides the instructions on how to install the electrical cables.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Electrical Cable Installation**SUBTASK 70-00-01-420-011-G00**

- (1) When you install an electrical cable, adjust the cable in the clamps to get the smoothest and largest radii.

SUBTASK 70-00-01-210-005-G00

- (2) Make sure that there are no sharp bends or kinks in the electrical cable.

SUBTASK 70-00-01-210-006-G00

- (3) Make sure that the cable does not twist.

SUBTASK 70-00-01-210-007-G00

- (4) Make sure that there is a minimum of 0.125 in. (3.175 mm) clearance between electrical cables and all components.

NOTE: This minimum does not apply between electrical cables and hoses.

———— **END OF TASK** ————

TASK 70-00-01-910-803-G00**11. Electrical Connector Disconnection and Connection****A. General**

- (1) This task provides the instructions on how to disconnect and connect the electrical connector.

B. Tools/Equipment

Reference	Description
STD-664	Pliers - Teflon-jawed (or Equivalent Soft-Jawed)

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Electrical Connector Disconnection and Connection**SUBTASK 70-00-01-020-002-G00**

MAKE SURE THAT THE ELECTRICAL CONNECTORS AND RECEPTACLES ARE CLEAN AND CLEAR OF UNWANTED MATERIALS BEFORE YOU DISCONNECT, OR CONNECT THEM. CONTAMINATION OF THE ELECTRICAL CONNECTORS AND RECEPTACLES CAN CAUSE DAMAGE TO EQUIPMENT.

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USE TEFLON-JAWED PLIERS TO LOOSEN ELECTRICAL CONNECTORS. DO NOT USE METAL-JAWED PLIERS. DAMAGE TO THE ELECTRICAL CONNECTORS COULD OCCUR.

- (1) Disconnect the electrical connector as follows:
- (a) Use your hand or the teflon-jawed pliers, STD-664 to disconnect the electrical connector.
NOTE: Make sure that you fully disengage the electrical connector.
 - (b) Visually examine the electrical connector and the receptacle for signs of damage, bent pins, contamination, or corrosion.
 - 1) If you find damage, repair or replace the component.
 - 2) Install caps on the electrical connector and receptacle for protection from damage and contamination.

SUBTASK 70-00-01-420-012-G00

**CAUTION**

MAKE SURE THAT THE ELECTRICAL CONNECTORS AND RECEPTACLES ARE CLEAN AND CLEAR OF UNWANTED MATERIALS BEFORE YOU DISCONNECT, OR CONNECT THEM. CONTAMINATION OF THE ELECTRICAL CONNECTORS AND RECEPTACLES CAN CAUSE DAMAGE TO EQUIPMENT.

**CAUTION**

DO NOT USE PLIERS THAT HAVE METAL JAWS TO TIGHTEN THE ELECTRICAL CONNECTOR. DAMAGE TO THE ELECTRICAL CONNECTOR CAN OCCUR.

- (2) Connect the electrical connector as follows:
- (a) Remove the caps from the electrical connector and receptacle.
 - (b) Make sure that the mating surfaces are clean and clear of unwanted materials.
 - (c) Engage the electrical connector with its receptacle.
NOTE: Make sure that the electrical connector does not move after you fully engage it.
 - (d) Tighten the electrical connector with your hand.
NOTE: Tighten the electrical connector until you cannot see the blue color marks on the receptacle. If it is not possible to cover the receptacle blue with hand strength, use the teflon-jawed pliers, STD-664.
 - (e) If you can get access to the electrical connector with the teflon-jawed pliers, STD-664, do these steps:
 - 1) Put the teflon-jawed pliers, STD-664 on the knurled coupling ring of the electrical connector.
 - 2) Tighten the electrical connector until you cannot move it or as specified in the task.
 - (f) If you cannot get access to the electrical connector with the teflon-jawed pliers, STD-664, do these steps:
 - 1) Tighten the knurled coupling ring of the electrical connector with your hand.
 - 2) Make sure that the backshell assembly of the electrical connector does not move from side-to-side with your hand.
 - 3) If the electrical connector does move, disconnect the electrical connector.

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- 4) Do the steps to connect the electrical connector again.

————— **END OF TASK** —————

TASK 70-00-01-400-806-G00

12. Hose Installation

(Figure 202)

A. General

- (1) This task provides the instructions on how to install the hoses.
- (2) When you remove a hose, make sure that you put a cap on the open ends. Do not use tape as an alternative to a cap.
- (3) You must not make new bends to a pre-formed hose or hose with a large diameter.
- (4) You must not bend a hose when you install it. If you bend a hose when it is cold, you can cause damage to the hose more easily. You can cause damage to the Teflon lining if you bend the hose.
- (5) You must not use a hose with a kink in it.
- (6) When you install the hose, make sure that you do not stretch or twist the hose.
- (7) Do not apply too much torque to the connectors. Do not apply torque that is more than the specified value to the connectors to try to correct a leak.

B. References

Reference	Title
70-51-00-800-801-G00	Instructions for Torque (Miscellaneous) (P/B 201)
70-51-00-800-802-G00	Wrench Arc Method (Miscellaneous) (P/B 201)

C. Consumable Materials

Reference	Description	Specification
D00599 [CP2442]	Oil - Engine	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Hose Installation

SUBTASK 70-00-01-210-008-G00

- (1) Examine the inner wall of the pre-formed hose to make sure that there is no damage to the Teflon lining
 - (a) Replace the hose if the lining is damaged.

SUBTASK 70-00-01-420-014-G00

- (2) Lubricate the tube or the hose coupling nut and ferrule with a clean engine oil, D00599 [CP2442], and install it.

SUBTASK 70-00-01-420-019-G00

- (3) Put the hose in position for the installation.

SUBTASK 70-00-01-420-015-G00

- (4) Use the wrench arc procedure to tighten the fluid fittings (TASK 70-51-00-800-802-G00).

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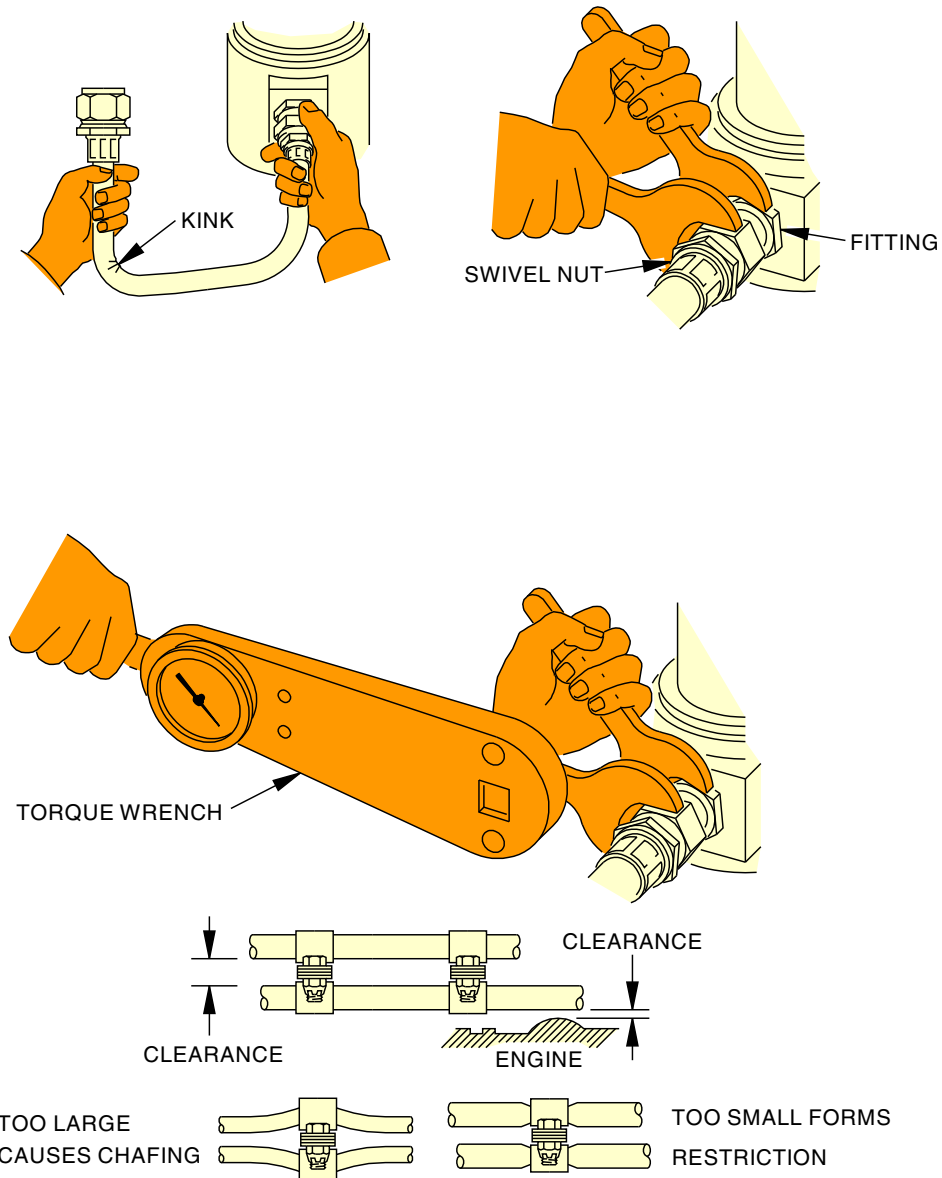
USE TWO WRENCHES TO TIGHTEN THE TUBE COUPLING NUTS. USE ONE TO HOLD THE MATING PART, AND THE OTHER TO TIGHTEN THE COUPLING NUT. IF YOU DO NOT USE TWO WRENCHES, DAMAGE TO THE TUBES AND MATING PART CAN OCCUR.

- (a) Use two wrenches to tighten the swivel coupling nuts on hoses, tubes, or fittings.
- (b) Hold the stable part with one wrench while you apply torque with the second wrench.
- (c) If you use torque wrenches to tighten the fluid fittings, use the instructions for the torque (TASK 70-51-00-800-801-G00).

NOTE: The adapter drive can be in one of three positions on the torque wrench. The illustration in the instructions for torque shows these positions. A change in the position of the adapter drive on the torque wrench will also change the torque applied. Use the examples in the instructions for torque to help find the correct torque values.

———— **END OF TASK** ————

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Hose Installation
Figure 202/70-00-01-990-803-G00

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TASK 70-00-01-400-807-G00

13. V-Band and V-Retainer Coupling Installation

(Figure 203, Figure 204, Figure 205, Figure 206, Figure 207, Figure 208, Figure 209, Figure 210 and Figure 211)

A. General

- (1) This task provides the instructions on how to install the V-band and V-retainer coupling.
- (2) V-band couplings are used to join two flanges together to shape a V-coupling joint. The coupling is tightened when you torque the nut, which tightens a circumferential band or an integral retainer and lugs which applies an inner radial force onto V-shaped retainer segments. These retainer segments then apply an axial clamp force onto the flanges, which connect and hold them together. V-couplings are referred to as V-band couplings (Figure 203 and Figure 204)
- (3) Most V-band and V-retainer couplings have bolt latches consisting of a T-bolt or eyebolt trunnion and locknut. The T-bolt can only be replaced on quick release latches. The T-bolt cannot be replaced on the basic T-bolt latch. Eyebolts cannot usually be replaced.
- (4) Safety latches are usually found on V-retainer couplings and some times on V-band couplings (Figure 207). This is a backup latch system if the primary latch becomes defective.
- (5) Most V-band and V-retainer couplings are tightened with an all-metal locknut. These locknuts have a limited number of installations and removal cycles on a bolt before thread galling and seizure occurs.
- (6) The following are guidelines for the successful use of all-metal locknuts on V-band and V-retainer coupling bolts:
 - (a) Both the locknut and bolt threads should be clean and free of dirt, burrs, and damaged threads.
 - (b) Nuts should be lubricated with Acheson GP460 compound, D50043 [C02-058] to prevent thread galling and seizure.
 - (c) When you install the locknut you should not turn the locknut more than 2 revolutions per second or 120 RPM. Too much nut rotation speed causes friction and heat, which causes thread galling.
 - (d) Installation of the locknut with a hand torque wrench is recommended.
 - (e) The running torque of the locknut shall be 6.5 in-lb (0.7 N·m) - 40.0 in-lb (4.5 N·m). If the running torque is not in the limits, the locknut must be replaced.
 - (f) V-band and V-retainer couplings are used on two different types of flanges, solid machined flanges and flexible sheet metal flanges. All solid machined flanges in pneumatic systems need a seal to make sure there is no leakage from the flanges. Flexible sheet metal flanges do not use a seal. These flanges are made so that they seal themselves on finely machined face surfaces.
 - (g) Before assembly, the coupling part number must be checked to make sure it is the correct one.

B. References

Reference	Title
71-00-00-790-803-G00	Test No. 3 - Wet Motor Leak Test (P/B 501)
71-00-00-910-802-G00	Start the Engine (Selection) (P/B 201)
71-00-00-910-806-G00	Stop the Engine (Usual Engine Stop) (P/B 201)
71-11-04-010-801-G00	Open the Fan Cowl Panels (Selection) (P/B 201)

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(Continued)

Reference	Title
71-11-04-410-801-G00	Close the Fan Cowl Panels (Selection) (P/B 201)
78-31-00-010-801-G00	Open the Thrust Reverser (Selection) (P/B 201)
78-31-00-010-802-G00	Close the Thrust Reverser (Selection) (P/B 201)
78-31-00-040-801-G00	Thrust Reverser Deactivation For Ground Maintenance (P/B 201)
78-31-00-440-801-G00	Thrust Reverser Activation After Ground Maintenance (P/B 201)

C. Consumable Materials

Reference	Description	Specification
B00679 [C04-035]	Alcohol - Isopropyl	
D00599 [CP2442]	Oil - Engine	
D50043 [C02-058]	Compound - Antiseize, Acheson GP460 (For Threaded Fasteners 0.250 Inches Diameter Or Larger, C02-079 Is An Alternative)	GE A50TF201 Class A
D50194 [C02-004]	Lubricant - Sprayable Air Drying	
G02348 [C10-010]	Pad - Abrasive - Scotch-Brite 7447	
G50435	Lockwire - Safety and Lock, .813mm (.032 inch) brass	ASTM B134
G50631 [C05-061]	developer powder - Zyglo ZP-14A or Zyglo ZP-4B	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Access Panels

Number	Name/Location
413	Left Fan Cowl, Engine 1
414	Right Fan Cowl, Engine 1
415	Left Thrust Reverser, Engine 1
416	Right Thrust Reverser, Engine 1
423	Left Fan Cowl, Engine 2
424	Right Fan Cowl, Engine 2
425	Left Thrust Reverser, Engine 2
426	Right Thrust Reverser, Engine 2

F. Prepare for Installation

SUBTASK 70-00-01-211-002-G00

- (1) Before assembly, do these steps:
- (a) Make sure that the couplings are marked with the correct part number and bolt torque.
 - (b) If the coupling is not marked, replace the coupling.
 - (c) Examine the V-band and V-retainer coupling components for cleanliness, correct assembly and operation.
 - (d) Clean, repair or replace the coupling as necessary before you assemble the coupling.

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G. V-Band and V-Retainer Coupling Installation

SUBTASK 70-00-01-400-001-G00

- (1) Assemble the V-band or V-retainer coupling as follows:
- (a) On a single-latch V-band coupling or V-retainer couplings, put the V-coupling over the flanged tube end (Figure 206).

NOTE: Do not overspread the band on sheet metal couplings

**CAUTION**

MAKE SURE THAT THE SEAL STAYS IN THE GROOVE WHEN YOU SET THE FLANGES. IF THE SEAL IS NOT IN THE GROOVE, DAMAGE TO THE SEAL AND THE FLANGES COULD OCCUR.

- (b) Install the seal in the male flange.
- (c) Move the mating flange into position.

SUBTASK 70-00-01-820-001-G00

- (2) Align the components that are being attached together as follows:

NOTE: The weight of any component that is to be assembled should not be supported only by the V-band or V-retainer coupling.

**CAUTION**

DO NOT USE THE V-BAND OR V-RETAINER COUPLING TO PULL OR ALIGN THE FLANGES. DAMAGE TO THE COUPLING OR FLANGES COULD OCCUR.

- (a) Align the tubes or tubing components to be connected to within the maximum gap shown in the illustration (Figure 205).
- NOTE: To align correctly, all adjacent support clamps or brackets should remain loose until the installation of the V-band or V-retainer coupling has been completed.
- (b) Make sure that couplings that attach all gearbox mounted components mount flush and no gaps can be seen in the mating flanges.

SUBTASK 70-00-01-640-001-G00

- (3) Make sure the coupling is correctly lubricated as follows:
- (a) Make sure that the channels on the V-retainer couplings are coated with a dry film lubricant on the inside surface.
- (b) If the dry film lubricant is missing, spray the inside surface with sprayable air drying lubricant, D50194 [C02-004].
- (c) For couplings in the external air systems, apply a thin layer of a clean engine oil, D00599 [CP2442] on the inside surface before you install the coupling.

SUBTASK 70-00-01-420-016-G00

- (4) Place the V-band or V-retainer coupling on the mated flanges and tighten the nut as follows:
- (a) On the quick release type V-band or V-retainer couplings, make sure that the bolt is fully seated in the latch (Figure 204).
- (b) On T-bolt quick release latches, make sure that you insert the widest part of the T-bolt head into the latch so that the latch resists the bolt being turned.
- NOTE: The incorrect position can cause failure of the quick release latch.
- (c) Put the coupling in its position (Figure 206).

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- (d) Tighten the nut to a minimum of 50 percent of the specified torque and do these steps:

NOTE: The torque values are in the AMM task and also marked on the coupling.

- 1) Make sure that the coupling is installed over the flanges equally around the circumference.
- 2) Make sure that the flanges are aligned correctly.

NOTE: The radial flange can be examined visually by looking between the adjacent retainers and examining the flange O.D. through the gaps in the retainer

- 3) Lightly tap the coupling around its circumference with a fiber mallet to equally apply band tension, being careful not to hit the latch.
- 4) Slowly torque the self locking nut to 100 percent as follows:
 - a) While you torque the self locking nut to 100 percent of the specified value, lightly tap around the outer periphery as necessary to prevent unequal loading.
 - b) After you have 100 percent of the specified torque, tap around the band and torque the self locking nut again to the specified value.

NOTE: No additional tightening should be necessary.

- (e) After tightening, examine the V-band or V-retainer coupling latch gap.

- 1) If you see them touch at any location, the installation is incorrect (Figure 203 and Figure 204).
- 2) The latch gap for the V-retainer couplings should not be less than the values in the table below.

V-Retainer Coupling Minimum Installed Latch Gaps

Tube OD	Latch Gap
1.50 inches (38.1 mm)	.150 inch (3.81 mm)
1.75 inches (44.5 mm)	.150 inch (3.81 mm)
2.00 inches (50.8 mm)	.175 inch (4.45 mm)
2.25 inches (57.2 mm)	.175 inch (4.45 mm)
2.50 inches (63.5 mm)	.190 inch (4.83 mm)
2.75 inches (69.9 mm)	.190 inch (4.83 mm)
3.00 inches (76.2 mm)	.190 inch (4.83 mm)
3.25 inches (82.6 mm)	.190 inch (4.83 mm)
3.50 inches (88.9 mm)	.190 inch (4.83 mm)
4.00 inches (101.6 mm)	.250 inch (6.35 mm)
4.50 inches (114.3 mm)	.250 inch (6.35 mm)
5.00 inches (127.0 mm)	.300 inch (7.62 mm)
5.50 inches (139.7 mm)	.300 inch (7.62 mm)
6.00 inches (152.4 mm)	.400 inch (10.16 mm)
6.50 inches (165.1 mm)	.400 inch (10.16 mm)
7.00 inches (177.8 mm)	.450 inch (11.43 mm)
7.50 inches (190.5 mm)	.450 inch (11.43 mm)

- 3) If the latch gap is less than the values in the table, replace the coupling and examine the flanges for wear.

- (f) Complete the assembly of all adjacent support clamps and brackets in the tube assembly per applicable AMM instructions.

SUBTASK 70-00-01-420-017-G00

- (5) Do a final check as follows:

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- (a) Safety the hex nuts that have safety wire holes.
- (b) Adjust and tighten the tubing supports as necessary after V-band or V-retainer coupling installation.

NOTE: Do not allow high bending loads from misaligned supports.

- (c) Do this task: Test No. 3 - Wet Motor Leak Test, TASK 71-00-00-790-803-G00.
- (d) If you find leaks at the joints, do these steps:
 - 1) Disassemble the V-band or V-retainer couplings.
 - 2) Do the V-band and V-retainer coupling inspection.

H. V-Band and V-Retainer Coupling, Seal and Flange Inspection

SUBTASK 70-00-01-211-003-G00

- (1) Do these steps to inspect the coupling (Figure 207, Figure 208, and Figure 209):
 - (a) Examine the coupling part number and make sure it is correct coupling for its location on the engine.

NOTE: Some couplings can be the same size and are physically interchangeable but are made for different applications. For example, it is possible that a lighter duty coupling could be accidentally installed in an application that needs a higher strength coupling, or a coupling made from materials intended for non-critical temperature applications may be incorrectly used in a higher temperature installation. Therefore, it is important to make sure the specified part number coupling is used.
 - (b) Examine the coupling for the following:
 - 1) Kinks or permanent twist due to overspreading
 - 2) Crowning or bending over the apex of the retainer because of over tightening
 - 3) Installation instructions and torque markings missing from the coupling
 - 4) Retainers for indications of permanent deformation, such as overspreading when the angle is more than 44 degrees (Figure 203 and Figure 204)
 - 5) Tool marks and cracks on the inside corner radii of the retainer
 - 6) Bolt for deformation and damaged threads

NOTE: Some small diameter V-band couplings are made with curved T-bolts.
 - 7) Trunnion and latch parts for evidence of overloading or binding with the strap
 - 8) Incorrect nut

NOTE: Most V-band or V-retainer couplings use a locknut.
 - 9) Damaged nut.

NOTE: The nut must be clean and free of chips and burrs with no damaged or galled threads.
 - (c) If you find a defect or defects, replace the coupling.

SUBTASK 70-00-01-211-004-G00

- (2) Do these steps to inspect the flange (Figure 210):
 - (a) Examine the flanges to be attached by the V-band or V-retainer coupling for the following:
 - 1) Correct fit between the flanges and the seal
 - a) Make sure that you use the correct V-coupling, and seal (if needed) for the applicable flanges.

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- 2) Dirt or grease
 - a) Clean the flange surface contamination with a cloth moistened with alcohol, B00679 [C04-035] and/or Scotch-Brite 7447 pad, G02348 [C10-010].
- 3) Cracks, tool marks, nicks, or dings on the machined inner corners of solid machined flanges that could cause interference or failure
 - a) Blend smooth all nicks and dings that could cause interference.
- 4) Surface wear on the flange interface surfaces that can cause interference with the V-band retainer and limit proper installation
 - a) Replace the components that have worn flanges.

SUBTASK 70-00-01-211-005-G00

- (3) Do these steps to inspect the seal (Figure 210):
 - (a) Make sure that the part number for the seal is correct.
 - (b) Make sure that the seal is new and clean.

NOTE: Removed seals should not be used again.
 - (c) Make sure that the seal is in the correct position in the flange seal cavity.

I. V-Band and V-Retainer Coupling Leak Test

NOTE: There are two leak test procedures to find the location of a pneumatic joint air leak. A leak test with aluminum foil and a leak test with a dry developer.

SUBTASK 70-00-01-940-001-G00

- (1) Do these steps to prepare for the aluminum foil leak test (Figure 211):
 - (a) Make one wrap of aluminum foil around the joint.
 - (b) Twist the end of the seam tight as shown.
 - (c) Make the wrap as tight as possible on the tube but do not cause damage to the wrap.
 - (d) Attach the wrap with the lockwire - .813 mm (.032 inch) Brass, G50435 at the sides of the joint as shown.

SUBTASK 70-00-01-940-002-G00

- (2) Do this step to prepare for the dry developer leak test:
 - (a) Apply the dry developer, G50631 [C05-061] around the fitting or fittings to be tested for leaks.

SUBTASK 70-00-01-100-002-G00

- (3) Make sure that the work area is clean and clear of tools and other items.

SUBTASK 70-00-01-860-001-G00

- (4) Do this task: Start the Engine (Selection), TASK 71-00-00-910-802-G00..
 - (a) Run the engine at idle for 5 minutes.

SUBTASK 70-00-01-860-002-G00

- (5) Do this task: Stop the Engine (Usual Engine Stop), TASK 71-00-00-910-806-G00..

SUBTASK 70-00-01-860-003-G00

- (6) Do these tasks in sequence to safely open the left and right thrust reversers on the applicable engine:

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**WARNING**

DO THE DEACTIVATION PROCEDURE FOR THE THRUST REVERSER TO PREVENT THE OPERATION OF THE THRUST REVERSER. ACCIDENTAL OPERATION OF THE THRUST REVERSER CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

- (a) Do this task: Thrust Reverser Deactivation For Ground Maintenance, TASK 78-31-00-040-801-G00.
- (b) Open the applicable left or right fan cowl panels (TASK 71-11-04-010-801-G00).
 - 1) Open these access panels:

<u>Number</u>	<u>Name/Location</u>
413	Left Fan Cowl, Engine 1
414	Right Fan Cowl, Engine 1
423	Left Fan Cowl, Engine 2
424	Right Fan Cowl, Engine 2

**WARNING**

OBEY THE INSTRUCTIONS IN THE PROCEDURE TO OPEN THE THRUST REVERSERS. IF YOU DO NOT OBEY THE INSTRUCTIONS, INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

- (c) Open the applicable left or right thrust reversers (TASK 78-31-00-010-801-G00).
 - 1) Open these access panels:

<u>Number</u>	<u>Name/Location</u>
415	Left Thrust Reverser, Engine 1
416	Right Thrust Reverser, Engine 1
425	Left Thrust Reverser, Engine 2
426	Right Thrust Reverser, Engine 2

SUBTASK 70-00-01-480-001-G00

- (7) Put an adjustable access platform into position.

SUBTASK 70-00-01-211-006-G00

- (8) Do a visual inspection as follows:
 - (a) Make sure there are no leaks at the ducts being tested.
 - 1) For the leak test with aluminum foil, a leaking coupling will cause the foil to balloon or burst.
 - 2) For the leak test with dry developer, a leaking coupling will displace the developer powder.
 - a) Clean the developer powder off of the ducts.
 - (b) If a leak is found, do these steps:
 - 1) Remove the V-band or V-retainer coupling.
 - 2) Do the V-Band and V-Retainer Coupling, Seal and Flange Inspection in this task.

J. Put the Airplane Back to Its Usual Condition

SUBTASK 70-00-01-080-001-G00

- (1) Remove the aluminum foil from the pneumatic joint.

SUBTASK 70-00-01-080-002-G00

- (2) Remove the access platforms.

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SUBTASK 70-00-01-860-004-G00

**WARNING**

OBEY THE INSTRUCTIONS IN THE PROCEDURE TO CLOSE THE THRUST REVERSERS. IF YOU DO NOT OBEY THE INSTRUCTIONS, INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT CAN OCCUR.

- (3) Do these tasks in sequence to safely close the applicable left or right thrust reversers:
- (a) Do this task: Close the Thrust Reverser (Selection), TASK 78-31-00-010-802-G00.
- 1) Close these access panels:
- | <u>Number</u> | <u>Name/Location</u> |
|---------------|---------------------------------|
| 415 | Left Thrust Reverser, Engine 1 |
| 416 | Right Thrust Reverser, Engine 1 |
| 425 | Left Thrust Reverser, Engine 2 |
| 426 | Right Thrust Reverser, Engine 2 |
- (b) Do this task: Close the Fan Cowl Panels (Selection), TASK 71-11-04-410-801-G00.
- 1) Close these access panels:
- | <u>Number</u> | <u>Name/Location</u> |
|---------------|--------------------------|
| 413 | Left Fan Cowl, Engine 1 |
| 414 | Right Fan Cowl, Engine 1 |
| 423 | Left Fan Cowl, Engine 2 |
| 424 | Right Fan Cowl, Engine 2 |
- (c) Do this task: Thrust Reverser Activation After Ground Maintenance, TASK 78-31-00-440-801-G00.

———— **END OF TASK** ————

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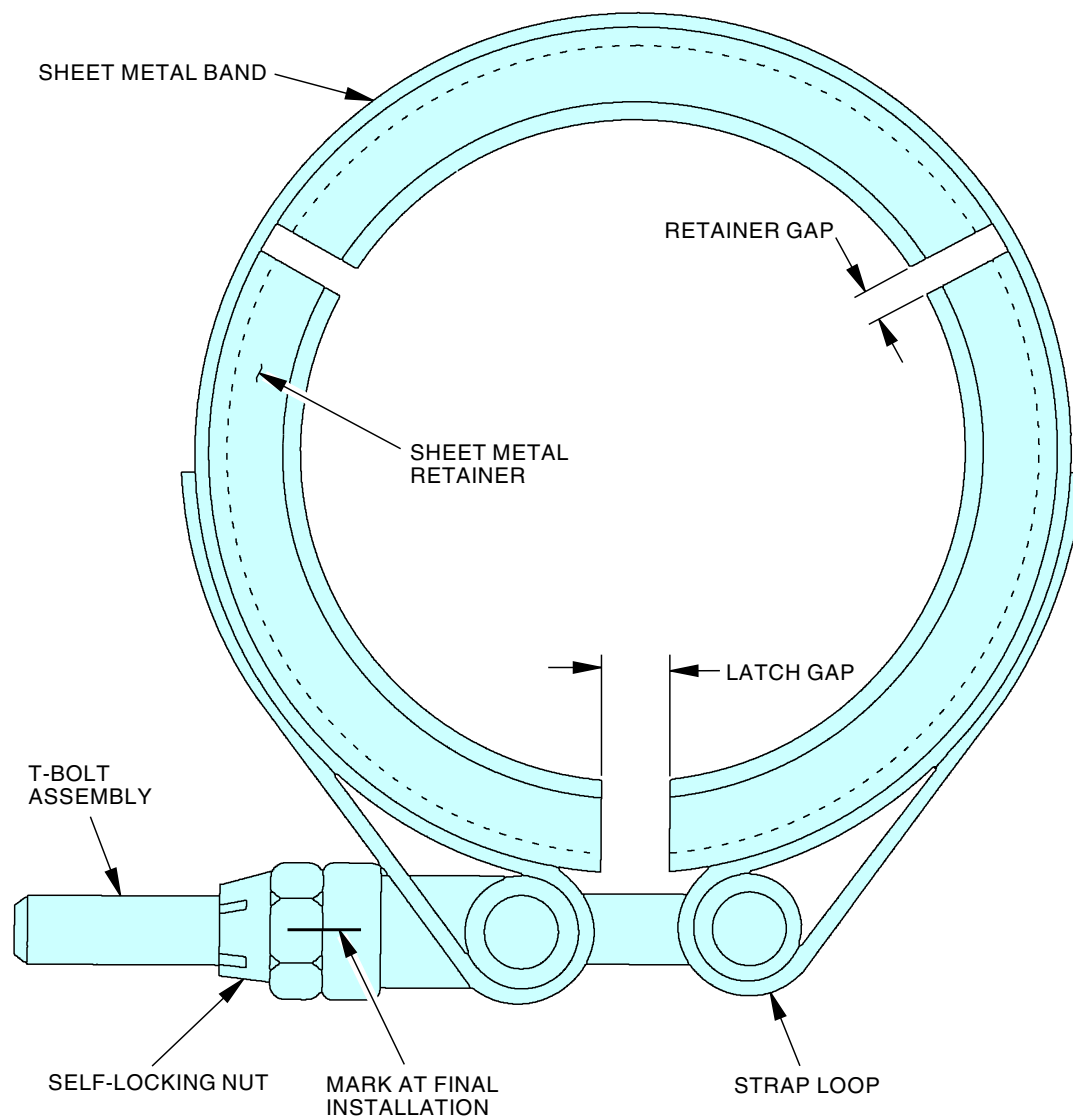
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**NOTE:**

TYPICAL OF AS1895 AND GE9187M73 PART NUMBERS.

1264322-00-A

2471630 S0000576540_V1

V-Band Coupling
Figure 203/70-00-01-990-804-G00 (Sheet 1 of 3)

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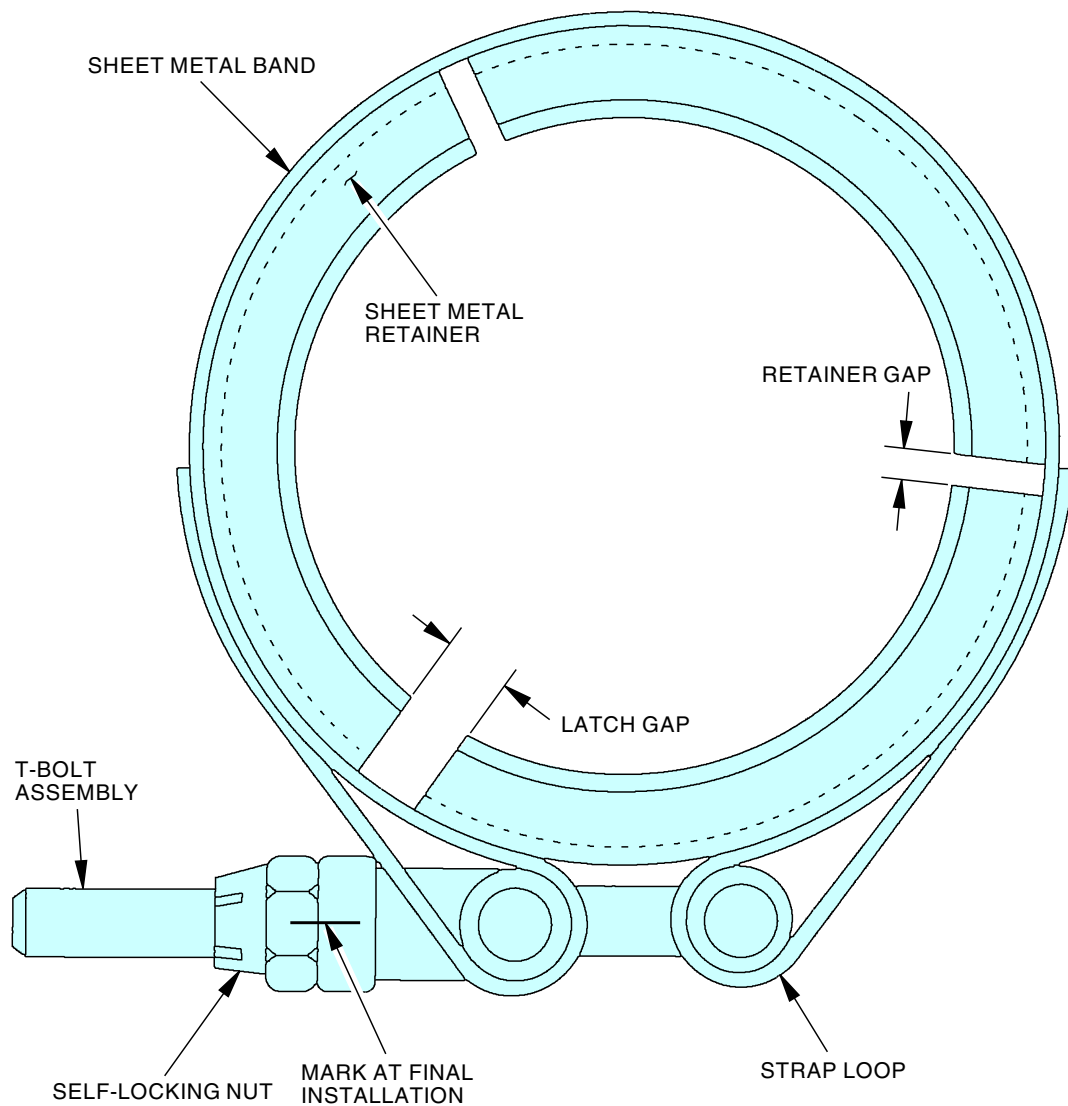
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**NOTE:**

TYPICAL OF GE 9359M59 PART NUMBERS.

1264323-00-A

2471632 S0000576542_V1

V-Band Coupling
Figure 203/70-00-01-990-804-G00 (Sheet 2 of 3)

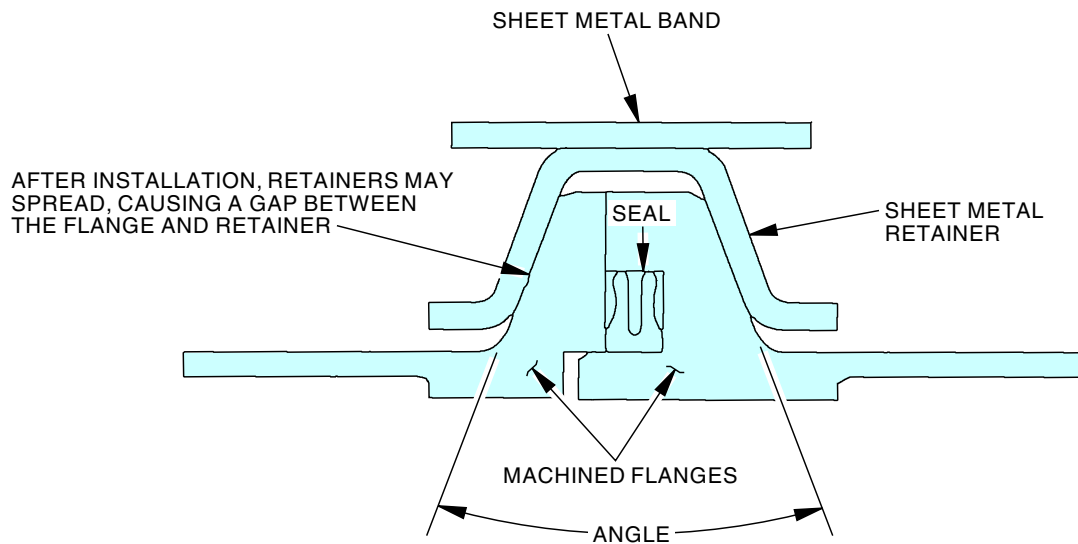
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1264324-00-A

2471638 S0000576544_V1

V-Band Coupling
Figure 203/70-00-01-990-804-G00 (Sheet 3 of 3)

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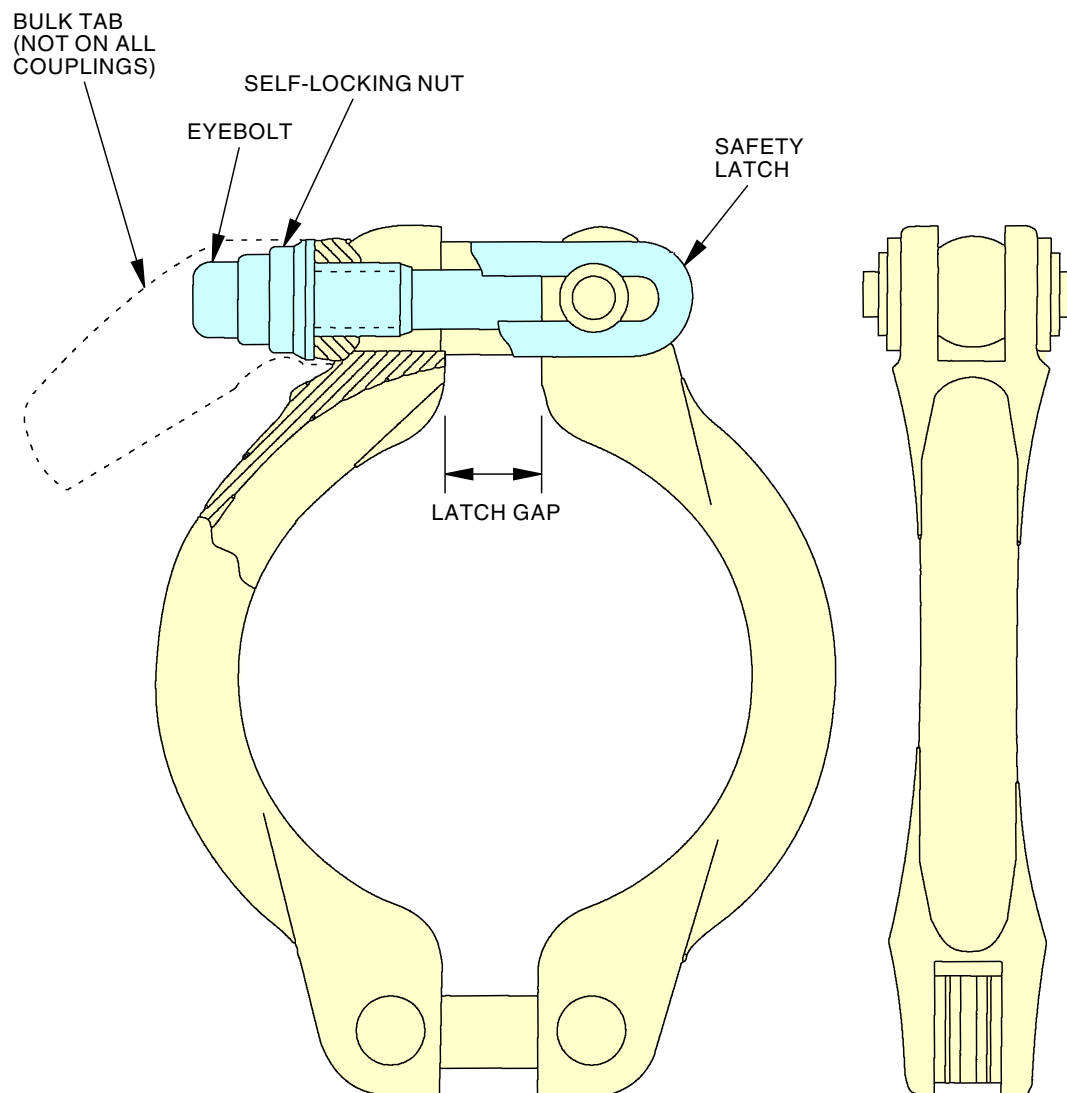
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**NOTE:**

TYPICAL OF GE PART NUMBERS 9222M97 AND 9303M42.

1264325-00-A

2471639 S0000576589_V1

V-Retainer Coupling
Figure 204/70-00-01-990-805-G00 (Sheet 1 of 2)

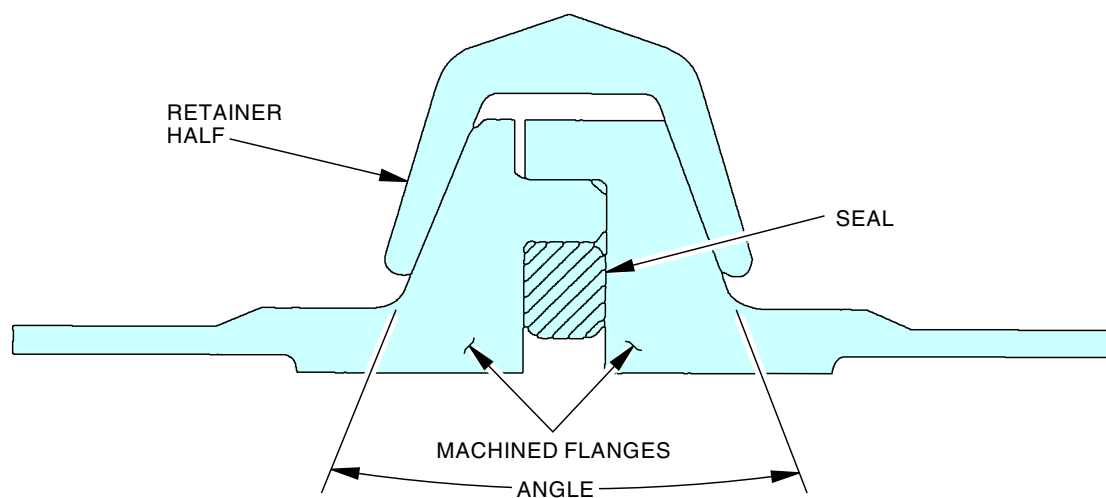
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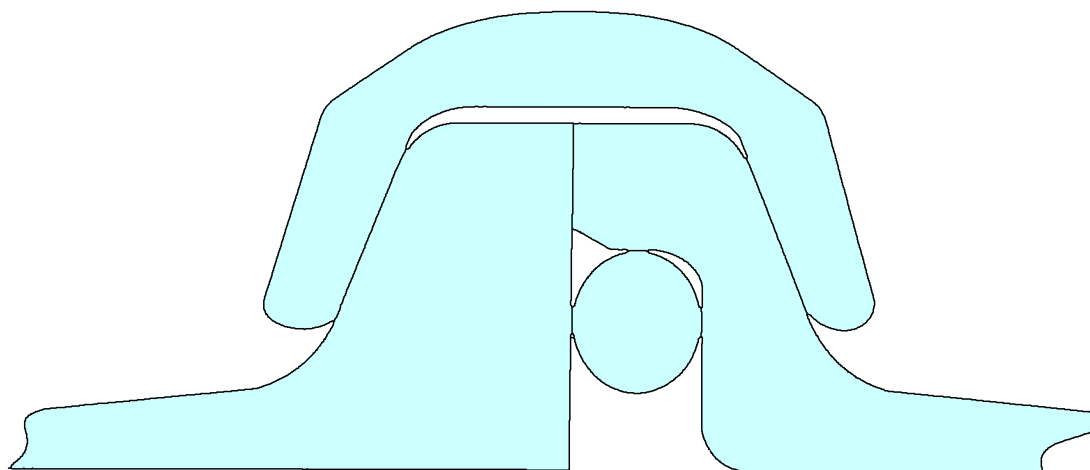
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TYPICAL TUBING CONNECTION



TYPICAL HARDWARE INSTALLATION

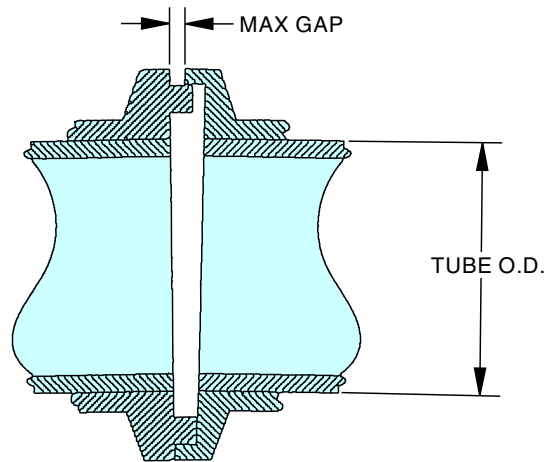
1264326-00-A
2471640 S0000576590_V1V-Retainer Coupling
Figure 204/70-00-01-990-805-G00 (Sheet 2 of 2)EFFECTIVITY
SIA ALL

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TUBE O.D.	AS1895	9187M73
1.50 (38.1)	0.080 (2.03)	0.073 (1.86)
2.00 (50.8)	0.098 (2.48)	--
2.50 (63.5)	0.115 (2.92)	--
3.00 (76.2)	--	0.126 (3.20)
4.00 (101.6)	--	0.161 (4.09)
5.00 (127.0)	--	0.195 (4.96)
6.00 (152.4)	--	0.231 (5.87)

MAXIMUM FLANGE GAP FOR COUPLING ASSEMBLIES, INCH (mm)
FOR PART NUMBERS AS1895 AND 9187M73

NOTE:

DIMENSIONS APPLY PRIOR TO COUPLING INSTALLATION.

1264327-00-A

2471642 S0000576592_V1

Assembly Alignment Check
Figure 205/70-00-01-990-806-G00

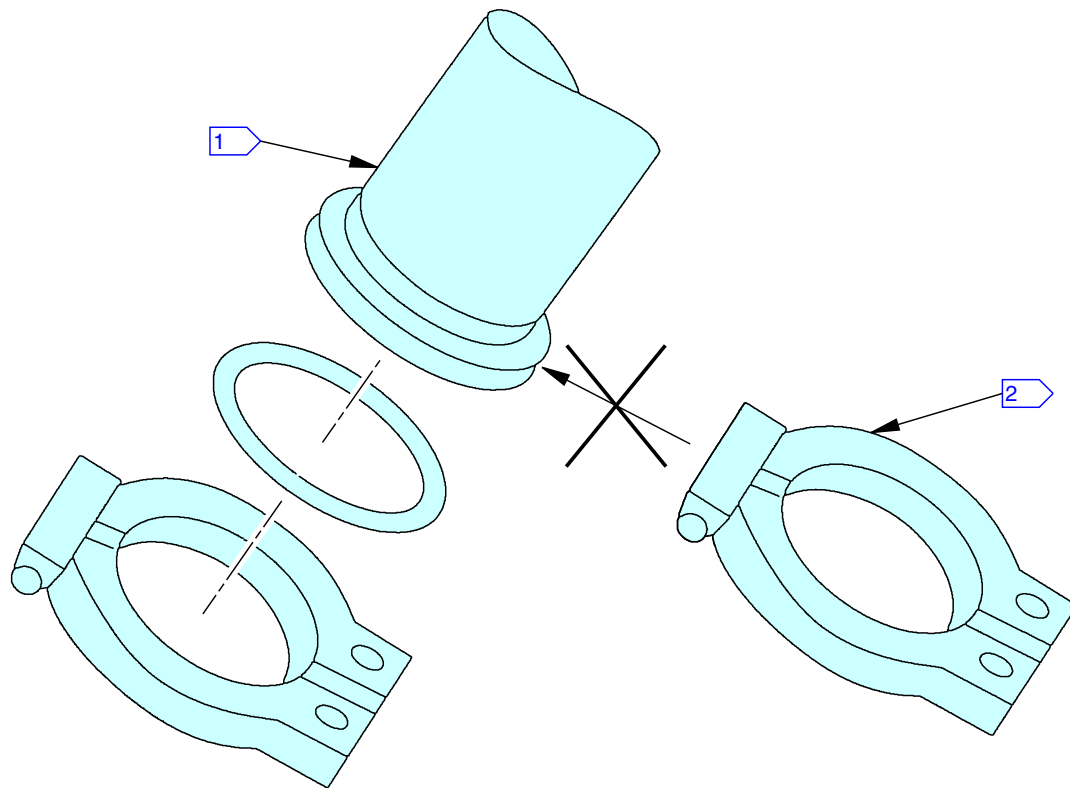
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1 PUT THE V-COUPLING OVER THE FLANGED TUBE END

2 INSTALLATION OF THE V-BAND COUPLING LIKE THIS CAN CAUSE OVERSPREADING AND DAMAGE

1264328-00-A

2471643 S0000576593_V2

Correct V-Coupling Installation
Figure 206/70-00-01-990-807-G00 (Sheet 1 of 2)

EFFECTIVITY
SIA ALL

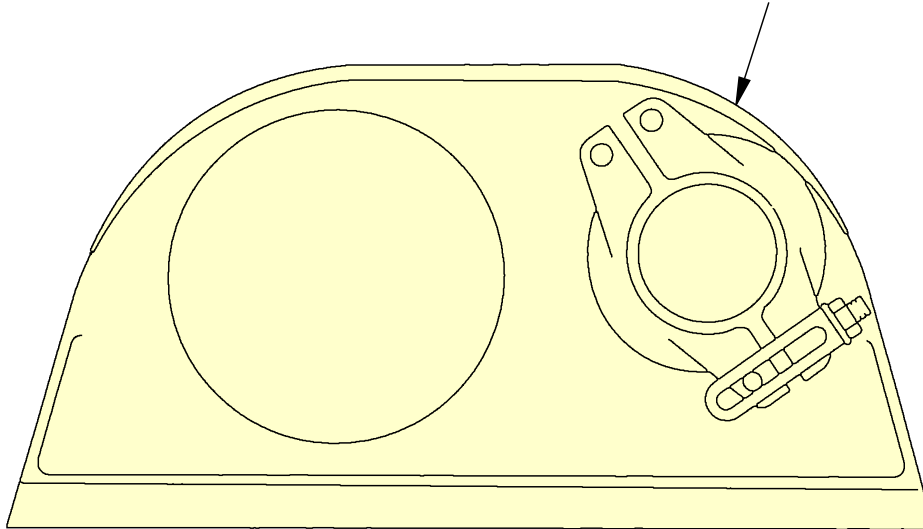
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

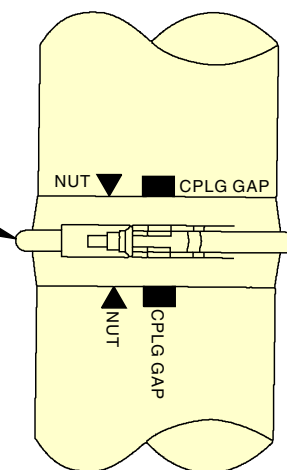
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CORRECT ALIGNMENT IS IMPORTANT TO PREVENT INTERFERENCE WITH FAIRING, COWLINGS, OR OTHER COMPONENTS.
MAINTAIN 0.125 INCH (3.18 mm) MINIMUM GAP WITH ADJACENT EQUIPMENT.



ALIGN COUPLING WITH MARKING ON DUCT
(NOT ALL DUCTS ARE MARKED)



1264329-00-A

2471647 S0000576594_V1

Correct V-Coupling Installation
Figure 206/70-00-01-990-807-G00 (Sheet 2 of 2)

EFFECTIVITY
SIA ALL

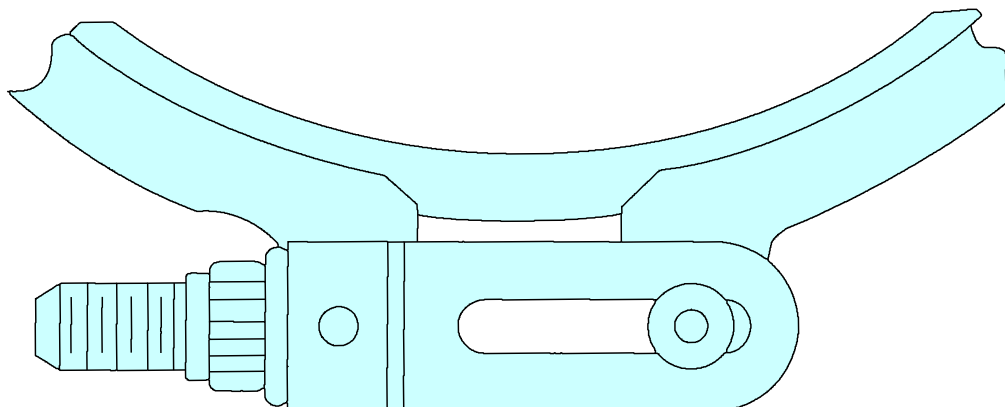
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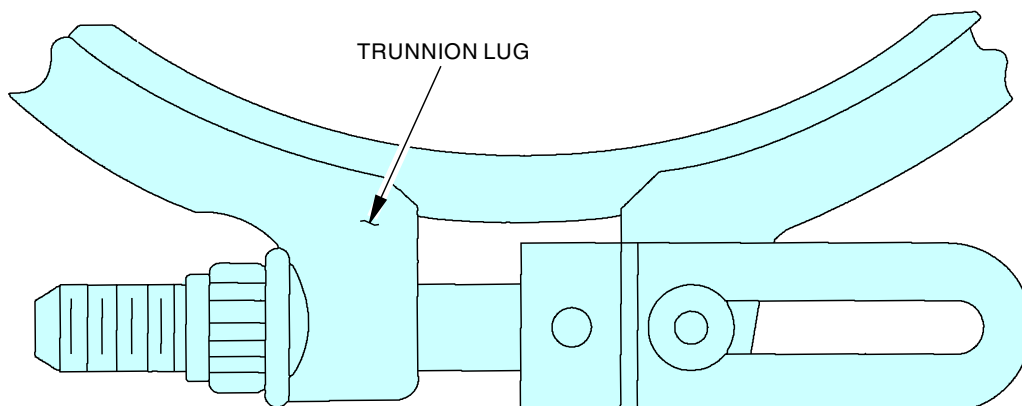
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CORRECT INSTALLATION
SAFETY LATCH IS IN FRONT OF THE TRUNNION LUG



INCORRECT INSTALLATION
SAFETY LATCH IS NOT IN FRONT OF THE TRUNNION LUG, MAKING IT INEFFECTIVE

1264330-00-A

2471648 S0000576595_V1

Correct Safety Latch Installation
Figure 207/70-00-01-990-808-G00

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PART WILL BE MARKED WITH:
PART IDENTIFICATION NUMBER
VENDOR IDENTIFICATION NUMBER
SERIAL NUMBER
LOT NUMBER
INSTALLATION TORQUE

DO A CHECK FOR OVERSPREADING
OF THE RETAINER

DO A CHECK FOR TOOL
MARKS AND CRACKS ON
THE INSIDE CORNER RADII

OVERTIGHTENING WILL
RESULT IN CROWNING
OR BENDING OF THE
RETAINER APEX

EXAMINE FOR BROKEN
WELDS AND/OR RIVETS

DO A CHECK FOR KINKS OR PERMANENT
TWIST DUE TO OVERSPREADING

EXAMINE T-BOLT FOR
DEFORMATION AND
DAMAGED THREADS

NUT MUST BE CLEAN AND CLEAR OF
CHIPS AND BURRS. THE THREADS
MUST NOT HAVE DAMAGE. NUT MUST
BE SPECIFIC TO THE T-BOLT.

TRUNNION PARTS SHOULD
OPERATE SMOOTHLY WITH
NO BINDING

1 SOME SMALL DIAMETER V-BAND COUPLINGS ARE
DESIGNED WITH CURVED BOLTS.

1264331-00-A
2471649 S0000576596_V2

V-Band Coupling Installation
Figure 208/70-00-01-990-809-G00

EFFECTIVITY
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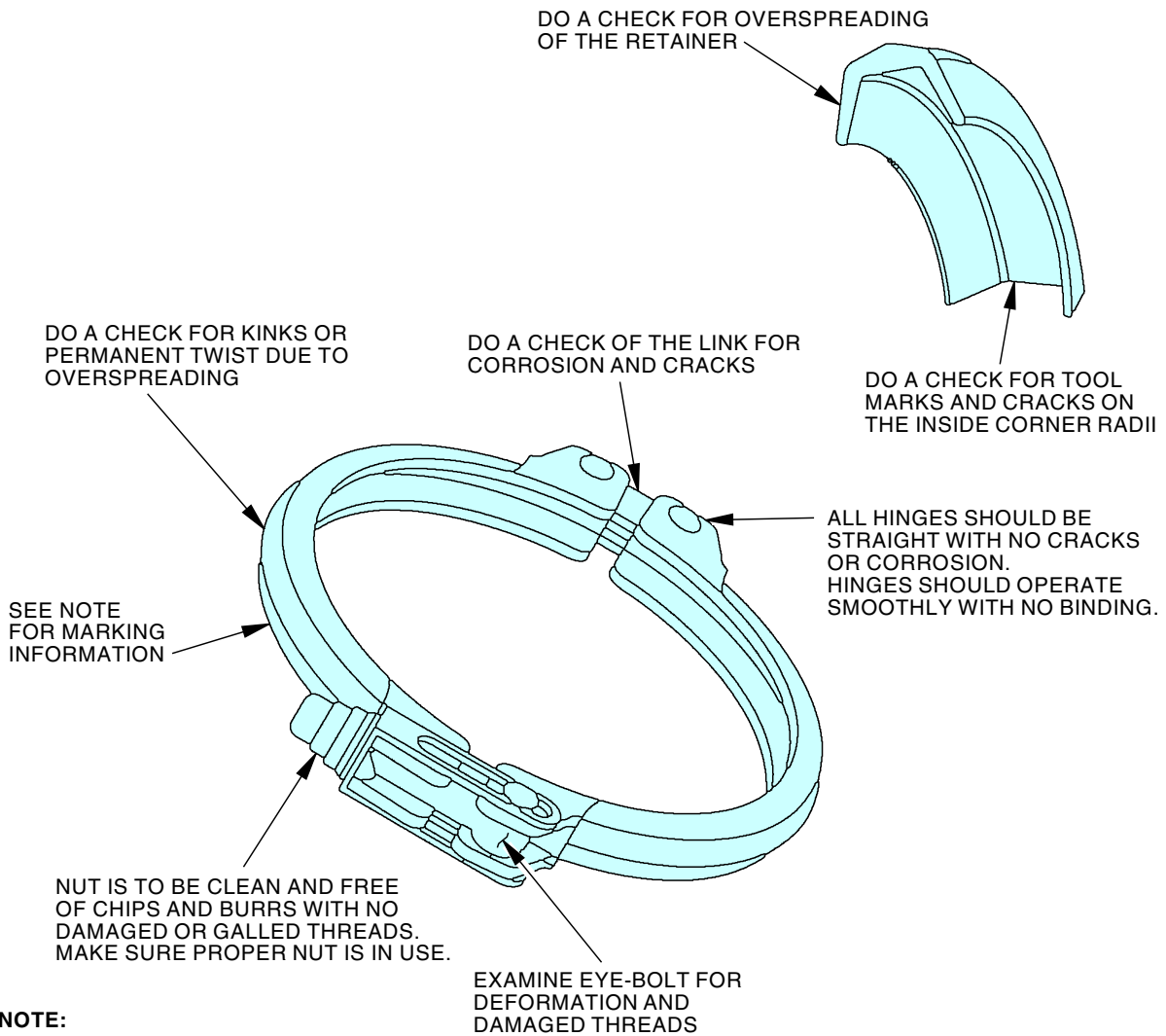
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**NOTE:**

CFM PARTS WILL BE MARKED WITH:

- CFM PART IDENTIFICATION NUMBER
- VENDOR IDENTIFICATION NUMBER
- SERIAL NUMBER
- LOT NUMBER
- INSTALLATION TORQUE

AS1895 PARTS WILL BE MARKED WITH:

- FULL PART NUMBER
- SUPPLIER PART NUMBER
- SUPPLIER NAME OR TRADEMARK AND CAGE CODE
- DATE OF MANUFACTURE
- INSTALLATION TORQUE

1264332-00-A

2471654 S0000576597_V2

V-Retainer Coupling Inspection
Figure 209/70-00-01-990-810-G00

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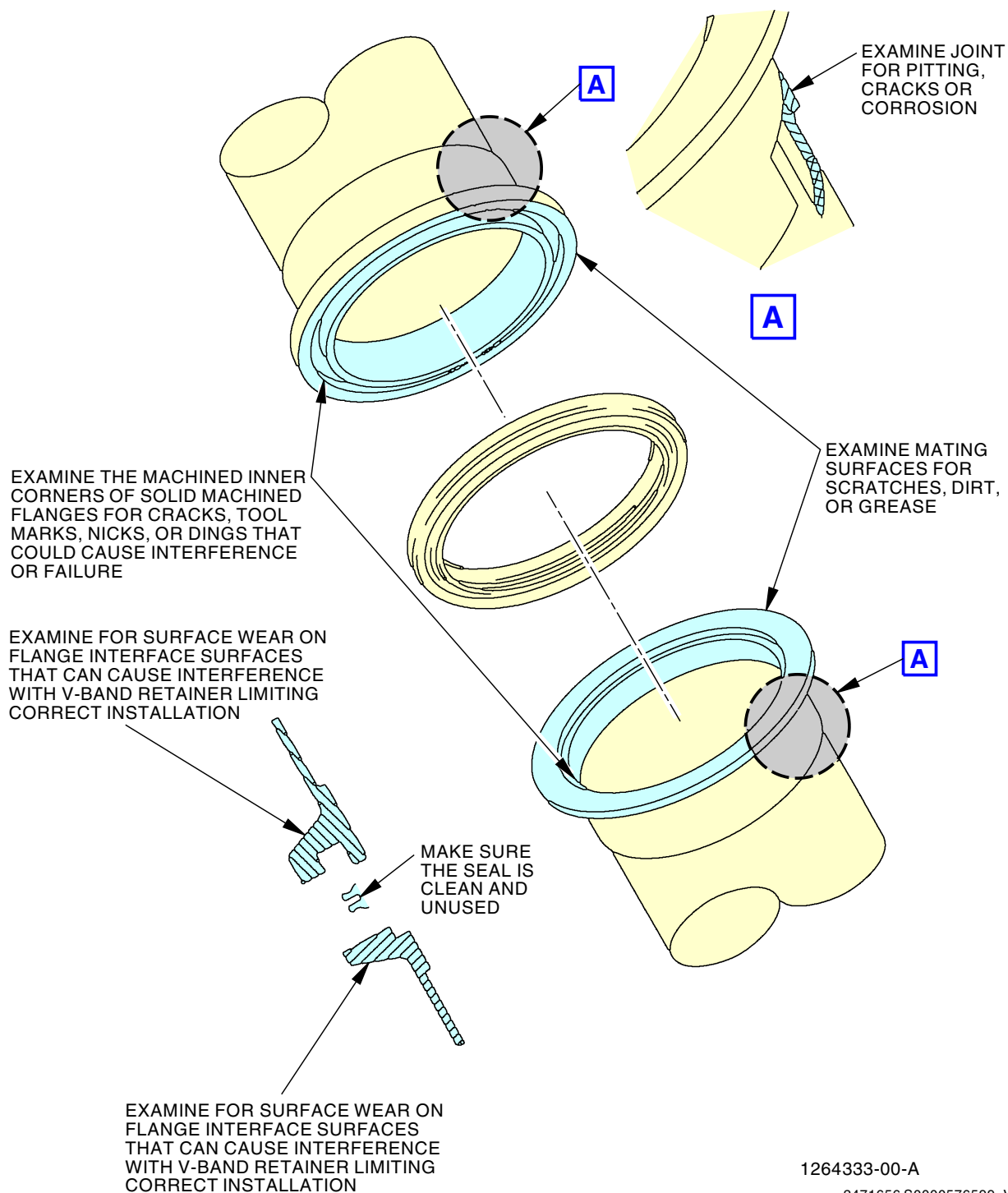
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2471656 S0000576599_V1

Flange and Seal Examination
Figure 210/70-00-01-990-811-G00 (Sheet 1 of 2)

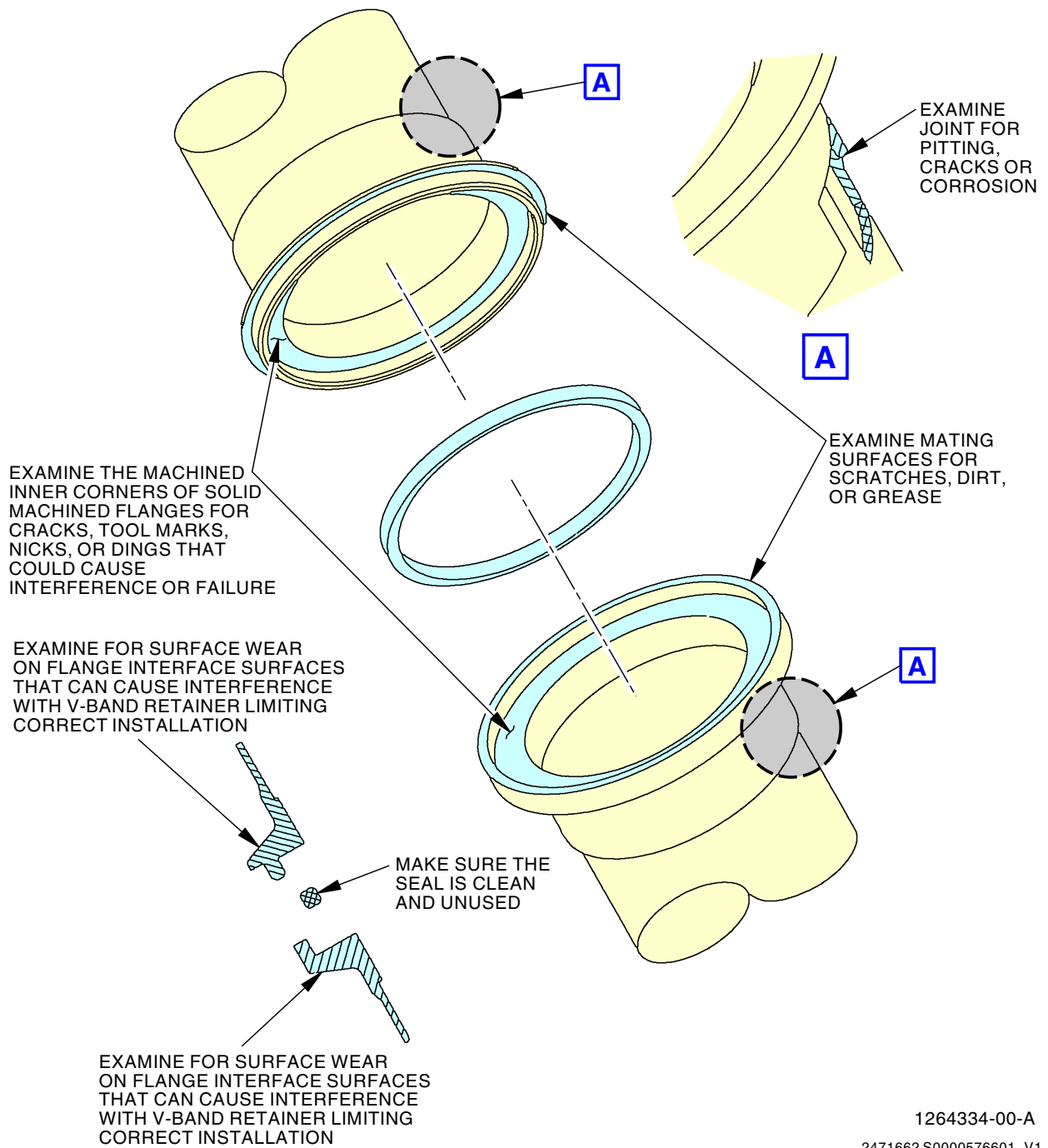
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Flange and Seal Examination
Figure 210/70-00-01-990-811-G00 (Sheet 2 of 2)

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 2471662 S0000576601_V1

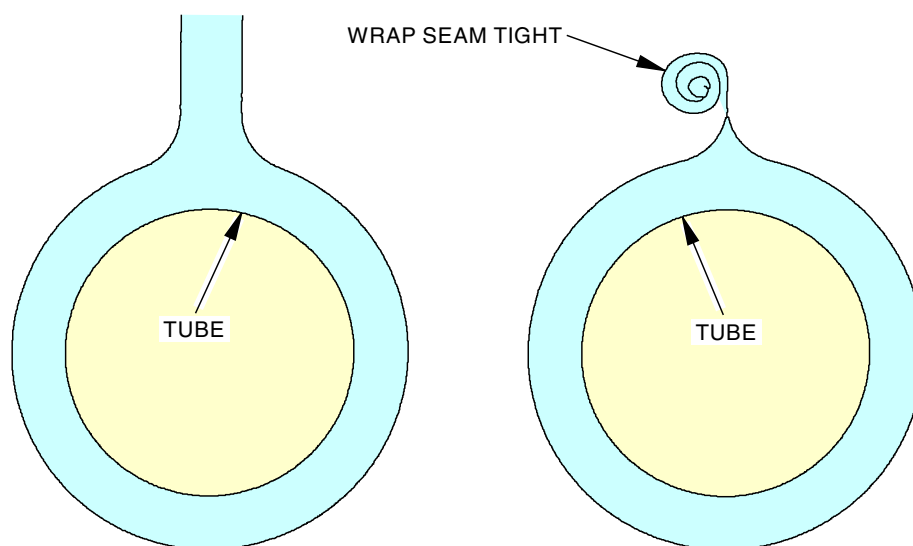
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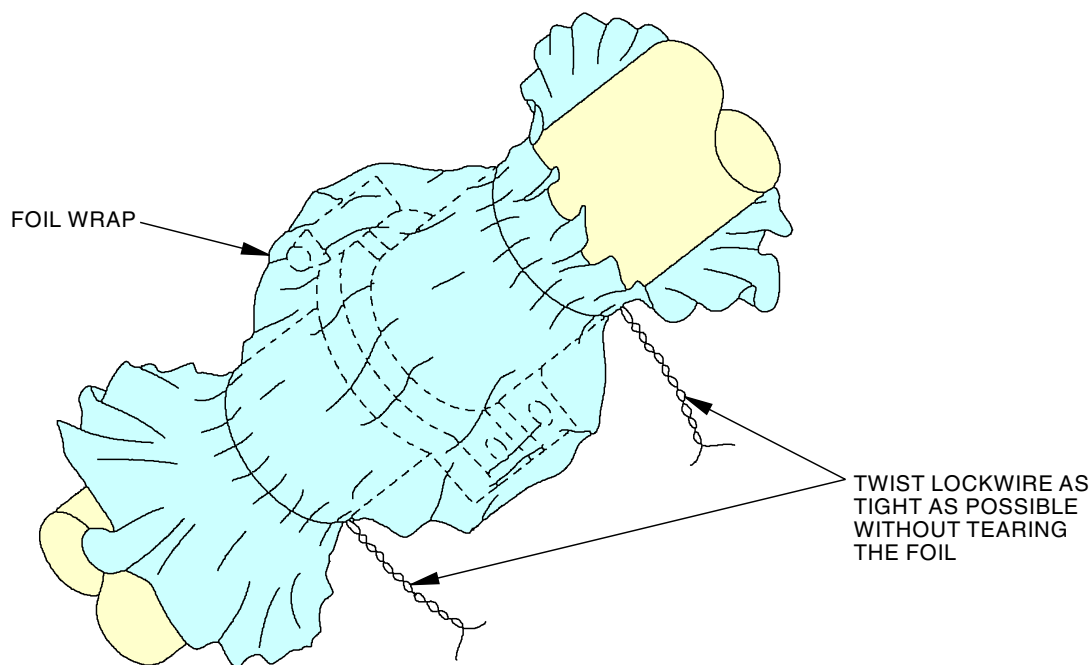
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TYPICAL FOIL WRAP CROSS SECTION



1264335-00-A

2471664 S0000576602_V1

Installation of Foil Wrap
Figure 211/70-00-01-990-812-G00EFFECTIVITY
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**737-7/8/8200/9/10
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TASK 70-00-01-000-801-G00**14. Pressure Sensitive Placard Removal****A. General**

(1) This task provides the instructions on how to remove a pressure sensitive placard.

B. Tools/Equipment

Reference	Description
STD-763	Scraper
STD-1415	Knife - Utility

C. Consumable Materials

Reference	Description	Specification
B00068	Alcohol - Denatured, Ethyl (Ethanol)	AMS 3002, MIL-E-51454 Type II
B00130	Alcohol - Isopropyl	TT-I-735
B00344	Solvent - Xylene, Nitration Grade	ASTM D843
B00666	Solvent - Methyl Propyl Ketone	BMS11-9
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	AMS3819 Class 1 Grade A or B Form 1 (Supersede BMS15-5 CL A)

D. Location Zones

Zone	Area
100	Lower Half of Fuselage
200	Upper Half of Fuselage
300	Empennage
400	Powerplant and Nacelle Struts
500	Left Wing
600	Right Wing
700	Landing Gear and Landing Gear Doors
800	Doors

E. Pressure Sensitive Placard Removal**SUBTASK 70-00-01-200-001-G00**

(1) Do a check of the placard to see if it is sufficiently bonded.

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

SUBTASK 70-00-01-020-004-G00

USE TOOLS CAREFULLY WHEN YOU DO WORK NEAR COMPOSITE PARTS. IT IS EASY TO CAUSE DAMAGE. IF YOU HIT A PART OR LET IT FALL, YOU CAN CAUSE DAMAGE THAT YOU CANNOT SEE.

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(CAUTION PRECEDES)



CAUTION

USE THE SCRAPER CAREFULLY. DO NOT USE TOO MUCH FORCE. IF YOU DO NOT USE THE SCRAPER CAREFULLY, DAMAGE TO THE SURFACE CAN OCCUR.

- (2) Put a scraper, STD-763, a sharp knife, STD-1415 or similar object under the edge of the placard and remove the placard from the adhesive area.

SUBTASK 70-00-01-020-005-G00



WARNING

DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE. OBEY THE MATERIAL SAFETY DATA SHEETS (MSDS) FOR SOLVENTS. OBEY LOCAL REGULATIONS FOR THE CORRECT PROCEDURES TO USE OR DISCARD SOLVENTS. SOLVENTS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

- (3) Remove the remaining adhesive film with a cotton wiper, G00034 moist with one of these solvents:
- (a) Ethyl alcohol, B00068, 95 percent
 - (b) Methyl Propyl Ketone (MPK), solvent, B00666
 - (c) Isopropyl alcohol, B00130
 - (d) Xylene, solvent, B00344.

————— **END OF TASK** —————

TASK 70-00-01-400-808-G00

15. Pressure Sensitive Placard Installation

A. General

- (1) This task provides the instructions on how to install a pressure sensitive placard.
- (2) Vinyl placards are prepared on a material that will not easily follow the contour of rough or textured surfaces.
 - (a) The placard will touch only the high spots and have a poor bond.
 - (b) Use an adhesive with vinyl placards to get a smooth surface and a firm bond for the placard.

B. Consumable Materials

Reference	Description	Specification
A00016	Adhesive - Pressure Sensitive Film For Interior Non-Structural Bonding	BMS5-91
A00119	Adhesive - Synthetic Rubber Cement, Naphtha Soluble	BMS5-55
A00134	Adhesive - Synthetic Rubber, Buna-N, 1 Part, Fuel Resistant	BMS5-14
A00870	Adhesive - Urethane Adhesive for Bonding, 2 Part, Room Temp Cure (for automatic blending)	BMS5-105 Type II

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(Continued)

Reference	Description	Specification
B00068	Alcohol - Denatured, Ethyl (Ethanol)	AMS 3002, MIL-E-51454 Type II
B00083	Solvent - VM&P Naphthas	TT-N-95 Type II, ASTM D-3735 Type III
B00130	Alcohol - Isopropyl	TT-I-735
B00137	Abrasive - Garnet Coated Paper	
B00316	Solvent - Aliphatic Naphtha (For Organic Coatings)	TT-N-95 Type I, ASTM D-3735 Type I
B00666	Solvent - Methyl Propyl Ketone	BMS11-9
C00012	Coating - Akzo Nobel Clear Polyurethane Topcoat, 683-3-2 Base with X-310A Catalyst (Akzo Nobel Aerospace Coatings)	
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	AMS3819 Class 1 Grade A or B Form 1 (Supersede BMS15-5 CLA)
G00270	Tape - Scotch Flatback Masking 250	ASTM D6123 (Supersedes A-A-883)

C. Location Zones

Zone	Area
100	Lower Half of Fuselage
200	Upper Half of Fuselage
300	Empennage
400	Powerplant and Nacelle Struts
500	Left Wing
600	Right Wing
700	Landing Gear and Landing Gear Doors
800	Doors

D. Prepare for the Installation**SUBTASK 70-00-01-390-002-G00**

- (1) If the placard uses adhesive, A00016, no special placard preparation is necessary.

SUBTASK 70-00-01-100-003-G00

- (2) If the placard has no backing adhesive, prepare the placard as follows:
- Make the rear surface of the placard rough with garnet coated paper abrasive, B00137.
 - Clean the placard with aliphatic naphtha solvent, B00083.
 - Remove the release paper from one side of adhesive, A00016.
 - Apply adhesive, A00016, to the rear of the placard.
 - Cut away unwanted adhesive, A00016.
 - Laminate adhesive, A00016, to the placard with one of these steps:
 - Roll placard on a hot roll laminator heated to 140°F (60°C).
 - Heat the placard to not more than 140°F (60°C) with a dry air blast or other applicable source.

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- a) Rub the release paper with cotton wiper, G00034.

<1> Do not move the release paper.

NOTE: Heat makes the bond between the adhesive and release paper soft.

E. Pressure Sensitive Placard Installation

SUBTASK 70-00-01-390-003-G00



DO NOT GET SOLVENTS IN YOUR MOUTH, YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. SOLVENTS ARE DANGEROUS MATERIALS. SOLVENTS CAN BE FLAMMABLE. OBEY THE MATERIAL SAFETY DATA SHEETS (MSDS) FOR SOLVENTS. OBEY LOCAL REGULATIONS FOR THE CORRECT PROCEDURES TO USE OR DISCARD SOLVENTS. SOLVENTS CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

- (1) Use cotton wiper, G00034, to clean the receiving surface with an approved cleaner:

- (a) Ethyl alcohol, B00068
- (b) Isopropyl alcohol, B00130
- (c) Methyl propyl ketone solvent, B00666.

SUBTASK 70-00-01-100-004-G00

- (2) Dry surface with cotton wiper, G00034.

- (a) Do not let air dry.

SUBTASK 70-00-01-400-002-G00

- (3) If the old placard was removed, install the placard:

NOTE: You can install the new placard immediately if you did not remove the old placard.

- (a) For an aluminum marker applied to the primed or painted rough interior surfaces, do the following steps:
 - 1) Mask an area approximately 1/16 in. (2 mm) smaller than the placard with the masking tape or attach a mask with necessary size.
 - 2) Make sure that the masked area is in the correct position.
 - a) If it is necessary, remove dry adhesive with naphtha cleaner.
 - 3) Use a brush to apply adhesive, A00119, or adhesive, A00870, to the prime contact area.
 - a) If adhesive, A00870, was applied, install marker within working life of adhesive.
 - b) If adhesive, A00119, was applied, let it dry fully in approximately 15 minutes.
 - 4) Remove Scotch Flatback Masking Tape 250, G00270, or a mask.
 - 5) Remove the release paper from the placard.
 - 6) Apply the placard to the center of the surface.
 - a) Prevent the air pockets.
 - 7) Rub the placard with firm hand pressure and cotton wiper, G00034, (cheesecloth pad).
 - 8) If the primed surface shows around the placard, remove unwanted adhesive with solvent, B00316.

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- (b) For aluminum markers applied to cadmium plated surfaces, unpainted laminated polyester, unpainted phenolic or unpainted rough surfaces, do the following steps:
- 1) Apply a light brush of adhesive, A00134, to the cleaned surface.
 - a) Do not apply adhesive, A00134, on primed or painted surfaces.
 - 2) Let adhesive, A00134, dry for 15-20 minutes.
 - 3) Apply the placard.

SUBTASK 70-00-01-390-004-G00

- (4) To seal the edges, do the following steps:
- (a) If you paint up to the edges of the placard, seal the edges of the placard with paint.
 - 1) If the placard has a premask, do these steps:
 - a) Apply the last layer of paint up to the placard.
 - b) Remove the premask.

NOTE: The paint will flow to seal the edges.
 - c) If this condition does not occur, seal the edges by the recommended procedure.
 - (b) Use a brush, to apply clear base Akzo Nobel 683-3-2 coating, C00012 (683-3-2 with X-310A catalyst (edge sealer)), to the edges of the placard:
 - 1) Make sure that a dry film thickness is 0.0015 in. (0.0381 mm) - 0.0020 in. (0.0508 mm).
 - (c) Let the adhesive cure for a minimum of 1/2 hour.
 - 1) Seal the edges of the pressure-sensitive placard with clear base Akzo Nobel 683-3-2 coating, C00012 (683-3-2 with X-310A catalyst (edge sealer)).

NOTE: The edge seal should extend a minimum of 0.5 in. (12.7 mm) on the substrate and 0.5 in. (12.7 mm) on the surface of the placard.

———— **END OF TASK** ————

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ENGINE COMPONENTS (PRECAUTIONS FOR REMOVAL/INSTALLATION) - MAINTENANCE PRACTICES

1. General

A. This procedure has one task:

- (1) General Precautions During the Removal and Installation of Engine Components.

TASK 70-00-02-800-801-G00

2. General Precautions During the Removal and Installation of Engine Components

A. General

- (1) This task provides the instructions on how to remove the engine components and accessories.
- (2) You must be very careful when you do maintenance operations in these engine critical areas:
 - (a) Air inlet cowl
 - (b) Bleed valve compartments
 - (c) Bleed air interfaces.
- (3) It is very important that the areas around the engine are clean before each engine run.
- (4) Foreign Object Debris (FOD) that go into the engine and engine parts that are not correctly attached can cause damage.

B. References

Reference	Title
70-00-04-000-801-G00	Preformed Packing Seal and Packing Retainer Removal (P/B 201)
70-00-04-000-803-G00	Gasket Seal (with Imbedded Flexible Seal Material) Removal (P/B 201)
70-00-04-400-801-G00	Preformed Packing Seal and Packing Retainer Installation (P/B 201)
70-00-04-400-803-G00	Gasket Seal (with Imbedded Flexible Seal Material) Installation (P/B 201)

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. General Precautions During the Removal and Installation of Engine Components

SUBTASK 70-00-02-940-001-G00

- (1) Do these general precautions when you do maintenance tasks:



WARNING

BE CAREFUL WHEN YOU DO WORK ON THE ENGINE PARTS AFTER THE ENGINE IS STOPPED. THE ENGINE PARTS CAN STAY HOT FOR ALMOST ONE HOUR. DO NOT TOUCH HOT PARTS WITHOUT APPLICABLE GLOVES. HOT PARTS CAN CAUSE INJURIES TO PERSONNEL.

- (a) If you will do the procedure after the engine is shutdown, let the engine cool down for a minimum of one hour.
- (b) Remove the contents from your pockets of your work clothes.
- (c) Make sure that the bottom of your footwear is clean.

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- (d) If an object falls into an engine component, stop the procedure and do this step:
 - 1) Find and remove the object before you continue with the procedure.
- (e) Lift all heavy parts with the correct fixtures, tools and hoists to prevent damage to parts or injury to personnel.
- (f) Hands and gloves must be clean when you touch machined surfaces.
- (g) If it is necessary, use a plastic, nylon, or rawhide faced hammer and drift to move engine components into their positions.
- (h) Keep the plugs and covers on the part until you install that part.

**CAUTION**

DO NOT LET SILVER OR CADMIUM PLATED TOOLS TOUCH TITANIUM PARTS. THESE TOOLS HAVE SMALL QUANTITIES OF CHLORINE SALTS THAT CAN CAUSE DAMAGE TO THE TITANIUM.

- (i) Silver or cadmium plated tools or hardware must not be used on titanium parts.
- (j) Use clean caps to prevent damage to the electrical connections when you disconnect the electrical systems.
- (k) Do these steps after you complete the maintenance tasks on the engine.
 - 1) Remove all tools, materials and engine parts that you do not use.
 - 2) Remove all tools, materials and engine parts from around the engine.
 - 3) Attach all clamps and brackets.
 - 4) Remove all loose (instrumentation and lockwire) wire.
 - 5) Visually examine the air inlet cowl and the ducts for the variable bypass valves and make sure that these areas are clear of unwanted objects.
 - 6) Clean areas that are not easy to get to with a vacuum cleaner.
 - 7) Make sure you install the engine covers if you do not operate the engine soon.

SUBTASK 70-00-02-020-001-G00

- (2) If you will disconnect oil system components, do these steps:
 - (a) Do not let the metal tools hit the components and accessories.
 - (b) Use clean covers and caps to prevent damage to the engine openings.
 - (c) Use clean covers and caps to prevent damage to all ends of a component that you remove.

NOTE: For example: Install covers on the gear shafts and all connections.

SUBTASK 70-00-02-960-001-G00

- (3) If you need to replace the gasket, do the steps that follow:
 - (a) Do this task: Gasket Seal (with Imbedded Flexible Seal Material) Removal, TASK 70-00-04-000-803-G00.
 - (b) Do this task: Gasket Seal (with Imbedded Flexible Seal Material) Installation, TASK 70-00-04-400-803-G00.

SUBTASK 70-00-02-960-002-G00

- (4) If you need to replace the seal, do the steps that follow:
 - (a) Do this task: Preformed Packing Seal and Packing Retainer Removal, TASK 70-00-04-000-801-G00.

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- (b) Do this task: Preformed Packing Seal and Packing Retainer Installation,
TASK 70-00-04-400-801-G00.

SUBTASK 70-00-02-840-001-G00



DO NOT LET THE OIL STAY ON YOUR SKIN. USE THE OIL IN AN AREA WITH GOOD VENTILATION. THE OIL IS POISONOUS AND CAN BE ABSORBED THROUGH YOUR SKIN. THE OIL FUMES CAN IRRITATE YOUR RESPIRATORY TRACT.



DO NOT OPEN THE OIL SYSTEM UNTIL THE PRESSURE GOES TO ZERO. THE PRESSURE GOES TO ZERO APPROXIMATELY 5 MINUTES AFTER AN ENGINE STOPS. A PRESSURIZED OIL SYSTEM CAN RELEASE A SPRAY OF HOT OIL THAT CAN BURN YOU.



DO NOT LET HOT OIL GET ON YOU. PUT ON CLOTHES, GOGGLES, AND OTHER EQUIPMENT FOR PROTECTION, OR LET THE ENGINE BECOME COOL. HOT OIL CAN BURN YOU.



DO NOT LET THE OIL STAY ON YOUR SKIN. USE THE OIL IN AN AREA WITH GOOD VENTILATION. THE OIL IS POISONOUS AND CAN BE ABSORBED THROUGH YOUR SKIN. THE OIL FUMES CAN IRRITATE YOUR RESPIRATORY TRACT.



DO NOT LET OIL GET ON THE ENGINE OR OTHER COMPONENTS. IMMEDIATELY CLEAN THE OIL WHEN IT FALLS ON THEM. OIL CAN CAUSE DAMAGE TO EQUIPMENT.

- (5) The accessories, tubes, and hoses can have oil or fuel in them when you remove them.
- (a) Make sure that you drain the fluids as much as possible before you remove them.
 - (b) Install the protective covers on all of the hoses and tubes that connect to the component.

SUBTASK 70-00-02-020-002-G00

- (6) If you will remove components and accessories, do these steps:
- (a) Make sure that the nameplate is present before you remove the component or accessory.
 - (b) Make sure that you record the part number and the serial number of the removed component before you send the component for repair.
 - 1) If the nameplate is missing, get the part number and the serial number from engine records.

SUBTASK 70-00-02-420-006-G00

- (7) If you will install components and accessories, do these steps:
- (a) Record the type and serial number before you install a component.
 - (b) Visually examine the general condition of the component.
 - 1) Make sure that there is no damage on the component before you install it.
 - (c) Make sure that the mounting faces and seal grooves are clean and not worn.
 - (d) Use only the tools made for the operation.
 - (e) Make sure that you see a minimum of one thread in the nuts and chambers after you tighten the last torque.

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USE TWO WRENCHES TO LOOSEN THE TUBE COUPLING NUTS. USE ONE TO HOLD THE MATING PART, AND THE OTHER TO LOOSEN THE COUPLING NUT. IF YOU DO NOT USE TWO WRENCHES, DAMAGE TO THE TUBES AND MATING PART CAN OCCUR.



USE TWO WRENCHES TO TIGHTEN THE COUPLING NUT. USE ONE TO HOLD THE FITTING, AND THE OTHER TO TURN THE COUPLING NUT. IF YOU DO NOT USE TWO WRENCHES, DAMAGE TO THE EQUIPMENT CAN OCCUR.

- (f) Make sure that you tighten to the specified torque values in the step sequence of the procedure.
- (g) Use gloves to hold the bearings and all other parts that can oxidate.
- (h) Do not use the cold-shrink procedure for the installation of bearings.

———— **END OF TASK** ————

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AIRCRAFT MAINTENANCE MANUAL

CLAMPSHELL TYPE CLAMPS - MAINTENANCE PRACTICES

1. General

- A. This procedure has one task:
- (1) Clampshell type clamp installation.

TASK 70-00-03-400-801-G00

2. Clampshell Type Clamp Installation

(Figure 201)

A. General

- (1) This task provides the instructions on how to install a clampshell type clamp.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Procedure

SUBTASK 70-00-03-420-001-G00



DO NOT PUT THE CLAMPSHELL ON A BEND IN THE TUBING. YOU CAN CAUSE DAMAGE TO THE CLAMPSHELL OR THE TUBING.

- (1) Put the clampshell type clamp on the straight part of the tube only.
 - (a) Put the clampshell halves on the tube.
 - (b) Put the clamp on the clampshell.

NOTE: Install the clamp in the center of the clampshells, if it is possible.

SUBTASK 70-00-03-420-002-G00

- (2) Install a fastener to attach the clampshell type clamp to the engine.

———— **END OF TASK** ————

EFFECTIVITY
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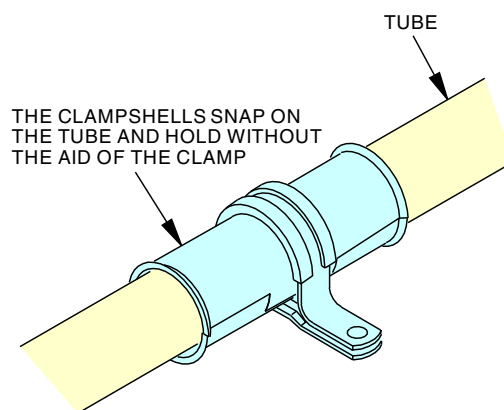
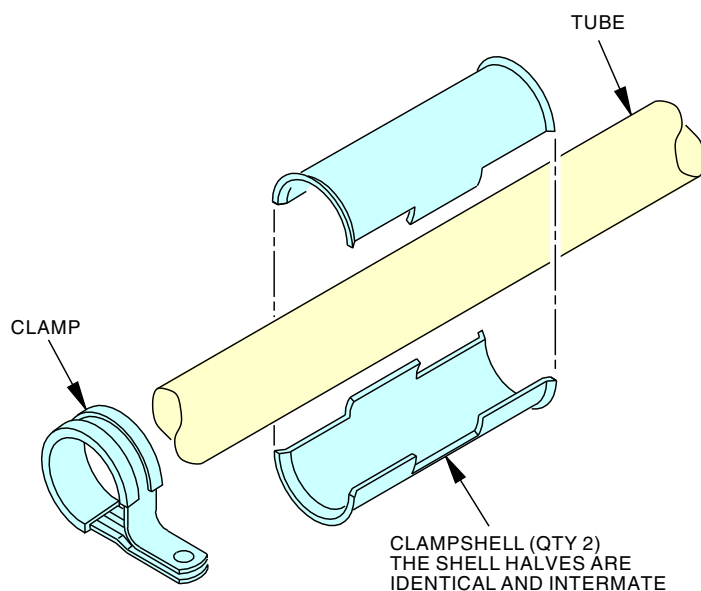
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Clampshell-Type Clamp Installation
Figure 201/70-00-03-990-801-G00

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SEALS (PREFORMED PACKINGS AND O-RINGS) AND GASKETS - MAINTENANCE PRACTICES

1. General

A. This procedure has six tasks:

- (1) Seal (preformed packing and o-ring) removal
- (2) Seal (preformed packing and o-ring) installation
- (3) E, C, and W metal seal removal
- (4) E, C, and W metal seal installation
- (5) Gasket seal with imbedded flexible seal material removal
- (6) Gasket seal with imbedded flexible seal material installation.

TASK 70-00-04-000-801-G00

2. Preformed Packing Seal and Packing Retainer Removal

(Figure 201)

A. General

- (1) This task provides the instructions on how to remove the preformed packing seals/O-rings and preformed packing retainers.
- (2) Some fuel system components use a combination of preformed packing retainers and preformed packing seals at high pressure fuel connections. There are two retainers used for each seal at these locations. Make sure to note the locations where the preformed packing seals and preformed packing retainers are removed to ensure correct installation of those parts.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Preformed Packing Seal and Preformed Packing Retainer Removal

SUBTASK 70-00-04-020-001-G00

- (1) Do these steps to remove the preformed packing seals and preformed packing retainers.



CAUTION

DO NOT USE A SHARP OR POINTED TOOL TO REMOVE A SEAL. DAMAGE TO THE SEALING SURFACE OF A COMPONENT CAN CAUSE AN ENGINE FAILURE AND DAMAGE TO THE EQUIPMENT.

- (a) Remove the preformed packing seals and preformed packing retainers from the component.
- (b) Discard the preformed packing seals and preformed packing retainers.

———— END OF TASK ————

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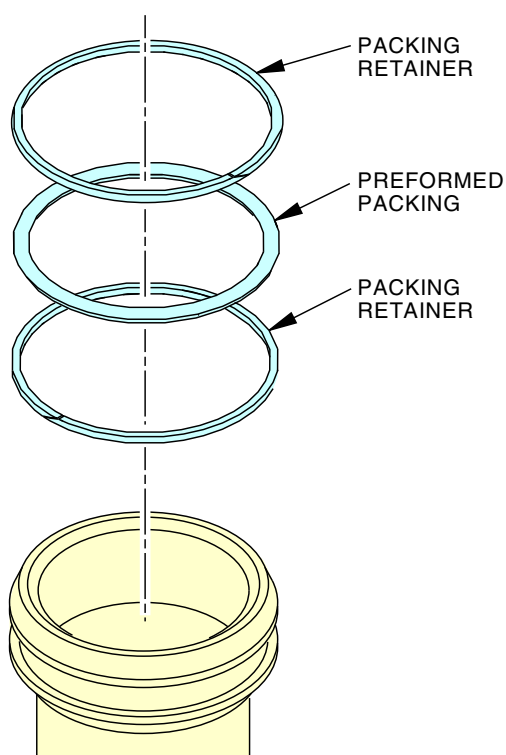
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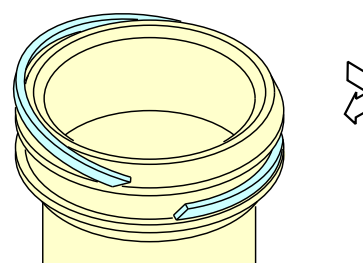
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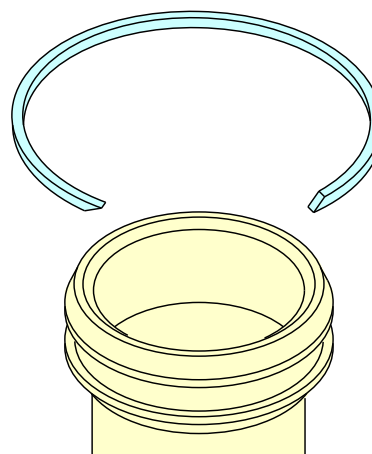
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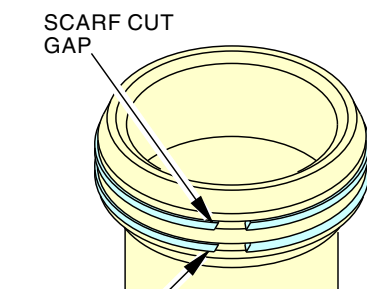
TYPICAL 1



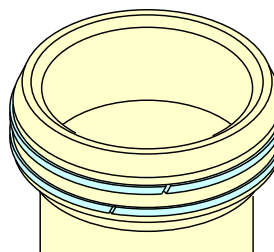
CORRECT INSTALLATION 1



INCORRECT INSTALLATION

SCARF CUT
GAP

INCORRECT 2



CORRECT 3

- 1 CAREFULLY TWIST THE PACKING RETAINER ON TO THE FUEL TUBE TO MINIMIZE THE SCARF GAP DURING INSTALLATION.
- 2 INCORRECT - SCARF CUT GAPS ARE LARGE AND IN ALIGNMENT
- 3 CORRECT - SCARF CUT GAPS ARE MINIMIZED AND NOT IN ALIGNMENT

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Preformed Packing Seal and Preformed Packing Retainer Installation
Figure 201/70-00-04-990-801-G00

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TASK 70-00-04-400-801-G00**3. Preformed Packing Seal and Packing Retainer Installation**

(Figure 201)

A. General

- (1) This task provides the instructions on how to install the preformed packing seals/O-rings and preformed packing retainer.
- (2) Some fuel system components use a combination of preformed packing retainers and preformed packing seals at high pressure fuel connections. There are two retainers used for each seal at these locations. Make sure to note the locations where preformed packing seals and preformed packing retainers are installed so that you can perform the correct installation of those parts.
- (3) Use only new preformed packing seals and preformed packing retainers when you install a component.
- (4) There are two preformed packing retainers used for each preformed packing seal. The preformed packing seal is installed between the two preformed packing retainers.

B. Consumable Materials

Reference	Description	Specification
D00599 [CP2442]	Oil - Engine	

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Preformed Packing Seals and Preformed Packing Retainer Installation

SUBTASK 70-00-04-420-001-G00

- (1) Install preformed packing seals and preformed packing retainer as follows:
 - (a) Make sure that you have the correct part numbers for the preformed packing seal and preformed packing retainers for the component installation.
 - (b) Make sure that the groove for the preformed packing seal and preformed packing retainer does not have nicks, or high metal.
 - (c) Lubricate the preformed packing seal and preformed packing retainers with clean engine oil, D00599 [CP2442] or with lubricant specified in the maintenance manual task.



INSTALL THE PACKING RETAINERS AND THE PREFORMED PACKING IN THE CORRECT SEQUENCE. IF YOU DO NOT INSTALL THE RETAINERS AND PACKING CORRECTLY, FUEL LEAKS CAN OCCUR. FUEL CAN CAUSE DAMAGE TO EQUIPMENT.



DO NOT CAUSE DAMAGE TO THE PREFORMED PACKINGS AND PACKING RETAINERS WHEN YOU INSTALL THE FUEL SYSTEM COMPONENTS. A DAMAGED PACKING CAN CAUSE ENGINE FUEL LEAKS.

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(CAUTION PRECEDES)



MAKE SURE THAT YOU DO NOT OPEN OR TWIST THE RETAINERS TOO MUCH. IF YOU DO, DAMAGE TO THE RETAINERS CAN OCCUR.

- (d) Install the first preformed packing retainer in the groove on the tube.

NOTE: The fuel port tube is used in this procedure to show the correct installation of the preformed packing seals and preformed packing retainers.



REMOVE AND INSTALL THE SEAL CAREFULLY (PREFORMED PACKING OR O-RING). YOU CAN CAUSE DAMAGE TO THE SEAL WHEN THE SEAL MOVES ACROSS THE THREADS AND INTO THE PACKING GROOVE. A DAMAGED SEAL CAN CAUSE AN ENGINE TO STOP DURING FLIGHT, AND DAMAGE TO OTHER EQUIPMENT.

- (e) Install the preformed packing seal.
(f) Install the second preformed packing retainer.

SUBTASK 70-00-04-210-001-G00

- (2) Examine the installation of the preformed packing retainer and preformed packing seal.
(a) Make sure that the preformed packing seal is seated correctly between the preformed packing retainers.

SUBTASK 70-00-04-211-001-G00

- (3) Examine the scarf cuts on the preformed packing retainers as follows:
(a) Make sure that the scarf cut gap is not excessive.
NOTE: An excessive scarf cut gap is an indication that the preformed packing retainer has been permanently deformed. It is also an indication that the preformed packing seal and retainer assembly is not installed correctly,
1) If the scarf cut gap is excessive, replace the preformed packing retainer.
(b) Make sure that the scarf cuts are not aligned.
1) If the scarf cuts are aligned, carefully spin one the preformed packing retainers so that scarf cuts do not align.

———— **END OF TASK** ————

TASK 70-00-04-000-802-G00

4. E, C, and W Metal Seal Removal

A. General

- (1) This task provides the instructions on how to remove the E, C, and W metal seals.
(2) The pneumatic system uses the E, C, and W metal seals.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

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C. E, C, or W Metal Seal Removal

SUBTASK 70-00-04-020-002-G00

- (1) Remove the E, C, or W metal seal from the component.

SUBTASK 70-00-04-210-002-G00

- (2) Examine the E, C, or W metal seal for damage.
- (a) You are not permitted to use a seal if it has any of these types of damage.
- 1) Out of round.
 - 2) Bent or twisted.
 - 3) Discolored from heat damage.
 - 4) Cracked or dented.

————— **END OF TASK** —————

TASK 70-00-04-400-802-G00**5. E, C, and W Metal Seal Installation****A. General**

- (1) This task provides the instructions on how to install the E, C, or W metal seals.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. E, C, or W Metal Seal Installation

SUBTASK 70-00-04-420-002-G00

- (1) Install the E, C, or W metal seal on the component.
- (a) Make sure that you have the correct part number for the E, C, or W metal seal.

————— **END OF TASK** —————

TASK 70-00-04-000-803-G00**6. Gasket Seal (with Imbedded Flexible Seal Material) Removal**

(Figure 202)

A. General

- (1) This task provides the instructions on how to remove the gasket seal (imbedded with flexible seal material).
- (2) The gasket seal is imbedded with a flexible seal material that is attached to a metal plate.
- (3) You use this type of gasket seal in the fuel and the lubrication systems.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Gasket Seal (with Imbedded Flexible Seal Material) Removal

SUBTASK 70-00-04-020-003-G00

- (1) Remove the gasket seal (imbedded with flexible seal material) from the component.

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SUBTASK 70-00-04-210-003-G00

- (2) Examine the gasket seal (imbedded with flexible seal material) for damage.
- (a) You are not permitted to use a flexible seal if the flexible seal has any of these kinds of damage.
- 1) The flexible seal material is not attached to the metal plate.
 - 2) The flexible seal material is flat and does not extend above the metal plate.
 - 3) The flexible seal material is missing or damaged.
 - 4) The flexible seal material is hard or brittle.
 - 5) The flexible seal material is cut.
 - 6) The metal plate has a crack.
 - 7) The metal plate is distorted.



DO NOT REMOVE THE FLEXIBLE SEAL MATERIAL FROM THE METAL PLATE. DAMAGE TO THE SEAL MATERIAL CAN CAUSE AN ENGINE TO STOP DURING FLIGHT, AND DAMAGE TO OTHER EQUIPMENT.

- (b) Remove all the thin, lacy flexible seal material that extends away from the surface of the metal plate.



DO NOT CAUSE DAMAGE TO THE SEAL MATERIAL WHEN YOU REMOVE METAL FROM THE METAL PLATE. REMOVE THE METAL FROM THE METAL PLATE CAREFULLY. DAMAGE TO THE SEAL MATERIAL CAN CAUSE AN ENGINE TO STOP DURING FLIGHT, AND DAMAGE TO EQUIPMENT.

- (c) Remove all high metal that extends from the surface of the metal plate or bolt holes of the gasket seal (imbedded with flexible seal material).

———— **END OF TASK** ————

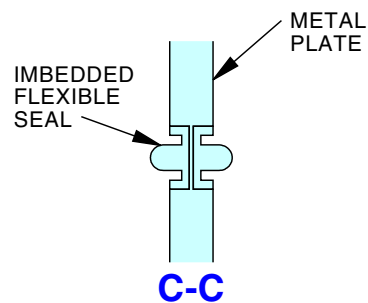
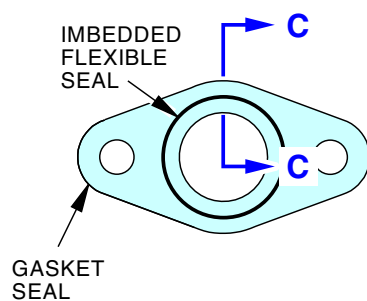
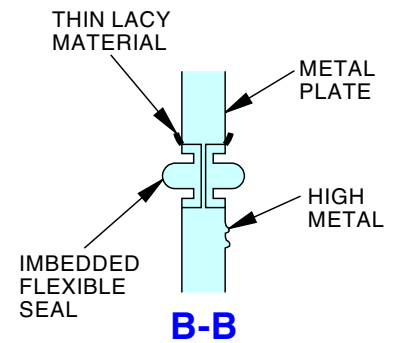
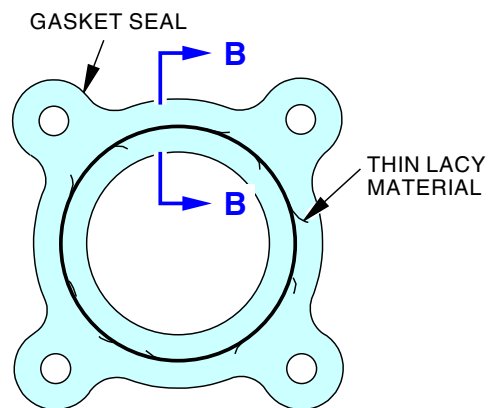
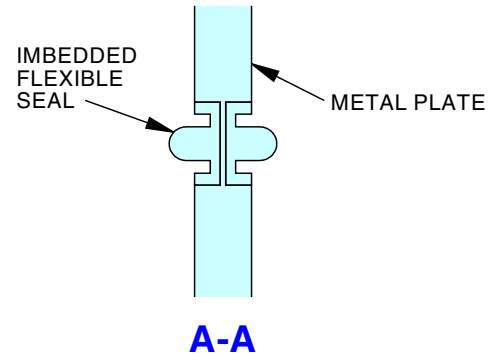
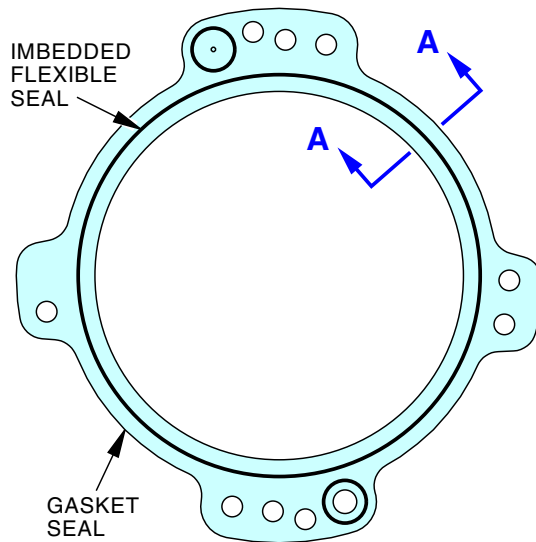
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Gasket Seal (with Imbedded Flexible Seal Material) - Installation
Figure 202/70-00-04-990-802-G00

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TASK 70-00-04-400-803-G00**7. Gasket Seal (with Imbedded Flexible Seal Material) Installation**

(Figure 202)

A. General

- (1) This task provides the instructions on how to install the gasket seal (imbedded with flexible seal material).

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Installation of the Gasket Seal (with Imbedded Flexible Seal Material)

SUBTASK 70-00-04-420-003-G00

- (1) Install the gasket seal (imbedded with flexible seal material).
- (a) Make sure that you have the correct gasket seal (imbedded with flexible seal material).
 - (b) Lubricate the gasket seal with the lubricant specified in the installation procedure.
 - (c) Install the gasket seal (imbedded with flexible seal material) on the component.

———— **END OF TASK** ————

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TUBE AND HOSE INSPECTION CRITERIA AND DAMAGE LIMITS - MAINTENANCE PRACTICES

1. General

A. This procedure contains one task:

- (1) The hose and tube inspection criteria and damage limits

TASK 70-00-05-200-801-G00

2. Tube and Hose Inspection Criteria and Damage Limits

(Figure 201, Figure 202, Figure 203, Figure 204, Figure 205, Figure 206, and Figure 207)

A. General

- (1) This task provides the instructions on how to do the inspection of the tube, hose and duct assemblies.
- (2) The hose, tube and manifold assemblies do not have parts or materials that you will replace at regular intervals.
- (3) A small flat area set in the bend of a hose assembly that has the teflon lining is permitted. The flat area must be because of the permanent set and cannot be in a buckle or crimp.

B. References

Reference	Title
70-43-42-300-802-G00	Blending Procedures - Hand Blending (P/B 201)
71-00-02-000-801-G00	Power Plant - Removal (P/B 401)
71-00-02-400-801-G00	Power Plant - Installation (P/B 401)

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Tubes and Manifolds Visual Inspection

SUBTASK 70-00-05-210-001-G00

- (1) Do the visual inspection of the tubes and manifolds as follows (Figure 201, Figure 202, Figure 203, and Figure 204):

NOTE: Do all the inspection of the tubes, hoses, manifolds and fittings after you remove the high metal (Blending Procedures - Hand Blending, TASK 70-43-42-300-802-G00).

- (a) Make sure that you use the correct category when you examine the tubing and manifolds as follows:

NOTE: The category class is for the pressure and the area where the tubing and manifolds will be.

- 1) Category A - fuel, sensor and hydraulic lines
- 2) Category B - air lines
- 3) Category C - oil supply and scavenge lines
- 4) Category D - drain lines and fuel protective shrouds.

SUBTASK 70-00-05-210-002-G00

- (2) Examine the category A tubes and manifolds as follows (Figure 202 and Figure 203):

- (a) Splits, cracks, or kinks
 - 1) None permitted

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- 2) Replace the tube or manifold.
- (b) Wrinkles in bends
 - 1) Permitted to a maximum of two percent in depth of the tube or manifold diameter.
 - 2) Wrinkles that are more than 0.040 inch (1.02 mm) in depth are not permitted.
 - 3) If more than the permitted limits, replace the tube or manifold.
- (c) Dents in straight sections and bends
 - 1) Permitted to a maximum of two dents for each linear 12.0 inches (305 mm) and as follows:
 - a) The depth is not more than 10% of the tube or manifold outer diameter.
 - b) The radius is not less than two times the thickness of the tube or manifold wall.
 - 2) If more than the permitted limits, replace the tube or manifold.
- (d) Flat areas
 - 1) Permitted to a maximum of two times the tube or manifold outer diameter in length and with this condition:
 - a) The contour change is not more than 10% of the tube or manifold outer diameter.
 - 2) If more than the permitted limits, replace the tube or manifold.
- (e) Nicks, scratches, chafing, or scores in straight sections and bends
 - 1) Permitted to a maximum of 0.005 inch (0.13 mm) in depth.
 - 2) If more than the permitted limits, replace the tube or manifold.

SUBTASK 70-00-05-210-003-G00

- (3) Examine the category B tubes or manifolds as follows:
 - (a) Splits, cracks, or kinks
 - 1) None permitted
 - 2) Replace the tube or manifold.
 - (b) Wrinkles in bends
 - 1) Permitted to a maximum of 2% in depth of the tube or manifold outer diameter.
 - 2) Wrinkles that are more than 0.040 inch (1.02 mm) in depth are not permitted.
 - 3) If more than the permitted limits, replace the tube or manifold.
 - (c) Dents
 - 1) Permitted to a maximum of four dents for each linear 12.0 inches (305 mm) with these conditions:
 - a) The dents are not less than 0.25 inch (6.4 mm) from each other.
NOTE: Measure the separation from the edge of a dent to the edge of one more dent.
 - b) The depth of the dent is not more than 10% of the tube or manifold outer diameter.
 - c) The radius of the dent is not less than two times the wall thickness.
 - 2) If more than the permitted limits, replace the tube or manifold.
 - (d) Flat areas

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- 1) Permitted to a maximum of two times the tube or manifold outer diameter in length and with this condition:
 - a) The contour change is not more than 10% of the tube or manifold outer diameter.
- 2) If more than the permitted limits, replace the tube or manifold.
- (e) Nicks, scratches, chafing, or scores in straight sections and bends
 - 1) Permitted to a maximum of 0.005 inch (0.13 mm) in depth.
 - 2) If more than the permitted limits, replace the tube or manifold.
- (f) Surface distress, peeling, or missing material
 - 1) Not permitted in areas that are 0.25 inch (6.4 mm) or less from the clamp areas.
 - 2) Permitted for all areas that are 0.25 inch (6.4 mm) from the clamp areas with these conditions:
 - a) The maximum depth is 0.025 inch (0.64 mm)
 - b) The maximum defect area is 1.25 inch (31.8 mm)
 - c) The maximum distance between defects is 0.5 inch (13 mm)
 - d) No more than five defects are permitted.
 - 3) If more than the permitted limits, replace the tube or manifold.
- (g) Nicks and scratches on the B-nut fitting wrenching flats and corners:
 - 1) Any amount, if you can tighten the B-nut to the correct torque.
 - 2) If you cannot tighten the B-nut to the correct torque, replace the tube or manifold.

SUBTASK 70-00-05-210-004-G00

- (4) Do an inspection of the category C tubes or manifolds as follows:
 - (a) Splits, cracks, or kinks
 - 1) Not permitted
 - 2) Replace the tube or manifold.
 - (b) Wrinkles in bends
 - 1) Permitted to a maximum of 10% in depth of the tube or manifold outer diameter.
 - 2) If more than the permitted limits, replace the tube or manifold.
 - (c) Dents
 - 1) Permitted if not more than six dents for each linear 12.0 inches (305 mm) with these conditions:
 - a) The dents are not less than 0.25 inch (6.4 mm) from each other.
NOTE: Measure the separation from the edge of a dent to the edge of one more dent.
 - b) The depth of the dent is not more than 20% of the tube or manifold outer diameter.
 - c) The radius of the dent is not less than two times the wall thickness.
 - 2) If more than the permitted limits, replace the tube or manifold.
 - (d) Flat areas
 - 1) Permitted with these conditions:

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- a) The length of the flat area is permitted to a maximum of three times the tube or manifold outer diameter.
- b) The contour change is not more than 20% of the tube or manifold outer diameter.
- 2) If more than the permitted limits, replace the tube or manifold.
- (e) Nicks, scratches, chafing, or scores in straight sections and bends
 - 1) Permitted to a maximum of 0.005 inch (0.13 mm) in depth.
 - 2) If more than the permitted limits, replace the tube or manifold.
- (f) Coking in the tube or manifold
 - 1) Not permitted
 - 2) Replace the tube or manifold assembly.
- (g) Coking out of the tube or manifold
 - 1) Permitted.
- (h) Tube or manifold external coking:
 - 1) Remove the coking and do a check for leaks.
 - 2) If you find a leak, replace the tube or manifold.
- (i) Nicks and scratches on the B-nut fitting wrenching flats and corners:
 - 1) Any amount, if you can tighten the B-nut to the correct torque.
 - 2) If you cannot tighten the B-nut to the correct torque, replace the tube or manifold.

SUBTASK 70-00-05-210-005-G00

- (5) Do an inspection of the category D tubes or manifolds as follows:
 - (a) Splits, cracks, or kinks
 - 1) Not permitted
 - 2) Replace the tube or manifold.
 - (b) Wrinkles in bends
 - 1) Permitted to a maximum of 15% in depth of the tube or manifold outer diameter.
 - 2) If more than the permitted limits, replace the tube or manifold.
 - (c) Dents
 - 1) Permitted to a maximum of six dents for each linear 12.0 inches (305 mm) with these conditions:
 - a) The dents are not less than 0.25 inch (6.4 mm) from each other.
 - NOTE:** Measure the separation from the edge of a dent to the edge of one more dent.
 - b) The depth of the dent is not more than 30% of the tube or manifold outer diameter.
 - c) The radius of the dent is not less than two times the wall thickness.
 - d) The dents in the shrouds do not touch the inner tube or manifold.
 - 2) If more than the permitted limits, replace the tube or manifold.
 - (d) Flat areas
 - 1) Permitted with these conditions:

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- a) The length of the flat area is permitted to a maximum of three times the tube or manifold outer diameter.
- b) The contour change is not more than 20% of the tube or manifold outer diameter.
- 2) If more than the permitted limits, replace the tube or manifold.
- (e) Nicks, scratches, chafing, or scores in straight sections and bends
 - 1) Permitted to a maximum of 0.005 inch (0.13 mm) in depth.
 - 2) If more than the permitted limits, replace the tube or manifold.
- (f) Nicks and scratches on the B-nut fitting wrenching flats and corners:
 - 1) Any amount, if you can tighten the B-nut to the correct torque.
 - 2) If you cannot tighten the B-nut to the correct torque, replace the tube or manifold.

E. Hose Visual Inspection

SUBTASK 70-00-05-210-006-G00

- (1) Do a visual inspection of the hose assemblies as follows (Figure 201):
 - (a) Internal blockage
 - 1) Not permitted
 - 2) Replace the hose.
 - (b) Cuts, tears, or chafing on the fire sleeve
 - 1) Permitted with these conditions:
 - a) The maximum depth is 0.063 inch (1.60 mm) and each defect is 0.50 square-inch (322.6 square- mm) or less.
 - b) The defects do not overlap.
 - 2) If more than the permitted limits, replace the hose.
 - (c) Hose leakage
 - 1) Not permitted
 - 2) Replace the hose.
 - (d) Nicks and scratches on the B-nut fitting wrenching flats and corners:
 - 1) Any amount, if you can tighten the B-nut to the correct torque.
 - 2) If you cannot tighten the B-nut to the correct torque, replace the tube or manifold.

SUBTASK 70-00-05-210-007-G00

- (2) Examine the groove flanges for the preformed packing of the tubes (categories A, B, C, and D) as follows (Figure 201):
 - (a) Nicks, dents, or scratches
 - 1) Permitted to a maximum of 0.002 inch (0.05 mm) in depth and not in the preformed packing groove.
 - 2) If more than the permitted limits, replace the tube or manifold.

F. Hose, Tube and Manifold Fittings Visual Inspection

SUBTASK 70-00-05-210-008-G00

- (1) Examine the hose, tube, and manifold fittings as follows (Figure 202):
 - (a) Damage corners
 - 1) Not permitted if you cannot tighten the nut to the correct torque.

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- 2) If you cannot torque the nut to the correct torque, replace the hose, tube or manifold assembly.
- (b) Damaged threads
 - 1) Permitted if you do not decrease the threads that have damage more than one after you chase it.
 - 2) If more than the permitted limits, replace the hose, tube, or manifold assembly.
- (c) Safety wire and hole deformation and wear
 - 1) Permitted for service if the metal around the hole is not cracked or torn.
 - a) Blend the high metal around the hole (TASK 70-43-42-300-802-G00).
 - 2) If the metal around the hole has a crack or torn through, do these steps:
 - a) Use a different hole to install the lockwire.
 - b) Blend the high metal around the hole that has the damage (TASK 70-43-42-300-802-G00).
 - 3) If there is no other hole to install the lock wire, replace the tube, hose, or manifold assembly.

SUBTASK 70-00-05-210-009-G00

- (2) Examine the hose, tube, and manifold swivel flange fittings as follows (Figure 203):
 - (a) Nicks or scratches on seating surface B
 - 1) Not permitted
 - 2) Replace the hose, tube or manifold assembly.
 - (b) Nicks or scratches on mating surface A
 - 1) Permitted to a maximum of 0.02 inch (0.50 mm) in depth.
 - 2) If more than the permitted limits replace the hose, tube or manifold assembly.
 - (c) Cracks in surfaces A and B
 - 1) Not permitted
 - 2) Replace the hose, tube or manifold assembly.
 - (d) Sealing surface A out-of-flat
 - 1) Permitted to a maximum of 0.035 inch (0.89 mm) out-of-flat.
 - 2) If more than the permitted limits replace the hose, tube or manifold assembly.
 - (e) Sealing surface B out-of-flat
 - 1) Permitted to a maximum of 0.005 inch (0.13 mm) out-of-flat.
 - 2) If more than the permitted limits replace the hose, tube or manifold assembly.
 - (f) Cracks that extend out from the bolt holes (surface A)
 - 1) Not permitted
 - 2) Replace the hose, tube or manifold assembly.
 - (g) Wear around the bolt hole and bolt head interface
 - 1) Permitted to the maximum condition below that occurs first:
 - a) Permitted in depth to a maximum of 10% of the bracket thickness.
 - b) Permitted to a maximum of 0.020 inch (0.51 mm) in the area of the bolt.
 - 2) If more than the permitted limits replace the hose, tube or manifold assembly.

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- (h) Weld joint cracks on the sleeve seat connecting flange surface (surface C)
 - 1) Not permitted
 - 2) Replace the hose, tube or manifold assembly.

SUBTASK 70-00-05-210-010-G00

- (3) Examine the solid flange fittings as follows (Figure 204):
 - (a) Nicks or scratches on the seating surface
 - 1) Nicks and scratches less than 0.125 inch (3.18 mm) from the inner diameter are not permitted.
 - 2) Nicks 0.25 inch (6.4 mm) long and 0.025 inch (0.64 mm) in depth are permitted as follows:
 - a) The nicks are 0.125 inch (3.18 mm) or more from the inner diameter.
 - 3) Scratches that are 0.005 inch (0.13 mm) in depth are permitted as follows:
 - a) The scratches are 0.125 inch (3.18 mm) or more from the inner diameter.
 - 4) If more than the permitted limits replace the hose, tube or manifold assembly.
 - (b) Cracks in the seating surface
 - 1) Not permitted
 - 2) Replace the hose, tube or manifold assembly.
 - (c) Sealing surface out-of-flat
 - 1) Permitted to a maximum of 0.005 inch (0.13 mm) out-of-flat.
 - 2) If more than the permitted limits replace the hose, tube or manifold assembly.
 - (d) Cracks that extend out from the bolt holes
 - 1) Not permitted
 - 2) Replace the hose, tube or manifold assembly.
 - (e) Wear around the bolt hole and bolt head interface
 - 1) Permitted to the maximum condition below that occurs first:
 - a) Permitted in depth to a maximum of 10% of the bracket thickness.
 - b) Permitted to a maximum of 0.020 inch (0.51 mm) in the area of the bolt.
 - 2) If more than the permitted limits replace the hose, tube or manifold assembly.
 - (f) Weld joint cracks on flange sleeve
 - 1) Not permitted
 - 2) Replace the hose, tube or manifold assembly.

SUBTASK 70-00-05-210-011-G00

- (4) Examine the fitting seating surface as follows (Figure 202):
 - (a) Circumferential scratches in area C
 - 1) Permitted to a maximum of 0.005 inch (0.13 mm) in depth.
 - 2) If more than the permitted limits replace the hose, tube or manifold assembly.
 - (b) Circumferential scratches in areas A and B
 - 1) Permitted if you cannot feel the scratch with a 0.40 inch (10.2 mm) radius ball scribe.
 - 2) if more than the permitted limits replace the hose, tube or manifold assembly.

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- (c) Axial scratches in areas A and B
 - 1) Not permitted
 - 2) Replace the hose, tube or manifold assembly.
- (d) Nicks and pits in area C
 - 1) Permitted to a maximum of 0.03 inch (0.8 mm) in depth.
 - 2) If more than the permitted limits replace the hose, tube or manifold assembly.
- (e) Nicks and pits in areas A and B
 - 1) Not permitted
 - 2) Replace the hose, tube or manifold assembly.
- (f) Scores and galling
 - 1) Not permitted
 - 2) Replace the hose, tube or manifold assembly.

SUBTASK 70-00-05-210-012-G00

- (5) Do an inspection for circumferential deformation (spreading) as follows (Figure 202):
 - (a) Tubes, manifolds, ferrules
 - 1) Permitted if the nut turns freely.
 - 2) If the nut does not turn freely, replace the hose, tube or manifold assembly.
 - (b) Flare nut
 - 1) Permitted if the nut turns freely.
 - 2) If the nut does not turn freely, replace the hose, tube or manifold assembly.
 - (c) Axial deformation (dishing) of the spherical seat fitting surface
 - 1) Permitted if the depth is constant and less than 0.005 inch (0.13 mm) normal to the surface.
 - 2) If more than the permitted limits replace the hose, tube or manifold assembly.

SUBTASK 70-00-05-210-013-G00

- (6) Do an inspection of the tube or manifold brackets and metal wear pads as follows:
 - (a) Wear
 - 1) Permitted to a maximum of 10% of the thickness or 10% of the hole diameter.
 - 2) If more than the permitted limits replace the part.
 - (b) Cracks
 - 1) Not permitted
 - 2) Replace the part.

SUBTASK 70-00-05-210-014-G00

- (7) Examine the flexible joints (flexible ducts) as follows:
 - (a) Permitted with these conditions:
 - 1) Tears and wear marks in the flexible duct in the clamp area are permitted with this condition:
 - a) They are not more than 0.25 inch (6.4 mm) from the clamp area.
 - 2) No tears or cracks go fully through the material and not more than 25 percent of the thickness.

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- 3) If more than the permitted limits replace the flexible ducts.
- (b) Wears, marks, or tears in the flexible duct
 - 1) Permitted to a maximum of 25% of the wall thickness and there is no blockage to the air flowpath.
 - 2) Permitted if 75% of the wall thickness remains after you remove the loose or blockage material from the flowpath.
- (c) Cracks, tear, and missing material between the end of the flexible duct and 0.125 inch (3.18 mm) from the hose clamp area
 - 1) Not permitted
 - 2) Replace the flexible duct.

SUBTASK 70-00-05-210-015-G00

- (8) Do an inspection of the HPTACC air manifolds as follows (Figure 205):
 - (a) Cracks in the manifold tubes
 - 1) Not permitted
 - 2) Replace the manifold.
 - (b) Nicks and scratches in the manifold tubes:
 - 1) Permitted to a maximum of 0.005 inch (0.13 mm) in depth.
 - 2) If more than the permitted limits replace the manifold.
 - (c) Dents in the manifold tubes
 - 1) Permitted if the contour is smooth and the outer diameter is not less than 80% of the initial outer diameter.
 - 2) If more than the permitted limits replace the manifold.
 - (d) Blocked cooling air holes (does not include holes blocked by brazing during production)
 - 1) Not permitted
 - 2) Replace the manifold.
 - (e) Wear at the mount locations
 - 1) Permitted if not more than 0.020 inch (0.51 mm) in depth.
 - 2) If more than the permitted limits replace the manifold.
 - (f) Edge deformation at the mount locations
 - 1) Permitted if not more than 0.150 inch (3.81 mm) in depth out of plane, 4.0 inches (102 mm) in length, and 0.375 inch (9.53 mm) in width.
 - 2) No deformation permitted in fillet radii.
 - 3) If more than the permitted limits replace the manifold.
 - (g) Cracks in all other areas of the HPTACC manifold
 - 1) Not permitted
 - 2) Replace the manifold.
 - (h) Nicks and scratches in all other areas of the HPTACC manifold
 - 1) Permitted to a maximum of 0.010 inch (0.25 mm) in depth.
 - 2) If more than the permitted limits replace the manifold.
 - (i) Dents in the non-brazed areas of the plenums and baffles on the HPTACC manifold

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- 1) Permitted to a maximum of 0.030 inch (0.76 mm) in depth and to a maximum of 1.00 inch (25.4 mm) in its diameter.
 - 2) If more than the permitted limits replace the manifold.
- (j) Dents in all other areas of the HPTACC manifold
- 1) Permitted to a maximum of 0.030 inch (0.76 mm) in depth and to a maximum of 0.20 inch (5.08 mm) in its diameter.
 - 2) If more than the permitted limits replace the manifold.

SUBTASK 70-00-05-210-016-G00

- (9) Do an inspection of the seal housing and the air ducting seals as follows:
- (a) Cracks
 - 1) Not permitted
 - 2) Replace the seal housing.
 - (b) Nicks and scratches
 - 1) Permitted to a maximum of 0.005 inch (0.13 mm) in depth.
 - 2) If more than the permitted limits replace the seal housing.
 - (c) Dents
 - 1) Permitted if the contour is smooth and you can correctly assemble the housing.
 - 2) If you cannot assemble the housing correctly, replace the seal housing.

SUBTASK 70-00-05-210-017-G00

- (10) Examine each V-style flange as follows:
- (a) Cracks
 - 1) Not permitted
 - 2) Replace the tube, duct or manifold assembly.
 - (b) Nicks, scratches, and gouges
 - 1) Not permitted
 - 2) Replace the tube, duct or manifold assembly.
 - (c) Sealing surface out-of-flat

NOTE: Do the inspection on a flat surface with a 15.0 pound (6.8 kg) weight on the face of the flange.

 - 1) Permitted to a maximum of 0.006 inch (0.15 mm).
 - 2) If more than the permitted limits replace the tube, duct or manifold assembly.
 - (d) Clamp mating surfaces (non-seal side) for high metal, nicks, scratches, and gouges
 - 1) Permitted with these conditions:
 - a) The nicks, scratches, and gouges are less than 0.005 inch (0.03 mm) in depth.
 - b) The high metal is less than 0.002 inch (0.025 mm).
 - 2) More than the limits but less than 0.010 inch in depth that you can repair are permitted.
 - a) Blend the nicks, scratches, and gouges (TASK 70-43-42-300-802-G00).

SUBTASK 70-00-05-210-018-G00

- (11) Examine the seal plate type of flanges as follows:

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- (a) Nicks and dents on the non-sealing surface
 - 1) Permitted with these conditions:
 - a) The length is less than 0.100 inch (2.54 mm) and the depth is less than 0.030 inch (0.76 mm).
 - b) They are more than 0.100 inch (2.54 mm) from the bolt holes or internal fillet radius.
 - 2) If more than the permitted limits replace the part.
- (b) The metal ring in the outer seal is not circular
 - 1) Permitted if there is no damage on the sealing surface.
 - 2) If there is damage, replace the part.

SUBTASK 70-00-05-210-019-G00

- (12) Examine the flexible clamps as follows:
 - (a) Wear
 - 1) Permitted to a maximum of 0.08 inch (2.0 mm) in depth.
 - 2) If more than the permitted limits replace the flexible clamp.
 - (b) Tears on edge
 - 1) Permitted to a maximum of 0.08 inch (2.0 mm) in depth.
 - 2) If more than the permitted limits replace the flexible clamp.
 - (c) Tears in holes
 - 1) Permitted to a maximum of 0.04 inch (1.0 mm) in depth.
 - 2) If more than the permitted limits replace the flexible clamp.

G. LPTACC Manifold Tubes Visual Inspection**SUBTASK 70-00-05-210-020-G00**

- (1) Do a visual inspection of the LPTACC manifold tubes as follows (Figure 207):
 - (a) Indications in the weld zones
 - 1) Through indications are not permitted.
 - 2) Indications that are less than 0.020 inch (0.51 mm) in length are permitted.
 - 3) Indications that have a length that is less than 0.060 inch (1.52 mm) and not linear are permitted as follows:
 - a) They are less than 0.250 inch (6.35 mm) from each other.
 - (b) Cracks
 - 1) Not permitted
 - 2) Replace the engine (TASK 71-00-02-000-801-G00 and TASK 71-00-02-400-801-G00).
 - (c) Nicks and scratches
 - 1) Permitted to a depth that is less than 0.005 inch (0.13 mm) after you remove the high metal.
 - a) Do this task: Blending Procedures - Hand Blending, TASK 70-43-42-300-802-G00.
 - (d) Dents
 - 1) Permitted with these conditions:

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- a) The contour is smooth.
- b) The outer diameter is not less than 80% of the initial outer diameter after you remove the high metal.

<1> Do this task: Blending Procedures - Hand Blending,
TASK 70-43-42-300-802-G00.

SUBTASK 70-00-05-210-021-G00

(2) Examine the brackets on the tubes as follows:

- (a) Cracks
 - 1) Not permitted
 - 2) Replace the part.
- (b) Wear, nicks, dents, and scratches
 - 1) Permitted to a depth that is less than 0.010 inch (0.25 mm) after you remove the high metal.
 - a) Do this task: Blending Procedures - Hand Blending,
TASK 70-43-42-300-802-G00.
- (c) Deformation
 - 1) Permitted if you can correctly install the manifold.
 - 2) If you cannot correctly install the manifold, replace the bracket.
- (d) Missing or loose nut plates
 - 1) Not permitted
 - 2) Replace the bracket.
- (e) Damaged threads on the nut plates:
 - 1) Not permitted
 - 2) Replace the bracket.
- (f) Damage to the self-locking function of the nut plates
 - 1) Not permitted
 - 2) Replace the bracket.
- (g) Rivets that are missing or loose on the nut plates
 - 1) Not permitted
 - 2) Replace the bracket.

SUBTASK 70-00-05-210-022-G00

(3) Examine all other areas of the LPTACC manifold as follows (Figure 207):

- (a) Cracks
 - 1) Not permitted
 - 2) Replace the engine (TASK 71-00-02-000-801-G00 and TASK 71-00-02-400-801-G00).
- (b) Nicks, dents, and scratches
 - 1) Permitted to a depth that is less than 0.010 inch (0.25 mm) after you remove the high metal.



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- a) Do this task: Blending Procedures - Hand Blending,
TASK 70-43-42-300-802-G00.

————— END OF TASK —————

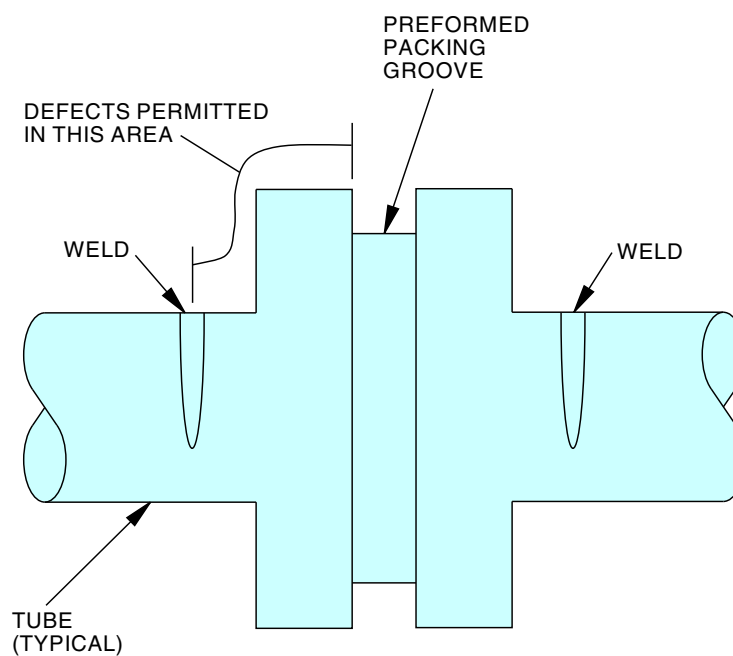
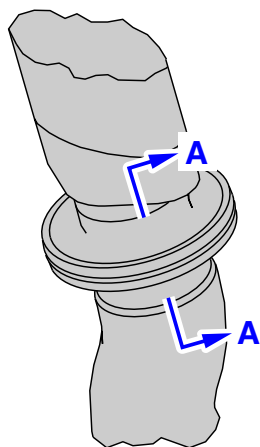
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Preformed Packing Flange Inspection
Figure 201/70-00-05-990-801-G00

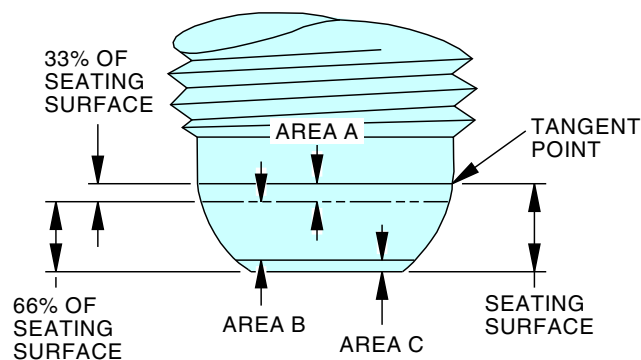
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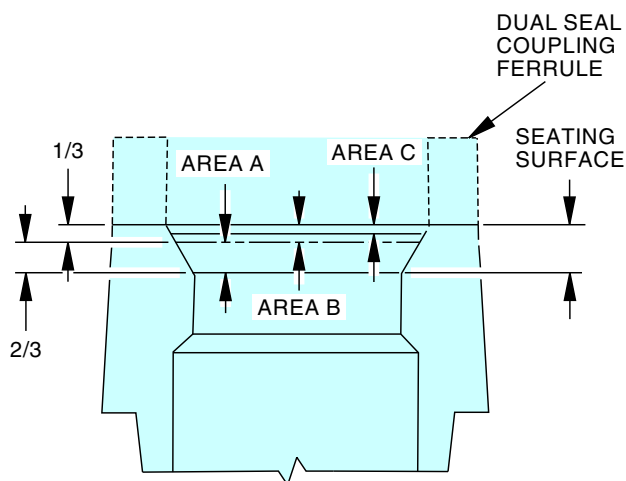
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SPHERICAL SEAT FITTINGS



TUBE/HOSE FERRULE

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Spherical Seat Fitting and Tube Ferrule Fittings Inspection
Figure 202/70-00-05-990-802-G00

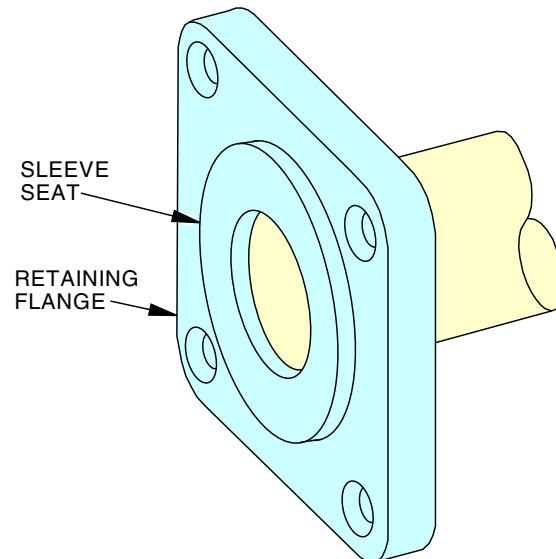
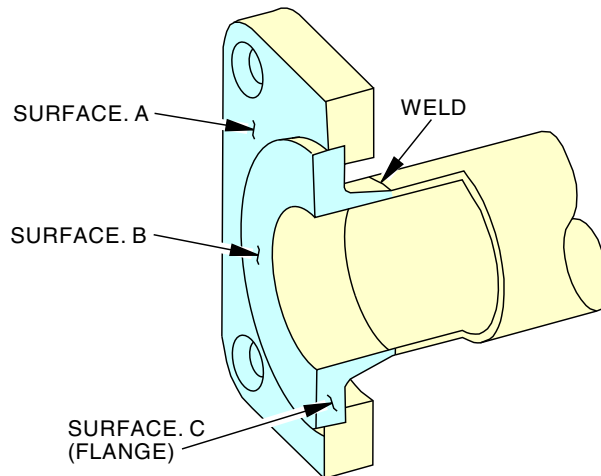
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2471674 S0000576649_V1

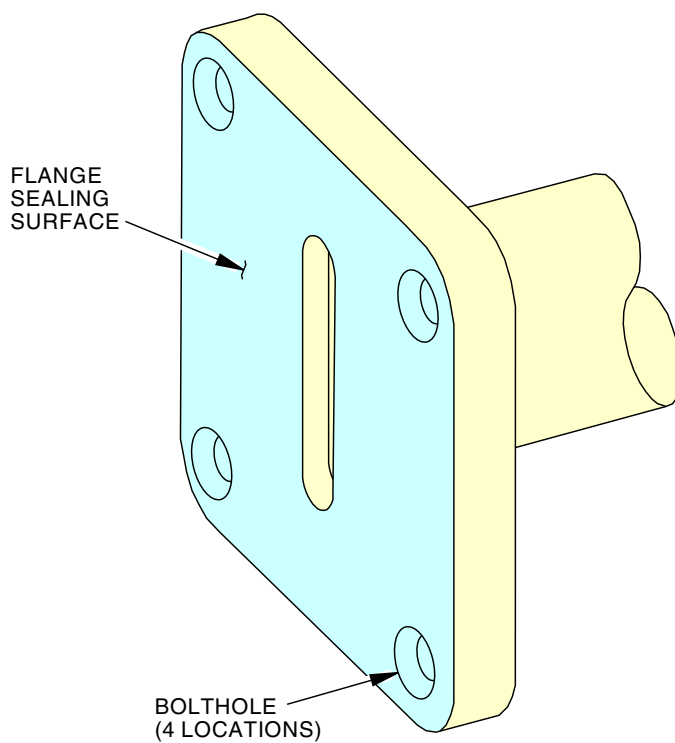
Swivel Flange Fitting Inspection
Figure 203/70-00-05-990-803-G00

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Solid Flange Fitting Inspection
Figure 204/70-00-05-990-804-G00

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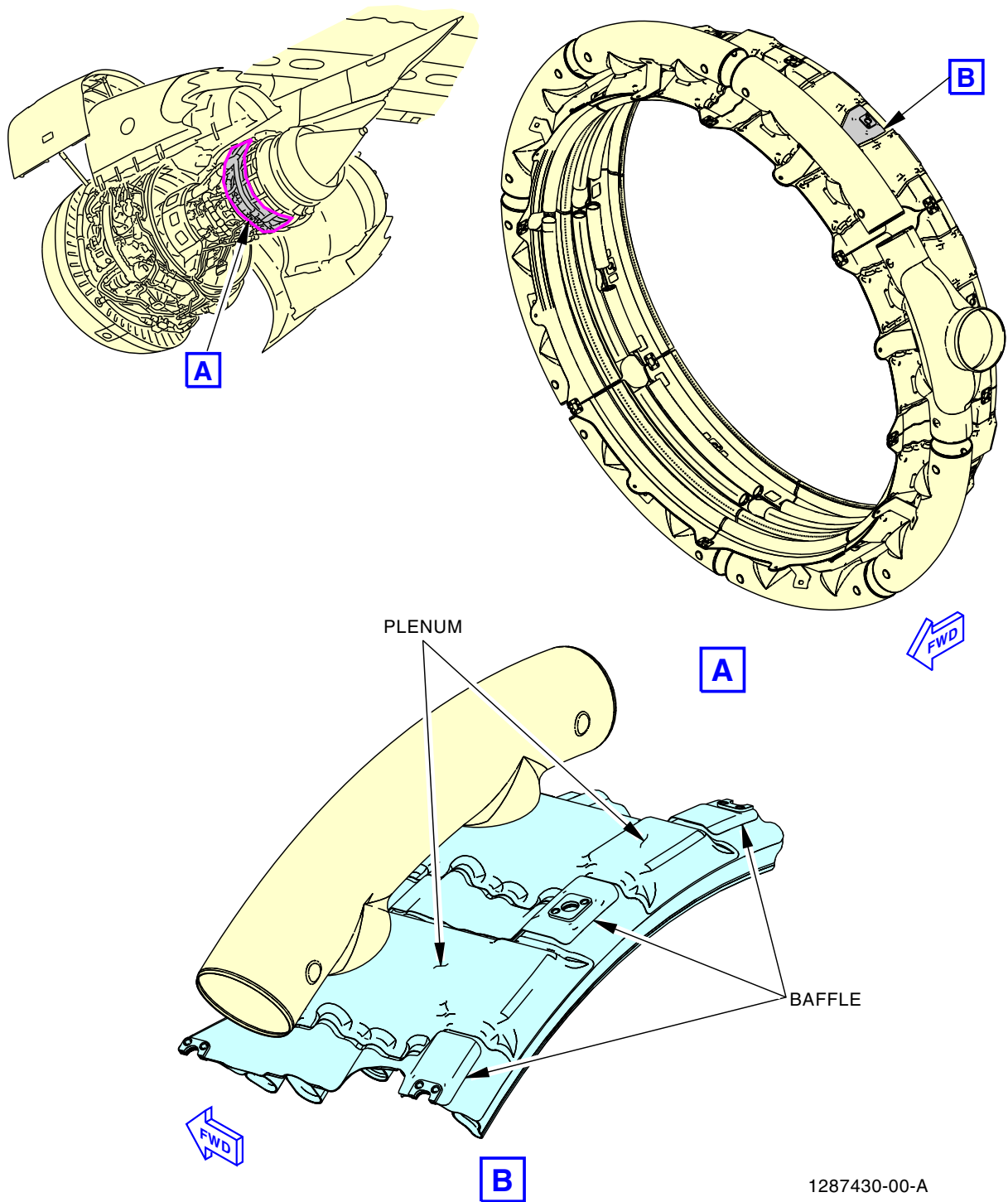
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HPTACC Air Manifold Inspection
Figure 205/70-00-05-990-805-G00

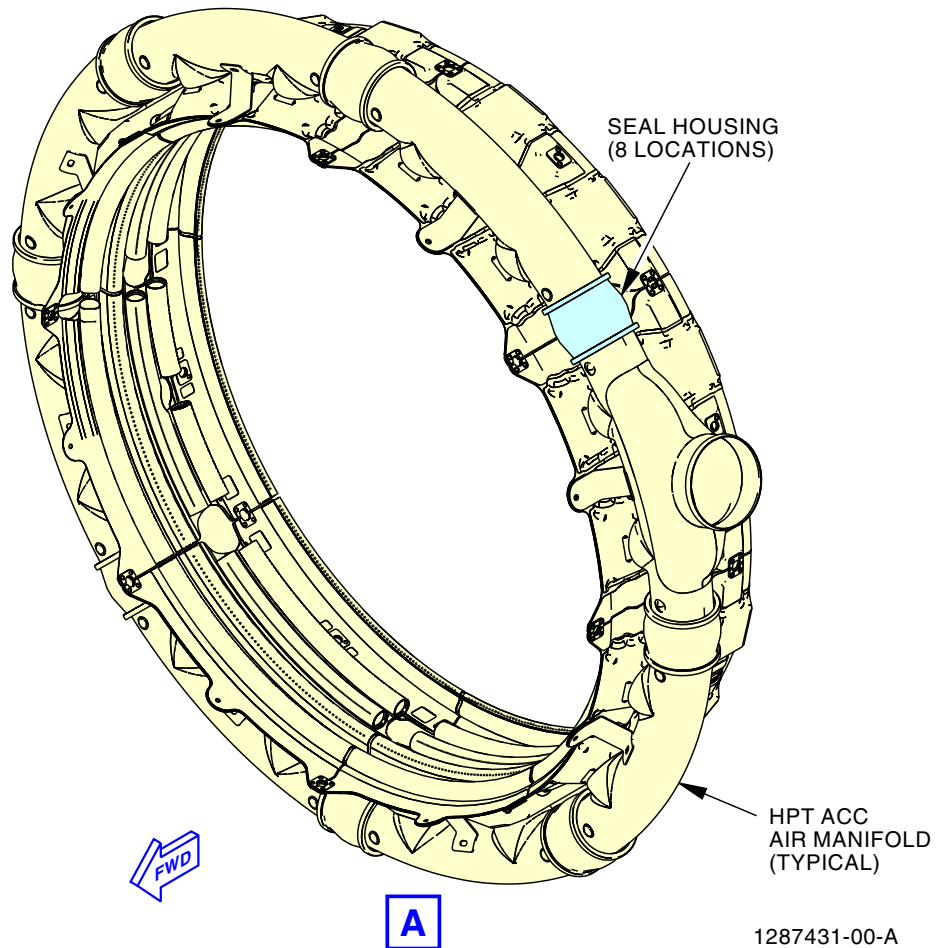
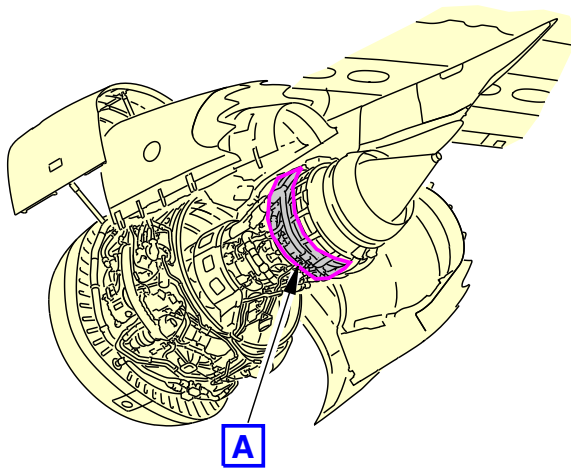
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HPTACC Air Manifold Seal Housing Inspection
Figure 206/70-00-05-990-806-G00

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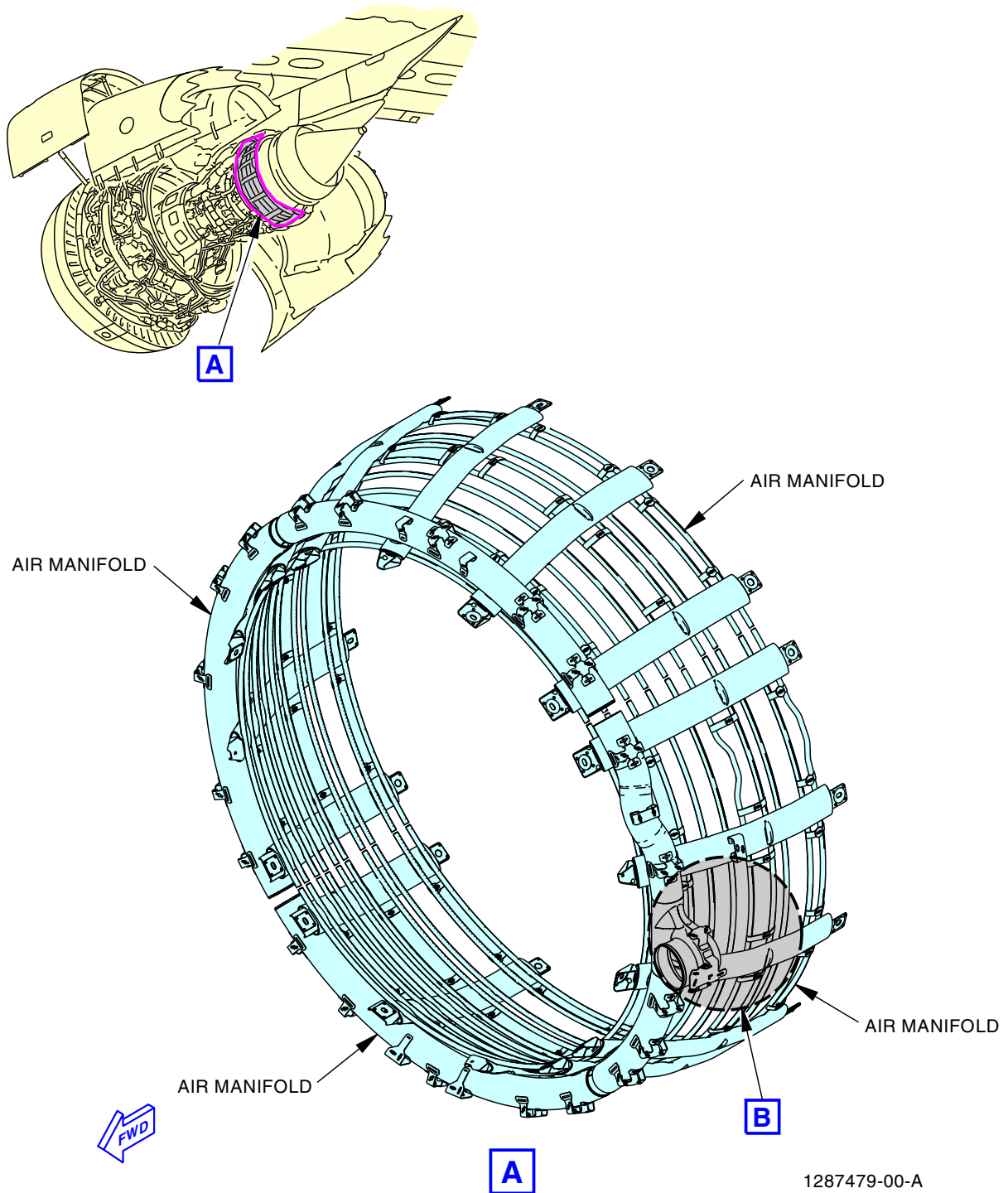
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LPTACC Manifolds Inspection
Figure 207/70-00-05-990-807-G00 (Sheet 1 of 2)

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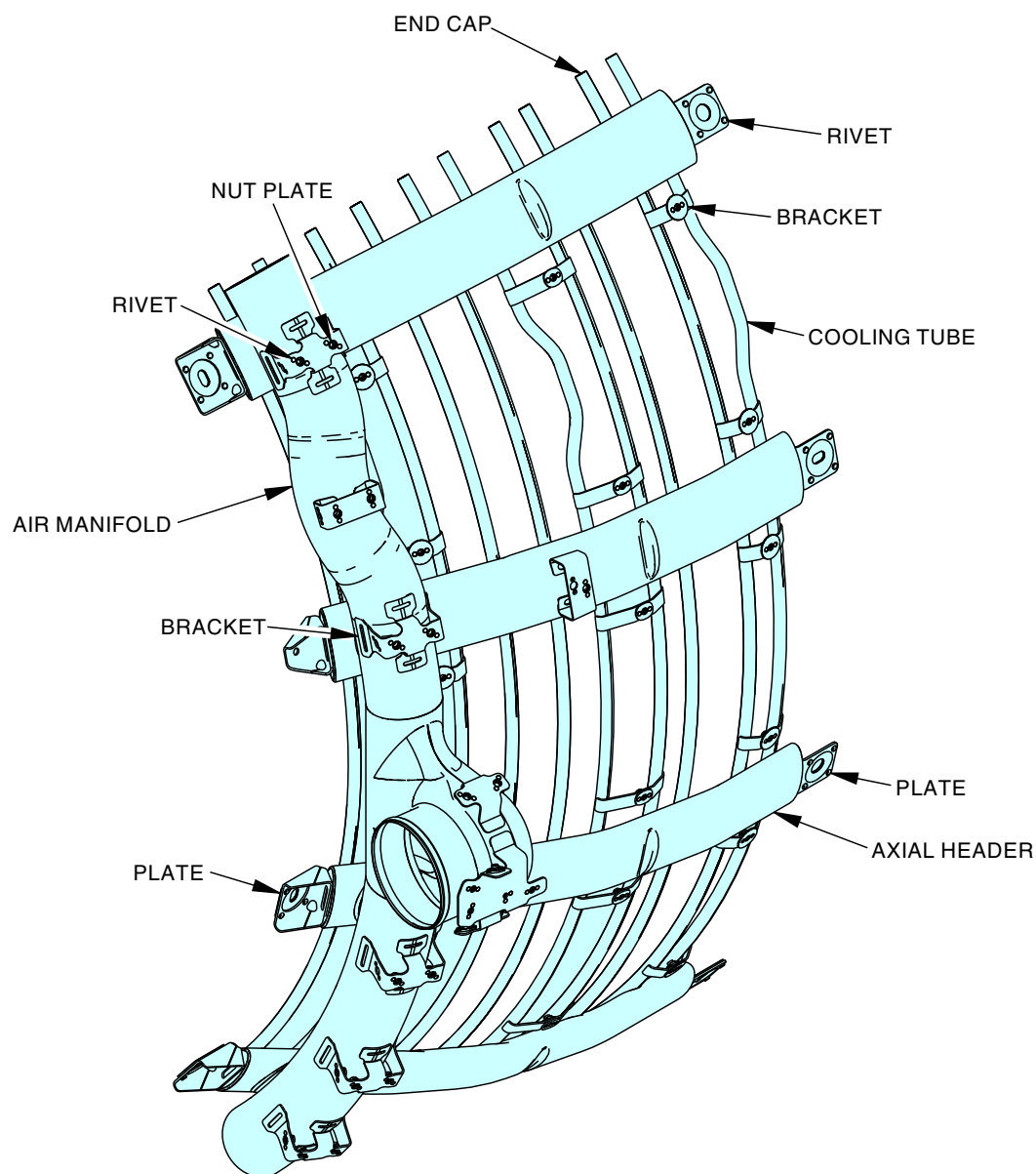
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(EXAMPLE)

B

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LPTACC Manifolds Inspection
Figure 207/70-00-05-990-807-G00 (Sheet 2 of 2)

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TERMS AND ABBREVIATIONS - MAINTENANCE PRACTICES

1. General

- A. This procedure gives the terms and abbreviations to use with the power plant procedures of the aircraft maintenance manual.

TASK 70-00-06-910-801-G00

2. Terms and Abbreviations

A. Terms

SUBTASK 70-00-06-910-001-G00

- (1) The use of notes, cautions and warnings are given as follows:



WARNING

WARNINGS LOOK LIKE THIS, AND PROVIDE ADDITIONAL SAFETY RELATED DATA TO MAKE YOU THINK ABOUT THE PROCEDURES OR LIMITS. IF YOU DO NOT CORRECTLY OBEY THE INSTRUCTIONS IN A WARNING, YOU CAN CAUSE INJURIES OR DEATH TO PERSONS AND DAMAGE TO THE EQUIPMENT.

- (a) Warnings refer to the step that follows it, just like this example.



CAUTION

CAUTIONS LOOK LIKE THIS, AND SUPPLY MORE EQUIPMENT RELATED DATA TO MAKE YOU THINK ABOUT THE PROCEDURES OR LIMITS. IF YOU DO NOT CORRECTLY OBEY THE INSTRUCTIONS IN A CAUTION, YOU CAN CAUSE DAMAGE TO THE EQUIPMENT.

- (b) Cautions refer to the step that follows it, just like this example.
(c) Notes are given to clarify the procedure and follow the step to which it refers.

NOTE: Notes look like this, and gives more details to make the task easier or to add to the explanation.

SUBTASK 70-00-06-910-002-G00

- (2) Use these terms to define and specify defects:

Table 201/70-00-06-993-801-G00

TERMS	DEFINITIONS	ASSOCIATED TERMS
Blister	A portion of a surface that is lifted, and is caused by the separation of the outer layers of the parent material, or the material that you applied.	Bubble, Flaking, Oxide formation, Peeling, Scale, Slag inclusion (weld)
Brittle	A change in the elasticity or resilience of the parent material. The defect is usually caused by age, extreme cold, chemical action, or cold-working.	Cold worked hard (like an O-ring)
Buckle	A large scale deformation of the original contour of a part that is usually caused by pressure. Possible causes are impacts with foreign objects, structural stress, excessive localized heat, high pressure differentials, or a mixture of these.	Ballooning, Bend, Bulge, Crease, Curl, Dent (do not confuse with a small area defect), Depression, Distortion, Elongation, Fold, Indentation, Kink, Protrusion, Rupture (caused by excessive buckling), Uneven, Warp, or Wrinkle

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Table 201/70-00-06-993-801-G00 (Continued)

TERMS	DEFINITIONS	ASSOCIATED TERMS
Burn	A fast, destructive, oxidizing effect that is usually caused by high temperatures or open flame. A change in color is usually associated with this condition	Burn-out, Erosion, Corrosion, Guttered, Heat-check, Heat deterioration, Hole (burnt), Hot Spot, Overheat, or Oxidation
Burnishing	To make a metal surface smooth by a mechanical action, but without a significant decrease in the material. You can find burnishing on a plain bearing surface. It is possible to find surface discoloration near the outer edges of the burnishing. Burnishing that is caused by the operation of the equipment is not dangerous, if the coverage approximates the load carrying surface and there is no evidence of burns.	Rub, Wear
Burr	A rough edge or a sharp point on the edge or the mating surface of the parent material.	
Chafing	Please see Gall or Scratch.	
Chip	An edge that breaks away from the parent material. A chip is usually caused when a foreign object hits the parent material.	Break, Nick, Notch spalling (a chip broken away from a flat surface)
Corrosion	Many small pits that can grow into a hole. The first sign of corrosion is usually a roughness in the surface of the parent material.	Pit
Crack	A separation or discontinuity of the parent material.	Break, Cold shut (castings), Crater (castings), Fatigue damage, Fissure, Fracture, Lap (forgings), Rupture, Seam, Separation, Slit, Tear
Crazing	Many small thin cracks that are found in a painted, glazed, or baked-on layered surfaces. Crazing is only found in the surface material, not the parent material. The crazing is usually caused by temperature differentials or deformation of the parent material.	
Creep	The slow and continuous distortion (plastic flow) of the parent material. Creep is usually caused by a constant stress that is applied to the parent material.	
Deformation	A change in shape or dimension that can be caused gradually, or suddenly. An impact can cause sudden deformation, creep can cause gradual deformation.	Bend, Creep, Distortion
Dent	A smooth surface depression in the surface of the parent material. A dent is usually caused by impact with a smooth, rounded object. In a dent, the parent material is displaced, but does not form a hole.	Peen

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Table 201/70-00-06-993-801-G00 (Continued)

TERMS	DEFINITIONS	ASSOCIATED TERMS
Deviation	A condition that causes the component to be different than the manufacturer's blueprint.	Damage, Defect, Flaw, Imperfection, Irregularity
Discontinuity	An interruption in the correct physical structure or configuration of a component.	Crack, Hole, Seam, Cold shut, Lap
Distortion	A twist, bend, or permanent strain that causes the shape of the component to change.	Bend, Deformation
Erosion	A surface imperfection that is caused by the slow, continuous wearing away of the parent material. Erosion is usually caused by fine particles that are suspended in a fast moving gas or liquid.	
Fatigue	The sequential fracture of a component that is caused by cyclical stress.	Crystallization, Fretting, Flaking
Flaking	See Spalling	
Fretting	The metal to metal wear that shows on parts, that is caused by low amplitude vibrations (usually associated with close fitting parts).	Wear, Galling
Galling	A defect that is caused when the component wears away. Galling is usually caused by a small quantity of unwanted material that gets between two moving surfaces.	Pickup
Gouge	A large, rough scratch or group of scratches.	
Groove	A long, thin, continuous depression.	If the depression is shallow and smooth, see WEAR. If the depression is rough and sharp, see SCRATCH.
High spot	Local distortions	Blister, Buckle, Bubble, Out-of-round.
High metal	Material that is adjacent to a defect, such as a nick or gouge, and has lifted above the surrounding area.	Burr
Imbalance	The state of being out of balance. An imbalance usually causes vibrations.	
Inclusion	Is an unwanted material that has become a part of the parent material. Inclusions are usually caused by alloy defects or by chemical reaction of the parent material.	
Indication	A defect in the material that you can see, or a tell-tale that you can see that implies that a defect exists.	
Looseness	A component that is not attached correctly.	Backed-out, Excessive play, Backlash, Insufficient torque, Shaky, Sloppy, Not-bottomed, Unpinned, Unwired
Misalignment	A component that is not installed correctly, or is made in such a way that it cannot align with the parts around it.	Eccentric, Out-of-round, Out-of-square, Mismatched

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Table 201/70-00-06-993-801-G00 (Continued)

TERMS	DEFINITIONS	ASSOCIATED TERMS
Nick	A defect in a component that pushed in with sharp corners. A nick is usually caused by the pressure of an impact with a sharp-edged object. The material is displaced, but none is usually broken off.	Chip, Dent, Notch
No apparent depth	This term describes a surface defect that you can see, but you can not feel it with your fingernail or the tip of a scribe point.	
Noise	An unusual sound that can include loose or misaligned components. The change that brings the noise to your attention is usually associated with an increase in volume or a change in pitch.	Bumps, Chatters, Clicks, Grates, Rings, Hums, Rattles, Rubs, Scraping sound, Screech, Thumps, Whistles
Obstruction	Unwanted material the prevents or obstructs the flow of gas or liquid into, around, or through a component.	Clogged, Contaminated, Plugged, Restricted
Oil-canning	A movement that displaces sheet metal that is held at its edges, like a diaphragm. The oil-canning is usually associated with a cyclic noise.	Buckling
Parent metal	The material in a single part that does not include the weld, braze filler, or their heat damaged zones. The heat damage zone is usually in 0.125 in. (3.175 mm) of the fusion line.	
Pinched	A distortion of the surface of the parent material that is caused by pressure.	Bound, Compressed, Flattened, Seized, Smashed, Squashed, Squeezed.
Pit	A small hole that does not have sharp edges. Pits are usually caused by chemical reaction of the parent metal of the components surface.	Corrosion, Crater, Electrolytic cavity, Inclusion, Perforation, Pin-hole, Pock-mark
Porous	An area that is full of pores that fluids, gas, or light can pass through. An area with many pits or pinholes.	Pits, pinholes
Rub	A surface defect that is caused by abrasion. Rubs are usually found on surfaces that touch as they move.	Wear, Scratch
Scale	A layer of metallic oxide that is often found on new metal. Scale is usually formed by chemical action of oxygen while the metal is hot.	Mill scale
Scratch	A long, thin, sharp cornered impression in the surface of the parent material. Scratch is usually caused as a sharp object is moved across the surface.	Abrasion, Chafe, Furrow, Groove, Score

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Table 201/70-00-06-993-801-G00 (Continued)

TERMS	DEFINITIONS	ASSOCIATED TERMS
Seizure	A welding or binding of the components that prevents movement. The welding can be caused by oxidation or heat.	Bound-up, Frozen, Pinched, Tight, Wedged, Welded
Shingling	When one blade mid-span shroud moves over another shroud. Shingling occurs at the blade tip shrouds of the LP turbine rotor (stages 3 and 4). The LP turbine condition is caused by too little twist in the blades, or too much radial movement.	Bound-up, Wedged
Spalling	Small particles of the metal that crack or flake off of the surface. Spalling is usually found in thin layers or confined areas.	Flaking, Fretting, Galling
Unbalance	Please see IMBALANCE	
Varnish film	A hard surface film that is made up of partially carbonized hydrocarbons, such as oil. Varnish is caused when the part is heated above the break-down point of the fluid.	Banded, Discolored, Oxidized, Stained
Wear	The slow removal of the parent material that is caused by the operation of the component.	Abrasion, Attrition, Brinnelled, Chafed, Erosion, Fraying, Fretting, Friction, Galling, Glazing, Grooved, Interference, Oxidation, Rough, Rubbed, Scarfed, Scuffed, Uneven, Weak, Worn

B. Abbreviations

SUBTASK 70-00-06-910-003-G00

- (1) The abbreviations that follow are used for terms that appear in the power plant procedures of the maintenance manual.

Table 202/70-00-06-993-802-G00

ABBREVIATION	DEFINITION
A's	AC Alternating Current ACC Active Clearance Control AGB Accessory Gearbox AML Application Memory Loader APU Auxiliary Power Unit AVM Advanced Vibration Monitoring
B's	BAI Booster Anti-Ice BAT Battery
C's	CBP Compressor Bleed Pressure

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Table 202/70-00-06-993-802-G00 (Continued)

ABBREVIATION	DEFINITION
CDP	Compressor Discharge Pressure
CEOD	Continuous Engine Operation Data
CG	Center of Gravity
CIT	Compressor Inlet Temperature
CONT	Continuous
D's	
DC	Direct Current
DIA	Diameter
E's	
EAI	Engine Anti-Ice
EEC	Electronic Engine Control
EGT	Exhaust Gas Temperature
EHM	Engine Health Monitoring
ENG	Engine
F's	
FIG	Figure
FLT	Flight
FOD	Foreign Object Damage
FPI	Fluorescent Penetrant Inspection
FWD	Forward
G's	
GND/GRD	Ground
H's	
HP	High Pressure
HPC	High Pressure Compressor
HPT	High Pressure Turbine
I's	
ID	Inside Diameter
IGB	Inlet Gearbox
IGN	Igniter/Ignition
IGV	Inlet Guide Vane
INOP	Inoperative
J's Not Used	
K's	

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Table 202/70-00-06-993-802-G00 (Continued)

ABBREVIATION	DEFINITION
KIAS	Knots, Indicated Air Speed
KPA	Kilo-Pascal
L's	
LP	Low Pressure
LPC	Low Pressure Compressor (Fan)
LPT	Low Pressure Turbine
LRU	Line Replaceable Unit
LVDT	Linear Variable Differential Transformer
M's	
MAX	Maximum
MIN	Minimum
MTC	Modulated Turbine Cooling
N's	
NGV	Nozzle Guide Vane
NLR	Corrected Fan Speed (Corrected N1)
Nm	Newton meter
NOB	Number 1 Bearing
NVM	Non-Volatile Memory
N1	Low Pressure % RPM (Fan Speed)
N1K	Corrected Fan Speed (Corrected N1)
N2	High Pressure % RPM (Core Speed)
O's	
OAT	Outside Air Temperature
OD	Outside Diameter
OGV	Outlet Guide Vane
ONS	Onboard Network System
OPS	EEC System Operation Software
P's	
PB	Bypass Pressure
PC	Regulated Servo Pressure
PCR	Regulated Case Pressure
PF	High Pressure Fuel (heated)
PLA	Power Lever Angle
PMAT	Portable Maintenance Access Terminal

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Table 202/70-00-06-993-802-G00 (Continued)

ABBREVIATION	DEFINITION
PMD	Portable Maintenance Device
Q's	
QAD	Quick Attach/Detach
QEC	Quick Engine Change
R's	
REF	Reference
RVDT	Rotary Variable Differential Transformer
S's Not Used	
T's	
TACH	Tachometer
TCF	Turbine Center Frame
TGB	Transfer Gearbox
TLA	Thrust Lever Angle
TRA	Thrust Resolver Angle
T12	Fan Inlet Temp (electrical sensor)
U's Not Used	
V's	
V	Volt
VBV	Variable Bleed Valve
VCD	Vortex Control Device
VSV	Variable Stator Vane
W thru Z Not Used	

————— **END OF TASK** —————

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WATER TYPES - MAINTENANCE PRACTICES

TASK 70-00-07-910-801-G00**1. Water Types****A. General**

- (1) This task defines all types of water used in the maintenance procedures. There are two types of water used, and they are:
 - (a) Water (Tap Water).
 - (b) Deionized Water.

B. Water (Tap Water)**SUBTASK 70-00-07-910-001-G00**

- (1) The term "water" as used in the Standard Practices of this manual refers to currently available drinking water having an average resistivity between 4000 and 5000 Ohm.cm. Since the resistivity of tap water supplied by local water networks (filtered and treated surface water or government approved spring water) is usually in the above range, the actual resistivity values are of little importance.

SUBTASK 70-00-07-910-002-G00

- (2) This water is approved for use in degreasing, stripping chrome plating and rinsing solutions, and in chemical conversion treatments (chromating, phosphating, black oxide coating). A 10000 Ohm.cm minimum resistivity is generally recommended, especially for chemical conversion treatments. The water must be clean and free from insoluble matter in suspension and from dissolved salts.

C. Deionized Water

NOTE: Deionized water is used for cleaning parts prone to contamination by mineral and organic impurities.

Deionized water is characterized by its resistivity.

SUBTASK 70-00-07-910-004-G00

- (1) Deionized water must be supplied with a minimum resistivity of 50000 Ohm.cm. The above type of water is designated in the Standard Practices Manual by the term "deionized water".

NOTE: This type of water is designated in the Standard Practices Manual by the term "deionized water"

SUBTASK 70-00-07-910-005-G00

- (2) For rinsing titanium and titanium alloys, deionized water used must be supplied with the following requirements:
 - (a) The deionized water must have a maximum of 50 Parts Per Million (PPM) in dissolved chlorine and chlorides.
 - (b) The deionized water must have a minimum resistivity of 50000 Ohm.cm or maximum conductivity of 20 μ S/cm.

D. Water Type Designation**SUBTASK 70-00-07-910-006-G00**

- (1) The above water-type designations are intended to aid in obtaining satisfactory results when applying standard methods and also to enable procurement of facilities supplying the water-types. Water of higher resistivity and/or purity can always be used in any application. Water of lower resistivity and or purity should not be used.

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E. Definition and Test Protocol

SUBTASK 70-00-07-910-007-G00

- (1) Chlorine/Chloride: Sum total of the chloride ions and other ions derived from chlorine (sometimes known as residual chlorine).
- (2) Chlorine analysis shall be according to ASTM D1253, ASTM D512 or equivalent approved procedures.

———— **END OF TASK** ————

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ULTRAVIOLET LIGHT TEST - MAINTENANCE PRACTICES

1. General

- A. This test is necessary to insure that high intensity self-filtered 125W UV bulbs are suitable for use in fluorescent-penetrant processes. It has been determined that white light emission from these bulbs in excessive amounts can cause a reduction in indication fluorescent intensity, and in worst cases, could cause small indications to be missed.
- B. This test involves two separate examinations for qualitative and quantitative analysis. The tests are a verification of power lighting of UV lamps and a verification of lighting. Both methods should be used in the recommended sequence.
- C. It is important that this test be performed whenever a new bulb is put into inspection service. Bulbs that have painted necks should be visually inspected for paint peel and must be retested if there is evidence of paint peel.
- D. Perform test in a darkened area with ambient background light levels.

TASK 70-00-08-910-801-G00

2. Ultraviolet Light Test

A. General

- (1) This test is necessary to make sure that the high intensity self-filtered 125W Ultraviolet Light (UVL) bulbs are correct for the Fluorescent Penetrant procedure. Too much white light from these bulbs can cause the indication fluorescent intensity to be decreased, and could cause small indications to not be seen.
- (2) This test gives two procedures to do the analysis of the bulbs. The procedures are to test the power lighting of Ultraviolet lamps and a verification of lighting. The two procedures must be used in the recommended sequence.
- (3) It is important that this test is done when a new bulb is to be used in inspections. Bulbs that have painted necks must have a visual inspection for paint peel and must be examined again if there is indication of paint peel.

B. Tools/Equipment

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt.", which stands for Optional.

Reference	Description
COM-11562	Radiometer

C. Test Equipment

SUBTASK 70-00-08-700-001-G00

- (1) Test One: Verification of power lighting of Ultraviolet lamps
 - (a) UV Radiometer equipped with a photo-cell that will measure Ultraviolet radiations with a wavelength of 365nm.

SUBTASK 70-00-08-700-002-G00

- (2) Test Two: Verification of lighting

NOTE: For the supplied device, request that the photometer supplier for the Relative Spectrum Sensitivity (Mean Values) Curve (Figure 201).

- (a) Ultraviolet Photometer with a sensor filtered and adapted to the spectral sensitivity of the human eye.

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(b) Inspection booth.

D. Test One - Verification of Power Lighting of Ultraviolet Lamps

SUBTASK 70-00-08-700-003-G00

(1) Clean the lamp bulb and the Wood filter.

NOTE: Clean the Wood Filter if it is not a part of the bulb.

SUBTASK 70-00-08-700-004-G00

(2) Plug in the lamp and let it to warm up for 10 minutes.

NOTE: This is not necessary for lamps that are self-lighting.

SUBTASK 70-00-08-700-005-G00

(3) Measure UVL with the radiometer, COM-11562 at a distance of 1.25 ft (0.38 m) away from the lamp.

SUBTASK 70-00-08-700-006-G00

(4) In the above conditions, the minimum permitted value shall be 1200 $\mu\text{W}/\text{cm}^2$ on examined area.

NOTE: The operation of secondary Ultraviolet lamps to supply background lighting to supplement the inspection lamps, or the lamps used to examine the washing of items, do not require an inspection. These non-calibrated lamps must not be used on their own for the inspection.

SUBTASK 70-00-08-700-007-G00

(5) Do this test weekly. If the intensity is under 1800 $\mu\text{W}/\text{cm}^2$ or at each bulb replacement, do this test daily.

E. Test Two - Verification of lighting

SUBTASK 70-00-08-700-008-G00

(1) Close the inspection booth.

SUBTASK 70-00-08-700-009-G00

(2) Clean the lamp bulb and the Wood filter.

NOTE: Clean the Wood Filter if it is not a part of the bulb.

SUBTASK 70-00-08-700-010-G00

(3) Plug in the lamp and let it warm up for 10 minutes.

NOTE: This is not necessary for lamps that are self-lighting.

SUBTASK 70-00-08-700-011-G00

(4) Turn off all white lights.

SUBTASK 70-00-08-700-012-G00

(5) Do the measurement with the ultraviolet photometer in these locations:

(a) Below the lamp on the work surface.

(b) At the operators eye level.

SUBTASK 70-00-08-700-013-G00

(6) The maximum permitted value is 20 lux.

SUBTASK 70-00-08-700-014-G00

(7) Do this test weekly.

————— **END OF TASK** —————

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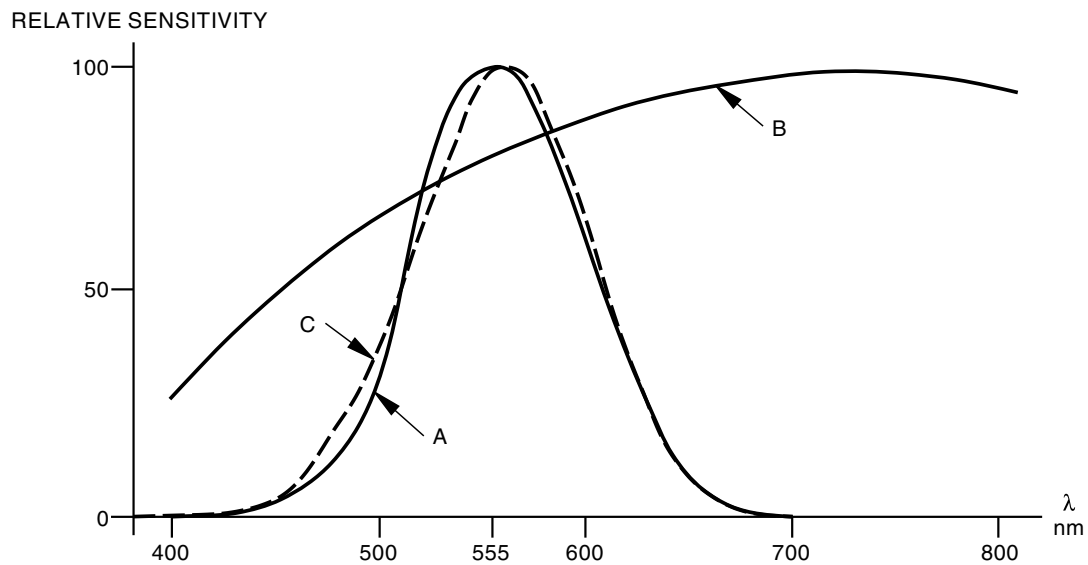
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A: C.I.E (COMMISSION INTERNATIONALE DE L'ÉCLAIREMENT) EYE CURVE
B: SILICON PHOTO-CELL ELEMENT WITHOUT FILTER
C: LUX METER MEASURING PROBE ADAPTER BY A CORRECTION FILTER

RELATIVE SPECTRAL SENSITIVITY (MEAN VALUES)
(EXAMPLE)

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Relative Spectral Sensitivity
Figure 201/70-00-08-990-801-G00

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FLUORESCENT PENETRANT INSPECTION - MAINTENANCE PRACTICES

1. General

- A. This procedure has two tasks:
- (1) Fluorescent Penetrant Inspection (General).
 - (2) Fluorescent Penetrant Inspection.

TASK 70-11-06-230-803-G00

2. Fluorescent Penetrant Inspection (General)

A. General

- (1) The fluorescent-penetrant inspection process is a visual inspection aid used for the detection of closed surface indications that may not be visible under white-light visual inspection. These indications can be cracks, inclusions, voids, or other types of indications which are inherent or which are caused by processing or service.

NOTE: Large surface indications which are easily visible to the naked eye will usually not retain penetrants and consequently will not reveal indications under white-light visual inspection for detection.

- (a) A fluorescent penetrating oil is applied to the part and allowed to penetrate the indication. The excess penetrant is removed from the surface of the part and the part is then dried. A developer is applied, and time is allowed for the developer to absorb penetrating oil from the indication. After the excess developer is removed from the part, the part is inspected under ultraviolet light where indications become visible.
- (b) Two basic types of penetrants are described in this manual: Post-emulsifiable and Water-washable.
 - 1) Post-emulsifiable penetrants require the application of an emulsifier to remove excess penetrant followed by a water wash to remove the emulsifier.
 - 2) Water-washable penetrants do not need the application of an emulsifier. The penetrant is removed by a water wash only.



DO NOT USE WATER WASHABLE PENETRANTS IN THE INSPECTION OF LIFE LIMITED ROTATING PARTS. IF YOU DO NOT FOLLOW INSTRUCTIONS, DAMAGE TO THE PARTS CAN OCCUR.

- (2) The inspection of parts requires personnel having specialized training, knowledge of procedures, and experience in the interpretation of indications. Inspectors must be able to distinguish between the different indications to do the examination correctly.
- (3) Parts on which coating is to be replaced because of deterioration (peeling, flaking, cracking, etc.) should not be inspected until after the coating is removed. Coatings normally produce areas of excessive background fluorescence (example: Thermal Spray) and fine network cracking (example: chrome plating) making these areas unable to be inspected to the level of sensitivity required on the remainder of the part under inspection. These areas are generally not to be inspected. Good practice is, however, to make sure these areas are reviewed for large and obvious anomalies. The process document will specify when these coatings must be removed for inspection.

NOTE: Any obvious indications of cracking above the normal level of background indication in the coated areas should be called out for further evaluation by white light inspection or coating removal and re-inspection based on the recommendations of the process document.

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- (4) Because of the geometric constraints of rotating components with recessed cavities, such as spools, shafts, disks-shafts, etc., special attention must be given to the washing, developing and inspection techniques used during the penetrant inspection process to assure an adequate inspection. These recommendations do not supersede any specialized techniques that may be issued on specific parts.



PUT ON A RESPIRATOR. DO NOT BREATHE THE FUMES. THE FUMES OF THE DEVELOPER ARE POISONOUS. INJURIES TO PERSONNEL CAN OCCUR.

- (5) During application of the developer, attention must be given to assure the developer is properly applied to inside the cavities between disks and down the length of shaft inside diameters. Normal electrostatic systems will not apply the developer to these areas. Apply the developer directing it into long nozzle or with a NAWD (Non-Aqueous Wet Developer) spray.
- (6) During the inspection process, inspect the OD (Outside Diameter) of the part first. Next, inspect the hub bores and hub faces. Finally, inspect the surfaces in the cavities between the disks. It is recommended to use a front surface mirror on an adjustable handle or sliding fixture for inspecting areas not visible by direct line of sight. To view and inspect the hub bore and hub face, tilt the mirror slightly back towards the centerline of the part. To view and inspect the web and rim areas, tilt the mirror slightly away from the center line of the part. It is recommended to use a white light to verify that the mirror is angled properly to inspect all required areas.
- (7) An ultraviolet borescope may be used to aid inspection of the recessed cavities or ID (Inside Diameter) of shafts. The scope may be used as an ultraviolet light source or used for direct viewing. The tip of the borescope must be held at a distance from the inspection surface to provide ultraviolet intensity higher than 1200 $\mu\text{W}/\text{cm}^2$ at 15 in. (380 mm) on inspected surface.
- (8) Use of a charge-coupled device (CDD) camera to see remote internal parts using FPI is permitted if the complete video system has demonstrated a sufficient sensitivity to fluorescent indications in the test inspection of a known indication standard.

B. Definitions

SUBTASK 70-11-06-800-001-G00

(1) Inspection Sensitivity Levels

Fluorescent Penetrant Inspection, TASK 70-11-06-230-802-G00 is applicable to all sensitivity levels. The sensitivity level shall be specified in the Process Document.

It is acceptable to substitute a Penetrant of higher sensitivity provided that the part exhibits a satisfactory indication to background fluorescence contrast. However, inspectors performing such inspections must have higher training, knowledge, techniques and experience in the interpretation of indications, as higher sensitivity level provides higher background fluorescence contrast that could lead to irrelevant indications.

SUBTASK 70-11-06-800-002-G00

(2) Portable Inspections

Portable equipment permits inspection of parts at locations distant from stationary facilities and can be used for inspection of areas when it is impractical to process the entire part and/or during repair operations.

SUBTASK 70-11-06-800-003-G00

(3) Emulsifier

Hydrophilic emulsifiers are used in solution in water. They are not soluble in the penetrant: their action, localized on surface, is characterized by a modification of the penetrant wettability.

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AIRCRAFT MAINTENANCE MANUAL****SUBTASK 70-11-06-800-004-G00****(4) Solvents Removers**

Solvent removers are non-halogenated products which dry quickly used for inspection of questionable indications.

SUBTASK 70-11-06-800-005-G00**(5) Methods of Application****(a) Spraying**

The inspection material is directed under pressure, in the form of droplets or as a mist, onto the surfaces of the part to be inspected.

(b) Brushing

The inspection material is applied with a brush to the surfaces of the part to be inspected.

(c) Flowing

The inspection material is applied as a liquid stream from a hose or by pouring from a container to flow over the surfaces of the part to be inspected.

SUBTASK 70-11-06-800-006-G00**(6) Interchangeability between penetrant systems**

- (a) A system of penetrant and emulsifiers from a single manufacturer must be used when a post-emulsifiable system is specified.
- (b) Any developer or solvent remover may be used with any one specific penetrant system. A non-aqueous wet developer (NAWD) may be used in place of any dry powder developer for any fluorescent penetrant process and with any penetrant system.
- (c) Products suppliers are listed in QPL AMS2644.

———— **END OF TASK** ————

TASK 70-11-06-230-802-G00**3. Fluorescent Penetrant Inspection****A. General**

- (1) The two fluorescent penetrant inspection procedures used for inspections at remote locations are post-emulsifiable hydrophilic and water washable.
 - (a) Post-emulsifiable hydrophilic penetrant inspection uses a penetrant, an emulsifier, a dry powder or non-aqueous wet developer and solvent removers.
 - (b) Water washable penetrant inspection uses a penetrant, a dry powder or non-aqueous wet developer and solvent removers.
 - (c) Portable fluorescent penetrant inspection is a localized process, limited to small areas or spot inspection of specific areas of parts. It is not intended for normal inspection.
 - (d) It is convenient to use for inspection of welded or other localized repair areas.
 - (e) The penetrant is applied only to a local area that needs to be inspected.
- (2) Titanium alloy parts are subject to stress corrosion cracking when residues of halogen containing compounds remain on a part that is subsequently subjected to high temperatures typical of welding, heat treating, or engine operation.
 - (a) These parts must be thoroughly cleaned with non-halogen compounds after exposure to any halogen containing compound to prevent cracking and possible failure of parts.

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- (b) When using water for processing parts made of titanium or titanium alloy, deionized water should be used when possible.
- (3) For general requirements on the Water Types and rinsing process, refer to Water Types, TASK 70-00-07-910-801-G00.
- (4) Solvent removers are only used for questionable indications. Emulsifiers and solvent removers are gradually contaminated with penetrant during use. Therefore, they must periodically be compared to a retained standard sample. Every time a new container of emulsifier is opened for use, or a new mixture of solvent remover is prepared, a master sample shall be obtained and kept as a standard sample for comparison test purposes.
- (5) Make sure that the parts are clean before you start the inspection process to accomplish a proper inspection and to prevent contamination of the inspection materials..
- (6) Penetrant inspection shall always precede magnetic particle inspection when both inspections are required.
- (7) Make sure that you plug or cap all tubes or holes on parts in the area that you will inspect to prevent penetrant or other material becoming entrapped.
- (8) Fluorescent penetrants and emulsifiers used together in an inspection process should be the products of one manufacturer. Developers and solvent removers supplied by other manufacturers may be used in this process.
- (9) If automatic or mechanized inspection processing systems are to be used, they should control the process in such a manner that defect detectability is equivalent to manual operations.
- (10) For general requirements and instructions on fluorescent-penetrant inspection process, refer to Fluorescent Penetrant Inspection (General), TASK 70-11-06-230-803-G00.

B. References

Reference	Title
70-00-07-910-801-G00	Water Types (P/B 201)
70-00-08-910-801-G00	Ultraviolet Light Test (P/B 201)
70-21-23-100-801-G00	Hand Wipe Solvent Degreasing With Chemical Agent (P/B 701)

C. Tools/Equipment

Reference	Description
STD-473	Hood - Black, Prevents Excessive Admission of White Light
STD-560	Lens - Magnifying, 3x
STD-569	Light - Black, Ultraviolet
STD-572	Light - White
STD-774	Respirator - Full-Face, Air Purifying (with filters/cartridges)
STD-818	Sprayer - Pressure
STD-1070	Lens - Magnifying, 10X, Hand Held
STD-3943	Timer - seconds (Stop Watch), Analog or Digital
STD-4055	6 Inch Minimum Length Stainless Steel Pocket Ruler, 1/32" And 1/64" Increments, or Mm And Cm Increments
STD-6169	Borescope - Black Light, 25 Watt
STD-6452	Air Source - Regulated, Dry Filtered, 0-200psig
STD-12914	Brush- soft bristle, small (similar in size to an artist brush)

D. Consumable Materials

Reference	Description	Specification
B00676 [CP1041]	Alcohol - Isopropyl	

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Reference	Description	Specification
B01058 [CP1039]	Solvent - Acetone, Reagent Grade	
B50190 [CP1040]	Solvent - Methyl Ethyl Ketone (MEK)	ASTM D740
G01659	Swab - Cotton Or Rayon, (Disposable)	
G02418	Water - De-ionized	
G50182 [CP3405]	Penetrant - Post-emulsified - Britemor 555	
G50183 [CP3404]	Remover - Hydrophilic - Britemor H91-A	
G50184 [CP3401]	Developer - F.P.I. Developer - Britemor PD 3	
G50185 [CP3406]	Developer - F.P.I. Developer - Britemor PD 4	
G50186 [CP3107]	Penetrant - Liquid Fluorescent Penetrant, Oil Soluble - Zyglo ZL 2C	
G50187 [CP2137]	Remover - Hydrophilic Remover Liquid - Zyglo ZR 10A	
G50188 [CP3105]	Remover - Hydrophilic Remover Liquid - Zyglo ZR 10B	
G50189 [CP3102]	Developer - Developer in Powder Form - Zyglo ZP 4B	
G50190 [CP3106]	Developer Powder - Zyglo ZP-9E/ZP-9F	
G50191 [CP3313]	Penetrant - Post-emulsifying Fluorescent Penetrant - Met-L-Chek FP93A	
G50192 [CP3316]	Emulsifier - Hydrophilic Emulsifier - Met-L-Chek E-58D	
G50193 [CP3317]	Developer - Dry Powder Developer - Met-L-Chek D-72A	
G50194 [CP3318]	Developer - Non-aqueous Wet Developer - Met-L-Chek D-70	
G50195 [CP3300]	Penetrant - Liquid Fluorescent Post-emulsified Penetrant - Sherwin RC 50	
G50196 [CP3306]	Emulsifier - Hydrophilic Emulsifier Liquid - Sherwin ER 83A	MIL-I-25135
G50197 [CP3307]	Developer - Developer Powder - Sherwin D 90 G	
G50198 [CP3308]	Developer - Non-aqueous Wet Developer - Sherwin D 100	MIL-I-25135
G50200 [CP3203]	Developer - Powder Developer - Fluro-Check DD 2A	
G50201 [CP3204]	Developer - Powder Developer - Fluro-Check DD 2B	
G50202 [CP2146]	Developer - Powder Developer in Aerosol - Fluro-Check NAD-NF	
G50205 [CP3010]	Developer - Developer in Powder Form - Ardrex 9 D4A	
G50206 [CP3008]	Developer - Liquid Developer of Wet Suspension Type - Ardrex 9D1/B	
G50527	Water	

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Reference	Description	Specification
G51397 [CP3017]	Penetrant - Water Washable, For Fluorescent Penetrant Inspection, Ardrex9703	
G51710 [CP3018]	Penetrant - Water Washable, For Fluorescent Penetrant Inspection, Ardrex 9704	
G51711 [CP3019]	Penetrant - Water-Washable, Fluorescent - ARDROX 9705	
G51712 [CP3400]	Penetrant - Water Washable - BRITEMOR 4455	
G51713 [CP2153]	Penetrant - Fluorescent, Liquid - FLURO-CHEK WP 100	
G51714 [CP2149]	Penetrant - Fluorescent, Liquid - FLURO-CHEK WP1B	
G51715 [CP3201]	Penetrant - Fluorescent, Water Washable - FLURO-CHEK WP170LS	
G51716 [CP3310]	Penetrant - Fluorescent, Water Washable - MET-L-CHEK FP-91B	
G51717 [CP3311]	Penetrant - Fluorescent, Water Washable - MET-L-CHEK FP-92B	
G51718 [CP3312]	Penetrant - Fluorescent, Water Washable - MET-L-CHEK FP-903	
G51719 [CP3303]	Penetrant - Water-Washable, Liquid - SHERWIN HM-3A	
G51720 [CP3305]	Penetrant - Liquid Water-Washable - SHERWIN HM-440	
G51721 [CP3319]	Penetrant - Liquid Water-Washable - MET-L-CHEK D-701	
G51722 [CP3101]	Penetrant - Fluorescent, Liquid - ZYGLO ZL-60C	
G51723 [CP3013]	Penetrant - Fluorescent, Liquid, Post-Emulsifiable - ARDROX 9812	
G51724 [CP3014]	Penetrant - Fluorescent, Liquid, Post-Emulsifiable - ARDROX 9813	
G51725 [CP3015]	Penetrant - Fluorescent, Liquid, Post-Emulsifiable - ARDROX 9814	
G51726 [CP3016]	Emulsifier - Hydrophilic - ARDROX 9881	
G51727 [CP3105]	Remover - Liquid Hydrophilic - ZYGLO ZR-10B/ZR-10C	
G51728 [CP3402]	Penetrant - Post Emulsifiable - BRITEMOR 600	
G51729 [CP3403]	Penetrant - Post Emulsifiable - BRITEMOR 668	
G51730 [CP3314]	Penetrant - Fluorescent, Post-Emulsifying - MET-L-CHEK FP-95A	
G51731 [CP3315]	Penetrant - Fluorescent, Post-Emulsifying - MET-L-CHEK FP-97A	

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Reference	Description	Specification
G51732 [CP3301]	Penetrant - Fluorescent, Liquid, Post-Emulsified - SHERWIN RC-65	
G51733 [CP3302]	Penetrant - Fluorescent, Liquid, Post-Emulsified - SHERWIN RC-77	
G51734 [CP3103]	Penetrant - Fluorescent, Liquid, Oil Soluble - ZYGLO ZL-27A	
G51735 [CP2141]	Penetrant - Fluorescent, Liquid, Very High Sensitivity - ZYGLO ZL-30A	
G51736 [CP3104]	Penetrant - Fluorescent, Liquid - ZYGLO ZL-37	

E. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

F. Prepare for the Inspection

SUBTASK 70-11-06-910-002-G00

(1) Get these tools and equipment before you start the inspection:

- (a) Use an inspection booth or a darkroom or a black hood, STD-473 (for remote locations) which prevents an unwanted quantity of white light.

NOTE: If you use too much white light, you can prevent the detection and indication of the size of a bad area. Use a test part that has a known defect to make an analysis of the quality of the white light shield.

- (b) Use a 0-200psig dry filtered regulated air source, STD-6452 to dry the parts and to remove excess dry powder developer under a maximum pressure of 29 psi (200 kPa).
- 1) The air supply must have filters to remove oil and moisture to prevent the contamination of the parts or inspection materials.
- (c) Use a pressure sprayer, STD-818 capable of applying fluorescent penetrant products (penetrants, emulsifiers and developers) with a maximum pressure of 29 psi (200 kPa).
- (d) Use an ultraviolet black light, STD-569 to find the fluorescent indications.
- 1) The ultraviolet (black) light source used for the detection of indications shall have an intensity no less than 1200 microwatts/cm² measured at a distance of 15 in. (380 mm) from the source, without filter. In addition, the ultraviolet black light source shall be tested according to Ultraviolet Light Test, TASK 70-00-08-910-801-G00 in order to verify that white light emission is within acceptable limits.
- (e) Use a white light, STD-572 for the visual inspection of the parts.
- (f) Use an analog or digital timer - seconds (stop watch), STD-3943 to measure the time to do the operations.
- (g) You must have these tools to do the inspection:
- 1) A 3x magnifying lens, STD-560 and 10x hand held magnifying lens, STD-1070 to see the fluorescent indications
- 2) A mixture of adjustable mirrors.
- 3) A pocket ruler, STD-4055, black light borescope, STD-6169 or equivalent gages to measure the dimension of the fluorescent indications.

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- 4) Use a paint brush, STD-12914 or swab, G01659 to apply the solvent to make an analysis of the indications that you are not sure of.
 - 5) Bulb-type applicator for dry powder developer when evaluating questionable indications.
- (h) Water system to provide washing and rinsing water. Water system should have the following:
- 1) water, G50527 with a maximum temperature of 100°F (38°C).
 - 2) Hose and spray nozzle to provide directed flow of water as droplets or mist.
 - 3) Water pressure at spray nozzle with a maximum pressure of 58 psi (400 kPa). If necessary, it is acceptable to add filtered air supply to nozzle to obtain a spray.
 - 4) For cleaning parts made of titanium or titanium alloys use de-ionized water, G02418.
 - 5) Ultraviolet lamp available to check effectiveness of water washing.
- (i) Circulating hot air dryer (if necessary). The dryer should have the following:
- 1) Capability to heat to 160°F (71°C) maximum.
 - 2) Indicating device for air temperature.

SUBTASK 70-11-06-910-003-G00

- (2) Get these materials before you start the inspection:

NOTE: Use all materials at ambient temperature. You can use the materials that follow for this class of inspection.

- (a) Penetrant inspection system

Table 201/70-11-06-993-801-G00 Penetrant Inspection Systems (Water-Washable)

Penetrant Inspection Systems	Water Soluble Penetrants	Dry Powder Developers	Non-Aqueous Wet Developers
Ardrox	penetrant, G51397 [CP3017] penetrant, G51710 [CP3018] ARDROX 9705 penetrant, G51711 [CP3019]	Ardrox 9 D4A - powder developer, G50205 [CP3010]	Ardrox 9D1/B - liquid developer, G50206 [CP3008]
Britemor	BRITEMOR 4455 penetrant, G51712 [CP3400]	F.P.I. developer - Britemor PD 3, G50184 [CP3401] F.P.I. developer - Britemor PD 4, G50185 [CP3406]	
Fluro-Check	FLURO-CHEK WP 100 penetrant, G51713 [CP2153] FLURO-CHEK WP1B penetrant, G51714 [CP2149] FLURO-CHEK WP1B penetrant, G51714 [CP2149] FLURO-CHEK WP170LS penetrant, G51715 [CP3201]	powder developer - Fluro-Check DD 2A, G50200 [CP3203] powder developer - Fluro-Check DD 2B, G50201 [CP3204]	aerosol powder developer - Fluro-Check NAD-NF, G50202 [CP2146]

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Table 201/70-11-06-993-801-G00 Penetrant Inspection Systems (Water-Washable) (Continued)

Penetrant Inspection Systems	Water Soluble Penetrants	Dry Powder Developers	Non-Aqueous Wet Developers
Met-L-Check	MET-L-CHEK FP-91B penetrant, G51716 [CP3310] MET-L-CHEK FP-92B penetrant, G51717 [CP3311] MET-L-CHEK FP-903 penetrant, G51718 [CP3312]	dry powder developer - Met-L-Check D-72A, G50193 [CP3317]	wet developer - Met-L-Check D-70, G50194 [CP3318] MET-L-CHEK D-701 developer, G51721 [CP3319]
Sherwin	SHERWIN HM-3A penetrant, G51719 [CP3303] SHERWIN HM-440 penetrant, G51720 [CP3305]	developer powder - Sherwin D 90 G, G50197 [CP3307]	wet developer - Sherwin D 100, G50198 [CP3308]
Zyglo	ZYGLO ZL-60C penetrant, G51722 [CP3101]	powder developer - Zyglo ZP 4B, G50189 [CP3102]	Zyglo ZP-9E/ZP-9F developer powder, G50190 [CP3106]

Table 202/70-11-06-993-802-G00 Penetrant Inspection Systems (Post-Emulsifiable)

Penetrant Inspection Systems	Oil Soluble Penetrants	Hydrophilic Emulsifiers	Dry Powder Developers	Non-Aqueous Wet Developers
Ardrox	ARDROX 9812 penetrant, G51723 [CP3013] ARDROX 9813 penetrant, G51724 [CP3014] ARDROX 9814 penetrant, G51725 [CP3015]	ARDROX 9881 emulsifier, G51726 [CP3016]	Ardrox 9 D4A - powder developer, G50205 [CP3010]	Ardrox 9D1/B - liquid developer, G50206 [CP3008]
Britemor	post-emulsified penetrant - Britemor 555, G50182 [CP3405] BRITEMOR 600 penetrant, G51728 [CP3402] BRITEMOR 668 penetrant, G51729 [CP3403]	Hydrophilic remover - Britemor H91-A, G50183 [CP3404]	F.P.I. developer - Britemor PD 3, G50184 [CP3401] F.P.I. developer - Britemor PD 4, G50185 [CP3406]	
Fluro-Check			powder developer - Fluro-Check DD 2A, G50200 [CP3203] powder developer - Fluro-Check DD 2B, G50201 [CP3204]	aerosol powder developer - Fluro-Check NAD-NF, G50202 [CP2146]

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Table 202/70-11-06-993-802-G00 Penetrant Inspection Systems (Post-Emulsifiable) (Continued)

Penetrant Inspection Systems	Oil Soluble Penetrants	Hydrophilic Emulsifiers	Dry Powder Developers	Non-Aqueous Wet Developers
Met-L-Check	post-emulsifying penetrant - Met-L-Chek FP93A, G50191 [CP3313]MET-L-CHEK FP-95A penetrant, G51730 [CP3314] MET-L-CHEK FP-97A penetrant, G51731 [CP3315]	Hydrophilic emulsifier - Met-L-Chek E-58D, G50192 [CP3316]	dry powder developer - Met-L-Chek D-72A, G50193 [CP3317]	wet developer - Met-L-Chek D-70, G50194 [CP3318]
Sherwin	post-emulsified penetrant - Sherwin RC 50, G50195 [CP3300] SHERWIN RC-65 penetrant, G51732 [CP3301] SHERWIN RC-77 penetrant, G51733 [CP3302]	Sherwin ER 83A emulsifier liquid, G50196 [CP3306]	developer powder - Sherwin D 90 G, G50197 [CP3307]	wet developer - Sherwin D 100, G50198 [CP3308]
Zyglo	liquid penetrant - Zyglo ZL 2C, G50186 [CP3107]ZYGLO ZL-27A penetrant, G51734 [CP3103] ZYGLO ZL-30A penetrant, G51735 [CP2141] ZYGLO ZL-37 penetrant, G51736 [CP3104]	hydrophic remover - Zyglo ZR 10A, G50187 [CP2137] hydrophilic remover - Zyglo ZR 10B, G50188 [CP3105] ZYGLO ZR-10B/ZR-10C remover, G51727 [CP3105]	powder developer - Zyglo ZP 4B, G50189 [CP3102]	Zyglo ZP-9E/ ZP-9F developer powder, G50190 [CP3106]

NOTE: In any case, do not exceed emulsifier concentration indicated in AMS2644 QPL.

- (b) Hydrophilic emulsifier concentration shall be a maximum of 5% for the spray application method.
- (c) Solvents

NOTE: Use only non-halogenated solvents on titanium parts.

- 1) alcohol, B00676 [CP1041]
- 2) acetone solvent, B01058 [CP1039]
- 3) solvent, B50190 [CP1040]

SUBTASK 70-11-06-160-002-G00

- (3) Prepare the part for the inspection as follows:
 - (a) Clean the parts according to the applicable task.
 - (b) Put a plug or cap on all the tubes holes in the area you will examine.

NOTE: This will keep the penetrant or other material out.

G. Fluorescent Penetrant Inspection

SUBTASK 70-11-06-230-001-G00

- (1) Application of penetrant.

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**WARNING**

BE CAREFUL WHEN YOU APPLY THE PENETRANT WITH A SPRAYER. KEEP IGNITION SOURCES AWAY FROM THE AREA TO PREVENT FIRE. THE PENETRANT IS FLAMMABLE WHEN YOU APPLY IT AS A SPRAY.

- (a) Use a pressure sprayer, STD-818 under a maximum pressure of 29 psi (200 kPa) or a paint brush, STD-12914 to apply the penetrant listed in Table 201 or Table 202 according to the fluorescent penetrant inspection process (water-washable or post-emulsifiable).
- (b) Allow a minimum of 20 minutes, in 2 successive cycles (application + draining) of 10 minutes each, for penetration before you remove the excess penetrant.
 - 1) If the process is not continued within 1 hour, the part should be re-wetted with penetrant before proceeding with penetrant removal.
 - a) A maximum of 8 hours may elapse before water washing.
 - b) If processing is interrupted for more than 8 hours, the part must be cleaned and reprocessed.

SUBTASK 70-11-06-230-002-G00

- (2) Removal of excess penetrant (only for post-emulsifiable process):
 - (a) Remove the excess penetrant from surface of part by spray washing with water at a maximum temperature of 100°F (38°C) under a maximum pressure of 58 psi (400 kPa) or with a clean cloth dampened with water.
 - (b) Observe part under ultraviolet light to make sure excess penetrant has been removed.

SUBTASK 70-11-06-230-011-G00

- (3) Apply the emulsifier as follows (only for post-emulsifiable process):
 - (a) Apply emulsifier listed in Table 202 for a maximum of 2 minutes using pressure sprayer, STD-818 under a maximum pressure of 29 psi (200 kPa)
 - (b) Rinse part with water to stop emulsification process by spray.

SUBTASK 70-11-06-230-008-G00

- (4) Rinse part by spray washing it with water at a maximum temperature of 100°F (38°C) under a maximum pressure of 29 psi (200 kPa) under ultraviolet light to make sure background fluorescence is not present, this could interfere with the inspection.

NOTE: Excessive washing will remove indications.

- (a) If excessive background fluorescence is present and caused by emulsifier, repeat water wash of the area.
- (b) If excessive background fluorescence is caused by penetrant, clean the part completely and reprocess it.

SUBTASK 70-11-06-230-012-G00**WARNING**

USE EYE PROTECTION WHEN YOU USE COMPRESSED AIR TO CLEAN, COOL, OR DRY PARTS OR TOOLS. PARTICLES CAN CAUSE AN INJURY TO YOUR EYES. DO NOT POINT COMPRESSED AIR AT YOURSELF OR OTHER PERSONS.

- (5) Remove entrapped water by siphoning, by blowing with 0-200psig dry filtered regulated air source, STD-6452 under a maximum pressure of 29 psi (200 kPa) at a minimum distance of 12 in. (300 mm), or by blotting with clean, lint-free towels.

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SUBTASK 70-11-06-230-013-G00

**WARNING**

USE EYE PROTECTION WHEN YOU USE COMPRESSED AIR TO CLEAN, COOL, OR DRY PARTS OR TOOLS. PARTICLES CAN CAUSE AN INJURY TO YOUR EYES. DO NOT POINT COMPRESSED AIR AT YOURSELF OR OTHER PERSONS.

**CAUTION**

MAKE SURE TO NOT CAUSE CONTAMINATION OR STAINS ON THE PARTS DURING THE DRYING PROCEDURE. CONTAMINATION AND STAINS CAN CAUSE DAMAGE TO THE PARTS.

- (6) Dry the part using any drying procedure, as long as the surface temperature of the part does not exceed 158°F (70°C).

SUBTASK 70-11-06-230-003-G00

- (7) Apply the developer listed in Table 201 or Table 202 according to the fluorescent-penetrant inspection process used (water-washable or post-emulsifiable) as follows:

**WARNING**

PUT ON A RESPIRATOR. DO NOT BREATHE THE FUMES. THE FUMES OF THE DEVELOPER ARE POISONOUS. INJURIES TO PERSONNEL CAN OCCUR.

- (a) Put on a full-face respirator, STD-774.
- (b) Apply developer by pressure sprayer, STD-818 only to a dry part at ambient temperature.
- 1) When you use an aerosol container, follow the manufacturer's directions.
 - 2) Hold the spray nozzle 8 in. (203 mm) to 10 in. (254 mm) from the part surface.
NOTE: If the recommended distance is not possible, keep the distance as close as possible to the recommendation.
 - 3) Spray under a maximum pressure of 29 psi (200 kPa).
 - 4) Apply a fine thin coating of the developer over the penetrant.
NOTE: Normally two passes are adequate.
 - 5) Make sure that the coverage is uniform and the metallic background is visible through the developer.
- (c) Allow a minimum of 10 minutes and a maximum of 1 hour for developer to absorb the penetrant before inspecting the parts.
- (d) Parts must be inspected within 2 hours of developing.
- 1) If part is not inspected within 2 hours, clean it completely and reprocess it.
- (e) If necessary, remove the excess dry powder developer by air blast with a maximum pressure of 4.9 psi (34 kPa) measured at a distance of 11.8 in. (300 mm) between part and nozzle.

SUBTASK 70-11-06-230-004-G00

- (8) Examine the part as follows:

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- (a) Use only bulbs certified by the Nondestructive Test (NDT) original equipment manufacturer.

NOTE: The use of high intensity ultraviolet bulbs which emit an excess amount of white light will affect the sensitivity of the fluorescent penetrant process. Use only bulbs certified by the NDT original equipment manufacturer as having passed their in-house inspection. In addition, these high intensity bulbs should be periodically tested for white light emission.

- (b) Point the ultraviolet black light, STD-569 on the part while in the inspection booth or darkroom.

NOTE: Lighting under white stray light must be less or equal to 20 lux on the inspected surface and at operator eye level.

- (c) Examine the parts for compliance with the limits.
(d) Examine indications that may indicate a defect as follows:



DO NOT GET CLEANING SOLVENT IN YOUR MOUTH OR EYES OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM THE CLEANING SOLVENT. PUT ON A PROTECTIVE SPLASH GOGGLE AND GLOVES WHEN YOU USE THE CLEANING SOLVENT. KEEP THE CLEANING SOLVENT AWAY FROM SPARKS, FLAME AND HEAT. THE CLEANING SOLVENT IS POISONOUS AND FLAMMABLE AND CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

- 1) Wipe the area once with solvent removers (alcohol, B00676 [CP1041], acetone solvent, B01058 [CP1039] or solvent, B50190 [CP1040]) using a swab, G01659, or paint brush, STD-12914.

NOTE: For composite materials, use only the product alcohol, B00676 [CP1041].

- 2) After the solvent dries, apply the developer to the area that you suspect.
3) Examine under a ultraviolet black light, STD-569.
a) Consider indications that show again in 3 minutes as valid indications.
4) If indications do not show again, inspect the part under white light, STD-572 with a 10x hand held magnifying lens, STD-1070.

- (e) Make a mark on the location of the indications with an approved marking procedure.

H. Put the Airplane Back to Its Usual Condition

SUBTASK 70-11-06-230-005-G00

- (1) Clean the parts after the inspection.



MAKE SURE ALL PENETRANT AND DEVELOPER MATERIAL IS REMOVED FROM THE PART AS SOON AS POSSIBLE. IF THE MATERIALS STAY ON THE PART, DANGEROUS CORROSION CAN OCCUR AT HIGHER TEMPERATURES. THIS CAN ALSO CAUSE PROBLEMS DURING THE WELDING PROCEDURES.



DO NOT CLEAN TITANIUM PARTS WITH COMPOUNDS THAT CONTAIN HALOGEN. HALOGEN WILL CAUSE DAMAGE TO THE METAL.

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(CAUTION PRECEDES)



MAKE SURE YOU ONLY USE DEIONIZED WATER WHEN YOU CLEAN PARTS MADE OF TITANIUM OR TITANIUM ALLOYS. IF YOU DO NOT USE DEIONIZED WATER, DAMAGE TO THE PARTS CAN OCCUR.

- (a) Remove developer and penetrant by water spray washing or scrubbing the part with brush and water.



DO NOT GET CLEANING SOLVENT IN YOUR MOUTH OR EYES OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM THE CLEANING SOLVENT. PUT ON A PROTECTIVE SPLASH GOGGLE AND GLOVES WHEN YOU USE THE CLEANING SOLVENT. KEEP THE CLEANING SOLVENT AWAY FROM SPARKS, FLAME AND HEAT. THE CLEANING SOLVENT IS POISONOUS AND FLAMMABLE AND CAN CAUSE INJURY TO PERSONS OR DAMAGE TO EQUIPMENT.

- (b) Remove penetrant residue by hand-wipe solvent degreasing. Refer to Hand Wipe Solvent Degreasing With Chemical Agent, TASK 70-21-23-100-801-G00.

NOTE: For composite materials, use only the product alcohol, B00676 [CP1041].

- (c) Make sure that all internal passages and recesses are completely cleaned and dry.
- 1) Blow out passages and recesses with 0-200psig dry filtered regulated air source, STD-6452 under a maximum pressure of 29 psi (200 kPa).

SUBTASK 70-11-06-210-001-G00

- (2) Examine the part under ultraviolet black light, STD-569 to make sure that you remove all penetrants and developer materials.

SUBTASK 70-11-06-160-003-G00

- (3) Make sure that you completely remove the residues of processing compounds.

SUBTASK 70-11-06-230-014-G00

- (4) Make sure that the emulsifier, solvent remover, developer and penetrant products have been controlled before using them.

————— END OF TASK —————

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MARKING PROCEDURES - MAINTENANCE PRACTICES

1. General

- A. This procedure has these tasks:
- (1) Use of markings
 - (2) Temporary marking methods
 - (3) Vibro-peen marking methods.

TASK 70-11-07-930-801-G00

2. Use of Markings

A. General

- (1) This task provides the instructions on the use of markings.
- (2) The markings can be temporary or done with a vibro engraving equipment.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Use of Markings

SUBTASK 70-11-07-930-002-G00

- (1) Use a marking as follows:
 - (a) Show the location of a defect you find during an inspection.
 - (b) Show the correct position of the parts in an assembly by a series of numbers or a matchmark.
 - (c) Identify the subassembly, the module, or the engine location where you removed the part.
 - (d) Show that you did a procedure or that you must do a procedure.

———— **END OF TASK** ————

TASK 70-11-07-930-802-G00

3. Temporary Marking Methods

A. General

- (1) This task provides the instructions on how to do temporary markings.

B. Consumable Materials

Reference	Description	Specification
G50530 [CP5061]	Marker - Temporary	

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Temporary Marking Methods

SUBTASK 70-11-07-930-003-G00

- (1) If it is necessary to make a temporary marking, do the marking at the location that is specified.

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SUBTASK 70-11-07-930-004-G00

- (2) If the correct procedure and location to make the mark are not specified, use the steps that follow:
- (a) If you use a metal tag, the tag must be stainless steel and connect the tag to the part with a wire made of stainless steel.
 - (b) If you use adhesive tape or labels, the adhesive must go through a test to make sure that it will not cause corrosion.
NOTE: The test must include a check for changes in the adhesive at high temperatures which can cause corrosion.
 - (c) Use a temporary marker, G50530 [CP5061] for procedures that require temporary marking.

**CAUTION**

DO NOT USE GREASE PENCILS OR LEAD (GRAPHITE) PENCILS TO MAKE MARKS ON THE COMBUSTION SECTION AND HOT SECTION PARTS. THESE MATERIALS CAN CAUSE DAMAGE WHEN THEY GET HOT.

- (d) For all inks, paints, pencil graphite and materials you will use, make sure that the material has gone through the tests and approval.
NOTE: These tests are to make sure that the material will not cause corrosion when the parts are at high temperatures.

————— **END OF TASK** —————

TASK 70-11-07-930-803-G00**4. Vibro-Peen Marking Methods****A. General**

- (1) This task provides the instructions on how to do the marking using Vibro-Peen method.
- (2) The Vibro-Peen marking uses a sharp, conically pointed, tungsten carbide tool which is vibrated, either electrically or pneumatically, against the surface to be marked while guided by the operator's hand, much like a pen. The point, vibrating at several thousand strokes per minute, peens or imprints the surface to be marked with depressions.

B. Tools/Equipment

Reference	Description
STD-6617	Equipment - Vibro-engraving

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Vibro-Peen Marking Method

SUBTASK 70-11-07-930-001-G00

- (1) Do these steps to mark the parts with Vibro-Peen method:
- (a) Make sure that the area to be marked is clean and clear of obstructions.
 - (b) Turn the vibro-engraving equipment, STD-6617 marking tool ON and adjust stroke if it is necessary.

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- (c) Guide the vibro-engraving equipment, STD-6617 marking tool by hand to "write" marking information.

NOTE: Markings from 0.001 in. (0.03 mm) - 0.006 in. (0.15 mm) are permitted.

- (d) Carefully remove all projections produced on the surface by the displaced metal.
(e) Examine the mark for uniformity and legibility.

———— **END OF TASK** ————

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TRI-WING FASTENERS - MAINTENANCE PRACTICES

1. General

- A. This procedure has two tasks:
- (1) Tri-wing fasteners removal
 - (2) Tri-wing fasteners installation.

TASK 70-11-08-000-801-G00

2. Tri-Wing Fasteners Removal

(Figure 201)

A. General

- (1) This task provides the instructions on how to remove the tri-wing fasteners.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Tri-Wing Fasteners Removal

SUBTASK 70-11-08-020-001-G00

- (1) Remove the fastener.
 - (a) Make sure that you use the correct driver for the fastener.

NOTE: The driver number must agree with the recess number of the fastener head as shown in the figure. If the fastener recess has a layer of paint or material for protection, use a driver one number smaller.
 - (b) Put the driver into the recess of the fastener.



MAKE SURE THAT THE AXIS OF THE DRIVE IS ALIGNED WITH THE AXIS OF THE FASTENER WHEN YOU INSTALL OR REMOVE THE FASTENER. IF THE DRIVE TOOL IS NOT ALIGNED WITH THE FASTENER, YOU CAN CAUSE DAMAGE TO THE RECESS OF THE FASTENER.

- (c) Align the axis of the driver with the axis of the fastener.
- (d) Turn the driver counter-clockwise.

SUBTASK 70-11-08-020-002-G00

- (2) If you find damage on the recess of the fastener, remove the fastener as follows:
 - (a) Select the correct drill bit and the correct screw removal tool for the dimension of the fastener.
 - (b) Drill a hole into the fastener to a depth that will let you use the screw removal tool.

NOTE: The bottom of the fastener recess has a shape that helps the drill bit to stay in the center of the fastener.
 - (c) Install the screw removal tool.
 - (d) Turn the screw removal tool counter-clockwise to loosen and remove the fastener.

———— **END OF TASK** ————

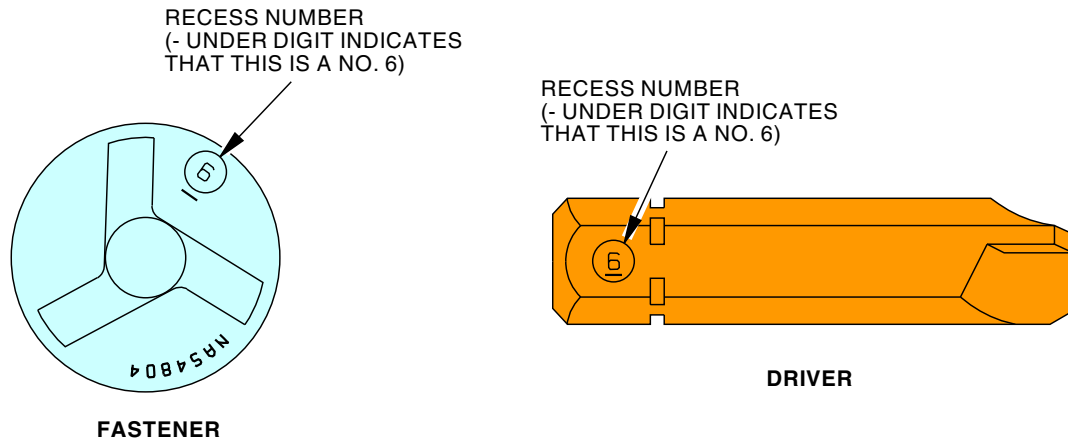
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Tri-Wing Fastener and Drive Configuration
Figure 201/70-11-08-990-801-G00

TASK 70-11-08-400-801-G00

3. Tri-Wing Fasteners Installation

(Figure 201)

A. General

(1) This task provides the instructions on how to install the tri-wing fasteners.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Tri-Wing Fasteners Installation

SUBTASK 70-11-08-420-001-G00

(1) Install the fastener as follows:

(a) Make sure that you use the correct driver for the fastener installation.

NOTE: The driver number must agree with the number of the fastener head as shown in the figure. If the recess of the fastener has a layer of paint or other material for protection, use a driver one size smaller.

(b) Put the driver into the recess of the fastener.

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**CAUTION**

MAKE SURE THAT THE AXIS OF THE DRIVE IS ALIGNED WITH THE AXIS OF THE FASTENER WHEN YOU INSTALL OR REMOVE THE FASTENER. IF THE DRIVE TOOL IS NOT ALIGNED WITH THE FASTENER, YOU CAN CAUSE DAMAGE TO THE RECESS OF THE FASTENER.

- (c) Align the axis of the driver with the axis of the fastener.
- (d) Turn the driver clockwise to tighten and install the fastener.

———— **END OF TASK** ————

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HOSE ASSEMBLIES - MAINTENANCE PRACTICES

1. General

- A. This procedure has one tasks:
- (1) Hose assembly fire sleeve standard repair.

TASK 70-11-10-300-801-G00

2. Hose Assembly Fire Sleeve Standard Repair

(Figure 201)

A. General

- (1) This task provides the instructions on how to repair a damaged fire sleeve of a hose assembly.
- (2) You can use this task if the damaged area is less than 0.5 in² (322.6 mm²).
- (3) This task is not applicable to the hydraulic hoses.

B. Tools/Equipment

Reference	Description
STD-549	Knife - Putty, Broad Blade

C. Consumable Materials

Reference	Description	Specification
A01072 [C01-049]	Compound - RTV Potting, 2-Part - RTV 577 (white)	
B00130	Alcohol - Isopropyl	TT-I-735
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	AMS3819 Class 1 Grade A or B Form 1 (Supersede BMS15-5 CLA)
G00252	Film - Polyethylene Film And Sheeting	ASTM D2103 (Supersedes L-P-512)
G02462 [C10-136]	Tape - Flash-Breaker - No. 855	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Hose Assembly Fire Sleeve Standard Repair

SUBTASK 70-11-10-160-001-G00

- (1) Do these steps to repair a damaged area on the fire sleeve of a hose assembly:



WARNING

DO NOT GET THIS MATERIAL IN YOUR MOUTH, EYES, OR ON YOUR SKIN. PUT ON EYE PROTECTION (GOGGLES, OR OTHER APPROVED PROTECTION) AND GLOVES WHEN YOU USE THIS MATERIAL. MAKE SURE THAT THERE IS SUFFICIENT AIRFLOW. KEEP THIS MATERIAL AWAY FROM SPARKS, FLAME, AND HEAT. THIS MATERIAL CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

- (a) Use cotton wiper, G00034, and alcohol, B00130, to clean the damaged area.
- (b) Prepare the damaged area as follows:

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- 1) Use broad blade putty knife, STD-549, to remove the material from around the damaged area.

NOTE: Do not remove more than 0.25 in. (6.35 mm) around the damaged area.

- 2) Make sure that the contour is smooth and that all of the damaged and loose material is removed.

- (c) Use cotton wiper, G00034, and alcohol, B00130, to clean the repair area.

**WARNING**

DO NOT GET SILICONE RUBBER IN YOUR MOUTH, EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SILICONE RUBBER. PUT ON GOGGLES, AND GLOVES WHEN YOU USE SILICONE RUBBER. KEEP SILICONE RUBBER AWAY FROM SPARKS, FLAME, AND HEAT. SILICONE RUBBER IS POISONOUS AND FLAMMABLE, AND CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

- (d) Mix RTV 577 compound, A01072 [C01-049], to this ratio.
 - 1) Use 99.5 parts (by weight) of RTV 577 compound, A01072 [C01-049].
 - 2) Use 0.5 part (by weight) of the catalyst.
- (e) Do these steps to apply RTV 577 compound, A01072 [C01-049], to the repair area.
 - 1) Fill the repair area with RTV 577 compound, A01072 [C01-049].
 - 2) Put more RTV 577 compound, A01072 [C01-049], on one side of the repair area.
- (f) Do these steps to put a layer of polyethylene film, G00252, around the repair area of the hose assembly:
 - 1) Wind polyethylene film, G00252, around the hose in a direction that will push the compound above the repair area.
 - 2) Tighten polyethylene film, G00252, around the hose to remove the air caught below polyethylene film, G00252.
 - a) Make sure that you push the compound into the repair area.
- (g) Apply No. 855 tape, G02462 [C10-136], around polyethylene film, G00252, and the hose assembly.
 - 1) Make sure that No. 855 tape, G02462 [C10-136], holds polyethylene film, G00252, on the repair area.
- (h) A minimum of six (6) hours at room temperature is necessary for RTV 577 compound, A01072 [C01-049], to dry.
- (i) Remove No. 855 tape, G02462 [C10-136], tape and polyethylene film, G00252.

SUBTASK 70-11-10-210-001-G00

- (2) Do a visual inspection to make sure that RTV 577 compound, A01072 [C01-049], is fully bonded.

———— **END OF TASK** ————

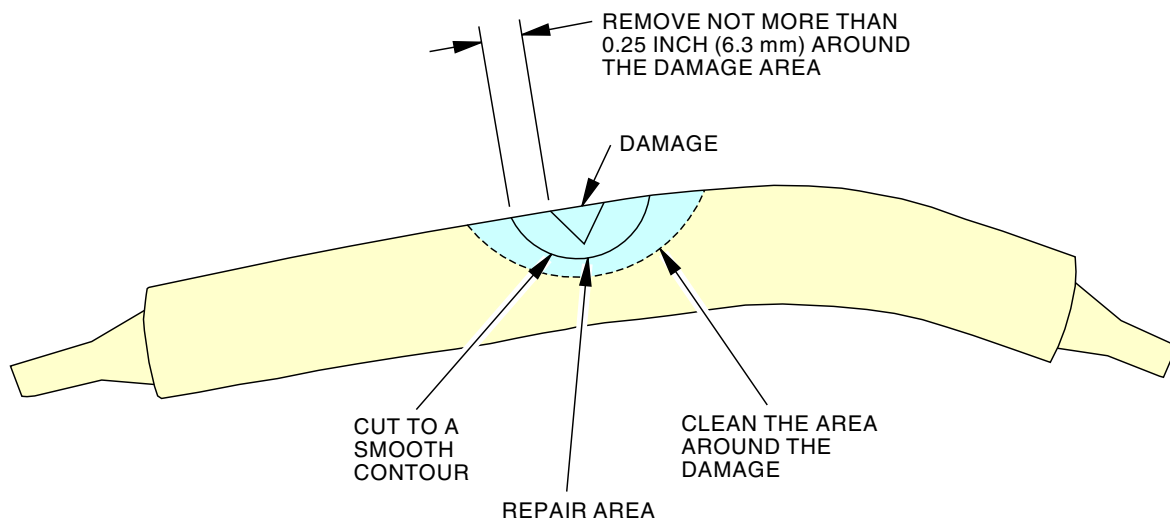
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PREPARATION OF THE REPAIR AREA

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Hose Assembly Fire Sleeve Repair
Figure 201/70-11-10-990-801-G00 (Sheet 1 of 2)

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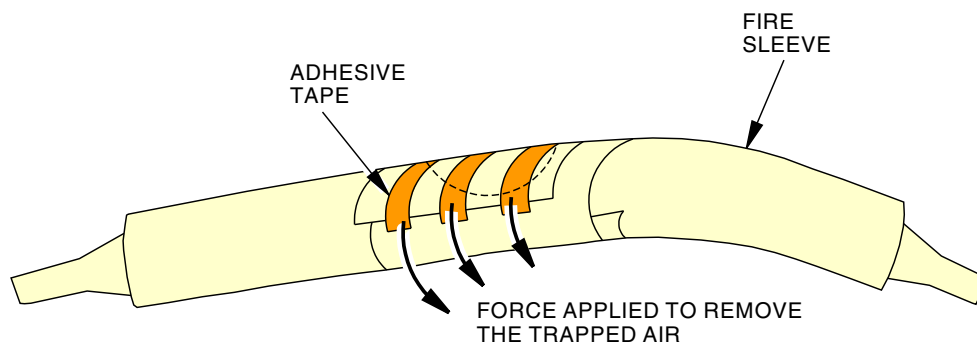
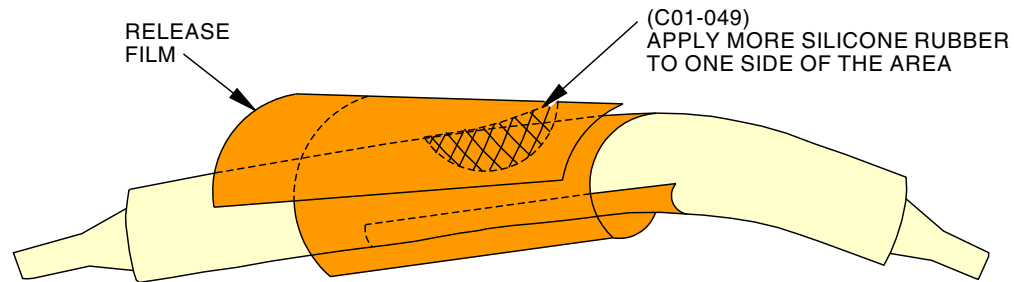
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APPLICATION OF THE RELEASE FILM OVER THE REPAIR AREA

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Hose Assembly Fire Sleeve Repair
Figure 201/70-11-10-990-801-G00 (Sheet 2 of 2)

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CLEANING METHOD - CLEANING/PAINTING

1. General

- A. This procedure has two tasks:
- (1) Steam cleaning method No. 3
 - (2) Hand wipe cleaning of metallic engine components.

TASK 70-11-11-100-801-G00**2. Steam cleaning method No. 3****A. General**

- (1) This task is steam cleaning method No. 3.
- (2) Steam cleaning combines the mechanical force of the spray jet with the chemical and physical action of the cleaning solution to remove oils, greases, and light soil from parts. This method is used when the part is too big for a soak tank or for component parts of different materials that cannot be put into acid or alkaline tanks.
- (3) An alternative to this process is to use steam cleaning at temperatures more than 212.0°F (100.0°C) without the detergent additive. At these elevated temperatures, most detergents break down and become ineffective. However, steam at these high temperatures will effectively remove oils, greases, and light soils without any detergent.
- (4) This process can be used on all materials except thermo-plastic materials.

B. Tools/Equipment

Reference	Description
STD-9077	Spray Gun

C. Consumable Materials

Reference	Description	Specification
B01041 [C04-208]	Solvent - Degreaser - Turco 5948 DPM	
B50200 [C04-152]	Cleaner - Turco 5948-R Mild Alkaline	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Steam Cleaning Method No. 3

SUBTASK 70-11-11-160-001-G00

**WARNING**

MAKE SURE THE PERSON WHO OPERATES THE STEAM CLEANER SPRAY GUN WEARS PROTECTIVE CLOTHING. THE HANDS, ARMS, FEET, BODY, AND FACE MUST HAVE PROTECTION. THIS WILL PREVENT INJURY TO PERSONS.

- (1) Use Turco 5948-R cleaner, B50200 [C04-152] or Turco 5948 DPM solvent, B01041 [C04-208] and steam clean as follows (Table 701):

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Table 701/70-11-11-993-802-G00 Alkaline Cleaning Solution

Consumable No.	Consumable Code	Consumable Product	Concentration (Initial Mix)	Operating Temperature
B50200	(C04-152)	Turco 5948-R	1.3 fl oz/US gals (10 ml/l)	160-220°F (70- 105°C)
B01041	(C04-208)	Turco 5948 DPM	1.3 fl oz/US gals (10 ml/l)	160-220 °F (70- 105 °C)

- (a) Adjust the appropriate water/steam/solution/temperature control to the necessary setting to get a proper cleaning action.

NOTE: This will give a wet spray with sufficient impact to clean the surface.

- (b) Hold the spray gun, STD-9077 approximately 10.0 - 12.0 inches (250.0 - 300.0 mm) from the surface and inclined at approximately 45 degrees to the surface.
- (c) Rinse the part with unheated water (optional).



CAUTION

DO NOT USE CHLORINATED SOLVENTS ON TITANIUM PARTS OR COMPONENTS.

- (d) Rinse the parts with hot water at a minimum 150.0°F (66.0°C) with a spray gun, STD-9077 with the cleaning solution supply shut off and as follows:
- 1) If this procedure is used on titanium, titanium is subject to the requirements that follow regarding chloride:
 - a) If parts will be exposed to subsequent processing that operates above 500.0°F (260.0°C) (for example, welding or heat treating).

<1> The final rinse water used on the parts must not be more than 50.0 ppm chloride (10000.0 ohm-cm minimum resistivity, 100.0 Microsiemens/cm maximum conductivity).
 - b) For parts that will not be exposed to subsequent processing that operates above 500.0°F (260.0°C).

<1> The final rinse water used on the parts can be potable water that must not be more than 250.0 ppm chloride (1800.0 ohm-cm minimum resistivity, 550.0 Microsiemens/cm maximum conductivity).



WARNING

WHEN YOU USE THE COMPRESSED AIR TO CLEAN, TO COOL OR TO DRY, DO NOT EXCEED 30 PSIG (207 KPA). MAKE SURE YOU WEAR EYE PROTECTION AND DO NOT DIRECT COMPRESSED AIR AT YOURSELF AND OTHERS. INJURY TO PERSONNEL CAN OCCUR.

- (e) Dry the part by one of the following two methods.

NOTE: Parts must be thoroughly dry before the fluorescent penetrant inspection (FPI). Water on the parts may degrade the sensitivity of the process, especially for the water washable penetrant process.

- 1) Flash dry the part as follows:

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- a) Let the steam and hot water stay on the part long enough to reach a temperature sufficient to give flash drying.
NOTE: The time necessary will vary with the part size, the water temperature and the tank size. Correct flash drying is indicated by seeing the water on the surface of a part start to “flash” or “whisk” off as the part is being removed from the hot water tank.
 - b) Use repositioning, suction, blotting with a clean, absorbent material, or by blowing off with an oil and the water filtered shop air gun to remove excess water.
- 2) You can substitute drying the part in an air re-circulating oven for the dwell time in the hot water spray.
 - a) Remove the part from the water.
 - <1> You can remove excess water by repositioning, suction, blotting with a clean absorbent material, or blowing the water off with an oil and water filtered shop air gun.
 - <2> It is recommended to keep the part in the oven for an additional 15 minutes after all traces of surface water have been removed.
 - b) Move the part into the oven and set the oven at a temperature compatible with part materials, heat treatments, and coatings.
 - <1> Keep the part in the oven until all traces of surface water are removed.
 - <2> It is recommended to keep the part in the oven for an additional 15 minutes after all traces of surface water have been removed.
- NOTE: A temperature of 200.0°F ± 25.0°F (93.0°C ± 14.0°C) is recommended.

SUBTASK 70-11-11-210-001-G00

- (2) Visually examine the cleanliness of the parts particularly for residues trapped in holes and recesses.

————— **END OF TASK** —————

TASK 70-11-11-100-802-G00

3. Hand Wipe Cleaning (Method No. 23) of Metallic Engine Components

A. General

- (1) This task is the hand wipe cleaning (method No. 23) of metal engine components.

NOTE: This task is applicable to metal components, including components made of titanium and non-titanium hardware.

NOTE: This task is not applicable to composite engine components.

- (2) Cleaners should be applied to the wipe cloths from dispensers that prevent contamination of the working fluid.
- (3) Some cleaners will need post-rinsing with water and others are very slow to dry. These conditions must be considered when you use these products before fluorescent penetrant inspection (FPI). For process known defect standards or parts with the selected cleaner if used before FPI make sure that the process capability is maintained.

B. Tools/Equipment

Reference	Description
STD-858	Tag - DO NOT OPERATE

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C. Consumable Materials

Reference	Description	Specification
B00094	Solvent - Toluene	A-A-59107
B00666	Solvent - Methyl Propyl Ketone	BMS11-9
B00679 [C04-035]	Alcohol - Isopropyl	
B00722	Solvent - Stoddard	MIL-PRF-680 Type I or II (Supersedes P-D-680 Type I or II)
B50085	Solvent - Skykleen 1000	BAC5750
B50272 [C04-261]	Solvent - 3M Novec HFE-7100 Engineered Fluid	
E50001	Solvent - Acetone	ASTM D 329 (Supersedes O-A-51)
G02351 [C04-140]	Cleaner - Liquid Gas Path	MIL-PRF-85704
G50031 [C10-108]	Brush - Disposable, Natural Bristle - No. 7237T4 or 7798T2	
G50035 [C10-182]	Cloth - Cleaning For Aircraft Structural	SAE-AMS 3819, BMS 15-5

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Prepare for the Cleaning

SUBTASK 70-11-11-860-001-G00

- (1) Do these steps to make sure that the ENGINE START switch and the START LEVER switch are not operated:
 - (a) Make sure that the applicable ENGINE START switch, on the P5 overhead panel, is in the AUTO or OFF position.
 - 1) Put a DO NOT OPERATE tag, STD-858, on the applicable ENGINE START switch.
 - (b) Make sure that the applicable START LEVER switch, on the P10 control stand, is in the CUTOFF position.
 - 1) Put a DO NOT OPERATE tag, STD-858, on the applicable START LEVER switch.

F. Hand Wipe Cleaning of Metallic Engine Components

DO NOT GET ISOPROPYL ALCOHOL (IPA) IN YOUR MOUTH, EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM IPA. PUT ON GOGGLES, AND GLOVES WHEN YOU USE IPA. KEEP IPA AWAY FROM SPARKS, FLAME, AND HEAT. IPA IS POISONOUS AND FLAMMABLE. IT CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

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(WARNING PRECEDES)**WARNING**

DO NOT GET SOLVENTS IN YOUR MOUTH OR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. PUT ON A RESPIRATOR, PROTECTIVE SPLASH GOGGLES, AND GLOVES WHEN YOU USE SOLVENTS. KEEP THE SOLVENTS AWAY FROM SPARKS, FLAME, AND HEAT. SOLVENTS ARE POISONOUS AND FLAMMABLE. SOLVENTS CAN CAUSE INJURIES TO PERSONNEL, AND DAMAGE TO EQUIPMENT.

SUBTASK 70-11-11-300-001-G00

- (1) Wipe the part with a clean cloth, G50035 [C10-182], soaked with one of the cleaners in the list that follows:

NOTE: You can also use a No. 7237T4 or 7798T2 brush, G50031 [C10-108], to clean the component. Do a final wipe of the component with a cloth, G50035 [C10-182], soaked with the cleaner.

- (a) solvent, B00722
- (b) solvent, E50001
- (c) alcohol, B00679 [C04-035]
- (d) solvent, B00094
- (e) solvent, E50001
- (f) solvent, B00666
- (g) solvent, B50085
- (h) 3M Novec HFE-7100, B50272 [C04-261]
- (i) gas path cleaner, G02351 [C04-140], 20% concentration

NOTE: You must flush the component with clean water when you use the gas path cleaner, G02351 [C04-140], to clean the component.

- (j) gas path cleaner, G02351 [C04-140]

NOTE: You must flush the component with clean water when you use the gas path cleaner, G02351 [C04-140], to clean the component.

- (k) You can also use type III cleaners that meet MIL-PRF-85704C in this procedure.

NOTE: You must flush the component with clean water when you use the approved type III cleaners to clean the component.

**CAUTION**

MAKE SURE YOU ONLY USE DEIONIZED WATER WHEN YOU CLEAN PARTS MADE OF TITANIUM OR TITANIUM ALLOYS. IF YOU DO NOT USE DEIONIZED WATER, DAMAGE TO THE PARTS CAN OCCUR.

- 1) Make sure that you use only deionized water when you flush a titanium component.
 - a) If this procedure is used on titanium, you must do the steps that follow:
 - <1> If the parts will be exposed to subsequent processing that operates above 500.0°F (260.0°C) (for example welding or heat treating) the final rinse water used on the parts must not exceed 50.0 ppm chloride (1000.0 ohm-cm minimum resistivity, 100.0 Microsiemens/cm maximum conductivity).

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<2> For parts that will not be exposed to subsequent processing that operates above 500.0°F (260.0°C) the final rinse water used on the parts can be potable water that must not exceed 250.0 ppm chloride (1800.0 ohm-cm minimum resistivity, 550.0 Microsiemens/cm maximum conductivity).

- (l) Dry the part with a clean cloth, G50035 [C10-182].
- (m) Blow dry with clean dry air.
- (n) Do an inspection of the component to make sure that it is clean.
 - 1) If it is necessary, do the cleaning procedure again

G. Put the Airplane Back to Its Usual Condition

SUBTASK 70-11-11-860-002-G00

- (1) Do these steps to remove the DO NOT OPERATE tags, STD-858, from the applicable ENGINE START switch and START LEVER switch:
 - (a) On the P5 overhead panel, remove the DO NOT OPERATE tag, STD-858, from the applicable ENGINE START switch.
 - (b) On the P10 control stand, remove the DO NOT OPERATE tag, STD-858, from the applicable START LEVER switch.

———— **END OF TASK** ————

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CHEMICAL CLEANING - MAINTENANCE PRACTICES

1. General

- A. This procedure contains general chemical cleaning instruction and provides a list of Organic solvents to be used for surface cleaning.

TASK 70-21-00-100-801-G00

2. Chemical Cleaning Process

A. Procedure

SUBTASK 70-21-00-100-001-G00

- (1) Chemical cleaning is a process used for removing surface contaminants such as oil, grease, carbon deposits, oxidizing agents and corrosion. It is employed to clean surfaces prior to visual inspection, prior to crack detection using fluorescent penetrant or magnetic particle inspection methods, and prior to making repairs.

NOTE: The effectiveness of some cleaning processes may be improved by manually assisting the process using various types of fiber bristle brushes and/or polishing pads. Obey all applicable safety cautions for the cleaning processes including cautions regarding contact with skin, eyes, and clothing.

- (2) The chemical cleaning processes are to be used in conjunction with the Process Document, which should cover the operations or special handling of parts that precede and follow the application of the particular process.

B. Special recommendations

SUBTASK 70-21-00-280-003-G00

- (1) Any drying process is allowed, as long as the surface temperature of the part does not exceed 70 degC (158 degF) by default. The drying process should not cause any contamination, or stains.
- (2) Various types of bristle brushes for part configuration or cleaning pads may be used in addition to the wiping cloths, clean, white, lint-free cotton cloths, or unsized cheesecloth.
- (3) Parts made entirely or partially out of titanium must not be degreased with halogenated solvents.

C. Material compatibility

SUBTASK 70-21-00-500-002-G00

- (1) Table 1 below provides a list of Organic solvents to be used for cleaning

———— **END OF TASK** ————

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			BASE MATERIAL							
			NON-ALLOY OR LOW ALLOY STEEL	STAINLESS STEEL	HIGH STRENGTH STEELS (Rm>1150 MPa)	NICKEL OR COBALT BASE ALLOYS	TITANIUM BASE ALLOYS	ALUMINUM BASE ALLOYS	COPPER BASE ALLOYS	MAGNESIUM BASE ALLOYS
SUPPLIER PRODUCT REFERENCE	BOEING BULK REFERENCE	PRODUCT NAME								
CP1039	B01058	ACETONE	A	A	A	A	A	A	A	A
CP1040	B50190	METHYL ETHYL KETONE	A	A	A	A	A	A	A	A
CP1041	B00676	ISOPROPYL ALCOHOL	A	A	A	A	A	A	A	A
CP2010	B50295	DEAROMATIZED WHITE SPIRIT	A	A	A	A	A	A	A	A
CP2559	B50290	ARDROX 5503 (ARDROX 552)	A	A	A	A	A	A	A	A
CP2687	B50333	DIESTONE DLS	A	A	A	A	A	A	NA	NA
CP2726	B50334	SUPERSOLV AS	A	A	A	A	A	A	NA	NA
CP2727	B50345	LOTOXANE FAST	A	A	A	A	A	A	NA	NA
CP2947	B50347	DYNA 200	A	A	NA	A	A	A	NA	NA
A: AUTHORIZATION FOR USE NA: UNAUTHORIZED USE IN THE ABSENCE OF DATA APPROVED BY SAFRAN AIRCRAFT ENGINES										

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**Table 1: Organic solvents
Figure 701/70-21-00-990-801-G00**

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HAND WIPE SOLVENT DEGREASING - CLEANING

1. General

- A. This procedure contains the hand wipe solvent degreasing with chemical agent task.

TASK 70-21-23-100-801-G00

2. Hand Wipe Solvent Degreasing With Chemical Agent

A. General

- (1) This process is used to clean parts contaminated with oil, grease or various slightly adherent deposits by a reduction in viscosity and/or dissolution in the solvent.
- (2) Cleaners should be applied to the wipe cloths from dispensers that prevent contamination of the working fluid.
- (3) Refer to: Chemical Cleaning Process, TASK 70-21-00-100-801-G00 for general requirements, material compatibilities and instructions on cleaning process.

B. References

Reference	Title
70-21-00-100-801-G00	Chemical Cleaning Process (P/B 701)

C. Consumable Materials

Reference	Description	Specification
B00676 [CP1041]	Alcohol - Isopropyl	
B01058 [CP1039]	Solvent - Acetone, Reagent Grade	
B50190 [CP1040]	Solvent - Methyl Ethyl Ketone (MEK)	ASTM D740
B50290 [CP2559]	Solvent - degreasing, Ardrex 5503	
B50295 [CP2010]	Solvent - cleaning, White Spirit	
B50333 [CP2687]	Solvent - Degreasing, Diestone DLS	
B50344 [CP2726]	Solvent - Supersolve AS	
B50345 [CP2727]	Solvent - Lotoxane Fast	
B50347 [CP2947]	Solvent - Degreasing, DYNA 200	

D. Prepare for the Cleaning



SOLVENTS ARE POISONOUS AND FLAMMABLE. DO NOT LET SOLVENTS TOUCH SKIN OR BREATHE FUMES. YOU MUST HAVE PRECAUTIONS AGAINST FIRE. IF YOU DO NOT OBEY INSTRUCTIONS, INJURIES TO PERSONNEL CAN OCCUR.



SOLVENT CLEANER CAN HAVE A LOW FLASH POINT. YOU MUST HAVE PRECAUTIONS AGAINST FIRE. IF YOU DO NOT OBEY INSTRUCTIONS, INJURIES TO PERSONNEL CAN OCCUR.

SUBTASK 70-21-23-100-001-G00

- (1) Wipe the parts with a clean cloth soaked with one of the products listed in Consumable Products - Table 1 below: acetone solvent, B01058 [CP1039], or solvent, B50190 [CP1040], or alcohol, B00676 [CP1041], or degreasing solvent, B50333 [CP2687], or Ardrex 5503, B50290 [CP2559], or White Spirit, B50295 [CP2010], or solvent, B50344 [CP2726], or solvent, B50345 [CP2727], or solvent, B50347 [CP2947].

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Table 1: Consumable Products

Material	Consumable Product Name	Supplier Product Reference	Boeing Bulk Reference	Reference Document
(1)	Acetone	CP1039	B01058	70-80-10-XXX-XXX
(2)	Methyl Ethyl Ketone	CP1040	B50190	70-80-10-XXX-XXX
(3)	Isopropyl Alcohol	CP1041	B00676	70-80-10-XXX-XXX
(4)	Diestone DLS	CP2687	B50333	70-80-26-XXX-XXX
(5)	Supersolve AS	CP2726	B50334	70-80-27-XXX-XXX
(6)	Ardrox 5503 (Ardrox 552)	CP2559	B50290	70-80-25-XXX-XXX
(7)	Lotoxane Fast	CP2727	B50345	70-80-27-XXX-XXX
(8)	Dearomatized White Spirit	CP2010	B50295	70-80-20-XXX-XXX
(9)	Dyna 200	CP2947	B50347	70-80-29-XXX-XXX

NOTE: All materials are used at ambient temperature.



MAKE SURE THAT YOU REMOVE ALL DRY RESIDUES AFTER IT IS DRY. IF YOU DO NOT REMOVE UNWANTED RESIDUES, DAMAGE TO EQUIPMENT CAN OCCUR.

- (2) Dry the part with the equipments specified in Equipment Products - Table 2 below:

Table 2 - Equipment Products

Equipment	Description	Note
Safety equipment	Use necessary safety equipment and devices to guarantee the application of the standard practice in complete safety for the operator	
Wiping cloths	Use clean, white, lint-free cotton cloths or unsized cheesecloth	
Bristle brushes	Use various types according to the part configuration or cleaning pads may be used.	

- (3) Blow dry with clean, dry air.

E. Quality Assurance

SUBTASK 70-21-23-210-001-G00

- (1) Visually check the part. It must display a uniform appearance and be free of runs, stains, chips and dry residues.
- (2) Repeat the process if necessary.

————— **END OF TASK** —————

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ULTRASONIC - INSPECTION

1. General

A. This procedure has this task:

- (1) A test for cracks and other defects with ultrasonic.

TASK 70-35-00-270-801-G00

2. Test for Cracks and Other Defects with Ultrasonic

(Figure 601, Figure 602, Figure 603, Figure 604, and Figure 605)

A. General

- (1) The ultrasonic methods of nondestructive testing are used to inspect engine components to determine if the parts contain discontinuities or defects that could affect the life, or use of the part, or to validate repairs such as various bonding tasks.
- (2) There are two basic types of ultrasonic testing:
 - The pulse-echo A scan test
 - The through-transmission or pitch-catch test.
- (a) In pulse-echo A scan testing, specific test apparatus converts electrical energy into short pulses of high frequency sound waves. These sound waves are then transmitted to the hardware to be inspected by means of coupling medium or couplant. After passing through this couplant the sound waves continue into or through the hardware and are altered or reflected by sonic reflectors (flaws or back surfaces) back through the couplant and into the ultrasonic receiving element. This sound wave pattern is then processed by the ultrasonic instrument and is observed by the inspector through the use of a Cathode Ray Tube (CRT). Recording equipment or other monitoring facilities may be used to modify this basic system and to provide permanent documentation of inspection results (Figure 601).
- (b) In the through-transmission or pitch-catch type of testing 2 transducers are used. Accurate positioning of the receiving transducer is required to assure the proper capture of transmitted energy (Figure 602).
- (3) Contact testing and immersion testing are the two basic ultrasonic testing techniques.
 - (a) Immersion testing is the generally applied inspection process. During immersion testing a waterproof transducer is used at a distance from the test part. The ultrasonic waves are then transmitted into the material through the liquid medium (couplant). The distance between the transducer and part surface now appears on the CRT display as a wide space between the initial sonic pulse and front surface reflection. In standard immersion testing both the transducer and hardware are immersed in the couplant, usually water. This permits easy changes in sonic incident angles and allows mode changes by angulating either the hardware or transducer holder (manipulator). However, a disadvantage to this system is the need for a tank sufficiently large enough to submerge both the transducer and hardware (Figure 603).

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- (b) In contact testing the transducer is used with a very thin film of couplant between the transducer assembly and test part. The CRT display from a contact system usually shows the initial sound pulse from the transducer and front surface reflection as superimposed or very close together. Contact testing can be complicated by the inability to maintain a constant and uniform coupling between the transducer assembly and the test part. Different test part contours and/or sonic propagation directions or modes usually require different transducer assemblies to ensure contact with test part surface. Contact testing is limited to those components and tasks where the specific test method, equipment, transducers, etc., have been judged to be suited for this inspection task.
- (4) The three primary modes of sonic wave propagation used during ultrasonic inspection are the following (Figure 604):
- Longitudinal
 - Shear
 - Surface wave.
- (a) Longitudinal or compression waves have particle vibrations in the same direction as the sound motion.
- (b) Shear or transverse wave particle vibrations are at right angles to the sound motion.
- (c) Surface or rayleigh waves produce an elliptical shear wave form that moves along the free boundary or surface of a solid and is normally confined to a penetration depth of approximately 25 percent of a wave length.
- (5) The following equation, an adaptation of Snell's Law, is used to calculate incident angles, refracted angles, and modes:
- (a) $\sin \theta_1 = V_1/V_2$
- θ_1 = Incident angle of beam from normal
 - θ_2 = Refracted beam angle in the test material
 - V_1 = Velocity of sound in the first medium
 - V_2 = Velocity of sound in the second medium.
- NOTE:** Maximum reflection from a sonic reflector is achieved when the reflector surface is 90 percent or perpendicular to the sound propagation direction.
- (6) When an ultrasonic wave that is traveling through one medium reaches a boundary between it and the second medium, part of the energy continues through the second medium while the remainder is reflected back into the first. The characteristics of each material that determines the amount of reflection is known as the acoustic impedance (z) of the material and is a product of the density of the material (p) and velocity of sound in the material (v), ($z = pv$). In a pulse-echo system the ultrasonic waves pass through an interface twice, once in each direction. If the second medium is air almost 100 percent of the sound energy will be reflected back into the first medium. If the second medium is not air a different percentage of sound energy will be reflected back toward the first medium. Acoustic impedance may be matched and reflection reduced by keeping the impedances the same, however, it is normally necessary in ultrasonic testing to transmit sound energy between mediums of greatly different acoustic impedances and some method must be available to accomplish this. The best method of reducing impedance mismatch is the liquid couplants.
- (7) The couplant couples the sound energy transmitted from the transducer to the test part. There is a wide range of couplants including liquids, pastes, and semi-liquids that fulfill the following requirements:

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- (a) The couplant must have an acoustic impedance between that of the transducer face and test specimen.
 - (b) The couplant should be harmless to the part, easily applied, viscous, easily removed, free of air bubbles and homogeneous, and should theoretically wet both the transducer face and specimen surfaces. Water, tap (as defined in TASK 70-00-07-910-801-G00), or with a wetting agent added, is commonly used for immersion testing and more viscous oils, glycerine, G51830 [CP1016], or other commercially available products, are used during contact testing.
- (8) Only experienced, qualified operators designated and approved to perform this specific ultrasonic inspection shall perform the test. Operator must be capable of performing equipment calibrations, carry out the intended inspection, and be capable of correctly interpreting test data before accepting or rejecting inspected parts.

NOTE: The personnel allocated to the performance of inspection operations by ultrasound shall be certified according to EN 4179/NAS 410 or any equivalent certification document acknowledged by the local regulatory agencies.

- (9) Ultrasonic test equipment generally consists of the following items:

NOTE: Manufacturer's instructions should be consulted for specific equipment being used.

- (a) The ultrasonic instrument generates electrical pulses, receives return information in the form of small amplitude voltages, amplifies the signals, and displays the signal as vertical deflections on the CRT. It contains the power supply to furnish the proper current requirements and timing mechanism that controls and synchronizes the pulse rate, sweep, and time delay circuits. It includes at least:
 - 1) A transmitter, with a square signal and pulse width suitable for the frequency of the transducer.
 - 2) A receiver (calibrated amplifier/attenuator and adjustable).
 - 3) A-scan type display, with the sampling frequency of a digital signal equal, at least, of 10 times the nominal frequency of the transducer.
 - 4) Monitoring electronic gate(s) enabling recording of the maximum amplitude of the measured signal. The time interval between gates and delay of one gate in relation to a reference event must be adjustable with a precision of at least 50 nanoseconds.
 - 5) Distance-amplitude correction device (DAC or TCG) in the case of immersion inspection. This device must satisfy the following characteristics:
 - Linear interpolation between two points
 - Precision ± 0.25 Db.
- (b) Transducers
 - 1) The transducer is the pulsing and sensing portion of the system. It is the unit that makes generation and detection of sound energy possible. It consists of a piezoelectric crystal mounted in a housing assembly, with an electrode connecting the crystal to the housing cable connector.
 - 2) The transducer front panel must not show any defects such as holes, bubbles, cracks.

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- 3) In certain special cases of immersion inspection, it may be necessary to equip the transducer with special accessories (mirror, transducer support,...) in order to obtain the required transducer/item distance. These adaptations may only be used if they do not cause a decrease in the amplitudes obtained on the reflectors of more than 1 dB.
- (c) Manipulators for parts or transducers are incorporated in most ultrasonic test systems to change the angular orientation of the ultrasonic beam with respect to the test specimen. This orientation is required to achieve proper introduction of the sound into the part being tested and is dependent upon the part geometry, nature of the defect, and expected defect orientation in order to obtain the maximum sound energy reflected to the transducer for greatest defect detectability.
- (d) Ultrasonic data acquisition system (except manual inspection), including at least:
 - 1) C-scan pictures, if required by the inspection
 - 2) Device should be able to record data in their raw form.
- (e) Calibration standards are used in ultrasonic testing for calibrating equipment by providing reproducible references for establishing system sensitivity and by verifying that the test system is functioning properly (Figure 605).
 - 1) The calibration standards must be representative of the part to be inspected:
 - Material
 - Type of discontinuity under study.
 - 2) The calibration standards must be permanently identified.

B. References

Reference	Title
70-00-07-910-801-G00	Water Types (P/B 201)

C. Consumable Materials

Reference	Description	Specification
G51830 [CP1016]	Glycerine - Pharmacological	

D. Test for Cracks and Other Defects with Ultrasonic**SUBTASK 70-35-00-210-001-G00**

- (1) Make sure that the inspection plans or operation sheets are prepared that define inspection parameters and procedures, including rejection criteria, part disposition, calibration requirements, etc., prior to the inspection of the part.

SUBTASK 70-35-00-210-002-G00

- (2) Make sure that the records are kept and maintained that reflect compliance with the test requirements and this practice.

SUBTASK 70-35-00-970-001-G00

- (3) Record the following at the start of each strip chart:
 - (a) Part number
 - (b) Part serial number
 - (c) Operator
 - (d) Date of inspection
 - (e) Reference of the working instruction and its index
 - (f) Identification of the facility used for the inspection

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- (g) Identification of the calibration standard used
- (h) Status concerning the part (acceptable or non-acceptable).

SUBTASK 70-35-00-970-002-G00

- (4) Record the following data for each scan:
 - (a) Scan number
 - (b) Gain of the recorder channels
 - (c) Mode/direction
 - (d) D.A.C off or on.

SUBTASK 70-35-00-970-003-G00

- (5) Document indications as follows:
 - (a) If an indication is found, carefully mark the beam entry point for the indication on the part.
 - (b) Record all pertinent information on the indication evaluation log.
 - 1) Record the description of each indication to be evaluated, including:
 - Number of inspection phase of the working instruction
 - Amplitude before and after angulation
 - Dimension (equivalent diameter, length, etc...)
 - Depth
 - Location (angular, radial, axial coordinates).
 - 2) For rotating hardware, do this step:
 - a) Record the circumferential position as referenced from the "I" of S/N and recorded clockwise forward looking aft.
 - 3) Record the radial position as referenced from the ID bore surface to the nearest 0.100 in. (2.54 mm).
 - (c) Make sure that the all inspection records are maintained with permanent record of the part.

SUBTASK 70-35-00-220-001-G00

- (6) Make sure that the normally inspection calibrations are performed before and after the inspection of each part.

SUBTASK 70-35-00-210-003-G00

- (7) If a series of inspections are performed, calibration may be performed at the beginning or end of the series, but should not be greater than 8 h between calibrations.
 - (a) If calibration signals vary by greater than ± 10 percent full scale, reinspect all material inspected during the interim period.
 - 1) If the calibration response has increased by more than +10 percent full scale, reinspect the hardware as the system would have been more sensitive than required.
 - (b) During the immersion inspection of forging and certain other applications, set the response signal from one or more 0.020 in. (0.51 mm) side drilled holes to 80 percent full scale amplitude to archive the calibration.
 - 1) Make sure that the distance of the hole(s) below the surface being inspected corresponds to the depth of material to be inspected and allows the necessary resolution.

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- (c) In other tests the calibration standard normally represents the condition that the test is being conducted.
- 1) When specific flaw standards are used as a base for calibration, make sure that they specific flaw standards represent the approximate limiting condition to be used for part acceptance.

SUBTASK 70-35-00-210-004-G00

- (8) Make sure that the part surfaces are clean and free of any oxides, scales, loose foreign material, or machining grooves that could interfere with the intended inspection.
- (a) Make sure that the reference points or other techniques for identifying and marking ultrasonic conditions of interest with respect to part position are identified and used.

SUBTASK 70-35-00-220-002-G00

- (9) Make sure that the maximum scanning index and speeds are no greater than that established for specific technique and assure acceptable inspection coverage and detectability.
- (a) Make sure that in the most inspections the maximum scanning index intervals is 75 percent of the effective beam width.

NOTE: With positioning accuracy of 0.01 inch/feet (0.25/304.8 mm) and spiral index, the scanning index may be increased to 100 percent of the effective beam width.

NOTE: Without a spiral index, scanning index shall be no more than 90 percent.

SUBTASK 70-35-00-220-003-G00

- (10) Make sure that the linear surface speed during visual inspection is no more than 6 in. (15.24 cm) per second.
- (a) Determine the linear surface speed during recording by the operating characteristics of the equipment.

NOTE: During surface wave contact testing the transducer is normally indexed and simultaneously rotated about its axis to conduct a thorough search of the inspection area.

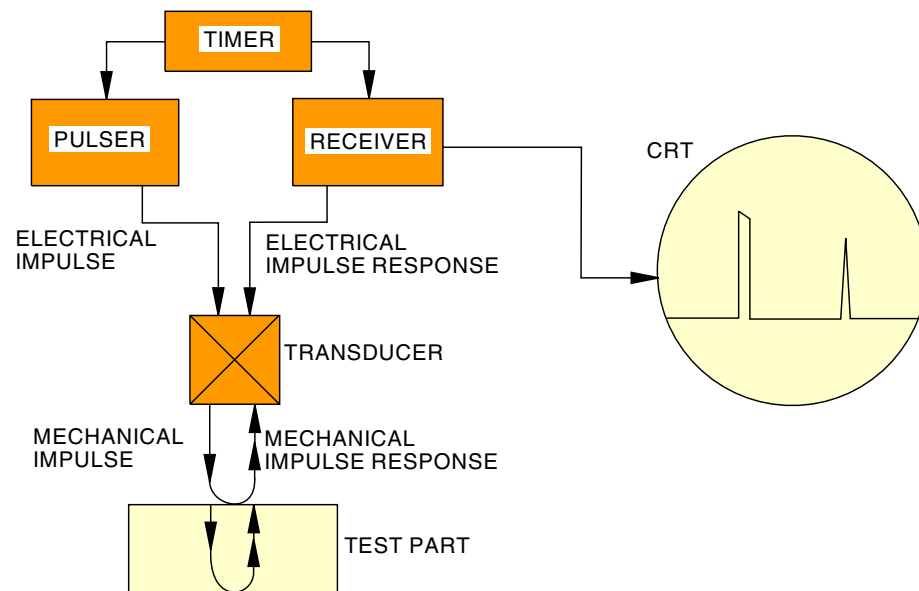
E. Inspection

SUBTASK 70-35-00-970-004-G00

- (1) Perform calibrations and calibration checks at intervals to assure that any part inspected to an improper calibration can be re-inspected prior to any additional processing of the part that would limit or compromise its re-inspection.

———— **END OF TASK** ————

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ICN-LEAP-00-703500-B-F0301-00001-A-002-01

3017466 S0000790124_V1

Pulse-Echo Testing
Figure 601/70-35-00-990-801-G00

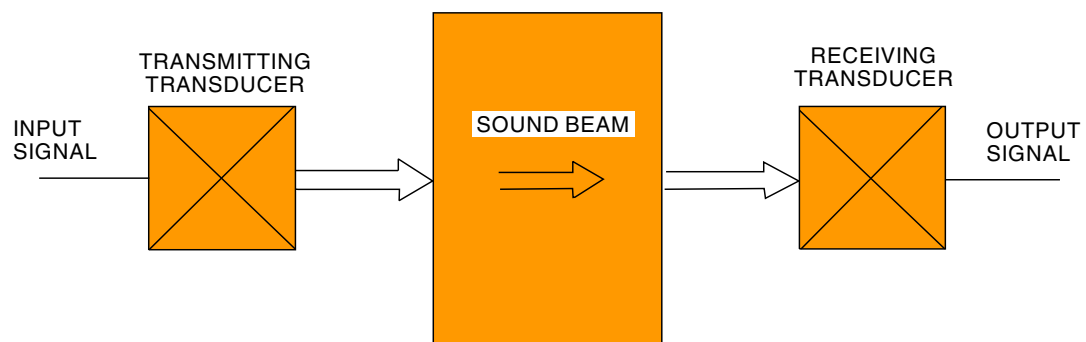
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3017467 S0000790125_V1

Through Transmission Testing
Figure 602/70-35-00-990-802-G00

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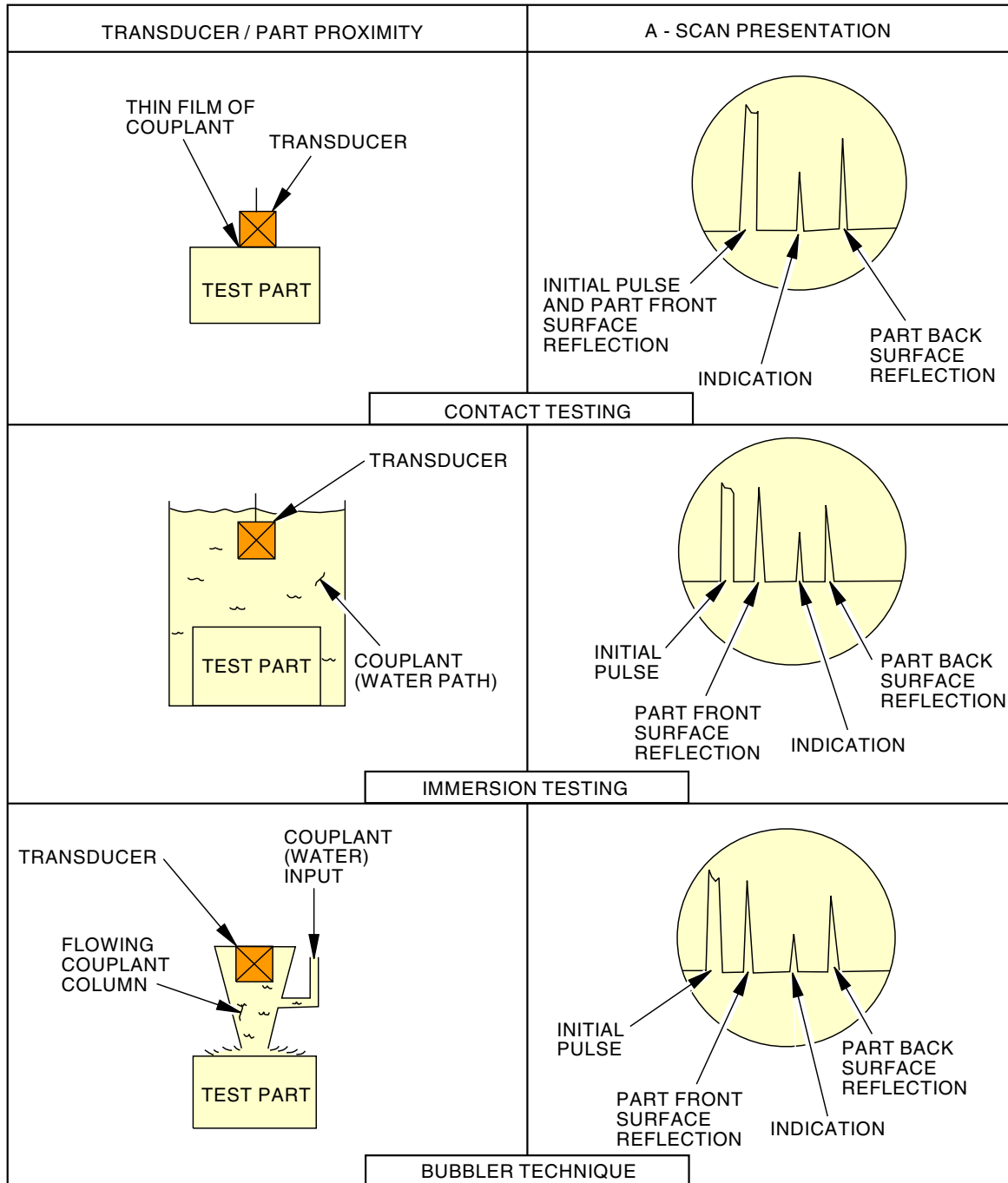
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3017468 S0000790126_V1

Test Methods
Figure 603/70-35-00-990-803-G00

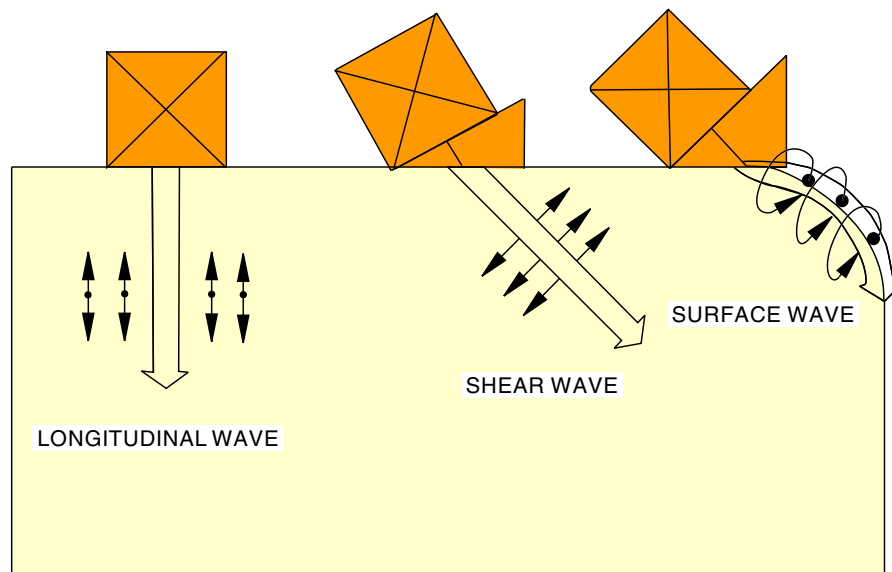
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3017469 S0000790127_V1

Ultrasonic Wave Propagation Directions
Figure 604/70-35-00-990-804-G00

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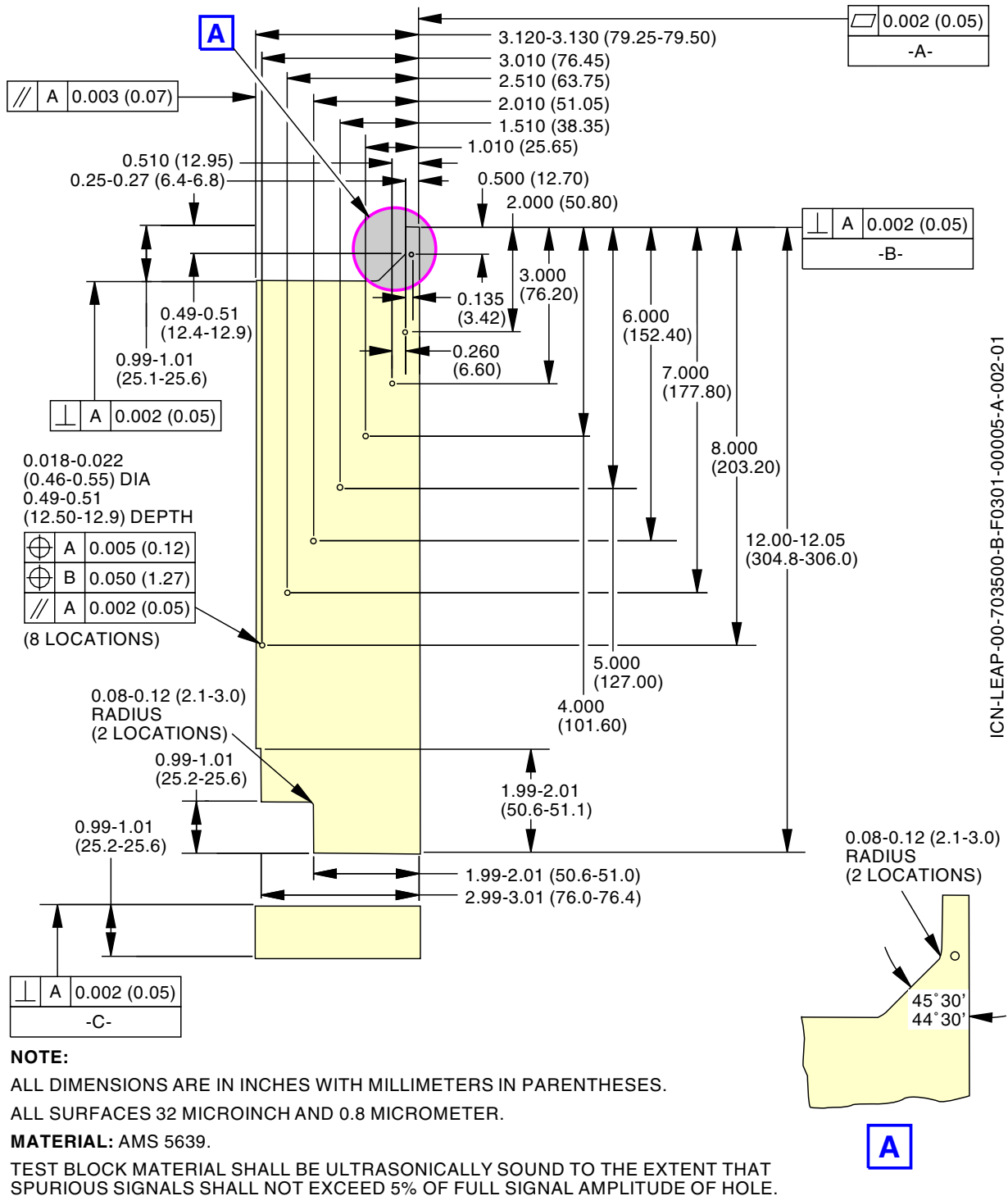
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ICN-LEAP-00-703500-B-F0301-00005-A-002-01

3017470 S0000790128_V1

**Ultrasonic Calibration Block
Figure 605/70-35-00-990-805-G00**

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LOCKING METHODS - MAINTENANCE PRACTICES

1. General

A. This procedure has these tasks:

- (1) Lockwire installation
- (2) Safety cable installation
- (3) Self-locking, hexagonal or castellated nut installation
- (4) Nut plate installation
- (5) Cotter pin installation
- (6) Tab washer installation.

TASK 70-41-00-400-801-G00

2. Lockwire Installation

(Figure 201, Figure 202 and Figure 203)

A. General

- (1) This task provides the instructions on how to install the lockwire.
- (2) You install lockwire to make sure that parts do not loosen.
- (3) You must install lockwire in the direction that prevents movement of the part that can cause it to loosen.
- (4) When you install lockwire, you must obey the steps that follow.
 - (a) Where possible, install stainless steel lockwire (AMS 5689). Unless specified differently, use the double-twist procedure to install lockwire.
 - 1) To install lockwire with the double-twist installation procedure, you start at a part that you must safety.
 - 2) Put the lockwire through the lockwire hole in the part. Make a loop with the lockwire.
 - 3) Twist the two ends of the lockwire together until you get to the subsequent part.
 - 4) You put the lockwire through the lockwire hole on that part and make a loop with the lockwire.
 - 5) Twist the two ends of the lockwire together again. You do these steps on each subsequent part.
 - 6) You use the single strand procedure to install lockwire only when it is specified (Figure 203) (View C).
 - (b) When you complete the lockwire installation, visually examine the installation for these conditions.
 - 1) Make sure that the lockwire does not rub against other parts.
 - 2) Make sure that engine vibration will not cause damage to the lockwire.
 - 3) Make sure that the only tension on the lockwire is that which is necessary to safety the part.
- (5) You must install the lockwire through the lockwire holes in the parts. If there is no hole, you can attach the lockwire to an adjacent part (Figure 203) (Views F and G).
- (6) Unless specified differently, these are the lockwire length limits (Figure 203) (Views H and I).
 - (a) The maximum distance between points safetied with lockwire is 6 in. (152 mm).
 - (b) The maximum length of one strand of lockwire is 24 in. (610 mm).

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- 1) You can safety only the maximum number of parts possible with a 24 in. (610 mm) piece of the lockwire.
- (c) The maximum number of parts that you can safety with one strand of lockwire is three (3).
- (d) You must use the double-twist procedure to install lockwire on parts that are more than 2 in. (51 mm) apart.



ALWAYS USE NEW LOCKWIRE. MAKE SURE THAT YOU USE THE LOCKWIRE THAT IS SPECIFIED FOR THIS LOCATION. USED LOCKWIRE CAN BREAK AND CAUSE DAMAGE TO EQUIPMENT.

- (7) Make sure that you use only 0.020 ±0.001 in. (0.51 ±0.03 mm) or 0.032 ±0.001 in. (0.81 ±0.03 mm) stainless steel lockwire on the engine.
 - (a) Use that largest diameter lockwire that will go through the lockwire hole in the part.
 - 1) When it is possible, use the 0.032 in. (0.81 mm) diameter lockwire.
- (8) Install lockwire to hose and electrical coupling nuts with the same procedure that you use for the tube coupling nuts as follows (Figure 203) (Views F, G, J, K, L, and M).



YOU MUST DO AN INSPECTION OF THE LOCKWIRE INSTALLATION. IF YOU CAUSE DAMAGE TO THE LOCKWIRE, IT CAN BREAK AND CAUSE DAMAGE TO THE ENGINE.

- (9) When you twist the lockwire, pull the lockwire tight but do not put too much force on the lockwire.
- (10) Make sure that you do not make nicks, kinks or cause other damage to the lockwire.
- (11) For the 0.020 ±0.001 in. (0.51 ±0.03 mm) diameter lockwire, there must be 9 to 12 twists for each 1 in. (25 mm).
- (12) For the 0.032 ±0.001 in. (0.81 ±0.03 mm) diameter lockwire, there must be 7 to 10 twists for each 1 in. (25 mm).
- (13) Use a safety wire pliers, COM-977, to twist the lockwire.
NOTE: The illustration shows two different types of lockwire twisting tools.
- (14) Use the illustration to identify correct and incorrect lockwire installations.



DO NOT TWIST OFF THE LOCKWIRE ENDS. CUT THE LOCKWIRE WITH A LOCKWIRE TOOL. MAKE SURE THE WIRE PIECES DO NOT GO INTO THE ENGINE. THIS WILL PREVENT DAMAGE TO THE ENGINE.

- (15) Always use wire cutters to cut the lockwire.
 - (a) If the lockwire is broken, it can cause damage to the lockwire holes in the part.

B. Tools/Equipment

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt.", which stands for Optional.

Reference	Description
COM-977	Pliers - Safety Wire Part #: WTR1A Supplier: 5K761

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C. Consumable Materials

Reference	Description	Specification
G01505	Lockwire - Safety And Lock	NASM20995

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Lockwire Installation

SUBTASK 70-41-00-910-001-G00

(1) Install the lockwire, G01505 as follows (Figure 201):

**CAUTION**

ALWAYS USE NEW LOCKWIRE. MAKE SURE THAT YOU USE THE LOCKWIRE THAT IS SPECIFIED FOR THIS LOCATION. USED LOCKWIRE CAN BREAK AND CAUSE DAMAGE TO EQUIPMENT.

- (a) Make sure that the lockwire holes in the parts are correctly aligned.
NOTE: Do not tighten the part more than the specified limits to align the holes.
- (b) If the holes do not correctly align when you tighten the part to the specified limits, replace the part.
- (c) Install the lockwire through the hole in one part.
- (d) Bend the lockwire that you put through the hole above the part or around it.
- (e) Do this step if you bend the lockwire around the part.
 - 1) Make sure that the lockwire that goes around the part goes below the lockwire that comes out of the hole.
NOTE: This will satisfactorily attach the lockwire.
- (f) Make sure that the lockwire is tight.
- (g) Then twist the lockwire until the twisted piece of lockwire touches the hole in the subsequent part.
 - 1) The twist in the lockwire must not be more than 0.125 in. (3.175 mm) from the hole in the part (Steps 3 and 4).
- (h) Do these steps if you bend the lockwire around the second part.
 - 1) Install the lockwire through the hole in the second part.
 - 2) Bend the lockwire that you put through the hole above the part or around it.
 - 3) Make sure that the lockwire that goes around the part goes below the wire that comes out of the hole.
 - 4) If the lockwire is bent above the second part, the direction that you twist the lockwire is not important.
 - 5) If you install lockwire to more than two parts in a row, do the last 4 steps again (Steps 5 and 6).
- (i) Do these steps after you attach the lockwire to the last part.
 - 1) Twist the lockwire 3 to 6 times. The twisted section of the lockwire must be 0.375 ±0.125 in. (9.525 ±3.175 mm).
 - 2) Cut off all the unwanted lockwire.

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- 3) Bend the twisted lockwire into the part (Steps 7 and 8).

NOTE: All lockwire must look almost the same as the examples shown in the illustrations.

SUBTASK 70-41-00-910-002-G00

- (2) Make sure that the tension in the lockwire is satisfactory. Refer to the limits in the table below:

Lockwire Installation Limits

Length of Lockwire Between Parts	Maximum movement at center
0.5 inch (12.7 mm)	.125 inch (3.2 mm)
1.0 inch (25.4 mm)	.250 inch (6.4 mm)
2.0 inch (50.8 mm)	.375 inch (9.5 mm)
3.0 inch (76.2 mm)	.500 inch (12.7 mm)
4.0 inch (101.6 mm)	.750 inch (19.1 mm)
5.0 inch (127.0 mm)	.750 inch (19.1 mm)
6.0 inch (152.4 mm)	.750 inch (19.1 mm)

- (a) Apply a light finger force to the center of the lockwire and push the wire in two directions.
- (b) If you cannot accept the lockwire, remove it and install new lockwire.
- (c) Always cut the lockwire to remove it.
- 1) This will prevent damage to the holes.

———— **END OF TASK** ————

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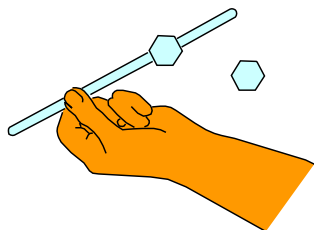
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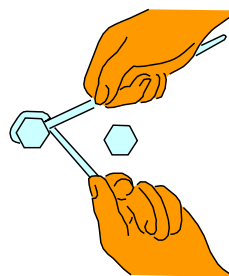
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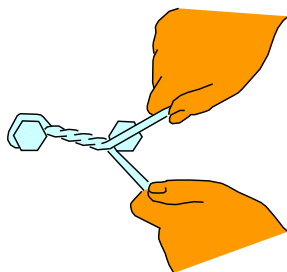
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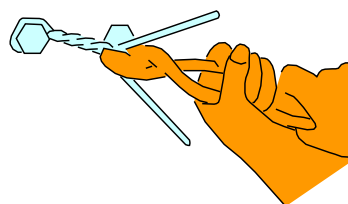
STEP 1



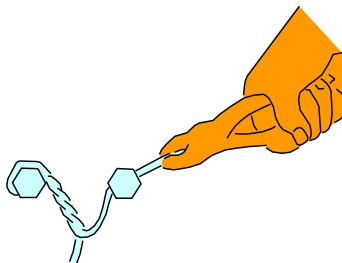
STEP 2



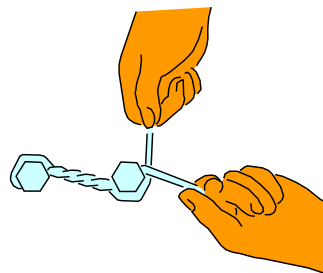
STEP 3



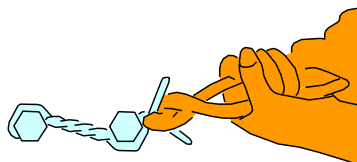
STEP 4



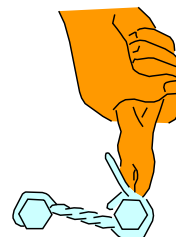
STEP 5



STEP 6



STEP 7



STEP 8

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2469490 S0000576788_V1

Lockwire Installation Techniques
Figure 201/70-41-00-990-801-G00

EFFECTIVITY
SIA ALL

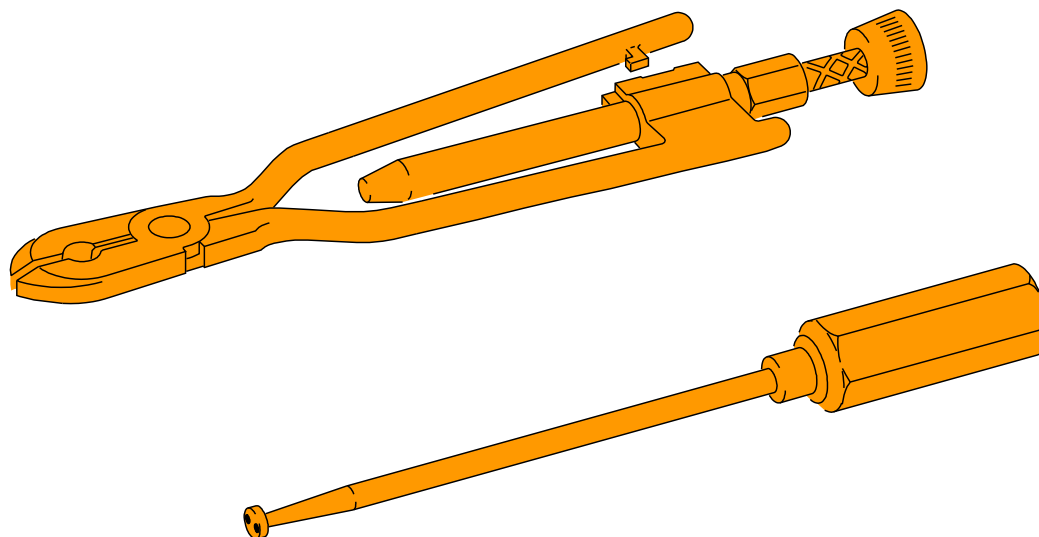
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2469491 S0000576789_V1

Lockwire Twisting Tools (Example)
Figure 202/70-41-00-990-802-G00

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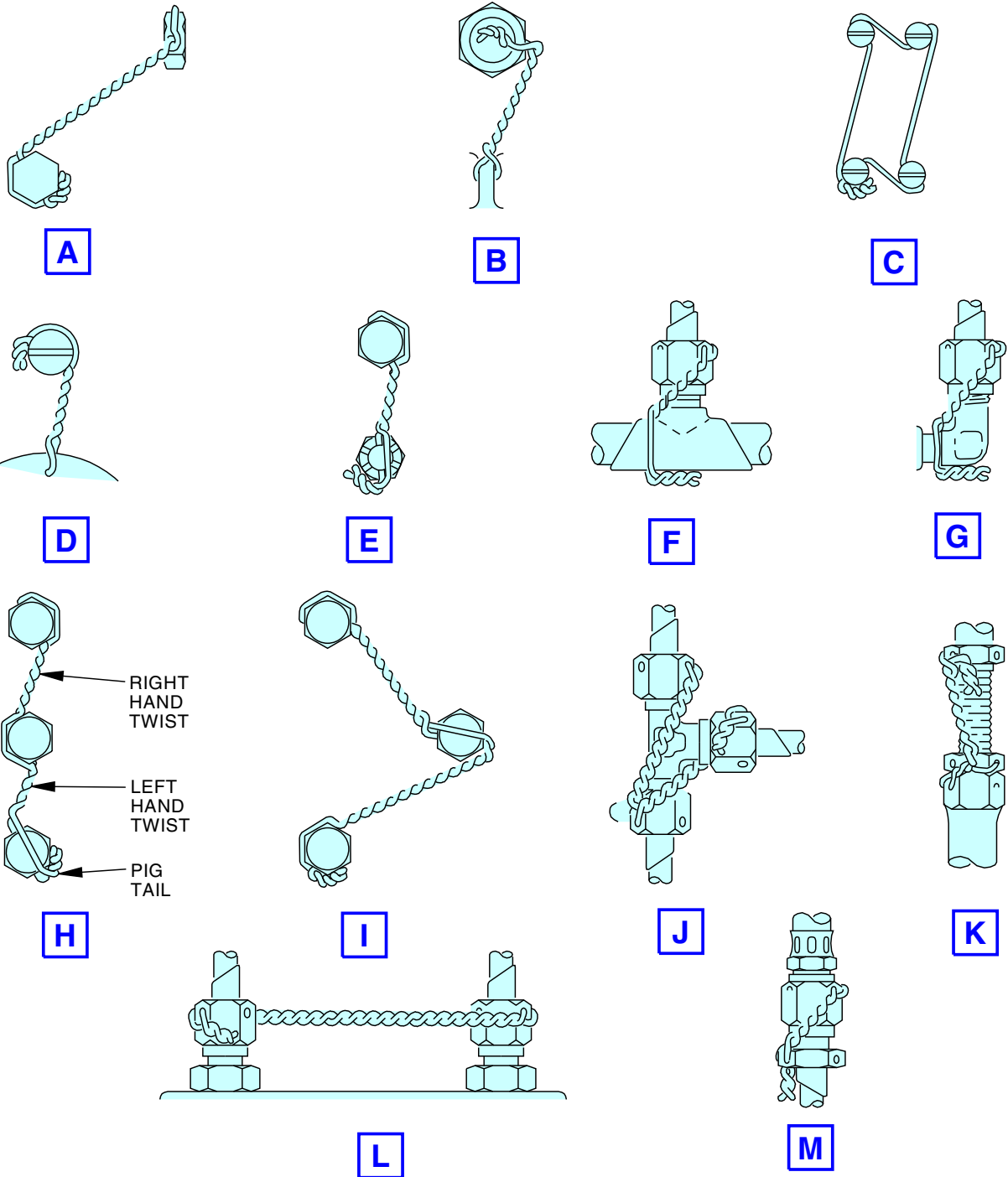
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2469492 S0000576790_V1

Lockwire Installation Examples
Figure 203/70-41-00-990-803-G00 (Sheet 1 of 2)

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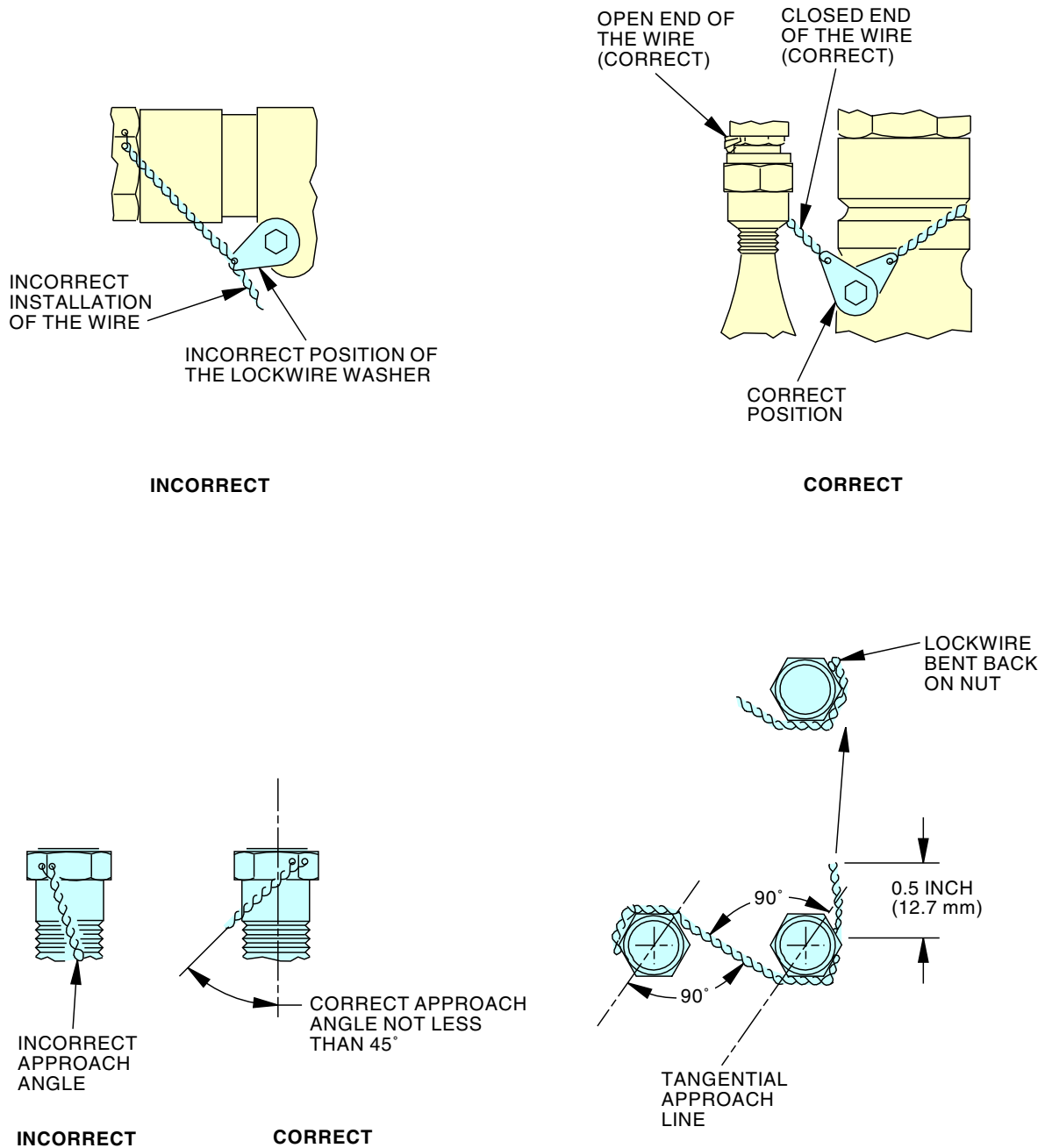
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2469493 S0000576791_V1

Lockwire Installation Examples
Figure 203/70-41-00-990-803-G00 (Sheet 2 of 2)

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TASK 70-41-00-400-802-G00**3. Safety Cable Installation**

(Figure 204, Figure 205, Figure 206, Figure 207, Figure 208 and Figure 209)

A. General

- (1) This task provides the instructions on how to install a safety cable.
- (2) You install a safety cable on two or more parts to make sure that the parts do not loosen.
- (3) The installation system for the safety cable has three components:
 - (a) The safety cable
 - (b) The ferrules
 - (c) The crimping tool.
- (4) The safety cable, G02325 [C10-145], is 0.032 in. (0.813 mm) in diameter and is made from AMS 5689 (321 stainless steel) material. There is a fitting on one end of the cable. The cable end fitting is made of AMS 5674 (347 stainless steel) material. The cable strands on the opposite end are fused together to make sure that the strands do not fray.
- (5) The ferrule, G02324 [C10-144], is made of AMS 5674 (347 stainless steel) material. The ferrule is held in a spring-loaded magazine. When the safety cable is installed, the ferrule is crimped on the open end of the cable.
- (6) There are two types of tools you can use to crimp the ferrule.
 - (a) The Bergen tool, M303 comes in different lengths. The manufacturer sets the crimping pressure of the tool. The primary parts of the crimping tool are the crimping head, tensioning wheel, slotted wheel, and handles. You use this tool to crimp the ferrule on the end of the safety cable. The crimping tool will also cut off the safety cable that extends through the ferrule (Figure 204).
 - (b) The Snap-On tool, C10-148 operates in one direction only. It has a cycle-end stop to let the user know when the ferrule is fully crimped. The manufacturer sets the crimping pressure of the tool. If necessary, you can adjust the crimping pressure with standard hand tools. The tool has a spring-loaded crimp rod to hold the ferrule in its position during the crimping procedure. The internal retraction mechanism controls the cable tension automatically (Figure 205).

B. Tools/Equipment

NOTE: When more than one tool part number is listed under the same "Reference" number, the tools shown are alternates to each other within the same airplane series. Tool part numbers that are replaced or non-procurable are preceded by "Opt:", which stands for Optional.

Reference	Description
COM-877	Test Block - Safety Cable Part #: SCT-TB1 Supplier: 11851 Part #: TB-201 Supplier: 70958
COM-905	Tester - Safety Cable Part #: MPT-250C Supplier: 11851 Opt Part #: MPT-200A-SC Supplier: 11851 Opt Part #: MPT-250B-SC Supplier: 11851
STD-257	Cutter - Diagonal, Side-Cushioned

C. Consumable Materials

Reference	Description	Specification
G02324 [C10-144]	Ferrule - Safety Cable	

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(Continued)

Reference	Description	Specification
G02325 [C10-145]	Cable, Safety - GE P/N J1285P01	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Procedure

SUBTASK 70-41-00-420-001-G00

- (1) Follow these steps to install the safety cable correctly.
 - (a) Do not let the safety cable touch parts that do not attach to the safety cable.
 - (b) Make sure that the cable is not damaged or bent when you install it.
 - 1) Frayed cable assemblies are not permitted.
 - (c) Install the safety cable only through safety cable or lockwire holes in the applicable parts.
 - (d) Unless specified differently, these are the safety cable limits:
 - 1) The maximum distance between two parts that use the same safety cable installation is 6 in. (152.4 mm).
 - 2) The maximum number of parts that you can safety with one safety cable installation is three (3).
 - 3) Do not use the safety cable on titanium parts.

SUBTASK 70-41-00-910-003-G00

- (2) When necessary, do a crimping tool verification of the Bergen crimping tool or the snap-on tool to make sure that the tool is in the specified limits.

F. Crimping Tool Verification for the Bergen Crimping Tool

SUBTASK 70-41-00-820-001-G00

- (1) Do the pull-off load test as follows (Figure 204 and Figure 206):

NOTE: You can use the safety cable tester, COM-905, as an alternative to this test (Refer to the manufacturer's instructions).

 - (a) Use the manufacturer's instructions to set up the safety cable test block, COM-877.
 - (b) Make sure that the pivot joint is in the forward direction.
 - (c) Move the cable stop at the end of the test block.
 - (d) Install the safety cable, G02325 [C10-145], through the cable stop hole.
 - (e) Pull the safety cable through the cable stop hole.
 - (f) Pull the safety cable through the hole in the pivot joint.
 - (g) Put the end of the safety cable (from the pivot joint) through a ferrule, G02324 [C10-144], in the ferrule magazine.
 - (h) Pull the safety cable through the ferrule.
 - 1) Use the safety cable to remove the ferrule from the magazine (Step 2, Figure 207).
 - (i) Put the end of the safety cable through the crimping head of the Bergen tool (Step 3, Figure 207).
 - (j) Make sure that the large hole of the crimping head is on the same side as the ferrule.

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- (k) Move the crimping tool along the safety cable until the crimping head is against the part (Step 4, Figure 207).
- (l) Make sure that the ferrule is fully in the hole of the crimping head.
- (m) If the ferrule will not go in the crimping head, do these steps:
 - 1) Remove the safety cable from the Bergen tool.
 - 2) Push the handles fully together.
NOTE: When you release the handles after you push them fully together, they will open automatically.
 - 3) Put the safety cable back through the crimping head.
 - 4) Move the Bergen tool along the safety cable until the crimping head is against the part.
 - 5) Make sure that the ferrule goes into the hole of the crimping head.



DO NOT PUT TOO MUCH TENSION ON THE SAFETY CABLE. THE CRIMPING TOOL WILL AUTOMATICALLY SET THE TENSION. TOO MUCH TENSION WILL BREAK THE SAFETY CABLE.

- (n) Put the safety cable across the slotted tensioning wheel on the side of the Bergen tool.
 - 1) Make sure that the safety cable is in the two slots in the wheel that align with the crimping head.
 - 2) Hold the Bergen tool at 90 degrees to the cable.
 - 3) Make sure that the ferrule is tight against the bolt head.
 - 4) Turn the tensioning wheel on the side of the Bergen tool until you hear a click (step 5, Figure 207).



DO NOT TRY TO REMOVE THE CRIMPING TOOL FROM THE FERRULE WITH THE HANDLES IN THE CLOSED POSITION. IF YOU TRY TO REMOVE THE CRIMPING TOOL WITH THE HANDLES CLOSED, YOU WILL CAUSE DAMAGE TO THE FERRULE.



DO NOT CRIMP THE FERRULE UNTIL YOU APPLY THE CORRECT TENSION TO THE TENSIONING WHEEL. IF YOU DO NOT APPLY THE CORRECT TENSION, A FAILURE OF THE FERRULE CAN OCCUR.

- (o) Apply constant pressure until you fully close the crimping tool handles and you cut the cable.
NOTE: If you release the handles on the Bergen tool before they are fully closed, the handles will not open. If this occurs, apply pressure to close the handles again until the handles release.
 - 1) Release the pressure on the handles.
 - 2) Remove and discard the unwanted safety cable from the tensioning wheel.
- (p) Do the load test for the torque breakaway as follows (Figure 206):
 - 1) Set a calibrated breakaway torque wrench to 70 in-lb (8 N·m).
 - 2) Install the torque wrench in the pivot joint on the safety cable test block, COM-877 (Figure 206).

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- 3) Move the torque wrench handle counterclockwise until the torque wrench clicks or the ferrule moves.
- 4) If the ferrule moves before you hear the torque wrench click, remove the Bergen tool from service.
- (q) Do a finger-pressure test as follows (Figure 206):
 - 1) Find the center of the safety cable in the safety cable test block, COM-877.
 - 2) With light finger pressure, try to push the center of the safety cable to the wall of the test block.

NOTE: The safety cable must not touch the wall.
- (r) If the safety cable does not touch the wall, then the safety cable is serviceable.
- (s) If the safety cable touches the wall, the safety cable is not serviceable.
 - 1) Cut the safety cable with the wire side-cushioned diagonal cutters, STD-257.
 - 2) Remove the safety cable from the safety cable test block, COM-877.
 - 3) Install a new safety cable and do the pull-off load test again.
 - 4) Make sure that the tension on the safety cable is correct.
 - 5) When you crimp the ferrule, make sure that you hold the Bergen tool at 90 degrees to the safety cable.
 - 6) Make sure that the ferrule is tight against the bolt head.
 - 7) Do the finger pressure test again.
 - 8) If the safety cable touches the wall again, use a new Bergen tool to do the pull-off load test.

SUBTASK 70-41-00-820-002-G00

- (2) Do a test to find the force necessary to break the crimped ferrule or safety cable, G02325 [C10-145].
 - (a) Do this test a minimum of one time each month.
 - (b) Refer to the manufacturer's instructions to use a safety cable tester, COM-905, to do this test (Figure 206).

G. Safety Cable Installation - Bergen tool, M303**SUBTASK 70-41-00-420-002-G00**

- (1) Install the safety cable, G02325 [C10-145] with the Bergen tool, M303.
 - (a) Do a visual inspection of the safety cable holes for damage.

NOTE: Keep the safety cable as straight as possible when you safety cable fasteners or parts together.

 - 1) If the hole is damaged, replace the part or use a different hole for the safety cable (Figure 208).
 - (b) Put the end of the safety cable (without the cable end fitting) into the hole in the part.

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- (c) Pull the safety cable through the hole until the cable end fitting is against the part (Step 1, Figure 207).

NOTE: The illustrations show examples of correct safety cable installations. The illustrations do not show all types of safety cable patterns. When you install a safety cable, use the examples of correct safety cable installations as shown in the illustrations.

NOTE: On two bolt patterns, do not install the safety cable in a negative pull direction. Make sure that the cable has a positive or neutral pull.

- (d) Put the end of the safety cable through the second part.
- (e) Use the hole in the part that will keep the safety cable as straight as possible.
- (f) Pull the safety cable through the second part.
- (g) If you install the safety cable on three parts, pull the safety cable through the third part.
- (h) Put the end of the safety cable (from the last part of the safety cable installation) through a ferrule, G02324 [C10-144].
- (i) Pull the safety cable through the ferrule. Use the safety cable to pull the ferrule out of the ferrule magazine (Step 2, Figure 207).
- (j) Put the end of the safety cable through the crimping head of the Bergen tool (Step 3, Figure 207).
- (k) Make sure that the large hole in the crimping head is on the same side as the ferrule.
- (l) Move the Bergen tool along the safety cable until the crimping head is against the part (Step 4, Figure 207).
- (m) Make sure that the ferrule is fully in the hole in the crimping head.
- (n) If the ferrule will not go in the crimping head, do these steps:
- 1) Remove the safety cable from the Bergen tool.
 - 2) Push the handles together.
- NOTE:** When you release the handles, they will open automatically again.
- 3) Put the safety cable back through the crimping head.
 - 4) Move the Bergen tool along the safety cable until the crimping head is against the part.
 - 5) Make sure that the ferrule goes into the hole in the crimping head.



CAUTION

DO NOT PUT TOO MUCH TENSION ON THE SAFETY CABLE. THE CRIMPING TOOL WILL AUTOMATICALLY SET THE TENSION. TOO MUCH TENSION WILL BREAK THE SAFETY CABLE.

- (o) Put the safety cable across the slotted tensioning wheel on the side of the Bergen tool.
- (p) Make sure that the safety cable is in the two slots in the wheel that align with the crimping head.
- (q) Hold the Bergen tool at 90 degrees to the safety cable.
- 1) Make sure that the ferrule is tight against the bolt head.
- (r) Turn the tensioning wheel on the side of the Bergen tool until you hear a click (Step 5, Figure 207).

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DO NOT TRY TO REMOVE THE CRIMPING TOOL FROM THE FERRULE WITH THE HANDLES IN THE CLOSED POSITION. IF YOU TRY TO REMOVE THE CRIMPING TOOL WITH THE HANDLES CLOSED, YOU WILL CAUSE DAMAGE TO THE FERRULE.



DO NOT CRIMP THE FERRULE UNTIL YOU APPLY THE CORRECT TENSION TO THE TENSIONING WHEEL. IF YOU DO NOT APPLY THE CORRECT TENSION, A FAILURE OF THE FERRULE CAN OCCUR.

- (s) Apply constant pressure to close the Bergen tool handles until you cut the safety cable.

NOTE: If you do not fully close the handles on the Bergen tool before you release them, the handles will not open. If this occurs, apply pressure on the handles to close them fully. This will release the handles and let them open.

- (t) Release the pressure on the handles.
(u) Remove and discard the unwanted safety cable from the tensioning wheel.

SUBTASK 70-41-00-210-001-G00

- (2) Examine the ferrule to make sure that it has a good crimp (Step 6, Figure 207).
- (a) Do a visual inspection of the safety cable, G02325 [C10-145], for kinks, frayed wires, or incorrect crimps.
- 1) Replace the safety cable if you find damage.
- (b) Push on the safety cable with light finger pressure on a point halfway between the two parts with the safety cable installation.
- (c) If the cable feels loose, do an inspection to make sure that the safety cable is serviceable (Figure 209):
- 1) Measure the distance between the safety cable parts (Dimension A).
 - a) Make a record of Dimension A.
 - b) If three parts are in a safety cable installation together, measure the distance between each of the parts (Figure 209).

<1> Add the two distances together to get Dimension A.
 - 2) Push on the safety cable with light finger pressure on a point halfway between the two parts with the safety cable installation.
 - 3) Measure the distance the safety cable moves laterally in one direction.

NOTE: If you measure the distance the safety cable moves laterally in the two directions, then write this as Dimension B.

 - a) Make a record of Dimension C.
 - 4) Compare Dimensions A and C to the limits given in Figure 209.



DO NOT TRY TO BREAK THE SAFETY CABLE. IF YOU MUST REMOVE THE SAFETY CABLE, CUT THE SAFETY CABLE TO PREVENT DAMAGE TO THE HOLES IN THE PARTS.

- (d) If the safety cable is not in the limits, then cut and remove the safety cable. Use the side-cushioned diagonal cutters, STD-257 to cut the cable.
- 1) Replace the safety cable.

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H. Crimping tool verification procedure- Snap-On tool, C10-148 - test block, C10-146

NOTE: You can use the safety cable tester, COM-905 to do this test. Refer to the manufacturer's instructions to use a safety cable tester, COM-905.

SUBTASK 70-41-00-820-003-G00

- (1) Do the pull-off load test as follows (Figure 205 and Figure 206):
 - (a) Refer to the manufacturer's instructions to set up the safety cable test block, COM-877.
 - (b) Make sure that the pivot joint is in the forward direction.
 - (c) Move the cable stop to the end of the test block.
 - (d) Install the safety cable, G02325 [C10-145] through the cable stop hole.
 - (e) Pull the safety cable through the cable stop hole.
 - (f) Put the safety cable through the hole in the pivot joint. Pull the cable through the hole.
 - (g) Put the end of the safety cable (from the pivot joint) through a ferrule, G02324 [C10-144] in the ferrule magazine.
 - (h) Pull the safety cable through the ferrule.
 - 1) Use the safety cable to pull the ferrule out of the ferrule magazine (Step 2, Figure 207).
 - (i) Put the end of the safety cable through the crimping head of the Snap-On tool (Step 3, Figure 207).
 - (j) Make sure that the large hole in the crimping head is on the same side as the ferrule.
 - (k) Move the Snap-On tool along the safety cable until the crimping head is against the ferrule (Step 4, Figure 207).
 - (l) Pull on the retraction knob (Step 5, Figure 207).
 - (m) Put the crimping head on the ferrule and release the retraction knob (Step 5, Figure 207).
 - (n) Make sure that the ferrule is fully in the crimping head (Step 5, Figure 207).
 - (o) Pull the safety cable through the tension block (Step 5, Figure 207).



CAUTION

DO NOT PUT TOO MUCH TENSION ON THE SAFETY CABLE. THE CRIMPING TOOL WILL AUTOMATICALLY SET THE TENSION. TOO MUCH TENSION WILL BREAK THE SAFETY CABLE.

- (p) Make sure that the safety cable is between the tension spring and the tension block.
- (q) Hold the Snap-On tool at 90 degrees to the cable in the bolt head.
- (r) Make sure that the ferrule is tight against the bolt head.
- (s) Lightly pull on the end of the safety cable to remove slack (Step 5, Figure 207).
- (t) Push the start cycle button.

NOTE: At the start of the cycle, the tension block will move rearward. This movement rearward gives the cable tension.

- (u) Turn the drive handle clockwise and release the start cycle button.
- (v) Turn the drive handle until it stops (approximately two full turns).
- (w) Pull up the end of the safety cable to remove it from the tension block.
- (x) Pull back on the retraction knob.
 - 1) Remove the Snap-On tool from the crimped ferrule and the remaining safety cable.

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- (y) Use the side-cushioned diagonal cutters, STD-257 and cut the unwanted safety cable flat with the crimped ferrule (Step 6, Figure 207).
 - 1) Discard the safety cable end.
- (z) Do the load test for torque breakaway that follows (Figure 206):
 - 1) Set a calibrated breakaway torque wrench to 70 in-lb (8 N·m).
 - 2) Install the torque wrench in the pivot joint of the safety cable test block, COM-877 (Figure 206).
 - 3) Move the torque wrench handle counterclockwise until the torque wrench clicks or the ferrule moves.
 - 4) If the ferrule moves before you hear the torque wrench click, remove the Snap-On tool from service.
- (aa) Do a finger-pressure test as follows (Figure 206):
 - 1) Find the center of the safety cable in the test block.
 - 2) Use light finger pressure and push the center of the safety cable to the wall of the test block.
 - 3) The safety cable must not touch the wall.
- (ab) If the safety cable does not touch the wall, then the Snap-On tool is serviceable.
- (ac) If the safety cable touches the wall, the Snap-On tool is not serviceable.
 - 1) Cut the safety cable with the side-cushioned diagonal cutters, STD-257.
 - 2) Remove the safety cable from the test block.
 - 3) Install a new safety cable and do the pull-off load test again.
 - 4) Make sure that the tension on the safety cable is correct.
 - 5) When you crimp the ferrule, make sure that you hold the Snap-On tool at 90 degrees to the safety cable.
 - 6) Make sure that the ferrule is tightly against the bolt head.
 - 7) Do the finger pressure test again.
 - 8) If the safety cable touches the wall again, use a new Snap-On tool to do the pull-off load test.

SUBTASK 70-41-00-820-004-G00

- (2) Do a test to find the force necessary to cause the crimped ferrule or the safety cable to break.
 - (a) You must do this test a minimum of one time each month.
 - (b) Use a safety cable tester, COM-905 to do this test (Figure 206).

NOTE: Refer to the manufacturer's instructions.

I. Safety Cable Installation - Snap-On tool, C10-148

SUBTASK 70-41-00-420-003-G00

- (1) Install the safety cable, G02325 [C10-145], with the Snap-On tool:
 - (a) Do a visual inspection of the safety cable holes for damage.

NOTE: Keep the safety cable as straight as possible when you safety cable fasteners or parts together.

 - 1) If the hole is damaged, replace the part or use a different safety cable hole.
 - (b) Put the end of the safety cable without the cable end fitting into the hole in the part.

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- (c) Pull the safety cable through the hole until the cable end fitting is against the part (Step 1, Figure 207).

NOTE: The illustrations show examples of correct safety cable installations. The illustrations do not show all types of safety cable patterns. When you install a safety cable, use the examples of correct safety cable installations as shown in the illustrations.

NOTE: On two bolt patterns, do not safety cable in a negative pull direction. Make sure that the cable has a positive or neutral pull.

- (d) Put the end of the safety cable through the second part.
- (e) Use the hole in the part that keeps the safety cable as straight as possible.
- (f) Pull the safety cable through the second part.
- (g) If you install the safety cable on three parts, pull the safety cable through the third part.
- (h) Put the end of the safety cable (from the last part of the safety cable installation) through a ferrule, G02324 [C10-144].
- (i) Pull the safety cable through the ferrule. Use the safety cable to pull the ferrule out of the ferrule magazine (Step 2, Figure 207).
- (j) Put the end of the safety cable through the crimping head of the Snap-On tool (Step 3, Figure 207).
- (k) Make sure that the large hole in the crimping head is on the same side as the ferrule.
- (l) Move the Snap-On tool along the safety cable until the crimping head is against the ferrule.
- (m) Pull back on the retraction knob (Step 5, Figure 207).
- (n) Put the crimping head on the ferrule and release the retraction knob (Step 5, Figure 207).
- (o) Make sure that the ferrule is fully in the crimping head (Step 5, Figure 207).
- (p) Pull the safety cable through the tension block (Step 5, Figure 207).



DO NOT PUT TOO MUCH TENSION ON THE SAFETY CABLE. THE CRIMPING TOOL WILL AUTOMATICALLY SET THE TENSION. TOO MUCH TENSION WILL BREAK THE SAFETY CABLE.

- (q) Make sure that the safety cable is between the tension spring and the tension block.
- (r) Hold the Snap-On tool at 90 degrees to the safety cable in the bolt head.
- (s) Make sure that the ferrule is tight against the bolt head.
- (t) Lightly pull on the end of the safety cable to remove the slack (Step 5, Figure 207).
- (u) Push the start cycle button.

NOTE: At the start of the cycle, the tension block will move rearward. This movement rearward gives the cable tension.

- (v) Turn the drive handle clockwise and release the start cycle button.
- (w) Turn the drive handle until it stops (approximately two full turns).
- (x) Pull up the end of the safety cable to remove it from the tension block.
- (y) Pull back on the retraction knob.
- 1) Remove the Snap-On tool from the crimped ferrule and the remaining safety cable.

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- (z) Use the side-cushioned diagonal cutters, STD-257 to cut the safety cable flat with the crimped ferrule (Step 6, Figure 207).
 - 1) Discard the unwanted safety cable end.

SUBTASK 70-41-00-210-002-G00

- (2) Examine at the ferrule to make sure it has a good crimp (Step 6, Figure 207):
 - (a) Examine the safety cable, G02325 [C10-145] for kinks, frayed wires, or incorrect crimps.
 - 1) Replace the safety cable if you find damage.
 - (b) Push on the safety cable with light finger pressure at a point halfway between the safety cabled parts.
 - (c) If the cable feels loose, do an inspection to make sure that the safety cable is serviceable (Figure 209):
 - 1) Measure the distance between the parts with the safety cable installation (Dimension A).
 - a) Make a record of Dimension A.
 - b) If three parts are safety cabled together, measure the distance between each of the parts (Figure 209).
 - <1> Add the two measurements together to get Dimension A.
 - 2) Push on the safety cable with light finger pressure at a point halfway between two safety cabled parts.
 - 3) Measure the distance the safety cable moves laterally in one direction.
NOTE: If you measure the distance the safety cable moves laterally in two directions, then write this as Dimension B.
 - a) Make a record of Dimension C.
 - 4) Compare Dimensions A and C to the limits (Figure 209).

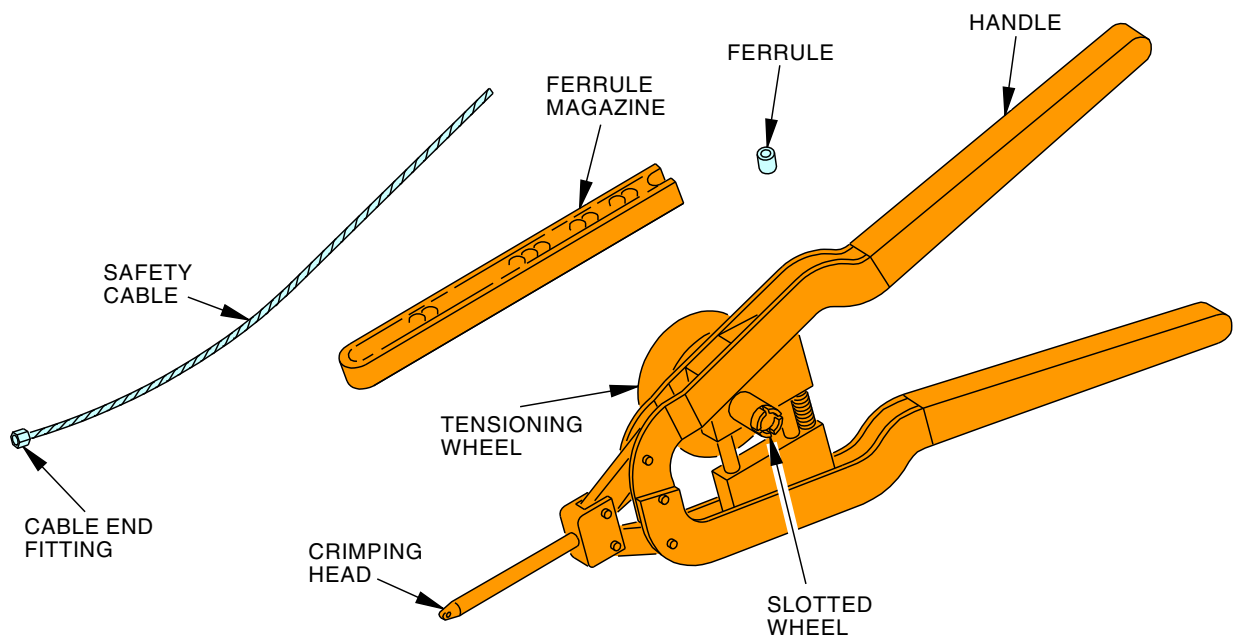
**CAUTION**

DO NOT TRY TO BREAK THE SAFETY CABLE. IF YOU MUST REMOVE THE SAFETY CABLE, CUT THE SAFETY CABLE TO PREVENT DAMAGE TO THE HOLES IN THE PARTS.

- (d) If the safety cable is not in the limits in the illustration, remove the cable (Figure 209).
 - 1) Use the side-cushioned diagonal cutters, STD-257 to remove the safety cable.
 - 2) Replace the safety cable.

———— **END OF TASK** ————

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1108131-00-C

2469494 S0000576792_V1

Bergen Crimping Tool (C10-148) - Safety Cable Components
Figure 204/70-41-00-990-804-G00

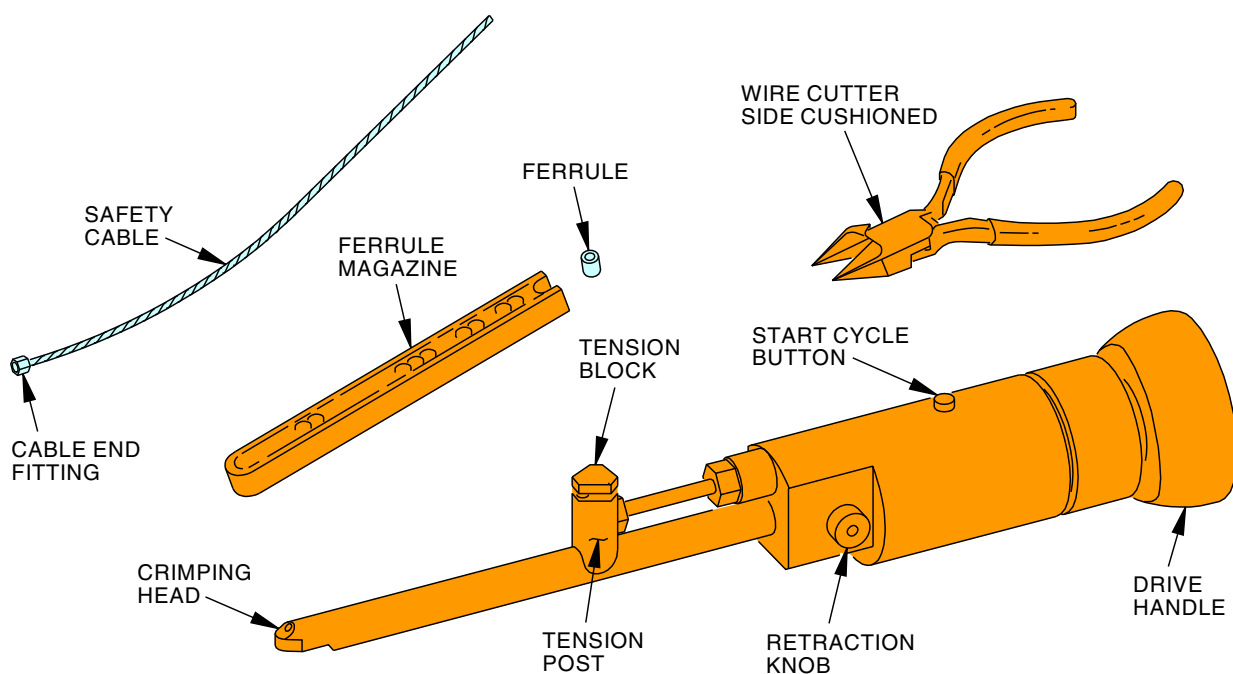
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 1105965-01-C
 2469495 S0000576793_V1

Snap-On Crimping Tool (C10-148) - Safety Cable Components
Figure 205/70-41-00-990-805-G00

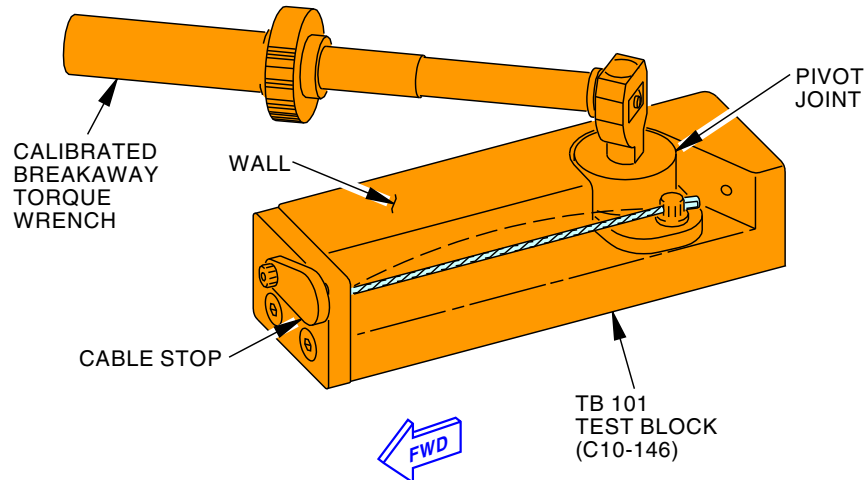
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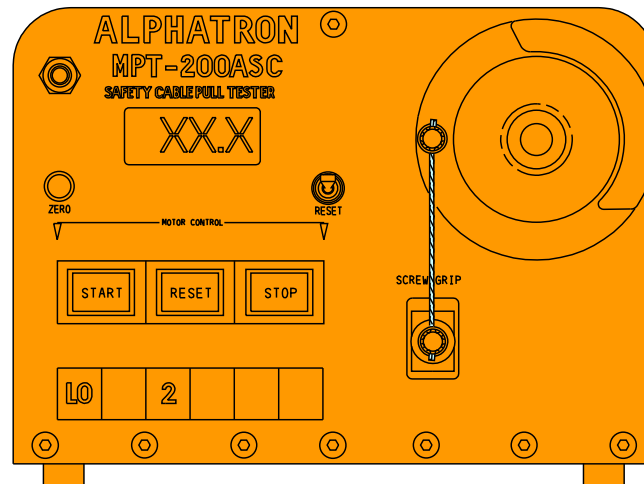
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**NOTE:**

WHEN CRIMPED, WIRE CAN NOT TOUCH WALL WITH LIGHT FINGER PRESSURE.



(10-147)

1108126-00-A
2469496 S0000576794_V1

Crimping Tool Verification Equipment
Figure 206/70-41-00-990-806-G00

EFFECTIVITY
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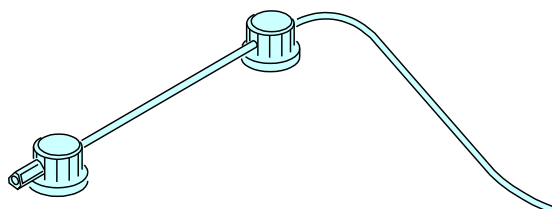
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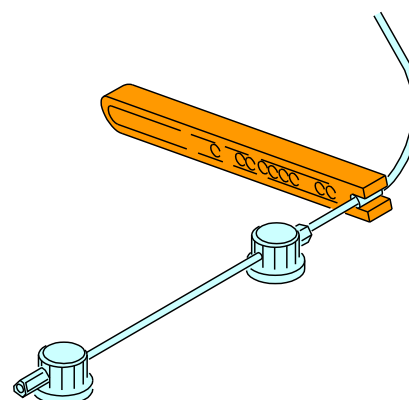
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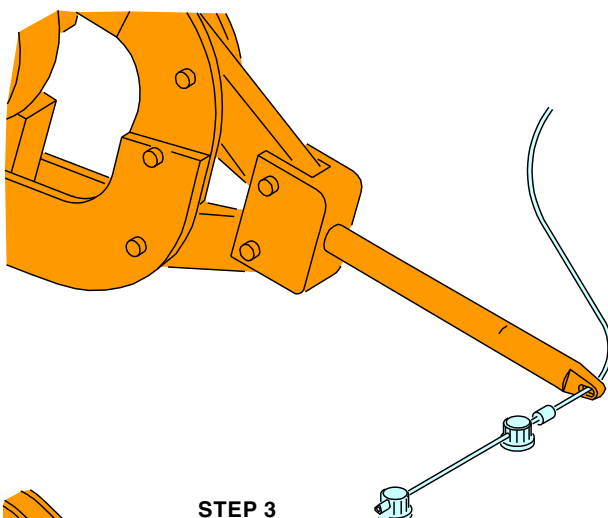
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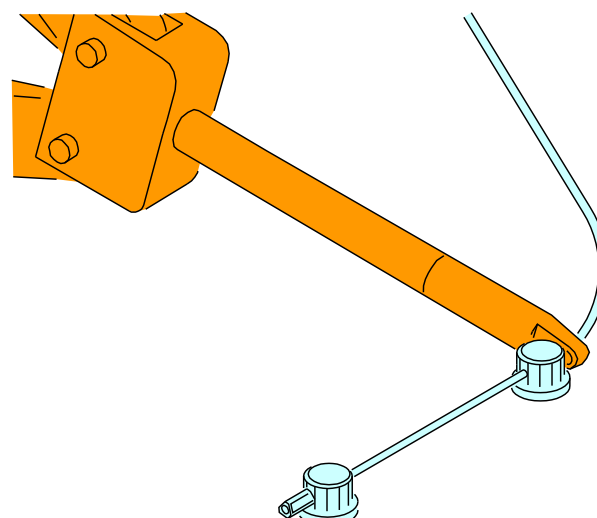
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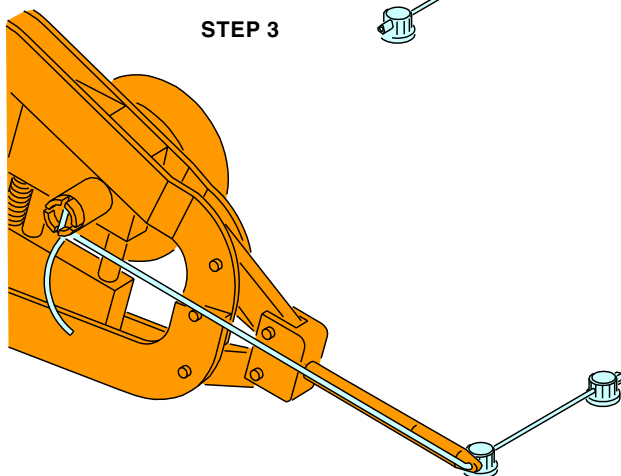
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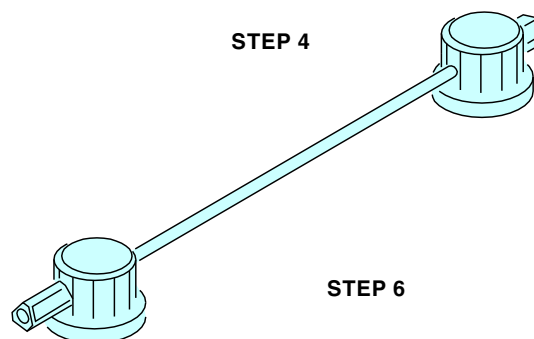
STEP 3



STEP 4



STEP 5



STEP 6

BERGEN CRIMPING TOOL

1108127-00-A
2469497 S0000576795_V1

Crimping Tool (C10-148) - Safety Cable Procedure
Figure 207/70-41-00-990-807-G00 (Sheet 1 of 2)

EFFECTIVITY
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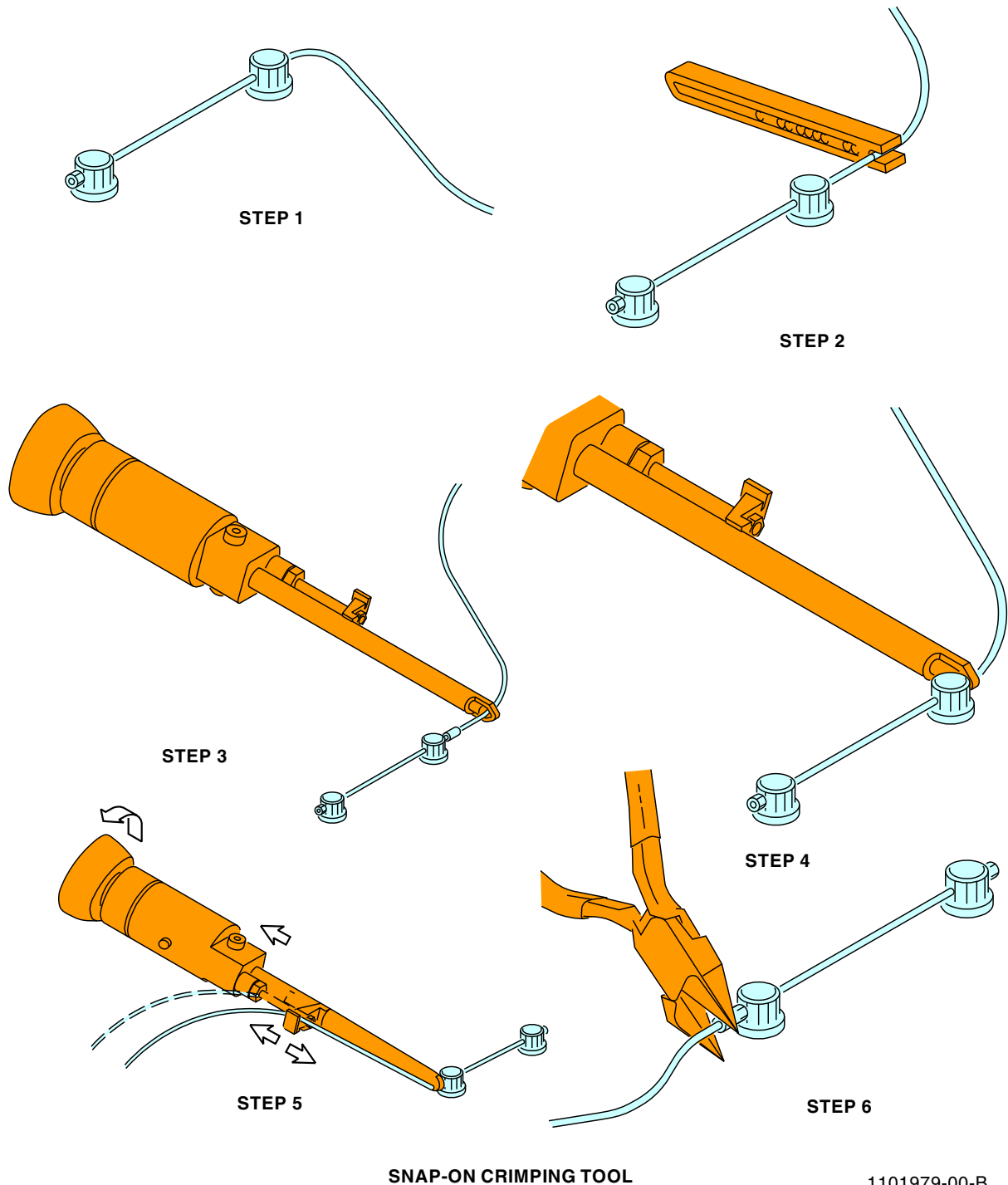
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1101979-00-B
2469498 S0000576796_V1

Crimping Tool (C10-148) - Safety Cable Procedure
Figure 207/70-41-00-990-807-G00 (Sheet 2 of 2)

EFFECTIVITY
SIA ALL

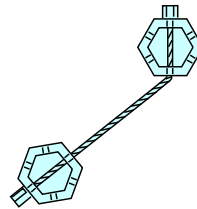
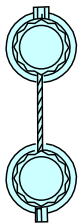
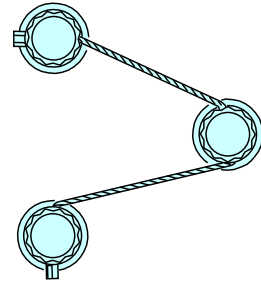
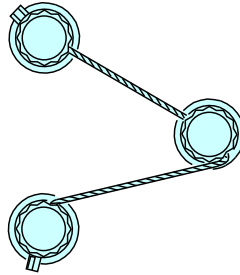
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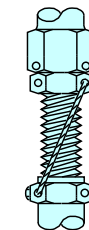
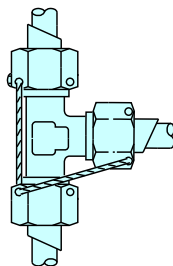
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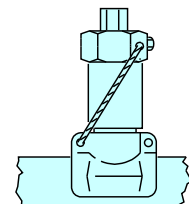
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**STANDARD HARDWARE
(EXAMPLE 1)**



**COUPLINGS
(EXAMPLE 2)**



1101185-00-B
2469499 S0000576797_V1

**Safety Cable Installation Examples
Figure 208/70-41-00-990-808-G00 (Sheet 1 of 2)**

EFFECTIVITY
SIA ALL

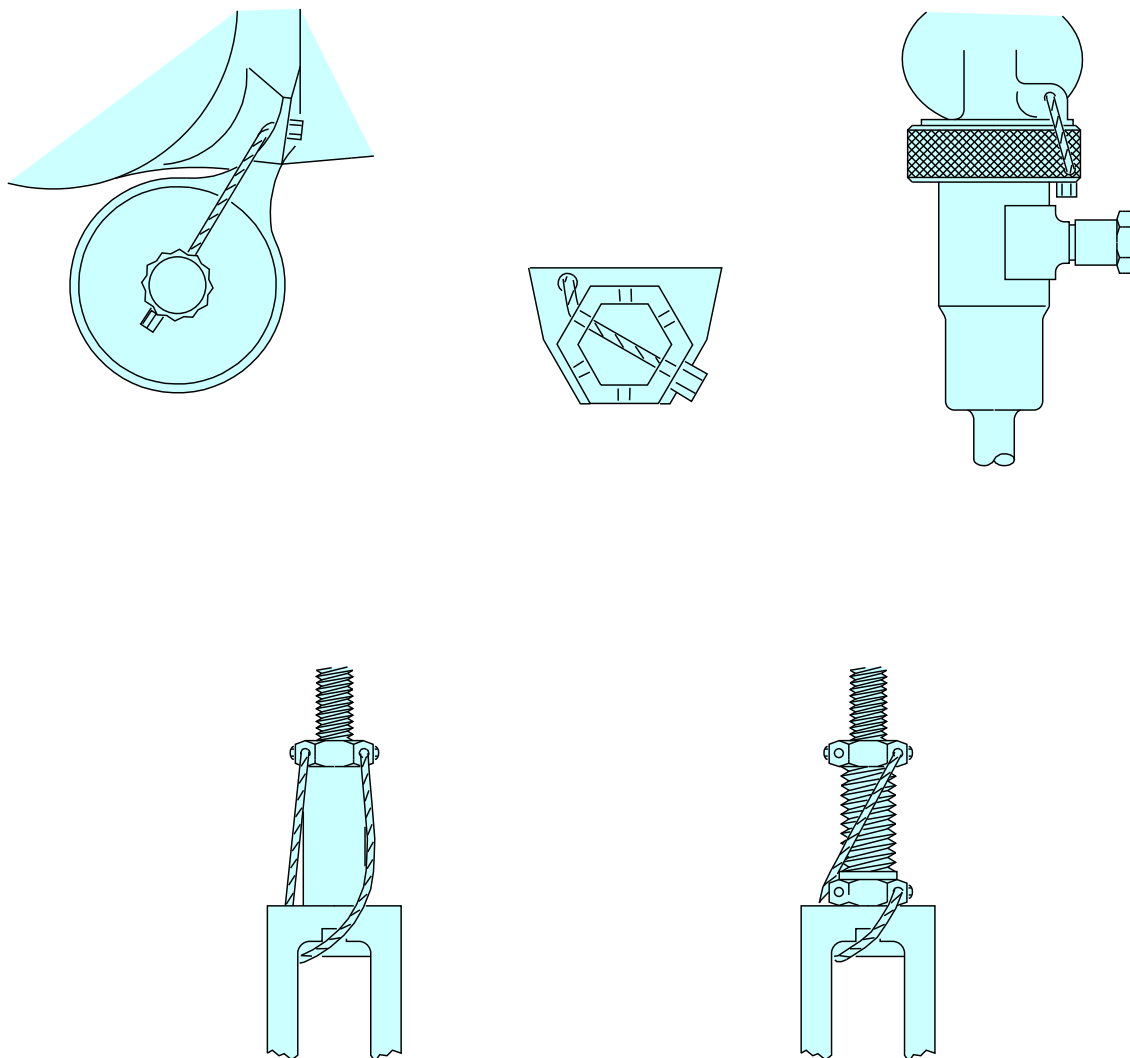
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**OTHER APPLICATIONS
(EXAMPLE 3)**

1101980-00-B
2469500 S0000576798_V1

Safety Cable Installation Examples
Figure 208/70-41-00-990-808-G00 (Sheet 2 of 2)

EFFECTIVITY
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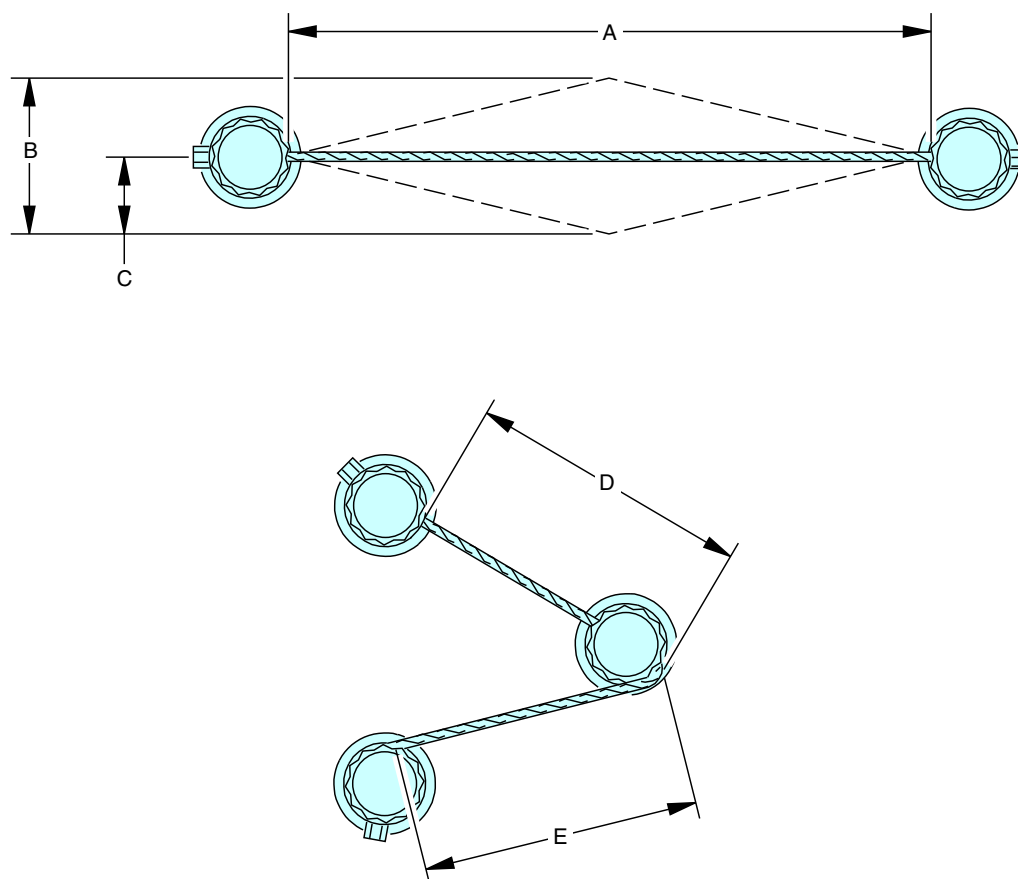
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**NOTE:**

FOR THREE BOLT PATTERNS,
DIMENSION A = DIMENSION D+E

A INCH (mm)	B INCH (mm)	C INCH (mm)
0.5 (12.7)	0.125 (3.175)	0.062 (1.575)
1.0 (25.4)	0.250 (6.350)	0.125 (3.175)
2.0 (50.8)	0.375 (9.525)	0.188 (4.775)
3.0 (76.2)	0.375 (9.525)	0.188 (4.775)
4.0 (101.6)	0.500 (12.700)	0.250 (6.350)
5.0 (127.0)	0.500 (12.700)	0.250 (6.350)
6.0 (152.4)	0.625 (15.875)	0.312 (7.925)

FLEX LIMITS, DIMENSIONS

1108129-00-A

2469501 S0000576799_V1

Safety Cable Flex Limits
Figure 209/70-41-00-990-809-G00

EFFECTIVITY
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TASK 70-41-00-400-803-G00**4. Self-Locking, Hexagonal or Castellated Nut Installation**

(Figure 210)

A. General

- (1) This task provides the instructions on how to install a self-locking or castellated nut.

B. References

Reference	Title
70-51-00-800-801-G00	Instructions for Torque (Miscellaneous) (P/B 201)

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Self-Locking, Hexagonal or Castellated Nut Installation**SUBTASK 70-41-00-210-003-G00**

- (1) Make sure that the new or the used nut meets the assembly specifications.
- (a) If it is necessary, refer to the illustrated parts catalog for the nut specified for the installation.

SUBTASK 70-41-00-420-004-G00

- (2) Install the nut on the bolt or the stud.

SUBTASK 70-41-00-210-004-G00

- (3) Make sure that the threads of the stud or bolt extend through the nut by a minimum of 1.5 threads unless specified differently.

SUBTASK 70-41-00-420-005-G00

- (4) Tighten the nut to the torque value specified in the procedure (TASK 70-51-00-800-801-G00).

————— **END OF TASK** —————

EFFECTIVITY
SIA ALL

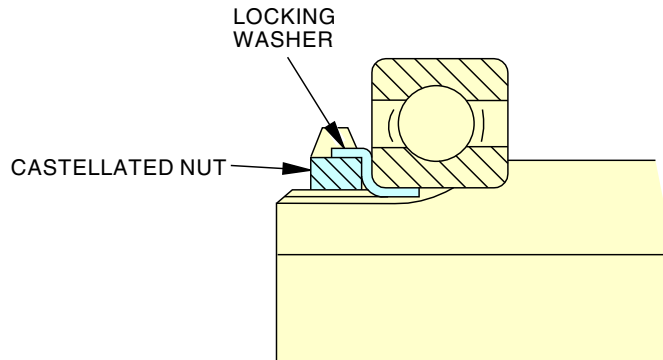
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CF8-1029-00-C
2469502 S0000576800_V1

Castellated Nut Installation
Figure 210/70-41-00-990-810-G00

TASK 70-41-00-400-804-G00

5. Nut Plate Installation

(Figure 211)

A. General

- (1) This task provides the instructions on how to install a new nut plate.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Nut Plate Installation

SUBTASK 70-41-00-210-006-G00

- (1) Make sure that the new nut plate has the correct part number.

SUBTASK 70-41-00-020-001-G00

- (2) Remove the nut plate that has damage.

SUBTASK 70-41-00-420-006-G00

- (3) Install the new nut plate to the part with the applicable rivets.

———— **END OF TASK** ————

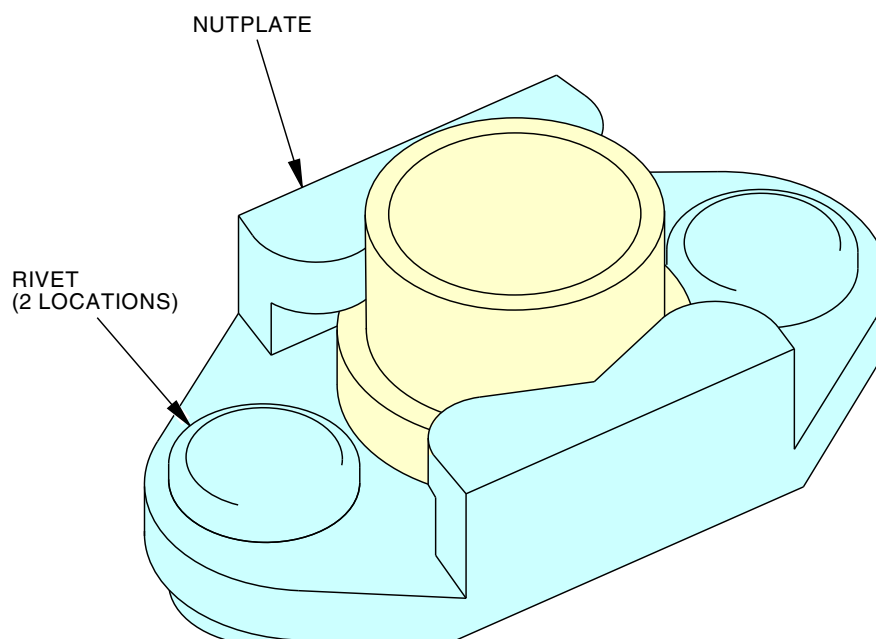
EFFECTIVITY
SIA ALL

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1298669-00-A
2469503 S0000576801_V1

Nut Plate Installation
Figure 211/70-41-00-990-811-G00

EFFECTIVITY
SIA ALL

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TASK 70-41-00-400-805-G00**6. Cotter Pin Installation**

(Figure 212)

A. General

- (1) This task provides the instructions on how to install the cotter pin.

B. References

Reference	Title
70-51-00-800-801-G00	Instructions for Torque (Miscellaneous) (P/B 201)

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Procedure

SUBTASK 70-41-00-420-007-G00



DO NOT APPLY MORE THAN THE MAXIMUM SPECIFIED TORQUE WHEN YOU TIGHTEN THE PARTS. DAMAGE TO THE PARTS CAN OCCUR IF YOU APPLY TOO MUCH TORQUE.

- (1) Install the castellated nut on the bolt or stud (TASK 70-41-00-400-803-G00).
- (a) Tighten the nut to the minimum torque value (TASK 70-51-00-800-801-G00).
 - (b) Tighten the nut slowly, until a slot on the nut aligns with the hole in the bolt or stud.
 - (c) If the slot in the nut will not align with the hole, loosen the nut by a half turn. Then tighten the nut again.
 - (d) If you cannot make the slot align with the hole after you loosen and tighten the nut, replace the nut.

SUBTASK 70-41-00-420-008-G00



ALWAYS USE A NEW COTTER PIN. A USED COTTER PIN CAN BREAK, AND DAMAGE TO EQUIPMENT CAN OCCUR.

- (2) Install the cotter pin.
- (a) Put the cotter pin through the hole in the bolt or stud.
 - (b) Make sure that the head of the cotter pin is in the slot of the castellated nut.
 - (c) Bend the top prong of the cotter pin up and back until it is on top of the bolt or stud.
 - 1) Make sure that the head of the cotter pin stays in the slot of the castellated nut.
 - (d) Bend the lower prong of the cotter pin down against the side of the nut.

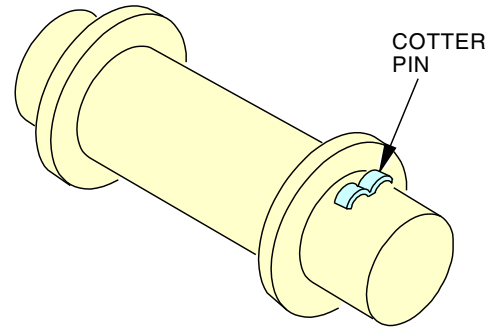
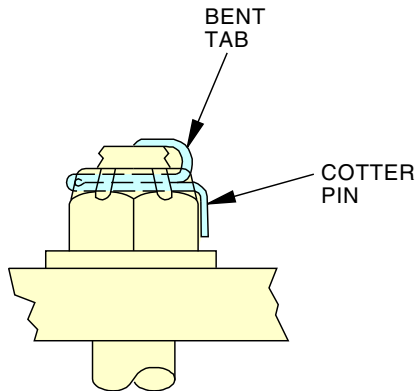
————— **END OF TASK** —————

EFFECTIVITY
SIA ALL

70-41-00

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CF8-1029-00-C
 2469504 S0000576802_V1

Cotter Pin Installation
Figure 212/70-41-00-990-812-G00

TASK 70-41-00-400-806-G00

7. Tab Washer Installation

(Figure 213)

A. General

- (1) This task provides the instructions on how to install the tab washer.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Procedure

SUBTASK 70-41-00-420-009-G00

- (1) Install the tab washer with the lock tab against the part.

SUBTASK 70-41-00-420-010-G00

- (2) Install and tighten the nut or bolt.

SUBTASK 70-41-00-420-011-G00

- (3) Bend the lock tab tightly against the flat side of the nut or bolt.

———— **END OF TASK** ————

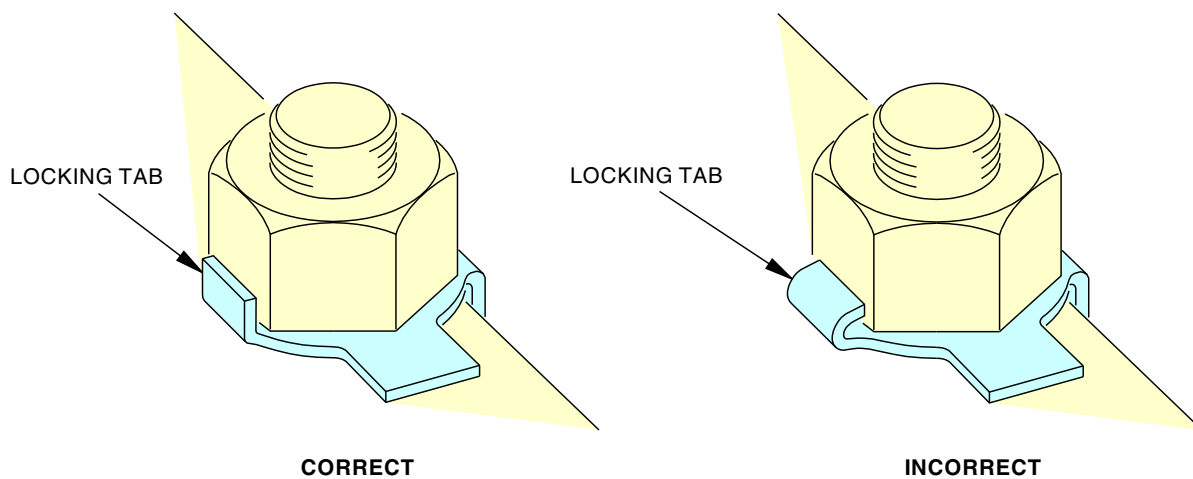
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CF8-1030-00-C
2469505 S0000576803_V1Tab Washer Installation
Figure 213/70-41-00-990-813-G00EFFECTIVITY
SIA ALL

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RIVET SYMBOLS/SPECIFICATIONS TECHNICAL DATA - MAINTENANCE PRACTICES

1. General

- A. This procedure has this task:
- (1) Identification of the rivets.

TASK 70-43-01-910-801-G00

2. Rivet Identification

(Figure 201, Figure 202, Figure 203, Figure 204, Figure 205, Figure 206, Figure 207, Figure 208, Figure 209, and Figure 210)

A. General

- (1) This task defines use of rivet symbols on LEAP engine components repaired by a riveting process.
- (2) This task is to specify rivets and rivet holes on the assembly drawing where rivet installation is intended. Series of rivet holes must match between component parts for proper assembly. For proper alignment of holes when matching multiple rivets a typical drawing call out is shown in Figure 201.
- (3) Symbols used.
 - (a) Each rivet is represented by a Greek cross (+).
 - (b) A chain dotted line represents the rivet centerline.
 - (c) The space between the crosses represents the rivet pitch (Figure 201).

B. Rivet Description

SUBTASK 70-43-01-910-001-G00

- (1) Full-shank rivets (View A, Figure 202).
 - (a) Rivets according to the French standards.
 - 1) 21215CM2410
 - 21215 - basic number
 - CM - material
 - 24 - nominal diameter (1/10 mm)
 - 10 - length (mm).
 - (b) Rivets according to American NAS standards.
 - 1) NAS1200M-4-8
 - NAS1200 - basic number
 - M - material (where applicable)
 - 4 - nominal diameter (1/32 inch)
 - 8 - length (1/16 inch).
 - (c) Rivets according to American MS Standards.
 - 1) MS20615-3M10
 - MS20615 - basic number
 - 3 - nominal diameter
 - M - material
 - 10 - length (1/16 inch).

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- (2) Blind bolt rivets (View B, Figure 202).
- (a) PLT220 or NAS167164
- PLT220 or NAS1671 - type
 - 6 - nominal diameter (1/32 inch)
 - 4 - grip length (1/16 inch).

SUBTASK 70-43-01-910-003-G00

- (3) Hi-lok bolt rivets (View C, Figure 202).
- (a) HL40-DU-8-8
- HL40 - type of bolt
 - DU - surface treatments (where applicable)
 - 8 - nominal diameter (refer to NOTE)
 - 8 - grip length (1/16 inch).

NOTE: The diameter reference (1st dash number) indicates:

- For the standard series, the nominal diameter expressed in 1/32 inch.
- For the series with repair dimensions, the nominal diameter expressed in 1/32 of an inch of the standard bolt that is replaced.

SUBTASK 70-43-01-910-004-G00

- (4) Standard and bulbed CHERRYLOCK blind rivets (View D, Figure 202).
- (a) NAS1399MW4-2
- NAS1399 - type of rivet (basic number)
 - MW - material
 - 4 - nominal diameter (1/32 inch)
 - 2 - grip length (1/16 inch).
- (b) CR2249-5-4
- CR2249 - type of rivet
 - 5 - nominal diameter (1/32 inch)
 - 4 - grip length (1/16 inch).

SUBTASK 70-43-01-910-005-G00

- (5) CHERRYMAX blind rivets (View D, Figure 202).
- (a) CR3213-6-4
- CR3213 - type of rivet
 - 6 - nominal diameter (1/32 inch)
 - 4 - grip length (1/16 inch).

SUBTASK 70-43-01-910-006-G00

- (6) HUCK blind rivets (View E, Figure 202).
- (a) NAS1921M-06S-07W
- NAS1921 - type of rivet
 - M - rivet material
 - 06 - nominal diameter (1/32 inch)

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- S - single action riveting
- 07 - grip length (1/16 inch)
- W - Delete the "W" for sleeves without cadmium plating or passivated.

NOTE: OSMLSP for repair rivet.

SUBTASK 70-43-01-910-007-G00

(7) HUCK BOLT rivets (View F, Figure 202).

(a) HUCK BOLT rivet stems.

1) NAS1466-08A

- NAS1466 - rivet type (NAS 1465, 1466, 1468, 1470, 1472 depending on diameter)
- 08 - grip length (1/16 inch)
- A - symbol letter for repair rivet.

(b) HUCK BOLT rivet collars.

1) NAS1080R05

- NAS1080 - collar type
- R - material
- 05 - nominal diameter (1/32 inch).

C. Acceptance Limit

SUBTASK 70-43-01-910-008-G00

(1) The acceptance limits for rivets are defined in each standard practice specific to a rivet type.

D. Rivet Installation

SUBTASK 70-43-01-910-009-G00

(1) The definition of rivet installation is stated in each standard practice (rivet holes, countersinking, dimpling).

NOTE: The direction in which a rivet is installed is not stated in the repair instructions, unless it is necessary.

E. Rivet Identification

SUBTASK 70-43-01-910-010-G00

(1) Identification of solid shank rivets.

Table 201/70-43-01-993-801-G00

REFERENCE	TYPE OF HEAD	MATERIAL	MARKING	IDENTIFICATION	COLOR
21215DB	FLAT ROUND	AG5MC			GREEN
21217DB	100° COUNTERSUNK		IN RELIEF	(View A, Figure 203)	
21215CA	FLAT ROUND	Z2CN18-10			YELLOW
21217CA	100° COUNTERSUNK		RECESSED	(View B, Figure 203)	
21215TC	FLAT ROUND	NC15Fe			
21217TC	100° COUNTERSUNK		IN RELIEF	(View C, Figure 203)	

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SUBTASK 70-43-01-910-011-G00

(2) Identification of blind bold rivets (Figure 204).

Table 202/70-43-01-993-802-G00

REFERENCE	MANUFACTURER	HEAD	MATERIAL	EQUIVALENTS
PLT 200 PLT 221	NATIONAL SCREW	HEXAGONAL	Z6 NCT 25	NAS 1671 NAS 1753 (1)
PLT 1005 PLT 1006	NATIONAL SCREW	100° COUNTERSUNK	Z6 NCT 25	

SUBTASK 70-43-01-910-012-G00

(3) Identification of Hi-Lok bolt rivets (Figure 205).

Table 203/70-43-01-993-803-G00

NUMBER	TYPE OF HEAD	TYPE	MATERIALS
HL 40 ^{*[1]} HL 140 ^{*[1]}	FLAT ROUND	SHEAR	Z6 NCT 25

*[1] Identification of manufacturers: HI-SHEAR = "SH" engraved on the head in addition to the number. VOI-SHAN = "VS" engraved on the head in addition to the number. STANDARD PRESS STEEL = "SPS" engraved on the head in addition to the number.

SUBTASK 70-43-01-910-013-G00

(4) Identification of CHERRYLOCK Rivets.

(a) Standard CHERRYLOCK rivets (Figure 206).

Table 204/70-43-01-993-804-G00

PART NO.	HEAD TYPE	MATERIAL
NAS 1398 D	UNIVERSAL	2017-T4
NAS 1398 MW	UNIVERSAL	MONEL
NAS 1399 C	COUNTERSUNK	A 286
NAS 1399 MW	COUNTERSUNK	MONEL
NAS 1399 D	COUNTERSUNK	2017-T4

NOTE: No identification for aluminium.

(b) Bulbed CHERRYLOCK rivets (Figure 207).

SUBTASK 70-43-01-910-014-G00

(5) Identification of CHERRYMAX rivets (Figure 208).

SUBTASK 70-43-01-910-015-G00

(6) Identification of HUCK rivets (Figure 209).

Table 205/70-43-01-993-805-G00

PART NO.	HEAD TYPE	MATERIAL
NAS 1919 B	PROTRUDING	ALU 5056
NAS 1921 B	COUNTERSUNK	ALU 5056

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**737-7/8/8200/9/10
AIRCRAFT MAINTENANCE MANUAL****Table 205/70-43-01-993-805-G00 (Continued)**

PART NO.	HEAD TYPE	MATERIAL
NAS 1919 M	PROTRUDING	MONEL
NAS 1921 M	COUNTERSUNK	MONEL

NOTE: No identification for aluminium.

SUBTASK 70-43-01-910-016-G00

(7) Identification of HUCK bolt rivets (Figure 210).

———— **END OF TASK** ————

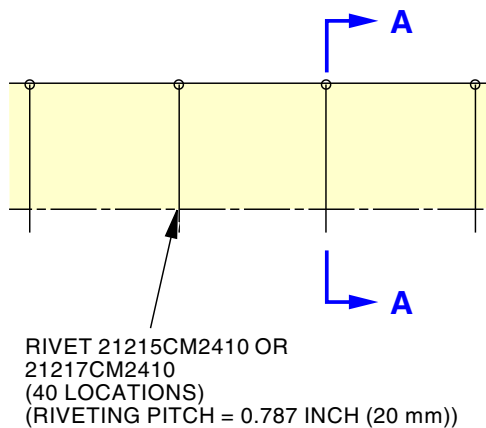
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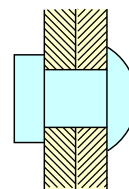
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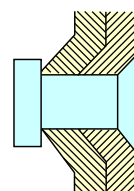


RIVET 21215CM2410 OR
21217CM2410
(40 LOCATIONS)
(RIVETING PITCH = 0.787 INCH (20 mm))

A

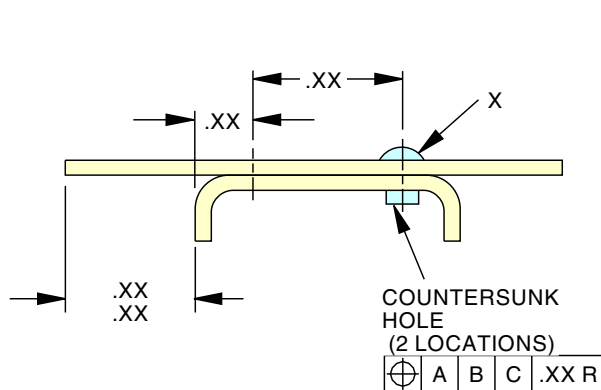


RIVET 21215CM2410

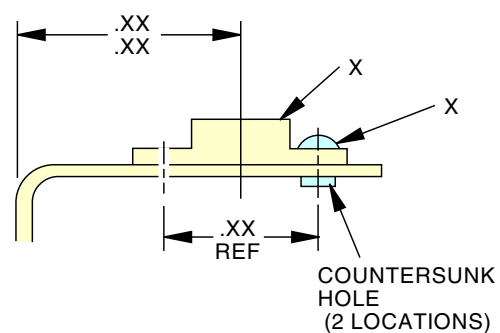


RIVET 21217CM2410

A-A



TWO PARTS MADE BY CFMI



**PART MADE BY CFMI USED ON A
COMMERCIALLY AVAILABLE PART**

2978378 S0000756748 V1

Method of Representing Rivets
Figure 201/70-43-01-990-801-G00

— EFFECTIVITY
SIA ALL

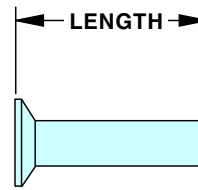
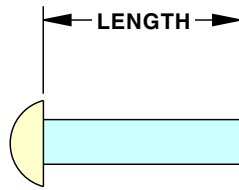
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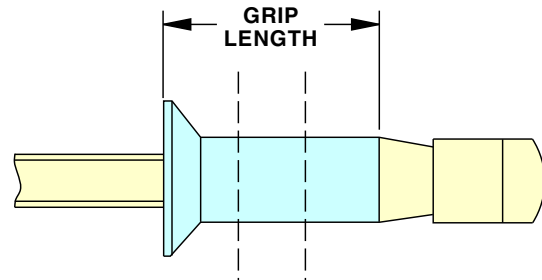
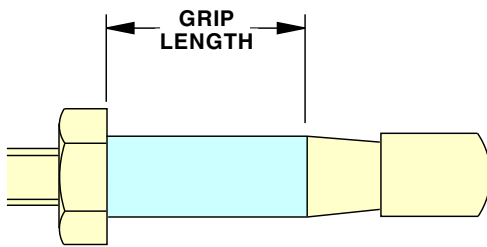
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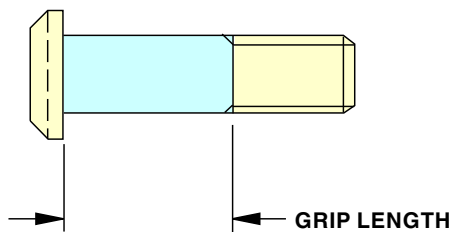
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FULL SHANK RIVET

A

BLIND BOLT RIVETS

B

HI-LOK BOLT RIVETS

C

2978379 S0000756749_V1

Effective Length Definition
Figure 202/70-43-01-990-802-G00 (Sheet 1 of 2)

EFFECTIVITY
SIA ALL

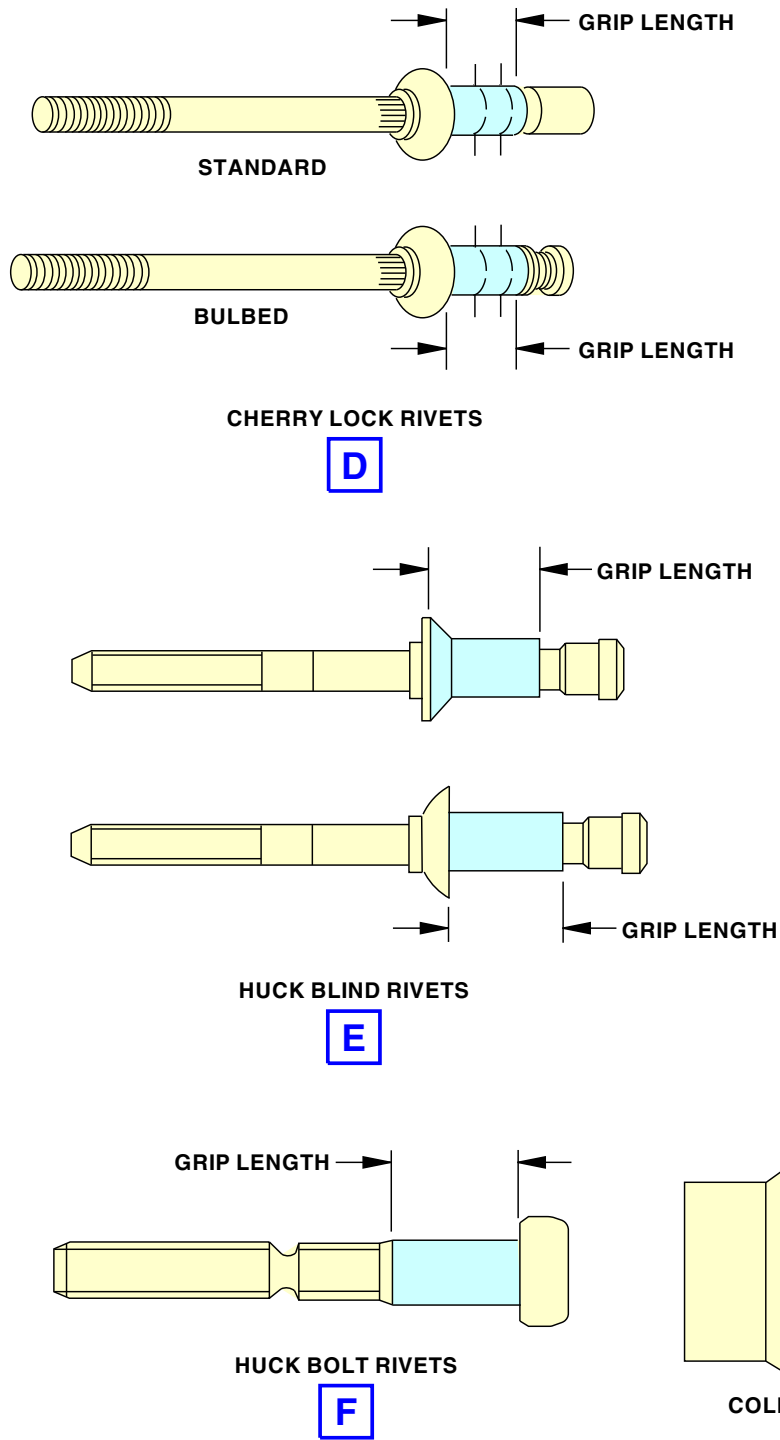
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2978380 S0000756750_V1

Effective Length Definition
Figure 202/70-43-01-990-802-G00 (Sheet 2 of 2)

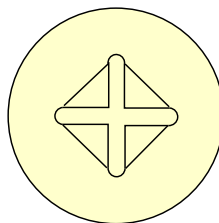
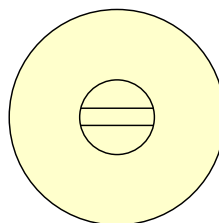
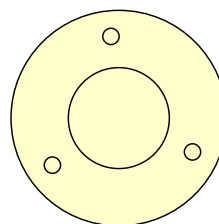
EFFECTIVITY
SIA ALL

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AIRCRAFT MAINTENANCE MANUAL**A****B****C**

2978486 S0000756751_V1

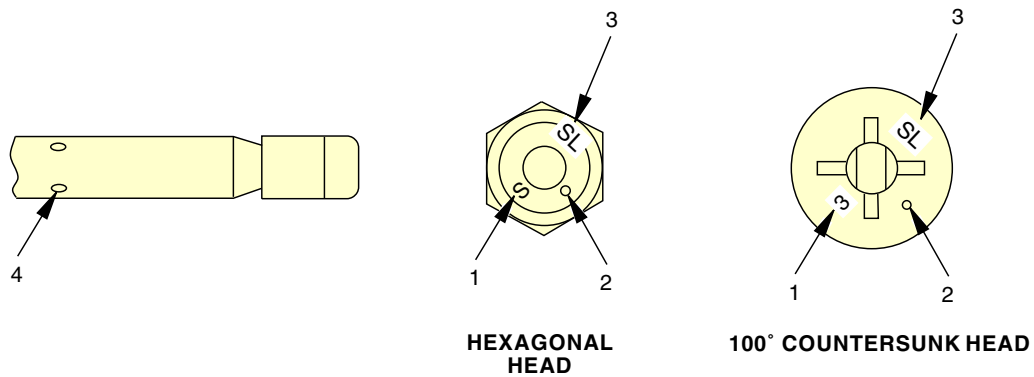
Solid Shank Rivets Identification
Figure 203/70-43-01-990-803-G00EFFECTIVITY
SIA ALL

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**LEGEND:**

1. IDENTIFICATION OF MANUFACTURER NS = NATIONAL SCREW
VS = VOI-SHAN
2. MATERIAL [0 = Z6 NCT 25]
3. SL = INDICATION OF SELF-LOCKING
4. SELF-LOCKING PRODUCED BY THREE POINTS

2978492 S0000756754_V1

Blind Rivets Identification
Figure 204/70-43-01-990-804-G00

EFFECTIVITY
SIA ALL

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2978495 S0000756755_V1

Hi-lok Bolt Rivets Identification
Figure 205/70-43-01-990-805-G00

EFFECTIVITY
SIA ALL

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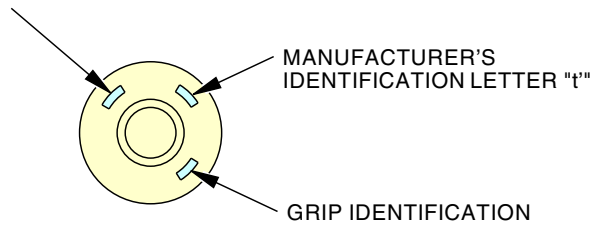
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MATERIAL CODE:

M: MONEL
C: A286
X: INCONEL X 750



2978500 S0000756756_V1

Standard Cherrylock Rivets Identification
Figure 206/70-43-01-990-806-G00

EFFECTIVITY
SIA ALL

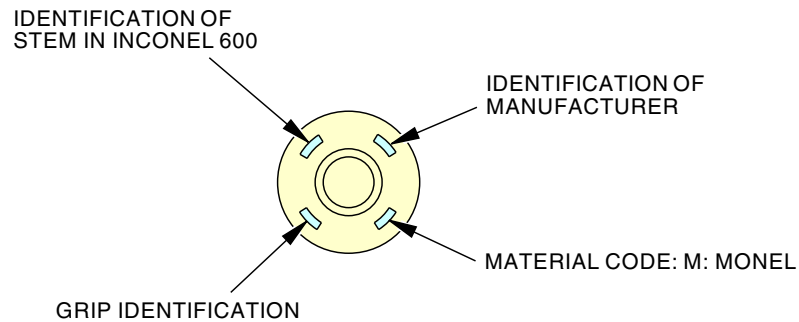
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2978501 S0000756757_V1

Bulbed Cherrylock Rivets Identification
Figure 207/70-43-01-990-807-G00

EFFECTIVITY
SIA ALL

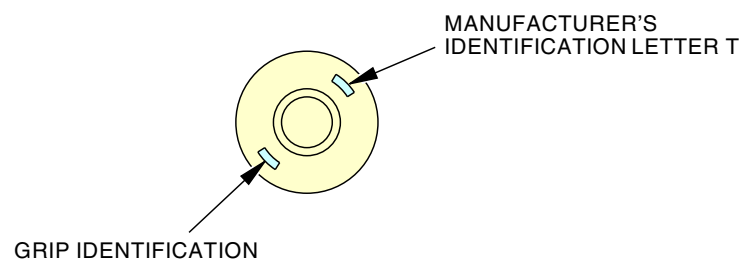
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2978502 S0000756758_V1

Cherrymax Rivets Identification
Figure 208/70-43-01-990-808-G00

EFFECTIVITY
SIA ALL

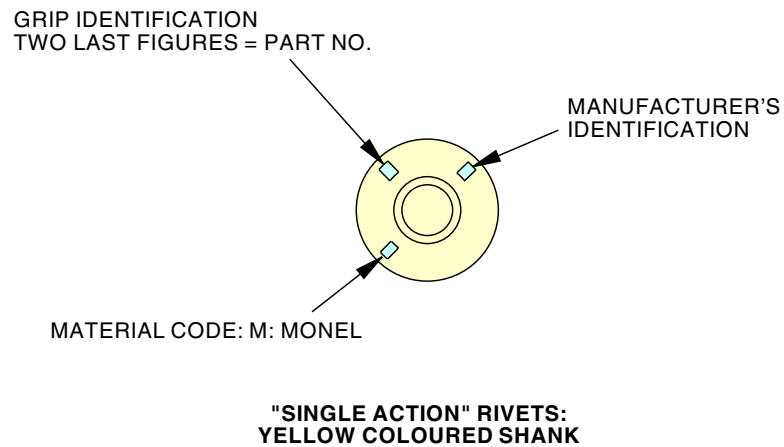
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2978503 S0000756759_V1

Huck Rivets Identification
Figure 209/70-43-01-990-809-G00

EFFECTIVITY
SIA ALL

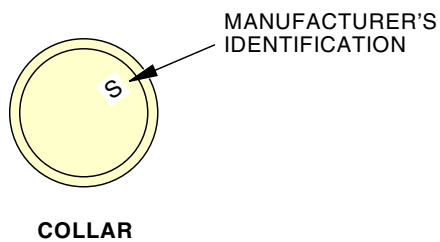
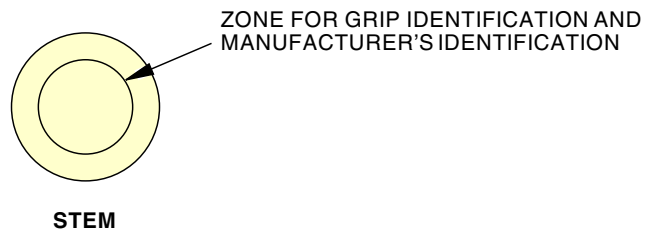
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**NOTE:**

FOR STANDARD RIVETS, MARKING IS ENGRAVED.

FOR REPAIR RIVETS, MARKING ZONE IS
RECESSED WITH INDICATIONS IN RELIEF

2978504 S0000756760_V1

Huck Bolt Rivet Collars Identification
Figure 210/70-43-01-990-810-G00

EFFECTIVITY
SIA ALL

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**737-7/8/8200/9/10
AIRCRAFT MAINTENANCE MANUAL**

CHEMICAL TOUCH UP FOR ALUMINUM - MAINTENANCE PRACTICES

1. General

A. This procedure has one task:

- (1) Chemical touch up for aluminum repair.

TASK 70-43-07-300-801-G00

2. Specifications Chemical Touchup for Aluminum Standard Repair

A. General

- (1) This task provides the instructions on how to touch up the chemical oxide film coating on aluminum alloys parts to give treated surface a good corrosion resistance.
- (2) For general requirements on water types rinsing process, refer to the Water Types, TASK 70-00-07-910-801-G00.

B. References

Reference	Title
70-00-07-910-801-G00	Water Types (P/B 201)
70-21-23-100-801-G00	Hand Wipe Solvent Degreasing With Chemical Agent (P/B 701)

C. Consumable Materials

Reference	Description	Specification
B00166	Abrasive - pumice	
C50208 [CP2659]	Coating - Chemical Conversion - Bonderite M-CR 1132 Aero Pen (Formerly Alodine 1132)	
C50408 [S1269]	Coating - Touch Up - SurTec 650 Chromital	
C50420 [S1313]	Coating - Bonderite M-CR 1200S, Touch-up	
C50421 [CP2925]	Coating - SurTec 650 Chromital RTU	
C50422 [CP2926]	Pen - SurTec 650 Chromital	
G02418	Water - De-ionized	
G02439	Brush - Nylon Bristle	
G50698 [P05-422]	Pad - Scrub, Scotch Brite 7448 Ultra Fine Pad	PMC 4435
G50699 [P05-421]	Pad - Scrub, Scotch Brite 7447 General Purpose Pad	PMC 4095
G51193	Pad - General Purpose, Abrasive Hand Pad, Maroon, Very Fine Grade. (Norton Bear-Tex 747)	
G51662 [CP2979]	Pad - Scotch-Brite 96, Aqua Scourer	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Equipment

SUBTASK 70-43-07-800-001-G00

- (1) The following equipment is required for the application of this process:
- (a) Safety equipment and devices necessary to guarantee the application of the standard practice in complete safety for the operator.
- (b) Processing plant for neutralizing waste and used solutions.

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(c) If it is necessary, efficient ventilation system for extracting and neutralizing vapors.

F. Prepare for the Touchup

SUBTASK 70-43-07-200-005-G00

- (1) Make sure that these conditions occur:
 - (a) All heat treat, forming, brazing, welding and machining operations must be carried out before the parts are processed by chemical conversion.
 - (b) Abrasives containing iron, such as steel wool, red iron oxide, or steel wire are prohibited for all cleaning operations as particles from them may become embedded in the metal and accelerate corrosion.
 - (c) Surface has no anomalies such as corrosion, impacts, scratches, or contamination liable to disrupt the treatment application.

SUBTASK 70-43-07-110-002-G00



THE SOLUTIONS USED IN THIS PROCESS ARE HIGHLY CORROSIVE. USE RESPIRATORS, GOGGLES OR FACE SHIELD, RUBBER OR NEOPRENE GLOVES, BOOTS AND APRONS WHEN HANDLING OR APPLYING THE SOLUTION. WASH OFF IMMEDIATELY IF SOLUTION CONTACTS THE SKIN. IF SOLUTION CONTACTS THE EYES, FLUSH THEM WITH CLEAR WATER, IRRIGATE WITH BORIC ACID SOLUTION, AND SEEK IMMEDIATE MEDICAL AID.



DO NOT PERMIT SURFACE COATING SOLUTION TO CONTACT ORGANIC SOLVENTS: IT CAN IGNITE THEM.



DO NOT BREATHE THE FUMES OF THE CLEANING SOLVENT OR GET IT IN YOUR MOUTH. THE CLEANING SOLVENT IS DANGEROUS. USE THE APPROVED FACE MASK. MAKE SURE TO USE THE CLEANING SOLVENT IN AN AREA WITH GOOD AIRFLOW. IF YOU GET THE CLEANING SOLVENT IN YOUR MOUTH, FLUSH IT WITH WATER. IF THE CLEANING SOLVENT IS BREATHED IN OR DRUNK, THERE CAN BE A HEALTH RISK.

- (2) Clean and degrease the surface to be treated, do this task: Hand Wipe Solvent Degreasing With Chemical Agent, TASK 70-21-23-100-801-G00.

SUBTASK 70-43-07-120-002-G00

- (3) Rub the area until the coating is completely removed.
 - (a) Use one of two alternative steps that follows:
 - 1) Rub the area lightly with a clean brush, G02439, with pumice abrasive, B00166, in a slightly dampened environment.
 - 2) Damp with de-ionized water, G02418, and rub the area with Scotch-Brite 7447 pad, G50699 [P05-421], Scotch-Brite 7448 pad, G50698 [P05-422], abrasive hand pad, G51193, or Scotch-Brite 96 pad, G51662 [CP2979].
 - (b) Make sure that the coating is completely removed.

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SUBTASK 70-43-07-170-001-G00

**CAUTION**

DO NOT LET LIQUIDS STAY IN THE HOLES OR CREASES IN THE PART. DAMAGE TO THE PROTECTIVE LAYER CAN OCCUR.

- (4) Rinse the area to be touched up with de-ionized water, G02418, or wet lint-free cloth until all traces of abrasives are removed.
- (a) Make sure that the water film is continuous.

NOTE: Coating has to be applied within 6 hours after surface preparation, unless specified in the manufacturer document.

G. Touchup

SUBTASK 70-43-07-200-004-G00

- (1) Make sure that the surface remains wet after preparation steps.

SUBTASK 70-43-07-370-003-G00

**WARNING**

DO NOT LET THE ACIDS TOUCH YOUR SKIN, EYES, CLOTHES AND DO NOT BREATHE THE FUMES OF ACIDS. IF THE ACID GOES INTO YOUR EYES OR ON YOUR SKIN, FLASH IMMEDIATELY WITH THE LARGE QUANTITY OF COOL WATER. GET MEDICAL AID. ACID SOLUTIONS ARE VERY POISONOUS AND CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

**CAUTION**

APPLY THE SOLUTION CAREFULLY. DO NOT LET THE SOLUTION TOUCH METAL WHERE IT IS NOT NECESSARY TO APPLY AN ANODIZED FINISH. THE SOLUTION CAN CAUSE CORROSION AND DAMAGE TO METAL SURFACES.

**CAUTION**

BE CAREFUL NOT TO SPRAY THE ACID SOLUTION ON PARTS NOT MADE OF ALUMINUM. THE ACID SOLUTION CAN CAUSE CORROSION. USE PROTECTION ON ALL PARTS NOT MADE OF ALUMINUM. IF YOU ARE NOT CAREFUL, YOU CAN DAMAGE TO THE LAYERS AND OTHER PARTS.

- (2) Apply the coating, using one of two alternative methods that follows:
- (a) Paint brush or pad touchup:
- 1) Lightly rub the surface to be treated with a paint brush or a pad soaked with the following:

NOTE: You can held the pad by a stainless steel wrench.

 - a) Bonderite M-CR 1200S coating, C50420 [S1313].

<1> Keep the part wet with solution until coating is fully formed between 1 and 10 minutes.
 - b) oxide film coating, C50408 [S1269], or oxide film coating, C50421 [CP2925].

<1> Keep the part wet with solution between 2 and 10 minutes.
- (b) Pen touchup:
- 1) Apply Bonderite M-CR 1132 Aero Pen, C50208 [CP2659], or oxide film pen, C50422 [CP2926], on the surface to be treated.
 - a) Overlap each stroke 50% to ensure full coverage.

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- b) Keep the area wet for at least 2 min.
- 2) Repeat the application a second time at a 90-degree angle within the following period:
 - a) For the Bonderite M-CR 1132 Aero Pen, C50208 [CP2659], within 5 minutes after drying of the first layer.
 - b) For the oxide film pen, C50422 [CP2926], within 10 minutes before drying of the first layer.

SUBTASK 70-43-07-100-002-G00



WHEN WIPING, BE CAREFUL TO AVOID SCRATCHING OR RUBBING OFF COATING, WHICH IS DELICATE WHEN FRESHLY FORMED.



DO NOT PERMIT SWABS, CLOTHS, PAPER, ETC., USED FOR APPLYING OR REMOVING SURFACE COATING SOLUTION TO DRY OUT. THESE MATERIALS ARE COMBUSTIBLE WHEN DRY, AND CONSTITUTE A FIRE HAZARD. IMMEDIATELY AFTER USE, SOAK ITEMS THOROUGHLY IN WATER BEFORE DISCARDING.

- (3) Wipe the surface with a wet lint-free cloth soaked with de-ionized water, G02418.

SUBTASK 70-43-07-100-001-G00



BE CAREFUL NOT TO MAKE A SCRATCH ON THE NEW ANODIZED FINISH. MAKE SURE THAT YOU DO NOT RUB THE NEW ANODIZED FINISH OFF THE PART. DAMAGE TO THE ANODIZED FINISH CAN OCCUR.

- (4) Dry the surface with clean, dry, and oil free air.

NOTE: A local heating system can be used as long as the surface temperature does not exceed 158 F (70 C) for oxide film coating, C50421 [CP2925], oxide film coating, C50408 [S1269], or oxide film pen, C50422 [CP2926] and between 140 F (60 C) and 158 F (70 C) for Bonderite M-CR 1132 Aero Pen, C50208 [CP2659] and Bonderite M-CR 1200S coating, C50420 [S1313].

SUBTASK 70-43-07-370-004-G00

- (5) If the part is to be painted, apply the paint between 30 minutes and 48 hours after the application of surface coating.

SUBTASK 70-43-07-550-002-G00

- (6) Keep the solution that you will not use in a plastic container.

NOTE: Keeping the solution in a regular glass or steel container cause it deterioration.

SUBTASK 70-43-07-120-003-G00

- (7) If the touch-up is non-acceptable, do the steps above to strip of the coating.

H. Coating Quality Test

SUBTASK 70-43-07-200-001-G00

- (1) Make sure that the appearance is uniform, with no stains, pitting, contamination, scratches, or heterogeneity.

SUBTASK 70-43-07-200-002-G00

- (2) Check the color.

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- (a) For Bonderite M-CR 1200S coating, C50420 [S1313], or Bonderite M-CR 1132 Aero Pen, C50208 [CP2659], the color may change from light yellow to brown, depending on alloys, except for pad reworking which may sometimes be grey.
- (b) For oxide film coating, C50421 [CP2925], oxide film coating, C50408 [S1269], or oxide film pen, C50422 [CP2926], the color is grey with green reflections.

NOTE: The color may change depending on alloys and processing conditions.

SUBTASK 70-43-07-200-003-G00

- (3) Check the adherence for oxide film coating, C50421 [CP2925], oxide film coating, C50408 [S1269], or oxide film pen, C50422 [CP2926].
 - (a) Wipe the surface with a clean lint free cloth at least 12 hours after processing.
 - (b) Make sure that there is no change in the appearance of the treated surface and no marks on the cloth.
 - (c) If the coating is very powdery, remove and redone the coating.

NOTE: A light powder deposit that does not leave the exposed metal after wiping is not a cause for rejection.

———— **END OF TASK** ————

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MATING SURFACES AND INSERTS STANDARD REPAIR - MAINTENANCE PRACTICES

1. General

- A. This procedure has one task:
- (1) Mating surfaces and inserts standard repair.

TASK 70-43-17-300-801-G00

2. Mating Surfaces and Inserts Standard Repair

A. General

- (1) This task provides the instructions on how to do the standard repair on mating surfaces and installation of inserts.
- (2) You use this procedure when it is necessary to fill nicks, dents, or scratches on mating surfaces.
- (3) You can also use this procedure to apply epoxy when you install threaded inserts, studs and bolts.

B. Tools/Equipment

Reference	Description
STD-200	Container - Fuel Resistant, 10 gallon (38 l)

C. Consumable Materials

Reference	Description	Specification
A01059 [C01-011]	Paste - Adhesive, Two Part (Hysol EA 934NA)	A50TF94 Class B
B01041 [C04-208]	Solvent - Degreaser - Turco 5948 DPM	
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	AMS3819 Class 1 Grade A or B Form 1 (Supersede BMS15-5 CL A)
G02439	Brush - Nylon Bristle	
G02442 [C10-141]	Abrasive - 120 Grit, SiC, Wet/Dry, Abrasive Paper / 180 Grit, SiC, Wet/Dry, Abrasive Paper	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Procedure

SUBTASK 70-43-17-350-001-G00

- (1) Do these steps to repair the mating surfaces and inserts:

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DO NOT GET CHLORINATED HYDROCARBON SOLVENTS IN YOUR MOUTH, EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM CHLORINATED HYDROCARBON SOLVENTS. PUT ON GOGGLES, AND GLOVES WHEN YOU USE CHLORINATED HYDROCARBON SOLVENTS. KEEP CHLORINATED HYDROCARBON SOLVENTS AWAY FROM SPARKS, FLAME, AND HEAT. CHLORINATED HYDROCARBON SOLVENTS ARE POISONOUS AND FLAMMABLE, AND CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

- (a) Use a clean brush, G02439 or cotton wiper, G00034 to clean the surface with Turco 5948 DPM solvent, B01041 [C04-208], or other approved solvent.
- (b) Fully clean the part(s) of oil, grease or other contamination that is on the surface.
- (c) Clean each void with a sharp pointed tool.
 - 1) Use the tool as a scraper on the surface until bright metal shows.



DISCARD THE EPOXY COMPONENTS IF THE CATALYST IS AN AMBER COLOR, OR IF THE PROPERTIES OF THE EPOXY CHANGE AT ROOM TEMPERATURE. THESE CONDITIONS WILL CAUSE THE BOND TO BE UNSATISFACTORY.

- (d) Fully mix the Hysol EA 934NA adhesive paste, A01059 [C01-011] in a clean 10 gallon (38 l) fuel resistant container, STD-200.
NOTE: This lets the catalyst mix equally through the resin.
- (e) After you fully mix the epoxy, use it immediately.
NOTE: The pot life of 220 grams mass of Hysol EA 934NA adhesive resin at 77 °F (25 °C) is approximately 20 minutes.
- (f) Fill the voids with the Hysol EA 934NA adhesive paste, A01059 [C01-011] mixture to a small height above the adjacent surfaces.
 - 1) If you have more Hysol EA 934NA adhesive paste, A01059 [C01-011] than is necessary, remove it immediately.
- (g) On an installation of a threaded insert or threaded part, apply the Hysol EA 934NA adhesive paste, A01059 [C01-011] resin mixture to the male threads only.
 - 1) Install the threaded part and immediately remove the Hysol EA 934NA adhesive paste, A01059 [C01-011] that is more than necessary.
- (h) Let the Hysol EA 934NA adhesive paste, A01059 [C01-011] dry at a room temperature of 75°F (24°C) for a minimum of 24 hours.
- (i) Sand the area lightly in a circular motion with abrasive paper, G02442 [C10-141].

— END OF TASK —

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ETCHING PROCEDURES FOR FLUORESCENT-PENETRANT INSPECTION - MAINTENANCE PRACTICES

1. General

A. This procedure has the following task:

- (1) Swab etching procedure and cleaning

TASK 70-43-24-100-802-G00

2. Swab Etching Procedure and Cleaning

A. General

- (1) This task provides the instructions on how to do the swab etching cleaning.
- (2) This procedure is used when etching is restricted to small local areas and when complete immersion is not practical or acceptable. The procedure for applying local etchants is standard for all metals, but the etchant used is dependent upon the metal to be etched. The etchants are classified into four groups of metal specified in Table 201.
- (3) For general requirements on water types and rinsing process, refer to Water Types, TASK 70-00-07-910-801-G00.

B. References

Reference	Title
70-00-07-910-801-G00	Water Types (P/B 201)

C. Consumable Materials

Reference	Description	Specification
G01659	Swab - Cotton Or Rayon, (Disposable)	
G50527	Water	
G51478 [S1096]	Etchant - Aluminum Alloy	
G51485 [S1093]	Etchant - Titanium Alloy	
G51628 [S1095]	Etchant - Carbon Steel	
G51629 [S1098]	Etchant - Stainless Steel, Nickel and Cobalt Superalloys	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Prepare for Procedure

SUBTASK 70-43-24-840-001-G00

- (1) The equipment needed to carry out the procedure are as follows:
 - (a) Safety equipment and devices necessary to guarantee the application of the standard practice in complete safety for the operator.
 - (b) Facilities for disposing of used solutions.
 - (c) If necessary, efficient system for ventilating gasses and vapors.
 - (d) Trays or containers for disposal of solution-impregnated swabs and rags after use.
 - (e) Containers carrying a label specifying the nature of each etchant. The containers material must be compatible and without any chemical interaction with the product (i.e. not damage the container).
 - (f) Supply of deionized water for rinsing of titanium.

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- (g) Cotton swab, G01659 and tweezers.
 - (h) Beaker and saucers for sampling and instant use of small quantities of solution. The beaker and saucer material must be compatible and without any chemical interaction with the product (i.e. not damage the container).
- (2) The materials for the procedure are as follows:

Table 201/70-43-24-993-803-G00 Materials

Class	Materials (Solution Number)	Metal to be Etched	Shelf Life of Stock Solution
A	titanium alloy etchant, G51485 [S1093]	All Titanium Alloys	1 Month
B	stainless steel, nickel and cobalt superalloys etchant, G51629 [S1098]	All Low Chromium Alloys, Nickel and Cobalt Alloys, High Chromium Alloys	6 Months
C	carbon steel etchant, G51628 [S1095]	Carbon and Low Alloys Steels	6 Months
D	aluminum alloy etchant, G51478 [S1096]	All Aluminum Alloys	1 Year

F. Swab Etching Procedure



DO NOT LET THE ACIDS TOUCH YOU. YOU MUST WEAR CLOTHING THAT SUPPLIES PROTECTION. YOU MUST WEAR GLOVES AND A FACE SHIELD. THE ACIDS ARE POISONOUS AND CAN CAUSE INJURIES TO PERSONS. IF THE ACID GETS INTO YOUR EYES, FLUSH YOUR EYES WITH COOL WATER. GET MEDICAL AID IMMEDIATELY.



DO NOT BREATHE THE FUMES FROM THE ACIDS. YOU MUST USE THE ACIDS IN AN AREA WITH GOOD AIRFLOW. THE FUMES ARE POISONOUS AND CAN CAUSE INJURIES TO PERSONS.



TO MAKE THE SOLUTION, YOU MUST ADD THE ACID TO THE WATER WHILE YOU CONTINUOUSLY MIX IT. DO NOT ADD WATER TO ACID BECAUSE THE HEAT WILL CAUSE THE ACID TO COME OUT OF THE CONTAINER. PUT ON CORRECT CLOTHING FOR PROTECTION. PUT ON GOGGLES (OR A FACE MASK), AND RUBBER (OR NEOPRENE) GLOVES. IF THE SOLUTION TOUCHES YOU, IT WILL BURN YOU.

SUBTASK 70-43-24-110-003-G00

- (1) All surfaces to be etched must be free from oil, grease, scale or other extraneous material.

SUBTASK 70-43-24-110-008-G00

- (2) Pour a small quantity of stock solution into a clean plastic beaker or dish (refer to Table 201 for the choice of the etching solution according to the material).

NOTE: This quantity will be the working solution, and is not to be returned to the stock bottle.

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SUBTASK 70-43-24-110-009-G00

**CAUTION**

MAKE SURE THAT ALL ADJACENT AREAS HAVE PROTECTION WHEN YOU ETCH THE SURFACE. DAMAGE CAN OCCUR IF THE ADJACENT AREAS DO NOT HAVE PROTECTION.

- (3) Saturate a cotton swab with the working solution, and swab the surface to be etched (refer to Table 202 for etching times).

NOTE: Use a tweezer to hold the cotton swab.

- (a) Make sure the etching solution is within the defined boundaries of the area to be etched.

NOTE: Masking may be required.

- (b) Make sure that fresh solution is in contact with the metal surface at all times

NOTE: This will prevent the formation of an inert sludge.

- 1) Dip the swab in the working solution periodically.
- 2) Rub the swab continuously over the surface of the metal being etched.

- (4) The guidelines for etching time are as follows:

Table 202/70-43-24-993-802-G00 Guideline for Etching Time

Material	Time	Class			
		A	B	C	D
All Titanium Alloys	60 seconds – 90 seconds	X			
Carbon Steels and Low Alloys Steels	60 seconds – 90 seconds			X	
All Aluminium Alloys	60 seconds – 90 seconds				X
Maraging Steels (Maraging 250, etc)	60 seconds – 90 seconds		X		
Low Expansion Alloys (Incoloy 903, 909, etc.)	2.5 minutes – 3 minutes		X		
All Stainless Steels (PH, etc.)	4 minutes – 5 minutes		X		
Iron Superalloys (A286, etc.)	4 minutes – 5 minutes		X		
Turbine Airfoil Nickel Superalloys (Rene 77, 95, 125, etc.)	60 seconds – 90 seconds		X		
Non Turbine Airfoil Nickel Superalloys (Inconel 600, 718, Udimet 500, 700, Inconel 625, etc.) - see note 2	4 minutes – 5 minutes		X		
Cobalt Superalloys - see note 2	4 minutes – 5 minutes		X		

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Table 202/70-43-24-993-802-G00 Guideline for Etching Time (Continued)

Material	Time	Class			
		A	B	C	D
<u>NOTE:</u> 1. When etching surfaces containing two different alloys with different etching times, use the shortest etching time specified. 2. A clean and active surface (a surface containing no oxides and no scales) is required for effective etching of cobalt and nickel super alloys. Light abrasion is recommended to activate the surface prior to etching.					

SUBTASK 70-43-24-110-004-G00

- (5) After etching, blot up etching solution from the metal surface with a clean paper towel or cloth.

SUBTASK 70-43-24-110-005-G00



CAUTION

MAKE SURE YOU ONLY USE DEIONIZED WATER WHEN YOU CLEAN PARTS MADE OF TITANIUM OR TITANIUM ALLOYS. IF YOU DO NOT USE DEIONIZED WATER, DAMAGE TO THE PARTS CAN OCCUR.

- (6) Gently wipe the etched area at least three times with a cloth or paper towel saturated with water, G50527.
- (a) Blot dry with clean cloth or paper towel.
- (b) Optional rinse procedure is the use of flowing water and dry air.

SUBTASK 70-43-24-160-001-G00



CAUTION

DO NOT POUR WORKING SOLUTION BACK INTO STOCK CONTAINER. ALTHOUGH THE SMALL QUANTITIES INVOLVED DO NOT ORDINARILY CONSTITUTE AN ENVIRONMENTAL HAZARD, FLUSH AWAY DISCARDED SOLUTIONS WITH SEVERAL VOLUMES OF WATER TO ENSURE ADEQUATE DILUTION.

- (7) Dispose the used working solution in accordance with local environmental, health, and safety regulations.
- NOTE:** Do not pour working solution back into stock container.
- (a) Rinse and dry the plastic container for future use.

SUBTASK 70-43-24-200-001-G00

- (8) Do a visual inspection when the surface is dry.
- (a) Make sure the swab etching has macroetched the surface.

———— **END OF TASK** ————

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BLIND RIVET ASSEMBLIES - MAINTENANCE PRACTICES

1. General

A. This procedure contains the following tasks:

- (1) Blind Rivet Assemblies Repair.

TASK 70-43-31-300-801-G00

2. Blind Rivet Assemblies Repair

(Figure 201, Figure 202, Figure 203, Figure 204, Figure 205, Figure 206, Figure 207, Figure 208, Figure 209, Figure 210, Figure 211, Figure 212, Figure 213, Figure 214, Figure 215, Figure 216)

A. General

- (1) Cherry rivets consist of a rivet sleeve, an inserted stem with pulling serrations and a break notch, and also a locking collar. Cherrylock rivet has a visible locking collar. Cherrymax rivet has a locking collar not visible in the non-installed condition and an anvil on the upper face of rivet head (Figure 201, Figure 202).
 - (2) During installation, the pulling force applied to the stem compresses and flattens the rivet sleeve between the shear ring and the locking collar to form the rivet head, and finally fractures the stem flush with the break notch.
 - (3) Installed Cherry rivets should not be submitted to tensile loads.
 - (4) Cherrylock and Cherrymax rivets can be installed either with a manual or a pneumatic tool fitted with a riveting head, which must match the type of rivet to be fitted. For standard and bulbed rivet installation, a different riveting head is used depending on the rivet type of head and diameter. For Cherrymax rivet installation, the same riveting head is used for the 3 diameters and the 2 styles of head. Refer to manufacturer documentation for tools identification.
- NOTE:** Pulling heads used for "Cherrymax" rivets are suitable for countersunk head rivets or oval head rivets.
- (5) Pneumatic guns can be fitted with straight, offset or right angle riveting heads depending on the part shape and the required riveting position.

B. References

Reference	Title
70-43-42-300-803-G00	Blending Procedures - Power Blending (P/B 201)
70-44-50-320-801-G00	Drilling (P/B 201)

C. Tools/Equipment

Reference	Description
STD-6626	Grinder - Right Angle, Air Driven

D. Prepare for the Repair

SUBTASK 70-43-31-300-001-G00

- (1) For rivet holes, do the following:
 - (a) Unless otherwise specified, drill the holes per Figure 203, (TASK 70-44-50-320-801-G00).

SUBTASK 70-43-31-300-002-G00

- (2) For countersinking, do the following:
 - (a) Unless otherwise specified, perform countersinks per Figure 204.
 - (b) Make sure that the machining doesn't create flats on countersinks.

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SUBTASK 70-43-31-300-003-G00

(3) For deburring, do the following:

- (a) After drilling, deburr the assembled sheets, as follows:
 - 1) If sheets are drilled separately or disassembled before rivet installation, perform deburring per Figure 205.
 - 2) If sheets are drilled when assembled and no disassembly occurs before rivet installation, only deburr external faces per Figure 205.
 - a) Make sure that the sheets are thoroughly squeezed to prevent introduction of chips in interface.
 - 3) When the assembly blind part is not accessible (inside a box type structure for instance) holes can be deburred with a small tool similar to the tool per Figure 206.

SUBTASK 70-43-31-220-001-G00

(4) Select the rivets, as follows:

- (a) Use the applicable blind rivet during the riveting process.
- (b) Use the rivets specified in the applicable task.
 - 1) Make sure that the thickness of sheet assembly is appropriate for rivet grip length.
- (c) Measure the sheets thickness with the gage (Figure 207, Figure 208).

NOTE: The gage can be purchased from the rivet manufacturer.

NOTE: For measuring sheet assembly thickness, the sheets must be thoroughly squeezed.

- (d) If the measured thickness is not compatible with the grip length of rivets recommended in the applicable task, select rivets meeting measured thickness requirements (Figure 209, Figure 210).

E. Rivet Installation

SUBTASK 70-43-31-200-001-G00

(1) Check the presence of the lubrication before installation.

NOTE: Excess heat, degreasing agents, and cleaning products can have adverse effects on the lubricant.

NOTE: Rivets are lubricated by the manufacturer with a special lubricant.

SUBTASK 70-43-31-210-001-G00



DO NOT LUBRICATE THE DEFECTIVE RIVETS. IF YOU DO NOT OBEY, DAMAGE CAN OCCUR.

(2) Visual check the rivet condition as follows:

- (a) Acceptable surface defects on rivet body are as follows:
 - 1) Tool marks, imprints and circular scores having a round bottom with a depth not more than 0.0024 in. (0.06 mm) and a width not more than 0.012 in. (0.3 mm).
 - 2) Drawing defects not inducing formation of cracks on rivet head.
 - a) To make sure that no crack appears on the rivet head, install one of the rivet showing the defect.
 - 3) Metal wrinkles with a depth not more than 0.012 in. (0.3 mm).

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- (b) Make sure that the rivet body and stem have no surface defects such as cracks, fissures, encrusted unwanted particles and wrinkles on visible parts.

NOTE: Circular scores are not permitted in the postformed area.

NOTE: These surface defects are unacceptable.

SUBTASK 70-43-31-400-001-G00

- (3) To form the bulb on the blind side, the mating surface of sheets must be maintained in contact during the rivet installation.

SUBTASK 70-43-31-400-002-G00



MAKE SURE THAT THERE IS NO CLEARANCE AFTER INSTALLATION. THE RIVET HEAD MUST FULLY INSTALL ON THE PART SURFACE. IF YOU DO NOT OBEY, THE DAMAGE CAN OCCUR.

- (4) Install the rivet per Figure 211.
- (a) When sheets are stacked together, check the hole coaxiality for holes drilled separately.
- (b) If necessary, use the cutting pliers or a hand-held pneumatic tool to make the rivet stem flush.

NOTE: The tools can be purchased from the rivet manufacturer.

F. Rivets Replacement

SUBTASK 70-43-31-000-001-G00

- (1) Make sure that you take necessary precautions not to damage rivets or sheets.

SUBTASK 70-43-31-300-004-G00



DO NOT SHAVE THE LOCKING COLLAR OR COUNTERSUNK HEADS TO MAKE THEM FLUSH. IF YOU DO NOT OBEY, DAMAGE CAN OCCUR.

- (2) Rivets removal.
- (a) To remove the rivets, do one of the following steps:
- 1) Remove rivet head with the grinder, STD-6626 (TASK 70-43-42-300-803-G00).
 - a) Use the pin drift to remove the locking collar.
 - 2) Remove the rivets with the drill (Figure 212), (TASK 70-44-50-320-801-G00):
 - a) Remove rivet stem with the pin drift (View A, Figure 212).
 - b) If rivets are installed in thin sheets, drill the stem out (View B and View C, Figure 212).

NOTE: It is recommended to drill a pilot hole with the center drill so as to guide final drilling.
 - c) Remove locking collar with pin drift (View D, Figure 212).
 - d) Drill rivet head as close to sheets as possible with the drill of diameter equal to rivet diameter (View E, Figure 212).
 - e) Use pin draft as a lever, to remove rivet (View F, Figure 212).

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- f) Remove rivet body with the pin drift of the diameter equal to rivet diameter (View G, Figure 212).

NOTE: Do not drill rivet body out. This operation can include enlargement of rivet hole.

- (b) If possible, remove rivets fallen in box type structures.

SUBTASK 70-43-31-200-002-G00

- (3) Rivet holes inspection.

- (a) Do a visual and dimensional check of the rivet holes as follows:
- 1) Cracks, unradiused sharp edges, ovalization are not acceptable.
 - 2) Make sure that the dimensions of holes are within the tolerances (Figure 203).
- (b) If rivet holes meet the above requirements, install original fit rivets.
- (c) If rivet holes do not meet the above requirements, install oversize rivets.

NOTE: You can use only oversize rivets specified for each particular case in the applicable task.

SUBTASK 70-43-31-200-003-G00

- (4) If countersinks have to be enlarged, make sure that the thickness of sheets is acceptable.

SUBTASK 70-43-31-400-003-G00

- (5) Install the new rivet according to the steps above.

G. Rivet Heads Inspection

SUBTASK 70-43-31-200-004-G00

- (1) Check the head seating (Figure 213).
- (a) Do a check of the slight gap between the head and seating surface.
- 1) The maximum value of a gap is not more than 0.004 in. (0.1 mm) for protruding heads.
 - 2) The maximum thickness of the 0.0028 in. (0.07 mm) feeler gage inserted under the countersunk head does not reach the rivet stem.
 - 3) The rivet head is in contact with at least 60% of the circumference.

SUBTASK 70-43-31-200-005-G00



DO NOT SHAVE THE LOCKING COLLAR OR COUNTERSUNK HEADS TO MAKE THEM FLUSH. IF YOU DO NOT OBEY, DAMAGE CAN OCCUR.

- (2) Check the flushness of countersunk heads (Figure 214).

NOTE: This check must be performed before making stem flush.

- (a) A 0.004 in. (0.1 mm) protruding countersunk head is permitted.

H. Stem and Collar Protrusion Check

SUBTASK 70-43-31-200-006-G00

- (1) For CHERRY-LOCK rivet, stem and collar protrusion must meet requirements specified in Figure 214.

SUBTASK 70-43-31-200-007-G00

- (2) For CHERRY-MAX rivet, stem protrusion must meet requirements specified in Figure 215.

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- (a) Align the locking collar with the rivet surface.

NOTE: After breaking, you can shave protruding stems, if you do necessary precautions not to damage rivet heads.

I. Rivets Visual Inspection

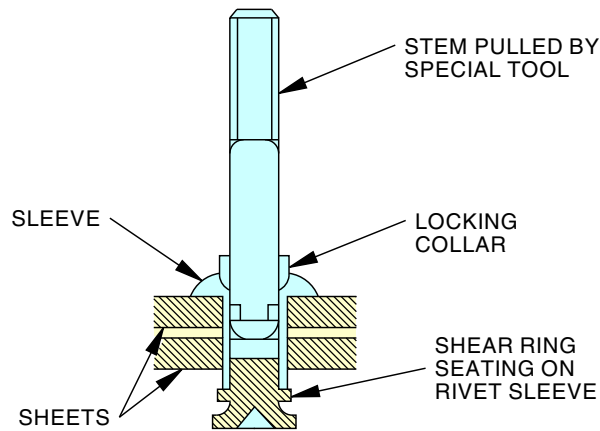
SUBTASK 70-43-31-200-008-G00

- (1) Check the limits for the slight burr on the locking collar, caused by the pressure exerted by the installation tool (Figure 216).

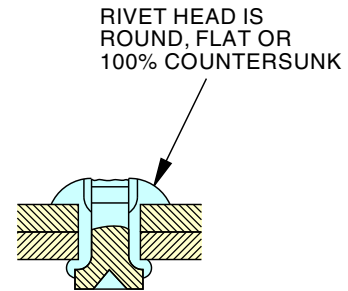
NOTE: When visible, the riveting may show fine surface cracks which are not detrimental to rivet strength and which are therefore acceptable.

———— **END OF TASK** ————

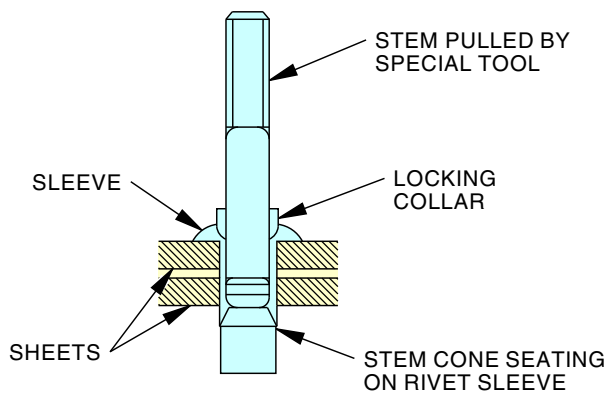
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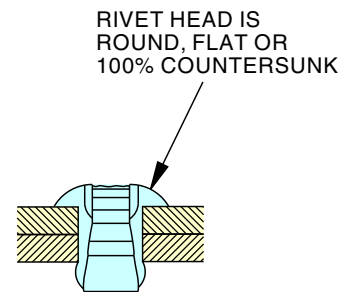
BULBED RIVET BEFORE INSTALLATION



BULBED RIVET INSTALLED



**STANDARD RIVET BEFORE
INSTALLATION**



STANDARD RIVET INSTALLED

2954786 S0000732427_V1

**Description of Cherrylock Rivets
Figure 201/70-43-31-990-801-G00**

EFFECTIVITY
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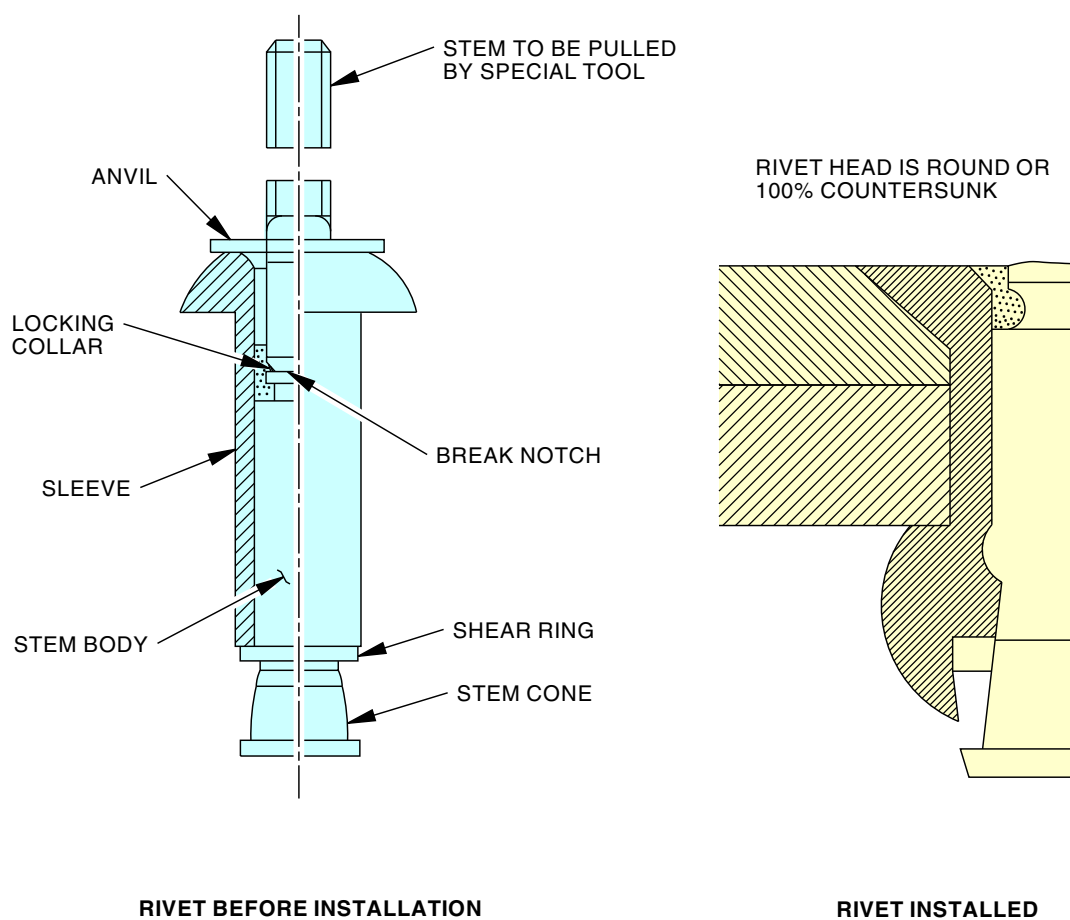
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

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2954787 S0000732428_V1

Description of Cherrymax Rivets
Figure 202/70-43-31-990-802-G00

EFFECTIVITY
SIA ALL

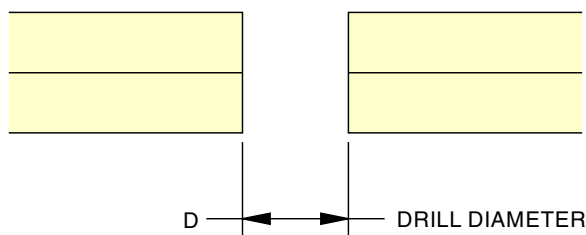
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1ST DASH NUMBER OF PART NUMBER	STANDARD CHERRYLOCK RIVETS NAS 1398 - NAS 1399		BULBED CHERRYLOCK RIVETS NAS 1738 - NAS 1739	
	NOMINAL DIAMETER	DRILL DIAMETER	NOMINAL DIAMETER	DRILL DIAMETER
- 3	0.094 (2.39)	0.100 (2.54) 0.097 (2.46)		
- 4	0.125 (3.18)	0.132 (3.36) 0.129 (3.28)	0.140 (3.56)	0.146 (3.71) 0.143 (3.63)
- 5	0.156 (3.96)	0.164 (4.16) 0.160 (4.06)	0.173 (4.39)	0.180 (4.57) 0.176 (4.47)
- 6	0.187 (4.75)	0.196 (4.98) 0.192 (4.88)	0.201 (5.12)	0.209 (5.31) 0.205 (5.21)
- 8	0.250 (6.35)	0.261 (6.63) 0.256 (6.50)		

1ST DASH NUMBER OF PART NUMBER	ORIGINAL FIT CHERRYMAX RIVETS		OVERSIZE CHERRYMAX RIVETS	
	NOMINAL DIAMETER	DRILL DIAMETER	NOMINAL DIAMETER	DRILL DIAMETER
- 4	0.126 (3.2)	0.132 (3.35) 0.129 (3.27)	0.140 (3.56)	0.146 (3.71) 0.137 (3.49)
- 5	0.157 (4.0)	0.164 (4.16) 0.160 (4.06)	0.173 (4.39)	0.179 (4.55) 0.170 (4.33)

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2955774 S0000732429_V1

**Rivet Hole Drilling Data
Figure 203/70-43-31-990-803-G00**

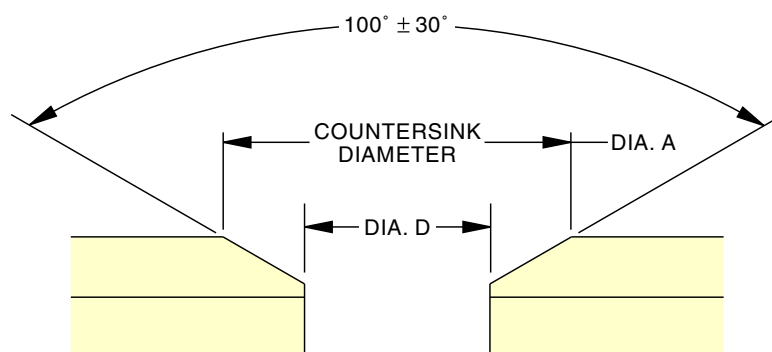
EFFECTIVITY
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1ST DASH NUMBER OF PART NUMBER	STANDARD CHERRYLOCK RIVET		BULBED CHERRYLOCK RIVET	
	NOMINAL DIAMETER	COUNTERSINK DIAMETER	NOMINAL DIAMETER	COUNTERSINK DIAMETER
- 3	0.094 (2.39)	0.183 (4.65) 0.175 (4.45)		
- 4	0.125 (3.18)	0.229 (5.82) 0.221 (5.62)	0.140 (3.56)	0.228 (5.79) 0.222 (5.63)
- 5	0.156 (3.96)	0.290 (7.36) 0.282 (7.16)	0.173 (4.39)	0.289 (7.34) 0.283 (7.18)
- 6	0.187 (4.75)	0.357 (9.07) 0.349 (8.87)	0.201 (5.12)	0.356 (9.04) 0.350 (8.89)
- 8	0.250 (6.35)	0.480 (12.20) 0.472 (12.00)		

CHERRYMAX

1ST DASH NUMBER OF PART NUMBER	NOMINAL DIAMETER	ORIGINAL FIT	COUNTERSINK	1ST REPAIR
		MAX. DIA. MIN. DIA.	MAX. DIA. MIN. DIA.	MAX. DIA. MIN. DIA.
- 4	0.125 (3.18)	0.132 (3.35) 0.129 (3.27)	0.228 (5.79) 0.222 (5.63)	0.146 (3.71) 0.137 (3.49)
- 5	0.156 (3.96)	0.164 (4.16) 0.160 (4.06)	0.289 (7.34) 0.283 (7.18)	0.179 (4.55) 0.170 (4.33)

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2955775 S0000732430_V1

Countersink Data
Figure 204/70-43-31-990-804-G00

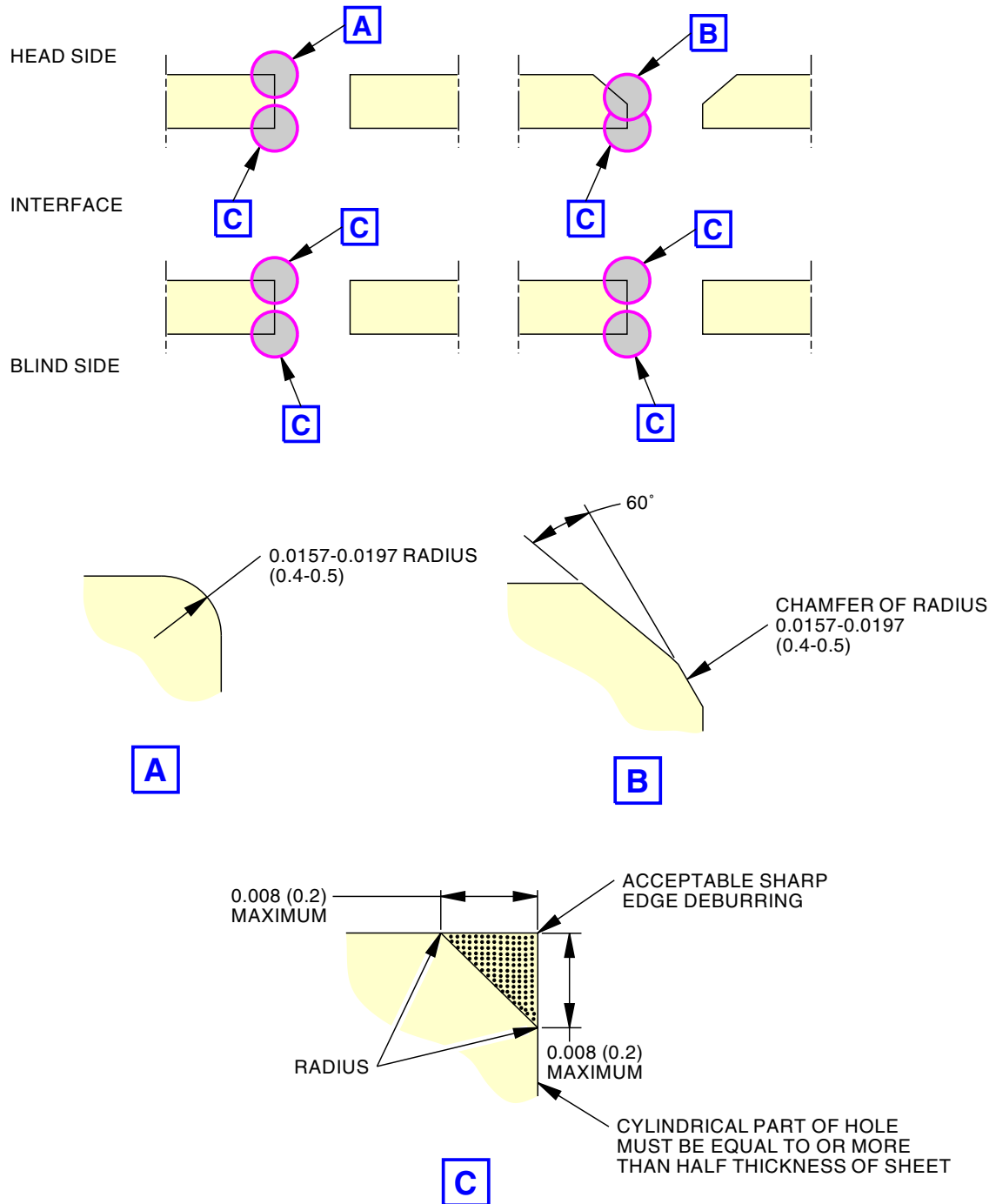
EFFECTIVITY
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**NOTE:**

ALL DIMENSIONS ARE IN INCHES (mm).

2955880 S0000732432_V1

Sheet Deburring
Figure 205/70-43-31-990-805-G00

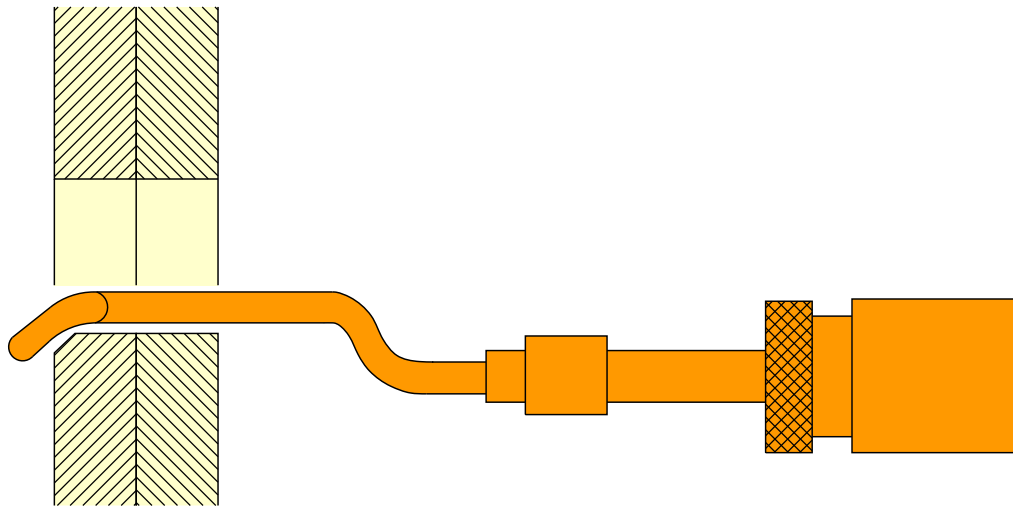
EFFECTIVITY
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2955776 S0000732433_V1

Deburring of Inaccessible Faces
Figure 206/70-43-31-990-806-G00

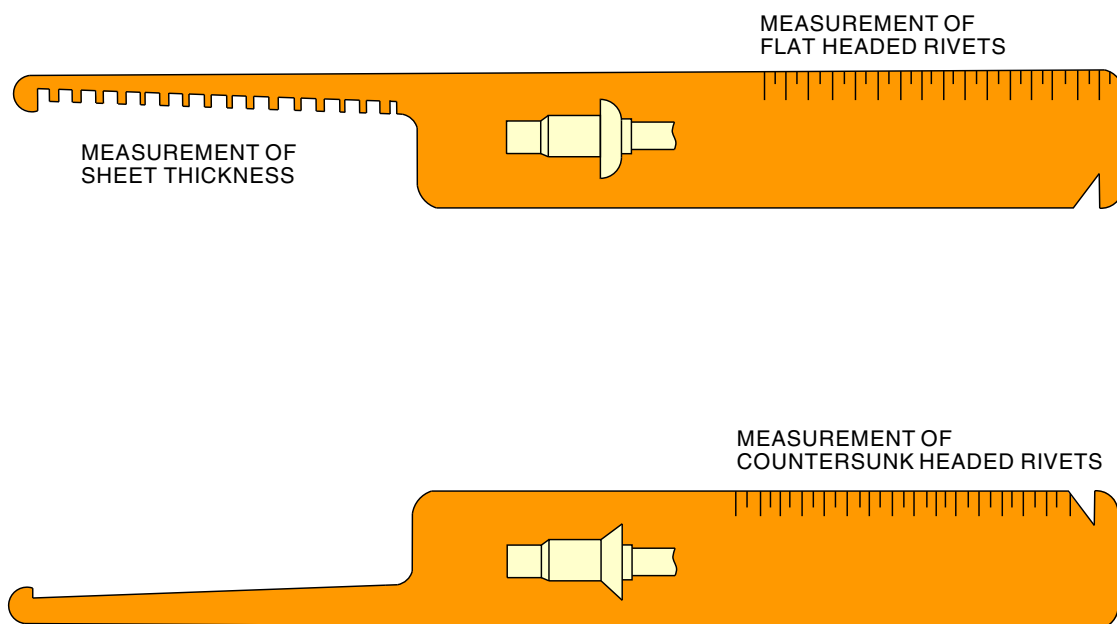
EFFECTIVITY
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2955777 S0000732434_V1

Thickness Measurement Gage
Figure 207/70-43-31-990-807-G00

EFFECTIVITY
SIA ALL

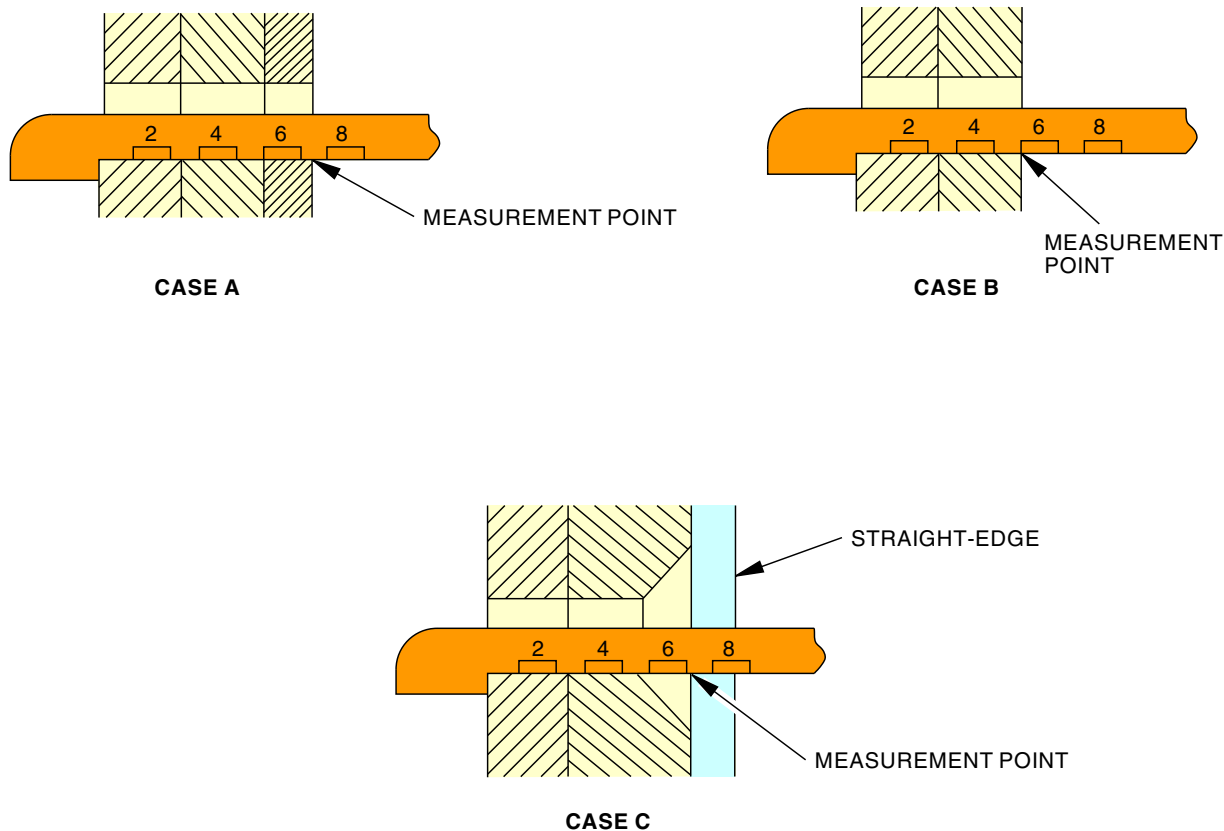
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1. INSERT GAGE INTO HOLE.
2. HOOK GAGE ONTO REAR FACE OF ASSEMBLY.
3. READ THICKNESS OF ASSEMBLY ON FRONT FACE.

CASE A: THE MEASUREMENT POINT IS LOCATED BETWEEN TWO MARKS. SELECT A RIVET HAVING A GRIP LENGTH IMMEDIATELY BELOW FIRST READABLE MARK. (IN THIS CASE THE RIVET GRIP LENGTH MUST BE 7/16 INCH).

CASE B: THE MEASUREMENT POINT IS LOCATED OPPOSITE A MARK. SELECT A RIVET HAVING A GRIP LENGTH COMPATIBLE WITH LENGTH INDICATED ON GAGE. (IN THIS CASE 6/16 INCH).

CASE C: THE MEASUREMENT POINT IS LOCATED OVER A COUNTERSINK USING A STRAIGHT-EDGE, MAKE SURE THICKNESS IS MEASURED AT EDGE OF COUNTERSINK. (IN THIS CASE, RIVET GRIP LENGTH MUST BE 7/16 INCH).

2955778 S0000732435_V2

Measurement of Assembled Sheet Thickness
Figure 208/70-43-31-990-808-G00

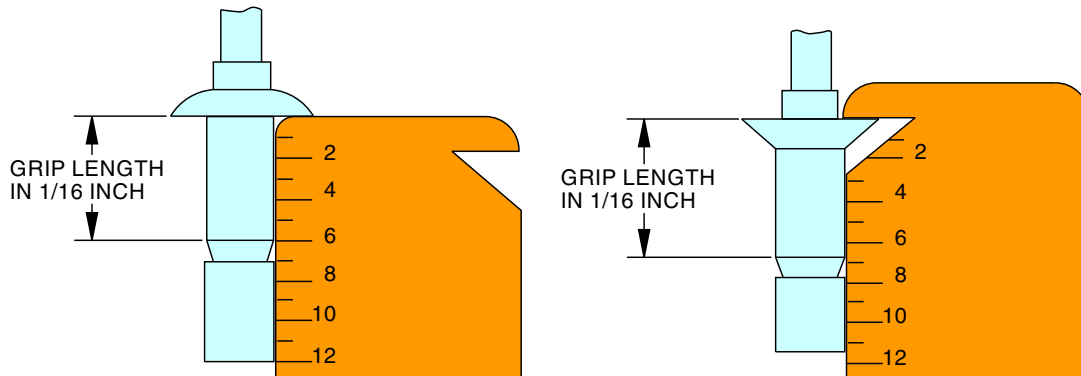
EFFECTIVITY
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CLAMPING CAPACITY		DASH NUMBERS IN PART NUMBER					RIVET DIAMETER	MIN. CLAMP CAPACITY
MINIMUM	MAXIMUM	DIA. 0.094 (2.38)	DIA. 0.125 (3.17)	DIA. 0.156 (3.96)	DIA. 0.187 (4.75)	DIA. 0.250 (6.35)		
(1)	0.062 (1.57)	-3-1	-4-1	-5-1	-6-1		0.094 (2.38)	0.020 (0.51)
0.063 (1.60)	0.125 (3.17)	-3-2	-4-2	-5-2	-6-2	-8-2	0.125 (3.17)	0.025 (0.63)
0.126 (3.20)	0.187 (4.75)	-3-3	-4-3	-5-3	-6-3	-8-3	0.156 (3.96)	0.031 (0.79)
0.188 (4.77)	0.250 (6.35)	-3-4	-4-4	-5-4	-6-4	-8-4	0.187 (4.75)	0.037 (0.94)
0.251 (6.37)	0.312 (7.92)		-4-5	-5-5	-6-5	-8-5	0.250 (6.35)	0.063 (1.60)
0.313 (7.95)	0.375 (9.52)		-4-6	-5-6	-6-6	-8-6		
0.376 (9.55)	0.437 (11.10)		-4-7 (2)	-5-7	-6-7	-8-7		
0.438 (11.13)	0.500 (12.70)		-4-8 (2)	-5-8	-6-8	-8-8		
0.501 (12.73)	0.562 (14.27)			-5-9 (3)	-6-9	-8-9		
0.563 (14.30)	0.625 (15.80)			-5-10 (3)	-6-10	-8-10		
0.626 (15.90)	0.687 (17.45)				-6-11	-8-11		
0.683 (17.48)	0.750 (19.05)				-6-12	-8-12		
0.751 (19.08)	0.812 (20.62)					-8-13		
0.813 (20.65)	0.875 (22.22)					-8-14		

STANDARD CHERRYLOCK RIVETS - FLAT HEAD NAS 1398

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

LEGEND:

1. SEE TABLE OPPOSITE
2. NOT SHOWN IN STANDARD NAS 1398
3. ONLY RIVETS IN A286 AND IN MONEL ARE COVERED BY STANDARD 1398
FOR DASH NUMBERS 5-9 AND 5-10.
SEE FIG. 10 IDENTIFICATION OF RIVETS FOR RIVET MATERIAL.

2955779 S0000732437_V1

Rivet Grip Length vs Clamping Capacity
Figure 209/70-43-31-990-809-G00 (Sheet 1 of 5)

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CLAMPING CAPACITY		DASH NUMBERS IN PART NUMBER				
MINIMUM	MAXIMUM	DIA. 0.094 (2.38)	DIA. 0.125 (3.17)	DIA. 0.156 (3.96)	DIA. 0.187 (4.75)	DIA. 0.250 (6.35)
(1)	0.125 (3.17)	-3-2	-4-2	-5-2	-6-2	
0.126 (3.20)	0.187 (4.75)	-3-3	-4-3	-5-3	-6-3	-8-3
0.188 (4.77)	0.250 (6.35)	-3-4	-4-4	-5-4	-6-4	-8-4
0.251 (6.37)	0.312 (7.92)		-4-5	-5-5	-6-5	-8-5
0.313 (7.95)	0.375 (9.52)		-4-6	-5-6	-6-6	-8-6
0.376 (9.55)	0.437 (11.10)		-4-7 (2)	-5-7	-6-7	-8-7
0.438 (11.13)	0.500 (12.70)			-5-8	-6-8	-8-8
0.501 (12.73)	0.562 (14.27)			-5-9 (3)	-6-9	-8-9
0.563 (14.30)	0.625 (15.80)			-5-10 (3)	-6-10	-8-10
0.626 (15.90)	0.687 (17.45)				-6-11	-8-11
0.688 (17.48)	0.750 (19.05)				-6-12	-8-12
0.751 (19.08)	0.812 (20.62)				-6-13 (2)	-8-13
0.813 (20.65)	0.875 (22.23)				-6-14 (2)	-8-14

RIVET DIAMETER	MIN. CLAMPING CAPACITY MS 20426
0.094 (2.38)	0.063 (1.60)
0.125 (3.17)	0.063 (1.60)
0.156 (3.96)	0.065 (1.65)
0.187 (4.75)	0.080 (2.03)
0.250 (6.35)	0.126 (3.20)

**STANDARD CHERRYLOCK RIVETS - 100% COUNTERSUNK HEAD NAS 1399
MS 20426 HEAD STYLE**

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

LEGEND:

1. SEE TABLE OPPOSITE
2. NOT SHOWN IN STANDARD NAS 1399
3. ONLY RIVETS IN A286 AND IN MONEL ARE COVERED BY STANDARD 1309 FOR DASH NUMBERS NO. 5-9 AND 5-10.

2955780 S0000732439_V1

**Rivet Grip Length vs Clamping Capacity
Figure 209/70-43-31-990-809-G00 (Sheet 2 of 5)**

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CLAMPING CAPACITY		DASH NUMBERS IN PART NUMBER		
MINIMUM	MAXIMUM	DIA. 0.140 (3.56)	DIA. 0.173 (4.39)	DIA. 0.201 (5.12)
0.062 (1.57)	0.020 (0.50)	-4-1	-5-1	-6-1
0.125 (3.18)	0.063 (1.60)	-4-2	-5-2	-6-2
0.187 (4.75)	0.126 (3.20)	-4-3	-5-3	-6-3
0.250 (6.35)	0.188 (4.78)	-4-4	-5-4	-6-4
0.312 (7.92)	0.251 (6.38)	-4-5	-5-5	-6-5
0.375 (9.53)	0.313 (7.95)	-4-6 (1)	-5-6	-6-6
0.437 (11.10)	0.376 (9.55)	-4-7 (1)	-5-7 (1)	-6-7
0.500 (12.70)	0.438 (11.13)	-4-8 (1)	-5-8 (1)	-6-8
0.562 (14.27)	0.501 (12.73)	-4-9 (1)	-5-9 (1)	-6-9 (1)
0.625 (15.87)	0.563 (14.30)		-5-10 (1)	-6-10 (1)
0.687 (17.45)	0.626 (15.90)		-5-11 (1)	-6-11 (1)
0.750 (19.05)	0.688 (17.48)			-6-12 (1)

BULBED CHERRYLOCK RIVETS - FLAT HEAD NAS 1738

LEGEND:

1. NOT INCLUDED IN NAS STANDARD

CLAMPING CAPACITY		DASH NUMBERS IN PART NUMBER		
MINIMUM	MAXIMUM	DIA. 0.140 (3.56)	DIA. 0.173 (4.39)	DIA. 0.201 (5.12)
0.045 (1.14)	0.062 (1.57)	-4-1		
0.063 (1.60) (2)	0.125 (3.18)	-4-2	-5-2	-6-2
0.126 (3.20)	0.187 (4.75)	-4-3	-5-3	-6-3
0.188 (4.78)	0.250 (6.35)	-4-4	-5-4	-6-4
0.251 (6.38)	0.312 (7.92)	-4-5	-5-5	-6-5
0.313 (7.95)	0.375 (9.53)	-4-6 (1)	-5-6	-6-6
0.376 (9.55)	0.437 (11.10)	-4-7 (1)	-5-7 (1)	-6-7
0.438 (11.13)	0.500 (12.70)	-4-8 (1)	-5-8 (1)	-6-8
0.501 (12.73)	0.562 (14.27)	-4-9 (1)	-5-9 (1)	-6-9 (1)
0.563 (14.30)	0.625 (15.80)		-5-10 (1)	-6-10 (1)
0.626 (15.90)	0.687 (17.45)		-5-11 (1)	-6-11 (1)
0.688 (17.48)	0.750 (19.05)			-6-12 (1)

LEGEND:

BULBED CHERRYLOCK RIVETS - 100% COUNTERSUNK HEAD - NAS 1739

1. NOT INCLUDED IN NAS STANDARD
2. MINIMUM CLAMPING CAPACITY 0.073 (1.85) FOR DASH NUMBER 6-2

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2955781 S0000732441_V1

Rivet Grip Length vs Clamping Capacity Figure 209/70-43-31-990-809-G00 (Sheet 3 of 5)

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DIAMETER	(1) MIN. CLAMPING CAPACITY
0.126 (3.20)	0.025 (0.635)
0.157 (4.00)	0.031 (0.787)
0.189 (4.80)	0.037 (0.940)

CLAMPING CAPACITY		DASH NUMBERS IN PART NUMBER		
MINIMUM	MAXIMUM	DIA. 0.126 (3.20)	DIA. 0.157 (4.00)	DIA. 0.189 (4.80)
(1)	0.062 (1.58)	-4-1	-5-1	-6-1
0.063 (1.59)	0.125 (3.19)	-4-2	-5-2	-6-2
0.126 (3.20)	0.188 (4.79)	-4-3	-5-3	-6-3
0.189 (4.80)	0.250 (6.35)	-4-4	-5-4	-6-4
0.250 (6.36)	0.312 (7.92)	-4-5	-5-5	-6-5
0.312 (7.93)	0.374 (9.52)	-4-6	-5-6	-6-6
0.375 (9.53)	0.436 (11.09)	-4-7	-5-7	-6-7
0.437 (11.10)	0.500 (12.70)	-4-8	-5-8	-6-8
0.500 (12.71)	0.562 (14.28)		-5-9	-6-9
0.563 (14.29)	0.625 (15.88)		-5-10	-6-10
0.626 (15.89)	0.687 (17.45)			-6-11
0.687 (17.46)	0.750 (19.05)			-6-12

CHERRYMAX NAS 1400 FLAT HEAD

DIAMETER	(1) MIN. CLAMPING CAPACITY
0.126 (3.20)	0.051 (1.30)
0.157 (4.00)	0.065 (1.65)
0.189 (4.80)	0.079 (2.03)

CLAMPING CAPACITY		DASH NUMBERS IN PART NUMBER		
MINIMUM	MAXIMUM	DIA. 0.126 (3.20)	DIA. 0.157 (4.00)	DIA. 0.189 (4.80)
(1)	0.125 (3.19)	-4-2	-5-2	-6-2
0.126 (3.20)	0.188 (4.79)	-4-3	-5-3	-6-3
0.189 (4.80)	0.250 (6.35)	-4-4	-5-4	-6-4
0.250 (6.36)	0.311 (7.92)	-4-5	-5-5	-6-5
0.312 (7.93)	0.374 (9.52)	-4-6	-5-6	-6-6
0.375 (9.53)	0.436 (11.09)	-4-7	-5-7	-6-7
0.437 (11.10)	0.500 (12.70)	-4-8	-5-8	-6-8
0.500 (12.71)	0.562 (14.28)		-5-9	-6-9
0.563 (14.29)	0.625 (15.88)		-5-10	-6-10
0.626 (15.89)	0.687 (17.45)			-6-11
0.687 (17.46)	0.750 (19.05)			-6-12

CHERRYMAX NAS 1400 COUNTERSUNK HEAD

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2955782 S0000732442_V1

Rivet Grip Length vs Clamping Capacity
Figure 209/70-43-31-990-809-G00 (Sheet 4 of 5)

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CLAMPING CAPACITY		DASH NUMBERS IN PART NUMBER		
MINIMUM	MAXIMUM	DIA. 0.126 (3.20)	DIA. 0.157 (4.00)	DIA. 0.189 (4.80)
0.196 (0.50)	0.063 (1.59)	-4-1	-5-1	-6-1
0.063 (1.60)	0.125 (3.19)	-4-2	-5-2	-6-2
0.126 (3.20)	0.188 (4.79)	-4-3	-5-3	-6-3
0.189 (4.80)	0.250 (6.35)	-4-4	-5-4	-6-4
0.250 (6.36)	0.311 (7.92)	-4-5	-5-5	-6-5
0.312 (7.93)	0.374 (9.51)	-4-6	-5-6	-6-6
0.374 (9.52)	0.436 (11.09)	-4-7	-5-7	-6-7
0.437 (11.10)	0.500 (12.70)	-4-8	-5-8	-6-8
0.500 (12.71)	0.562 (14.28)		-5-9	-6-9
0.563 (14.29)	0.625 (15.88)		-5-10	-6-10
0.626 (15.89)	0.687 (17.45)			-6-11
0.687 (17.46)	0.750 (19.05)			-6-12

CHERRYMAX NAS 1740 FLAT HEAD

DIAMETER	(1) MIN. CLAMPING CAPACITY
0.126 (3.20)	0.045 (1.14)
0.157 (4.00)	0.063 (1.60)
0.189 (4.80)	0.073 (1.85)

CLAMPING CAPACITY		DASH NUMBERS IN PART NUMBER		
MINIMUM	MAXIMUM	DIA. 0.126 (3.20)	DIA. 0.157 (4.00)	DIA. 0.189 (4.80)
(1)	0.125 (3.19)	-4-2	-5-2	-6-2
0.126 (3.20)	0.188 (4.79)	-4-3	-5-3	-6-3
0.189 (4.80)	0.250 (6.35)	-4-4	-5-4	-6-4
0.250 (6.36)	0.311 (7.92)	-4-5	-5-5	-6-5
0.312 (7.93)	0.374 (9.51)	-4-6	-5-6	-6-6
0.374 (9.52)	0.436 (11.09)	-4-7	-5-7	-6-7
0.437 (11.10)	0.500 (12.70)	-4-8	-5-8	-6-8
0.500 (12.71)	0.562 (14.28)		-5-9	-6-9
0.563 (14.29)	0.625 (15.88)		-5-10	-6-10
0.626 (15.89)	0.687 (17.45)			-6-11
0.687 (17.46)	0.750 (19.05)			-6-12

CHERRYMAX NAS 1740 COUNTERSUNK HEAD

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2955783 S0000732443_V1

**Rivet Grip Length vs Clamping Capacity
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TYPE	CHERRY NUMBER	NAS NUMBER	BODY MATERIAL	SURFACE TREATMENT OF BODY
CHERRYLOCK, STANDARD, FLAT HEAD	CR 2563 CR 2163 CR 2563 M	1398 MW 1398 D	MONEL 2017-T4 MONEL	CADMIUM PLATING ANODIZING CADMIUM PLATING
CHERRYLOCK, STANDARD, 100° COUNTERSUNK HEAD	CR 2662 CR 2562 CR 2162	1399 C 1399 MW 1399 D	A 286 MONEL 2017-T4	DRY FILM CHERY C-30 CADMIUM PLATING ANODIZING
CHERRYLOCK, BULBED, FLAT HEAD	CR 2539 P	1738 MW	MONEL	CADMIUM PLATING
CHERRYLOCK, BULBED, 100° COUNTERSUNK HEAD	CR 2538 P	1739 MW	MONEL	CADMIUM PLATING
CHERRYMAX, FLAT HEAD	CR 3213 REPAIR: CR 3243	- -	A. 5056 A. 5056	CHEMICAL CONVERSION TREATMENT MIL-C-5541
CHERRYMAX, 100° COUNTERSUNK HEAD	CR 3212 REPAIR: CR 3242	- -	A. 5056 A. 5056	CHEMICAL CONVERSION TREATMENT MIL-C-5541

2955784 S0000732444_V2

**Identification of Blind Rivets
Figure 210/70-43-31-990-810-G00**

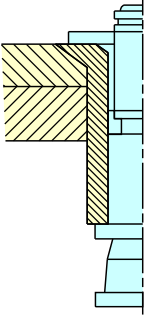
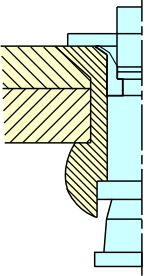
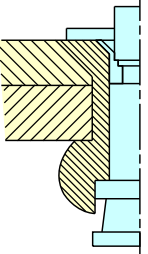
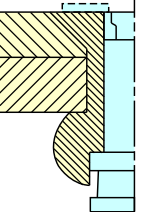
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	LEGEND: 1. ENGAGE STEM SERRATIONS IN TOOL PULLING HEAD UNTIL ANVIL COMES AGAINST RIVETING TOOL HEAD.
	2. STEM IS PULLED INSIDE RIVET SLEEVE. THRUST RING FORCES RIVET BLIND HEAD TO FORM A WIDE BULBED HEAD AGAINST BLIND SHEET SO AS TO SQUEEZE SHEETS TOGETHER. THE RIVET SLEEVE EXPANDS, COMPRESSED BETWEEN THRUST RING AND ANVIL.
	3. PULLING OF STEM CAUSES SHEAR RING TO SHEAR AND TO MOVE DOWN STEM CONE SO AS TO ADJUST RIVET TO SHEETS THICKNESS. SHEAR RING TRAVEL VARIES WITH THE THICKNESS OF SHEET ASSEMBLY. PULLING OF STEM CAUSES LOCKING COLLAR AND ANVIL TO COME INTO CONTACT.
	4. LOCKING COLLAR PRESSURE ON ANVIL CAUSES THE LOCKING COLLAR TO DEFORM INTO RIVET SLEEVE RECESS SO AS TO LOCK STEM. FURTHER PULLING STARTS TO FRACTURE STEM FLUSH WITH RIVET HEAD.

CHERRYMAX RIVETS

2955372 S0000732445_V2

Installation of Cherry Rivets
Figure 211/70-43-31-990-811-G00 (Sheet 1 of 3)

EFFECTIVITY
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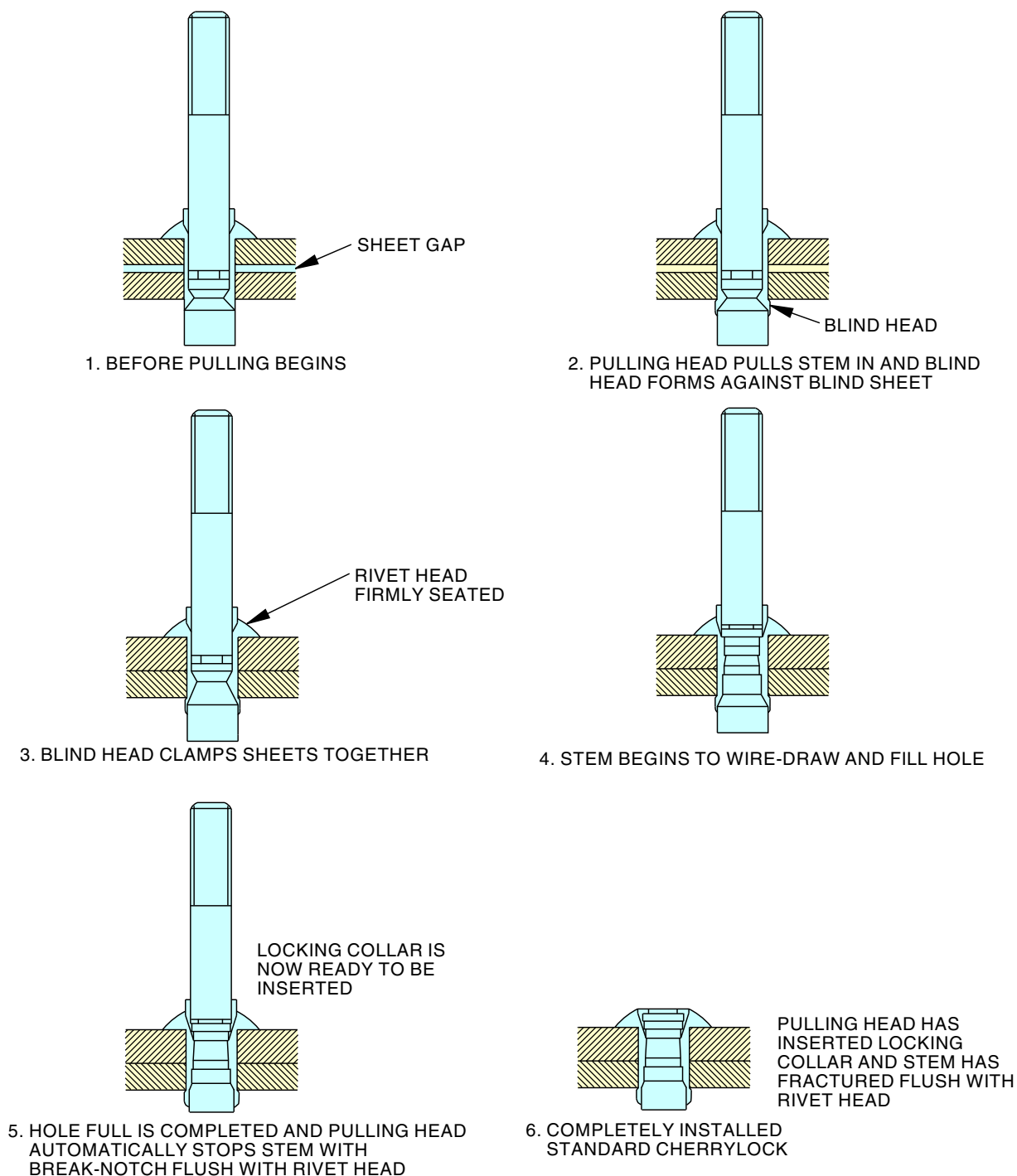
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

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STANDARD CHERRYLOCK RIVETS

2955347 S0000732461_V1

Installation of Cherry Rivets
Figure 211/70-43-31-990-811-G00 (Sheet 2 of 3)

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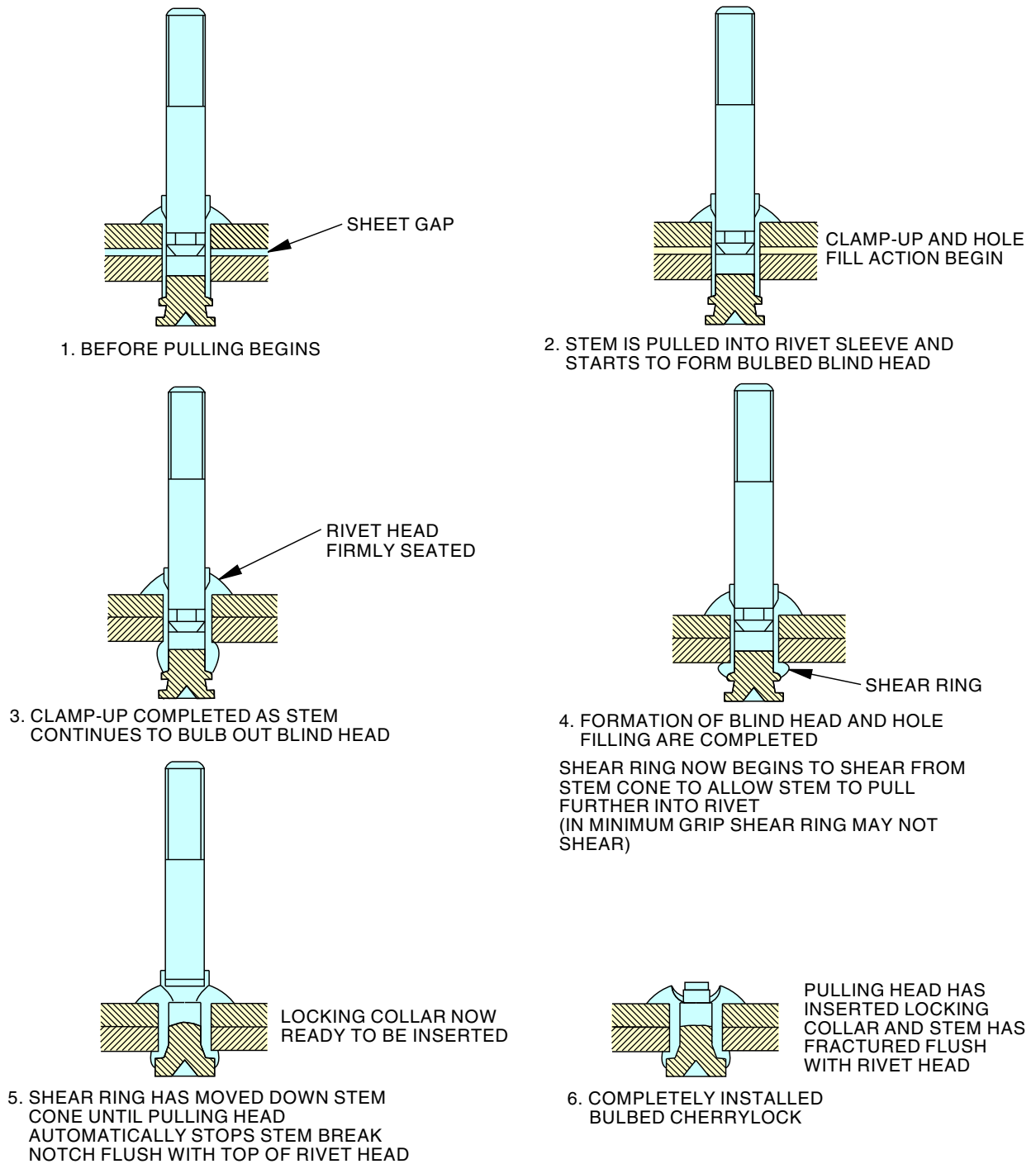
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

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**BULBED CHERRYLOCK RIVETS**

2955348 S0000732448_V1

Installation of Cherry Rivets
Figure 211/70-43-31-990-811-G00 (Sheet 3 of 3)

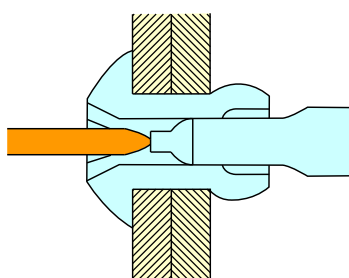
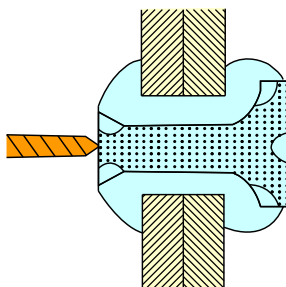
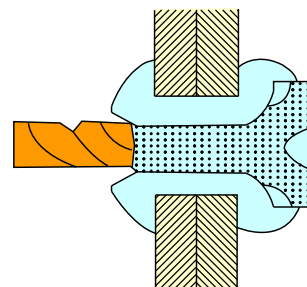
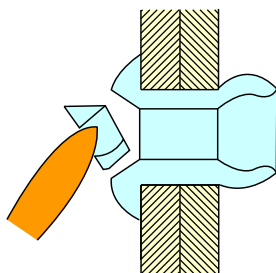
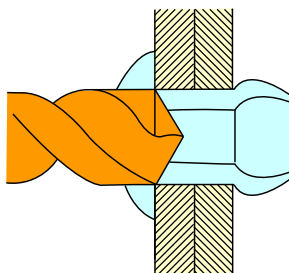
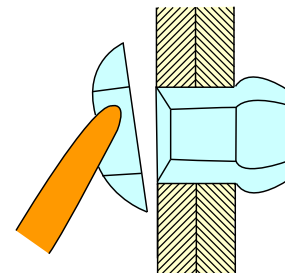
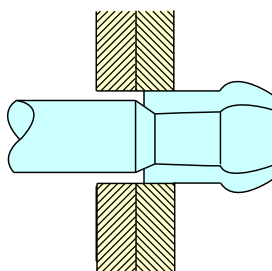
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**A****B****C****D****E****F****G**

2955345 S0000732449_V1

Replacement of Cherrylock Rivets
 Figure 212/70-43-31-990-812-G00

EFFECTIVITY
 SIA ALL

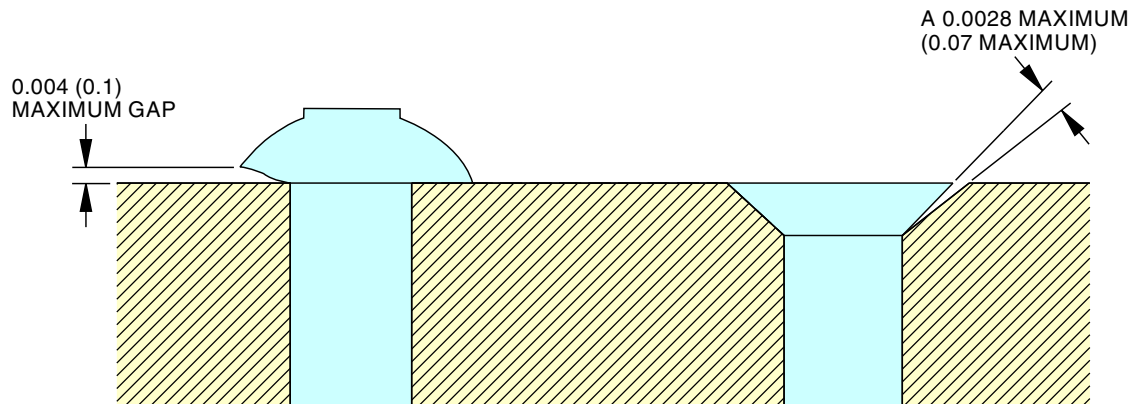
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

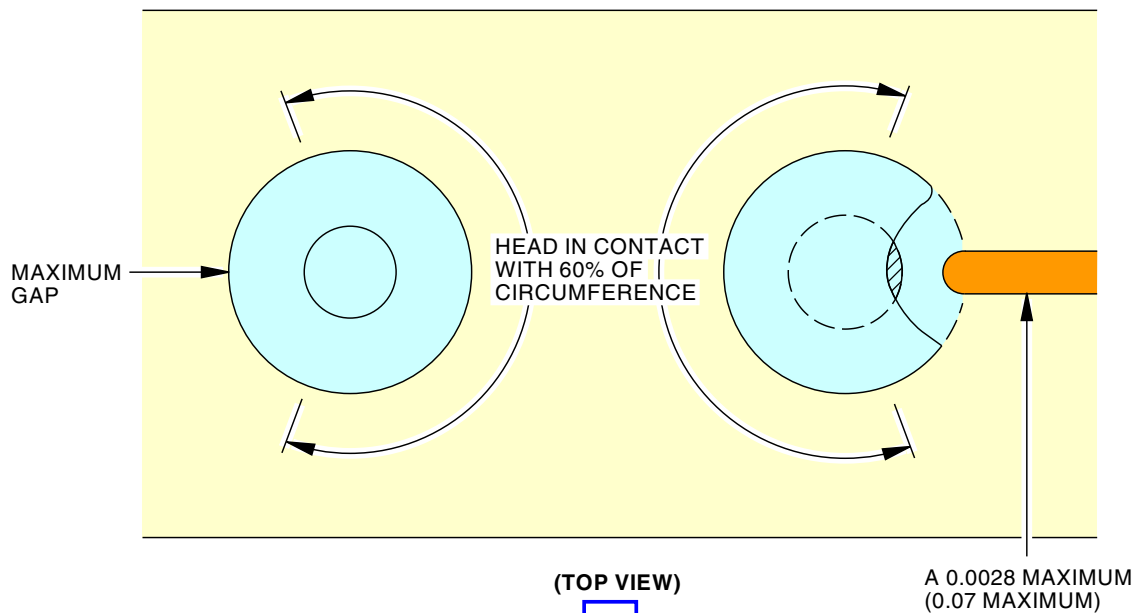
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A



(TOP VIEW)

A

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2955341 S0000732450_V2

Head Seating Check
Figure 213/70-43-31-990-813-G00 (Sheet 1 of 2)

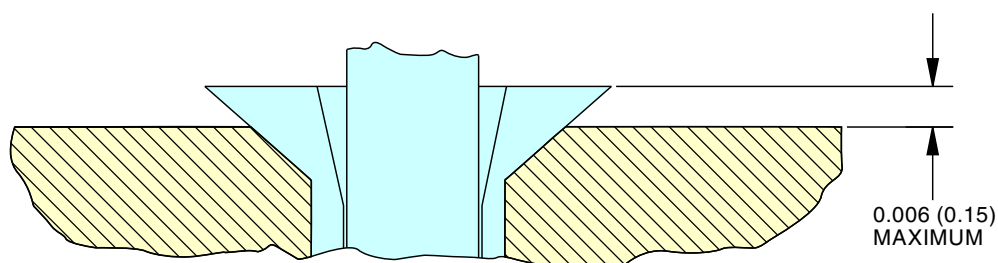
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AIRCRAFT MAINTENANCE MANUAL**NOTE:**

ALL DIMENSIONS ARE IN INCHES (mm).

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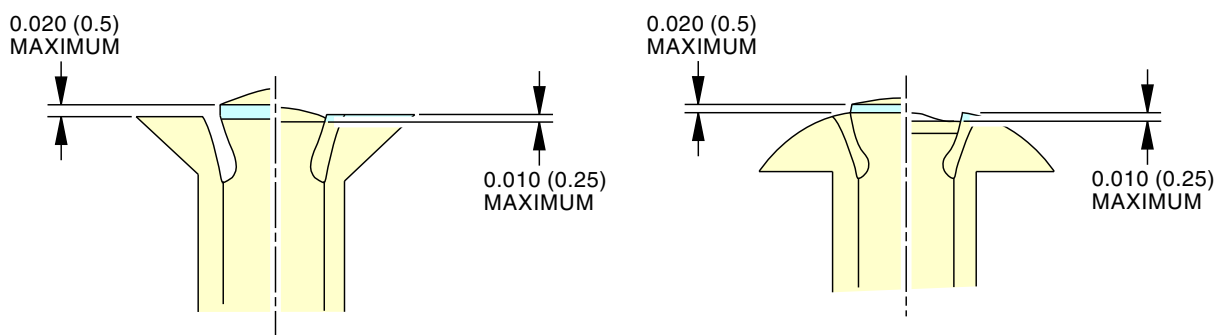
Head Seating Check
Figure 213/70-43-31-990-813-G00 (Sheet 2 of 2)EFFECTIVITY
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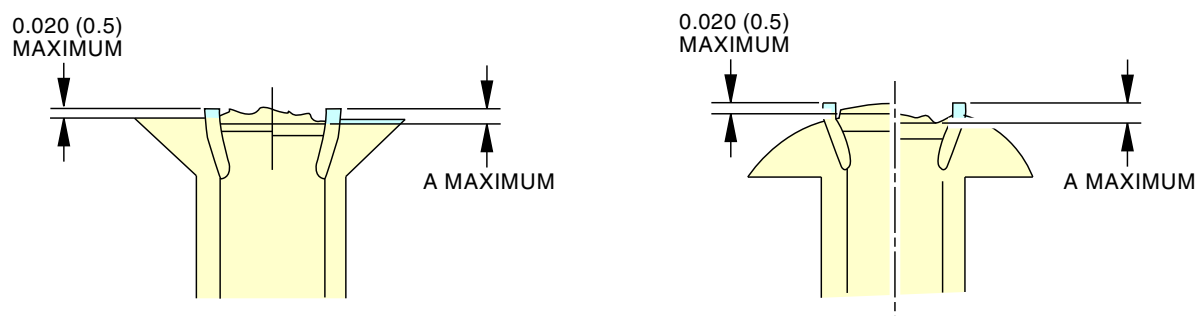
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STEM PROTRUSION LIMITS



COLLAR PROTRUSION LIMITS

DASH NUMBER	-4	-5	-6	-8
A MAXIMUM	0.015 (0.40)	0.020 (0.50)	0.025 (0.65)	0.030 (0.75)

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2955326 S0000732452_V1

**Stem and Collar Flushness
Figure 214/70-43-31-990-814-G00**

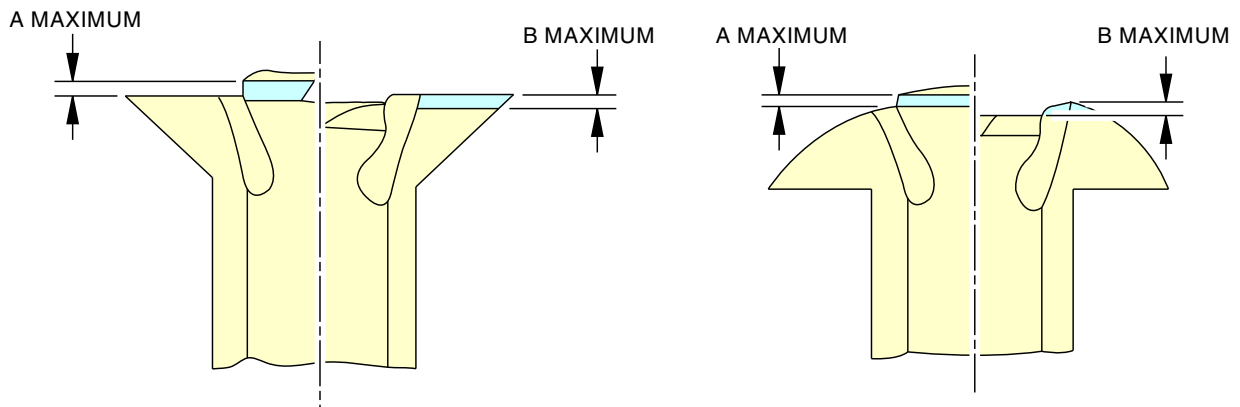
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NOMINAL DIAMETER	0.125 (3.2)	0.156 (4)	0.190 (4.8)
MAX A	0.010 (0.25)	0.010 (0.25)	0.010 (0.25)
MAX B	0.015 (0.38)	0.020 (0.50)	0.020 (0.50)

STEM PROTRUSION LIMITS

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2955241 S0000732454_V1

Stem flushness for CHERRY-MAX rivet
Figure 215/70-43-31-990-815-G00

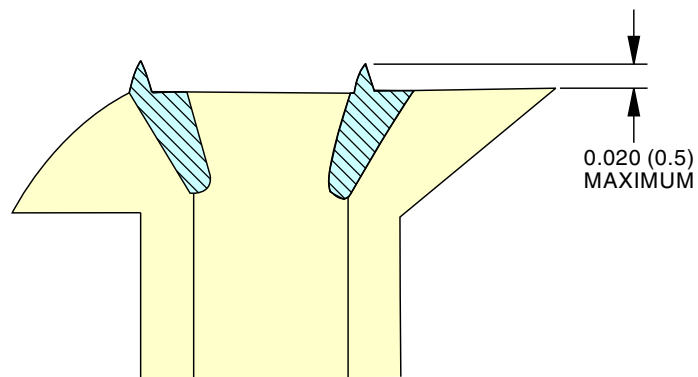
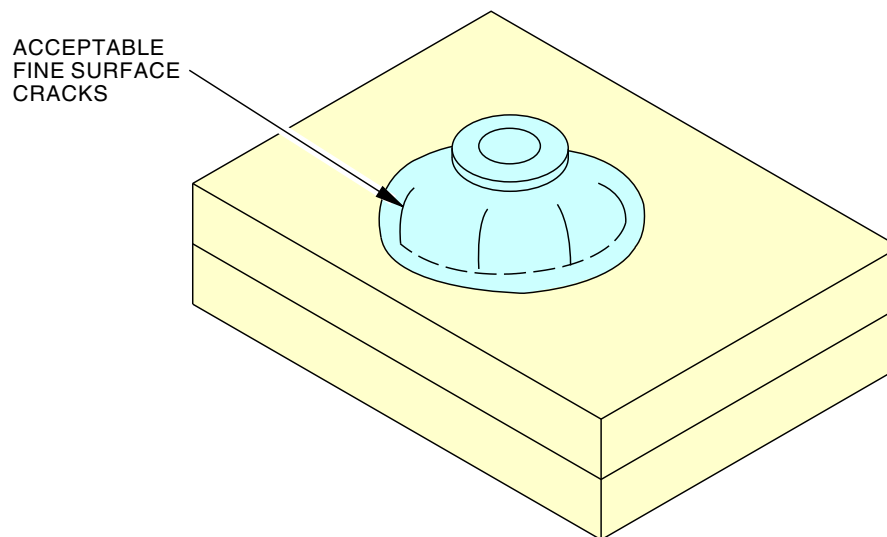
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AIRCRAFT MAINTENANCE MANUAL**LOCKING COLLAR****RIVETING****NOTE:**

ALL DIMENSIONS ARE IN INCHES (mm).

2955236 S0000732456_V1

Visual Check of Rivet
Figure 216/70-43-31-990-816-G00EFFECTIVITY
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SIMFAST FLOATING BOLT ASSEMBLIES RIVET - MAINTENANCE PRACTICES

1. General

- A. This procedure has the following task:
- (1) Simfast floating bolt assemblies rivet repair.

TASK 70-43-34-300-801-G00

2. Simfast Floating Bolt Assemblies Rivet Repair

(Figure 201, Figure 202, Figure 203, Figure 204, Figure 205, Figure 206, Figure 207, Figure 208, Figure 209, Figure 210, Figure 211 and Figure 212)

A. General

- (1) The Simfast bolt consists of a removable nut/plate which is maintained by 4 spigots in a cage.
- (2) This floating and removable nut can be easily replaced without removing the cage.
- (3) This captive nut is available in several inch or metric size threads and can also be equipped with an insert.
- (4) The base of the cage crimped in the housing secures the cage on the flange or the receiving support. When the insert is used, it replaces the base of the cage.
- (5) Simfast cage can be installed either with a manual or a pneumatic tool fitted with a nose adapter depending on the bolt head size.

NOTE: Refer to manufacturer documentation for tools identification.

- (6) To engage and clip the nut in its cage, a specific tool is needed.
- (7) To remove the nut, pliers, STD-10670 are needed.
- (8) Use a counterdrill for removing the cage.

B. Tools/Equipment

Reference	Description
STD-10670	Pliers

C. Procedure

SUBTASK 70-43-34-200-001-G00

- (1) Conditions of parts before assembly:
 - (a) Verify the following:
 - 1) Drilling edges are properly broken to 0.01 in. (0.2 mm) max.
 - 2) The seating faces of the receiving flange and the cage are free from any burrs or scale, or any other surface contamination that could prevent a correct contact.
 - (b) Select a crimping tool for central collar cages and cage/insert assemblies as a function of swaging counterbore (Figure 201, Figure 202, Figure 203 and Figure 204).

SUBTASK 70-43-34-400-002-G00

- (2) Installation of Simfast Cage.

NOTE: Pneumatic crimping is not allowed on composites.

- (a) Pneumatic crimping principle (Figure 206).
 - 1) For the cage installation, refer to Figure 208. Lock the central collar cage or cage/insert assembly on the pulling mandrel.
 - 2) For the cage crimping, refer to Figure 208. Insert mandrel/cage assembly until the bottom of the cage is in contact with the support and the locating pin is engaged.

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- 3) Insert the pulling nose until the mandrel is totally engaged (Figure 206).
 - 4) Crimp the insert by actuating the trigger for at least 3 seconds.
 - a) If the crimping tool does not unscrew upon completion, actuate the trigger again.
 - b) If the crimping tool remains attached, manually unscrew the pulling element through the hexagonal socket end piece Rep.C (Figure 206) at the rear of the gun using a 4 mm allen wrench.
 - 5) Upon completion of crimping, remove the pulling mandrel from the cage.
- (b) Manual Crimping Principle (Figure 207).
- 1) Adjust the tooling displacement in accordance with Figure 205.
 - 2) Position the holding tool equipped with the central collar cage or the cage/insert assembly onto the support or the receiving case.
 - 3) Position the tool and screw the pulling element in the holding tool by actuating the lever Rep.A (Figure 207).
 - 4) Crimp the insert by actuating the lever Rep.B (Figure 207).
 - 5) Unscrew the pulling element by actuating the lever Rep.A (Figure 207).
- (c) Do an inspection of the crimping. Refer to Inspection.
- 1) If the installation of the cage is incorrect, do these steps:
 - a) Remove the cage and the insert. Refer to Replacement/Repair.
 - b) Assemble a new cage and a new insert. Refer to Pneumatic Crimping Principle or Manual Crimping Principle.

SUBTASK 70-43-34-400-003-G00

(3) Nut Installation.

**CAUTION**

DO NOT USE PLIERS TO INSTALL THE NUT. THIS CAN CAUSE DAMAGE ON THE NUT KIT.

**CAUTION**

DO NOT TWIST THE CAGE BEFORE OR AFTER THE NUT KIT INSTALLATION. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT CAN OCCUR.

- (a) Make sure the nut is engaged in its cage and clipped using a specific tool. Refer to Figure 209.
- (b) Make sure the 4 spigots are totally clipped in the locating hole of the cage. Refer to Figure 210.
- (c) Do the Nut Kit Installation Inspection below to make sure of correct nut installation.

SUBTASK 70-43-34-000-003-G00

(4) Nut Removal.

**CAUTION**

MAKE SURE THAT YOU USE NEW NUTS. REMOVED NUTS HAVE DAMAGE TO THE NUT LUGS.

- (a) Use pliers to tighten the nut lugs (Figure 211).

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SUBTASK 70-43-34-300-001-G00

(5) Replacement/Repair.**CAUTION**

MAKE SURE THAT YOU USE NEW NUTS. REMOVED NUTS HAVE DAMAGE TO THE NUT LUGS.

- (a) If there is cage damage or partial uncrimping, counterdrill the crimped part using a drill without damaging support.
- (b) If no damage of the housing is observed, reinstall the same type of cage.

D. Inspection

SUBTASK 70-43-34-200-002-G00

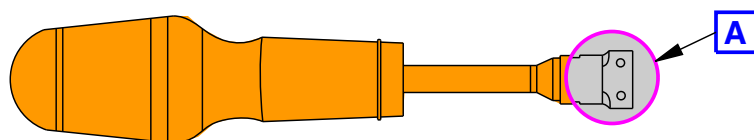
- (1) Inspection after crimping (cage and insert), (Figure 212).
 - (a) Anti-rotating device must be correctly engaged in its housing.
 - (b) The crimped insert must not protrude, no machining rework is permissible, unless otherwise specified in the appropriate repair document.
 - (c) Circular crack is not acceptable.
 - (d) 3 axial cracks maximum not leading into cylindrical part are acceptable.
 - (e) Cage shall be in contact with the support.
 - (f) Axial movement between cage and support are not acceptable.

SUBTASK 70-43-34-200-003-G00

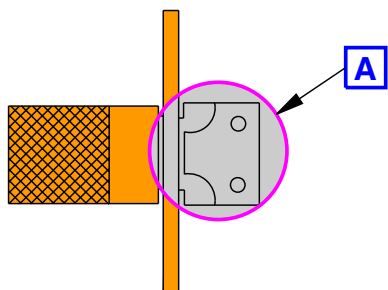
- (2) Nut Kit Installation Inspection.
 - (a) Check that the nut kit is correctly clipped by applying a 11 lbf (50 N) to it.
NOTE: Use the specific tool OSD835, referenced in Figure 210.

———— **END OF TASK** ————

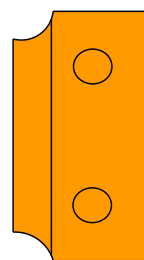
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LONG VERSION

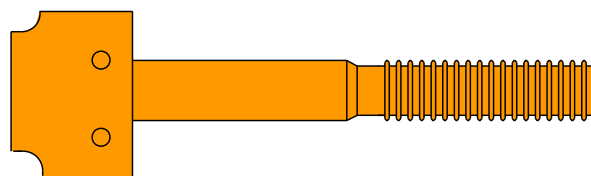
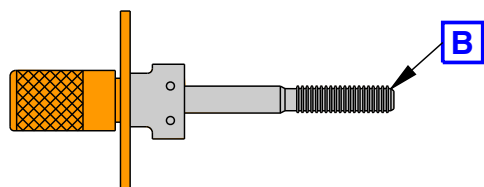
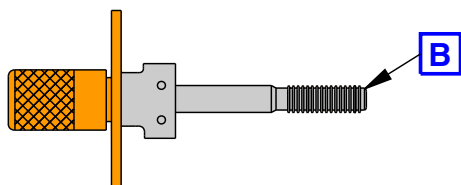


SHORT VERSION



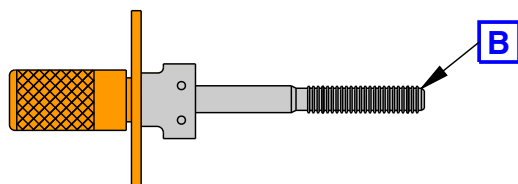
HOLDING TOOL

A



CRIMPING MANDREL

B



2954088 S0000701887_V1

Selection of Crimping Tools
Figure 201/70-43-34-990-801-G00 (Sheet 1 of 2)

EFFECTIVITY
SIA ALL

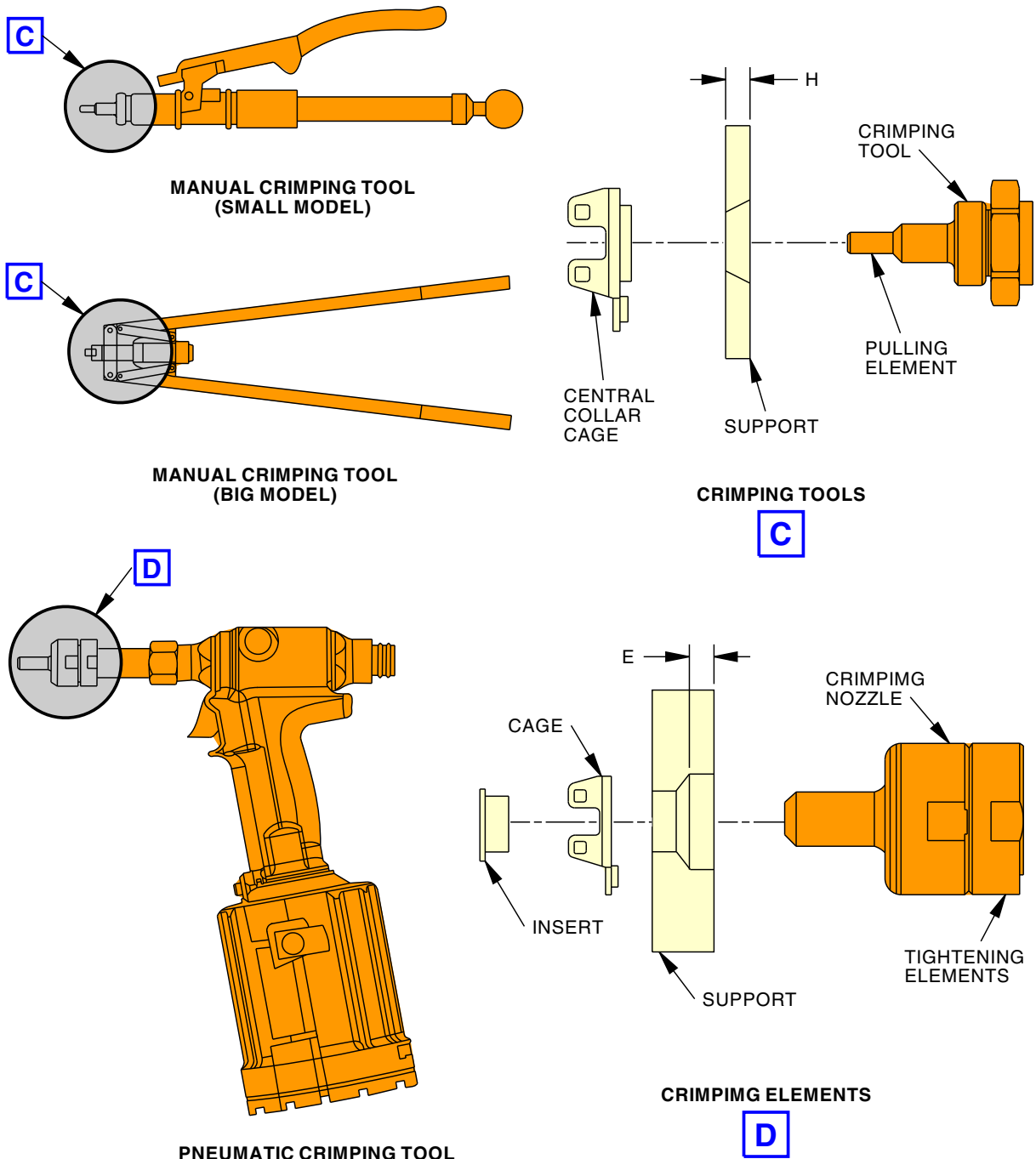
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

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2954090 S0000701888_V1

Selection of Crimping Tools
Figure 201/70-43-34-990-801-G00 (Sheet 2 of 2)

EFFECTIVITY
SIA ALL

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	SUPPORT	HOLDING TOOL		PRODUCT		CRIMPING PLIERS	CRIMPING TOOLS	
NUT THREAD	COUNTER BORE DEPTH "E" (mm)	LONG VERSION OSD258TE	SHORT VERSION OSD781TE	CRIMPING INSERT P/N	CAGE P/N	MANUAL PLIERS	PULLING ELEMENT OSD477T-UNJ OSD401T-MJ	CRIMPING END ELEMENT OSD437T-UNJ OSD381T-MJ
.1900-32 UNJF-3B	0 TO 3	OSD776E	OSD782	649-305-547-0 649-305-528-0 TO 649-305-530-0	649-305-500-0	OSD406	OSD478	OSD469
	3 TO 8							OSD470
	8 TO 13							OSD471
MJ5	0 TO 3	OSD396E	OSD785				OSD402	OSD384
	3 TO 8							OSD408
	8 TO 13							OSD409
.2500-28 UNJF-3B	0 TO 3	OSD777E	OSD783	649-305-548-0 649-305-520-0 TO 649-305-523-0	649-305-501-0		OSD480	OSD472
	3 TO 8							OSD473
	8 TO 13							OSD474
MJ6	0 TO 3	OSD262E	OSD786				OSD403	OSD382
	3 TO 8							OSD410
	8 TO 13							OSD411
.3125-24 UNJF-3B	0 TO 3	OSD778E	OSD784	649-305-549-0 649-305-536-0 TO 649-305-538-0	649-305-502-0		OSD482	OSD457
	3 TO 8							OSD458
	8 TO 13							OSD459
MJ8	0 TO 3	OSD397E	OSD787				OSD404	OSD385
	3 TO 8							OSD412
	8 TO 13							OSD413
.3750-24 UNJF-3B	0 TO 8	OSD779E		649-305-550-0 649-305-544-0 TO 649-305-546-0	649-305-503-0	OSD629	OSD598	OSD599

2954092 S0000701889_V1

Selection of Manual Crimping Tooling for Cage/Insert Assemblies Depending on Crimping Counterbore (Dimension E)
Figure 202/70-43-34-990-802-G00

EFFECTIVITY
SIA ALL

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	SUPPORT	HOLDING TOOL		PRODUCT	CRIMPING PLIERS	CRIMPING TOOLS		
NUT THREAD	COUNTER BORE DEPTH "H" (mm)	LONG VERSION OSD258TE	SHORT VERSION OSD781TE	CENTRAL COLLAR CAGE P/N	MANUAL PLIERS	PULLING ELEMENT OSD477T-UNJ OSD401T-MJ	CRIMPING END ELEMENT OSD437T-UNJ OSD381T-MJ	
.1900-32UNJF -3B	1,2 TO 5	OSD776E	OSD782	649-305-360-0	OSD406	OSD478	OSD469	
MJ5		OSD396E	OSD785				OSD402	OSD470
								OSD471
.2500-28UNJF -3B	1,2 TO 5	OSD777E	OSD783	649-305-361-0		OSD480		OSD384
							OSD408	
MJ6		OSD262E	OSD786			OSD403	OSD409	
							OSD472	
.3125- 24UNJF-3B	1,2 TO 5	OSD778E	OSD784	649-305-362-0		OSD482	OSD473	
							OSD474	
MJ8		OSD397E	OSD787			OSD404	OSD382	
							OSD410	
							OSD411	
MJ8		OSD397E	OSD787			OSD404	OSD457	
	OSD458							
	OSD459							
MJ8	OSD397E	OSD787	OSD404	OSD385				
				OSD412				
				OSD413				

2954093 S0000701890_V1

**Selection of Manual Crimping Tooling for Central Collar Cage Depending on Support Thickness
(Dimension H)**

Figure 203/70-43-34-990-803-G00

EFFECTIVITY
SIA ALL

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	SUPPORT	PRODUCT		CRIMPING TOOL	CRIMPING ELEMENTS	
NUT THREAD	COUNTER BORE DEPTH "E" (mm)	CRIMPING INSERT P/N	CAGE P/N	PNEUMATIC TOOL	PULLING MANDREL OSD821TE	CRIMPING END ELEMENT OSD831TE
.1900-32 UNJF-3B AND MJ5	15 mm MAX	649-305-547-0 649-305-528-0 649-305-529-0 649-305-530-0	649-305-500-0	OSD836KIT PNEUMATIC GUN 2012 + NOSE 99-1827 + PNEUMATIC COUPLING 253-7532 ET 367-5427 + PRESSURE CONTROLLER M3300-1082 + PLUG M3300-1083	OSD822E	OSD832E
		—			OSD823E	
		—			OSD824E	
.2500-28 UNJF-3B AND MJ6		649-305-548-0 649-305-520-0 649-305-521-0 649-305-522-0	649-305-501-0		OSD825E	OSD833E
		649-305-523-0 649-305-525-0			OSD826E	
		649-305-526-0			OSD827E	
.3125- 24UNJF-3B AND MJ8		649-305-549-0 649-305-536-0 649-305-537-0 649-305-538-0	649-305-502-0		OSD828E	OSD834E
		—			OSD829E	
		—			OSD830E	
.3750- 24UNJF-3B		649-305-550-0 649-305-544-0 649-305-545-0 649-305-546-0	649-305-503-0			
		—				
		—				

2954094 S0000701891_V1

**Selection of Pneumatic Crimping Tooling for Cage/Insert Assemblies Depending on Crimping
Counterbore (Dimension E)**
Figure 204/70-43-34-990-804-G00

EFFECTIVITY
SIA ALL

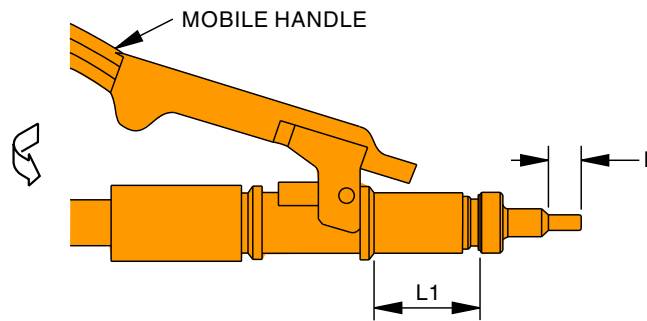
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CRIMPING INSERT REFERENCES	L ± 0,2 INCH	L ± 0,5 mm
649-305-547-0	0.30	7.5
649-305-548-0		
649-305-549-0		
649-305-550-0		
649-305-528-0	0.33	8.5
649-305-520-0		
649-305-536-0		
649-305-544-0		
649-305-529-0	0.37	9.5
649-305-521-0		
649-305-537-0		
649-305-545-0		
649-305-530-0	0.41	10.5
649-305-522-0		
649-305-538-0		
649-305-546-0		
649-305-523-0	0.45	11.5
649-305-526-0	0.61	15.5



CRIMPING DISPLACEMENT

NOTE:

L VALUE MATCHES THE CRIMPING LENGTH, IT PERMITS A GOOD NUMBER OF THREAD ENGAGED IN THE TOOL.

L VALUE IS EQUAL TO THE HEIGHT OF THE INSERT + 3 THREADS ENGAGED.

L1 VALUE ADJUSTMENT IS USED TO ADAPT THE OPENING ANGLE OF THE MOBILE HANDLE AND TO ADAPT THE TOOL TO THE FINAL USER. THAT ERGONOMICAL SETTING IS PERFORMED THANKS TO A THREADED RING.

2954097 S0000701892_V1

**Value Adjustment for Manual Crimping
Figure 205/70-43-34-990-805-G00**

EFFECTIVITY
SIA ALL

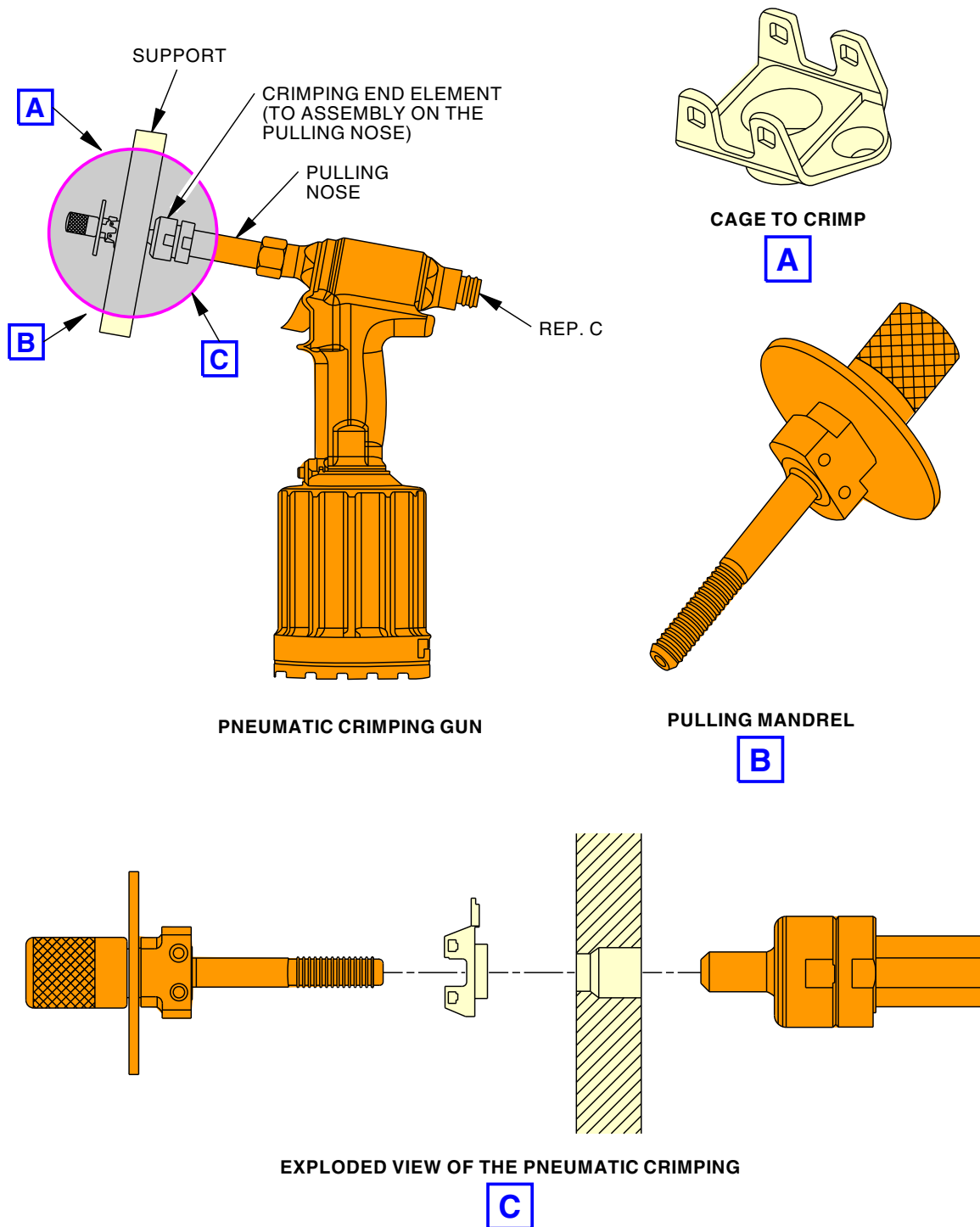
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2954098 S0000701893_V1

Pneumatic Crimping
Figure 206/70-43-34-990-806-G00

EFFECTIVITY
SIA ALL

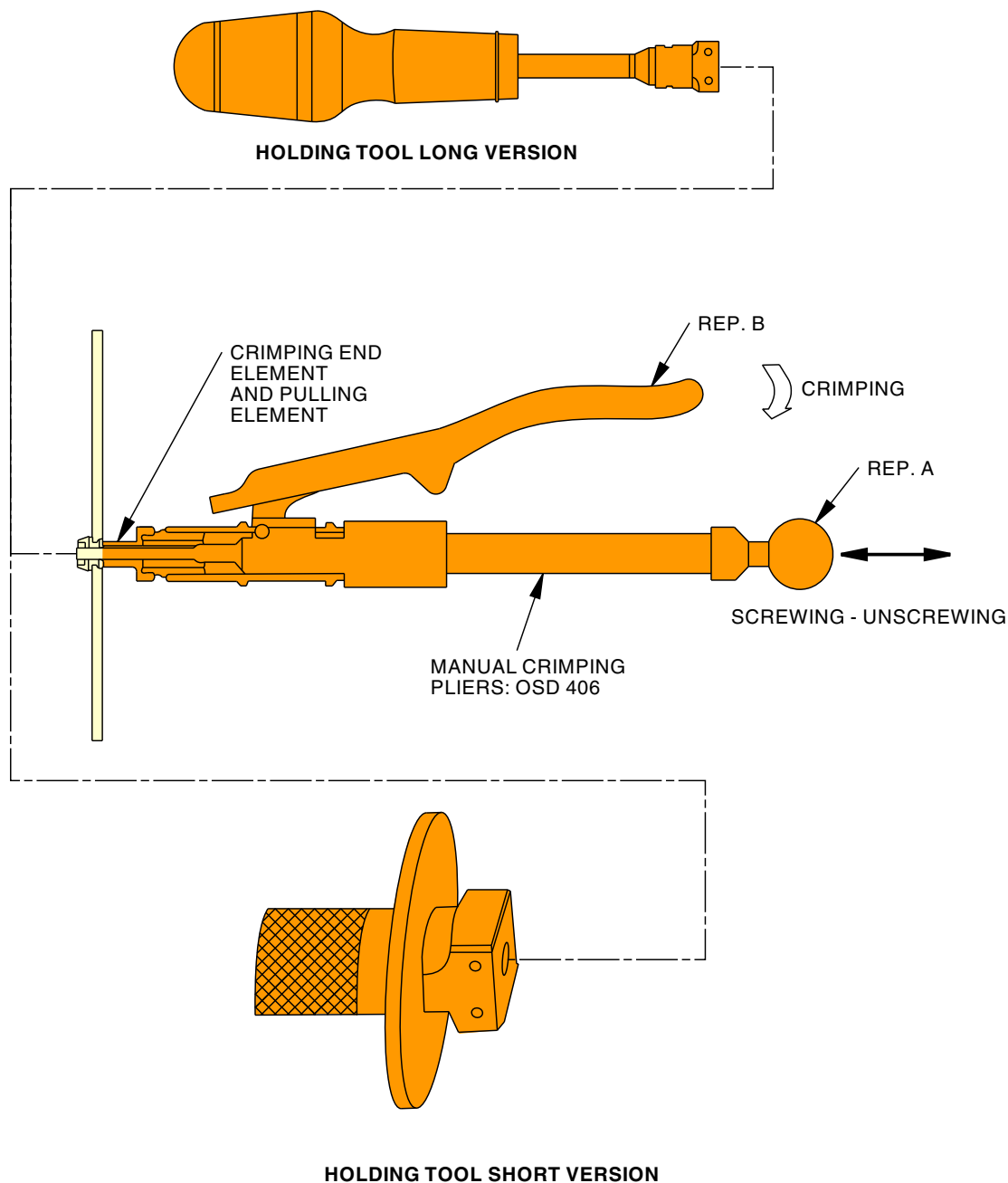
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2954101 S0000701894_V1

Manual Crimping Tool
Figure 207/70-43-34-990-807-G00

EFFECTIVITY
SIA ALL

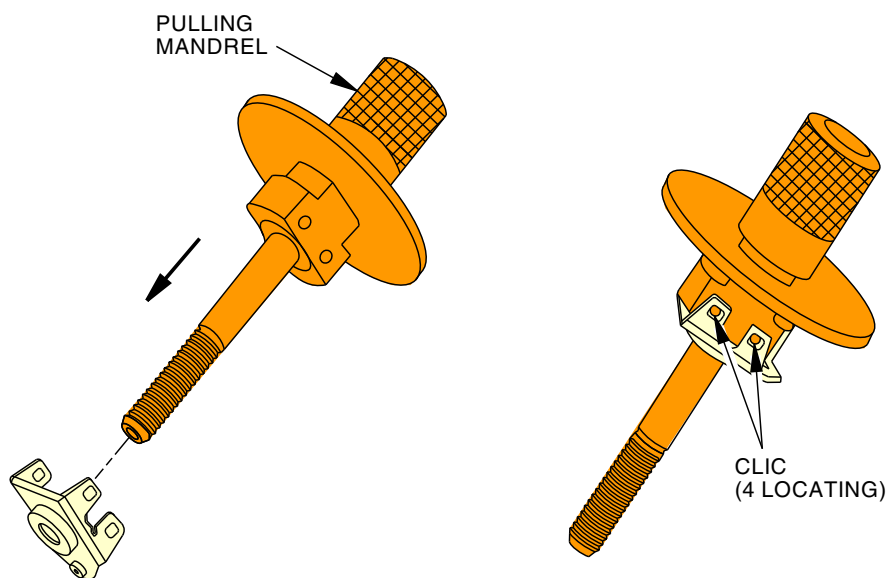
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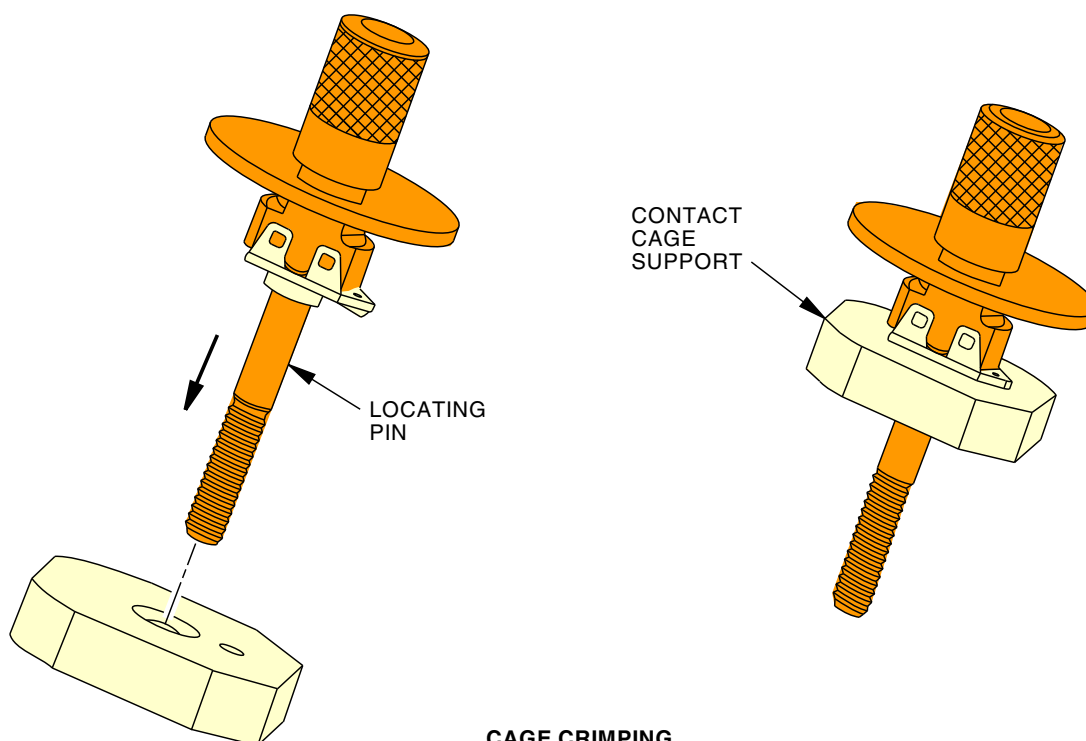
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CAGE INSTALLATION



CAGE CRIMPING

2954102 S0000701895_V1

Cage Installation and Crimping
Figure 208/70-43-34-990-808-G00

EFFECTIVITY
SIA ALL

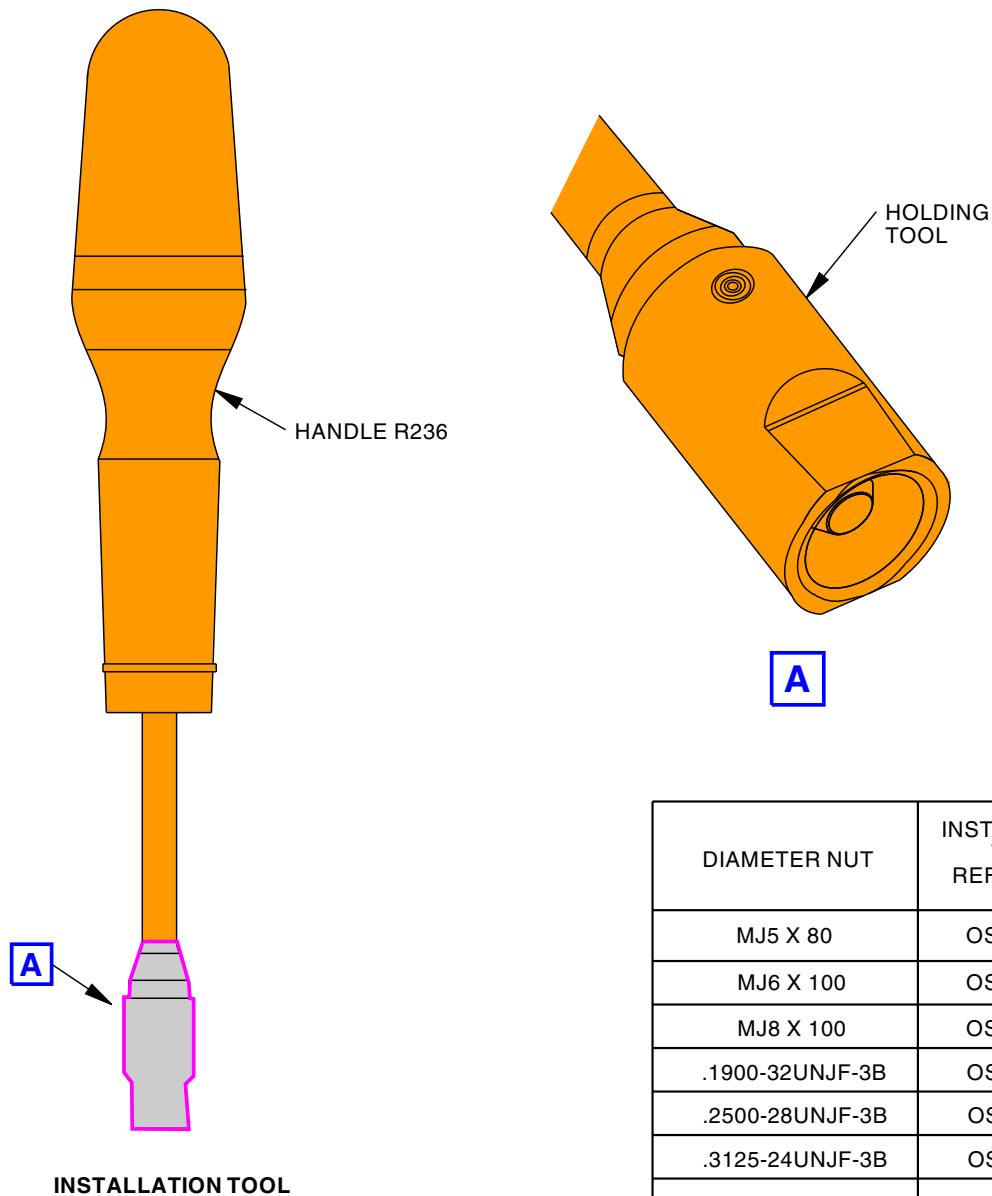
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**NOTE:**

IT IS IMPORTANT TO ENSURE THAT THE NUT IS CORRECTLY CLIPPED IN THE CAGE.

2954103 S0000701896_V1

Nut Installation
Figure 209/70-43-34-990-809-G00

EFFECTIVITY
SIA ALL

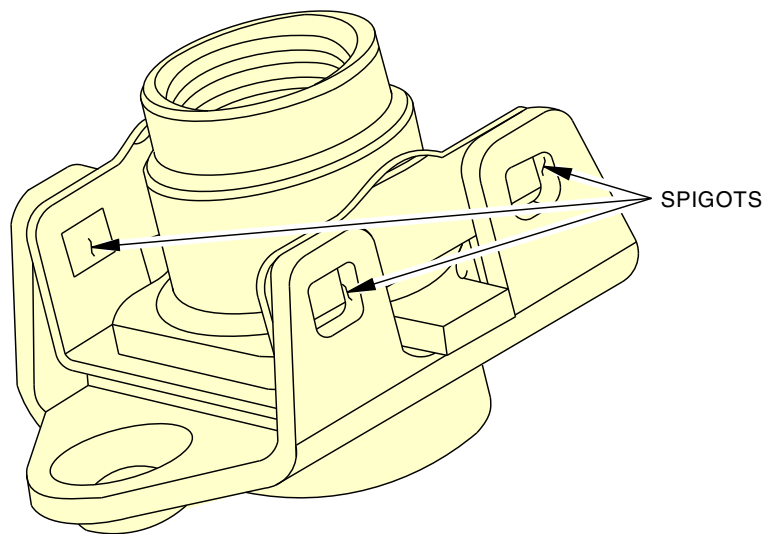
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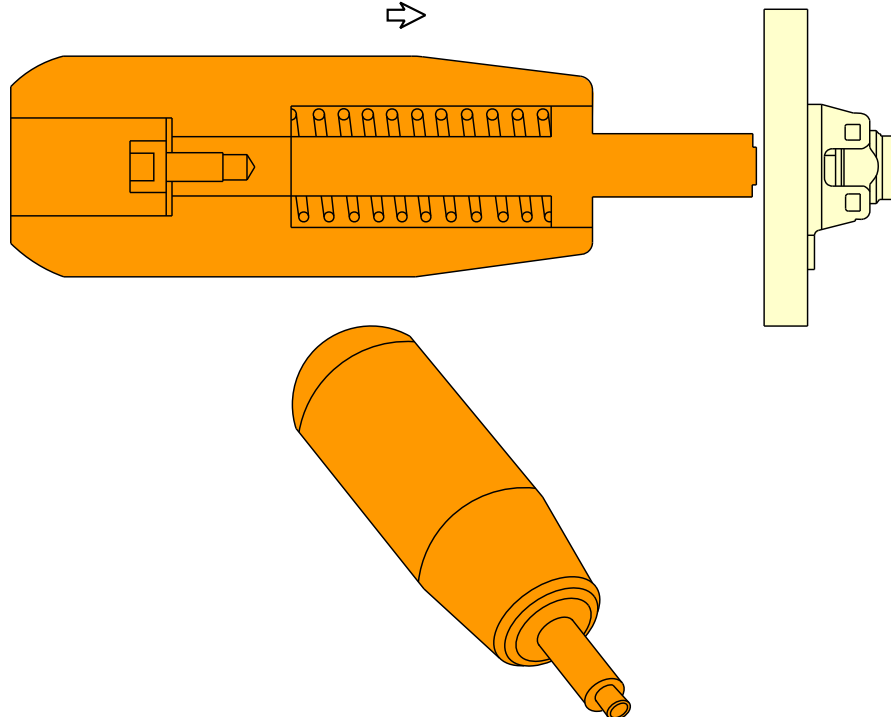
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CORRECTLY INSTALLED

EFFORT
APPROXIMATELY 50 N



TOOL OSD835

2954104 S0000701897_V1

Nut Kit Installation and Inspection
Figure 210/70-43-34-990-810-G00

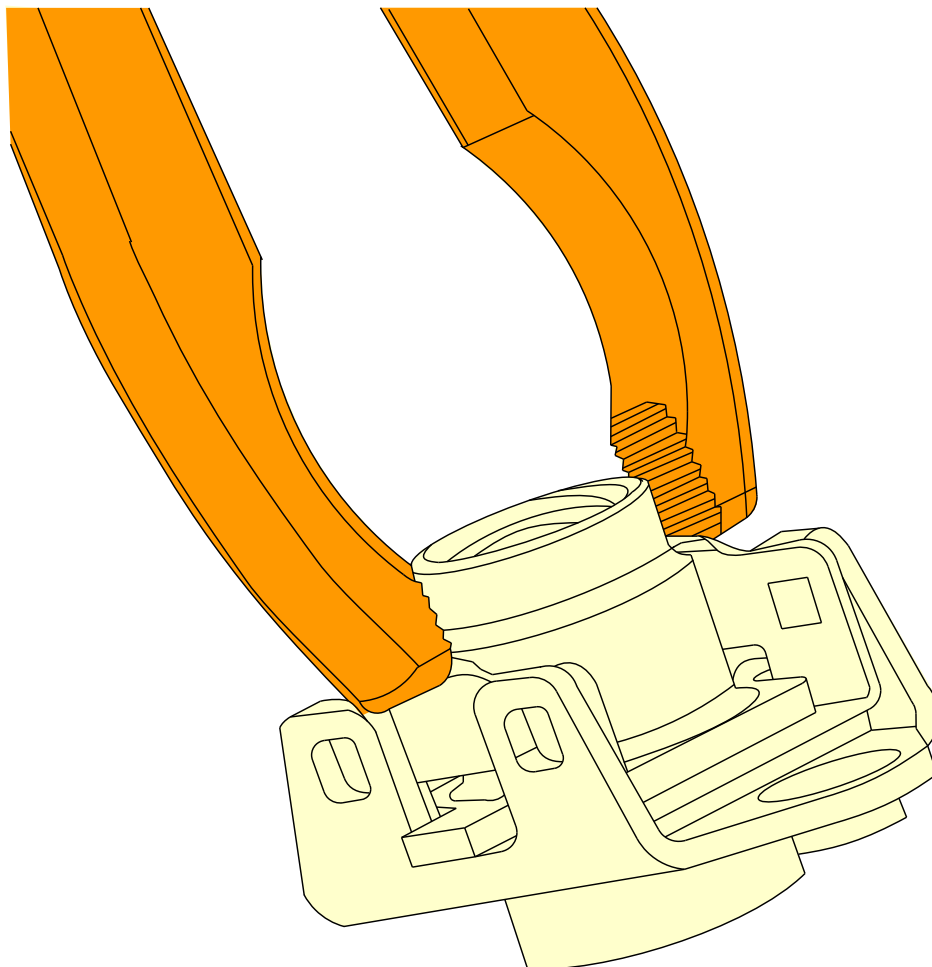
EFFECTIVITY
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Nut Removal
Figure 211/70-43-34-990-811-G00

EFFECTIVITY
SIA ALL

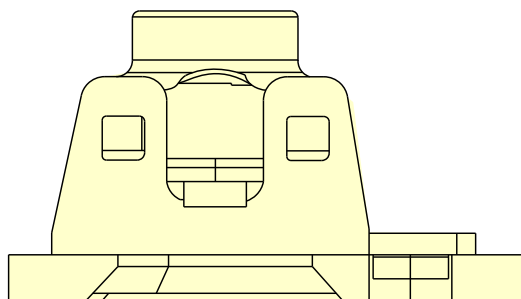
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

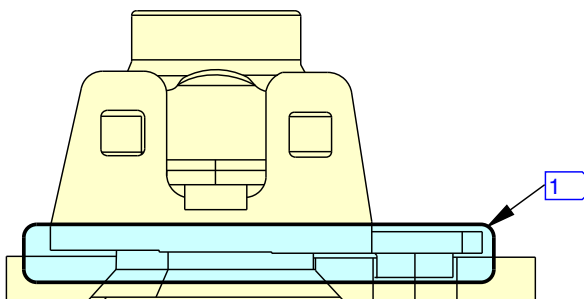
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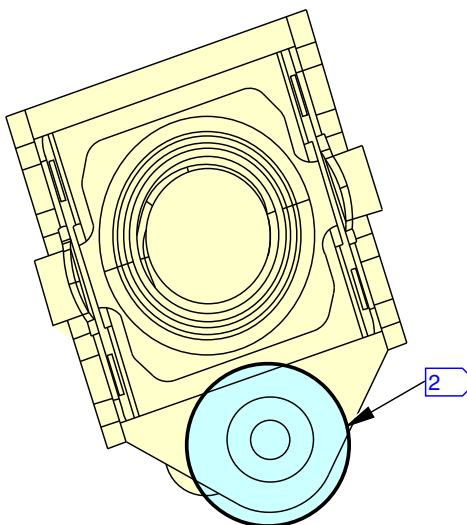
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**NOTE:**

CORRECT INSTALLATION: CAGE IS IN CONTACT WITH THE SUPPORT AND LOCATING PIN IS IN ITS HOUSING.

**NOTE:**

1 WRONG INSTALLATION: CAGE IS NOT IN CONTACT WITH THE SUPPORT.

**NOTE:**

2 WRONG INSTALLATION: THE LOCATING PIN IS NOT IN ITS HOUSING.

2954106 S0000701899_V2

Inspection After Crimping
Figure 212/70-43-34-990-812-G00

EFFECTIVITY
SIA ALL

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BLENDING PROCEDURES - MAINTENANCE PRACTICES

1. General

A. This procedure has these tasks:

- (1) Blending Procedures - General.
- (2) Blending Procedures - Hand Blending.
- (3) Blending Procedures - Power Blending.

TASK 70-43-42-300-804-G00

2. Blending Procedures - General

(Figure 201)

NOTE: Refer to the applicable Aircraft Maintenance Manual (AMM) task for the blend limits of the part under review. Use the limits in this procedure only when no specific limits are specified for the component in the applicable AMM task.

A. General

- (1) Blending is a repair procedure that is used to remove stress concentrations caused by nicks, scratches, or other sharp-edged damage marks on critical parts. Removal of the material surrounding the stress concentration so that the sharp edges are blended into a smooth contour, relieves the stress concentration and permits further use of the part by lessening the danger of cracking.
- (2) Blending is also used to remove sharp edges as a result from machining or drilling and to repair the initial contour and surface finish to parts that have been repaired by welding or brazing.
- (3) General requirements:
 - (a) The preferred blend shape is smooth, continuous, and round-bottomed, extending as far as it is necessary from the initially deviated area (Figure 201).
 - (b) Direction of blends:
 - 1) When blending a cylindrical part, blend in a circumferential direction, not along the axis of the part, unless the damage is radially oriented.
 - 2) Damage that is radially oriented must be blended in a radial direction.
 - 3) When blending a feature that involves a radius, shape the radius as specified in the repair section. If the radius is not specified, shape it as near as possible to the initial contour. Refer to a location that is not damaged in the feature or a equivalent part if necessary to find the initial radius.
 - 4) When blending rotor blades, stator vanes, and equivalent parts, blend in a radial direction in relation to the engine centerline.
 - (c) The finish of the blended area must be as near as possible to the initial finish of the part.
 - (d) These types of part deviations can be repaired by hand-blending or by power-blending. Always refer to applicable part inspection paragraph for a description of part deviation limits as follows:
 - 1) Nick. A V-shaped depression in the part made by a sharp-edged object pushing the metal inward.
 - 2) Pit. A round, sharp-edged hole with a rounded bottom caused by corrosion.
 - 3) Scratch. A V-shaped line or furrow in the part, such as it would be made by dragging a sharp object across the surface.

EFFECTIVITY
SIA ALL

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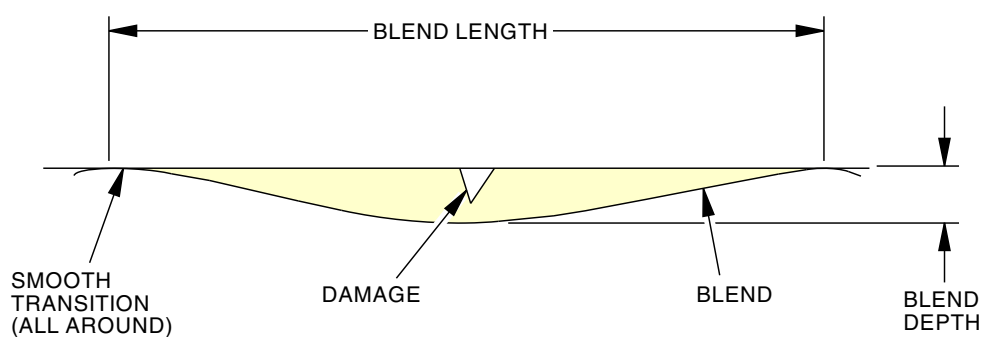
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- 4) Dent. A smooth, rounded depression in the part made by impact with a rounded object. If there is a noticeable sharp discontinuity in the depression, it should be considered a nick. Waviness of leading or trailing edge is to be treated as a dent.
- 5) Erosion. A sand- or shot-blasting effect on the leading edges or the leading portion of the concave side, caused by sand or dust going through the engine.
- 6) Torn Metal. A separation or pulling apart of material by force, leaving jagged edges.

B. Choice of Blending Method

- (1) Power blending causes thermal stress to parts because of the local heating. It should be used only when specified in the repair instructions. It is usually specified on non-rotating or non-critically stressed parts. When specified, it is then usually followed by hand blending or stress relief heat treatment.
- (2) Hand blending is the usual procedure specified for rotating and critically stressed parts. It does not cause thermal stress to a part. It is also used for better control on the quantity of material removed.

———— **END OF TASK** ————



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Blending Guidelines
Figure 201/70-43-42-990-806-G00

EFFECTIVITY
SIA ALL

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TASK 70-43-42-300-802-G00**3. Blending Procedures - Hand Blending**

(Figure 202)

A. General

- (1) For general requirements concerning blending, refer to: Blending Procedures - General, TASK 70-43-42-300-804-G00.
- (2) Hand blending is a procedure that is used to remove metal deposits, rough surfaces, cracks, stress concentrations caused by nicks, scratches, or other sharp-edged damage marks on parts. The removal of the material around the stress concentration, so that the sharp edges are blended into a smooth contour, relieves the stress concentration, which lowers the danger of cracking. Hand blending does not give a thermal stress to parts which are blended.
 - (a) For hand blending procedures, refer to "General hand blending (non-rotating parts)" and "Hand blending on rotating parts" in the procedure.
- (3) High metal is caused by the displacement of metal above a surface. It is found around indications equivalent to nicks and scratches. This procedure removes the displacement of metal above a surface and must not touch the surface of the part.
 - (a) For High metal removal procedure, refer to "General removal of high metal" in the procedure.

B. Equipment

- (1) Unless otherwise specified in this task, the following equipment is required for hand blending:
 - Assorted hand files
 - Abrasive stones.

C. Materials

DO NOT USE TOOLS THAT CONTAIN ALUMINUM OXIDE TO REMOVE OR TO POLISH TITANIUM SURFACES. THE ALUMINUM OXIDES CAN CAUSE CONTAMINATION OF THE TITANIUM SURFACES. THE CONTAMINATION CAN CAUSE DAMAGE TO THE TITANIUM SURFACES.



DO NOT USE ABRASIVES OR STONES WHICH INCLUDE A VITRIFIED BOND ON TITANIUM PARTS. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT CAN OCCUR.

- (1) Unless otherwise specified in this task, the following consumables are required for hand blending:

NOTE: Only abrasive consumables of silicon carbide grit or corundum (alumina) are permitted.

- Abrasive sheets
- Abrasive belts
- Abrasive disks
- Crocus cloths.

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D. Procedure

DO NOT BREATHE THE PARTICLES FROM BLENDING OR LET THE PARTICLES TOUCH YOU. THE PARTICLES FROM BLENDING CAN CAUSE DAMAGE, INJURY, OR IRRITATION TO YOU. USE PROTECTION EQUIPMENT. USE LOCAL MECHANICAL EXHAUST VENTILATION OR AN APPROVED RESPIRATOR.



DO NOT LET TITANIUM DUST COLLECT. TITANIUM DUST IS VERY FLAMMABLE. DISCARD ALL TITANIUM WASTE IN AN APPROVED CONTAINER. TITANIUM DUST CAN CAUSE INJURY TO PERSONNEL.



DO NOT USE WATER TO EXTINGUISH A TITANIUM FIRE. EXTINGUISH WITH AN APPROVED CHEMICAL FOR METAL FIRES. IF YOU DO NOT OBEY, OPERATION OF A WATER EXTINGUISHER COULD CAUSE INJURY TO PERSONNEL.



DO NOT USE TOOLS THAT CONTAIN ALUMINUM OXIDE TO REMOVE OR TO POLISH TITANIUM SURFACES. THE ALUMINUM OXIDES CAN CAUSE CONTAMINATION OF THE TITANIUM SURFACES. THE CONTAMINATION CAN CAUSE DAMAGE TO THE TITANIUM SURFACES.



DO NOT USE ABRASIVES OR STONES WHICH INCLUDE A VITRIFIED BOND ON TITANIUM PARTS. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT CAN OCCUR.



DO NOT USE TOOLS ON TITANIUM THAT WERE USED ON OTHER MATERIALS. IT WILL CAUSE CONTAMINATION OF THE TITANIUM. KEEP THE BLENDING ABRASIVE TOOL USED FOR THE TITANIUM ISOLATED FROM TOOLS USED FOR OTHER METALS. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT CAN OCCUR.



CLEAN THE THE ABRASIVE TOOL BEFORE YOU USE IT. CONTAMINATION CAN CAUSE DAMAGE TO EQUIPMENT.



DO NOT USE COMPOUNDS TO CLEAN THAT CONTAIN HALOGEN OR TOOLS THAT CONTAIN CADMIUM OR THAT ARE CADMIUM PLATED. IF YOU USE ADHESIVE TAPES THAT ARE PRESSURE SENSITIVE, MAKE SURE THAT YOU CHEMICALLY CLEAN AND THEN REMOVE THE ADHESIVE TAPES IMMEDIATELY. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT CAN OCCUR.

SUBTASK 70-43-42-320-007-G00

- (1) General hand blending (non-rotating parts).

NOTE: Refer to the specified procedures and limits in the appropriate Aircraft Maintenance Manual (AMM) task applicable to each part of the engine. The specified procedures and limits in the appropriate AMM task for a part always override those in the standard practices section.

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- (a) Blend out the sharp edges and rough-out indications using abrasive tools. Refer to the materials section.
- 1) If necessary, start the blend with grade 60 or a finer for fast initial removal but not coarser than necessary for the removal of the material.
 - 2) Complete the blend with grade 150 or a finer abrasive material or crocus cloths until the surface is as smooth as or smoother than the adjacent surfaces.

NOTE: Keep the abrasive consumable clean from removed material.

NOTE: Do not remove metal from the leading and trailing edges of part sections, which can cause the edges to become thin or sharp. Blend the material to keep approximately the initial contour.

SUBTASK 70-43-42-320-005-G00

- (2) Hand blending on rotating parts:

NOTE: This procedure is not be applicable to certain critical areas, for example: disk dovetail areas, critical bolt holes and critical embossments. Refer to the appropriate AMM tasks for those locations.

NOTE: Refer to the specified procedures and limits in the appropriate AMM task applicable to each part of the engine. The specified procedures and limits in the appropriate AMM task for a part always override those in the standard practices section.

- (a) If the blended area and a corner connects, break the sharp edges to the limits specified in the appropriate AMM task for that item. If not specified, do one of the following steps:
- 1) Blend the corner to a radius of 0.015 in. (0.38 mm) - 0.030 in. (0.76 mm).
 - 2) Blend to align the general radius of the corner. Refer to an adjacent, non-blended location of the corner or an equivalent part if necessary to find the initial radius.
- (b) If the blended area and a curved feature connects, restore the general shape of the initial contour. Refer to an adjacent, non-blended location of the curved feature or an equivalent part if necessary to find the initial contour.
- (c) Blend out the sharp edges and rough-out indications using abrasive tools. Refer to the materials section.
- 1) If necessary, start the blend with grade 60 or a finer abrasive for fast initial removal of material but not coarser than necessary for the removal of the material.
 - 2) Complete the blend using a grade 150 or finer abrasive.
- NOTE: Keep the abrasive clean from removed material.
- NOTE: Do not remove metal from the leading and trailing edges of part sections, which can cause the edges to become thin or sharp. Blend the material to keep approximately the initial contour.

SUBTASK 70-43-42-320-006-G00

- (3) General removal of high metal.

NOTE: Refer to the specified procedures and limits in the appropriate AMM task applicable to each part of the engine. The specified procedures and limits in the appropriate AMM task for a part always override those in the standard practices section.

- (a) Remove high metal as follows:
- 1) Use a fine abrasive stone, emery cloth, or crocus cloth to remove high metal.
 - 2) Remove only the material that is extended above the initial surface contour (Figure 202).

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- 3) Complete the blends with grade 150 or finer of abrasives or crocus cloths until the surface is as smooth as or smoother than the adjacent surfaces.

E. Quality Assurance

SUBTASK 70-43-42-200-002-G00

- (1) Make sure that the surface condition of the blending is equivalent to that of the adjacent areas. Areas must be smooth and continuous.

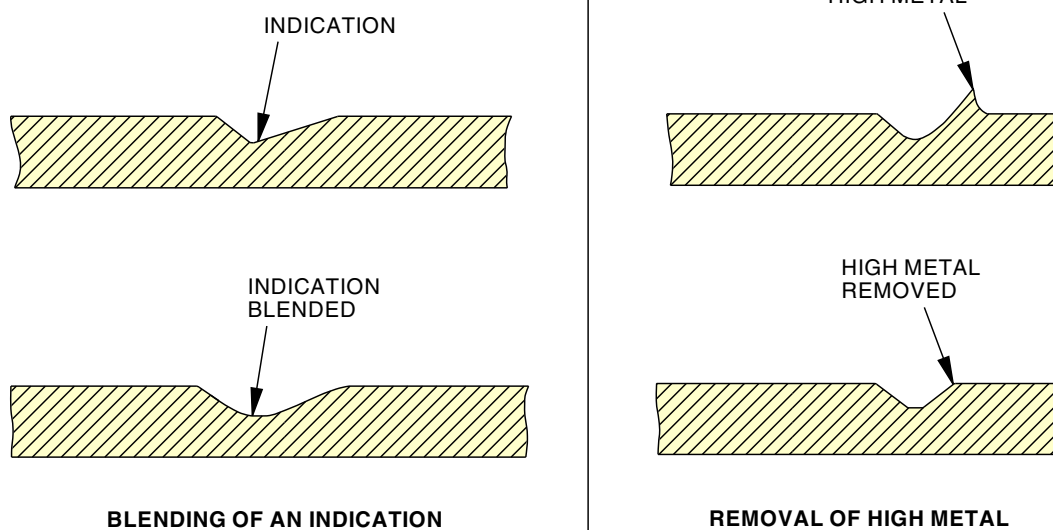
SUBTASK 70-43-42-200-003-G00

- (2) Complete a visual check of edges on all parts and edges for each of adjusted shapes or zones with a lighting intensity of a minimum of 1000 Lux:
 - (a) Make sure that there are no burrs, impacts, scratches, tool marks and other damage.
 - (b) Make sure that there is no overheating or discoloration.
 - (c) Make sure that there are no stuck chips, incrustations, residues or pollution.

SUBTASK 70-43-42-200-004-G00

- (3) Final blend depth must be within the limits specified in the appropriate AMM task after blending.

———— **END OF TASK** ————



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Indication - Blending and High Metal - Removal
Figure 202/70-43-42-990-805-G00

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TASK 70-43-42-300-803-G00**4. Blending Procedures - Power Blending**

(Figure 203)

A. General

- (1) For general requirements concerning blending, refer to: Blending Procedures - General, TASK 70-43-42-300-804-G00.
- (2) Power blending is a fast metal removal procedure that is used to remove metal deposits, unwanted weld metal, rough surfaces, cracks, nicks, scratches or other sharp-edged damage marks on the parts.

B. Equipment

- (1) The application of this task requires a power tool (Electric or Air).

C. Materials

DO NOT USE TOOLS THAT CONTAIN ALUMINUM OXIDE TO REMOVE OR TO POLISH TITANIUM SURFACES. THE ALUMINUM OXIDES CAN CAUSE CONTAMINATION OF THE TITANIUM SURFACES. THE CONTAMINATION CAN CAUSE DAMAGE TO THE TITANIUM SURFACES.



DO NOT USE ABRASIVES OR STONES WHICH INCLUDE A VITRIFIED BOND ON TITANIUM PARTS. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT CAN OCCUR.

- (1) Abrasive consumables and milling tools.

NOTE: Abrasive consumables and milling tools are an alternative to each other.

- (a) Flexible abrasive consumables or hard abrasive consumables made of Silicon Carbide or Alumina (Corundum) (Figure 203).
- (b) Milling tools (Figure 203).

NOTE: It is recommended to use milling tools on sharp edges.

D. Procedure

DO NOT BREATHE THE PARTICLES FROM BLENDING OR LET THE PARTICLES TOUCH YOU. THE PARTICLES FROM BLENDING CAN CAUSE DAMAGE, INJURY, OR IRRITATION TO YOU. USE PROTECTION EQUIPMENT. USE LOCAL MECHANICAL EXHAUST VENTILATION OR AN APPROVED RESPIRATOR.



DO NOT LET TITANIUM DUST COLLECT. TITANIUM DUST IS VERY FLAMMABLE. DISCARD ALL TITANIUM WASTE IN AN APPROVED CONTAINER. TITANIUM DUST CAN CAUSE INJURY TO PERSONNEL.



DO NOT USE WATER TO EXTINGUISH A TITANIUM FIRE. EXTINGUISH WITH AN APPROVED CHEMICAL FOR METAL FIRES. IF YOU DO NOT OBEY, OPERATION OF A WATER EXTINGUISHER COULD CAUSE INJURY TO PERSONNEL.

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(WARNING PRECEDES)



CAUTION

DO NOT USE TOOLS THAT CONTAIN ALUMINUM OXIDE TO REMOVE OR TO POLISH TITANIUM SURFACES. THE ALUMINUM OXIDES CAN CAUSE CONTAMINATION OF THE TITANIUM SURFACES. THE CONTAMINATION CAN CAUSE DAMAGE TO THE TITANIUM SURFACES.



CAUTION

DO NOT USE ABRASIVES OR STONES WHICH INCLUDE A VITRIFIED BOND ON TITANIUM PARTS. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT CAN OCCUR.



CAUTION

MAKE SURE THAT POWER BLENDING DOES NOT SUPPLY TOO MUCH HEAT AND THERMAL STRESS. IF YOU DO NOT OBEY, TOO MUCH HEAT CAN CAUSE DAMAGE TO THE MATERIAL.



CAUTION

DO NOT USE TOOLS ON TITANIUM THAT WERE USED ON OTHER MATERIALS. IT WILL CAUSE CONTAMINATION OF THE TITANIUM. KEEP THE BLENDING ABRASIVE TOOL USED FOR THE TITANIUM ISOLATED FROM TOOLS USED FOR OTHER METALS. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT CAN OCCUR.



CAUTION

MAKE SURE THAT YOU DRESS THE ABRASIVE TOOL BEFORE OPERATION. IF YOU DO NOT OBEY, YOU CAN CONTAMINATE THE WHEEL AND CAN CAUSE DAMAGE TO THE TITANIUM PARTS.



CAUTION

DO NOT LET SPARKS TOUCH THE BLEND AREA OR OTHER AREAS OF A PART. TO PREVENT CONTAMINATION, USE A MASK OR A SHIELD TO KEEP SPARKS AND REMOVED MATERIAL FROM OTHER AREAS. IF YOU DO NOT OBEY, DEVIATION CAN OCCUR.



CAUTION

DO NOT USE COMPOUNDS TO CLEAN THAT CONTAIN HALOGEN OR TOOLS THAT CONTAIN CADMIUM OR THAT ARE CADMIUM PLATED. IF YOU DO NOT OBEY, DAMAGE TO THE COMPONENTS CAN OCCUR.

SUBTASK 70-43-42-320-008-G00

- (1) General power blending (non-rotating parts):

NOTE: Refer to the specified procedures and limits in the appropriate Aircraft Maintenance Manual (AMM) task applicable to each part of the engine. The specified procedures and limits in the appropriate AMM task for a part always override those in the standard practices section.

- (a) Blend out the sharp edges and rough-out indications first using abrasive tools or milling tools. Refer to the materials section.
- 1) If necessary, start the blend with grade 60 or finer tool for fast initial removal but not coarser than necessary for the removal of the material.

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- 2) Complete the blend with grade 150 or finer abrasives tools or milling tools until the surface is as smooth as or smoother than the adjacent surfaces.

NOTE: Keep the abrasive tool clean from removed material. If not, the tool cannot operate correctly.

NOTE: Do not remove metal from the leading and trailing edges of part sections, which can cause the edges to become thin or sharp. Blend the material to keep approximately the initial contour.

SUBTASK 70-43-42-320-009-G00

- (2) Power blending on rotating parts:

NOTE: This procedure is not be applicable to certain critical areas, for example: disk dovetail areas, critical bolt holes and critical embossments. Refer to the appropriate AMM task for those locations.

NOTE: Refer to the specified procedures and limits in the appropriate AMM task applicable to each part of the engine. The specified procedures and limits in the appropriate AMM task for a part always override those in the standard practices section.

- (a) If the blended area and a corner connects, break the sharp edges to the limits specified in the appropriate AMM task for that item. If not specified, do one of the following steps:
 - 1) Blend the corner to a radius of 0.015 in. (0.38 mm) - 0.030 in. (0.76 mm).
 - 2) Blend to align the general radius of the corner. Refer to an adjacent, non-blended location of the corner or an equivalent part if necessary to find the initial radius.
- (b) If the blended area and a curved feature connects, restore the general shape of the original contour. Refer to an adjacent, non-blended location of the curved feature or an equivalent part if necessary to find the initial contour.
- (c) Blend out the sharp edges and rough-out indications first using abrasive tools or milling tools. Refer to the materials section.
 - 1) If necessary, start the blend with grade 60 or finer tool for fast initial removal of material but not coarser than necessary to remove material.
 - 2) Complete the blend by hand, do this task: Blending Procedures - Hand Blending, TASK 70-43-42-300-802-G00.

NOTE: Power blending cannot be used to complete the blend.

NOTE: Keep the abrasive tool clean from removed material. If not, the tool cannot operate correctly.

NOTE: Do not remove metal from the leading and trailing edges of part sections which can cause the edges to become thin or sharp. Blend the material to keep approximately the initial contour.

E. Quality Assurance

SUBTASK 70-43-42-200-001-G00

- (1) Make sure that the surface condition of the blending is equivalent to that of the adjacent areas. Areas must be smooth and continuous.

SUBTASK 70-43-42-200-005-G00

- (2) Complete a visual check of edges on all parts and edges for each of adjusted shapes or zones with a lighting intensity of a minimum of 1000 Lux:
- (a) Make sure that there are no burrs, impacts, scratches, tool marks and other damage.
 - (b) Make sure that there are no overheating or discoloration.

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(c) Make sure that there are no stuck chips, incrustations, residues or pollution.

SUBTASK 70-43-42-200-006-G00

- (3) Final blend depth must be within the limits specified in the appropriate AMM task after blending.

———— **END OF TASK** ————

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TOOL HOLDER	TYPES OF TOOLS	EXAMPLES OF TOOLS
	MILLING TOOLS	ROTARY BURR 
	FLEXIBLE ABRASIVE TOOLS	BRUSHES AND WHEELS 
		ABRASIVE BELT ON A TOOL 
		ABRASIVE DISKS 
		ABRASIVE BELTS 
	HARD ABRASIVE TOOLS	GRINDING WHEEL ON ROD OR ROTARY ABRASIVE POINTS  

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**Example of Abrasive and Milling Tools for Power Blending
Figure 203/70-43-42-990-804-G00**

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THERMOSETTING COMPOSITE MATERIALS - MAINTENANCE PRACTICES

1. General

A. This procedure contains these tasks:

- (1) Masking and cleaning of epoxy and polyester matrix repair
- (2) Drying of the thermosetting composite materials repair
- (3) Vacuum bag the thermosetting composite repair.

TASK 70-43-43-300-801-G00

2. Mask and Clean the Epoxy and Polyester Matrix Repair

(Figure 201, Figure 202, and Figure 203)

A. General

- (1) This task provides the instructions on how to do the mask and clean the epoxy, and polyester matrix repair.
- (2) Use this standard practice for composite materials only.
- (3) This procedure describes methods to mask and clean commercial aircraft epoxy and polyester matrix composite parts in preparation for repairs and wipe cleaning during repair and before bonding procedures. This procedure also shows how to do a water break check.

B. Tools/Equipment

Reference	Description
STD-858	Tag - DO NOT OPERATE

C. Consumable Materials

Reference	Description	Specification
B00062	Solvent - Acetone (99.5% Grade)	ASTM D 329 (Supersedes O-A-51)
B00148	Solvent - Methyl Ethyl Ketone (MEK)	ASTM D740
B00151	Solvent - Methyl Isobutyl Ketone	ASTM D1153
B00679 [C04-035]	Alcohol - Isopropyl	
B50200 [C04-152]	Cleaner - Turco 5948-R Mild Alkaline	
B50223 [C04-164]	Cleaner - Mild Alkaline, Water Based (Blue Gold Industrial Cleaner)	
G01659	Swab - Cotton Or Rayon, (Disposable)	
G02462 [C10-136]	Tape - Flash-Breaker - No. 855	
G50030 [C10-040]	Tape -Teflon, Scotch Brand 5490, Teflon 1 x 0.002 in. thick	
G50033 [C10-133]	Film, Polymer FEP, Unperforated, 0.001 inch (0.03 Mm) Thick	
G50035 [C10-182]	Cloth - Cleaning For Aircraft Structural	SAE-AMS 3819, BMS 15-5
G50208 [C10-137]	Film - Vacuum bag, 0.001 or 0.002 inch width	
G50209 [C10-142]	Film - Polyester (Mylar) film, 0.002-0.004 inch thick	

D. Location Zones

Zone	Area
411	Engine 1 - Engine

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Zone	Area
421	Engine 2 - Engine

E. Prepare for the Repair

SUBTASK 70-43-43-860-001-G00

- (1) Do these steps to make sure that the ENGINE START switch and the START LEVER switch are not operated:
 - (a) Make sure that the applicable ENGINE START switch, on the P5 overhead panel, is in the AUTO or OFF position.
 - 1) Put a DO NOT OPERATE tag, STD-858, on the applicable ENGINE START switch.
 - (b) Make sure that the applicable START LEVER switch, on the P10 control stand, is in the CUTOFF position.
 - 1) Put a DO NOT OPERATE tag, STD-858, on the applicable START LEVER switch.

F. Mask and Clean the Epoxy and Polyester Matrix Repair

SUBTASK 70-43-43-160-001-G00

- (1) Composite Masking Method 3 - Masking An Uncleaned Part To Prevent Contamination From Uncleaned Areas And To Prevent Resin Spills.

NOTE: This procedure gives instructions for masking around the damage on an uncleaned part to prevent contamination from uncleaned areas and to prevent resin spills.

NOTE: This masking can be done for several different reasons. It may be that the part is large, or is still located on wing so that overall cleaning is not practical and the dirty area needs masking to prevent cross contamination. Also if a wet lay up repair is being done or liquid or paste adhesives are used the remainder of the part will need to be protected from spills and drips.

NOTE: It is necessary to estimate the size of the largest repair patch or ply that will be put on the outside so that the masking does not interfere with the accomplishment of the repair. If the masking is too small, you must increase the size of the masking.

- (a) Use a dry cloth, G50035 [C10-182] to remove all the water you can see and as much dirt as you can from around the repair area.
- (b) Use Composite Cleaning Method 4, or Composite Cleaning Method 5, to clean the area where you will put the film and tape.
- (c) Measure the size and shape of the damage area.
- (d) Cut pieces of film, G50033 [C10-133], vacuum bag film, G50208 [C10-137], or 0.002 - 0.004 inch thick polyester film, G50209 [C10-142], to fit around the repair area for at least 24.0 inches (610.0 mm) larger on each side than the damage area.
 - 1) Do not put film over the damage area. Make the inside edge 1.0 inch (25.4 mm) larger than the outside edge of the estimated repair area.
- (e) Make the film smooth over the area around the damage.
- (f) Hold the film at each corner with small pieces of Scotch 5490 tape, G50030 [C10-040], or No. 855 tape, G02462 [C10-136].
- (g) Put the tape along all the edges of the film next to the repair area.
 - 1) If the film is folded, hold the folds down with a piece of tape.
 - 2) Make sure that the tape around the edge covers the film edge at the fold (Figure 201).

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- (h) Put the tape on the outer edges of the film at equal distances as necessary to hold it in position.
 - 1) If the repair is in an open area, put tape along all the edges of the film.
- (i) Rub the surface of the tape firmly with your fingers.
 - 1) Push any air bubbles to the edge of the tape.
 - 2) Make sure that all edges are firmly pushed down.
- (j) Make sure all the edges are held down with tape.

SUBTASK 70-43-43-160-002-G00

- (2) Composite Masking Method 4 – Masking Of A Prepared Repair Area When It Is Not Being Worked On.

NOTE: This masking is for shop or outdoor use and is to prevent airborne contamination from people working in adjacent areas and general atmospheric contamination. It also helps to prevent people from touching a prepared surface. This masking can be applied over the masking applied using Masking Method 3. In this case the tape should be attached to the existing masking.

- (a) Cut a piece of film, G50033 [C10-133], vacuum bag film, G50208 [C10-137], or 0.002 - 0.004 inch thick polyester film, G50209 [C10-142], approximately 6.0 inches (152.4 mm) bigger all around than the exposed repair area.
- (b) Put the film over the repair and hold it in place with pieces of Scotch 5490 tape, G50030 [C10-040], or No. 855 tape, G02462 [C10-136].
 - 1) Put the tape at equal distances as necessary to hold it in position.
- (c) If the repair is out in an open area where wind, rain or dust could fall on it, put tape along all the edges of the film.
 - 1) If the film is folded, hold the folds down with a piece of tape.
 - 2) Make sure that the tape around the edge covers the film edge at the fold.

SUBTASK 70-43-43-160-003-G00

- (3) Composite Masking Method 5 – Masking To Prevent Excess Resin On Part During The Cure Procedure.

NOTE: If a lot of flash is possible, a heavy duty flashbreaker tape should be used to prevent the tape being trapped under the repair adhesive. When bonding small details, all the non-bonding surfaces of the detail should be covered in tape.

- (a) Make a decision where the resin or adhesive edge must be.
 - 1) Make an allowance for an adhesive fillet when making overlap joints.
- (b) Apply pieces of Scotch 5490 tape, G50030 [C10-040], or No. 855 tape, G02462 [C10-136], along the edge to cover the part up to the surrounding masking.

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G. Procedure for Cleaning Composite Materials

SUBTASK 70-43-43-160-004-G00

- (1) Composite Cleaning Method 3 - Hot Or Cold Water Hand Wash Cleaning Procedure.

NOTE: Water hand wash cleaning combines hand rubbing with the chemical and physical action of the cleaning solution to remove oils, greases, and light soil from parts.

NOTE: This method can be used to clean single skin composite components and sandwich panels with or without acoustically treated areas. Care should be taken not to apply more water than is necessary to clean and rinse the part especially with thin skinned honeycomb sandwich structures or where porosity is suspected. Special care should be taken with parts with aluminum core or fittings, as the residue of alkaline cleaners could cause corrosion of the aluminum.

NOTE: The advantage of this method is its flexibility in that it can be done with a minimum of equipment. The disadvantages are that it is labor intensive and the results are directly related to the diligence of the operator to get good results. Care is necessary to make sure that there are no residual chemical deposits after drying.

NOTE: This method is only suitable for initial part cleaning. Do not use for cleaning of prepared areas.

**WARNING**

OBEY THE VENDOR SAFETY PROCEDURES FOR THE ALKALINE CLEANER. IF YOU TOUCH THE ALKALINE CLEANER, YOU CAN IRRITATE OR BURN THE SKIN OR EYES.

- (a) Prepare Turco 5948-R cleaner, B50200 [C04-152], in a polypropylene bucket at a temperature of 160.0 - 180.0°F (71.0 - 82.2°C) as follows:
- 1) Fill a bucket two-thirds full with water.
 - 2) Add Turco 5948-R cleaner, B50200 [C04-152], slowly and carefully while stirring the solution to mix.
 - 3) Fill the bucket with water to working level.
 - 4) Stir solution again to mix.
- (b) Alternative Procedure: Prepare mild alkaline cleaner, B50223 [C04-164], in a polypropylene bucket at a temperature of 130.0 - 150.0°F (55.0 - 66.0°C).
- 1) Prepare a bucket of water at the same temperature as the diluted solution.
 - 2) Fill a bucket two-thirds full with water.
 - 3) Add mild alkaline cleaner, B50223 [C04-164], slowly and carefully while stirring the solution to mix.
 - 4) Fill the bucket with water to working level.
 - 5) Stir solution again to mix.

**WARNING**

PUT ON A FACE SHIELD, GLOVES, PROTECTIVE CLOTHING, AND PROTECTIVE SHOES. INJURIES TO PERSONNEL CAN OCCUR.

- (c) Make a clean cloth, G50035 [C10-182], moist with the solution.

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- 1) Use the cloth to put the solution on the surface to remove the dirt and oil until the part is clean.

NOTE: A stiff bristle brush may be used to remove dirt that cannot be removed with the cloth.

- (d) Make a clean cloth, G50035 [C10-182], moist with water and wipe over the surface to rinse the part.
 - 1) Take care not to put more water on the part than is necessary to remove the cleaning solution.
- (e) Dry the part with a clean cloth, G50035 [C10-182], to remove all the moisture that you can see.

**WARNING**

BEFORE YOU USE COMPRESSED AIR, PUT ON GOGGLES FOR EYE PROTECTION. DO NOT POINT THE NOZZLE AT OTHER PERSONNEL. IF YOU DO NOT OBEY THESE PRECAUTIONS, INJURIES TO PERSONNEL CAN OCCUR.

- (f) Use clean, dry, compressed air that does not contain oil to remove any moisture that stays in areas that you can not get access to.
- (g) Make sure that the part is clean.
 - 1) Look for dirt trapped in holes and areas that are difficult to get access to.
 - 2) If the part is not clean, repeat the cleaning steps.

SUBTASK 70-43-43-160-005-G00

- (2) Composite Cleaning Method 4 – Wipe Cleaning with a Commercial Solvent- One Cloth Method Procedure

NOTE: This method of cleaning is most commonly used in small local areas and for degreasing composite parts immediately before bonding.

NOTE: The advantages of this method are that it can be done easily with no special equipment and is a reliable method of degreasing before bonding. No water is introduced onto the part surface so no further drying is necessary although care should be taken to make sure that all the solvent has had time to evaporate from the wiped surface.

NOTE: The disadvantages of the method are that solvents used are toxic and often highly flammable, some also contribute to the CFC emissions. The high volatility of some of the solvents can cause the solvent to evaporate before the next wipe so that the grease is spread over the surface instead of being lifted from it.

- (a) Get several cloths, G50035 [C10-182].

**WARNING**

SOLVENTS ARE TOXIC AND HIGHLY FLAMMABLE. AVOID PROLONGED INHALATION OF VAPORS OR CONTACT WITH THE SKIN. TAKE PRECAUTIONS AGAINST FIRE.

- (b) Get solvent, B00148, solvent, B00151, solvent, B00062, or alcohol, B00679 [C04-035].
- (c) Put solvent on a cloth, G50035 [C10-182], to make the cloth moist.
 - 1) Do not use so much solvent that drops of solvent fall from the cloth.
- (d) Move the cloth lightly in one direction across the part that is to be cleaned.
- (e) Look at the cloth.
 - 1) If the cloth is dirty, turn the cloth to a clean area and wipe the area again.

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- (f) Do this procedure until a clean area of the cloth stays clean.
- (g) Do the last wipe with a dry cloth before the solvent on the part dries.
- (h) Use a swab, G01659, in the small areas to make sure that all areas are clean.
- (i) Let the part dry for a minimum of 15 minutes.

SUBTASK 70-43-43-160-006-G00

- (3) Composite Cleaning Method 5 – Wipe Cleaning with a Commercial Solvent- Two Cloth Method Procedure

NOTE: This method is preferred with the faster evaporating solvents as a way of wiping the surface before the solvent evaporates.

- (a) Get several cloths, G50035 [C10-182].



WARNING

SOLVENTS ARE TOXIC AND HIGHLY FLAMMABLE. AVOID PROLONGED INHALATION OF VAPORS OR CONTACT WITH THE SKIN. TAKE PRECAUTIONS AGAINST FIRE.

- (b) Get solvent, B00148, solvent, B00151, solvent, B00062, or alcohol, B00679 [C04-035].
- (c) Put solvent on a cloth, G50035 [C10-182], to make the cloth moist.
 - 1) Do not use so much solvent that drops of solvent fall from the cloth.
- (d) Move the first cloth lightly in one direction across the part that is to be cleaned.
- (e) Use a second dry cloth to wipe the part before the solvent on the part dries (Figure 202).
- (f) Do this procedure until a clean part of the cloth stays clean.
- (g) Do the last wipe with a clean dry cloth before the solvent on the part dries.
- (h) Use a swab, G01659, in the small areas to make sure that all areas are clean.
- (i) Let the part dry for a minimum of 15 minutes.

H. Water Break Test Procedure

SUBTASK 70-43-43-160-007-G00

- (1) Do the water break test procedure as follows:

NOTE: A water break test is used to find if any residual oils or greases stay on surfaces to be bonded. This test is normally used after all cleaning has been completed.

NOTE: The water break test is a simple way to see if a surface is grease free. It should be used with caution on bonding surfaces adjacent to honeycomb because water entering the honeycomb can be difficult remove. In these cases it is difficult to make sure that the repair area is thoroughly dry.

NOTE: The test works well on normal composite abraded surfaces, however, if the surface is polished to a very smooth finish it can be difficult to pass the test even with a clean surface. But if the surface is very rough the surface tension of the water film may be interrupted making assessment of the water breaks more difficult. You can get good sensitivity in composite laminates abraded with grits in the range 80 to 400 grit.

- (a) Put de-ionized or distilled water in a clean polyethylene bottle with a small spray nozzle and spray the water onto the prepared surface until the surface is just covered.
- (b) Alternative procedure. Put de-ionized or distilled water on a clean cloth, G50035 [C10-182], and move the cloth across the surface to put a thin layer of water on the surface.
- (c) Look at the water on the surface.

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- 1) The water shall form a thin layer over the surface with no areas where the surface tension causes the water to separate into drops or beads of water to form.
- 2) The water shall not leave any part of the surface uncovered (Figure 203).
- (d) Leave the water on the surface for 30 seconds.
 - 1) The water shall remain on all of the surface.
- (e) If the water separates or drops or beads form within 30 seconds do the cleaning procedure and the test again.
- (f) After you do the test, dry the surface with a dry cloth, G50035 [C10-182].
- (g) Allow the surface to dry for 30 minutes minimum before bonding.

I. Put the Airplane Back to Its Usual Condition

SUBTASK 70-43-43-860-002-G00

- (1) Do these steps to remove the DO NOT OPERATE tags, STD-858, from the applicable ENGINE START switch and START LEVER switch:
 - (a) On the P5 overhead panel, remove the DO NOT OPERATE tag, STD-858, from the applicable ENGINE START switch.
 - (b) On the P10 control stand, remove the DO NOT OPERATE tag, STD-858, from the applicable START LEVER switch.

———— **END OF TASK** ————

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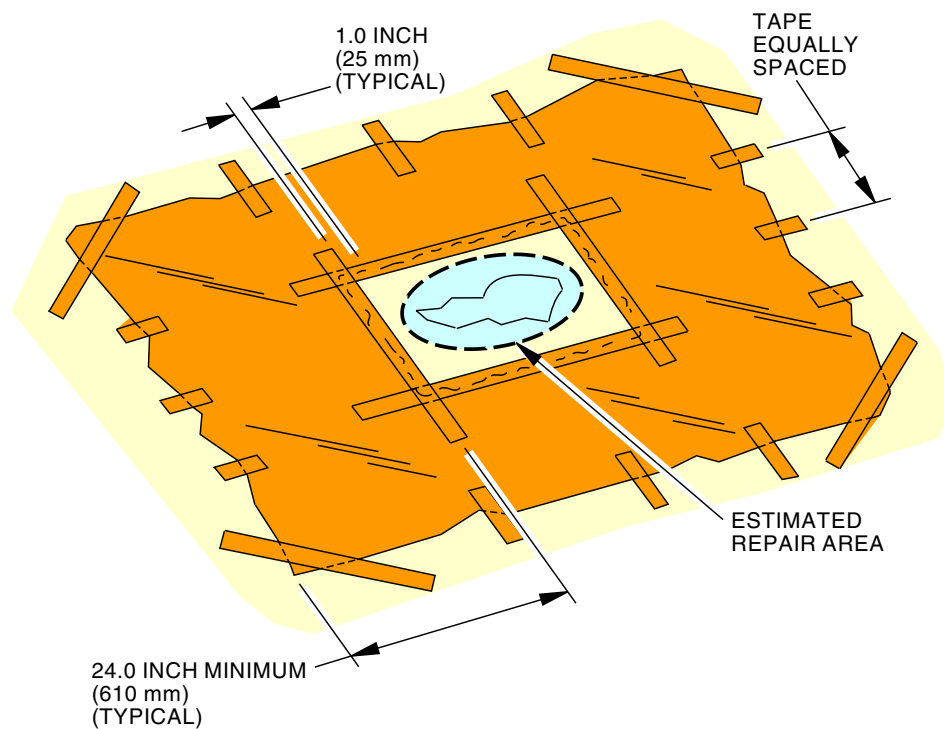
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Masking Around the Damaged Area
Figure 201/70-43-43-990-801-G00

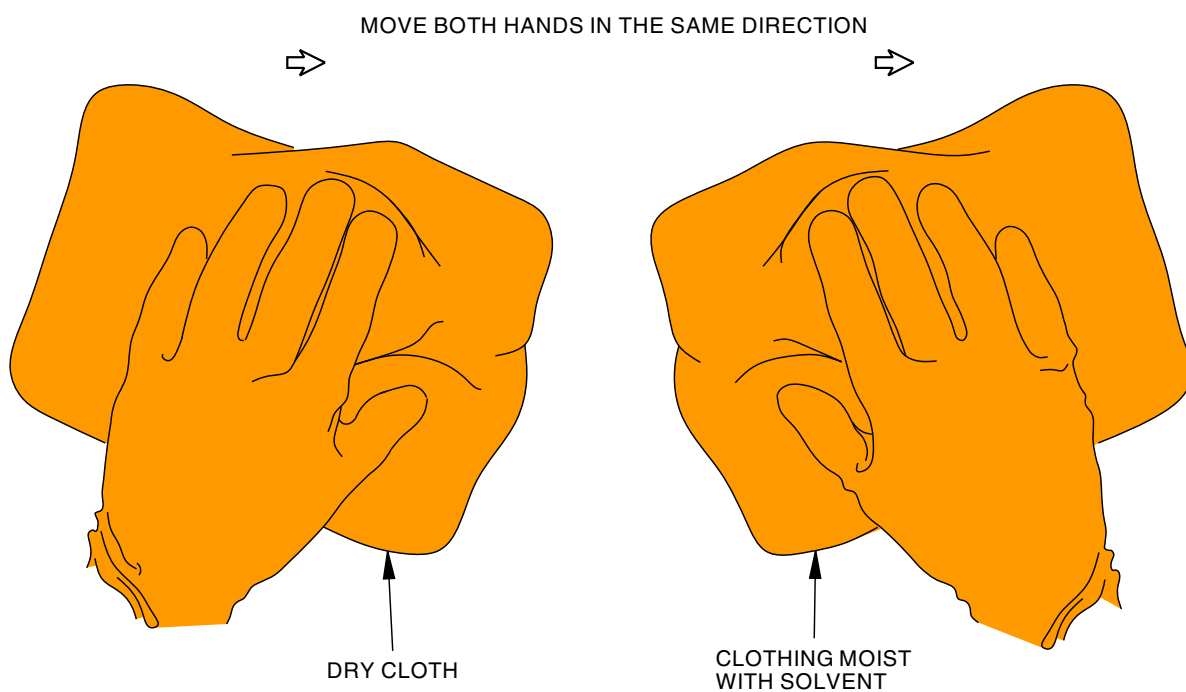
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Two-Cloth Cleaning Method
Figure 202/70-43-43-990-802-G00

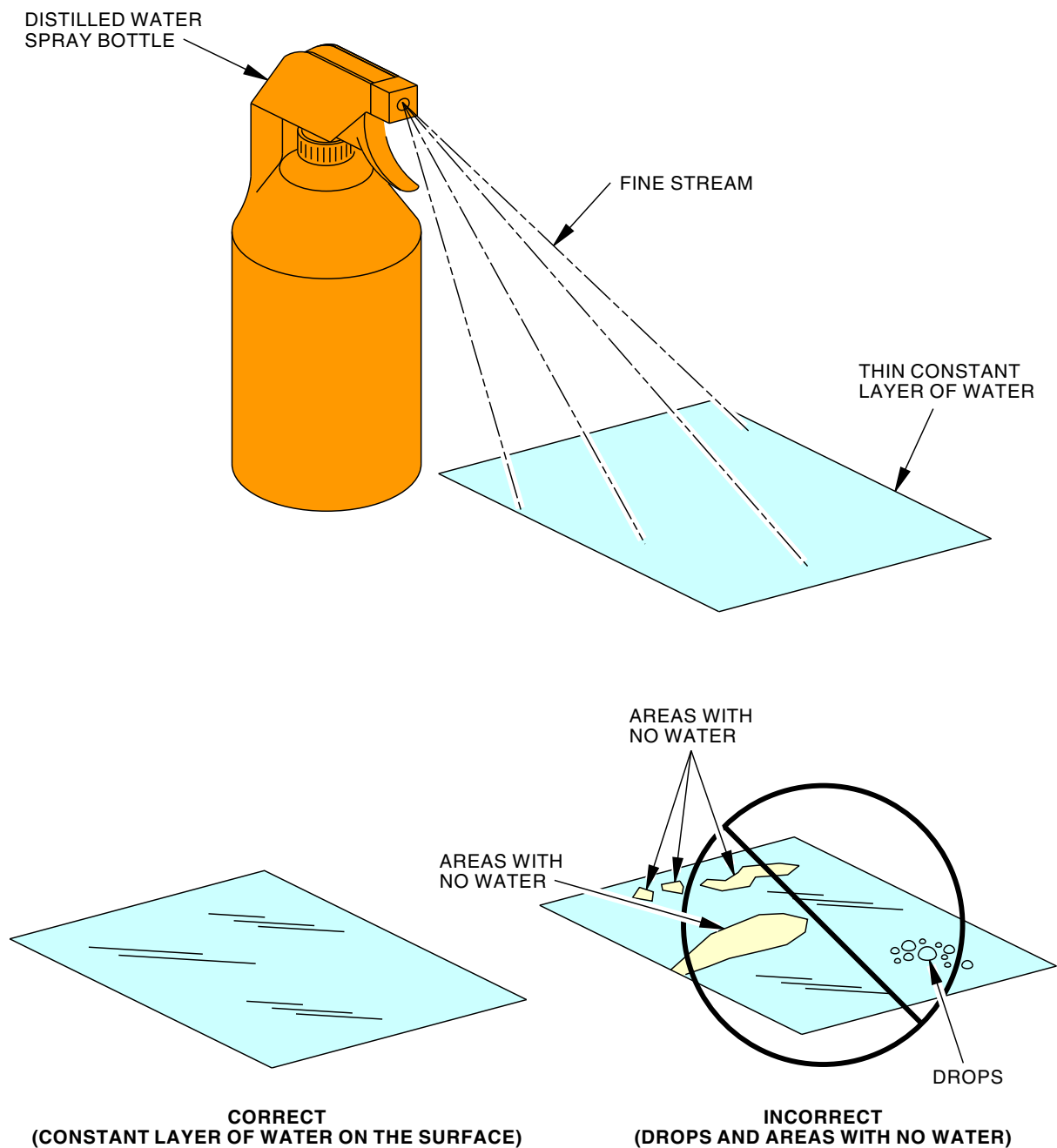
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Water Break Test
Figure 203/70-43-43-990-803-G00

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TASK 70-43-43-300-802-G00**3. Drying of the Thermosetting Composite Materials Repair**

(Figure 204, Figure 205, Figure 206, Figure 207, Figure 208, Figure 209, and Figure 210)

A. General

- (1) This task provides the instructions on how to remove the liquids that have collected inside the structures through open damage, microcracks or porosity and the removal of absorbed moisture from the composite material.
- (2) The definitions that follow are used:
 - (a) Visible liquids (there are two categories of visible liquids):
 - 1) Liquids that dry in open air or under heat, leaving no residue or residue that can be easily wiped away and can be cleaned with the standard methods. Water and solvents are the most commonly found types.
 - 2) Liquids that do not dry with standard methods but leave a residue or some remaining liquid that standard cleaning methods will not remove. Hydraulic fluid and jet fuel are the most common types.
 - a) Visible liquids may only be visible as a darker area of the composite surface.
 - (b) Absorbed moisture: Composite structures can become saturated with moisture in humid environments. The moisture level can be detrimental to the quality of a bonded repair. It is necessary to dry areas that will be in contact with the repair bond surface area. The honeycomb replacement pieces must be dried before they are used if absorbed moisture could be present.
- (3) Some types of composites can also absorb water or solvents during the cleaning process (Aramid reinforced laminates and honeycomb absorb more). Use a method for absorbed moisture removal to make sure that solvent has completely evaporated in a shorter time. A bond completed before all the solvent has evaporated can cause low bond strength.
- (4) General Drying Information:
 - (a) The process of drying a composite structure will in general consist of these steps:
 - 1) Removing visible liquids.
 - 2) Cleaning (when liquid is other than water) and removing any permanently contaminated area.
 - 3) Drying to get a visually dry structure before you continue with the repair area preparation.
 - 4) Final drying before bonding.
 - (b) Visible Liquid:
 - 1) Description:
 - a) Liquid can collect on structures or inside through existing openings or damaged areas. It can usually be removed with absorbent cloths, vacuum, or by blowing with compressed air (when it is water).
 - b) Liquid can also be found inside sandwich panels as the result of skin damage, delamination, debonding, skin microcracks, skin porosity, or a combination of these cases. In acoustic liners the perforated facesheets in the acoustically treated area can also let moisture into the part.

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- c) Visible liquid in honeycomb panels can cause damage because of freezing, corrosion of aluminum honeycomb, or the possible reduction in the structural strength if left for a long period of time. There is also a risk of the steam pressure build up during a hot bond repair causing delamination or debonding.
 - d) Fluids other than water can deteriorate not only the honeycomb and honeycomb/skin bond line, but also the skins. The degradation should be suspected when the substrate shows discoloration that cannot be removed by the drying methods given in this standard practice.
 - e) Removal of liquid from honeycomb panels will usually make it necessary to cut one skin to get access. Contaminated areas that cannot be cleaned will also have to be
 - f) When the degradation of the honeycomb or honeycomb/skin bond line is suspected, you must replace the honeycomb. Before you continue with the repair area preparation, the structure must be clean and visually dry.
- 2) Visible liquid detection:
- a) Liquid can be detected visually on or inside structures and in open damage. The presence of liquid inside honeycomb panels must be suspected when debonding is found or when the surface is in a poor condition (paint deterioration and/or erosion) or shows signs of porosity.
 - b) A discoloration of the composite is usually the indication of contamination. Non-destructive inspection (NDI) methods such as thermography, ultrasonic checks, or X-rays can confirm the presence of trapped liquid. On glass or aramid structures, moisture meters can also be used.
- 3) Removal Methods:
- a) Depending on the type of fluid and on the location and time available, various methods can be used. Mopping, vacuuming, blowing compressed air, and the vacuum bagging the affected area are possible methods for the water removal.
 - b) Mopping and vacuuming are also commonly used for the removal of liquids other than water. A thorough cleaning should follow. If the cleaning is not successful, the contaminated area shall be removed.
- 4) Drying Time:
- a) The criteria are to have a clean and visually dry structure. The time necessary will depend on the method used.
- 5) Control Methods:
- a) A visual inspection will usually show if all the liquid has been removed. On honeycomb panels, standard nondestructive methods can be used to show that the liquid is removed.
 - b) If it is necessary, cut open additional cells. After the area is visually clean, liquids other than water can be found by the application of local heating, not more than 176.0°F (80.0°C).
 - c) The absorbed fluid has the tendency to seep to the skin during heating. A water break test will make sure of the cleanliness of the structure.
- (c) Absorbed Moisture:
- 1) Description:

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- a) Composites, as a result of their chemical structure, will absorb moisture when in contact with humid air. The absorption can reach a maximum value (saturation) that depends on the resin system and fiber reinforcement used (carbon, aramid, or glass), on the temperature and on the humidity of the surrounding air.
- <1> Saturation values can range from 1 to 3% by weight. The nonmetallic honeycomb will generally reach saturation at a higher value, for example up to 5% for Nomex honeycomb. This moisture saturation combined with a hot environment (hot/wet condition) is one of the most adverse conditions met by a structure. It is taken into account at the design stage and in the testing of the main components.
 - <2> The effect of moisture during a repair will depend mainly on the curing time and temperature and to a lesser extent on the repair and parent materials. The strength characteristics of the bond line and the repair patch quality could be affected.
 - <3> Experience has shown that, for repair purposes, complete drying of a composite structure is not necessary. A dry surface will in general be sufficient provided it remains dry for the complete cure cycle. Moisture migration back to the surface during the cure cycle should be taken into account to determine the drying time and temperature.
 - <4> One way of making sure of a dry surface is to carry out a final drying cycle (after the laminate appears dry) at the temperature of the cure for the time of the cure. Because only the surface of the laminate will be dried, the drying must take place after all stepping, scarfing, or other material removal steps have been completed.
 - <5> One way of making sure of a dry surface is to carry out a final drying cycle (after the laminate appears dry) at the temperature of the cure for the time of the cure. Because only the surface of the laminate will be dried, the drying must take place after all stepping, scarfing, or other material removal steps have been completed. The Figure 204 and Figure 205 are given to illustrate the length of time typical laminates take to absorb moisture and the time to completely remove all absorbed moisture. These figures are given for information only and should not be used to determine drying cycle time and temperature.
 - <6> The slow migration of moisture explains why surface drying is used and shows the importance of drying after the material removal. The Figure 204 shows the average moisture content plotted against drying time of a composite laminate first saturated with moisture and then dried. The curves represent laminates of different thicknesses.
 - <7> Graphs for two different drying temperatures are shown. The Figure 205 shows a graphical representation of the percentage saturation across a laminate thickness at different times. The Figure 205, View 2B represents the values for a skin initially dry and exposed to humid atmosphere from one side. The Figure 205, View 2C represents the values for a skin initially saturated and then dried. Absorption and desorption time are affected by the composite skin thickness, material type, temperature, and relative humidity.
- 2) Low Temperature Repairs - Temperature less than 212.0°F (100.0°C).

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- a) There is little data available today about low temperature cure repairs on moisture saturated structures. Nevertheless, the effect of moisture has been found to be minor in real repair conditions where there is always a period of time when the repair area can dry in open air.
 - b) This natural drying time occurs in addition to the final drying recommended for all repairs. Care should be taken with repair resin systems that cure at temperatures slightly below the boiling point of water.
 - c) Even though the cure is monitored closely, when using heating blankets the temperature could rise locally above the boiling point. In addition, the boiling point will drop due to the lower atmospheric pressure inside the vacuum bag. For this reason when a structure is found soaked with water, once this water is removed and the structure is visually dry, it is necessary to perform a final drying before bonding.
- 3) High Temperature Repairs - Temperature more than 212.0°F (100.0°C).
- a) A high moisture level will generally affect the repair lay-up bond to the structure and the repair patch quality. Additionally there is a high risk of debonding/delamination in areas outside the repair area if the whole part is to be heated. When you do a high temperature repair it is necessary to have a dry structure.
 - b) The moisture content of the structure is generally unknown and could be suitable for high temperature repairs without any further drying. Nevertheless, when water is suspected to have been inside the structure for a long period of time, it is essential to do a final drying before bonding. Dry the part after the repair area preparation on a visually dry structure.

B. Tools/Equipment

Reference	Description
STD-858	Tag - DO NOT OPERATE

C. Consumable Materials

Reference	Description	Specification
G51145 [C10-055]	Heat Blankets - Heat Blankets, Controllers, Lamps and Hot Bonders	
G51146 [C10-054]	Heat Gun	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Prepare for the Repair

SUBTASK 70-43-43-860-003-G00

- (1) Do these steps to make sure that the ENGINE START switch and the START LEVER switch are not operated:
 - (a) Make sure that the applicable ENGINE START switch, on the P5 overhead panel, is in the AUTO or OFF position.
 - 1) Put a DO NOT OPERATE tag, STD-858, on the applicable ENGINE START switch.
 - (b) Make sure that the applicable START LEVER switch, on the P10 control stand, is in the CUTOFF position.

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- 1) Put a DO NOT OPERATE tag, STD-858, on the applicable START LEVER switch.

F. Drying of the Thermosetting Composite Materials Repair

SUBTASK 70-43-43-160-008-G00

- (1) The drying parameters are as follows:

- (a) Drying Temperature

- 1) Unless otherwise specified in the repair, heat the part to 140.0 - 180.0°F (60.0 - 82.0°C) at a rate of the temperature rise of approximately 5.0°F (3.0°C) per minute.

- (b) Drying Time

- 1) Unless otherwise specified in the repair use the times that follow:

- a) Low Temperature Repairs - After all visible moisture has been removed, apply heat to the part for a minimum of 1 hour to remove absorbed moisture and to make a dry surface layer.
 - b) High Temperature Repairs - After all visible moisture has been removed, heat the part to the repair cure temperature and hold at that temperature for the time of the cure.

<1> Take special care to use the same repair conditions (the same jig, tool, heat application methods, vacuum bag, etc.) to avoid possible distortion.

SUBTASK 70-43-43-160-009-G00

- (2) The drying methods are as follows:

- (a) Visible Liquid Removal - Method 1 (Water)

- 1) Absorb the water as follows:

- a) Use any clean, dry, oil free, water absorbent material.
 - b) Put the material in the water.
 - c) Remove the material and discard.
 - d) Repeat until you have removed as much water as possible.

- 2) Repeat until you have removed as much water as possible.

- a) Use a filter or a vacuum source that will not be damaged by water.
 - b) If it is necessary, make vacuum pipes and nozzles to reach all the areas of water.
 - c) Put the nozzle in the water and apply the vacuum.

- 3) Blow compressed air as follows:



WHEN YOU USE THE COMPRESSED AIR TO CLEAN, TO COOL OR TO DRY, DO NOT EXCEED 30 PSIG (207 KPA). MAKE SURE YOU WEAR EYE PROTECTION AND DO NOT DIRECT COMPRESSED AIR AT YOURSELF AND OTHERS. INJURY TO PERSONNEL CAN OCCUR.



USE OIL FREE AND DRY COMPRESSED AIR. OIL CAN CAUSE DAMAGE TO THE PART.

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(CAUTION PRECEDES)



CAUTION

MAKE SURE THAT YOU DO NOT PUSH WATER INTO THE STRUCTURE WITH THE COMPRESSED AIR. IF THE COMPRESSED AIR HAS TOO MUCH PRESSURE, IT CAN CAUSE DAMAGE TO THE STRUCTURE.

- a) Use a compressed air nozzle to blow the air on the water. Continue until all the water is removed.
- 4) Use one of the Absorbed Moisture Removal methods (Methods 1 through 5).
- (b) Visible liquid removal - Method 2 (Liquid Other Than Water):



WARNING

IF THE LIQUID IS FLAMMABLE, PUT DISCARDED MATERIALS INTO AN APPROVED FLAMMABLE WASTE CONTAINER. IF YOU DO NOT FOLLOW THESE INSTRUCTIONS, INJURY TO PERSONNEL CAN OCCUR.

- 1) Absorb the liquid as follows:
 - a) Use any clean, dry, oil free, water absorbent material.
 - b) Put the material in the liquid.
 - c) Remove the material and discard.
 - d) Repeat until you have removed as much liquid as possible.



WARNING

IF THE LIQUID THAT YOU WILL REMOVE IS FLAMMABLE, DO NOT LET THE LIQUID OR ITS GAS GO INTO THE VACUUM PUMP. PUT A FILTER IN THE VACUUM PIPE THAT WILL REMOVE THE LIQUID AND GAS. IF YOU DO NOT FOLLOW THESE INSTRUCTIONS, INJURY TO PERSONNEL CAN OCCUR.

- 2) Use a vacuum to remove the liquid as follows:
 - a) Use a filter or a vacuum source that will not be damaged by the liquid.
 - b) If it is necessary, make vacuum pipes and nozzles to reach all the areas of liquid.
 - c) Put the nozzle in the liquid and apply the vacuum.
- 3) Clean the area, refer to Mask and Clean the Epoxy and Polyester Matrix Repair, TASK 70-43-43-300-801-G00.
- 4) Make sure that all the liquid has been removed and the composite material is not stained.
- (c) Absorbed Moisture Removal - Method 1 (Vacuum Bag and Heat Blanket).

NOTE: This method is usually used on honeycomb structures. If only one skin is damaged, only one vacuum bag is necessary, refer to the Figure 206, Sheets 1 - 2. If the damage penetrates both skins, a vacuum bag is necessary on both sides, or if the part is suitable it can be enclosed in an envelope bag. A second vacuum bag can also be used to hold a heat blanket to the skin opposite the repair area. Application of heat to the skin opposite the repair area is preferred if it is possible, refer to the Figure 206, Sheet 3.

- 1) Get the equipment for use in this method, refer to the Heat Blanket, G51145 [C10-055], and heat lamps and as follows:

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- a) A heat blanket capable of a uniform temperature distribution over the required area.
 - b) Thermocouples with a monitoring device, for example, a chart recorder or a digital read out.
 - c) A control system that can monitor the thermocouples and adjust the power to the heat blanket.
- 2) Make a vacuum bag as follows (Figure 206):
- a) Refer to Vacuum Bag the Thermosetting Composite Repair, TASK 70-43-43-300-803-G00, to tell you how to make the bag.
 - b) Use a perforated metal plate to support the vacuum bag pressure on small damages only, refer to the Figure 206, Sheet 1.

<1> A 4.0 inches (100.0 mm) wide damage will need a 0.16 inch (4.0 mm) thick aluminum perforated plate.
 - c) On large repairs where the honeycomb has been removed, use a piece of the honeycomb inserted in the repair area to support the vacuum bag pressure refer to the Figure 206, Sheet 2 - 3.
 - d) If you have access to the opposite side, make a second vacuum bag to hold the heat blanket on the opposite side, refer to the Figure 206, Sheet 3.
 - e) Put the intake vent line as far away from the vacuum line as you can. This is to get good air flow across the repair area.
- 3) Apply the vacuum and adjust the intake vent line flow to maintain a vacuum of 12.0 inches (305.0 mm) of mercury.
- 4) If the time and temperature parameters are not in the repair document, refer to step E.(1), drying parameters, for the parameters for your repair type.
- 5) Use the heat blanket control system to apply the vacuum and heat for the time specified.
- a) Monitor the thermocouples to make sure that the temperature is not more than the specified temperature.
- (d) Absorbed Moisture Removal - Method 2 (Radiant Heater)

NOTE: This method uses a radiant heater. To prevent heat damage to the structure, a calibration of the set-up must be done with one or more heaters.

NOTE: This method can be used with a vacuum bag.

- 1) Get the equipment for use in this method refer to the Heat Blanket, G51145 [C10-055], and heat lamps and as follows:
 - a) Heat Lamp: 250 watts lamps are commonly used.
 - b) Radiator: 500 to 1000 watts coil elements with a reflector can be used.
 - c) Thermocouples with a monitoring device, for example, a chart recorder or a digital read out.
 - d) A control system can be used that can monitor the thermocouples and adjust the power to the heater.
- 2) Do a calibration of the heater as follows:
 - a) Make a graph similar to the Figure 207, View 4B, for the temperature at the center of the heated area as a function of the distance between the heater and the surface.

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- b) Use the graph to find the distance from the heater to the part for the specified temperature.
 - c) Make a second graph similar to the Figure 207, View 4C for the temperature as a function of the distance from the center of the heated area at the distance chosen above.
 - d) If several heaters will be used, make the previous two graphs for the combined heaters similar to the Figure 207, View 4D.
- 3) Install the heaters as follows (Figure 208):
- a) Install one or more heaters to get the specified temperature in the area to be dried. Use the calibration graph to get the distance.
 - b) Install thermocouples at the center of the heated area and at any positions where the specified temperature may be exceeded.
 - <1> Use the thermocouple at the center of the heated area for a heater control system, if available.
- 4) If the time and temperature parameters are not in the repair document, refer to E.(1), drying parameters, for the parameters for your repair type.
- 5) If available, use the control system to control the heat for the time specified.
- a) Monitor the thermocouples to make sure that the temperature is not greater than the specified temperature.
- (e) Absorbed Moisture Removal - Method 3 (Hot Air Dryer).
- NOTE:** This method uses a hot air dryer, refer to the Figure 209. To avoid heat damage to the structure, use a holding fixture to keep the hot air dryer a constant distance from the part. Calibration of the set up is necessary.
- 1) Get the equipment for use in this method, refer to Heat Gun, G51146 [C10-054], Heat Blanket, G51145 [C10-055], heat lamps, and as follows:
 - a) Hot air dryer with variable temperature control are commonly used.
 - b) Thermocouples with a monitoring device, either a chart recorder or a digital read out.
 - c) A control system can be used that can monitor the thermocouples and adjust the power to the heater.
 - 2) For calibration of the heat gun use the method described for heat lamps, refer to Absorbed Moisture Removal - Method 2, Step (2)(d).
 - 3) Install the Heat Gun, G51146 [C10-054] as follows (Figure 209):
 - a) Install the heat gun to get the specified temperature in the area to be dried. Use the calibration graph to get the distance.
 - <1> If the heat gun has a variable temperature control, make sure that the control is at the same setting as that used to make the calibration graph.
 - b) Install thermocouples at the center of the heated area and at the other positions where the specified temperature may be exceeded.
 - <1> Use the thermocouple at the center of the heated area for a heat gun control system, if it is available.
 - 4) If the time and temperature parameters are not in the repair document, refer to Step E.(1), Drying Parameters, for the parameters for your repair type.

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- 5) If it is available, use the control system to control the heat for the time specified.
 - a) Monitor the thermocouples to make sure that the temperature is not greater than the specified temperature.
- (f) Absorbed Moisture Removal - Method 4 (Portable Oven).

NOTE: In this method the heat is indirectly applied and is more evenly spread. The oven can be made with light sheet metal and allows larger areas to be dried, refer to the Figure 210.

NOTE: Use a hot air dryer or any hot air supply equipment as a heat source.

- 1) Get the equipment for use in this method, refer to the Heat Gun, G51146 [C10-054], and as follows (Figure 210):
 - a) Hot air dryer 1500 to 2000 watts with the adjustable temperature or the equivalent hot air supply.
 - b) A control system can be used that can monitor the thermocouples and adjust the power to the heater.
- 2) Make a sheet metal oven for the area to be repaired (Figure 210).
 - a) Use a hot air source with temperature adjustment.
- 3) Do a calibration of the oven to find any hot areas as follows:
 - a) Put the oven on a surface similar to the one to be dried and adjust the hot air dryer to give approximately the required temperature on the surface.
 - b) Make a map of the area covered by the oven that shows the surface temperatures.
 - c) Install the oven and the thermocouples for temperature monitoring and the heat control system, if it is available.
 - <1> Install the thermocouples in the hot areas previously found in Step (2)(f).3).b).
- 4) If the time and temperature parameters are not in the repair document, refer to E.(1), Drying Parameters, for the parameters for your repair type.
- 5) If it is available, use the control system to control the heat for the time specified.
 - a) Monitor the thermocouples to make sure that the temperature is not greater than the specified temperature.
- (g) Absorbed Moisture - Method 5 (Oven).

NOTE: This method is particularly suitable for large shop repairs when a complete part has to be dried or when several hours of drying are necessary.

- 1) Get an oven with an adjustable temperature from 120.0 - 180.0°F (49.0 - 82.0°C) and a temperature uniformity of $\pm 9.0^\circ\text{F}$ (5.0°C).
 - a) The oven must be capable of running with a humid internal atmosphere without damage.
- 2) Put the part in the oven.
 - a) Put the thermocouples in the area that you want to dry.
- 3) If the time and temperature parameters are not in the repair document, refer to step E.(1), Drying Parameters, for the parameters for your repair type.
- 4) Use the oven control system to control the heat for the time specified.

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- a) Monitor the thermocouples to make sure that the temperature is not greater than the specified temperature.

G. Put the Airplane Back to Its Usual Condition

SUBTASK 70-43-43-860-004-G00

- (1) Do these steps to remove the DO NOT OPERATE tags, STD-858, from the applicable ENGINE START switch and START LEVER switch:
 - (a) On the P5 overhead panel, remove the DO NOT OPERATE tag, STD-858, from the applicable ENGINE START switch.
 - (b) On the P10 control stand, remove the DO NOT OPERATE tag, STD-858, from the applicable START LEVER switch.

———— **END OF TASK** ————

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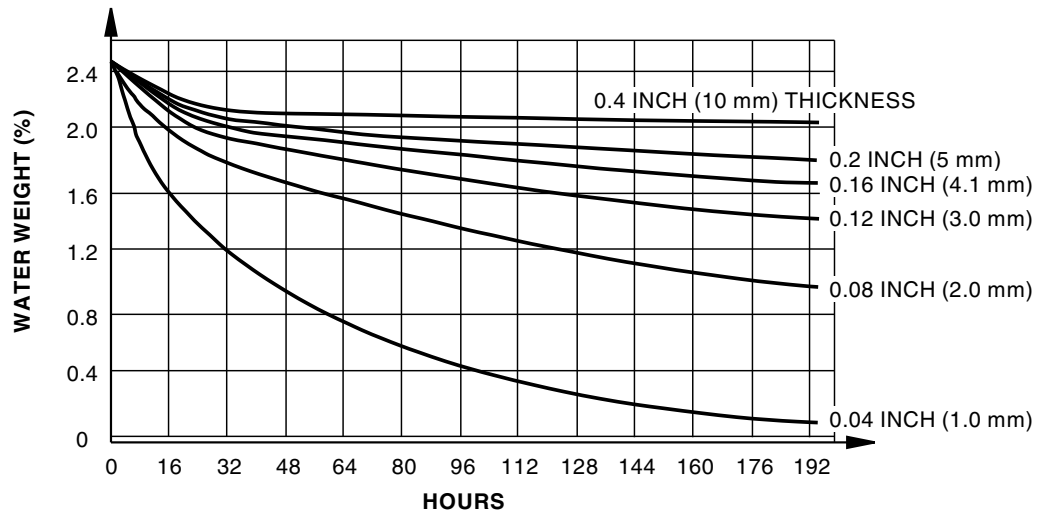
ECCN 9E991 BOEING PROPRIETARY - See title page for details

70-43-43

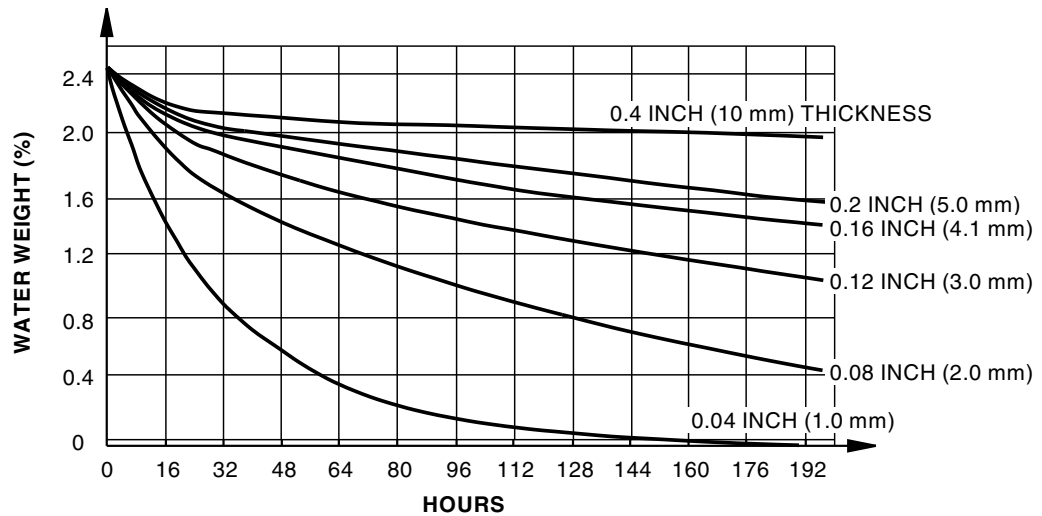
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**TYPICAL DRYING CURVE: CARBON EPOXY MONOLITHIC LAMINATE
70°C (158°F) DRYING TEMPERATURE**



**TYPICAL DRYING CURVE: CARBON EPOXY MONOLITHIC LAMINATE
90°C (194°F) DRYING TEMPERATURE**



1361212-00

2471590 S0000576917_V1

**Moisture Content of Typical Laminates (Average Moisture Through Thickness)
Figure 204/70-43-43-990-804-G00**

EFFECTIVITY
SIA ALL

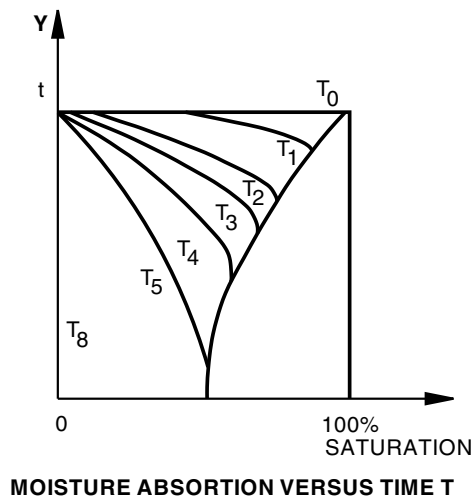
D633AM101-SIA

ECCN 9E991 BOEING PROPRIETARY - See title page for details

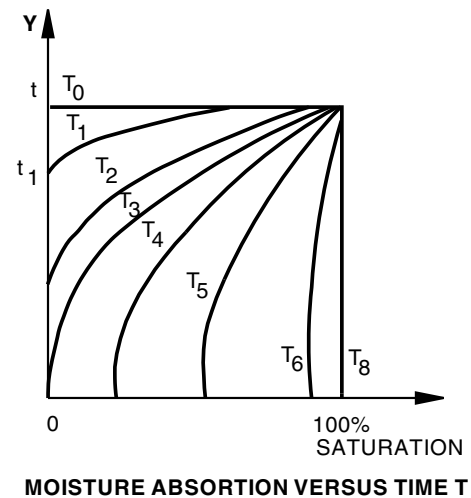
70-43-43

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2C



2B

NOTE:**VIEW 2A:**

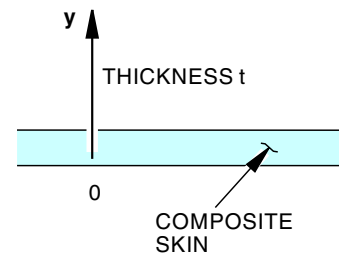
1. DRYING PROCESS APPLIED FROM ONE SIDE ONLY.
2. % SATURATION IS THE RATIO OF ACTUAL MOISTURE CONTENT TO MOISTURE CONTENT AT SATURATION.

VIEW 2B:

1. THE DARK LINE SHOWS THE INITIAL MOISTURE CONTENT ACROSS THE SKIN.
2. AT THE TIME " T_0 " THE DRY COMPOSITE IS PUT IN CONTACT WITH HUMID ATMOSPHERE.
3. AT THE TIME " T_1 " THE MOISTURE HAS MIGRATED DOWN TO A DEPTH t .
4. AT " T_8 " THE MOISTURE CONTENT WILL REACH 100% SATURATION ACROSS THE SKIN THICKNESS.

VIEW 2C:

1. THE DARK LINE SHOWS THE INITIAL MOISTURE CONTENT ACROSS THE SKIN.
2. AT THE TIME " T_0 " THE COMPOSITE IS PUT IN CONTACT WITH A DRY ATMOSPHERE.
3. AT THE TIME " T_1 " THE TOP SURFACE IS PARTIALLY DRY AND THE MOISTURE CONTENT INCREASES WITH DEPTH TO MEET THE INITIAL CURVE.
4. AT " T_8 " THE COMPOSITE IS DRY ACROSS THE THICKNESS.



2A

1361213-00

2471592 S0000576918_V1

Graphical Representation of the Moisture Content Across a Composite Skin (Fick Law)
Figure 205/70-43-43-990-805-G00

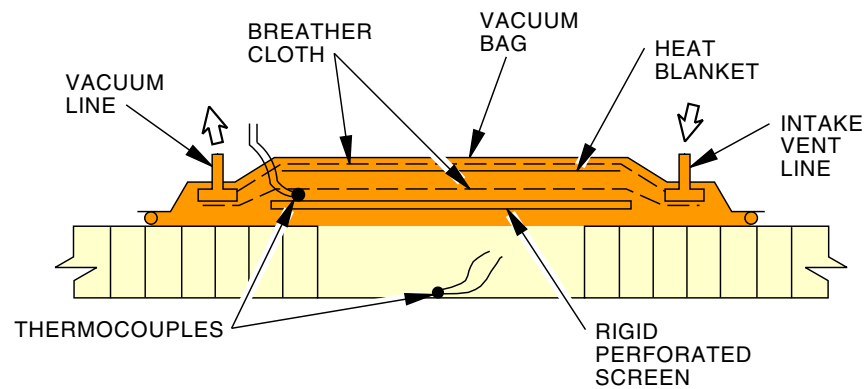
EFFECTIVITY
SIA ALL

D633AM101-SIA

ECCN 9E991 BOEING PROPRIETARY - See title page for details

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 1361214-00
 2471593 S0000576919_V1

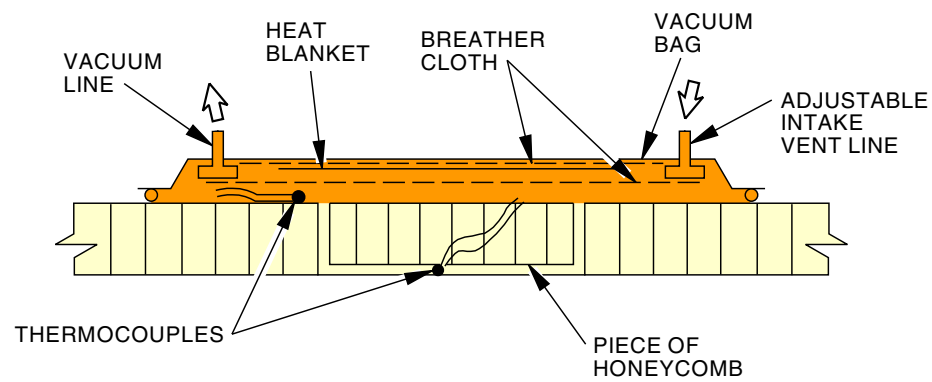
Absorbed Moisture Removal - Method 1 Vacuum Bag and Heating Blanket
Figure 206/70-43-43-990-806-G00 (Sheet 1 of 3)

 EFFECTIVITY
 SIA ALL

D633AM101-SIA

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 2471595 S0000576920_V1

Absorbed Moisture Removal - Method 1 Vacuum Bag and Heating Blanket
Figure 206/70-43-43-990-806-G00 (Sheet 2 of 3)

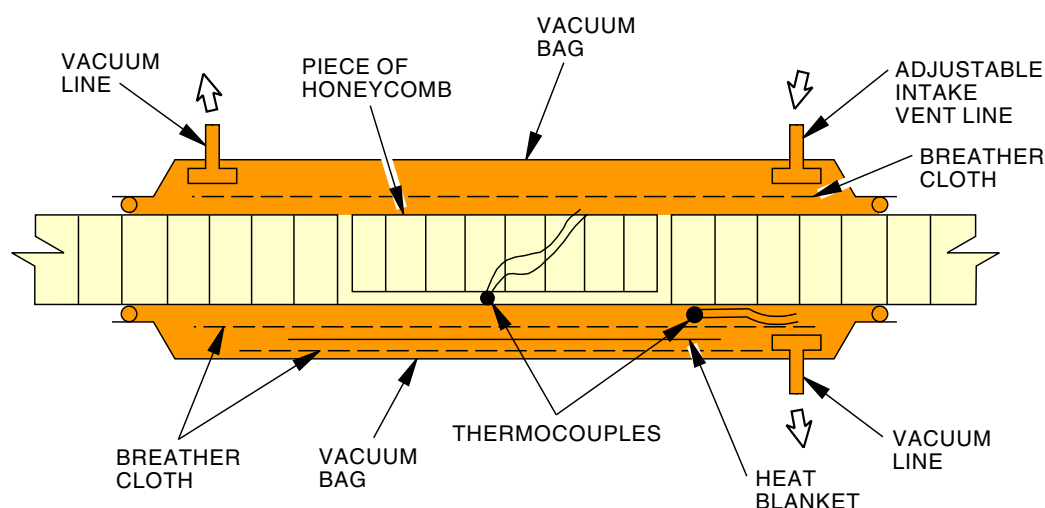
 EFFECTIVITY
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THE FOLLOWING EQUIPMENT IS SUGGESTED FOR USE IN THIS METHOD:

- A. HEAT BLANKETS CAPABLE OF A UNIFORM TEMPERATURE DISTRIBUTION OVER THE REQUIRED AREA.
- B. THERMOCOUPLES WITH A MONITORING DEVICE, FOR EXAMPLE, A CHART RECORDER OR A DIGITAL READ OUT.
- C. A CONTROL SYSTEM THAT CAN MONITOR THE THERMOCOUPLE AND ADJUST THE POWER TO THE HEAT BLANKET.

NOTE:

FOR DETAIL OF BAGGING MATERIALS REFER TO
70-43-43-300-803-G00 VACUUM BAG THE
THERMOSETTING COMPOSITE REPAIR.

1361216-00
2471596 S0000576921_V1

Absorbed Moisture Removal - Method 1 Vacuum Bag and Heating Blanket
Figure 206/70-43-43-990-806-G00 (Sheet 3 of 3)

EFFECTIVITY
SIA ALL

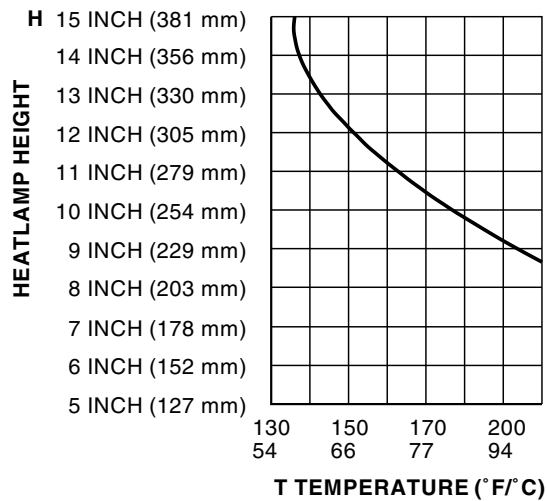
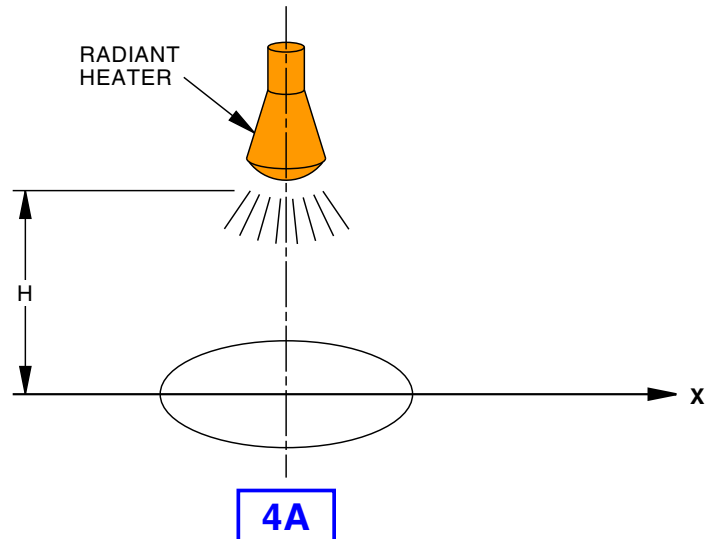
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

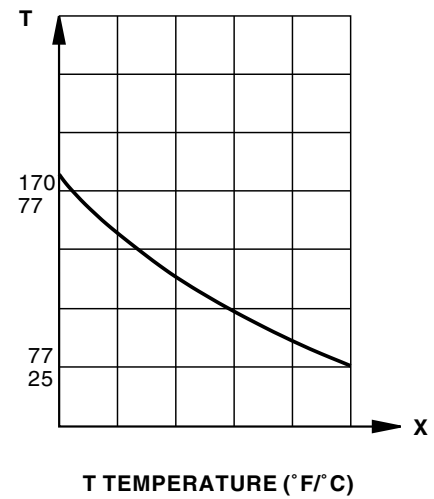
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4B



4C

Calibration of Radiant Heater
Figure 207/70-43-43-990-807-G00 (Sheet 1 of 2)

EFFECTIVITY
SIA ALL

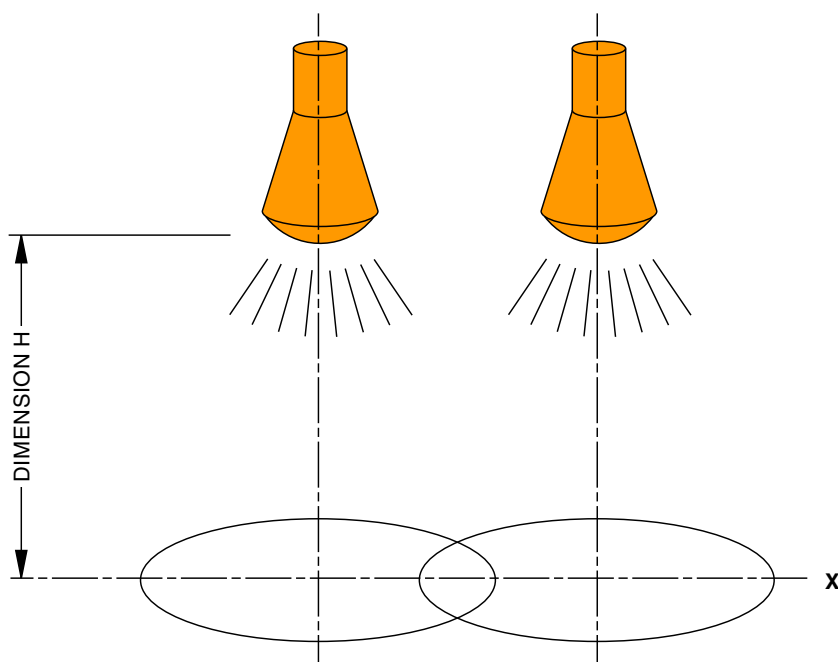
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**4D**1361218-00
2471598 S0000576923_V1

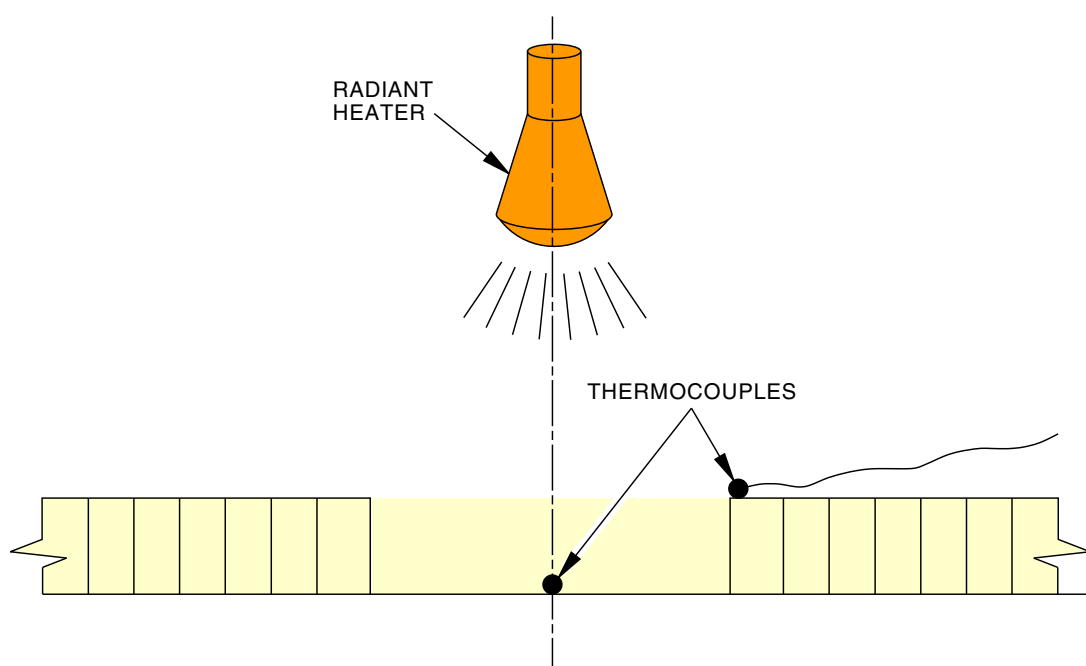
Calibration of Radiant Heater
Figure 207/70-43-43-990-807-G00 (Sheet 2 of 2)

EFFECTIVITY
SIA ALL

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1361220-00

2471600 S0000576924_V1

Absorbed Moisture Removal - Method 2 Radiant Heater
Figure 208/70-43-43-990-808-G00

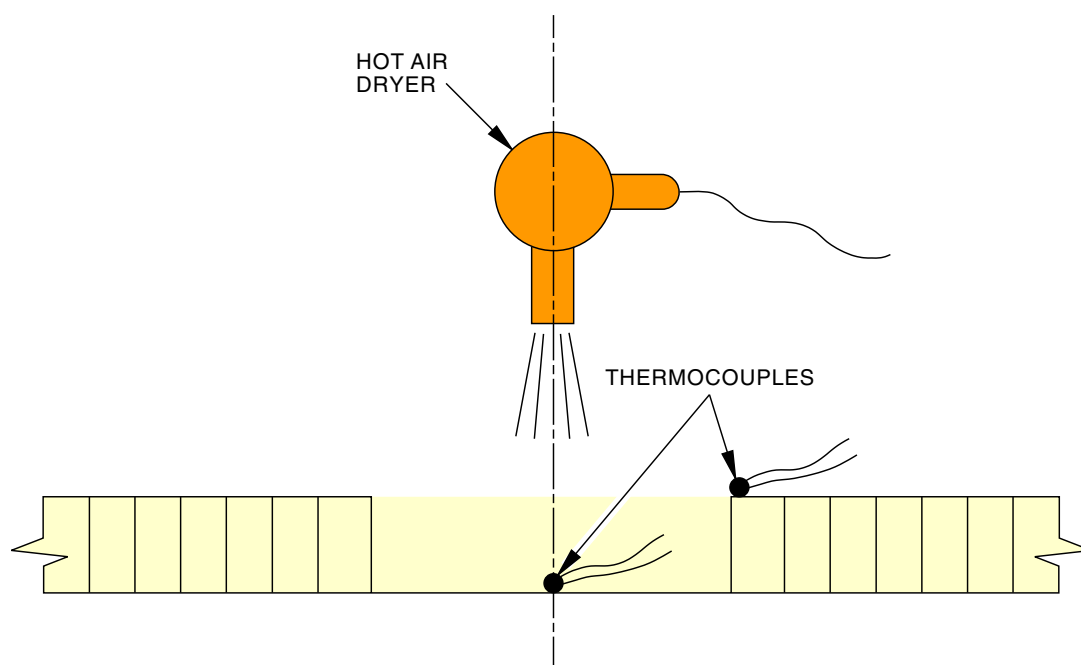
EFFECTIVITY
 SIA ALL

D633AM101-SIA

ECCN 9E991 BOEING PROPRIETARY - See title page for details

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1361221-00

2471601 S0000576925_V1

Absorbed Moisture Removal - Method 3 Hot Air Dryer
Figure 209/70-43-43-990-809-G00

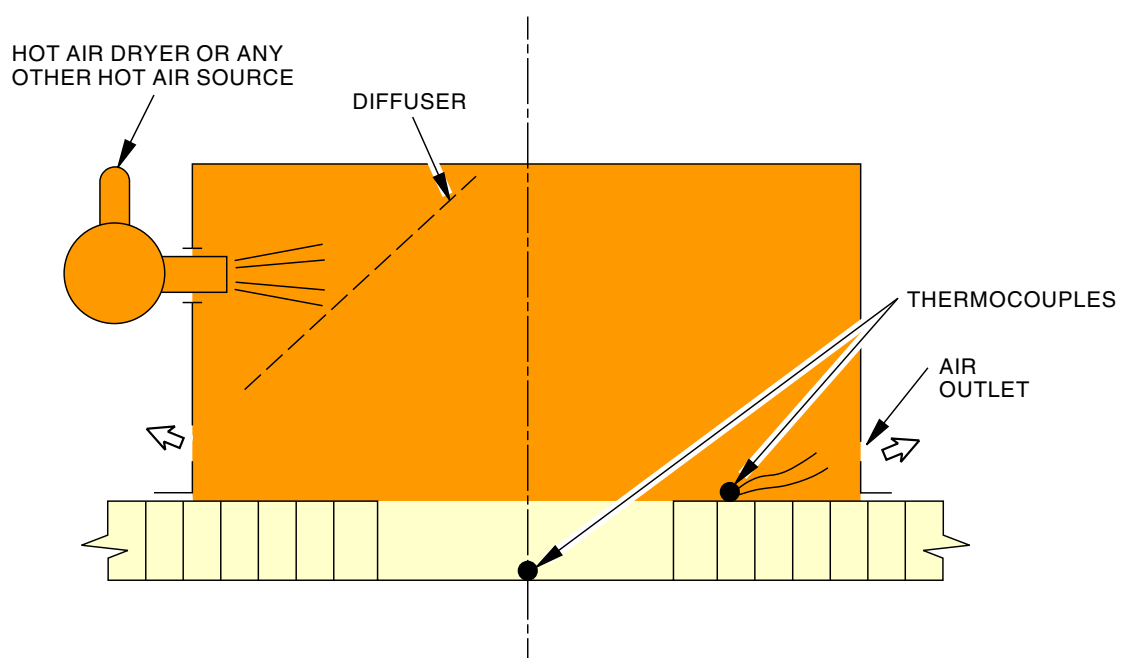
EFFECTIVITY
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

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1361222-00

2471602 S0000576926_V1

Absorbed Moisture Removal - Method 4 Portable Oven
Figure 210/70-43-43-990-810-G00

EFFECTIVITY
 SIA ALL

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TASK 70-43-43-300-803-G00**4. Vacuum Bag the Thermosetting Composite Repair**

(Figure 211, Figure 212, Figure 213, Figure 214, Figure 215, Figure 216, Figure 217, Figure 218, Figure 219, Figure 220, Figure 221, Figure 222, Figure 223, Figure 224, and Figure 225)

A. General

- (1) This task provides the instructions on how to repair the thermosetting composite with the vacuum bag.
- (2) The vacuum bagging procedure is a part of the procedure for adhesive bonding and composite repairs. The bagging procedure refers to the sealing of the repaired area by enclosing it in an impervious plastic film. Air can then be removed from the bag to put pressure upon the materials of the repair. For the vacuum bag cure, you can get heat from heat blankets, heat lamps, or by putting the assembly in an oven or autoclave.

B. Tools/Equipment

Reference	Description
STD-858	Tag - DO NOT OPERATE

C. Consumable Materials

Reference	Description	Specification
D00630 [C10-013]	Lubricant - PTFE Release Agent - Miller-Stephenson MS-122XD (Replaces MS-122DF and MS-122V Lubricants)	
G02462 [C10-136]	Tape - Flash-Breaker - No. 855	
G50030 [C10-040]	Tape -Teflon, Scotch Brand 5490, Teflon 1 x 0.002 in. thick	
G50033 [C10-133]	Film, Polymer FEP, Unperforated, 0.001 inch (0.03 Mm) Thick	
G50208 [C10-137]	Film - Vacuum bag, 0.001 or 0.002 inch width	
G50209 [C10-142]	Film - Polyester (Mylar) film, 0.002-0.004 inch thick	
G51034 [C10-003]	Fabric - Glass Fabric, Style No. 1581	SAE-AMS-C-9084 Type VIIIA
G51145 [C10-055]	Heat Blankets - Heat Blankets, Controllers, Lamps and Hot Bonders	
G51147 [C10-131]	Material - Peel Ply Style 52006/51789, SRB	
G51148 [C10-132]	Film - Polymer FEP Perforated, 0.001 Inch (0.030 mm) Thick	
G51149 [C10-134]	Cloth - Breather / Bleeder	
G51150 [C10-138]	Tape - Sealant, Vacuum Bag	
G51151 [C10-178]	Cloth - Glass, PTFE Coated (Porous)	
G51152 [C10-179]	Cloth - Glass, PTFE Coated (Non-Porous)	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

EFFECTIVITY
SIA ALL

D633AM101-SIA

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E. Prepare for the Repair

SUBTASK 70-43-43-860-005-G00

- (1) Do these steps to make sure that the ENGINE START switch and the START LEVER switch are not operated:
 - (a) Make sure that the applicable ENGINE START switch, on the P5 overhead panel, is in the AUTO or OFF position.
 - 1) Put a DO NOT OPERATE tag, STD-858, on the applicable ENGINE START switch.
 - (b) Make sure that the applicable START LEVER switch, on the P10 control stand, is in the CUTOFF position.
 - 1) Put a DO NOT OPERATE tag, STD-858, on the applicable START LEVER switch.

F. Materials and Installation Procedures for Bagging Operations

NOTE: This section describes the materials needed to carry out the different bagging steps and to describe the correct installation techniques, function, and potential problems of each of the vacuum bag materials.

NOTE: In this standard practice it is assumed that the repair materials have already been applied. It is recommended that this section be referred to when you follow the instructions for the correct installation using the methods of vacuum bagging in Step F, Methods of Bagging.

NOTE: All vacuum bag fabrics, films, and tapes need to be kept dry to prevent adding moisture to the repair. The storage environment needs to be noncontaminating, dust and oil-free. Protect materials from exhaust fumes, soot, oils, sprayed silicone, mist, rain, or other obvious particulate contaminants. If there is a risk of contamination, put the materials in a sealed bag or store in a closed, sealed container.

SUBTASK 70-43-43-300-001-G00

- (1) Install the fabrics as follows:

NOTE: Note that some fabrics are capable of more than one use inside and outside of the vacuum bag.

- (a) Install and remove the peel ply material, G51147 [C10-131] as follows:

NOTE: Peel ply is a layer of open-weave material, usually polyester or heat-set nylon, applied directly to the surface of an uncured lay up. It protects the surface from contamination during subsequent procedures. It is preferable to leave the peel ply on until it is removed from the cured laminate immediately before further surface preparation, bonding or painting of the repair.

NOTE: In some applications it is possible to bond directly to the surface after the peel ply has been removed. However, further surface preparation can be necessary before subsequent bonding or painting procedures. Refer to the repair document for further instructions on surface preparation. Dry peel ply can also be used as a light weight breather between the release film, heat blankets and caul plates. Peel ply is available, pre-impregnated or dry.



DO NOT USE RELEASE FABRICS, OR PLIES WITH A RELEASE AGENT, ON A SURFACE WHERE A BONDING OPERATION CAN OCCUR. IF YOU DO, THE SUBSEQUENT BOND CAN BE WEAK.

- 1) Install the peel ply material, G51147 [C10-131] as follows:
 - a) When you apply the peel ply, remove all the wrinkles.

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- b) If it is necessary, on the complex contours, cut and overlap the pieces of the peel ply to prevent wrinkles.
- 2) Remove the peel ply material, G51147 [C10-131] as follows:
 - a) The peel ply will release easily from the repaired area after the cure.
 - b) To remove the peel ply, carefully lift one corner and pull the peel ply back over itself.
 - c) A sharp knife or a single edged razor blade can be used to lift the peel ply to begin the removal.
 - d) Use caution to prevent damage to the composite plies below the peel ply.
- (b) Install the breather cloth, G51149 [C10-134] for the edge bleed or the vertical bleed as follows:

NOTE: The same consumable materials are also used as breather materials, refer to Step E.(1)(c).

NOTE: Bleeder cloth is a woven fabric (for example a glass fabric, G51034 [C10-003] or non-woven breather cloth, G51149 [C10-134]. It is used in single or multiple layers that are put over the perforated release film to permit the passage of air or other gasses and to absorb resin squeezed from the laminate. It can also be put around the edge of the laminate or repair to give an edge bleed. Some lay ups, especially prepreg, do not require bleed, and therefore do not use bleeder plies. It is important to note that the number of bleeder plies, in the combination with the selected bleeder cloth, peel ply, and/or perforated release film, will have a direct effect on the resin content of the cured component. Too few plies of bleeder cloth can result in a resin rich repair; too many plies of bleeder cloth can result in a resin starved repair.

NOTE: There are two ways to bleed resin from a laminate: vertical and horizontal. The vertical bleed can be done with the assembly bleeding through the top surface. The horizontal bleed is known as the Squeeze Out Method. If you do the Squeeze Out Method, edge bleeder is used to absorb excess resin.

- 1) Install the breather cloth, G51149 [C10-134] for the edge bleed as follows:
 - a) Put a minimum of three narrow strips of breather cloth, G51149 [C10-134] around the edge of the lay up.
 - b) Overlap the strips of bleeder material approximately 1.5 inches (38.0 mm) to create a continuous border or window frame around the repair area.

NOTE: In an edge bleed repair this bleeder material also acts in conjunction with a ventilation channel as an edge breather.

- 2) Install the breather cloth, G51149 [C10-134] for the vertical bleed as follows:
 - a) Put the breather cloth, G51149 [C10-134] smoothly over the assembly with as few wrinkles as possible and laid flat against the contour of the component.
 - b) If bridging is possible, splice the bleeder cloth to maintain full contact with the component as follows (Figure 211):
 - <1> Cut the cloth into two pieces and overlap approximately 0.5 inch (13.0 mm) minimum.
 - <2> If the overlap is too small, movement can make a gap when the vacuum is applied.
 - <a> This can interrupt the vacuum path.

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<3> Use small pieces of Scotch 5490 tape, G50030 [C10-040] or No. 855 tape, G02462 [C10-136] to hold the overlapped edges together.

- c) if it is necessary, use the tape to hold the bleeder cloth in its position.
- d) Do not let the tape under or over the vacuum bag sealant tape.
- e) Do not let the bleeder cloth touch the vacuum bag sealant tape.

NOTE: Bleeder cloth fibers across the sealant tape can cause leaks.

- (c) Install the breather cloth, G51149 [C10-134] as follows:

NOTE: The same consumable materials are also used as bleeder materials, refer to Step E.(1)(b).

NOTE: Breather cloth is a woven fabric (for example a glass fabric, G51034 [C10-003] or non-woven breather cloth, G51149 [C10-134]. It is used in single or multiple layers that are put inside the vacuum bag to give a continuous vacuum path to remove the air initially inside the bag. Breather cloth is also used to prevent resin from blocking vacuum ports, lines, valves, etc. In unheated areas of the repair, sisal or polyamide nylon rope can be put around the periphery of the vacuum bag to give a low air resistance ventilation channel to minimize vacuum drop across the vacuum bag. A ventilation channel is necessary in edge bleed vacuum bags to improve the resin bleed from the edge of the repair.

- 1) Cover all the area under the vacuum bag with breather cloth, G51149 [C10-134] to make sure that there is a good vacuum path.
- 2) Put the breather cloth smoothly over the assembly with as few wrinkles as possible and laid flat against the contour of the component.
- 3) Put additional breather cloth, G51149 [C10-134] on all sharp areas where the vacuum bag can be punctured.
- 4) If it is necessary, put an open weave material around the periphery of the repair area.

NOTE: This is to make a good vacuum path.

- 5) If bridging is possible, splice breather cloth to maintain full contact with the component as follows (Figure 211):

- a) Cut the cloth into two pieces and overlap a minimum of 1.0 inch (25.0 mm).
- b) Be sure that the overlap is sufficient.

NOTE: If the overlap is too small, movement can make a gap when the vacuum is applied. This can interrupt the vacuum path.

- c) Use small pieces of Scotch 5490 tape, G50030 [C10-040] or No. 855 tape, G02462 [C10-136] to hold the overlapped edges together.
- 6) If it is necessary, use the tape to hold the breather cloth in its position.
- 7) Do not let the tape under or over the vacuum bag sealant tape.
- 8) Do not let the breather cloth, G51149 [C10-134] touch the vacuum bag sealant tape.

NOTE: Breather cloth fibers across the sealant tape can cause leaks.

- (d) Install the breather cloth, G51149 [C10-134] as insulation as follows:

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- 1) Put the breather cloth, G51149 [C10-134] under the vacuum bag film over the heat blanket.
NOTE: The number of layers of breather cloth under the vacuum bag can have a direct effect on the compaction of the repair. Too many layers of breather cloth can result in reduced compaction.
- 2) Alternative procedure, put the breather cloth over the vacuum bag film and hold to the vacuum bag with Scotch 5490 tape, G50030 [C10-040] or No. 855 tape, G02462 [C10-136].
- 3) Adjust the number of insulation plies for the ambient temperature and the necessary cure temperature.

SUBTASK 70-43-43-300-002-G00

- (2) Install the films as follows:

NOTE: Some films are capable of more than one use inside the vacuum bag. Check with the material manufacturer to make sure that the film to be used is suitable for the application.

- (a) Install the release film as follows:

NOTE: Release film is a permeable or impermeable layer of film that does not bond to the resin being cured. The most common films available are modified halohydrocarbons, PVF, coated fiberglass cloth (pourous glass cloth, G51151 [C10-178] and non-pourous glass cloth, G51152 [C10-179], 0.002 - 0.004 inch thick polyester film, G50209 [C10-142], and Fluorinated Ethylene Propylene (FEP), film, G51148 [C10-132] and film, G50033 [C10-133] are used as release films for all types of epoxy resins and are light weight and easily conformable although the ability of the thinner films to stretch can make them difficult to apply to flat surfaces without wrinkles.

NOTE: Perforated release film, G51148 [C10-132], also known as porous parting film or separator, is put between the repair plies (or peel ply, if used) and the bleeder cloth. This allows for gas flow and resin to bleed out through the film, and prevents the bleeder plies from bonding to the repair plies during the cure cycle. The kind of film selected (hole size and type of perforations, as well as perforation spacing) in combination with the choice of bleeder cloth has a direct effect on the resin content of the cured component.

NOTE: The film, G50033 [C10-133] also known as non-porous parting film or separator, is put over the bleeder plies to stop resin flow from bleeder plies into the breather cloth layers. It must be spliced or otherwise overlapped wide enough to prevent bleed-through of the resin or adhesive into the breather plies. Unperforated release film is also used as a barrier to stop excess resin from bleeding onto heat blankets and caul plates when they are used.

- 1) Put the film smoothly over the surface to maintain full contact with the surface of the repair plies during the cure cycle.
- 2) Use cuts and overlaps as necessary to prevent wrinkles, gaps or bridging at changes in shape in the assembly (Figure 211).
NOTE: If the film has not been put completely against the contour of the assembly, all the subsequent plies (bleeder, breather, etc.) will have the same bridging condition. This can cause a weak repair.
- 3) Keep overlaps small and use small, narrow pieces of tape on the splices to cover less holes in the perforated release film.

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- (b) Install the vacuum bag film, G50208 [C10-137] as follows:

NOTE: Vacuum bag film is a plastic film that will not let air through, such as nylon or PVF. It is used to cover the repaired area or completely envelope the part (and the tool, if used). It is sealed at the edges so that the vacuum can be applied. The vacuum bag film most typically used is 0.002 to 0.004 inch (0.05 to 0.10 mm) in thickness. Use of a thicker gauge of film helps to prevent punctures on complex shapes. Take care when you apply the vacuum bag film, avoid wrinkles as much as you can. Keep sharp edged tools away from the vacuum bag film when they are not in use to prevent accidental cuts in the film.

NOTE: Nylon vacuum bag film permits moisture from the air to be absorbed into the film. When the film is in a humid environment it is more flexible and is less likely to crack during bag fabrication. If brittle material is used the vacuum bag film may rip or tear. Ideal conditions are 50.0 to 70.0°F (10.0 to 21.0°C) and 40 to 60 percent relative humidity.

NOTE: Do not envelope bag hollow parts. This can cause crushing. Highly curved or flexible parts need a rigid support tool to maintain the part contour.

- (c) There are different methods of making a bag over the repaired area.
- 1) If the area to be repaired is small compared to the size of the part it is possible to seal only the area around the repair to the part surface this is known as a surface bag.
 - 2) Use an envelope bag or a bag that holds the part to a rigid tool in the following situations (Figure 212).
 - a) Large repairs.
 - b) Cures at the original cure temperature of the composite material.
 - c) Cures at the cure temperature of the adhesives on honeycomb sandwich parts.
 - d) Oven or autoclave cures.
- (d) Install the vacuum bag film, G50208 [C10-137] (Figure 212, Figure 213, and Figure 214).
- 1) Cut the vacuum bag film, G50208 [C10-137] large enough to allow for movement under pressure and to allow for making tucks or pleats (Figure 213).
 - 2) Use approximately 1.5 times the length and width of the area to be covered by the vacuum.
 - 3) Put the vacuum bag sealant tape, G51150 [C10-138] around the repair area, refer to Step E.(3).
 - 4) After you remove the paper backing from the vacuum bag sealant tape, G51150 [C10-138], take care to position the vacuum bag film, G50208 [C10-137] evenly around the edge of the repair area.
 - 5) Put the vacuum bag film, G50208 [C10-137] on the sealant tape with 1.0 - 2.0 inches (25.0 - 51.0 mm) overlap of vacuum bag film over the vacuum bag sealant tape, G51150 [C10-138].
 - 6) Seal the vacuum bag film, G50208 [C10-137] at a minimum of four places equally spaced around the repair area.
 - 7) Work from one side to the next making tucks and sealing the vacuum bag film, G50208 [C10-137] to the vacuum bag sealant tape, G51150 [C10-138].
 - a) Put tucks at all sharp contour changes and on highly contoured parts to prevent bridging (Figure 214).

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- 8) Make a tuck as follows:
- a) Pull the vacuum bag film, G50208 [C10-137] from the vacuum bag sealant tape and put a piece of vacuum bag sealant tape, G51150 [C10-138] in the fold.
 - b) Push the vacuum bag film, G50208 [C10-137] firmly onto the vacuum bag sealant tape, G51150 [C10-138] to obtain an air-tight seal.
 - c) If the vacuum bag film, G50208 [C10-137] pulls on the sealant tape or bridges, the bag is too small or the tucks are not correctly positioned.

SUBTASK 70-43-43-300-003-G00

- (3) Install the vacuum bag sealant tape, G51150 [C10-138] as follows:

NOTE: Some tapes have many uses both inside and outside of the vacuum bag. If you use the tape for a purpose other than that described in this standard practice, check with the tape material manufacturer to make sure that the tape to be used is suitable for the application.

- (a) Install the vacuum bag sealant tape, G51150 [C10-138] for the surface bag and the envelope bag as follows:

NOTE: The vacuum bag sealant tape, G51150 [C10-138] is a semi-cured plastic material with the tackiness to hold and seal the vacuum bag film during the cure cycle. It is supplied in rolls with one side covered with backing paper. Sealant tape is the sealing medium between the vacuum bag film and either the tool surface or the periphery of the repair area. Use the vacuum bag sealant tape designed for the temperature and pressure necessary or as called out by the repair document. Be aware of temperature limitations of some tapes.

- 1) Install the vacuum bag sealant tape, G51150 [C10-138] for a surface bag as follows:
- a) Clean the surfaces where you will put the vacuum bag sealant tape, G51150 [C10-138].

NOTE: Refer to Composite Cleaning Methods 3, 4, or 5 in Mask and Clean the Epoxy and Polyester Matrix Repair, TASK 70-43-43-300-801-G00

- b) Put the vacuum bag sealant tape, G51150 [C10-138], approximately 6.0 inches (152.0 mm) larger than the largest repair ply.
- c) Apply the sealant tape in one continuous strip.
 - <1> Turn it at each corner and push it firmly with your thumb or the palm of your hand.
- d) When you apply the sealant tape, be careful not to stretch the tape.
 - <1> This can cause the vacuum bag film to wrinkle when the tension is released.
- e) Keep the paper backing on to prevent stretch in the sealant tape during application and to keep it clean from contaminants.
- f) Do not remove the paper backing from the sealant tape until you are ready to apply the vacuum bag film.
- g) Where sealant tape ends meet, the two strips should overlap (Figure 215).
 - <1> To do this, remove the paper from the sealant to be crossed and put the second strip over the sealant.

- 2) Install the vacuum bag sealant tape, G51150 [C10-138] for an envelope bag as follows:

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- a) To make an envelope bag, apply the vacuum bag sealant tape, G51150 [C10-138] around the periphery of the vacuum bag film approximately 2.0 inches (51.0 mm) from the edge of the film using the same method as described in Step E.(3)(a)1) above.
 - b) When the bag is ready to be sealed fold the vacuum bag film around the part (and the tool, if used) to completely enclose the part.
 - c) Push the vacuum bag sealant tape, G51150 [C10-138] together (Figure 212).
- (b) Install Scotch 5490 tape, G50030 [C10-040] or No. 855 tape, G02462 [C10-136] as follows:

NOTE: The Scotch 5490 tape, G50030 [C10-040] or No. 855 tape, G02462 [C10-136] is used for a variety of applications in the composite fabrication process. It will stick to another material when applied under finger pressure and it is capable of the temperatures during a high temperature cure. The tape is removed after the cure cycle is complete and is not part of the final composite assembly. The tape can be used, for example, to hold thermocouple wires and to hold the fabrics and films in position during assembly of the vacuum bag

NOTE: The No. 855 tape, G02462 [C10-136] is nylon or polyester one sided, noncontaminating, adhesive coated, film tape.

- 1) Use the No. 855 tape, G02462 [C10-136] around the edge of a bonded joint or repair patch so that any adhesive that is squeezed out during cure can be easily removed.

NOTE: Refer to Composite Masking Method 5 in Mask and Clean the Epoxy and Polyester Matrix Repair, TASK 70-43-43-300-801-G00.

- 2) Use the No. 855 tape, G02462 [C10-136] for other applications in the composite repair process.
 - a) For example to hold thermocouple wires around the repair area and to cover a caul plate to protect it from adhesive bleed out.
- 3) Use double backed tape to hold items in its position in vacuum bag layups, for example to hold peel plies and breather cloths.

NOTE: Double backed tape is a polyester film coated on both sides with a non-contaminating adhesive.

G. Equipment and Installation Procedures for Bagging Operations

NOTE: This section describes the equipment needed to make different types of vacuum bags. This section describes equipment generically, in sufficient detail to allow a suitable commercial product to be purchased. It is not intended that the information given be biased to any particular manufacturer and no commercial product is recommended in preference to any other. All equipment used should be capable of the temperatures at which cure is required.

NOTE: This section also describes correct installation techniques, function and potential problems of vacuum bag equipment. It is assumed that the repair materials have already been applied. Refer to this section when you follow the instructions for installation described in the methods of vacuum bagging in Step I, Method of Bagging.

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SUBTASK 70-43-43-300-004-G00

- (1) Install the thermocouples as follows:

NOTE: The thermocouples (also known as T/Cs) are used to monitor the cure temperature during the cure cycle. Several types of thermocouples can be found, but they always use the same principle: a device which uses a circuit of two wires of dissimilar metals or alloys, with dissimilar thermo-electric characteristics, joined at one end. Refer to the repair document for the number of thermocouples necessary and their location, especially with regard to heat sinks and their effects.

- (a) Do a test of the thermocouples before you install them.
 - 1) Make sure that the thermocouples operate correctly.
 - 2) This is necessary to prevent the repair of the bag because a thermocouple is not working correctly.
 - (b) Put the wires through a seam in the vacuum bag sealant tape.
 - 1) Hold the wires to the base structure inside the bag with a pressure sensitive No. 855 tape, G02462 [C10-136].
 - (c) Put the wires over the vacuum bag sealant tape, G51150 [C10-138] that is on the tool or part surface.
 - (d) Cover the wires with a second piece of vacuum bag sealant tape, G51150 [C10-138].
 - (e) Keep the wires separated so that air cannot leak between the wires.
 - (f) If it is necessary, seal the thermocouple wires to prevent vacuum leakage as follows:
 - 1) If a thermocouple with a braided insulation is used, remove the braided insulation in the area where the wires go into the bag to prevent air leaks through the braid.
 - 2) For other types of insulation, try to get the necessary vacuum.
 - a) If you find a leak around the wire, remove the exterior insulation locally.
- NOTE:** Do not let the section of the wire that has no insulation touch metal surfaces of tools or metal caul plates. This will cause the thermocouple to give inaccurate readings.
- (g) Make sure that the wires do not cross any sharp corners or transitions that can damage the wires.
 - (h) Do not let thermocouple wires cross each other when under the vacuum bag.
 - 1) This can cause inaccurate readings.
 - 2) Hold the wires with Scotch 5490 tape, G50030 [C10-040] or No. 855 tape, G02462 [C10-136].

SUBTASK 70-43-43-300-005-G00

- (2) Use a caul plate for the purposes that follow:

- (a) A caul plate is a smooth support plate, usually metal, cured composite or silicone sheet, and the caul plates are used in the following ways:
 - 1) To enhance the aerodynamics and aesthetic appearance by giving a smooth surface on the finished laminate.
 - 2) To be a local tool to maintain the contour possibly with the assembly tool to hold the part details in its position.
 - 3) To support the bag over an area where the vacuum bag pressure may cause local crushing at vulnerable edges.

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- a) For example, at core splices or at repair edges when you do a drying operation on honeycomb parts.

NOTE: Refer to Drying of the Thermosetting Composite Materials Repair, TASK 70-43-43-300-802-G00.

- b) In complex parts a caul plate can also be used during cure to support the bag over pockets or holes.

NOTE: Unless the caul plate is silicone rubber or similar material the pressure on the repair will be uneven, or non-existent, if the caul plate does not conform to the repair plies.

- 4) To give a more uniform temperature distribution when you use a heat blanket, heat lamps or heat guns.

- a) A thin, flexible, metal sheet (the same size as the heat blanket, if one is used) can be used for even heat distribution to the repair area during cure.

SUBTASK 70-43-43-300-006-G00

- (3) Install a pressure pad as follows:

NOTE: A pressure pads, also somewhat inaccurately known as pressure intensifiers, are used to make sure of ply compaction in a specific location. They are generally made from felt or rubber. A pad may be used around square edges of honeycomb panels or to control the bondline thickness in a doubler area where a critical dimension is to be met. Pads can also be used on sharp edges or radii to prevent the rupture of the vacuum bag film.

NOTE: Pads can be applied in direct contact with the part or on top of release films (Figure 217).

- (a) Cover the pad with MS-122XD lubricant, D00630 [C10-013], No. 855 tape, G02462 [C10-136] or film, G50033 [C10-133] if the pad will touch uncured materials.
- (b) Cover the pad with breather material before you install the vacuum bag film, G50208 [C10-137].

SUBTASK 70-43-43-300-007-G00

- (4) Install the Heat Blanket, G51145 [C10-055] as follows:

NOTE: Heat blankets are commonly made of a silicone rubber sheet with an electrical resistance heating circuit. They must be flexible to match the repair contour and have a good temperature uniformity to minimize hot and cold areas. Use caution when bending or forming heat blankets to prevent breaking the fragile wires in the blanket. Check with the heat blanket manufacturer for recommendations and/or limitations.

- (a) The heat blankets have a cooler area around the perimeter of the blanket.
- 1) Put the heat blanket so that it extends past the repair on all sides by a minimum of 2.0 inches (51.0 mm).
- (b) Put the heat blanket wires through a convenient area of the vacuum bag sealant tape, G51150 [C10-138] and away from any thermocouple wires.
- (c) Hold the wires to the base structure inside the bag with a Scotch 5490 tape, G50030 [C10-040] or No. 855 tape, G02462 [C10-136].
- (d) Put the wires over the vacuum bag sealant tape, G51150 [C10-138] that is on the tool or part surface.
- (e) Cover the wires with a second piece of sealant tape (Figure 216).

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SUBTASK 70-43-43-300-008-G00

- (5) Install the vacuum ports and tube ports as follows:

NOTE: The vacuum ports give air passage through the vacuum bag film and a connection for the vacuum pump and vacuum gauge or other vacuum monitor. A number of port designs are commercially available such as two piece ports or tube type ports. The two piece ports give more efficiency as there are fewer points of contact where a leak could occur. Tube type ports can be used when no space on the tool or repair periphery is available. The vacuum port and the vacuum gauge port (refer to Step F.(6)) must be positioned at opposite corners of the bag where it is possible. At least one vacuum port and one vacuum gauge port are necessary.

- (a) Install a two piece vacuum port as follows (Figure 218 and Figure 219):
- 1) Make a decision where you will put the ports.
 - 2) If it is possible, put the vacuum port and the vacuum gauge port near opposite corners of the bag.
- (b) Put the port away from the repair area.
- 1) If no space is available around the repair, put the port in a tuck (Figure 219).
 - 2) This will prevent contact of the port with the repair area which can cause damage to the surface.
 - 3) If the repair uses the local heat application, put the port on an unheated area of the part and not on or near the edge of the heat blanket, if one is used.
 - a) The concentration of heat in the metallic parts of the port can cause damage to the Heat Blanket, G51145 [C10-055].
 - 4) Where you will put the vacuum port, cut a hole in the vacuum bag film, G50208 [C10-137] with a circular hole punch or fold the film and cut a half circle, 1.0 inch (25.0 mm) diameter.
 - 5) Put the vacuum bag film, G50208 [C10-137] over the vacuum connection and push firmly onto the gasket.
 - a) If there is no gasket, make a gasket from vacuum bag sealant tape, G51150 [C10-138].
 - 6) Attach the outer ring of the fitting onto the stem of the port to clamp the vacuum port to vacuum bag film, G50208 [C10-137].
 - 7) Make a breather cloth pad from a piece of breather cloth, G51149 [C10-134] 12.0 inches (294.0 mm) long and 12.0 inches (294.0 mm) wide.
 - a) Fold the cloth into a 4.0 inch (102.0 mm) square, 9 ply thick pad.
 - b) Make a breather cloth pad for each fitting.
 - 8) Put the breather cloth pad inside the vacuum bag under the vacuum ports.
 - a) This is to prevent an obstruction of the air flow by the edges of the port and to absorb any resin flow before it gets into the vacuum line.
 - 9) If the vacuum bag is large, use one vacuum port for every square meter.
- (c) Install the tube port and as follows (Figure 220):
- 1) Make or buy a length of the tube with a vacuum line connection at one end and a series of perforations at the other.
 - 2) Cover the perforated end of the tube with glass fabric, G51034 [C10-003].

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- a) Make the glass fabric, G51034 [C10-003] approximately 10.0 inches (254.0 mm) longer than the tube.
NOTE: The glass fabric will be put in contact with the top of the breather system inside the bag. This will give a good vacuum path between the vacuum source and the breather system.
- 3) Make a decision where you will put the port.
 - a) If it is possible put the vacuum port and the vacuum gauge port near opposite corners of the bag.
- 4) Put the port through a seam with the vacuum bag sealant tape around it.
- 5) Keep a space between the fitting and the part.
 - a) The tube, when correctly installed, is in a tuck and does not touch the part (Figure 220).
- 6) Put the glass fabric, G51034 [C10-003] that is attached to the tube on the breather cloth, G51149 [C10-134].

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- (6) Install the vacuum gauge ports as follows:

NOTE: A vacuum gauge port is identical to a vacuum port, but is used to attach a vacuum gauge or a vacuum monitor line to measure the vacuum. You must have a minimum of one vacuum gauge port connection. If possible, put the connection at the opposite corner of the bag to the vacuum port, refer to Step F.(5).

NOTE: A vacuum gauge is a device attached directly to the vacuum gauge port capable of reading vacuum pressure. A negative vacuum pressure range of 0.0 - 30.0 inch Hg (0 - 100.0 kPa) is necessary.

NOTE: A vacuum monitor line is a vacuum hose connected to the vacuum gauge port and to a remote vacuum monitoring device via permanent vacuum piping. This is usually used when curing parts in an oven or autoclave where it is not possible to read a gauge attached to the vacuum bag.

- (a) Install the vacuum gauge port.

NOTE: Refer to the vacuum port installation instructions in Step F.(5)(a).

H. Application of Vacuum Pressure and Leak Check

NOTE: The vacuum integrity check (leak test) is done as the last in the bagging process. It is important to make sure that the bag is sealed correctly and does not have leaks, before starting the cure. If the bag fails during the cure cycle, the vacuum bag will not be able to put equal pressure to the assembly. A failed bag can cause damage to the repair, this can cause you to have to do the repair again.

SUBTASK 70-43-43-300-010-G00

- (1) Apply the vacuum pressure as follows:
 - (a) When you have sealed the bag, make the vacuum connections as follows:
 - 1) Connect a vacuum gauge or vacuum monitor line to the vacuum gauge port.
 - 2) Connect the vacuum port to the vacuum source.
 - (b) Apply a vacuum of approximately 5.0 inch Hg (17.0 kPa).
 - (c) Make sure that the bag is drawn into all contour changes, hollows and areas of overlays.
 - (d) Make sure that no bridging occurs and adjust tucks if necessary.

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SUBTASK 70-43-300-011-G00

(2) Do a check of the bag for leaks as follows:

- (a) Apply the minimum obtainable vacuum pressure available in the vacuum system, the vacuum must be a minimum of 22.0 inch Hg (75.0 kPa) unless otherwise specified in the repair document.
- (b) Keep the vacuum applied until the gauge value does not change.
- (c) Disconnect the vacuum source and measure the rate of vacuum loss (leak rate).
- (d) The leak rate must be less than 5.0 inch Hg (17.0 kPa) pressure drop timed for a 5 minute period.
- (e) If the leak rate is more than this rate do the steps that follow to repair the leaks until the rate is less than the rate in Step G.(2)(d).

1) Look and listen for the leaks, where the leaks often occur in the locations as follows:

NOTE: If it is available, you can use an ultrasonic leak detector that gives an audible warning of leaks as the detector is passed along the possible leak paths to find the leaks.

- a) Where the vacuum bag sealant tape has been doubled.
 - <1> For example, at thermocouple locations, heat blanket wire locations, tucks or joints.
 - b) Vacuum port and vacuum gauge port locations (at locations where a hole is cut in the bag to accommodate the vacuum port fitting including vacuum line connections and fittings).
 - c) Where the bleeder or breather material fibers are stuck to the vacuum bag sealant tape.
 - d) If the release film is over the sealant tape.
 - e) Pin holes in the vacuum bag film.
 - f) Vacuum bag sealant tape not secured to the part or surface especially if the surface is not correctly cleaned or not fully cured from a previous stage of the repair.
 - g) Leaks between heat blanket wires, or thermocouple wires and insulation.
 - h) Leaks at part fastener locations that are under a surface bag.
 - i) Tool leaks associated with porosity and tool attachment points.
- 2) Push the film more firmly into the sealant tape with a radius edged tool or your finger.
- 3) If you find a hole or tear in the vacuum bag film, repair the hole as follows:
- a) Cut a patch made from vacuum bag film larger than the hole or tear to be repaired by at least 2.0 inches (51.0 mm) in all directions.
 - b) Apply vacuum bag sealant tape to the patch and attach the patch over the leak.
 - c) Look at the patch.
 - <1> A correct patch will pull down as the air is removed from the patch.

NOTE: Do not put vacuum bag sealant tape over the hole or tear. The cure pressure and heat will push the sealant through the pinhole or tear and make the bag leak again.

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I. Repair Integrity and Evaluation Guidelines

SUBTASK 70-43-43-300-012-G00

- (1) After the cure cycle has begun and a drop in vacuum is found, there are many factors to consider to make a decision on how the repair quality will be affected:
 - (a) Where the leak occurred.
 - (b) The amount of vacuum and how long it was not applied.
 - (c) The stage of the cure when the leak occurred.
 - (d) If the loss of vacuum is on the edge seal of the bag and a channel breather or edge breather is being used, a leak is less likely to be detrimental.
 - 1) If the leak is coming through the back side of the repair or through the honeycomb and there is a possibility of the air going through the repair area, a problem is more likely in the repair.
 - 2) If the vacuum drops during a heat blanket cure, it will be easier to reseal the bag than if it is an oven cure where access is limited.
 - (e) If the leak occurred before the resin was cured for up to 75 percent of the total necessary cure soak time, the quality of the repair may be degraded.
 - 1) Before a resin has reached 75 percent of its soak time, it may not be completely gelled.
 - 2) Use caution, since this may not apply to all resins.
 - 3) Once the resin has become gelled, it may be acceptable only if the heat source, such as a heat blanket, has not lifted away from the surface of the repair, resulting in uneven heat transfer.
 - 4) As a general rule, a loss of 5.0 inches Hg (17.0 kPa) may be acceptable for the rest of the cure, if more than that is lost, the quality of the repair may be compromised.
 - (f) These are guidelines only.
 - 1) The Engineering and Inspection Authority must evaluate these situations and determine the further action.

J. Methods of Bagging

NOTE: The methods given are standard methods for the bagging of thermosetting composite materials that are referenced in repair documents. The methods must only be used when specified in an approved repair.

NOTE: In the methods given, all instructions are necessary unless they are specifically stated as optional. Optional steps are added for specific repair needs. Optional step should only be used if specified in the repair document.

NOTE: Read the methods carefully before you make the bag. Read all the optional procedures to make sure that they apply.

SUBTASK 70-43-43-300-013-G00

- (1) Method 1 - Vertical Bleed Cure With or Without the Use of a Heat Blanket (Figure 221).

NOTE: Refer to the Installation Procedures, Step E. Materials and Installation Procedures for Bagging Operations, thru Step G, Application of Vacuum Pressure and Leak Check, for more detailed information on each step.

- (a) Apply No. 855 tape, G02462 [C10-136] around the edge of the repair area.

NOTE: Refer to Composite Masking Method 5 in Mask and Clean the Epoxy and Polyester Matrix Repair, TASK 70-43-43-300-801-G00.

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- (b) If the peel ply is specified (optional), put a layer of the peel ply material, G51147 [C10-131] over the repair plies.
 - 1) Make the peel ply material, G51147 [C10-131] approximately 0.5 inch (13.0 mm) larger than the edge of the repair.
- (c) If the edge breather is specified (optional), put a minimum of three strips of narrow breather cloth, G51149 [C10-134] approximately 4.0 inches (102.0 mm) from the edge of the largest repair ply around the repair.
 - 1) Keep 0.5 inches (13.0 mm) away from the peel ply.
- (d) Apply the vacuum bag sealant tape, G51150 [C10-138] to the edge of the repair area, approximately 6.0 inches (152.0 mm) from the largest repair ply.
 - 1) Use the Figure 221 as a guide to find the location of the vacuum bag sealant tape, G51150 [C10-138] and the other materials inside the vacuum bag.
 - 2) Do not put the vacuum bag sealant tape, G51150 [C10-138] on the flashbreaker tape.
 - 3) This can cause leaks.
 - 4) Do not remove the protective paper at this time.
- (e) Install the thermocouples.

NOTE: Refer to Step F.(1) for more information.
- (f) Put a layer of perforated release film, G51148 [C10-132] over the repair area approximately 2.0 inches (51.0 mm) larger than the edge of the repair.
 - 1) Make the perforated release film smooth and remove wrinkles.
- (g) Put the breather cloth, G51149 [C10-134] over the perforated release film approximately 2.0 inches (51.0 mm) larger than the edge of the perforated release film.
 - 1) If you will use a Heat Blanket, G51145 [C10-055], make sure that the bleeder material will be a minimum of 2.0 inches (51.0 mm) larger than the edge of the heat blanket, refer to the repair document for the number of bleeder plies.
- (h) Put a layer of film, G50033 [C10-133] over the bleeder plies.
 - 1) Make the film, G50033 [C10-133] 2.0 inches (51.0 mm) smaller than the edge of the bleeder plies.
- (i) If a caul plate is specified in the repair document, do the steps as follows (optional):

NOTE: If a caul plate is specified in the repair document then the material, size and thickness of the caul plate must also be specified.

 - 1) Put one layer of peel ply material, G51147 [C10-131] over the film, G50033 [C10-133] as a breather cloth layer under the caul plate.
 - a) Make sure that the peel ply touches the bleeder plies along the edges.
 - 2) Put the caul plate over the peel ply.
- (j) If a heat blanket is specified as the heat source (optional):
 - 1) Put one layer of peel ply over the film, G50033 [C10-133] (or the caul plate if one is used) as a breather cloth layer under the heat blanket.
 - a) Make sure that the peel ply touches the bleeder plies along the edges.

NOTE: The peel ply is used because it has better heat transfer than woven cloth or non-woven mat breather material.

 - 2) Put the heat blanket on the peel ply.

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- 3) If it is necessary to monitor the heat blanket to prevent a heat blanket temperature higher than permitted by the heat blanket specification then put a thermocouple over the center of the heat blanket.
- 4) Put two to three layers of breather cloth, G51149 [C10-134] over the heat blanket.
 - a) This will also insulate the heat blanket and prevent damage to the vacuum bag film.
 - b) Make sure that the breather cloth, G51149 [C10-134] touches the bleeder plies along the edges.
- (k) If a heat blanket is not specified, put one to two layers of breather cloth over the unperforated release film or the caul plate if specified.
 - 1) Make sure that the breather cloth makes contact with the bleeder plies along the edges.
- (l) Install the vacuum ports and cover the repair area with vacuum bag film, G50208 [C10-137] as follows:
 - 1) Cut the vacuum bag film 1.5 times the size of the area to be covered.
 - 2) Make a minimum of two openings in opposite corners of the vacuum bag film.
 - a) One will be used for the vacuum port and one will be connected to the vacuum gauge port.
 - 3) Seal the vacuum ports to the vacuum bag film.
 - 4) Put the vacuum ports on the breather cloth pad, 4 plies thick minimum, and put them near the edge of the breather cloth layers.
 - a) Do not put the vacuum ports on or near the repair area.
 - b) If there is not sufficient area to put the vacuum ports next to the repair area, put the vacuum ports in a tuck.
 - 5) Start to seal the vacuum bag as follows:
 - a) Remove the paper from the vacuum bag sealant tape adjacent to the vacuum port.
 - b) Lightly apply the film to the sealant tape.
 - c) Make sure that the vacuum bag film is not stretched and is in the correct position.

<1> Adjust if it is necessary.
 - d) Push the vacuum bag film firmly onto the vacuum bag sealant tape to make a seal.
 - 6) Continue to remove the backing paper from the sealant tape and seal the edge of the vacuum bag to the sealant tape.
 - 7) Put tucks in the vacuum bag film at intervals to permit for material stretch and contour changes.
- (m) Remove the air from the bag as follows:
 - 1) Connect the vacuum source and slowly remove the air.
 - a) Make the bag smooth with your hands as the air is removed.
 - 2) Stop and make adjustments to the vacuum bag film, G50208 [C10-137] to prevent the local stretch of the film.
 - 3) Continue to remove the air from the vacuum bag.

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- 4) If it is necessary, check the bag for leaks and seal it again.
 - a) If it is available, use an ultrasonic leak detector to detect air leaks in the vacuum bag.
 - b) A minimum vacuum pressure reading of 22.0 inches Hg (75.0 kPa) is necessary, unless otherwise specified by the repair document.
- 5) Wait for 5 minutes after the readings remain constant.
- 6) Disconnect the vacuum source at the probe and check the rate of vacuum loss.
 - a) The leak rate should be less than 5.0 inches Hg (17.0 kPa) pressure drop, timed over a 5 minute period.
- 7) If the leak is larger than this rate, adjust the seal until it is satisfactory.
- (n) If you used a heat blanket and the rate of the temperature increase is too slow, put the breather cloth, G51149 [C10-134] as insulation material on the outside of the vacuum bag to make the heat loss slower.

SUBTASK 70-43-43-300-014-G00

- (2) Method 2 - No Bleed Cure With or Without the use of a Heat Blanket (Figure 222).

NOTE: Refer to the Installation Procedures, Step E., Materials and Installing Procedures for Bagging Operations, thru Step G, Application of Vacuum Pressure and Leak Check, for more detailed information on each step.

- (a) Apply the No. 855 tape, G02462 [C10-136] around the edge of the repair area.

NOTE: Refer to Composite Masking Method 5 in Mask and Clean the Epoxy and Polyester Matrix Repair, TASK 70-43-43-300-801-G00.

- (b) If the peel ply is specified (optional), put a layer of the peel ply material, G51147 [C10-131] over the repair plies.

- 1) Make the peel ply approximately 0.5 inch (13.0 mm) larger than the edge of the repair.

- (c) If the edge breather is specified (optional), put a minimum of three strips of narrow breather cloth, G51149 [C10-134] approximately 4.0 inches (102.0 mm) from the edge of the largest repair ply around the repair.

- 1) Keep 0.5 inches (13.0 mm) away from the peel ply.

- (d) Apply the vacuum bag sealant tape, G51150 [C10-138] to the edge of the repair area, approximately 6.0 inches (152.0 mm) from the largest repair ply.

- 1) Use the Figure 222 as a guide to find the location of the vacuum bag sealant tape, G51150 [C10-138] and the other materials inside the vacuum bag.
- 2) Do not put the vacuum bag sealant tape, G51150 [C10-138] on the flashbreaker tape.
- 3) This can cause leaks.
- 4) Do not remove the protective paper at this time.

- (e) Install the thermocouples.

NOTE: Refer to Step F.(1) for more information.

- (f) Put a layer of film, G50033 [C10-133] over the repair area.

- 1) Make the film, G50033 [C10-133] approximately 2.0 inches (51.0 mm) larger than the edge of the repair.
- 2) Make the release film smooth and remove wrinkles.

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- (g) If a caul plate is specified in the repair document, do the steps as follows (optional).

NOTE: If a caul plate is specified in the repair document then the material, size and thickness of the caul plate must also be specified.

- 1) Put one layer of the peel ply material, G51147 [C10-131] over the unperforated release film, G51148 [C10-132] as a breather cloth layer under the caul plate.
- 2) Put the caul plate over the peel ply.

- (h) If a heat blanket is specified as the heat source (optional):

- 1) Put one layer of the peel ply material, G51147 [C10-131] over the film, G50033 [C10-133] (or the caul plate if one is used) as a breather cloth layer under the heat blanket.

NOTE: The peel ply is used because it has better heat transfer than woven cloth or non-woven mat breather material.

- 2) Put the heat blanket on the peel ply.
- 3) If it is necessary, to monitor the heat blanket to prevent a heat blanket temperature higher than permitted by the heat blanket specification then put a thermocouple over the center of the heat blanket.

- 4) Put two to three layers of breather cloth, G51149 [C10-134] over the Heat Blanket, G51145 [C10-055].

- a) This will also insulate the heat blanket and prevent damage to the vacuum bag film.

- (i) If a heat blanket is not specified, put one to two layers of breather cloth over the unperforated release film or the caul plate if specified.

- (j) Install the vacuum ports and cover the repair area with vacuum bag film, G50208 [C10-137] as follows:

- 1) Cut the vacuum bag film 1.5 times the size of the area to be covered.
- 2) Make a minimum of two openings in opposite corners of the vacuum bag film.
 - a) One will be used for the vacuum port and one will be connected to the vacuum gauge port.
- 3) Seal the vacuum ports to the vacuum bag film.
- 4) Put the vacuum ports on the breather cloth pad, 4 plies thick minimum, and put them near the edge of the breather cloth layers.
 - a) Do not put the vacuum ports on or near the repair area.
 - b) If there is not sufficient area to put the vacuum ports next to the repair area, put the vacuum ports in a tuck.
- 5) Start to seal the vacuum bag as follows:
 - a) Remove the paper from the vacuum bag sealant tape adjacent to the vacuum port.
 - b) Lightly apply the film to the sealant tape.
 - c) Make sure that the vacuum bag film is not stretched and is in the correct position.

<1> Adjust if it is necessary.
 - d) Push the vacuum bag film firmly onto the vacuum bag sealant tape to make a seal.

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- 6) Continue to remove the backing paper from the sealant tape and seal the edge of the vacuum bag to the sealant tape.
- 7) Put tucks in the vacuum bag film at intervals to allow for material stretch and contour changes.
- (k) Remove the air from the bag as follows:
 - 1) Connect the vacuum source and slowly remove the air.
 - a) Make the bag smooth with your hands as the air is removed.
 - 2) Stop and make adjustments to the vacuum bag film, G50208 [C10-137] to prevent the local stretch of the film.
 - 3) Continue to remove the air from the vacuum bag.
 - 4) If it is necessary, Check the bag for leaks and seal it again.
 - a) If it is available, use an ultrasonic leak detector to detect air leaks in the vacuum bag.
 - b) A minimum vacuum pressure reading of 22.0 inches Hg (75.0 kPa) is necessary, unless otherwise specified by the repair document.
 - 5) Wait for 5 minutes after the readings remain constant.
 - 6) Disconnect the vacuum source at the probe and check the rate of vacuum loss.
 - a) The leak rate should be less than 5.0 inches Hg (17.0 kPa) pressure drop, timed over a 5 minute period.
 - 7) If the leak is larger than this rate, adjust the seal until it is satisfactory.
- (l) If you used a heat blanket and the rate of the temperature increase is too slow put the breather cloth, G51149 [C10-134] as insulation material on the outside of the vacuum bag to make the heat loss slower.

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- (3) Method 3 - Squeeze Out Bleed Method (Figure 223).

NOTE: Refer to the Installation Procedures, Step E., Materials and Installing Procedures for Bagging Operations, thru Step G., Application of Vacuum Pressure and Leak Check, for more detailed information on each step.

- (a) Apply the No. 855 tape, G02462 [C10-136] around the edge of the repair area.

NOTE: Refer to Composite Masking Method 5 in Mask and Clean the Epoxy and Polyester Matrix Repair, TASK 70-43-43-300-801-G00.

- (b) Put impregnated peel ply over outer laminate.
 - 1) Extend over the edge by 0.4 inch (10.0 mm).
- (c) Apply sisal or polyamide nylon rope around the repair area approximately 4.0 inches (102.0 mm) from the edge of the largest repair ply.
- (d) Put a minimum of three strips of narrow breather cloth, G51149 [C10-134] over the rope approximately 4.0 inches (102.0 mm) from the edge of the largest repair ply around the repair.
 - 1) Keep 0.5 inch (13.0 mm) away from the peel ply (Figure 223).
- (e) Apply the vacuum bag sealant tape, G51150 [C10-138] to the edge of the repair area, approximately 6.0 inches (152.0 mm) from the largest repair ply.
 - 1) Use the Figure 223 as a guide to find the location of the vacuum bag sealant tape and the other materials inside the vacuum bag.

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- 2) Do not put the vacuum bag sealant tape on the flashbreaker tape.
 - 3) This can cause leaks.
 - 4) Do not remove the protective paper at this time.
- (f) Install the thermocouples.
- NOTE: Refer to Step F.(1) for more information.
- (g) Install the vacuum ports and cover the repair area with vacuum bag film as follows:
- 1) Cut the vacuum bag film 1.5 times the size of the area to be covered.
 - 2) Make a minimum of two cut openings in opposite corners of the vacuum bag film.
 - a) One will be used for the vacuum port and one will be connected to the vacuum gauge port.
 - 3) Seal the vacuum ports to the vacuum bag film.
 - 4) Put the vacuum ports on a breather cloth pad, 4 plies thick minimum, and put them on the edge breather layers.
 - a) Do not put the vacuum ports on or near the repair area.
 - b) If there is not sufficient area to put the vacuum ports next to the repair area, put the vacuum ports in a tuck.
 - 5) Start to seal the vacuum bag as follows:
 - a) Remove the paper from the vacuum bag sealant tape adjacent to the vacuum port.
 - b) Lightly apply the film to the sealant tape.
 - c) Make sure that the vacuum bag film is not stretched and is in the correct position.

<1> Adjust if it is necessary.
 - d) Push the vacuum bag film firmly onto the vacuum bag sealant tape to make a seal.
 - 6) Continue to remove the backing paper from the sealant tape and seal the edge of the vacuum bag to the sealant tape.
 - 7) Put tucks in the vacuum bag film at intervals to allow for material stretch and contour changes.
 - 8) Do not put the tucks so that pleats are formed over the repair area.
 - a) Try to make the vacuum bag smooth over the surface of the repair.
- (h) Remove the air from the bag as follows:
- 1) Connect the vacuum source and slowly remove the air.
 - a) Make the vacuum bag smooth with your hands over the surface of the repair as the air is removed.
 - 2) Stop and make adjustments to the vacuum bag film, G50208 [C10-137] to prevent the local stretch of the film.
 - 3) Continue to remove the air from the vacuum bag.
 - 4) If it is necessary, check the bag for leaks and seal it again.
 - a) If it is available, use an ultrasonic leak detector to detect air leaks in the vacuum bag.

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- b) A minimum vacuum pressure reading of 22.0 inches Hg (75.0 kPa) is necessary, unless otherwise specified by the repair document.
- 5) Wait for 5 minutes after the readings stay constant.
- 6) Disconnect the vacuum source at the probe and check the rate of vacuum loss.
 - a) The leak rate should be less than 5.0 inches Hg (17.0 kPa) pressure drop timed over a 5 minute period.
- 7) If the leak is larger than this rate, adjust the seal until it is acceptable.

SUBTASK 70-43-43-300-016-G00

- (4) Method 4 - Core Restoration (Figure 224).

NOTE: Refer to the General Installation Procedures in Step E. to Step G. for more detailed information on each step. For single sided heat application, refer to the repair document for core plug thickness limits.

- (a) Apply the No. 855 tape, G02462 [C10-136] around the edge of the core replacement area.

NOTE: Refer to Composite Masking Method 5 in Mask and Clean the Epoxy and Polyester Matrix Repair, TASK 70-43-43-300-801-G00.

- (b) If the edge breather is specified (optional), put a minimum of three strips of narrow breather cloth, G51149 [C10-134] approximately 4.0 inches (102.0 mm) from the edge of the core replacement area.
- (c) Apply the vacuum bag sealant tape, G51150 [C10-138] to the edge of the repair area, approximately 6.0 inches (152.0 mm) from the largest repair ply.
 - 1) Use the Figure 224 as a guide to find the location of the vacuum bag sealant tape and the other materials inside the vacuum bag.
 - 2) Do not put the vacuum bag sealant tape on the flashbreaker tape.
 - 3) This can cause leaks.
 - 4) Do not remove the protective paper at this time.
- (d) Install the thermocouples around the core replacement area and in the core.

NOTE: Refer to Step F.(1), for more information.
- (e) Put a layer of perforated release film, G51148 [C10-132] over the core replacement area approximately 2.0 inches (51.0 mm) larger than the edge of the core replacement area.
- (f) Put the breather cloth, G51149 [C10-134] over the perforated release film approximately 2.0 inches (51.0 mm) larger than the edge of the perforated release film.
 - 1) If you will use a Heat Blanket, G51145 [C10-055], make sure that the bleeder material will be a minimum of 2.0 inches (51.0 mm) larger than the edge of the heat blanket.

NOTE: Refer to the repair document for the number of bleeder plies.
- (g) Put a layer of film, G50033 [C10-133] over the bleeder plies.
 - 1) Make the film, G50033 [C10-133] 2.0 inches (51.0 mm) smaller than the edge of the bleeder plies.
- (h) If a heat blanket is specified as the heat source (optional):
 - 1) Put one layer of the peel ply over the film, G50033 [C10-133] as a breather cloth layer under the heat blanket.

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- a) Make sure that the peel ply touches the bleeder plies along the edges.

NOTE: The peel ply is used because it has better heat transfer than woven cloth or non-woven mat breather material.

- 2) Put the heat blanket on the peel ply.
- 3) If it is necessary to monitor the heat blanket to prevent a heat blanket temperature higher than permitted by the heat blanket specification then put a thermocouple over the center of the heat blanket.
- 4) Put two to three layers of breather cloth, G51149 [C10-134] over the heat blanket.
 - a) This will also insulate the heat blanket and prevent damage to the vacuum bag film.
 - b) Make sure that the breather cloth, G51149 [C10-134] touches the bleeder plies along the edges.
- (i) If a heat blanket is not specified, put one to two layers of breather cloth over the unperforated release film.
 - 1) Make sure that the breather cloth makes contact with the bleeder plies along the edges.
- (j) Install the vacuum ports and cover the core replacement area with the vacuum bag film, G50208 [C10-137] as follows:
 - 1) Cut the vacuum bag film 1.5 times the size of the area to be covered.
 - 2) Make a minimum of two openings in opposite corners of the vacuum bag film.
 - a) One will be used for the vacuum port and one will be connected to the vacuum gauge port.
 - 3) Seal the vacuum ports to the vacuum bag film.
 - 4) Put the vacuum ports on the breather cloth pad, 4 plies thick minimum, and put them near the edge of the breather cloth layers.
 - a) Do not put the vacuum ports on or near the core replacement area.
 - b) If there is not sufficient area to put the vacuum ports next to the core replacement area, put the vacuum ports in a tuck.
 - 5) Start to seal the vacuum bag as follows:
 - a) Remove the paper from the vacuum bag sealant tape adjacent to the vacuum port.
 - b) Lightly apply the film to the sealant tape.
 - c) Make sure that the vacuum bag film is not stretched and is in the correct position.

<1> Adjust if it is necessary.
 - d) Push the vacuum bag film firmly onto the vacuum bag sealant tape to make a seal.
 - 6) Continue to remove the backing paper from the sealant tape and seal the edge of the vacuum bag to the sealant tape.
 - 7) Put tucks in the vacuum bag film at intervals to allow for material stretch and contour changes.
- (k) Remove the air from the bag as follows:
 - 1) Connect the vacuum source and slowly remove the air.

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- a) Make the bag smooth with your hands as the air is removed.
- 2) Stop and make adjustments to the vacuum bag film, G50208 [C10-137] to prevent the local stretch of the film.
- 3) Continue to remove the air from the vacuum bag.
- 4) If it is necessary, check the bag for leaks and seal it again.
 - a) If it is available, use an ultrasonic leak detector to detect air leaks in the vacuum bag.
 - b) A minimum vacuum pressure reading of 22.0 inches Hg (75.0 kPa) is necessary, unless otherwise specified by the repair document.
- 5) Wait for 5 minutes after the readings remain constant.
- 6) Disconnect the vacuum source at the probe and check the rate of vacuum loss.
 - a) The leak rate should be less than 5.0 inches Hg (17.0 kPa) pressure drop, timed over a 5 minute period.
- 7) If the leak is larger than this rate, adjust the seal until it is satisfactory.
- (l) If you used a heat blanket and the rate of the temperature increase is too slow put breather cloth, G51149 [C10-134] as insulation material on the vacuum bag to make the heat loss slower.
- (m) If a heat blanket is specified and the back of the repair area is accessible, apply a heat blanket to the back of the repair.
 - 1) Do the steps l.(4)(c),(d), (h), (j), (k) and (l).

SUBTASK 70-43-43-300-017-G00

(5) Method 5 - Drying Bag (Figure 225).

NOTE: Refer to the Installation Procedures, Step. E., Materials and Installing Procedures for Bagging Operations, thru Step G, Application of Vacuum Pressure and Leak Check, for more detailed information on each step, refer to the (Figure 203) in Drying of the Thermosetting Composite Materials Repair, TASK 70-43-43-300-802-G00, for the alternative vacuum bag methods.

- (a) Apply the vacuum bag sealant tape, G51150 [C10-138] around the edge of the repair area.
 - 1) Use the Figure 225 as a guide to find the location of the vacuum bag sealant tape and the other materials inside the vacuum bag.
 - 2) Do not remove the protective paper at this time.
- (b) Install a rigid perforated screen or temporary honeycomb core plug.

NOTE: Refer to the Absorbed Moisture Removal Method 1 in Drying of the Thermosetting Composite Materials Repair, TASK 70-43-43-300-802-G00, for details and restrictions.

- (c) Install the thermocouples around the core replacement area and in the core.

NOTE: Refer to Step F.(1) for more information.

- (d) Apply one ply of the breather cloth, G51149 [C10-134] over the perforated screen, or temporary honeycomb core plug, approximately 2.0 inches (51.0 mm) larger than the heat blanket.

NOTE: When opposite face is accessible, it is recommended to apply heat on the opposite face. A vacuum bag for additional heat and for moisture removal can also be used on the near face.

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- (e) If a heat blanket is specified as a heat source and is specified to be placed on the near side (optional):
 - 1) Put the heat blanket on the breather material.
 - 2) If it is necessary, to monitor the heat blanket to prevent a heat blanket temperature higher than allowed by the heat blanket specification then put a thermocouple over the center of the heat blanket.
 - 3) Put two to three layers of breather cloth, G51149 [C10-134] over the heat blanket.
 - a) This will also insulate the heat blanket and prevent damage to the vacuum bag film.
- (f) Install the vacuum ports and cover the repair area with vacuum bag film, G50208 [C10-137] as follows:
 - 1) Cut the vacuum bag film 1.5 times the size of the area to be covered.
 - 2) Make a minimum of two openings in opposite corners of the vacuum bag film.
 - a) One will be used for the vacuum port and one will be connected to a port to let some air into the bag.
 - NOTE: Refer to the Absorbed Moisture Removal Method 1 in Drying of the Thermosetting Composite Materials Repair, TASK 70-43-43-300-802-G00, for details.
 - 3) Seal the vacuum ports to the vacuum bag film.
 - 4) Put the vacuum ports on the breather cloth pad, 4 plies thick minimum, and put them near the edge of the breather cloth layers.
 - a) Do not put the vacuum ports on or near the repair area.
 - b) If there is not sufficient area to put the vacuum ports next to the repair area, put the vacuum ports in a tuck.
 - 5) Start to seal the vacuum bag as follows:
 - a) Remove the paper from the vacuum bag sealant tape adjacent to the vacuum port.
 - b) Lightly apply the film to the sealant tape.
 - c) Make sure that the vacuum bag film is not stretched and is in the correct position. Adjust if it is necessary.
 - d) Push the vacuum bag film firmly onto the vacuum bag sealant tape to make a seal.
 - 6) Continue to remove the backing paper from the sealant tape and seal the edge of the vacuum bag to the sealant tape.
 - 7) Put tucks in the vacuum bag film at intervals to allow for material stretch and contour changes.
- (g) Remove the air from the bag as follows:
 - 1) Connect the vacuum source and slowly remove the air.
 - a) Make the bag smooth with your hands as the air is removed.
 - 2) Stop and make adjustments to the vacuum bag film, G50208 [C10-137] to prevent the local stretch of the film.
 - 3) Continue to remove the air from the vacuum bag.
 - 4) If it is necessary, check the bag for leaks and seal it again.

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- a) If it is available, use an ultrasonic leak detector to detect air leaks in the vacuum bag.
- b) A minimum vacuum pressure reading of 12.0 inches Hg (41.0 kPa) is necessary, unless otherwise specified by the repair document.

NOTE: For drying it is not necessary to obtain a leak rate less than 5.0 inches Hg (17.0 kPa) pressure drop timed over a 5 minute period.

- (h) Open the port opposite the vacuum port to allow a controlled flow of air through the bag to assist the drying process.
 - 1) Make sure that you keep a minimum vacuum of 12.0 inches Hg (41.0 kPa) in the bag.
- (i) If a heat blanket is specified (optional), you can add more insulating material over the vacuum bag to make the heat loss slower.
- (j) If a heat blanket is specified and the back of the repair area is accessible, apply a heat blanket to the back of the repair.
 - 1) Do the steps I.(5)(a), (c), (e), (f), (g) and (i).

K. Put the Airplane Back to Its Usual Condition

SUBTASK 70-43-43-860-006-G00

- (1) Remove the DO-NOT-OPERATE tags from the applicable ENGINE START switch and FUEL CONTROL switch, do these steps:
 - (a) On the Overhead Panel, P5, remove the DO-NOT-OPERATE tag from the applicable ENGINE START switch.
 - 1) Put the applicable ENGINE START switch to the NORM position.
 - (b) On the Aft Electronics Panel, P8, remove the DO-NOT-OPERATE tag from the applicable FUEL CONTROL switch.
 - 1) Put the applicable FUEL CONTROL switch to the CUTOFF position.

———— **END OF TASK** ————

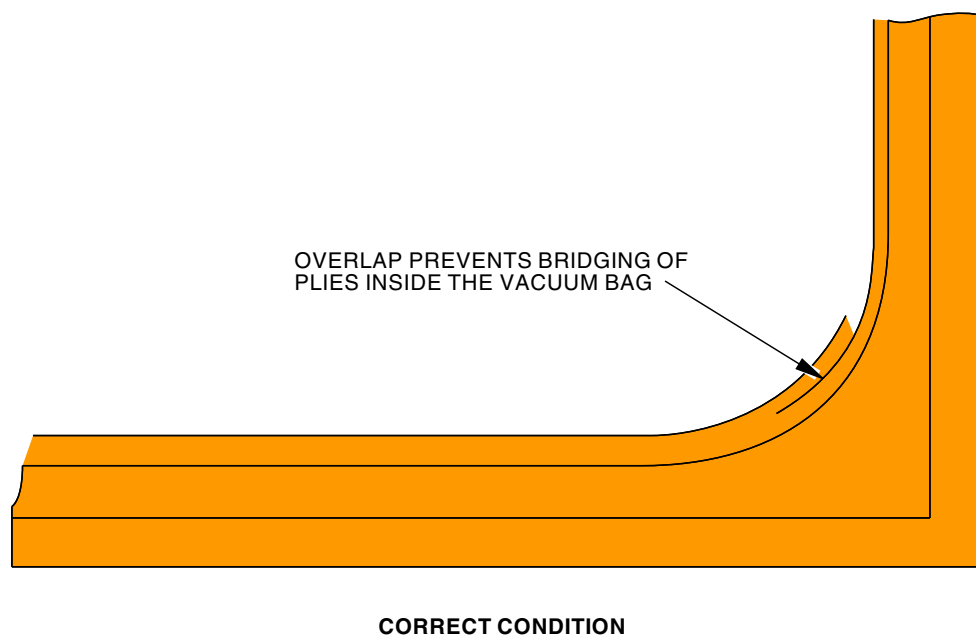
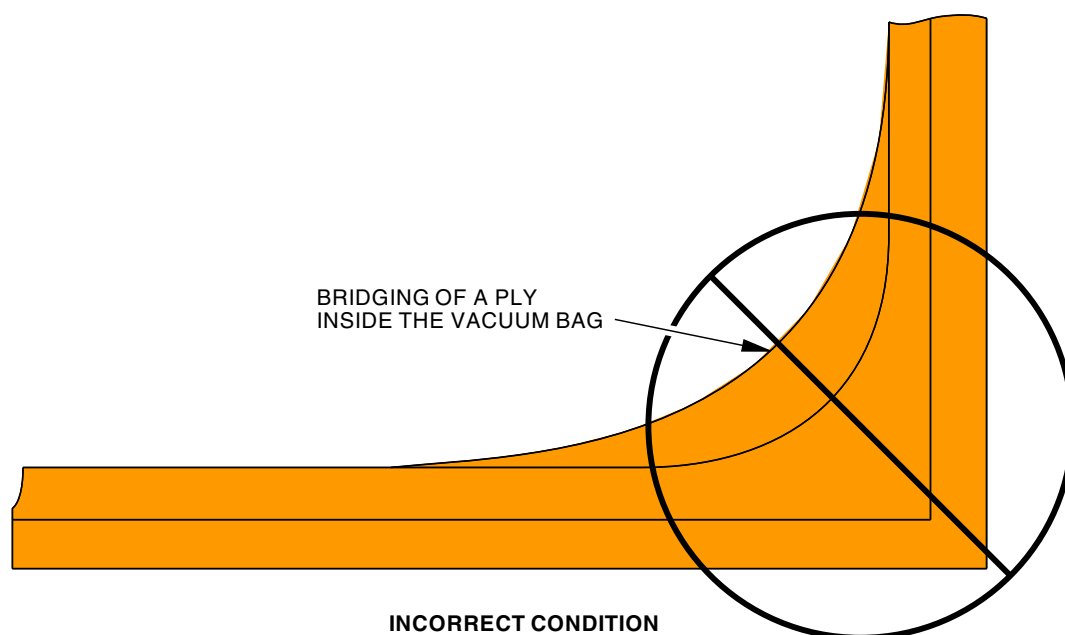
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Comparison of Bridged Plies (Incorrect Condition) vs. Unbridged Plies
Figure 211/70-43-43-990-811-G00

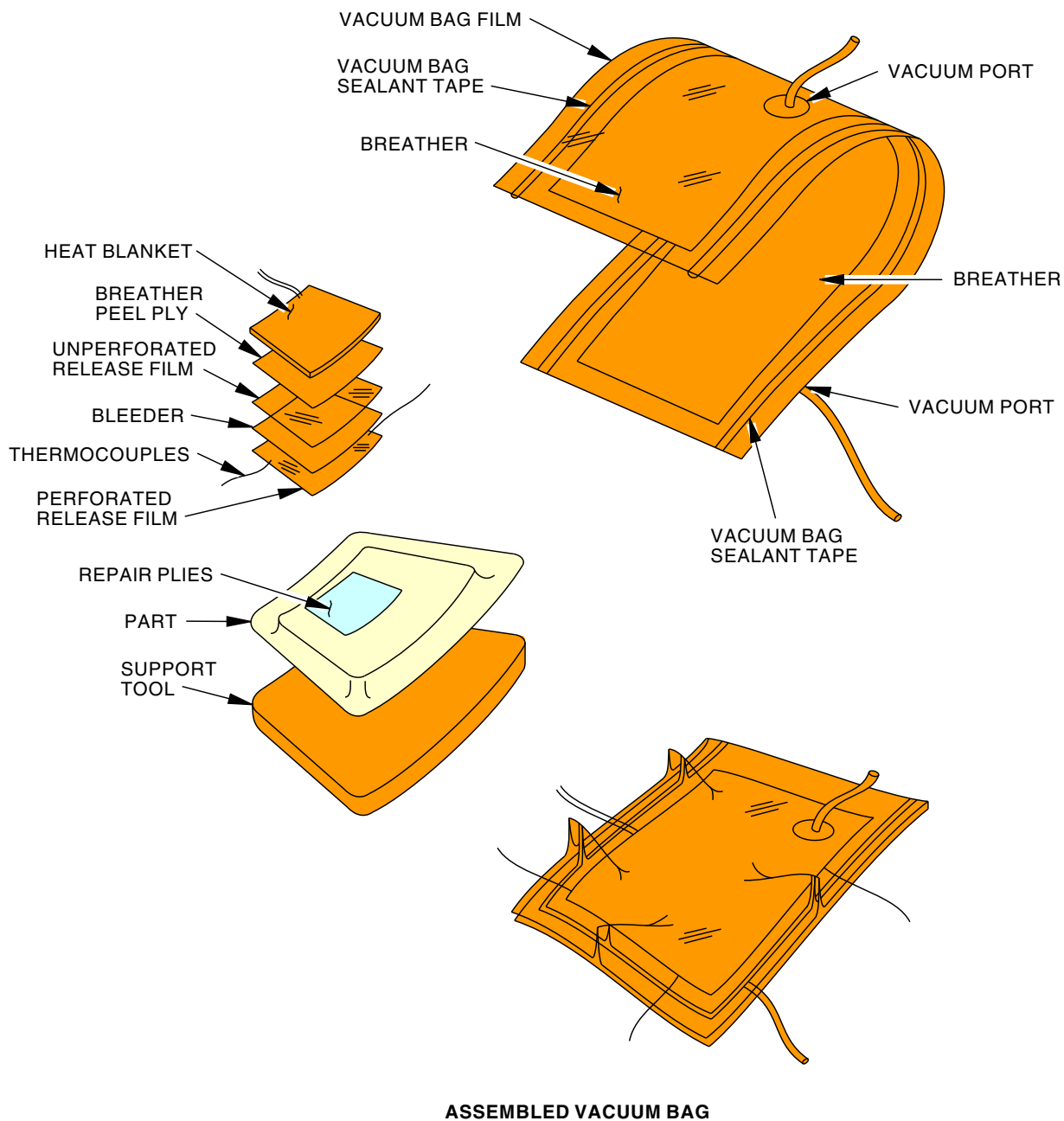
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Envelope Bag
Figure 212/70-43-43-990-812-G00

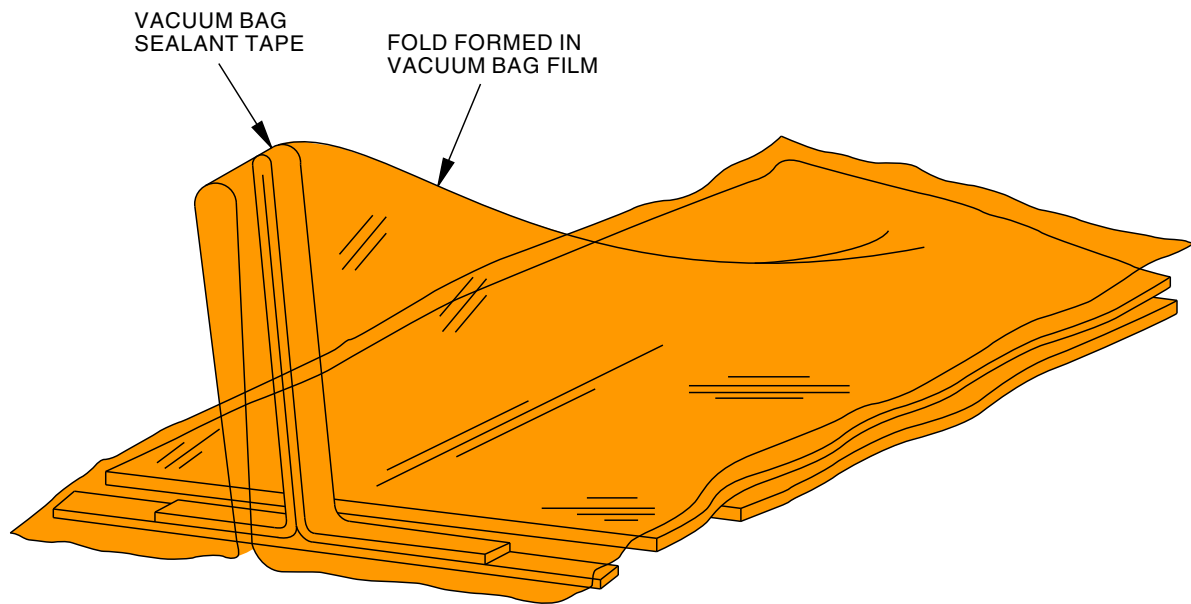
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AIRCRAFT MAINTENANCE MANUAL**NOTE:**

IT IS OPTIONAL TO ENCLOSE THE BREATHER INTO THE FOLD OF THE VACUUM BAG FILM WHEN YOU MAKE THE TUCK.

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Typical Vacuum Bag Film Tuck or Pleat
Figure 213/70-43-43-990-813-G00

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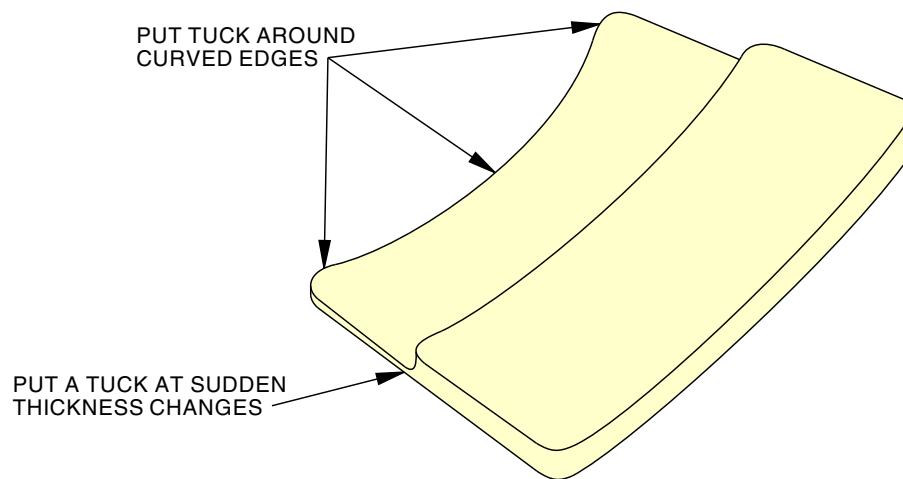
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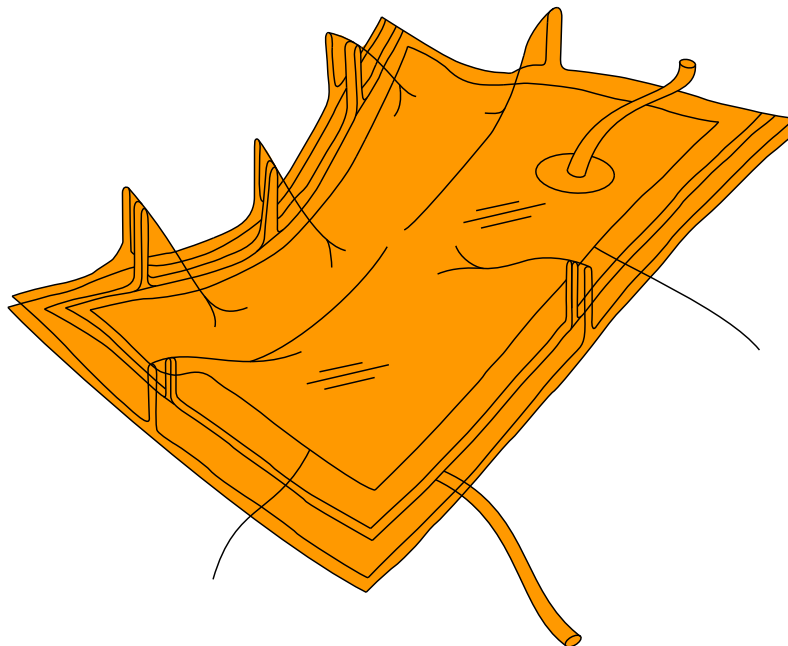
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TYPICAL PART REQUIRING ENVELOPE BAGGING



ASSEMBLED VACUUM BAG

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Typical Tuck Locations
Figure 214/70-43-43-990-814-G00

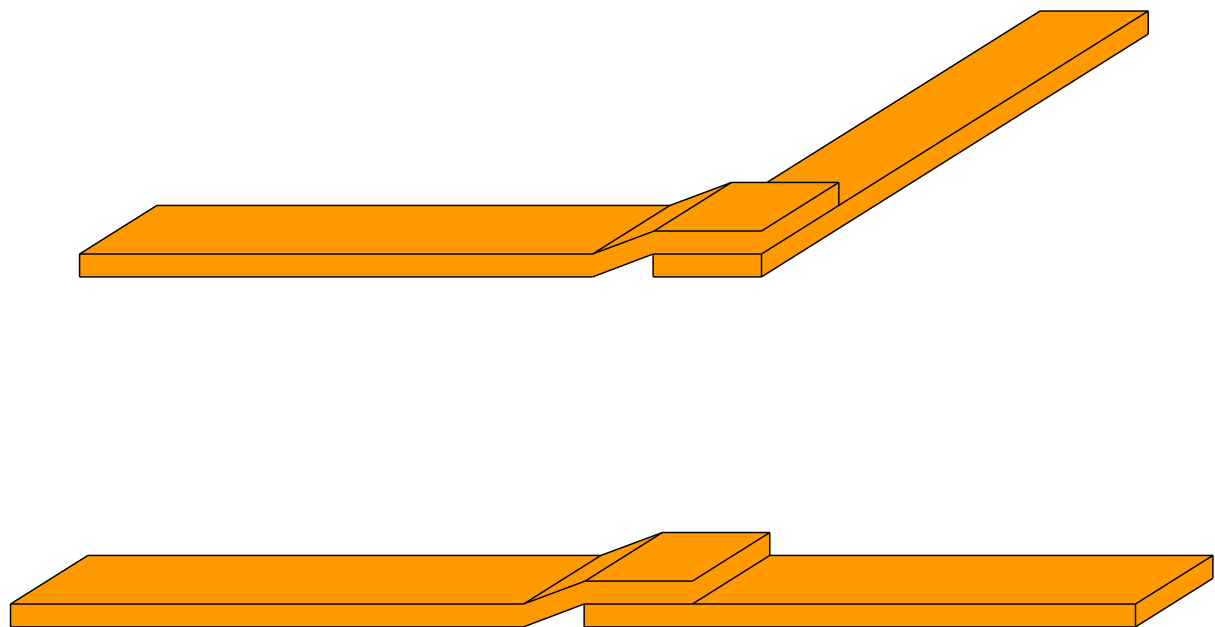
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Vacuum Bag Sealant Tape Overlap
Figure 215/70-43-43-990-815-G00

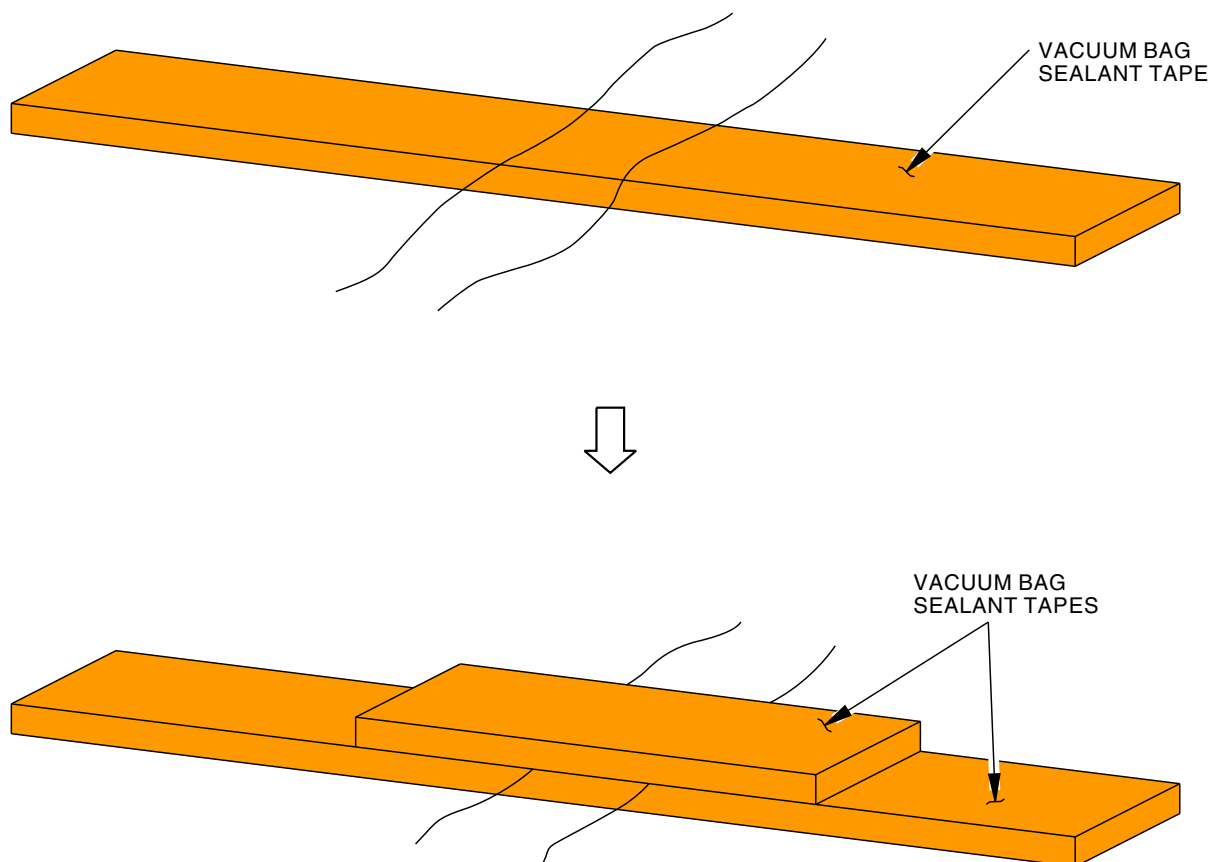
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Installation of Thermocouples or Heat Blanket Wires
Figure 216/70-43-43-990-816-G00

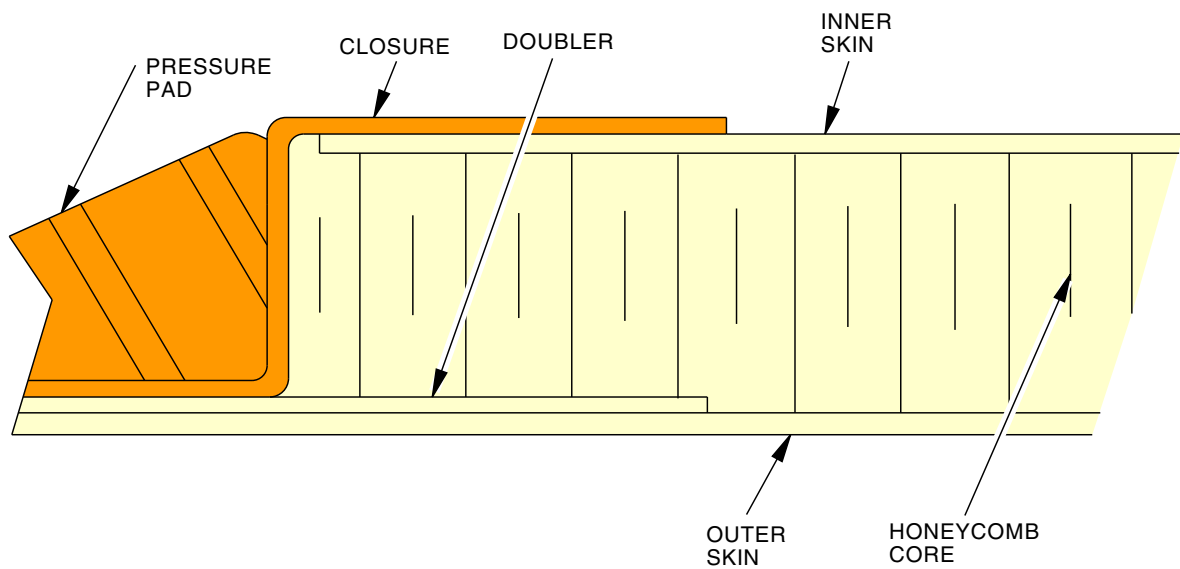
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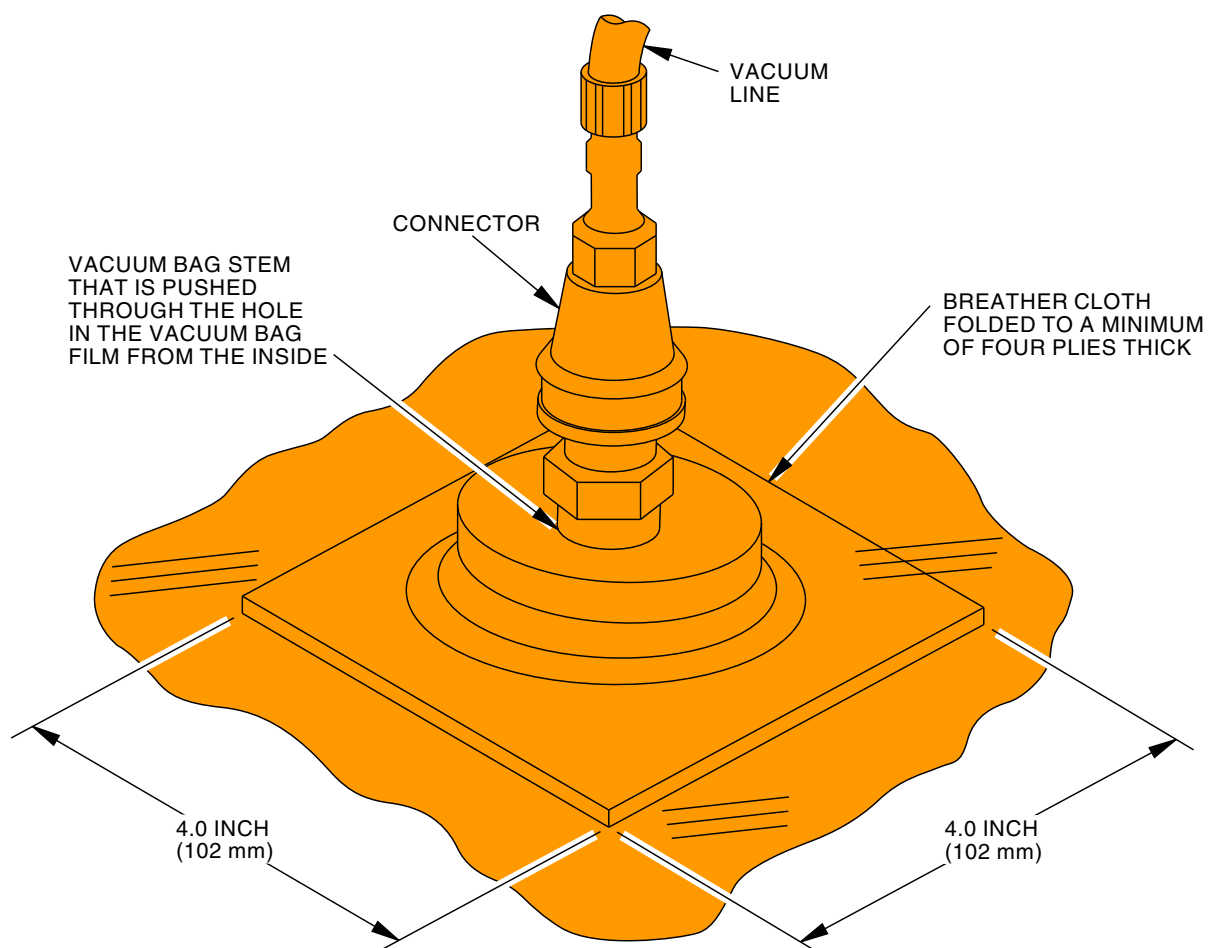
Installation of Pressure Pad
 Figure 217/70-43-43-990-817-G00

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Typical Two Piece Vacuum Port
 Figure 218/70-43-43-990-818-G00

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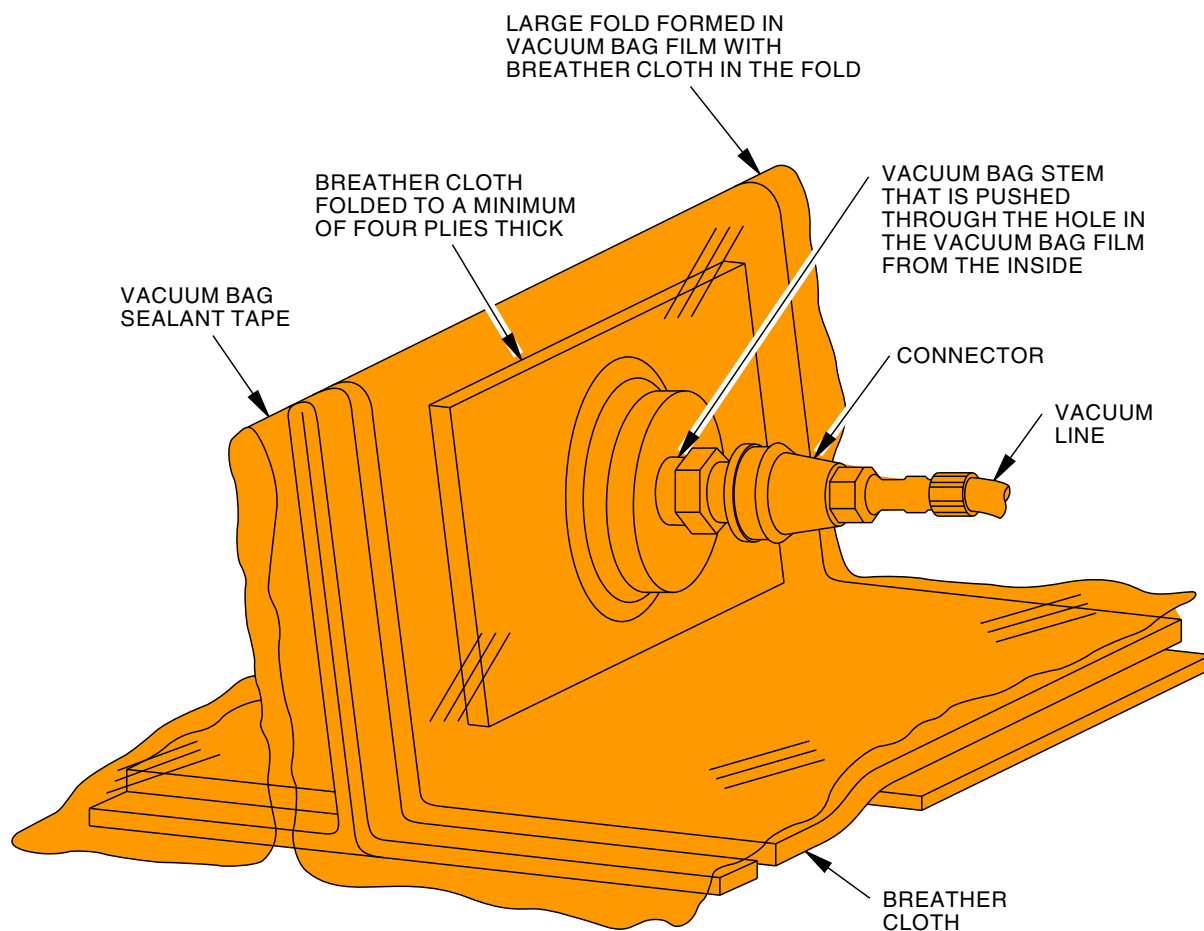
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Vacuum Port Located on a Tuck
Figure 219/70-43-43-990-819-G00

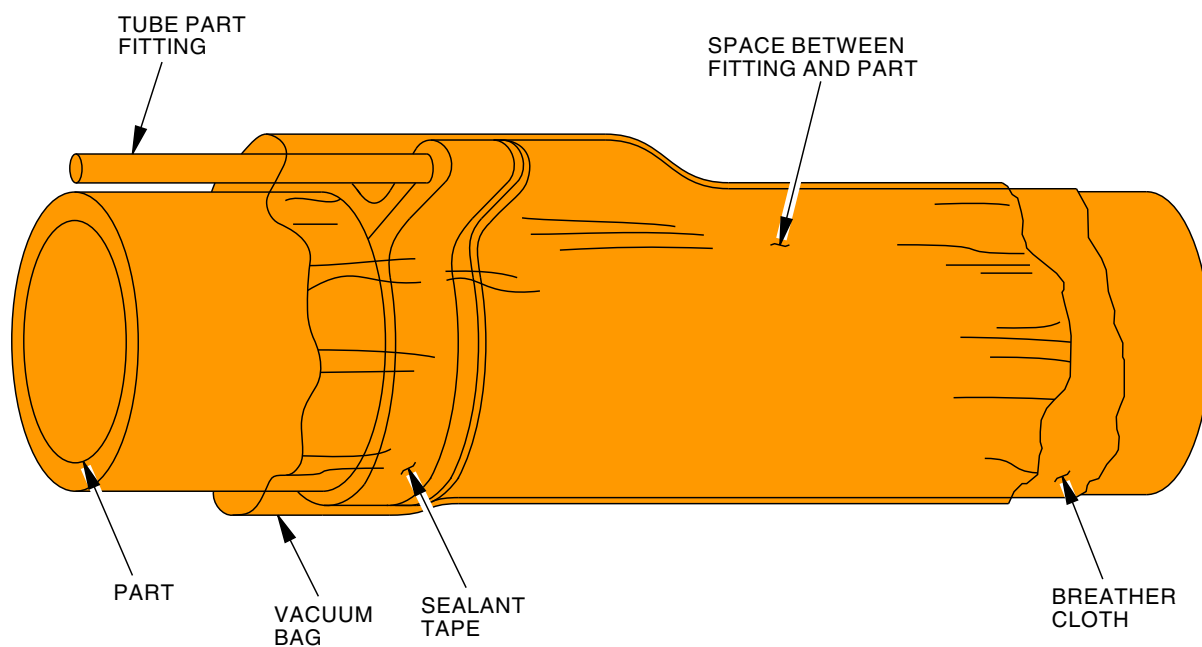
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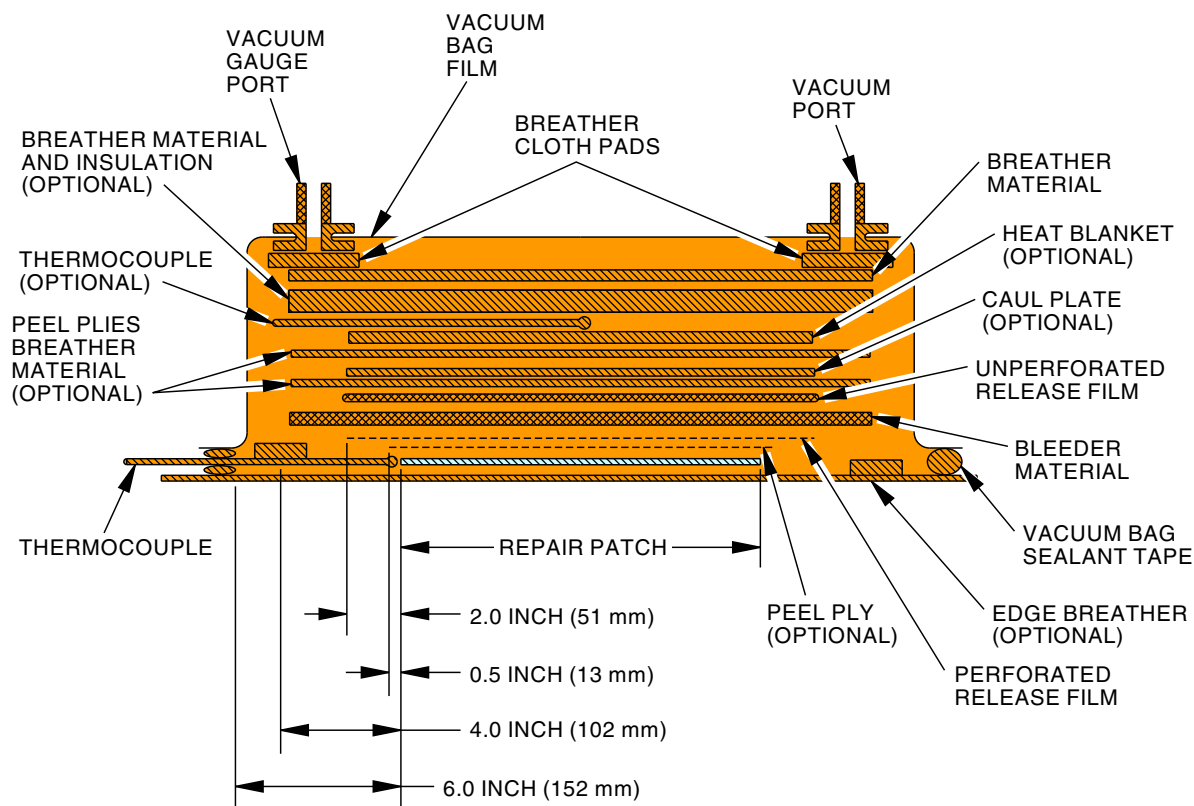
1361284-00
2471615 S0000576941_V1**Installation of a Tube Type Port**
Figure 220/70-43-43-990-820-G00EFFECTIVITY
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1361285-00

2471616 S0000576942_V1

Method 1 - Vertical Bleed Cure
Figure 221/70-43-43-990-821-G00

EFFECTIVITY
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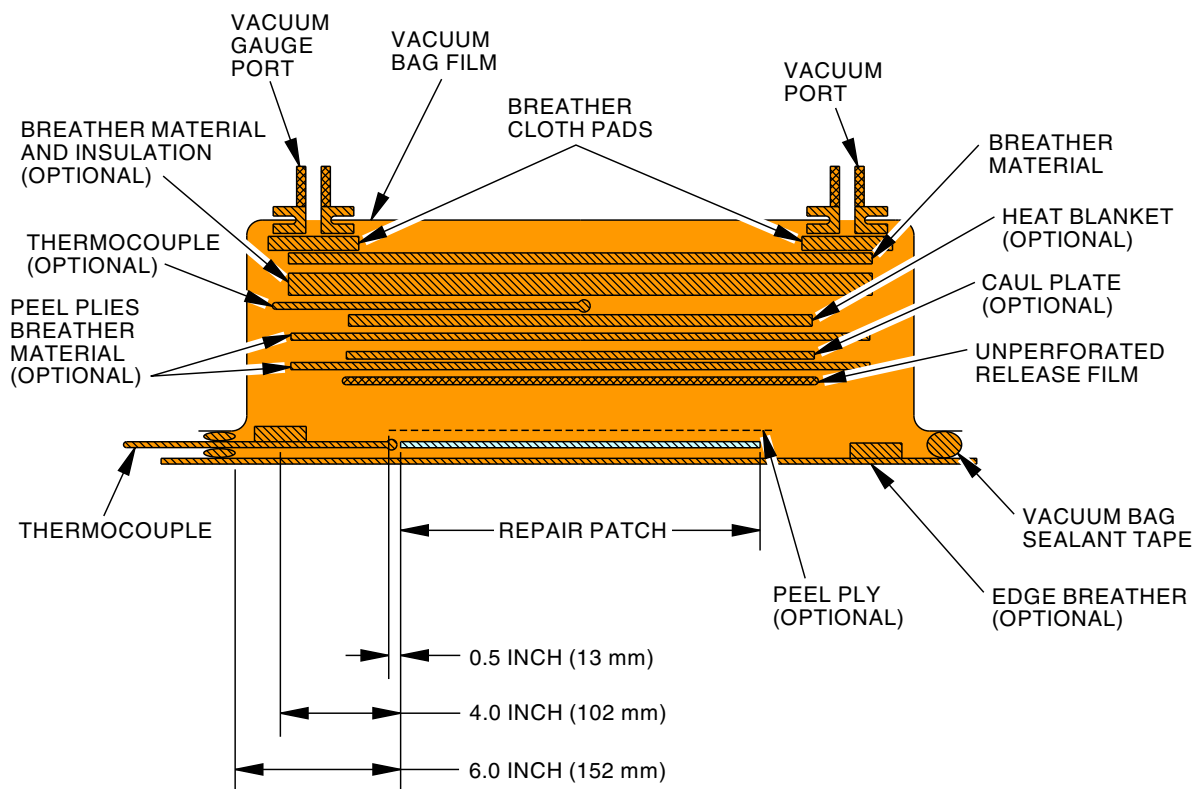
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1361286-00

2471617 S0000576944_V1

Method 2 - No Bleed Cure
Figure 222/70-43-43-990-822-G00

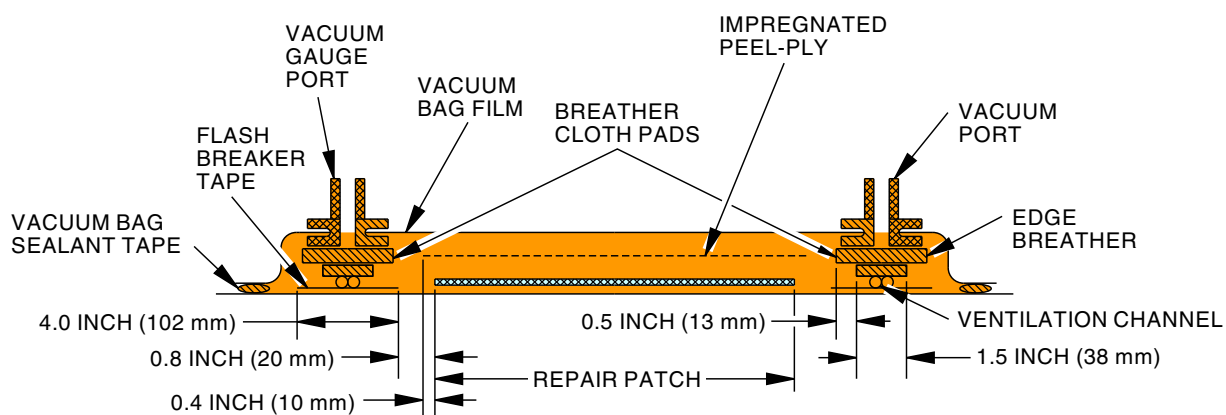
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1361287-00

2471618 S0000576945_V1

Method 3 - Squeeze Out Method Vacuum Bag
Figure 223/70-43-43-990-823-G00

EFFECTIVITY
 SIA ALL

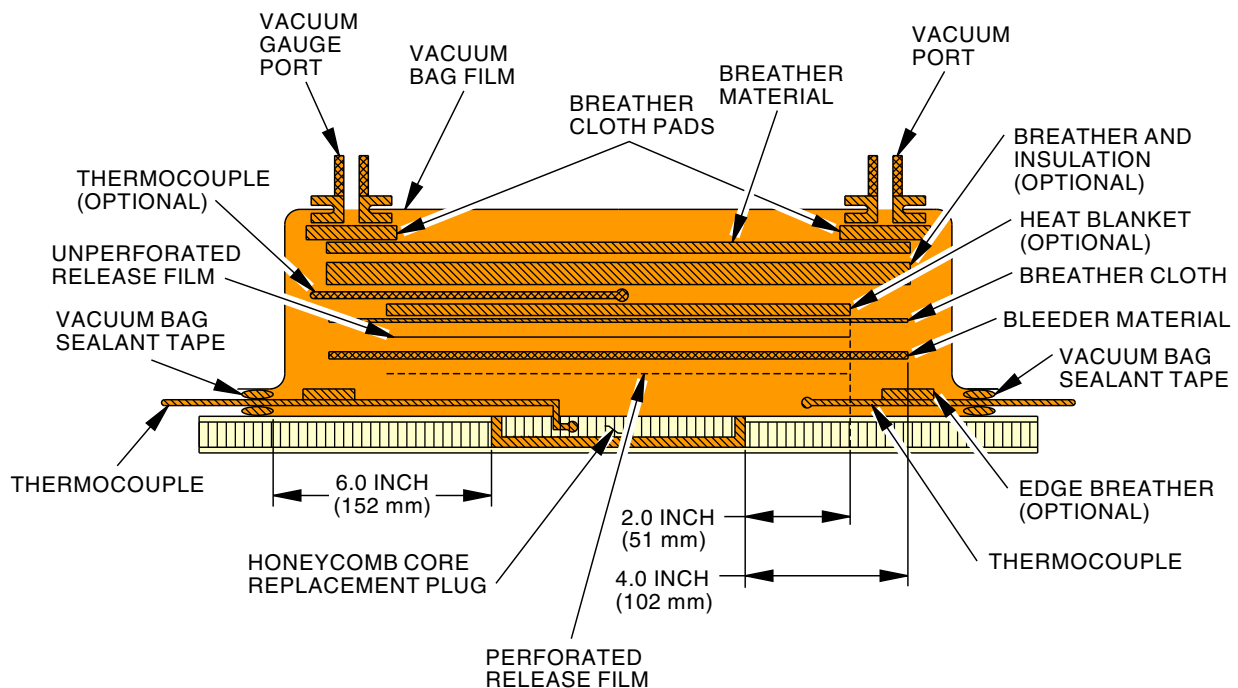
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1361288-00

2471619 S0000576947_V1

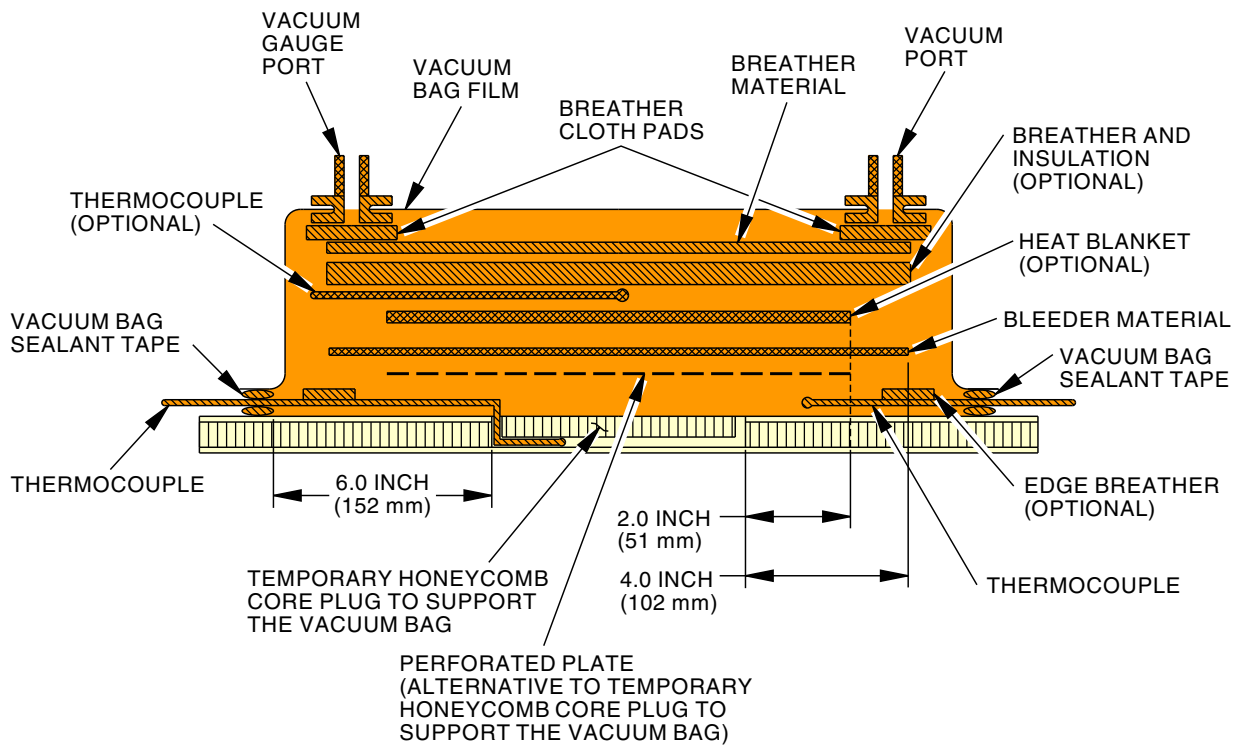
Method 4 - Core Restoration Method Vacuum Bag
Figure 224/70-43-43-990-824-G00

EFFECTIVITY
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1361289-00

2471620 S0000576948_V1

Method 5 - Drying Method Vacuum Bag
Figure 225/70-43-43-990-825-G00

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HI-LOK AND HI-LITE BOLT ASSEMBLIES RIVET - MAINTENANCE PRACTICES

1. General

A. This procedure has this task:

- (1) Hi-Lok and Hi-Lite Bolt Assemblies Rivet Repair.

TASK 70-43-51-300-801-G00

2. Hi-Lok and Hi-Lite Bolt Assemblies Rivet Repair

Figure 201, Figure 202, Figure 203, Figure 204, Figure 205, Figure 206, Figure 207, Figure 208, Figure 209, and Figure 210.

A. General

- (1) The Hi-Lok and Hi-Lite are fasteners consisting of a threaded pin and a self-locking threaded collar.
- (a) The pin threaded end contains a hexagonal shaped recess. The hex wrench tip driving tool engages the recess to prevent rotation of the pin while the collar is being installed.
- (b) The collar has an internal counterbore at the base to accommodate variations in material thickness. At the opposite end of the collar is a wrenching device which is torqued by the driving tool until it shears off during installation.
- The shear-off point occurs when predetermined preload or clamp-up is attained.
- (c) Hi-Lok and Hi-Lite bolt rivets can be installed either with manual or power driven tools. Refer to the manufacturer's documentation for tool references and selection.
- (d) Hi-Lok and Hi-Lite bolt rivets can be removed using common hand tools or a special removal tool kit available from the bolt manufacturer.
- (e) Hi-Lok protrusion can be checked using special gages available from the bolt manufacturer.

B. References

Reference	Title
70-44-50-320-801-G00	Drilling (P/B 201)

C. Preparation

SUBTASK 70-43-51-300-001-G00

- (1) For bolt holes, do the following:
- (a) Perform drilling perpendicularly to the head seating surface ($90^\circ \pm 30'$).
- 1) Unless otherwise specified, drill holes per the requirements found in Figure 201 per NAS618 and refer to Drilling, TASK 70-44-50-320-801-G00.
- (b) Whenever possible, perform drilling with the sheets clamped together to avoid offset holes.

SUBTASK 70-43-51-300-002-G00

- (2) For countersinking, do the following:
- (a) Unless otherwise specified, perform countersinks per Figure 202.

SUBTASK 70-43-51-300-003-G00

- (3) For deburring, do the following:
- (a) The hole edge of the parts to be assembled must be deburred as specified:
- 1) Under the bolt heads (flat head) edges must comply with the Figure 203.

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- 2) Edges under the nuts and the intermediate sides as well as under the countersunk heads must be deburred in compliance with the Figure 203.
- 3) Edges A and edges on intermediate sheets must be deburred within the limits specified by the hatched area in the Figure 203 but the cylindrical portion of the hole shall be ≥ 0.5 of the sheet metal thickness.
- 4) When sheets are drilled separately, the hole coaxiality must be checked.

SUBTASK 70-43-51-220-001-G00

- (4) When selecting bolts, do the following:
- (a) Use the applicable blind bolt rivet during the riveting process.
 - (b) Bolts to be used are specified in the applicable task; however, it is necessary to make sure that the thickness of sheet assembly is appropriate for rivet grip length.
 - (c) Using the gage illustrated in Figure 204, measure the thickness of assembled sheets per Figure 205. The gage can be purchased from the bolt manufacturer.
NOTE: For measuring sheet assembly thickness, the sheets must be in contact.
 - (d) If the measured thickness is not compatible with the grip length of bolts recommended in the applicable task, select bolts that meet the measured thickness requirements. See Figure 206

D. Installation of Hi-Lok and Hi-Lite Bolts

SUBTASK 70-43-51-220-002-G00

- (1) Do the following to install Hi-Lok and Hi-Lite Bolts:
- (a) Degrease the base surface of the nut.
 - (b) Bolts are lubricated by the manufacturer with a special lubricant. Check for presence of the lubrication before installation.
NOTE: Excess heat, degreasing agents, and cleaning products damage the lubricant.
 - (c) Visually check bolt for cracks, discontinuities, bumps.
 - 1) Bolts having any of the above defects must be rejected and discarded, except for round defects on the screw head within 0.004 in. (0.1 mm) deep.
 - (d) Squeeze the sheets before riveting.
 - (e) Install bolt per Figure 207, and as follows:
 - 1) Insert the pin into the prepared non-interference fit hole.
 - 2) Manually thread the collar onto the pin at least 2 pitches.
 - 3) Engage the installation tool hexagonal wrench in the bolt hexagonal driving recess.
NOTE: Do not reuse the nuts.
 - 4) Firmly press the power driver against the collar, wrenching the device until it has been torqued off.
NOTE: When Hi-Lok pins are pressed or driven into interference fit holes, the fit is sufficiently tight to grip the pin to prevent it from rotating during assembly with the collar. This means that the driving tool hex wrench tip engagement is not required to keep the pin from rotating. Hi-Lok driver tools are available using a finder pin instead of the hex wrench tip to locate the tool on the collar and pin. Except for this difference, the fastener installation is the same as described above.

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E. Replacement of Hi-Lok and Hi-Lite Bolts

SUBTASK 70-43-51-420-002-G00

(1) Do the following to replace the Hi-Lok and Hi-Lite Bolts:

(a) Removal of bolts.

NOTE: In non-interference fit holes, Hi-Loks and and Hi-Lite can be removed with common hand tools in a manner similar to removing a nut from a bolt.

1) Use a hex wrench to prevent the pin from rotating while the collar is being unscrewed with pliers.

NOTE: Whenever possible, retrieve bolts that have fallen in box-type structures.

a) Discard the nut.

(b) Inspection of bolt holes.

1) Perform visual and dimensional check of bolt holes as follows:

a) No visual defects such as cracks, unradiused sharp edges, ovalization, and etc., are acceptable.

b) Dimensions of holes must be within the tolerances specified in Figure 201.

2) When bolt holes meet the above requirements, install the original fit bolts.

3) When bolt holes do not meet the above requirements, install the oversize bolts as specified in the applicable task.

NOTE: Oversized bolts to be used can be specified for each particular case in the applicable task.

(c) Install the new bolt as previously indicated.

F. Inspection

SUBTASK 70-43-51-200-001-G00

(1) Inspection of the bolt after installation.

NOTE: Hi-Lok and Hi-Lite fasteners are visually inspected. No inspection tools or torque wrenches are required.

(a) Holding strength of the assembly

1) Check that it is not possible to move manually the bolt or nut relative to the assembled parts or the nut relative to the bolt.

(b) Bolt underhead gap

1) A bolt underhead gap (J) is permissible within the limits defined in Figure 208, provided the gap does not affect more than 10% of the bolts of the same line or of the same set providing the same assembly.

(c) Protrusion of Hi-lok and Hi-lite bolts

1) Check that bolt used is suited for the thickness of the flanges to be assembled.

2) Measure the bolt protrusion using a jig in accordance with the Figure 209. The base surface of the jig shall correspond to the machined surface of the flange or possibly the base washer located under the nut.

3) The protrusion must be in the limits defined in Figure 210 specific to each type of bolt.

————— **END OF TASK** —————

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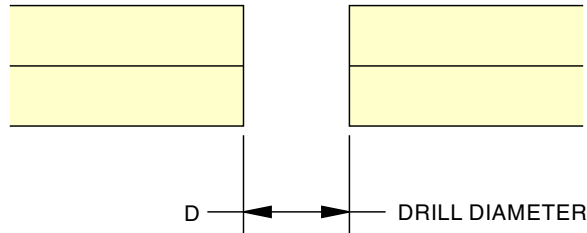
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1 ST DASH NUMBER OF PART NUMBER	STANDARD HI-LOK NOMINAL DIAMETER	DRILL DIAMETER	
		CLOSE LIMIT	GENERAL LIMIT
- 4	0.125 (3.18)	0.1375-0.1385 (3.49-3.52)	0.138-0.142 (3.51-3.61)
- 5	0.156 (3.96)	0.1635-0.1645 (4.15-4.18)	0.164-0.168 (4.17-4.27)
- 6	0.187 (4.76)	0.1895-0.1905 (4.81-4.84)	0.190-0.194 (4.83-4.93)
- 8	0.250 (6.35)	0.2495-0.2505 (6.34-6.37)	0.250-0.254 (6.35-6.45)
- 10	0.312 (7.94)	0.3120-0.3130 (7.92-7.95)	0.3125-0.3165 (7.94-8.04)
- 12	0.375 (9.52)	0.3745-0.3755 (9.51-9.54)	0.375-0.379 (9.53-9.63)
- 14	0.437 (11.11)	0.4370-0.4380 (11.10-11.13)	0.4375-0.4425 (11.11-11.21)
- 16	0.500 (12.70)	0.4995-0.5005 (12.69-12.72)	0.500-0.505 (12.70-12.80)

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2949288 S0000724847_V1

Bolt Hole Drilling Data
Figure 201/70-43-51-990-801-G00 (Sheet 1 of 3)

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1 ST DASH NUMBER OF PART NUMBER	1 ST REPAIR DIAMETER	DRILL DIAMETER	
		CLOSE LIMIT	GENERAL LIMIT
- 4	NO REPAIR BOLTS FOR THESE DIAMETERS		
- 5			
- 6	0.2026-0.2021 (5.15-5.14)	0.2026-0.2036 (5.15-5.18)	0.203-0.207 (5.16-5.26)
- 8	0.2651-0.2646 (6.73-6.72)	0.2651-0.2661 (6.73-6.76)	0.266-0.270 (6.76-6.86)
- 10	0.3276-0.3271 (8.32-8.31)	0.3276-0.3286 (8.32-8.35)	0.328-0.332 (8.33-8.43)
- 12	0.3901-0.3896 (9.91-9.90)	0.3901-0.3911 (9.91-9.94)	0.391-0.395 (9.93-10.03)
- 14	0.4526-0.4521 (11.50-11.48)	0.4526-0.4536 (11.50-11.53)	0.453-0.458 (11.51-11.61)
- 16	0.5151-0.5146 (13.08-13.06)	0.5151-0.5161 (13.08-13.11)	0.516-0.521 (13.11-13.21)

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2949287 S0000724848_V1

Bolt Hole Drilling Data
Figure 201/70-43-51-990-801-G00 (Sheet 2 of 3)

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1 ST DASH NUMBER OF PART NUMBER	2 ND REPAIR DIAMETER	DRILL DIAMETER	
		CLOSE LIMIT	GENERAL LIMIT
- 4	NO REPAIR BOLTS FOR THESE DIAMETERS		
- 5			
- 6	0.2182-0.2177 (5.54-5.53)	0.2182-0.2192 (5.54-5.57)	0.219-0.223 (5.56-5.66)
- 8	0.2807-0.2802 (7.13-7.12)	0.2607-0.2817 (7.13-7.16)	0.281-0.285 (7.14-7.24)
- 10	0.3432-0.3427 (8.72-8.71)	0.3432-0.3442 (8.72-8.75)	0.344-0.348 (8.74-8.84)
- 12	0.4057-0.4052 (10.30-10.29)	0.4057-0.4067 (10.30-10.33)	0.406-0.410 (10.31-10.41)
- 14	0.4682-0.4677 (11.89-11.88)	0.4682-0.4692 (11.89-11.91)	0.469-0.474 (11.91-12.01)
- 16	0.5307-0.5302 (13.38-13.47)	0.5307-0.5317 (13.48-13.50)	0.531-0.536 (13.49-13.59)

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2949630 S0000724849_V1

Bolt Hole Drilling Data
Figure 201/70-43-51-990-801-G00 (Sheet 3 of 3)

EFFECTIVITY
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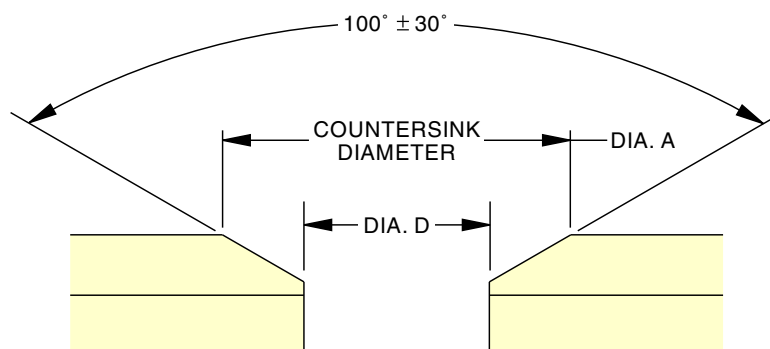
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1 ST DASH NUMBER OF PART NUMBER	COUNTERSINK DIAMETER	MINIMUM THICKNESS OF SHEETS
- 4	0.221-0.225 (5.61-5.73)	0.055 (1.4)
- 5	0.261-0.266 (6.63-6.75)	0.063 (1.6)
- 6	0.301-0.306 (7.65-7.77)	0.071 (1.8)
- 8	0.395-0.400 (10.03-10.15)	0.090 (2.2)
- 10	0.480-0.490 (12.19--12.31)	0.100 (2.5)
- 12	0.560-0.565 (14.22-14.34)	0.125 (3.2)
- 14	0.668-0.673 (16.97-17.09)	0.160 (4.0)
- 16	0.754-0.759 (19.15-19.27)	0.188 (4.8)

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2949631 S0000724850_V1

**Countersinking Data
Figure 202/70-43-51-990-802-G00**

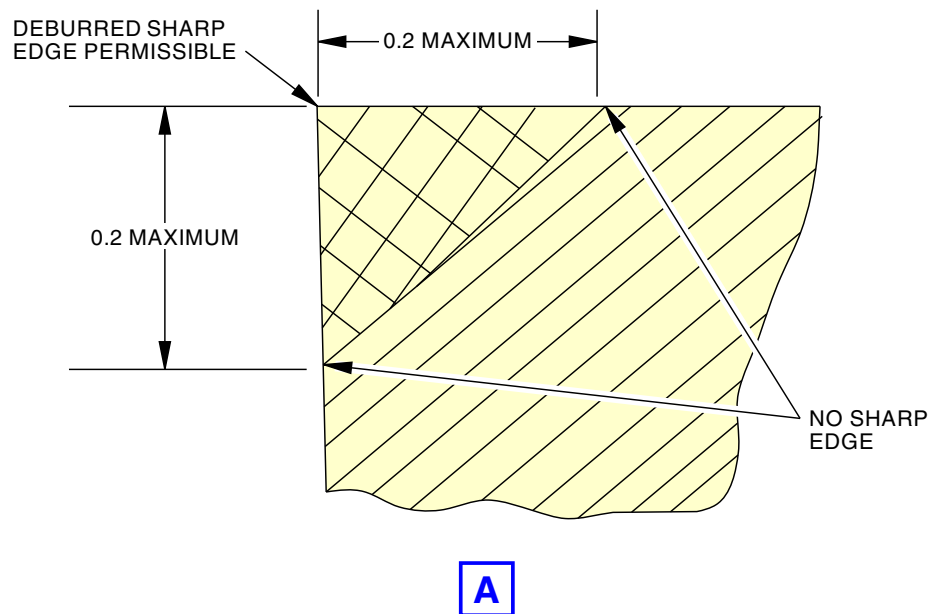
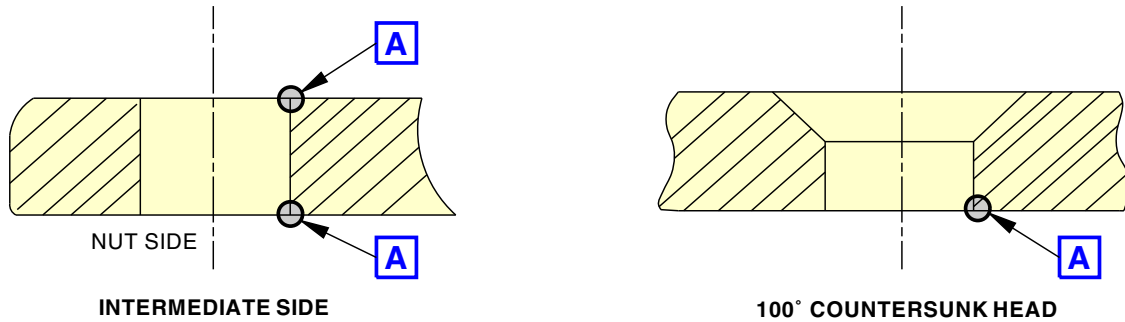
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2949632 S0000724851_V1

Sheet Deburring
Figure 203/70-43-51-990-803-G00

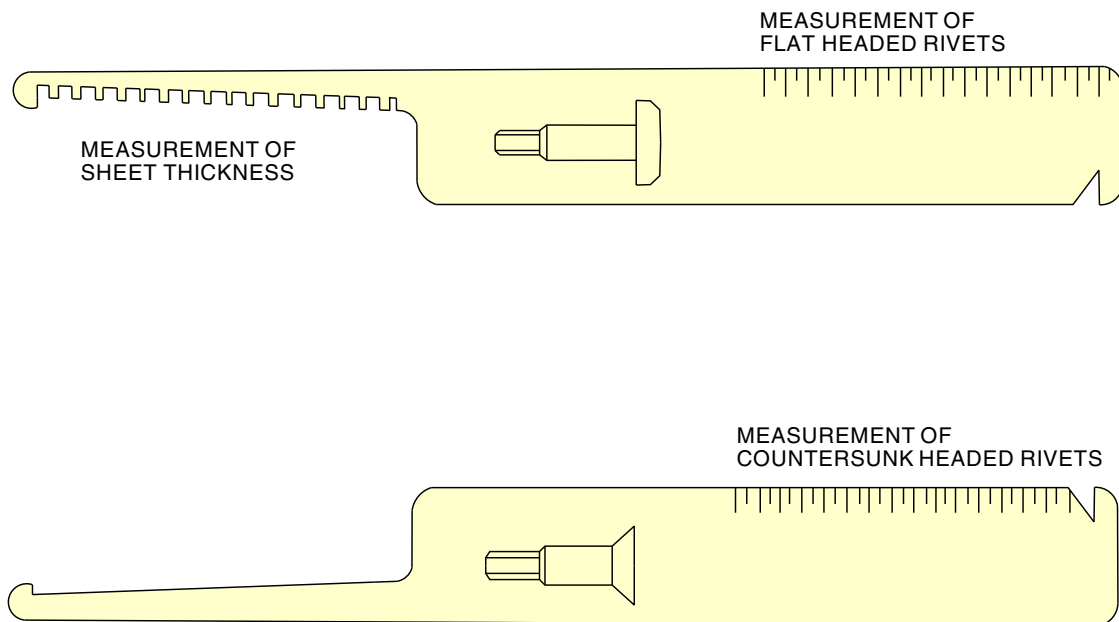
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2949637 S0000724852_V1

Thickness Measurement Gage
Figure 204/70-43-51-990-804-G00

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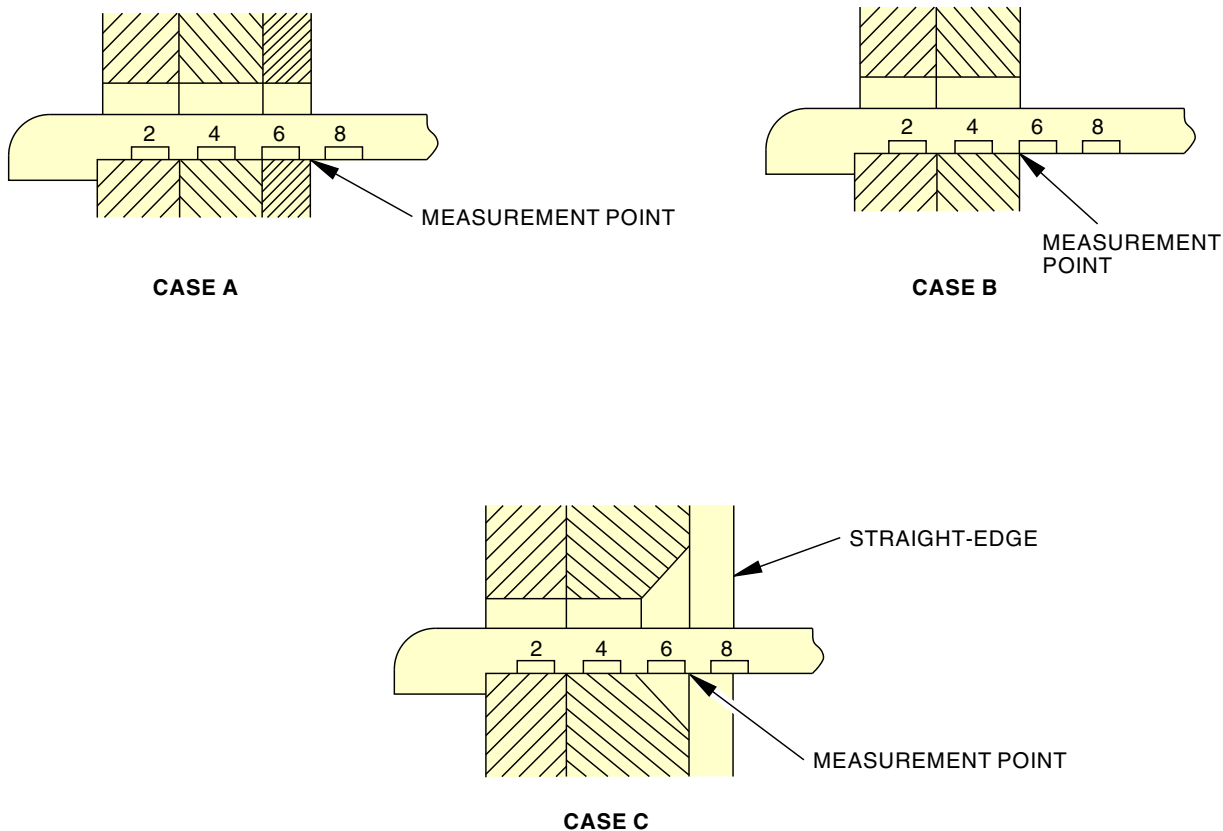
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**LEGEND:**

1. INSERT GAGE INTO HOLE.
2. HOOK GAGE ONTO REAR FACE OF ASSEMBLY.
3. READ THICKNESS OF ASSEMBLY ON FRONT FACE.

CASE A: THE MEASUREMENT POINT IS LOCATED BETWEEN TWO MARKS. SELECT A RIVET HAVING A GRIP LENGTH IMMEDIATELY BELOW FIRST READABLE MARK. (IN THIS CASE THE RIVET GRIP LENGTH MUST BE 7/16 INCH).

CASE B: THE MEASUREMENT POINT IS LOCATED OPPOSITE A MARK. SELECT A RIVET HAVING A GRIP LENGTH COMPATIBLE WITH LENGTH INDICATED ON GAGE. (IN THIS CASE 3/8 INCH).

CASE C: THE MEASUREMENT POINT IS LOCATED OVER A COUNTERSINK USING A STRAIGHT-EDGE, MAKE SURE THICKNESS IS MEASURED AT EDGE OF COUNTERSINK. (IN THIS CASE, RIVET GRIP LENGTH MUST BE 7/16 INCH).

2949624 S0000724853_V1

Assembled Sheet Thickness Measurement
Figure 205/70-43-51-990-805-G00

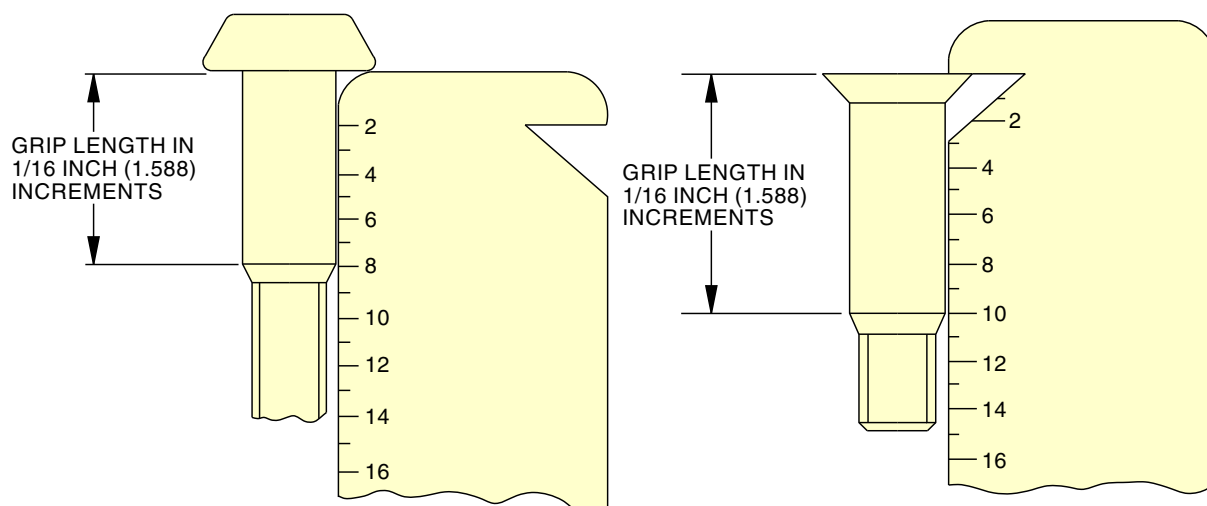
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1 ST DASH NUMBER OF PART NUMBER	MINIMUM	MAXIMUM
- 4	0.188 (4.78)	0.250 (6.35)
- 5	0.251 (6.38)	0.312 (7.92)
- 6	0.313 (7.95)	0.375 (9.52)
- 8	0.438 (11.13)	0.500 (12.70)
- 10	0.563 (14.30)	0.625 (15.87)
- 12	0.688 (17.48)	0.750 (19.05)
- 14	0.813 (20.65)	0.875 (22.22)
- 16	0.938 (23.83)	1.000 (25.40)

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2949665 S0000724854_V1

**Bolt Grip Length for Clamping Capacity
Figure 206/70-43-51-990-806-G00**

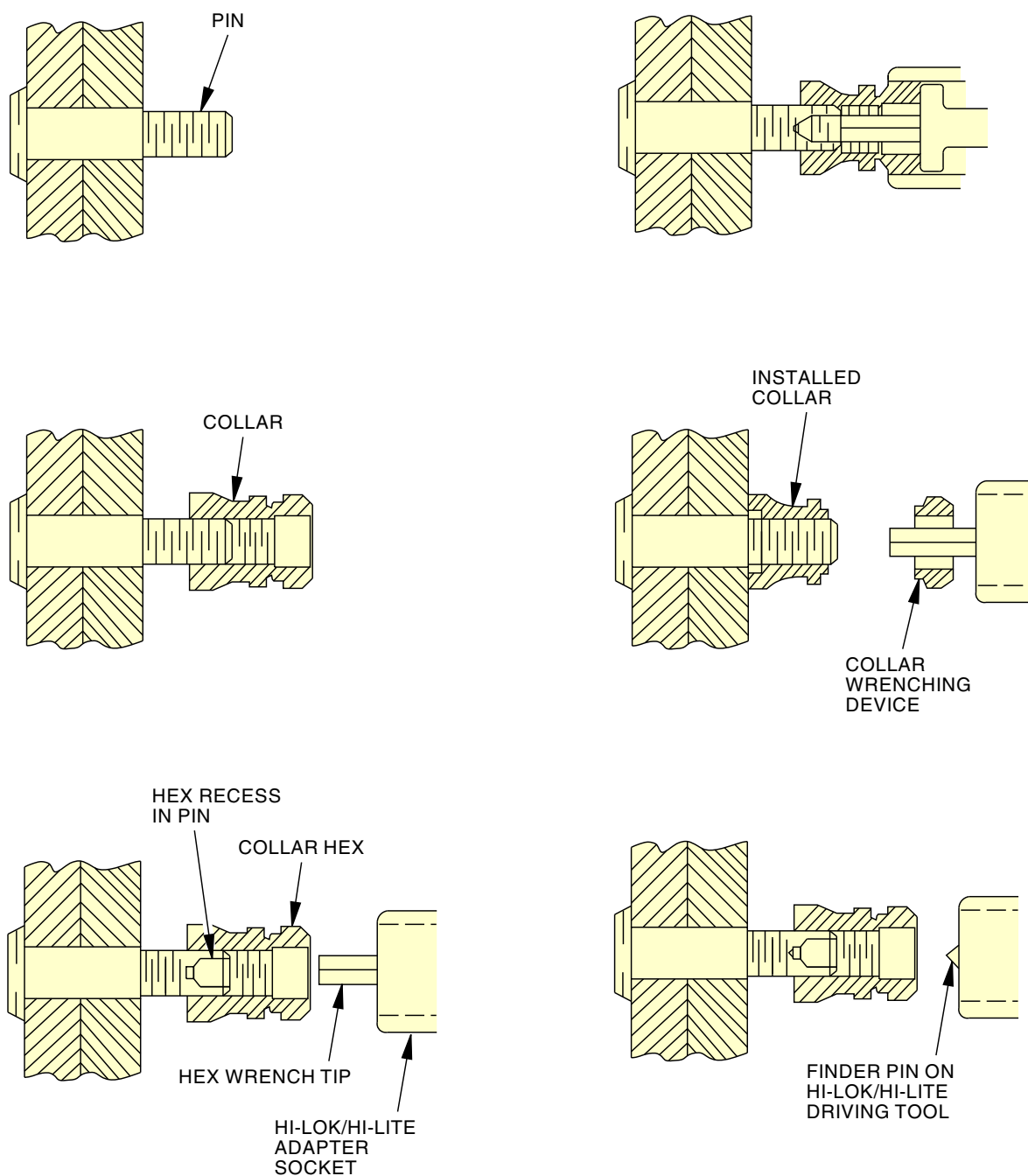
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2949730 S0000724855_V1

Hi-Lok/Hi-Lite Pin in Non-Interference Fit Hole Installation Steps
Figure 207/70-43-51-990-807-G00

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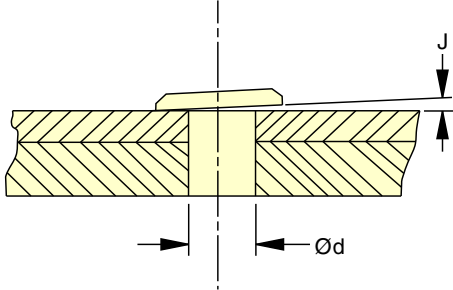
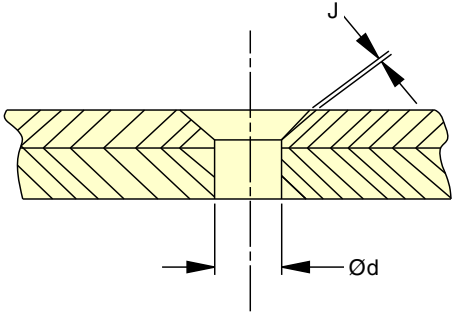
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J = THE GREATER OF THE FOLLOWING VALUES: 2% d OR 0.0039 INCH (0.1 mm)	J = THE GREATER OF THE FOLLOWING VALUES: 1.5% d OR 0.0028 INCH (0.07 mm)
OVER 40% MAX. OF THE PERIPHERY	OVER 50% MAX. OF THE PERIPHERY
IN BOTH CASES THE FEELER GAGE MUST NOT REACH THE STEM OF THE BOLT.	

2949691 S0000724856_V2

Bolt Underhead Gap
Figure 208/70-43-51-990-808-G00

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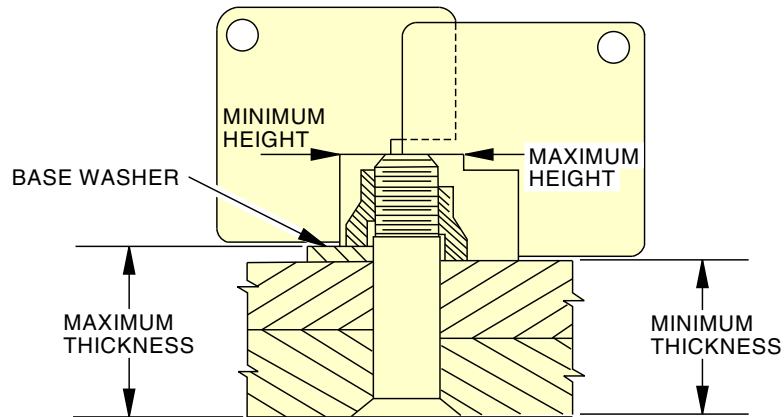
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BOLT NOMINAL DIAMETER	JIG HI-SHEAR REF (BATCH) (FOR INFORMATION ONLY)	BOLT NOMINAL DIAMETER	JIG HI-SHEAR REF (BATCH) (FOR INFORMATION ONLY)
HI-LOK (INCHES)	2-1522 (BLACK CHARACTERS)	HI-LOK (INCHES)	2-1522 HST (RED CHARACTERS)
5/32 (3.96) 3/16 (4.76) 1/4 (6.35) 5/16 (7.93) 3/8 (9.52)		5/32 (3.96) 3/16 (4.76) 1/4 (6.35) 5/16 (7.93) 3/8 (9.52)	
HI-LOK (SI UNITS)	2-1522 HLM (PURPLE CHARACTERS)	HI-LOK (SI UNITS)	2-1522 HSTM (GREEN CHARACTERS)
4 5 6 8 10 12		4 5 6 8 10 12	

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Hi-Shear Reference of Existing Jig (For Information Only)
Figure 209/70-43-51-990-809-G00

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DIA. REF.	BOLT NOMINAL DIAMETER	HEIGHT	
		MINIMUM	MAXIMUM
05	3.96 (5/32)	7.65 (0.302)	9.75 (0.384)
06	4.76 (3/16)	8.00 (0.315)	10.10 (0.397)
08	6.35 (1/4)	9.80 (0.385)	11.9 (0.467)
10	7.93 (5/16)	12.45 (0.490)	14.55 (0.572)
12	9.52 (3/8)	13.60 (0.535)	15.7 (0.617)
14	11.11 (7/16)	15.90 (0.625)	18.00 (0.707)
16	12.7 (1/2)	17.15 (0.675)	19.25 (0.757)
18	14.28 (9/16)	19.30 (0.760)	21.38 (0.842)
20	15.87 (5/8)	20.70 (0.815)	22.78 (0.897)

TABLE 1: HI-LOK BOLT/NUT INCH

DIA. REF.	BOLT NOMINAL DIAMETER	HEIGHT	
		MINIMUM	MAXIMUM
05	3.96 (5/32)	6.85 (0.270)	8.94 (0.352)
06	4.76 (3/16)	7.11 (0.280)	9.19 (0.362)
08	6.35 (1/4)	7.87 (0.310)	9.95 (0.392)
10	7.93 (5/16)	9.39 (0.370)	11.48 (0.452)
12	9.52 (3/8)	10.41 (0.410)	12.49 (0.492)
14	11.11 (7/16)	12.06 (0.475)	14.14 (0.557)
16	12.7 (1/2)	13.08 (0.515)	15.16 (0.597)
18	14.28 (9/16)	14.98 (0.590)	17.06 (0.672)
20	15.87 (5/8)	16.51 (0.650)	18.59 (0.732)

TABLE 2: HI-LITE BOLT/NUT INCH

DIA. REF.	BOLT NOMINAL DIAMETER	HEIGHT	
		MINIMUM	MAXIMUM
04	4	8.10	9.60
05	5	8.10	9.90
06	6	10.45	11.95
08	8	12.70	14.20
10	10	14.95	16.45
12	12	17.90	19.40

TABLE 3: HI-LOK BOLT/NUT (SI UNITS)

DIA. REF.	BOLT NOMINAL DIAMETER	HEIGHT	
		MINIMUM	MAXIMUM
04	4	6.86	8.36
05	5	7.40	8.90
06	6	8.40	9.90
08	8	9.40	10.90
10	10	11.57	13.07
12	12	13.08	14.58

TABLE 4: HI-LITE BOLT/NUT (SI UNITS)

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**Hi-Lok and Hi-Lite Bolts Values Protrusion
Figure 210/70-43-51-990-810-G00**

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BORE/DRILL/REAM - MAINTENANCE PRACTICES

1. General

A. This procedure has this task:

- (1) A drilling.

TASK 70-44-50-320-801-G00

2. Drilling

(Figure 201, Figure 202, Figure 203, and Figure 204)

A. General

- (1) Drilling is a machining operation that supplies circular holes with a tool, known as a twist drill. It usually has 2 cutting edges. Drilling common materials are simple in the nature but the drilling of jet engine high-temperature alloys is not easy because of work hardening materials.
- (2) Drilling speeds are generally slower than those used for other operations because the cutting edge is in continuous contact with the metal when cutting, and cutting edges are shielded from the flow and beneficial cooling action of the drilling fluid.
- (3) Successful drilling of jet engine alloys depends largely on the construction of the twist drill, rigidity of the machine and part's support, depth of the hole, and effectiveness of the drilling fluid.
- (4) In this task, L/D means length, height, depth, or thickness of a hole divided by its diameter.
- (5) The types of drilling are described as follows:
 - (a) Reaming
 - 1) Machining process designed to enlarge or improve the surface condition or sizing of a hole with a multi-fluted cutting tool.
 - (b) Single Point Boring
 - 1) The tool comprises of a boring head and a cutting tool. This process allows the production of holes of precise diameter < 0.00039 in. (0.00991 mm), the value of which can be adapted by adjustable off-centering using a micrometer. It is also possible to incorporate guiding pads.
 - (c) Gun-Drill
 - 1) A high pressure coolant fed drilling process is used to obtain deep holes (commonly L/D>3) in a single pass with an automatically guided tool with one flute and chip removal. Deep holes can also be obtained with conventional twist drills but this is not the same as gun-drilling.
 - (d) Gun Reaming
 - 1) Reaming with high-pressure lubrication for the sizing of deep holes (commonly L/D >3) using an automatically guided multi-fluted tool with chip removal.
 - (e) Helical ramp milling
 - 1) Milling process with the end of the tool by associating a circular trajectory movement following the profile of the hole combined with a continuous axial feed according to the hole axis so as to generate or enlarge a hole.
 - (f) Counterbore/Spotface/Countersink
 - 1) Drilling process designed to enlarge, improve the surface condition or the sizing of a hole using a multi-fluted cutting tool.
 - (g) Drilling-Boring.

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- 1) Precision drilling operation in which a single tool is used to perform a core drilling operation followed by a reaming machining operation to center and size the hole.

B. References

Reference	Title
70-21-23-100-801-G00	Hand Wipe Solvent Degreasing With Chemical Agent (P/B 701)

C. Consumable Materials

Reference	Description	Specification
B00676 [CP1041]	Alcohol - Isopropyl	
B01058 [CP1039]	Solvent - Acetone, Reagent Grade	
B50190 [CP1040]	Solvent - Methyl Ethyl Ketone (MEK)	ASTM D740

D. Equipment

SUBTASK 70-44-50-800-001-G00

- (1) The basic drilling machine is equipped with:
 - Base
 - Column
 - Powered spindle
 - Worktable.
- (a) The spindle is built to accept taper shank drills or drill chucks and is capable of running at a variety of speeds through the change of gears or a belt/pulley arrangement.
- (b) Either manual or power feed moves the spindle and/or worktable up and down to accommodate the size of the workpiece.

E. Materials

SUBTASK 70-44-50-800-002-G00

- (1) Twist Drills
 - (a) The recommended twist drill material for use on particular alloys is shown in Figure 201.
 - (b) Twist drill point geometry is shown in Figure 202.

SUBTASK 70-44-50-800-003-G00

- (2) Drilling Fluids
 - (a) Drilling fluids are used for cooling and lubricating the cutting tool and workpiece.
NOTE: The glue or adhesive used to maintain elements (tools, temporary protections, dampers, etc.) in temporary contact can affect the physical, chemical, and mechanical properties of the parts to be machined.
 - (b) There are 2 classes of drilling fluids:
 - 1) Straight cutting oils
 - 2) Water soluble products (synthetic or non-synthetic fluids).

**CAUTION**

MAKE SURE THAT THE DRILLING FLUIDS DO NOT CONTAIN CHLORINE WHEN YOU DRILL TITANIUM PARTS. IF YOU DO NOT OBEY, DAMAGE TO THE TITANIUM PARTS CAN OCCUR.

- (c) The drilling fluids must be inactive, must not cause any chemical reaction with the workpiece especially those used with the machining of aluminum and copper alloys.

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F. Drilling

SUBTASK 70-44-50-800-004-G00



DO NOT SPINDLE SPEED AND FEEDRATE OVERRIDES TO ADJUST THE PROGRAMMED CUTTING PARAMETERS DURING MACHINING. IF YOU DO NOT OBEY, INJURY TO PERSONNEL CAN OCCUR.

- (1) For conventional drilling, it is recommended the restrictive machining conditions shown in Figure 201.

SUBTASK 70-44-50-300-001-G00

- (2) The cause and solution to avoid poor tool life are the following:
 - (a) The cause of poor tool life in deep hole drilling (holes more than 3 or 4 diameters) is that the deeper the drill penetrates, the tighter the hole become.
NOTE: This tightening action generates more heat and shortens the tool life.
 - (b) To resolve the poor tool life, do these steps (Figure 203):
NOTE: This 2-step drilling procedure improves the drill life from 2 holes per drill sharpening to 40 holes.
NOTE: Because 5/16 in. (7.94 mm) diameter holes must penetrate more than 6 diameters (2 in. (50.8 mm)) material, it is necessary to use the special drilling steps.
 - 1) Drill a half-way hole through the material with the nominal size drill.
 - 2) Continue to drill the hole with a smaller drill than the one used to drill the first half of the hole.
 - a) Ream the hole of the same size throughout its length.

SUBTASK 70-44-50-700-001-G00

- (3) To improve the success of the drilling operation, do these steps:
 - (a) Make sure that drilling setup is rigid.
NOTE: A rigid setup prevents any vibration that causes work hardening and cutting edges' chipping.
 - (b) If it is possible, plan for a single operation.
NOTE: It can be difficult to start a second operation because of work hardened surfaces caused by the first operation.

G. Quality Assurance

SUBTASK 70-44-50-700-002-G00

- (1) Check the machined part to make sure that the drilled holes are properly positioned and are of the correct diameter.

SUBTASK 70-44-50-100-001-G00



YOU MUST USE ISOPROPYL ALCOHOL CP1041 TO REMOVE GREASE FROM THE COMPOSITE PARTS. IF YOU DO NOT OBEY, DAMAGE TO THE COMPOSITE PARTS CAN OCCUR.

- (2) To remove any temporary protection products and degrease the machined area use acetone solvent, B01058 [CP1039], or solvent, B50190 [CP1040], or alcohol, B00676 [CP1041] (TASK 70-21-23-100-801-G00).

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SUBTASK 70-44-50-700-003-G00

- (3) Check the parts for defects (Figure 204).
 - (a) Make sure that the parts are free from coloring, unusual burrs, unusual surface appearance (orange peel, waviness, etc.), residue, or pollution.

———— **END OF TASK** ————

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	WROUGHT NICKEL-BASED ALLOYS (TYPE INCONEL 718)		
	0.5: MULTIPLY BY THIS FACTOR TO CALCULATE THE CUTTING SPEED WHEN USING HIGH SPEED STEEL TOOLS		
	RECOMMENDED MAXIMUM RADIAL DEPTH OF CUT IN FINISHING OPERATIONS: 0.015 INCH (0.381 mm) UNLESS OTHERWISE SPECIFIED		
HOLE MAKING PROCESS	REQUIREMENTS		RECOMMENDATIONS
	MAXIMUM CUTTING SPEED INCH/MIN (M/MIN)	MAXIMUM CHIP LOAD INCH/TOOTH (mm/TOOTH)	HOLE MAKING TOOLS / METHODS
DRILL (L/D ≤ 3)	539.4 (13.7)	0.0020 (0.051)	POINT ANGLE OF 135° TO 150°. HELIX ANGLE 12°-28° MAX. VARIATION IN CUTTING LIP HEIGHT: 0.00049 INCH (0.0127 mm) USE THE PECK DRILLING METHOD FOR DEEP HOLES.
DRILL (DIA. > 0.149 INCH (3.81 mm), L/D > 3)	480.3 (12.2)	0.0015 (0.038)	
DRILL (DIA. ≤ 0.149 INCH (3.81 mm), L/D > 3)	421.3 (10.7)	0.0015 (0.038)	
DRILL-BORE (L/D ≤ 1)	539.4 (13.7)	0.0015 (0.038)	SPIRAL AT 140°; NARROW MARGIN WIDTH BORE CUTTING FACE ANGLE: 28° TO 32° MAX. VARIATION IN CUTTING LIP HEIGHT: 0.00049 INCH (0.0127 mm) DRILL THROUGH BEFORE BORE BEGINS. DEPTH OF CUT FOR BORE: 0.0059 INCH (0.15 mm) TO 0.0118 INCH (0.30 mm)
DRILL-BORE (L/D > 1)	539.4 (13.7)	0.0015 (0.038)	
COOLANT-FED TOOL OR GUN-DRILLING	960.6 (24.4)	0.0015 (0.038) FOR COOLANT-FED TOOLS 0.00071 (0.018) FOR GUN-DRILL	FLUID PRESSURE > 797 PSI (55 BARS) RECOMMENDED FOR GUN-DRILL
PLUNGE MILL (NON APPLICABLE PARAMETERS FOR THE LAST MACHINING STEP)	421.3 (10.7)	0.00098 (0.025)	NARROW MARGIN WIDTH DO NOT EXCEED 0.0020 INCH/TOOTH (0.051 mm/TOOTH) MAX. RADIAL DEPTH OF CUT 0.0020 INCH (0.51 mm) FOR FINISHING CUTS
PERIPHERAL MILL	598.4 (15.2)	0.00098 (0.025)	NARROW MARGIN WIDTH MAX. FEED RATE: 0.499 INCH/MIN (12.7 mm/MIN) CALCULATE THE FEED RATE AT THE OUTER DIAMETER OF THE CUTTER AND NOT AT THE CENTER MAXIMUM RADIAL DEPTH OF CUT: 0.0099 INCH (0.254 mm)
HELICAL RAMP MILLING	960.6 (24.4)	0.0029 (0.076)	MINIMUM TOOL CORNER RADIUS: 0.0399 INCH (1.016 mm) AXIAL FEED: 0.0099 INCH (0.254 mm) PER PASS USE CENTER-CUTTING END-MILL WITH GENEROUS GASH AND SMOOTH BLENDS
REAM / END-MILL SIZE (L/D ≤ 4)	421.3 (10.7)	0.0015 (0.038)	MAX. REAMER MARGIN WIDTH: 0.0099 INCH (0.254 mm) END CHAMFER: 45° REAMER (THROUGH-HOLE): RIGHT-HAND HELIX 12-15°, RIGHT-HAND CUT END-MILLING: PRIMARY AND SECONDARY CLEARANCES AXIAL CLEARANCE BETWEEN 0.007 AND 0.013 INCH/INCH (mm/mm) MAXIMUM MARGIN WIDTH: 0.0049 INCH (0.127 mm) MAXIMUM RADIAL DEPTH OF CUT: 0.0099 INCH (0.254 mm) FOR REAMER AND 0.0149 INCH (0.381 mm) FOR END MILL.
REAM / END-MILL SIZE (L/D > 4)	358.2 (9.1)	0.0015 (0.038)	
COOLANT-FED REAM AND GUN REAM	421.3 (10.7)	0.0015 (0.038) FOR COOLANT-FED 0.0005 (0.013) FOR GUN REAM	6 FLUTES RADIAL DEPTH OF CUT: 0.0059 INCH (0.152 mm) TO 0.00799 INCH (0.203 mm) FOR GUN REAM AND 0.0099 INCH (0.254 mm) MAX FOR REAM
SINGLE POINT BORE	1440.9 (36.6)	0.00098 (0.025)	MAXIMUM RADIAL DEPTH OF CUT: 0.0059 INCH (0.152 mm) RIGID BORING BAR REQUIRED
COUNTERBORE AND SPOTFACE	539.4 (13.7)	0.0015 (0.038)	
COUNTERSINK, RADIUS CUTTER AND CHAMFERMILL	720.5 (18.3)	0.00098 (0.025)	4 FLUTES MINIMUM DEPTH OF CHAMFER: 0.0099 INCH (0.254 mm) TO 0.0199 INCH (0.508 mm)
HAND-FED RADIUS CUTTER OR HAND-FED COUNTERSINK (PLUNGE)	358.2 (9.1)	0.00098 (0.025)	4 FLUTES MINIMUM DEPTH OF CHAMFER: 0.0099 INCH (0.254 mm) TO 0.0149 INCH (0.381 mm)
SINGLE POINT CHAMFER	720.5 (18.3)		
SINGLE POINT RADIUS	720.5 (18.3)		

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Machining Parameters and Recommendations for Tools and Cutting Conditions
Figure 201/70-44-50-990-801-G00 (Sheet 1 of 2)

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	WROUGHT TITANIUM-BASED ALLOYS (Ti17, TA6V)		
	0.8: MULTIPLY BY THIS FACTOR TO CALCULATE THE CUTTING SPEED FOR HIGH SPEED STEEL TOOLS.		
HOLE MAKING PROCESS	REQUIREMENTS		RECOMMENDATIONS
	MAXIMUM CUTTING SPEED INCH/MIN (M/MIN)	MAXIMUM CHIP LOAD INCH/TOOTH (mm/TOOTH)	HOLE MAKING TOOLS / METHODS
DRILL (L/D ≤ 3)	838.5 (21.3)	N/A	POINT ANGLE OF 140°. HELIX ANGLE 12°-28° MAX. VARIATION IN CUTTING LIP HEIGHT: 0.00049 INCH (0.0127 mm) USE THE PECK DRILLING METHOD FOR DEEP HOLES.
DRILL (DIA. > 0.149 INCH (3.81 mm), L/D > 3)	779.5 (19.8)	N/A	
DRILL (DIA. ≤ 0.149 INCH (3.81 mm), L/D > 3)	661.4 (16.8)	N/A	
DRILL-BORE (L/D ≤ 1)	838.5 (21.3)	N/A	SPIRAL AT 140°; NARROW MARGIN WIDTH BORE CUTTING FACE ANGLE: 28° TO 32° MAX. VARIATION IN CUTTING LIP HEIGHT: 0.00049 INCH (0.0127 mm) DRILL THROUGH BEFORE BORE BEGINS. DEPTH OF CUT FOR BORE: 0.0059 INCH (0.15 mm) TO 0.0118 INCH (0.30 mm)
DRILL-BORE (L/D > 1)	779.5 (19.8)	N/A	
COOLANT-FED TOOL OR GUN-DRILLING	1440.9 (36.6)	N/A	FLUID PRESSURE > 797 PSI (55 BARS) RECOMMENDED FOR GUN-DRILL
PLUNGE MILL (PARAMETERS NOT APPLICABLE TO LAST MACHINING STEP)	661.4 (16.8)	N/A	NARROW MARGIN WIDTH DO NOT EXCEED 0.0020 INCH/TOOTH (0.051 mm/TOOTH) MAX. RADIAL DEPTH OF CUT 0.0020 INCH (0.51 mm) FOR FINISHING CUTS
PERIPHERAL MILL	901.5 (22.9)	N/A	NARROW MARGIN WIDTH MAX. FEED RATE: 0.499 INCH/MIN (12.7 mm/MIN) CALCULATE THE FEED RATE AT THE OUTER DIAMETER OF THE CUTTER AND NOT AT THE CENTER MAXIMUM RADIAL DEPTH OF CUT: 0.0099 INCH (0.254 mm)
HELICAL RAMP MILLING	1440.9 (36.6)	N/A	MINIMUM TOOL CORNER RADIUS: 0.0399 INCH (1.016 mm) AXIAL FEED: 0.0099 INCH (0.254 mm) PER PASS USE CENTER-CUTTING END-MILL WITH GENEROUS GASH AND SMOOTH BLENDS
REAM / END-MILL SIZE (L/D ≤ 4)	539.4 (13.7)	0.0019 (0.05)	MAX. REAMER MARGIN WIDTH: 0.0099 INCH (0.254 mm) END CHAMFER: 45° REAMER (THROUGH-HOLE): RIGHT-HAND HELIX 12-15°, RIGHT-HAND CUT END MILLING: PRIMARY AND SECONDARY CLEARANCES REAR CONICITY OF EFFECTIVE PART BETWEEN 0.007 AND 0.013 INCH/INCH (mm/mm) MAXIMUM MARGIN WIDTH: 0.0049 INCH (0.127 mm) MAX. RADIAL DEPTH OF CUT: 0.0099 INCH (0.254 mm) FOR REAMER AND 0.0149 INCH (0.381 mm) FOR END MILL.
REAM / END-MILL SIZE (L/D > 4)	539.4 (13.7)	0.0019 (0.05)	
COOLANT-FED REAM OR CENTRE OR GUN REAM	539.4 (13.7)	0.0019 (0.05)	6 FLUTES RADIAL DEPTH OF CUT: 0.0059 INCH (0.152 mm) TO 0.00799 INCH (0.203 mm) FOR GUN REAM AND 0.0099 INCH (0.254 mm) MAX FOR REAM
SINGLE POINT BORE	1799.2 (45.7)	N/A	MAXIMUM RADIAL DEPTH OF CUT: 0.0059 INCH (0.152 mm) RIGID BORING BAR REQUIRED
COUNTERBORE AND SPOTFACE (MULTI-TOOTH)	779.5 (19.8)	N/A	
COUNTERSINK OR RADIUS CUTTER OR CHAMFERMILL	1200.7 (30.5)	N/A	4 FLUTES MINIMUM DEPTH OF CHAMFER: 0.0099 INCH (0.254 mm) TO 0.0199 INCH (0.508 mm)
HAND-FED RADIUS CUTTER OR HAND-FED COUNTERSINK (PLUNGE)	598.4 (15.2)	N/A	4 FLUTES MINIMUM DEPTH OF CHAMFER: 0.0099 INCH (0.254 mm) TO 0.0149 INCH (0.381 mm)
SINGLE POINT CHAMFER	838.5 (21.3)	N/A	
SINGLE POINT RADIUS	838.5 (21.3)	N/A	

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Machining Parameters and Recommendations for Tools and Cutting Conditions
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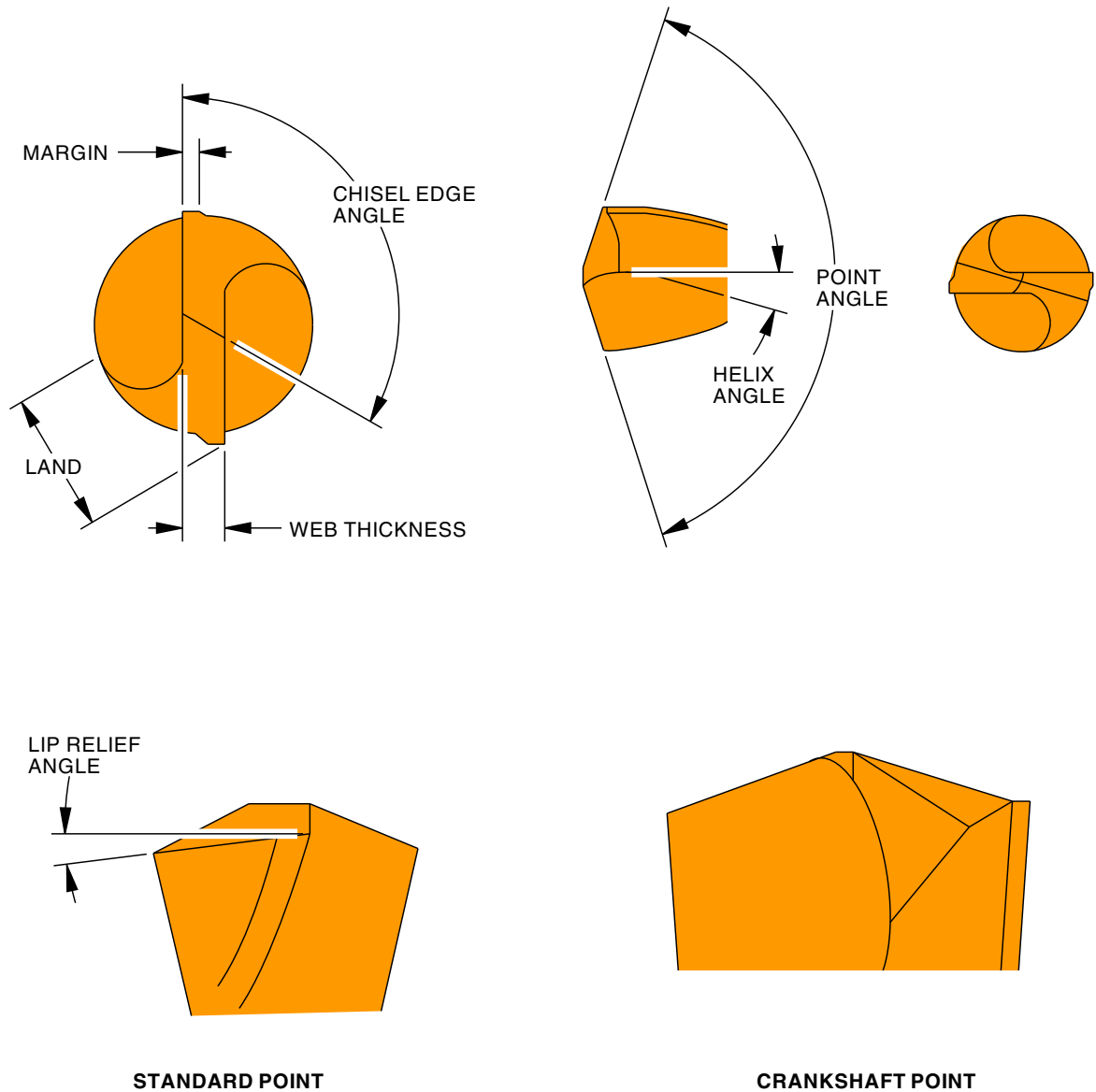
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Twist Drill Point Nomenclature
Figure 202/70-44-50-990-802-G00

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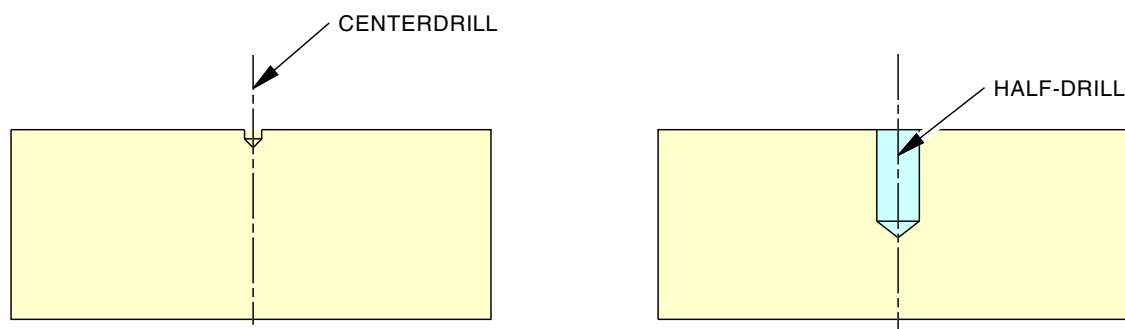
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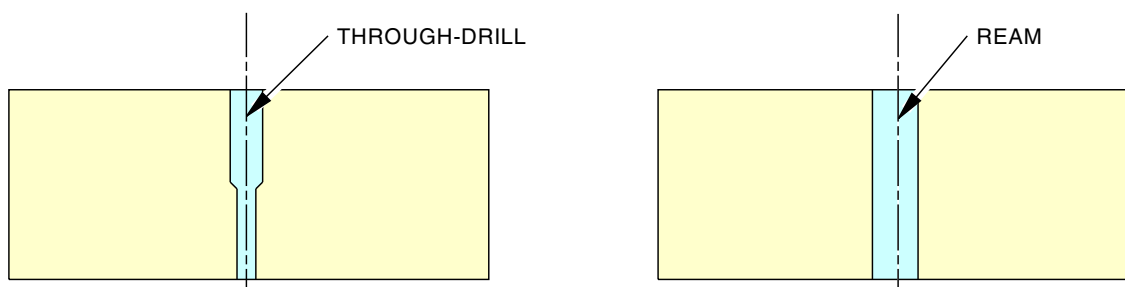
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STEP 1



STEP 2

STEP-DRILLING DEEP HOLES IN INCONEL 718

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Two-Step Drilling
Figure 203/70-44-50-990-803-G00

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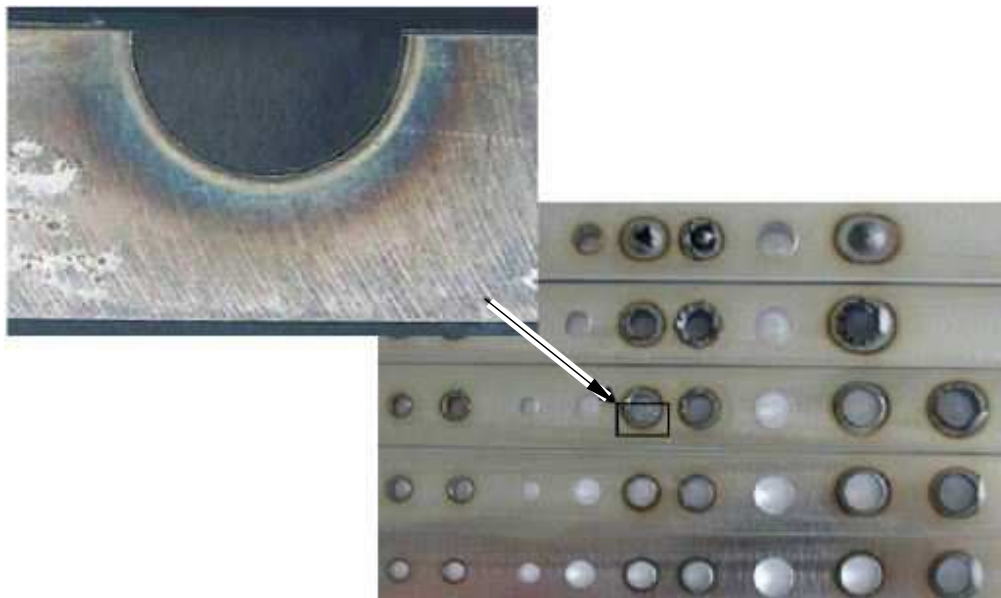
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**COLORING FOR DIFFERENT DEGRADED CONDITIONS IN THE DRILLING OF INCONEL 718
(EXAMPLE)**



**COLORED HOLES AFTER DRILLING OPERATIONS IN INCONEL 718
(EXAMPLE)**

NOTE:

THE COLORING OF A HOLE CORRESPONDS TO A METAL OXIDATION AFTER MACHINING DUE TO EXCESSIVE HEATING. EXCESSIVE HEATING DURING MACHINING OPERATIONS MAY LEAD TO THE FORMATION OF A POTENTIALLY HARMFUL AFFECTED LAYER THAT CAN REDUCE THE FATIGUE RESISTANCE OF THE PART.

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Surface Drilling Induced Anomalies on Parts
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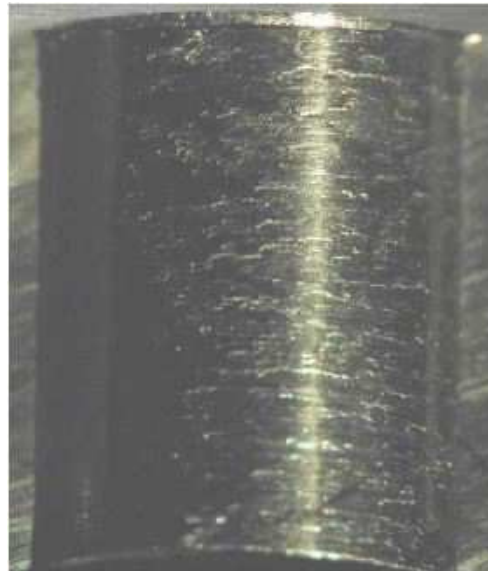
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UNUSUAL BURRS (B AND C) IN COMPARISON WITH A BURR AFTER
DRILLING IN REFERENCE CONDITIONS (A)
(EXAMPLE)



GLUED CHIPS TO THE SURFACE OF A HOLE
(EXAMPLE)

NOTE:

UNUSUAL BURRS ARE THOSE WHICH ARE LONGER OR THICKER THAN TYPICAL. THIS DEVIATION IS CONSEQUENCE OF AN INCORRECT CUT OR EXCESSIVELY WORN CUTTING TOOL AND REPRESENTS THE VISIBLE PART OF A SEVERELY DEFORMED UNDERLAYER.

A HIGH DENSITY OF GLUED CHIPS TO THE SURFACE OF A HOLE INDICATES A HIGH PROBABILITY OF EMBEDDED CHIPS INSIDE THE MATERIAL CAUSING SOME ZONES WITH POTENTIAL CRACK INITIATIONS.

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Surface Drilling Induced Anomalies on Parts
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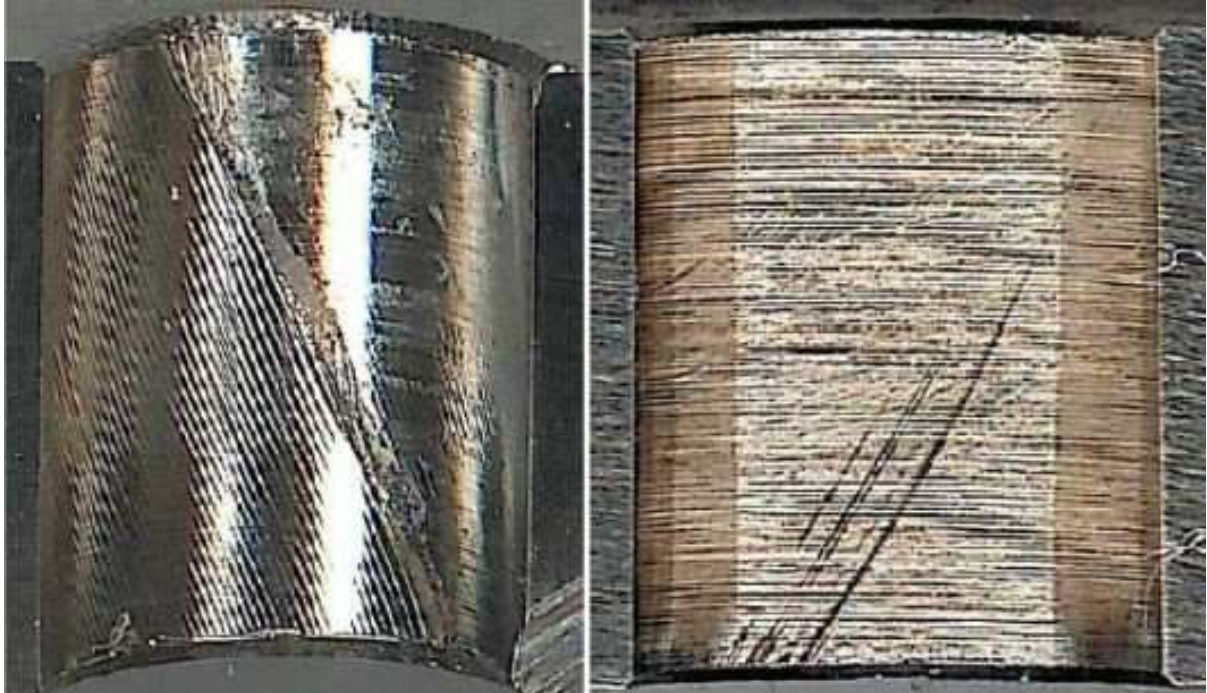
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**VIBRATION MARKS AND OF ABNORMAL STRIATIONS OF UPWELLING
(EXAMPLE)**

NOTE:

THE UNUSUAL SURFACE APPEARANCES CORRESPOND TO ALL MARKS PRESENT ON THE MACHINED SURFACE, EXCEPTING THE NORMAL SURFACE LAY PRODUCED BY THE PROGRESS OF THE DRILLING TOOLS. THESE MARKS CAN BE:

- CYCLIC, SUCH AS THE MARKS OF VIBRATION, UNDULATIONS OR ORANGE PEEL (EVIDENCE OF AN INSTABILITY OF THE CUT);
- SPECIFIC, SUCH AS:
 - VERY PRONOUNCED STRIATIONS OF UPWELLING, DEEP MACHINING STRIATIONS (EVIDENCE OF ADHERENCE PROBLEMS OF THE CHIP TO THE TOOL)
 - A POLLUTION OF THE SURFACE OF THE HOLE BY PIECES OF TOOLS, EXTERNAL ELEMENTS, OR RE-BONDED CHIPS/PARTICLES OF THE WORK MATERIAL
 - CRACKS

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**Surface Drilling Induced Anomalies on Parts
Figure 204/70-44-50-990-804-G00 (Sheet 3 of 3)**

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AIRCRAFT MAINTENANCE MANUAL**

ALUMINUM CASTINGS STANDARD REPAIR (BLIND THREADED HOLE) - MAINTENANCE PRACTICES

1. General

A. This procedure has one task:

- (1) Aluminum castings standard repair (blind threaded hole).

TASK 70-48-09-300-801-G00

2. Aluminum Castings Standard Repair (Blind Threaded Hole)

(Figure 201)

A. General

- (1) This task provides the instructions on how to do an aluminum casting (blind threaded hole) repair.
- (2) You can repair a blind threaded hole in an aluminum casting when there is sufficient wall thickness in the part. The procedure is almost the same as the installation of a threaded insert into a hole. You must prepare the threaded hole and make a threaded plug.

B. References

Reference	Title
70-43-07-300-801-G00	Specifications Chemical Touchup for Aluminum Standard Repair (P/B 201)
70-43-17-300-801-G00	Mating Surfaces and Inserts Standard Repair (P/B 201)

C. Tools/Equipment

Reference	Description
STD-293	Drill - Tap
STD-864	Tap - Bottoming

D. Consumable Materials

Reference	Description	Specification
A01059 [C01-011]	Paste - Adhesive, Two Part (Hysol EA 934NA)	A50TF94 Class B
D00656 [C02-047]	Lubricant - Cutting Fluid - Cimperial 1070	

E. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

F. Procedure

SUBTASK 70-48-09-320-001-G00

- (1) Do these steps to repair a damaged blind threaded hole in an aluminum casting:
- (a) Prepare the threaded hole:
- 1) Use a tap drill, STD-293 with Cimperial 1070 lubricant, D00656 [C02-047] and drill out all the damage.
 - a) After you use the tap drill, make sure that there is a minimum wall thickness of 0.125 in. (3.18 mm).
 - b) Make sure that the tapped bushing has a minimum wall thickness of 0.063 in. (1.6 mm).
 - 2) Visually align the centerline of the tap drill, STD-293 with the centerline of the damaged hole.

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- 3) Set the drill perpendicular to the hole, and drill out the boss to the depth of the original hole.
 - 4) Tap the hole in two operations:
 - a) Use a plug tap of the correct size to start the threads.
 - b) Use a bottoming tap, STD-864 to continue the threads to the bottom of the hole.
 - 5) Use a vacuum to remove all the loose metal particles from the hole.
- (b) Make a threaded plug:

NOTE: This procedure gives instructions to make a threaded plug from Aluminum, AMS 4117, 4218, or 4219, or Aluminum bronze , AMS 4640.

- 1) Machine a plug to the correct diameter and length to fit in the threaded hole.
 - a) Make sure that the completed length of the plug is a minimum of 0.10 in. (2.54 mm) longer than the threaded depth of the hole.
 - 2) Thread the plug.
 - 3) Chamfer one end of the plug.
 - 4) The steps that follow are optional:
 - a) Drill a pilot hole through the full length of the plug along its axial centerline.
 - b) The diameter of the hole must be smaller than the tap drill, STD-293 that you will use to make the final internal threads of the bushing.

<1> Make sure that the diameter of the hole is sufficiently large to use as a pilot hole.
 - c) Make sure that the hole is concentric to a maximum of 0.007 in. (0.18 mm) with the external thread diameter.

NOTE: The pilot hole will be a vent when the plug is installed into the boss.
 - d) Make a cut or mill a diametrical slot in the unchamfered end of the plug, not less than 0.063 in. (1.600 mm) in depth.

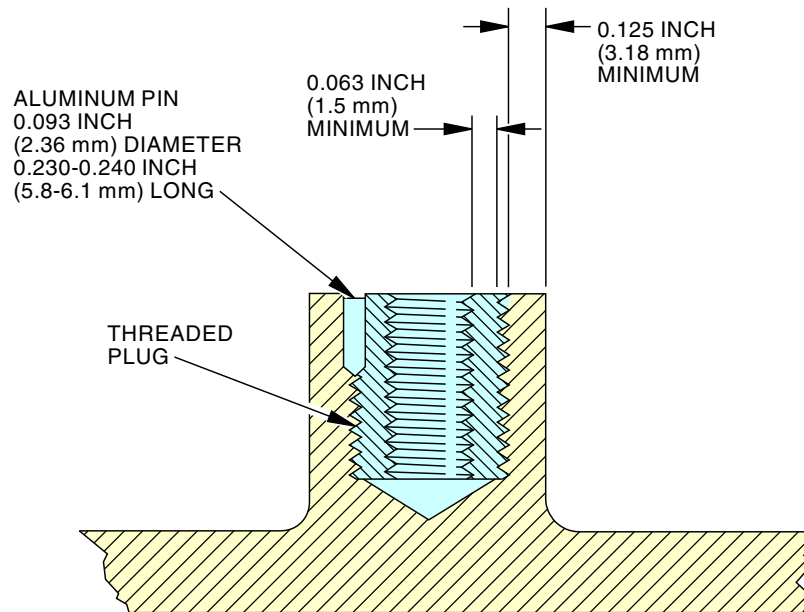
NOTE: You do this step to let you use a screwdriver to assemble the parts.
 - 5) Use a vacuum to remove all loose metal particles from the plug.
- (c) Install the threaded plug into the tapped hole.
- 1) Put a light layer of Hysol EA 934NA adhesive paste, A01059 [C01-011] on the plug and threaded hole (TASK 70-43-17-300-801-G00).
 - 2) Install the plug into the threaded hole until the plug bottom touches the bottom of the threaded hole.
 - 3) Immediately remove the unwanted Hysol EA 934NA adhesive paste, A01059 [C01-011].
 - 4) Let the Hysol EA 934NA adhesive paste, A01059 [C01-011] on the threads dry for 24 hours at room temperature.
 - 5) Machine the plug flush with the face of the boss.
 - 6) Drill a hole of 0.0935 ± 0.0005 in. (2.37 ± 0.02 mm) diameter and 0.255 ± 0.005 in. (6.48 ± 0.13 mm) in depth at the pitch line of the threaded hole and plug.
 - 7) Use a vacuum to remove all loose metal particles from the hole.
 - 8) Machine an aluminum (AMS 4218, 4219, or AMS 4640) pin with a diameter of 0.093 in. (2.36 mm) and a length of 0.235 ± 0.005 in. (5.97 ± 0.13 mm).

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- 9) Put the pin into the hole.
 - a) Peen or stake the pin to keep it in the hole.
 - b) Remove the high metal.
- 10) Use the tap drill, STD-293 and drill a hole in the same location and same dimension of the original threaded hole.
 - a) Visually align the centerline of the tap drill, STD-293 with the centerline of the damaged hole.
 - b) Set the drill perpendicular to the hole, and drill out the boss to the depth of the original hole.
 - c) Make sure that the completed wall thickness of the bushing is a minimum of 0.063 in. (1.6 mm).
- 11) Make a chamfer and tap the hole to the dimension of the original threaded hole.
 - a) Use a plug tap of the correct size to start the threads.
 - b) Use a bottoming tap, STD-864 to continue the threads to the bottom of the hole.
 - c) Use a vacuum to remove all loose metal particles from the hole.
- 12) Apply a finish to the repaired surfaces (TASK 70-43-07-300-801-G00).
- 13) If it is necessary, do a pressure check of the part(s).
 - a) Make sure that there are no leaks.

———— **END OF TASK** ————

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**NOTE:**

DRILL TO THE DEPTH OF THE ORIGINAL HOLES.

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Repair of Blind Threaded Holes
Figure 201/70-48-09-990-801-G00

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ALUMINUM CASTINGS STANDARD (THREADED THROUGH-HOLE) REPAIR - MAINTENANCE
PRACTICES

1. General

A. This procedure has one task:

- (1) Aluminum castings standard repair (threaded-through hole).

TASK 70-48-10-300-801-G00

2. Aluminum Castings Standard Repair (Threaded-Through Hole)

(Figure 201)

A. General

- (1) This task provides the instructions on how do an aluminum casting (threaded through-hole) repair.
- (2) You can repair a threaded through-hole in an aluminum casting when there is sufficient wall thickness in the part.

B. References

Reference	Title
70-43-07-300-801-G00	Specifications Chemical Touchup for Aluminum Standard Repair (P/B 201)
70-43-17-300-801-G00	Mating Surfaces and Inserts Standard Repair (P/B 201)

C. Tools/Equipment

Reference	Description
STD-293	Drill - Tap

D. Consumable Materials

Reference	Description	Specification
A01059 [C01-011]	Paste - Adhesive, Two Part (Hysol EA 934NA)	A50TF94 Class B
D00656 [C02-047]	Lubricant - Cutting Fluid - Cimperial 1070	

E. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

F. Procedure

SUBTASK 70-48-10-320-001-G00

- (1) Prepare the threaded hole.
- (a) Use a tap drill, STD-293 with Cimperial 1070 lubricant, D00656 [C02-047] and drill out all the damage.
- 1) Make sure that the tap drill, STD-293 is sufficiently large to accept a tapped bushing with a wall thickness a minimum of 0.063 inch (1.600 mm).
- 2) Make sure that there is a minimum wall thickness of 0.125 inch (3.180 mm) after you drill the hole.
- (b) Visually align the centerline of the tap drill, STD-293 with the centerline of the damaged hole.
- (c) Set the drill perpendicular to the hole and drill through the full depth of the boss.
- (d) Use a vacuum to remove all the loose metal particles from the work area.

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- (e) Use a plug tap of the correct size to tap the hole until all the truncated threads of the tap extend through the bottom surface of the casting.

SUBTASK 70-48-10-320-002-G00

- (2) Make a threaded plug.

NOTE: This procedure gives instructions to make a threaded plug from aluminum, AMS 4117, 4218, or 4219, or aluminum bronze, AMS 4640.

- (a) Machine a plug to the correct diameter and length to fit in the threaded hole.
 - 1) Make sure that the completed length of the plug is a minimum of 0.10 inch (2.54 mm) longer than the threaded depth of the hole.
- (b) Thread the plug.
- (c) Chamfer one end of the plug.
- (d) The steps that follow are optional:
 - 1) Drill a pilot hole through the full length of the plug along its axial centerline.
 - 2) The diameter of the hole must be smaller than the tap drill, STD-293 that you will use to make the final internal threads of the bushing.
 - a) Make sure that the diameter of the hole is sufficiently large to use as a pilot hole.
 - 3) Make sure that the hole is concentric to a maximum of 0.007 inch (0.180 mm) with the external thread diameter.
 - 4) Make a cut or mill a diametrical slot in the unchamfered end of the plug, not more than 0.063 inch (1.600 mm) in depth.

NOTE: You do this step to let you use a screwdriver to assemble the parts.

- (e) Use a vacuum to remove all loose metal particles from the work area.

SUBTASK 70-48-10-320-003-G00

- (3) Install the threaded plug into the tapped hole.
 - (a) Put a light layer of Hysol EA 934NA adhesive paste, A01059 [C01-011] on the plug and threaded hole (TASK 70-43-17-300-801-G00).
 - (b) Install the plug into the threaded hole until the bottom of the plug is flush with the bottom surface of the casting.
 - (c) Immediately remove the unwanted Hysol EA 934NA adhesive paste, A01059 [C01-011].
 - (d) Let the Hysol EA 934NA adhesive paste, A01059 [C01-011] on the threads dry for 24 hours at room temperature.
 - (e) Machine the plug flush with the face of the boss.
 - (f) Drill a hole of 0.0935 ± 0.0005 in. (2.37 ± 0.02 mm) diameter and 0.255 ± 0.005 in. (6.48 ± 0.13 mm) in depth at the pitch line of the threaded hole and plug.
 - (g) Use a vacuum to remove all loose metal particles from the hole.
 - (h) Machine an aluminum (AMS 4218, 4219, or AMS 4640) pin with a diameter of 0.093 in. (2.36 mm) and a length of 0.235 ± 0.005 in. (5.97 ± 0.13 mm).
 - (i) Put the pin into the hole.
 - 1) Peen or stake the pin to keep it in the hole.
 - 2) Remove the high metal.
 - (j) Use the tap drill, STD-293 and drill a hole in the same location and same dimension of the original threaded hole.

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- 1) Visually align the centerline of the tap drill, STD-293 with the centerline of the damaged hole.
 - 2) Set the drill perpendicular to the hole, and drill the hole through the boss.
 - 3) Make sure that the completed wall thickness of the bushing is a minimum of 0.063 in. (1.60 mm).
- (k) Make a chamfer at the top of the hole to let the plug tap start easily.
- 1) Use a plug tap of the correct size to tap the hole until all truncated threads of the tap extend through the bottom surface of the casting.
 - 2) Use a vacuum to remove all loose metal particles from the work area.
- (l) Apply a finish to the repaired surfaces (TASK 70-43-07-300-801-G00).
- (m) If it is necessary, do a pressure check of the part(s).
- 1) Make sure that there are no leaks.

———— **END OF TASK** ————

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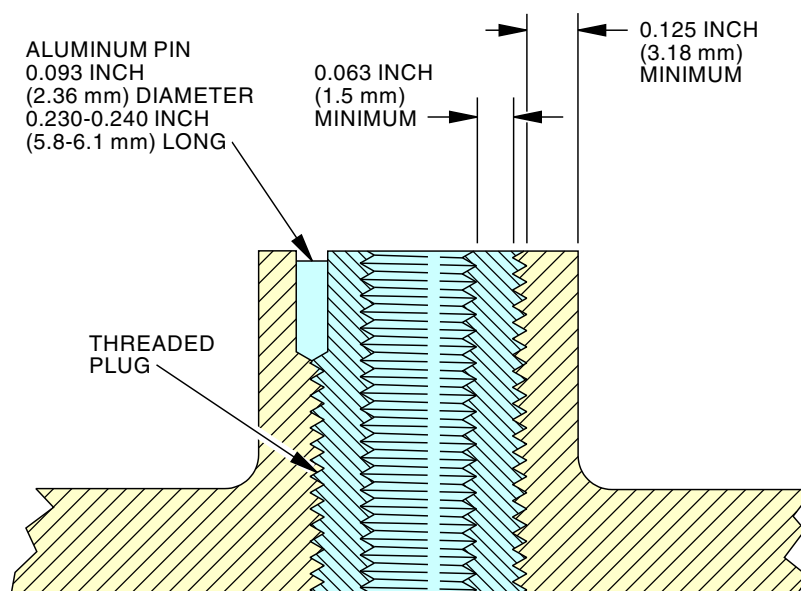
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Open or Through Threaded Holes Repair
Figure 201/70-48-10-990-801-G00

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AIRCRAFT MAINTENANCE MANUAL
ROSAN STUDS - MAINTENANCE PRACTICES

1. General

- A. This procedure has two tasks:
- (1) Rosan studs removal
 - (2) Rosan studs installation.

TASK 70-48-16-000-801-G00**2. Rosan Studs Removal**

(Figure 201 and Figure 202)

A. General

- (1) This task provides the instructions on how to remove a defective rosan stud.
- (2) You must have the correct size replacement stud and the correct tools for this task.

B. References

Reference	Title
70-43-17-300-801-G00	Mating Surfaces and Inserts Standard Repair (P/B 201)

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Procedure**SUBTASK 70-48-16-970-001-G00**

- (1) Measure the stud to get the correct size replacement stud (Mating Surfaces and Inserts Standard Repair, TASK 70-43-17-300-801-G00).

SUBTASK 70-48-16-020-001-G00

- (2) Do these steps to remove the stud (Figure 202):
 - (a) Carefully align the axis of the stud with the drill press spindle.
 - (b) Use a clamp to hold the part to the drill press table.
 - (c) Install the removal tool into the chuck of the drill press.
 - (d) Set the spindle speed at 300-700 RPM.
 - (e) Lower the removal tool on the top of the stud shank before you start the drill.
 - (f) Start the drill.
NOTE: Do not retract the spindle.
 - (g) Mill the lockring.
NOTE: Do not mill fully through the lockring.
 - 1) Mill only through the flange of the insert with serrations.
NOTE: Do not mill through the second flange.
 - 2) Lift the drill from the part frequently to let the metal particles clear from the cutting teeth.
 - (h) Turn the stud counterclockwise until the threads push on the lower surface of the lockring.
 - (i) Continue to turn the stud until the lockring is pushed out.

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- (j) If you milled the lockring completely through and could not lift it out with the stud, do these steps:
- 1) Break the lockring with a punch.
 - 2) Remove the lockring.

————— **END OF TASK** —————

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STANDARD STUD SIZES		ROSAN TOOL PART NUMBER		
STUD END DIAMETER INCH (mm)	NUT END DIAMETER INCH (mm)	REMOVAL TOOL	WRENCH	DRIVE TOOL
0.190 (4.83)	0.164 (4.17)	SM81-16	R1103W	S81D10
0.250 (6.35)	0.164 (4.17)	SM81-16	R1103W	S81D10
0.250 (6.35)	0.190 (4.83)	SM91-16	R1104W	S91D10
0.3125 (7.94)	0.190 (4.83)	SM91-16	R1104W	S91D10
0.3125 (7.94)	0.250 (6.35)	SM101-18	R1105W	S101D12
0.375 (9.53)	0.250 (6.35)	SM101-18	R1105W	S101D12
0.375 (9.53)	0.3125 (7.94)	SM111-20	R1106W	S111D12
0.4375 (11.11)	0.3125 (7.94)	SM111-20	R1106W	S111D12
0.4375 (11.11)	0.375 (9.53)	SM121-22	R1107XW	S121D12
0.500 (12.70)	0.4375 (11.11)	SM131-24	R1108W	S131D14
0.5625 (14.29)	0.500 (12.70)	SM141-25	R1110W	S141D14

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**Rosan Stud Sizes and Tools
Figure 201/70-48-16-990-801-G00**

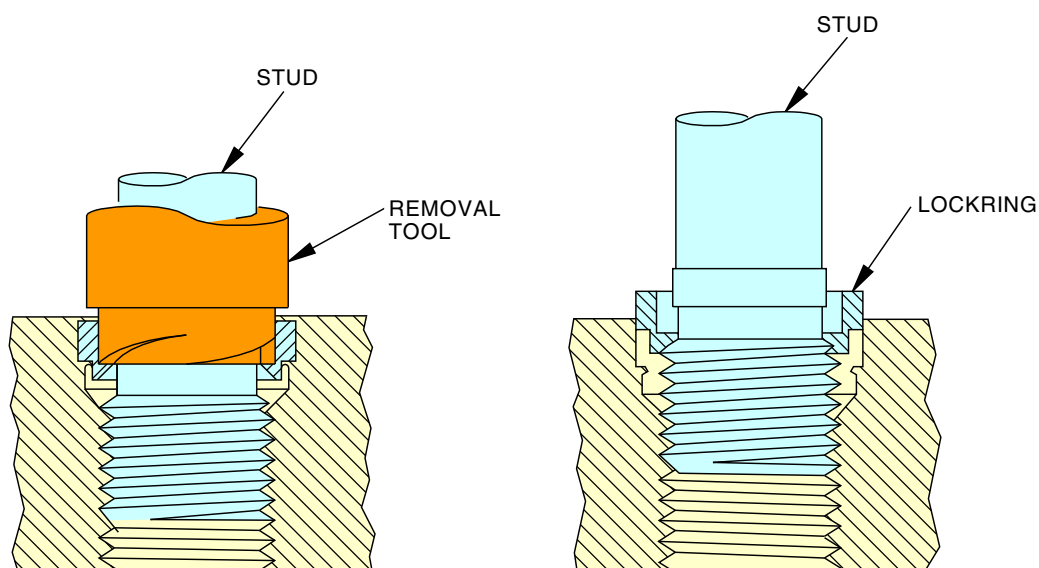
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Rosan Stud Removal
Figure 202/70-48-16-990-802-G00

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TASK 70-48-16-400-801-G00**3. Rosan Studs Installation**

(Figure 203)

A. General

- (1) This task provides the instructions on how to install a rosan stud.

B. References

Reference	Title
70-43-07-300-801-G00	Specifications Chemical Touchup for Aluminum Standard Repair (P/B 201)

C. Consumable Materials

Reference	Description	Specification
C00941 [C03-001]	Primer - Zinc Chromate	TT-P-1757, Type 1 or 2, Class C or Class N, AMS 3110 Color Y
C00943 [C03-006]	Coating - Chemical Conversion - Bonderite M-CR 1200S Aero (Formerly Alodine 1200S)	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Procedure**SUBTASK 70-48-16-210-001-G00**

- (1) Make sure that the hole with the threads is clear and is not damaged.
- (a) It is permitted for a maximum of one full thread to be missing.

SUBTASK 70-48-16-370-001-G00

- (2) Put a new finish on the hole with Bonderite M-CR 1200S Aero coating, C00943 [C03-006] (Specifications Chemical Touchup for Aluminum Standard Repair, TASK 70-43-07-300-801-G00).

SUBTASK 70-48-16-370-002-G00

DO NOT GET ZINC CHROMATE PRIMER IN YOUR MOUTH OR EYES OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM ZINC CHROMATE PRIMER. PUT ON PROTECTIVE SPLASH GOGGLES AND GLOVES WHEN YOU USE ZINC CHROMATE PRIMER. KEEP ZINC CHROMATE PRIMER AWAY FROM SPARKS, FLAMES, OR HEAT. ZINC CHROMATE PRIMER IS A POISONOUS AND FLAMMABLE SOLVENT THAT CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

- (3) Put a layer of the primer, C00941 [C03-001] on the stud end threads.

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SUBTASK 70-48-16-420-001-G00



MAKE SURE THAT YOU KNOW THE LOCATION OF THE FLANGE WHEN YOU INSTALL THE HYDRAULIC RING LOCKED STUDS. MAKE SURE THAT THE DRIVE TOOL FOR THE LOCK RING WILL NOT TOUCH THE SURFACE A. DO NOT HIT, OR PUT PRESSURE ON THE SURFACE. YOU CAN CAUSE DAMAGE TO THE THREADS IN THE MATERIAL, OR MAKE THE PART LOOSE.

- (4) Do these steps to install the rosan stud:

NOTE: Replace the rosan stud and the lock ring with the same size parts as those removed. Make sure that you install the parts in the same manner as the original installation.

- (a) Make sure that you do not hit or cause pressure on the surface A.
- (b) Install the stud to the correct depth with the applicable wrench before the primer dries.
- (c) Make sure that the external serrations do not align with the serrations in the parent material.

NOTE: You can turn the new lock ring to prevent this position.

- (d) Install the lock ring to the correct depth with the applicable drive tool.

———— **END OF TASK** ————

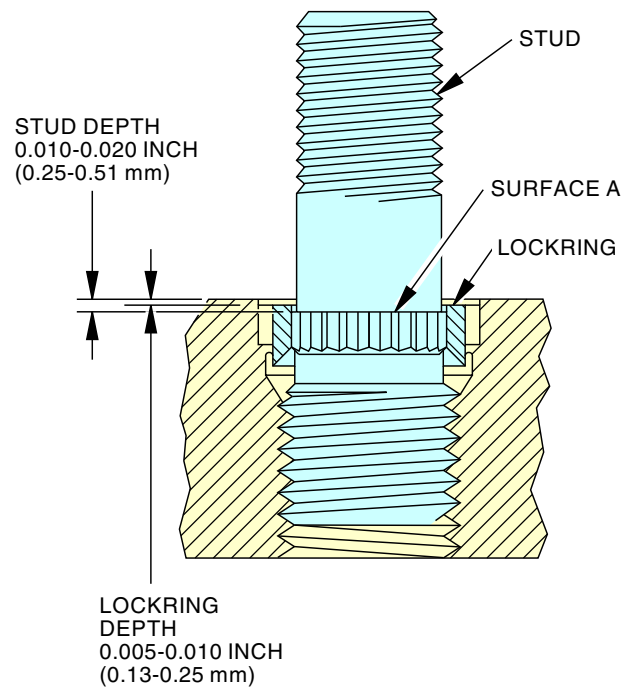
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2470599 S0000577134_V1**Rosan Stud Installation**
Figure 203/70-48-16-990-803-G00EFFECTIVITY
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ROSAN RING LOCKED INSERT - MAINTENANCE PRACTICES

1. General

- A. This procedure has three tasks:
- (1) Rosan ring locked insert removal
 - (2) Rosan ring locked insert installation
 - (3) Aluminum part standard repair (damaged internal threads).

TASK 70-48-19-000-801-G00

2. Rosan Ring Locked Insert Removal

(Figure 201, Figure 202, and Figure 203)

A. General

- (1) This task provides the instructions on how to remove a defective rosan ring locked insert.
- (2) The ring locked inserts are installed on the gearbox and the accessories.
- (3) You can replace the insert without damage to the threads of the parent material. Rosan inserts use a ring with serrations to tighten and lock the insert in its position. You must use over-sized parts for the replacement of the insert only if there is very bad damage.
- (4) This procedure refers to the rosan ring locked insert as the insert.

B. Consumable Materials

Reference	Description	Specification
G00270	Tape - Scotch Flatback Masking 250	ASTM D6123 (Supersedes A-A-883)

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Procedure

SUBTASK 70-48-19-020-001-G00

- (1) Do these steps to remove the insert (Figure 201, Figure 202):
 - (a) Use a plug or Scotch Flatback Masking Tape 250, G00270 to seal the openings in the assembly to prevent contamination.
 - (b) Get the correct dimension drill bit.
 - (c) Use a clamp to hold the part to the drill press table.
 - (d) Install the drill bit into the chuck of the drill press.
 - (e) Carefully align the drill with the centerline of the insert.
 - (f) Set the spindle speed at 300-700 RPM.
 - (g) Drill through the lockring and the neck of the insert to break the serration interlock.
 - 1) Make sure that you do not drill more than the depth of the counterbore in the parent material.
 - (h) Use a drill stop to stop the drill at or before the depth of the counterbore.

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- (i) Put a square screw extractor into the insert.

NOTE: When you turn the insert, the sides of the insert will lift up the lockring. The lockring will lift up when you continue the turn the insert. You can then remove the insert.

- (j) Turn the extractor to remove the insert.

- (k) Do these steps if you drilled the lockring through and could not lift it with the insert:

- 1) Break the lockring with a punch.
- 2) Remove the lockring.

- (l) Remove the burrs in the counterbore area and clean the hole.

———— **END OF TASK** ————

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INSERT DASH NUMBER MSS7997	STEP DRILL		WRENCH	LOCKRING DRIVE TOOL	REMOVAL DRILL SIZE (INCH)
	ALUMINUM	MAGNESIUM			
-102 -202	RCADC16-149 RDADC16-149	RCADC16-149 RDADC16-149	R1102W R1102W	R102D R102D	7/32 (5.563 mm)
-103 -203	RCADC18-177 RCADC18-177	RCADC18-177 RCADC18-177	R1103W R1103W	R103D R103D	1/4 (6.350 mm)
-104 -204	RCADC21-201 RCADC21-201	RCADC21-201 RCADC21-201	R1104W R1104W	R104D R104D	19/64 (7.541 mm)
-105 -205	RCADC24-257 RCADC24-257	RCADC24-257 RCADC24-257	R1105W R1105W	R105D R205D	F
-106 -206	RCADC28-312 RCADC28-312	RCADC28-312 RCADC28-312	R1106W R1106W	R106D R206D	5/16 (7.938 mm)
-107 -207	RCADC33-422 RCADC33-422	RCADC33-422 RCADC33-422	R1107XW R1107XW	RA107D RA207D	V
-108 -208	RCADC38-484 RCADC38-484	RCADC38-484 RCADC38-484	R1108W R1108W	R108D R208D	29/64 (11.510 mm)
-109 -209	RCADC47-531 RCADC47-531	RCADC47-531 RCADC47-531	R1110W R1110W	R109D R209D	9/16 (14.288 mm)
-110 -210	RCADC56-641 RCADC56-841	RCADC56-641 RCADC56-641	R1111W R1111W	R110D R210D	11/16 (17.463 mm)
-311	RCADC64-796	RCADC64-796	R1112W	R211D	25/32 (19.844 mm)
-312	RCADC72-921	RCADC72-921	R1113W	R212D	57/64 (22.622 mm)
-312.1	RCADC72-906	RCADC72-906	R1113W	R212D	57/64 (22.622 mm)
-313	RCADC82-1031	RCADC82-1031	R1114W	R213D	1-1/32 (26.194 mm)
-314	RCADC90-1156	RCADC90-1156	R1115W	R214D	1-11/64 (29.766 mm)
-315	RCADC100-1281	RCADC100-1281	R1116W	R315D	1-9/32 (32.544 mm)

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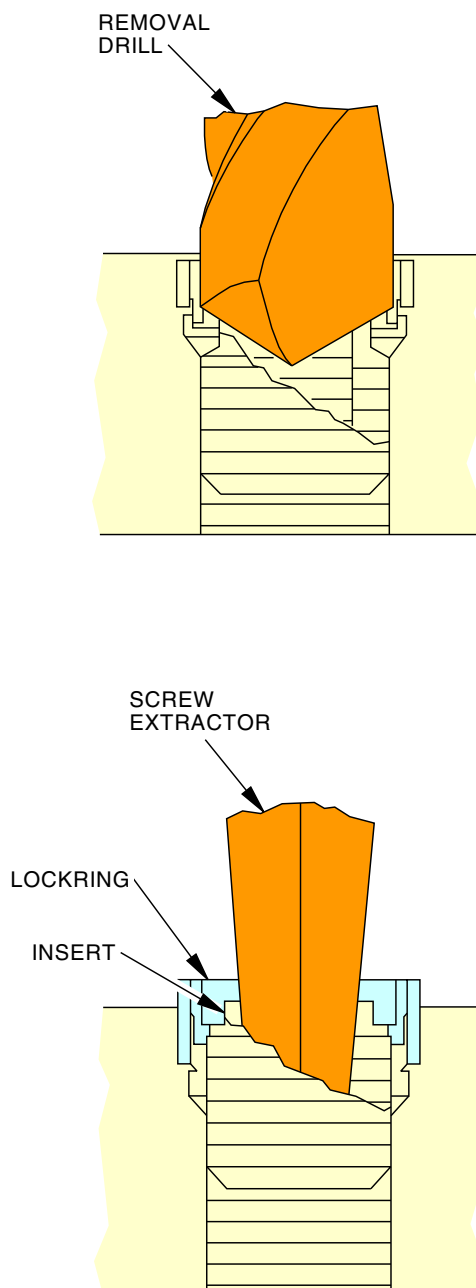
Tooling for MS51991 Inserts
Figure 201/70-48-19-990-801-G00

EFFECTIVITY
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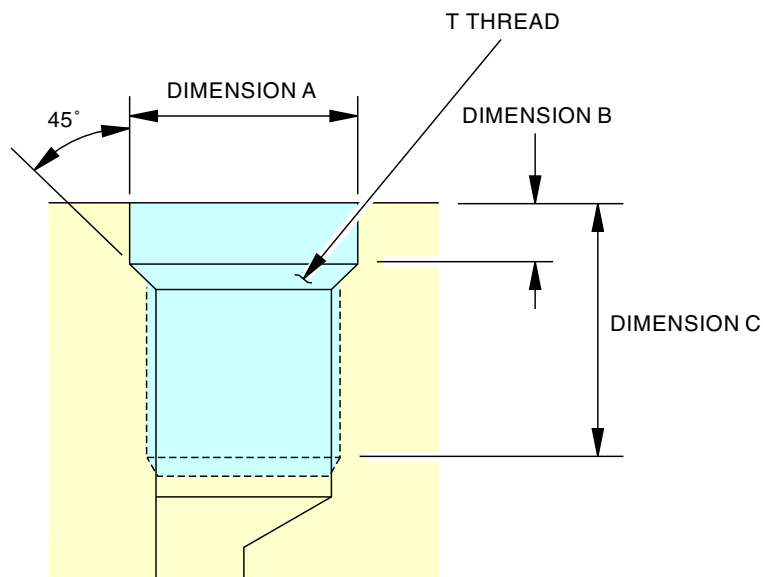
Rosan Ring Locked Insert Removal
Figure 202/70-48-19-990-802-G00EFFECTIVITY
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

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2470602 S0000577139_V1

Insert and Hole Preparation
Figure 203/70-48-19-990-803-G00 (Sheet 1 of 2)

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MS INSERT PART NUMBER	THREAD T NATIONAL CLASS 3	COUNTERBORE DEPTH +0.030 INCH (+0.76 mm) -0.000 INCH (-0.00 mm) DIMENSION B	COUNTERBORE DEPTH +0.030 INCH (+0.76 mm) -0.000 INCH (-0.00 mm) DIMENSION A
MS51991E202	#10(.190)-24 NC	0.094 INCH (2.39 mm)	0.250 A11 0.258 MAG.
MS51991E203	#12(.216)-24 NC	0.109 INCH (2.77 mm)	0.281 A11 0.291 MAG.
MS51991E204	1/4(.250)-20 NC	0.109 INCH (2.77 mm)	0.328 A11 0.337 MAG.
MS51991E205	5/16(.3125)-18 NC	0.141 INCH (3.58 mm)	0.375 A11 0.381 MAG.
MS51991E206	3/8(.375)-16 NC	0.156 INCH (3.96 mm)	0.437 A11 0.448 MAG.
MS51991E207	1/2(.500)-13 NC	0.172 INCH (4.37 mm)	0.515 A11 0.526 MAG.
MS51991E208	9/16(.5625)-12 NC	0.172 INCH (4.37 mm)	0.593 A11 0.601 MAG.
MS51991E209	5/8(.625)-11 NC	0.218 INCH (5.54 mm)	0.734 A11 0.747 MAG.
MS51991E210	3/4(.750)-10 NC	0.203 INCH (5.16 mm)	0.875 A11 0.888 MAG.

MS INSERT PART NUMBER	MINIMUM FULL THREAD DIMENSION C
MS51991E202	0.285 INCH (7.24 mm)
MS51991E203	0.345 INCH (8.76 mm)
MS51991E204	0.415 INCH (10.54 mm)
MS51991E205	0.475 INCH (12.07 mm)
MS51991E206	0.535 INCH (13.59 mm)
MS51991E207	0.595 INCH (15.11 mm)
MS51991E208	0.655 INCH (16.64 mm)
MS51991E209	0.725 INCH (18.42 mm)
MS51991E210	0.785 INCH (19.94 mm)

STANDARD DIMENSION FOR HOLE PREPARATION

2470603 S0000577140_V1

**Insert and Hole Preparation
Figure 203/70-48-19-990-803-G00 (Sheet 2 of 2)**

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AIRCRAFT MAINTENANCE MANUAL

TASK 70-48-19-400-801-G00**3. Rosan Ring Locked Insert Installation**

(Figure 201, Figure 204, and Figure 205)

A. General

- (1) This task provides the instructions on how to install a rosan ring locked insert.
- (2) The rosan ring locked insert is referred to as the insert.

B. Consumable Materials

Reference	Description	Specification
C00941 [C03-001]	Primer - Zinc Chromate	TT-P-1757, Type 1 or 2, Class C or Class N, AMS 3110 Color Y

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. Procedure**SUBTASK 70-48-19-210-001-G00**

- (1) Get the same dimension and type of insert and lockring as the ones that you remove.
NOTE: Rosan part numbers are interchangeable to the MS part numbers in the illustration.
 - (a) Use the last two numbers of the insert number to find the applicable lockring.
NOTE: If the insert part number is MS51991E206, use the lockring part number MS51990E106P.

SUBTASK 70-48-19-320-001-G00

- (2) Prepare the hole in the parent material as specified in the data sheet table (Figure 204).
NOTE: The tap drill and counterbore must be concentric to 0.003 inch (0.008 mm) total indicator reading (TIR).

SUBTASK 70-48-19-320-002-G00

- (3) If the parent material surface is not flat or is not normal to the axis of the hole, you must machine a spotface for correct lockring entry.

SUBTASK 70-48-19-410-001-G00

- (4) Get the correct wrench (Figure 201)

SUBTASK 70-48-19-410-002-G00

DO NOT GET ZINC CHROMATE PRIMER IN YOUR MOUTH OR EYES OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM ZINC CHROMATE PRIMER. PUT ON PROTECTIVE SPLASH GOGGLES AND GLOVES WHEN YOU USE ZINC CHROMATE PRIMER. KEEP ZINC CHROMATE PRIMER AWAY FROM SPARKS, FLAMES, OR HEAT. ZINC CHROMATE PRIMER IS A POISONOUS AND FLAMMABLE SOLVENT THAT CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

- (5) If the part is aluminum, apply primer, C00941 [C03-001] to the external threads of the insert.
NOTE: You must install the insert while the primer is wet.

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SUBTASK 70-48-19-420-001-G00



MAKE SURE THAT YOU KNOW THE LOCATION OF THE FLANGE WHEN YOU INSTALL THE HYDRAULIC RING LOCKED STUDS. MAKE SURE THAT THE DRIVE TOOL FOR THE LOCK RING WILL NOT TOUCH THE SURFACE A. DO NOT HIT, OR PUT PRESSURE ON THE SURFACE. YOU CAN CAUSE DAMAGE TO THE THREADS IN THE MATERIAL, OR MAKE THE PART LOOSE.

- (6) Install the insert into the machine as follows (Figure 205)
- (a) Make sure that you do not hit or put pressure on the surface A.
 - (b) Tap the cavity to the depth as shown in the illustration.

SUBTASK 70-48-19-420-002-G00

- (7) Do these steps to install the lock ring (Figure 201)
- (a) Get the correct drive tool.
 - (b) Install the lock ring to the correct depth with the applicable drive tool.
 - (c) If it is necessary, turn the new locking to align the serration on the locking with the serration of the parent material from the previous locking.

———— **END OF TASK** ————

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MS* PART NUMBER	ROSAN* PART NUMBER	MS* PART NUMBER	ROSAN* PART NUMBER	MS* PART NUMBER	ROSAN* PART NUMBER
MS51991-102	RJ102SB4	MS51991-202	RJ202SB4	MS51991-311	RJ311SB14
MS51991-103	RJ103SB5	MS51991-203	RJ203SB5	MS51991-312	RJ312SB16
MS51991-104	RJ104SB6	MS51991-204	RJ204SB6	MS51991-312.1	RJ312SB16F
MS51991-105	RJ105SB7	MS51991-205	RJ205SB7	MS51991-313	RJ313SB18
MS51991-106	RJ106SB8	MS51991-206	RJ206SB8	MS51991-314	RJ314SB20
MS51991-107	RAJ107SB9	MS51991-207	RAJ207SB9	MS51991-315	RJ315SB22F
MS51991-108	RJ108SB10	MS51991-208	RJ208SB10		
MS51991-109	RJ109SB11	MS51991-209	RJ209SB11		
MS51991-110	RJ110SB12	MS51991-210	RJ210SB12		
MS51991E102	RJ102SU4	MS51991E202	RJ202SU4	MS51991E311	RJ311SU14
MS51991E103	RJ103SU5	MS51991E203	RJ203SU5	MS51991E312	RJ312SU16
MS51991E104	RJ104SU6	MS51991E204	RJ204SU6	MS51991E312.1	RJ312SU16F
MS51991E105	RJ105SU7	MS51991E205	RJ205SU7	MS51991E313	RJ313SU18
MS51991E106	RJ106SU8	MS51991E206	RJ206SU8	MS51991E314	RJ314SU20
MS51991E107	RAJ107SU9	MS51991E207	RAJ207SU9	MS51991E315	RJ315SU22F
MS51991E108	RJ108SU10	MS51991E208	RJ208SU10		
MS51991E109	RJ109SU11	MS51991E209	RJ209SU11		
MS51991E110	RJ110SU12	MS51991E210	RJ210SU12		

* ADD LETTER "L" TO "MS" PART NUMBER AND ROSAN PART NUMBER FOR INTERNAL THREAD LOCKING FEATURE. EXAMPLE: MS51991-102L = RJ102SB4L

**INTERCHANGEABILITY TABLES, MS VERSUS ROSAN
MS51991 INSERTS**

MS INSERT PART NUMBER	MS LOCKRING PART NUMBER	ROSAN LOCKRING PART NUMBER
MS51991E202	MS51990E102P	RLRR16SU5
MS51991E203	MS51990E103P	RLRR18SU6
MS51991E204	MS51990E104P	RLRR21SU6
MS51991E205	MS51990E105P	RLRR24SU7
MS51991E206	MS51990E106P	RLRR28SU8
MS51991E207	MS51990E107P	RLRR33SU9
MS51991E208	MS51990E108P	RLRR38SU9
MS51991E209	MS51990E109P	RLRR47SU10
MS51991E210	MS51990E110P	RLRR56SU11

LOCKRING PART NUMBERS

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**Insert and Lockring Part Numbers
Figure 204/70-48-19-990-804-G00**

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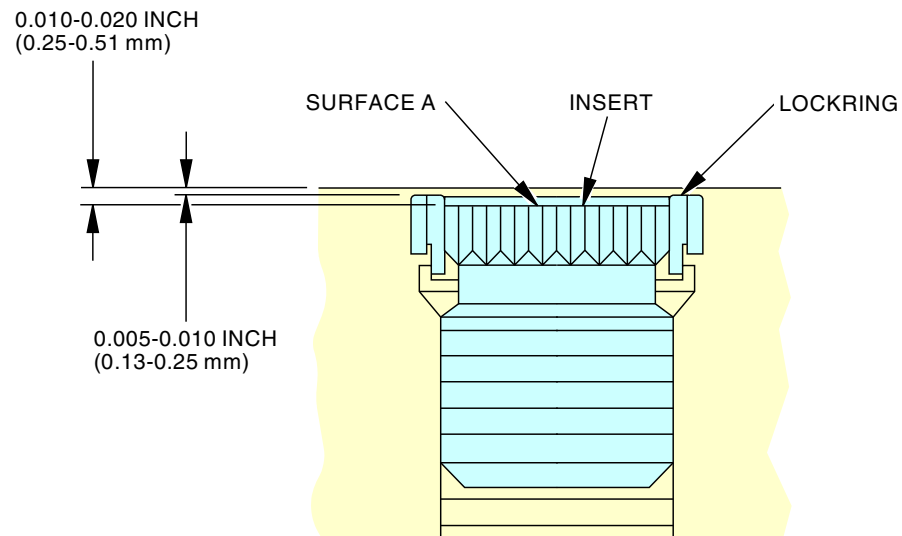
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Insert and Lockring Installation
Figure 205/70-48-19-990-805-G00

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TASK 70-48-19-300-801-G00**4. Aluminum Part Standard Repair (Damaged Internal Threads)**

(Figure 206 and Figure 207)

A. General

- (1) This task provides the instructions on how to repair an aluminum part with damaged internal threads in the parent material.

B. References

Reference	Title
70-48-09-300-801-G00	Aluminum Castings Standard Repair (Blind Threaded Hole) (P/B 201)
70-48-10-300-801-G00	Aluminum Castings Standard Repair (Threaded-Through Hole) (P/B 201)

C. Consumable Materials

Reference	Description	Specification
G00270	Tape - Scotch Flatback Masking 250	ASTM D6123 (Supersedes A-A-883)

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Procedure

SUBTASK 70-48-19-320-003-G00

- (1) Do these steps to repair an aluminum part with damaged internal threads in the parent material (Figure 206).
- (a) Use a plug or Scotch Flatback Masking Tape 250, G00270 to seal the openings in the assembly to prevent contamination.
 - (b) Drill out the damage and install a threaded plug (TASK 70-48-09-300-801-G00 or TASK 70-48-10-300-801-G00).
 - 1) To machine the boss on the centerline of the original hole, do these steps:
 - a) Drill a pilot hole through the center of the threaded plug before you install the threaded plug, or
 - b) Keep the center of the boss below the spindle after you remove the damage with the drill. Install the threaded plug, then center drill a pilot hole.
 - (c) Machine the boss at the original hole location to fit a standard size insert.
- NOTE:** The cutter tools shown in the list in the illustration will help when you machine the internal cavity. After you tap drill 0.015-0.030 inch (0.380-0.760 mm) undersize, use the contour cutter to complete the thread minor diameter and all other properties in one operation. Then tap the part.
- 1) Tap drill the internal cavity.
 - 2) Make the counterbore L diameter 0.225 ±0.005 in. (5.72 ±0.13 mm) in depth.
 - 3) Make the counterbore K diameter to the depth shown (flat bottom).
 - 4) Make a counterbore 20 degree angle (40 degree, included) on the L diameter to the depth shown in the illustration.

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- 5) Tap the A thread to the P minimum full thread depth.

NOTE: The thread pitch diameter and L diameter must be concentric to the K diameter within 0.003 inch (0.08 mm), full indicator reading (FIR). The thread pitch diameter must be concentric to the L diameter within 0.002 inch (0.050 mm), (FIR).

SUBTASK 70-48-19-420-003-G00

- (2) If it is necessary, install a new insert (TASK 70-48-19-400-801-G00) (Figure 206).

———— **END OF TASK** ————

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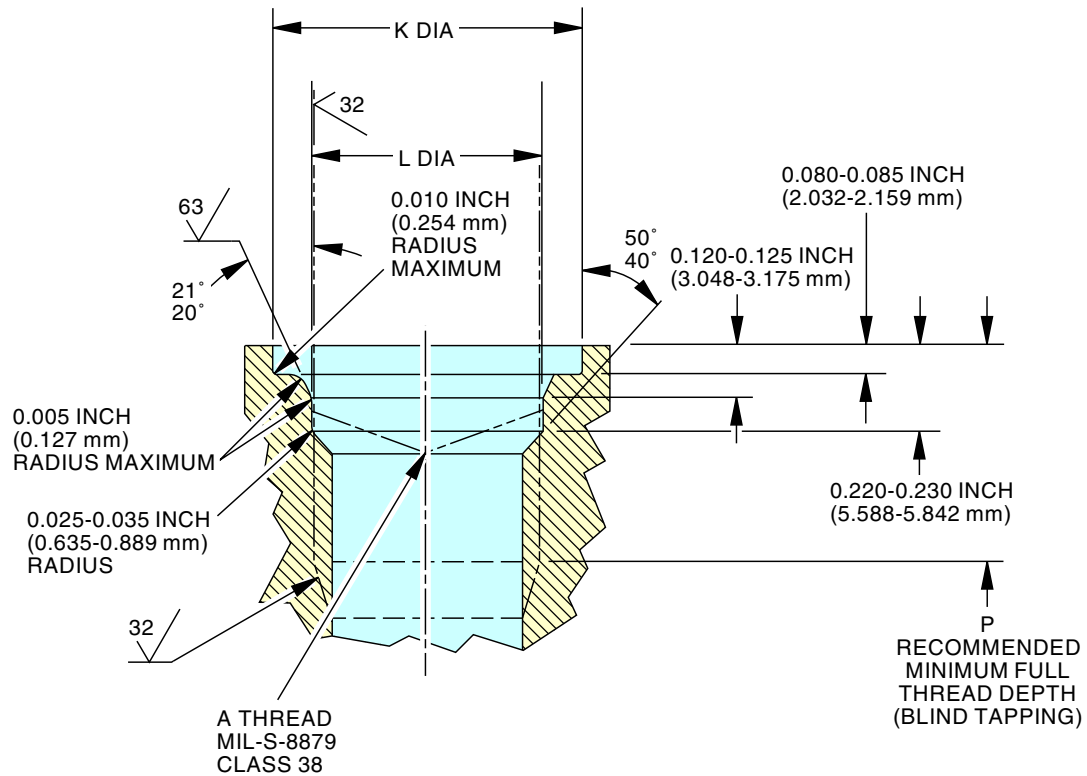
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INSERT THREAD SIZE		A THREAD (MIL-S-8879) (INCHES)	K DIAMETER 0.005 -0.000 (INCH)	L DIAMETER +0.002 -0.000 (INCH)	P MINIMUM (INCH)
EXTERNAL	INTERNAL				
9/16-24	7/16-20	0.5625 (14.2575 mm)-24UNJEF-38	0.795 (20.193 mm)	0.603 (15.316 mm)	0.610 (15.494 mm)
5/8-24	1/2-20	0.6250 (15.8750 mm)-24UNJEF-38	0.858 (21.793 mm)	0.666 (16.916 mm)	0.610 (15.494 mm)
11/16-24	9/16-18	0.6875 (15.4625 mm)-24UNJEF-38	0.905 (22.987 mm)	0.728 (18.491 mm)	0.660 (16.764 mm)
15/16-20	3/4-16	0.9375 (23.8125 mm)-20UNJEF-38	1.155 (29.337 mm)	0.958 (24.333 mm)	0.795 (20.193 mm)
1-1/16-18	7/8-14	1.0625 (26.9875 mm)-18UNJEF-38	1.280 (32.512 mm)	1.083 (27.508 mm)	0.885 (22.479 mm)

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Machining Requirements for Threaded Hole Repair
Figure 206/70-48-19-990-806-G00

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INSERT THREAD SIZES		INSERT REMOVAL DATA		INSTALLATION TOOLING		INSTALLATION TORQUE	PORT CONTOUR
EXTERNAL	INTERNAL	DRILL DIAMETER (INCH)	REMOVAL COUNTER- BORE TOOL	WRENCH	LOCKRING DRIVER	POUND-INCHES	CUTTER TOOL
9/16-24	7/16-20	17/32 (13.494 mm)	RF8504R	RF8504WA	RF8504DA	80-105 (9-12 Nm)	RPT9504
5/8-24	1/2-20	19/32 (15.081 mm)	RF8505R	RF8505WA	RF8505DA	120-150 (14-17 Nm)	RPT9505
11/16-24	9/16-18	21/32 (16.669 mm)	RF8506R	RF8506WA	RF8506DA	145-185 (16-21 Nm)	RPT9506
15/16-20	3/4-16	7/8 (22.225 mm)	RF8508R	RF8508WA	RF8508DA	350-400 (40-45 Nm)	RPT9508
1 1/16-18	7/8-14	1 (25.4 mm)	RF8510R	RF8510WA	RF8510DA	500-600 (56-68 Nm)	RPT9510

NOTE:

THE PARTS CAN BE OBTAINED FROM:

- THE ROSAN, INC.
2901 WEST COAST HIGHWAY
NEWPORT BEACH, CA.

FLUID FITTING (ROSAN)

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**Insert Replacement Data
Figure 207/70-48-19-990-807-G00**

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RING-LOCK SELF-LOCKING INSERT - MAINTENANCE PRACTICES

1. General

A.

This procedure has two tasks:

- (1) Ring-locked self-locking insert removal
- (2) Ring-locked self-locking insert installation.

TASK 70-48-02-020-801-G00

2. Ring Locked Self Locking Insert Removal

(Figure 201, Figure 202, Figure 203, Figure 204, Figure 205 and Figure 206)

A. General

- (1) This task provides instructions on how to remove a defective ring-locked self-locking insert.
- (2) Ring-Locked inserts are installed on the core module cases.
- (3) You can replace the insert without damage to the threads of the parent material.
- (4) Ring-locked self-locking inserts use an oval shaped ring with serrations to tighten and lock the insert in its position.

B. References

Reference	Title
70-43-42-300-802-G00	Blending Procedures - Hand Blending (P/B 201)

C. Tools/Equipment

Reference	Description
STD-183	Cleaner - Vacuum
STD-293	Drill - Tap
STD-1280	Source - Air, Regulated, Dry Filtered, 0-30 PSIG

D. Consumable Materials

Reference	Description	Specification
G00270	Tape - Scotch Flatback Masking 250	ASTM D6123 (Supersedes A-A-883)

E. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

F. Prepare for the Removal

SUBTASK 70-48-02-100-001-G00

- (1) Clean the work area prior to all repairs to prevent contamination of the assembly.

G. Ring Locked Self Locking Insert Removal

SUBTASK 70-48-02-020-001-G00

- (1) Remove the non-serviceable threaded inserts and locking rings from the assembly as follows:
 - (a) Use a plug or Scotch Flatback Masking Tape 250, G00270, to seal the openings in the assembly or a vacuum cleaner, STD-183, to prevent contamination.
 - (b) Identify the insert as follows:

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- 1) Insert 1693M83P12 has a 0.375 in. (9.52 mm) diameter internal thread.
 - 2) Insert 1693M83P13 has a 0.250 in. (6.35 mm) diameter internal thread.
 - 3) Insert 1693M83P14 has a 0.375 in. (9.52 mm) diameter internal thread.
 - 4) Insert 1693M83P15 has a 0.250 in. (6.35 mm) diameter internal thread.
 - 5) Insert 1693M83P17 has a 0.3125 in. (7.938 mm) diameter internal thread.
 - 6) Insert 1693M83P18 has a 0.250 in. (6.35 mm) diameter internal thread.
 - 7) Insert 1693M83P19 has a 0.250 in. (6.35 mm) diameter internal thread.
- (c) Select the drill size that you will use as follows:
- 1) For insert 1693M83P12, use a 0.4375 in. (11.112 mm) diameter drill.
 - 2) For insert 1693M83P13, use a 0.3125 in. (7.938 mm) diameter drill.
 - 3) For insert 1693M83P14, use a 0.4375 in. (11.112 mm) diameter drill.
 - 4) For insert 1693M83P15, use a 0.3125 in. (7.938 mm) diameter drill.
 - 5) For insert 1693M83P17, use a 0.375 in. (9.52 mm) diameter drill.
 - 6) For insert 1693M83P18, use a 0.3125 in. (7.938 mm) diameter drill.
 - 7) For insert 1693M83P19, use a 0.3125 in. (7.938 mm) diameter drill.



MAKE SURE THAT YOU USE PROTECTION EQUIPMENT. METAL PARTICLES WHEN YOU DRILL OR MILL CAN CAUSE DAMAGE TO EQUIPMENT AND INJURY TO PERSONS.



DO NOT DRILL INTO THE ASSEMBLY PARENT MATERIAL. DAMAGE TO THE ASSEMBLY WILL OCCUR.



MAKE SURE THAT THE ASSEMBLY DOES NOT MOVE DURING THE DRILLING. DAMAGE TO THE ASSEMBLY CAN OCCUR.

- (d) Use a drill stop collar, drill the assembly as follows:
- 1) Align the drill with the center line of the insert that have the damage.
 - 2) Drill into the insert to a depth of 0.090 in. (2.29 mm) or less.
NOTE: Make sure that you do not drill into the parent material.
NOTE: It is recommended that you use a vacuum when you drill to reduce metal particles contamination.
 - 3) Use a pointed punch to remove the locking ring as follows (Figure 201):
 - a) Put the punch on one end of the locking ring and use a hammer to tap the punch lightly.
 - b) Carefully lift the locking ring from the oval shaped counterbore hole.
 - 4) Use the correctly sized allen key to remove the damaged insert (Figure 204).
NOTE: Discard the damaged insert.

SUBTASK 70-48-02-100-002-G00

- (2) Remove all unwanted materials from the assembly area.

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AIRCRAFT MAINTENANCE MANUAL****SUBTASK 70-48-02-160-001-G00**

- (3) If it is necessary, remove the high metal from the threaded hole with a tap drill, STD-293, to chase the threads as follows (Figure 206):
- (a) For insert 1693M83P12, use a 0.4375-20 UNJF-3A tap.
 - (b) For insert 1693M83P13, use a 0.3125-24 UNJF-3A tap.
 - (c) For insert 1693M83P14, use a 0.4375-20 UNJF-3A tap.
 - (d) For insert 1693M83P15, use a 0.3125-24 UNJF-3A tap.
 - (e) For insert 1693M83P17, use a 0.375-24 UNJF-3A tap.
 - (f) For insert 1693M83P18, use a 0.3125-24 UNJF-3A tap.
 - (g) For insert 1693M83P19, use a 0.3125-24 UNJF-3A tap.
 - (h) Use clean air to remove loose metal chips from the tapped hole.

SUBTASK 70-48-02-960-001-G00

- (4) Replace the part if more than the first thread has damage after you chase the threads, the part is not repairable with this procedure.

SUBTASK 70-48-02-320-001-G00

- (5) Blend the counterbore by hand to remove high metal (Blending Procedures - Hand Blending, TASK 70-43-42-300-802-G00).

NOTE: Full removal of high metal in the counterbore will decrease the risk of interference in the locking ring installation and prevent further removal of the locking ring.

SUBTASK 70-48-02-160-002-G00

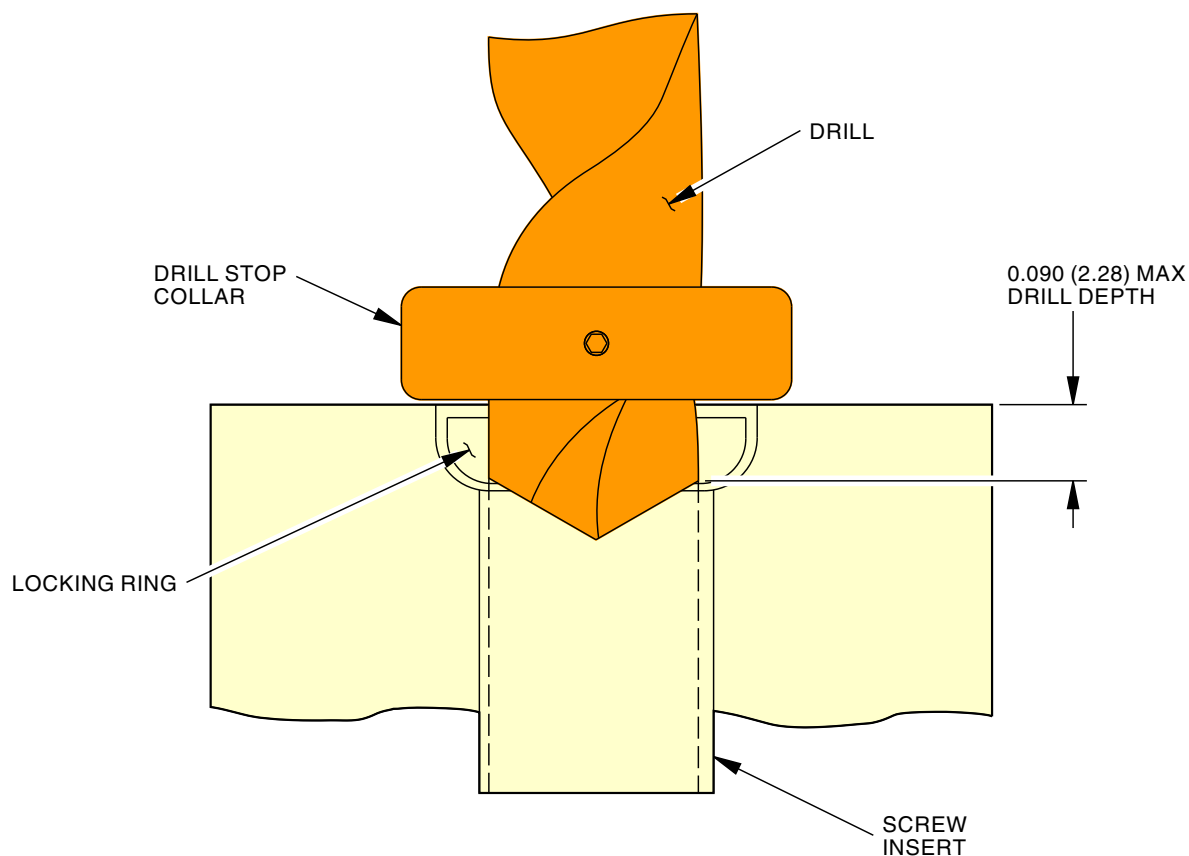
USE EYE PROTECTION WHEN YOU USE COMPRESSED AIR TO CLEAN, COOL, OR DRY PARTS OR TOOLS. PARTICLES CAN CAUSE AN INJURY TO YOUR EYES. DO NOT USE MORE THAN 30 PSIG (200 KPA). DO NOT POINT COMPRESSED AIR AT YOURSELF OR OTHER PERSONS.

- (6) Use 0-30 psig dry filtered regulated air source, STD-1280, to remove loose metal chips from tapped hole.

SUBTASK 70-48-02-220-001-G00

- (7) Do a dimensional inspection of the counterbore as follows (Figure 202):
- (a) If the dimensions do not agree with the limits, you cannot repair the extension case by this procedure.

———— **END OF TASK** ————

**NOTE:**

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

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Locking Ring and Threaded Insert Removal
Figure 201/70-48-02-990-801-G00 (Sheet 1 of 2)

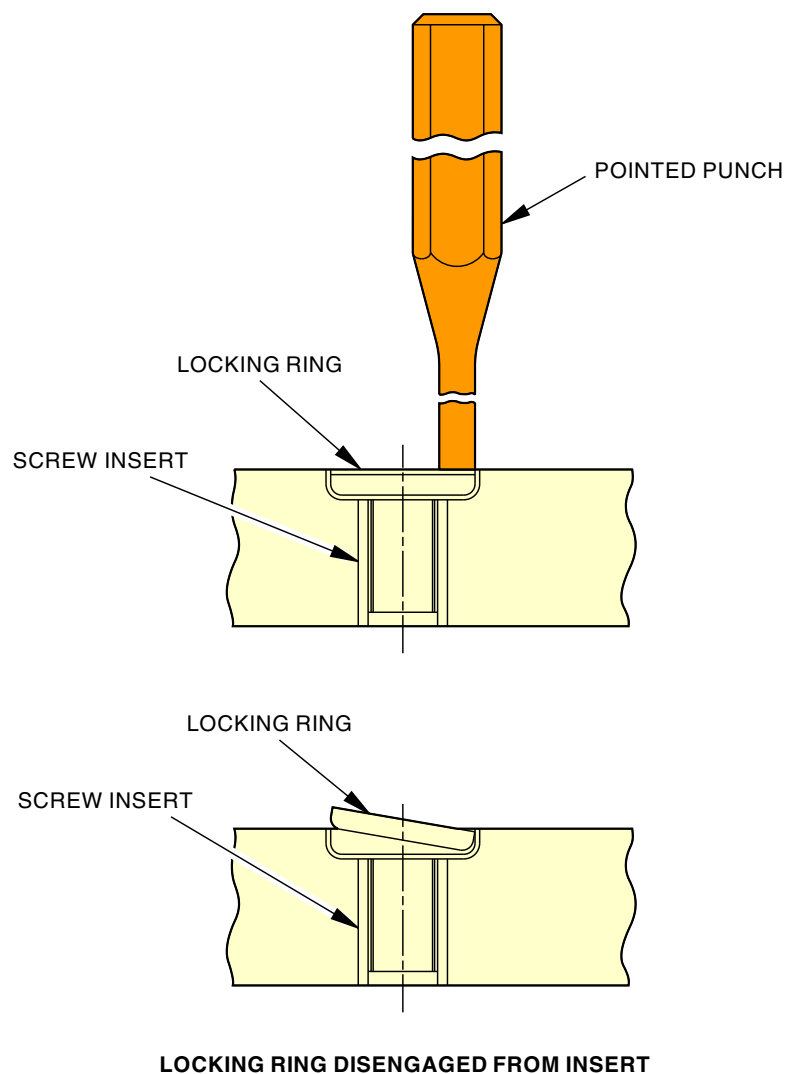
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5035062-00

2570076 S0000616263_V1

Locking Ring and Threaded Insert Removal
Figure 201/70-48-02-990-801-G00 (Sheet 2 of 2)

EFFECTIVITY
SIA ALL

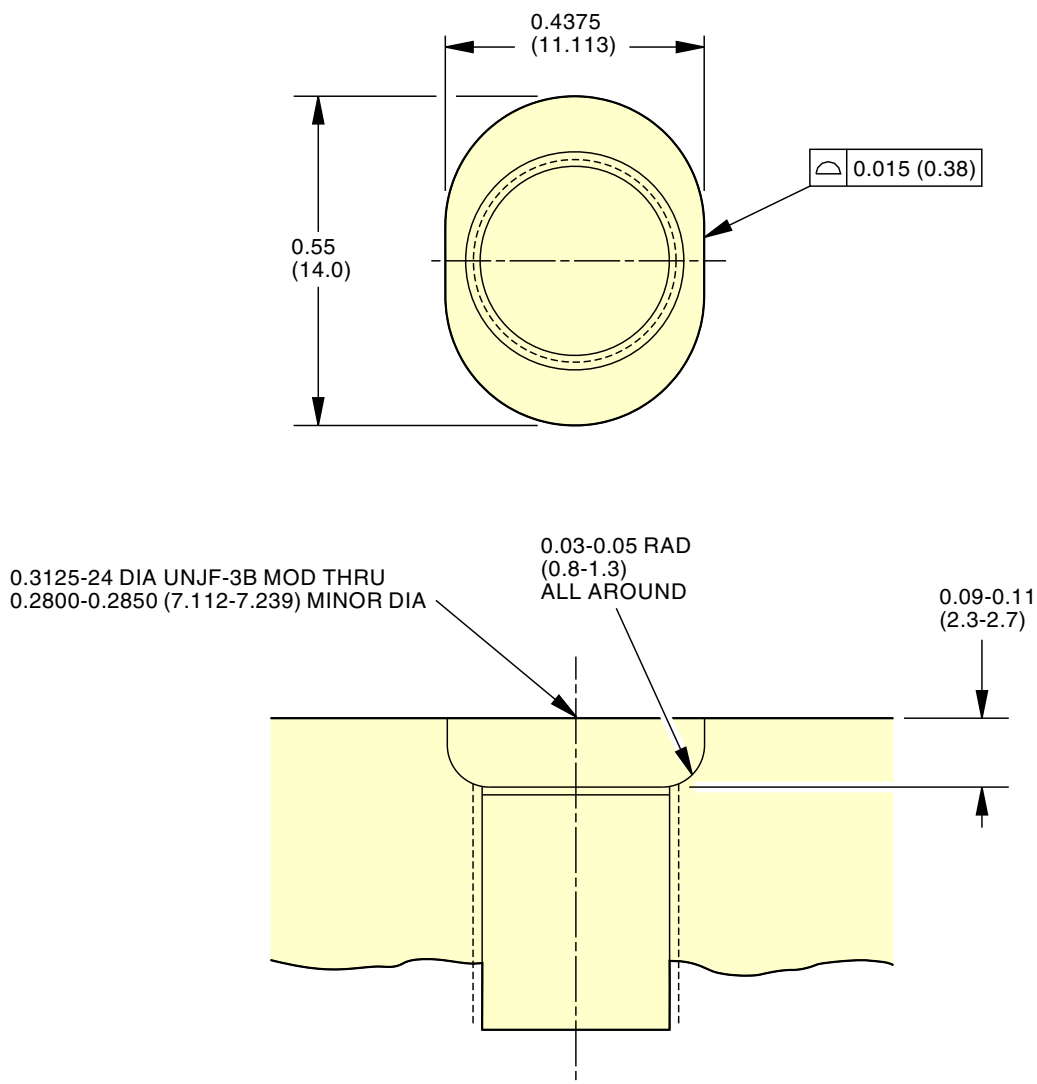
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**NOTES:**

1. DIMENSIONS ARE IN INCHES WITH MILLIMETERS IN PARENTHESES.
2. APPLIES TO 0.250 (6.35) ID INSERTS.

5035063-00
2570336 S0000616264_V1

**Locking Ring and Threaded Insert Installation
Figure 202/70-48-02-990-807-G00 (Sheet 1 of 3)**

EFFECTIVITY
SIA ALL

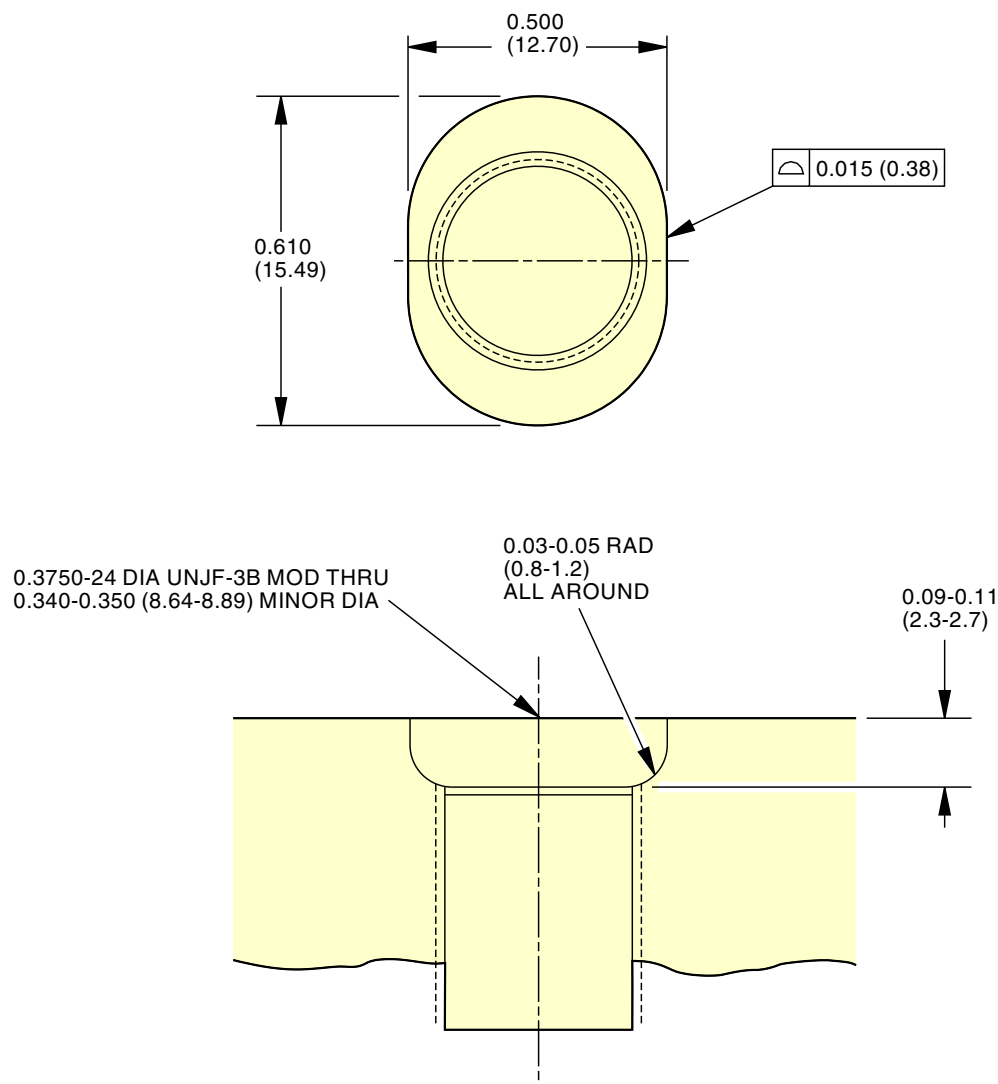
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**NOTES:**

1. DIMENSIONS ARE IN INCHES WITH MILLIMETERS IN PARENTHESES.
2. APPLIES TO 0.3125 (7.938) ID INSERTS.

5035064-00

2570337 S0000616265_V1

**Locking Ring and Threaded Insert Installation
Figure 202/70-48-02-990-807-G00 (Sheet 2 of 3)**

EFFECTIVITY
SIA ALL

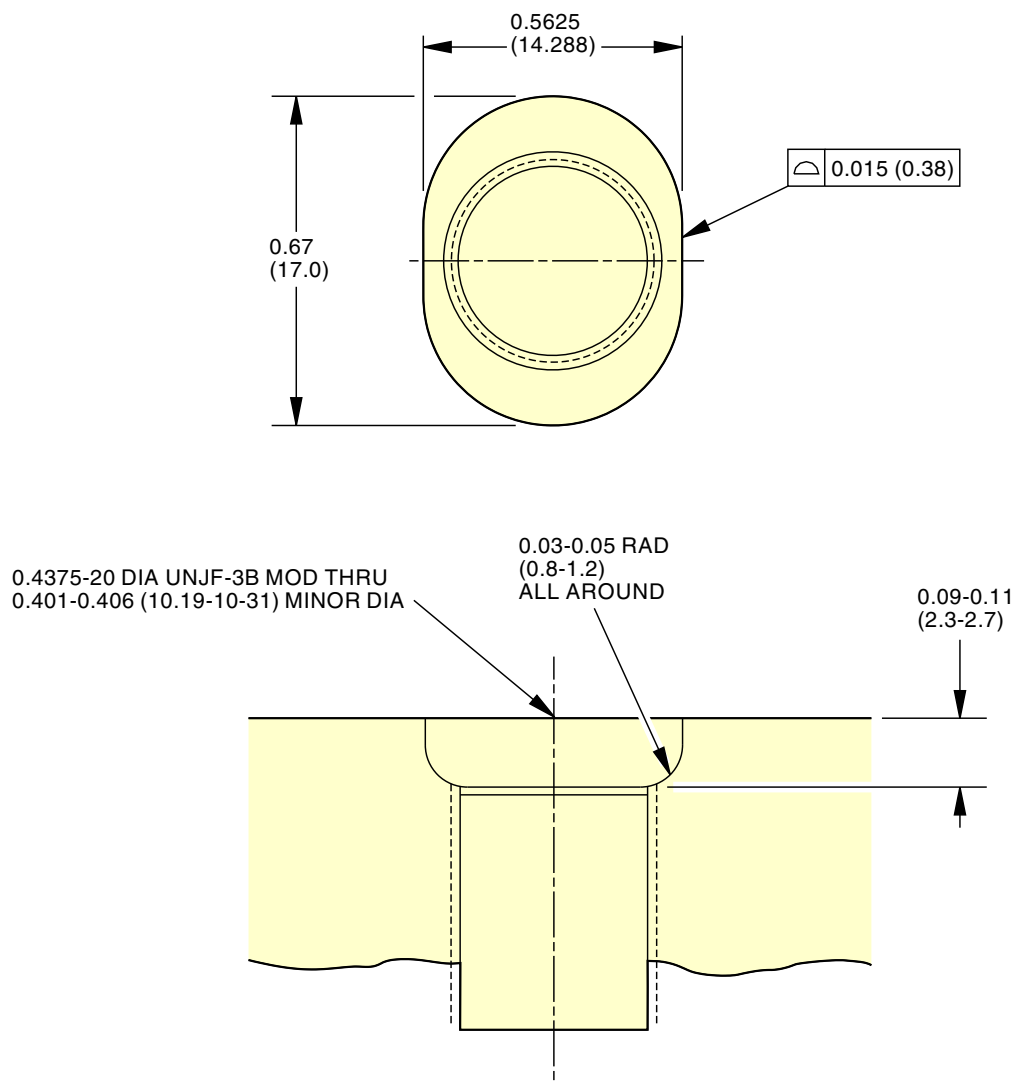
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**NOTES:**

1. DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.
2. APPLIES TO 0.375 (9.53) ID INSERTS.

5035065-00

2570338 S0000616266_V1

**Locking Ring and Threaded Insert Installation
Figure 202/70-48-02-990-807-G00 (Sheet 3 of 3)**

EFFECTIVITY
SIA ALL

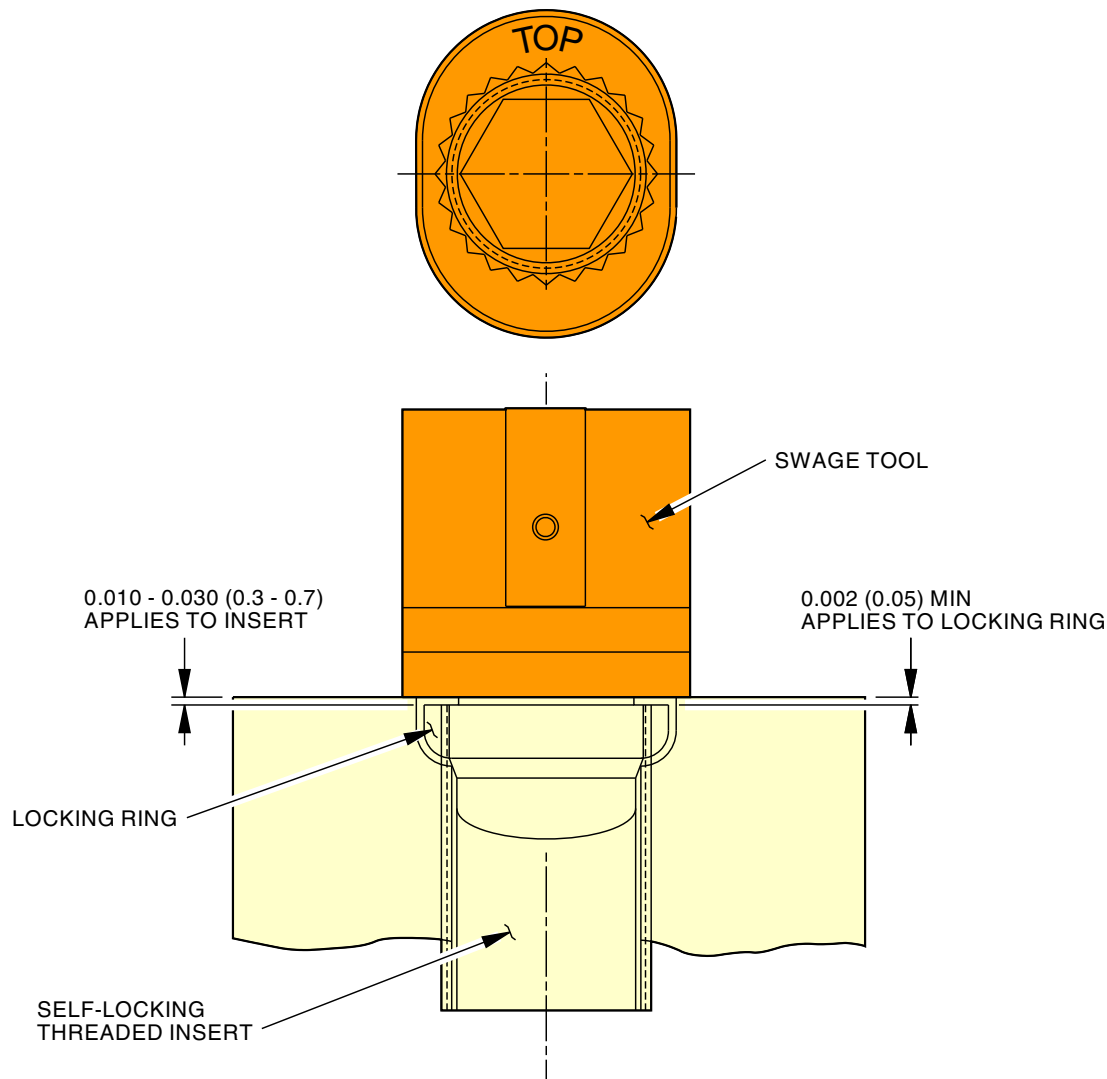
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**NOTES:**

1. DIMENSIONS ARE IN INCHES WITH MILLIMETERS IN PARENTHESES.
2. APPLIES TO INSERTS.

5035066-00
2570339 S0000616267_V1

Locking Ring and Threaded Insert Installation Swage Tool
Figure 203/70-48-02-990-808-G00 (Sheet 1 of 2)

EFFECTIVITY
SIA ALL

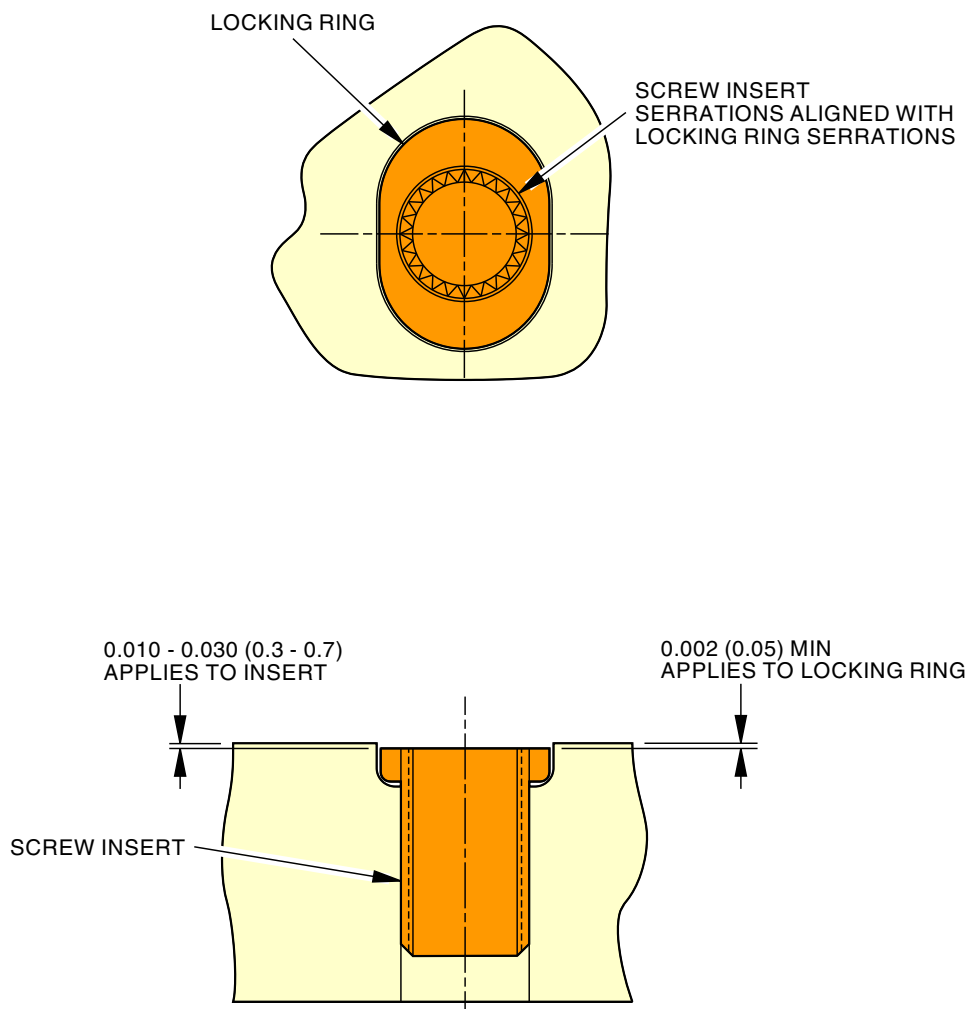
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**NOTES:**

1. DIMENSIONS ARE IN INCHES WITH MILLIMETERS IN PARENTHESES.
2. APPLIES TO INSERTS.

5035067-00

2570340 S0000616268_V1

Locking Ring and Threaded Insert Installation Swage Tool
Figure 203/70-48-02-990-808-G00 (Sheet 2 of 2)

EFFECTIVITY
SIA ALL

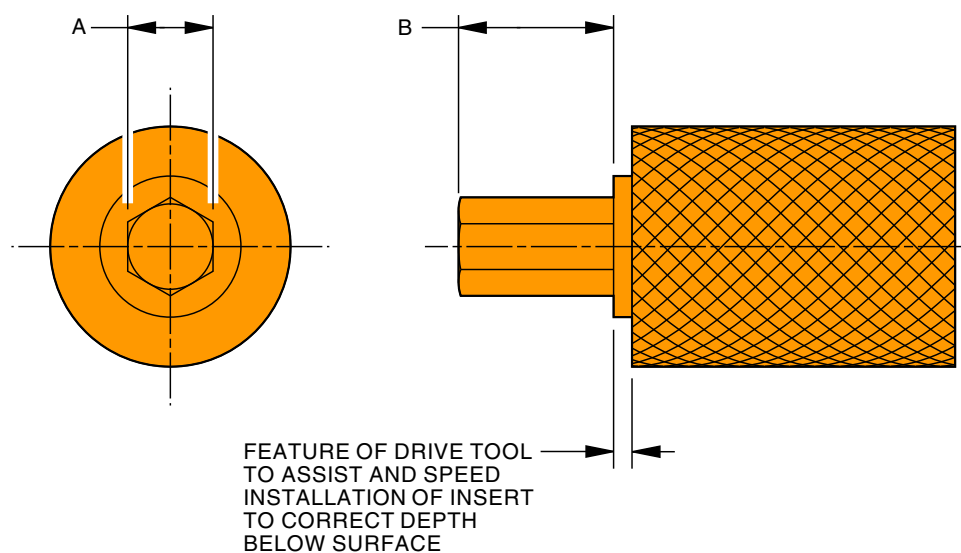
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INSERT	A		B
	IN(MM)		
	MIN	MAX	
1693M83P12	0.307(7.798)	0.317(8.052)	0.331(8.407)
1693M83P13	0.199(5.055)	0.209(5.309)	0.227(5.766)
1693M83P14	0.307(7.798)	0.317(8.052)	0.331(8.407)
1693M83P15	0.199(5.055)	0.209(5.309)	0.227(5.766)
1693M83P17	0.251(6.375)	0.258(6.553)	0.266(6.756)
1693M83P18	0.199(5.055)	0.209(5.309)	0.227(5.766)
1693M83P19	0.199(5.055)	0.209(5.309)	0.227(5.766)

5035068-00

2570341 S0000616269_V2

Drive Tool Dimensions
Figure 204/70-48-02-990-809-G00

EFFECTIVITY
SIA ALL

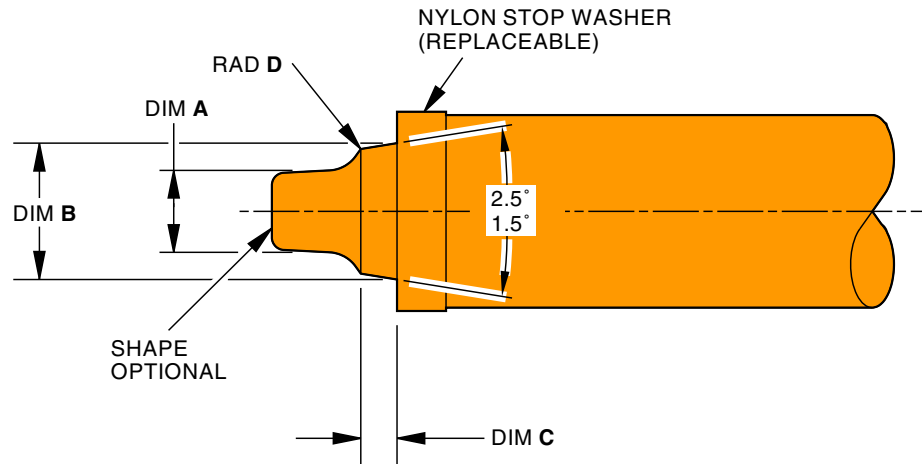
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IN(MM)				
INSERT	A MAX	B ±0.0006(0.0152)	C ±0.005(0.127)	RAD D ±0.010(0.254)
1693M83P12	0.315(8.001)	0.4085(10.3759)	0.032(0.813)	0.043(1.092)
1693M83P13	0.197(5.004)	0.2805(7.1247)	0.032(0.813)	0.032(0.813)
1693M83P14	0.315(8.001)	0.4085(10.3759)	0.032(0.813)	0.043(1.092)
1693M83P15	0.197(5.004)	0.2805(7.1247)	0.032(0.813)	0.032(0.813)
1693M83P17	0.256(6.502)	0.345(8.763)	0.032(0.813)	0.039(0.991)
1693M83P18	0.197(5.004)	0.2805(7.1247)	0.032(0.813)	0.032(0.813)
1693M83P19	0.197(5.004)	0.2805(7.1247)	0.032(0.813)	0.032(0.813)

5035069-00

2570342 S0000616270_V2

**Swage Tool Dimensions
Figure 205/70-48-02-990-810-G00**

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INSERT	LOCKRING	DRILL (INCH)	TAP (INCH)
1693M83P12	1689M74P07	0.4375	0.4375-20 UNJF-3A
1693M83P13	1689M74P06	0.3125	0.3125-24 UNJF-3A
1693M83P14	1689M74P09	0.4375	0.4375-20 UNJF-3A
1693M83P15	1689M74P08	0.3125	0.3125-24 UNJF-3A
1693M83P17	1689M74P11	0.375	0.375-24 UNJF-3A
1693M83P18	1689M74P06	0.3125	0.3125-24 UNJF-3A
1693M83P19	1689M74P08	0.3125	0.3125-24 UNJF-3A

5035070-00

2570343 S0000616271_V2

**Insert Part Number
Figure 206/70-48-02-990-811-G00****EFFECTIVITY
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TASK 70-48-02-420-801-G00**3. Ring Locked Self Locking Insert Installation**

(Figure 201, Figure 202, Figure 203, Figure 204, Figure 205 and Figure 206)

A. General

- (1) This task provides instructions on how to install a new ring-locked self-locking insert.

B. Tools/Equipment

Reference	Description
STD-12701	Lens - Magnifying, 10X Magnification

C. Consumable Materials

Reference	Description	Specification
D00418	Oil - Aircraft Turbine Engine Synthetic Base	MIL-PRF-7808
D50043 [C02-058]	Compound - Antiseize, Acheson GP460 (For Threaded Fasteners 0.250 Inches Diameter Or Larger, C02-079 Is An Alternative)	GE A50TF201 Class A
D50072 [C02-023]	Oil - Engine Lubricating (Refer to the model specific GE Service Bulletin 79-0001 for CF6, GENx, GE90, or GE9X engines)	

D. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

E. Ring Locked Self Locking Insert Installation**SUBTASK 70-48-02-100-003-G00**

- (1) Make sure that you remove all unwanted material from the threaded hole and the counterbore.

SUBTASK 70-48-02-420-001-G00

- (2) Install the new insert and the new locking ring in the assembly as follows:

NOTE: Make sure that you use the same size insert as the threaded insert that you removed.

- (a) Put the insert into the threaded hole.

NOTE: Use of aircraft turbine engine oil, D00418, (MIL-PRF-7808) or oil, D50072 [C02-023], (MIL-PRF-23699) or Acheson GP460 compound, D50043 [C02-058], for assembly of the screw is permitted.

- (b) Turn the insert using the correctly sized allen key wrench (Figure 204).

- (c) Install the insert in the case until the top face of the insert is 0.01 in. (0.25 mm) to 0.03 in. (0.76 mm) below the assembly surface (Figure 203).

SUBTASK 70-48-02-420-002-G00

- (3) Install the new locking ring on the insert and into the oval shaped hole of the assembly as follows:

- (a) For insert 1693M83P12, use locking ring 1689M74P07.
- (b) For insert 1693M83P13, use locking ring 1689M74P06.
- (c) For insert 1693M83P14, use locking ring 1689M74P09.
- (d) For insert 1693M83P15, use locking ring 1689M74P08.
- (e) For insert 1693M83P17, use locking ring 1689M74P11.

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- (f) For insert 1693M83P18, use locking ring 1689M74P06.
- (g) For insert 1693M83P19, use locking ring 1689M74P08
- (h) Make sure that the word TOP on the locking ring faces out from the assembly.
- (i) Align the serrations on the insert with the serrations of the locking ring.

SUBTASK 70-48-02-420-003-G00

- (4) Swage the new insert into the locking ring as follows:
 - (a) Make a swage tool to meet the dimension requirements for the insert (Figure 205).
NOTE: Swage tool is modified such that dimension C is decreased to 0.032 in. (0.813 mm) (extra nylon washer or additional nylon stop washer thickness).
 - (b) Put the swage tool into the screw insert and the locking ring.
 - (c) Push the locking ring to make sure that it makes contact with the bottom of the counterbore.
 - (d) Use a hammer to tap the swage tool until the nylon stop washer of the swage tool touches the pad on the assembly.

SUBTASK 70-48-02-080-001-G00

- (5) Remove the swage tool.

SUBTASK 70-48-02-211-001-G00

- (6) Do an inspection of the insert and locking ring as follows:
 - (a) Use a 10X magnifying lens, STD-12701.
 - (b) Make sure that the insert serrations are swaged into the serrations of the locking ring.
 - (c) Make sure that the locking ring is a minimum of 0.002 in. (0.05 mm) below the assembly surface.
 - (d) Use a pointed pick and try to lift the locking ring with light hand pressure on the pick.
 - 1) Make sure that the locking ring does not lift out of the counterbore.

SUBTASK 70-48-02-220-002-G00

- (7) Do a check of the self-locking torque of the insert as follows:
 - (a) For insert 1693M83P12, put a 0.375 in. (9.52 mm) heavy duty flat washer with 0.060 in. (1.52 mm) minimum thickness by 0.75 in. (19.0 mm) minimum outer diameter on a 0.375-24 UNJF-3A bolt.
 - (b) For insert 1693M83P13, put a 0.250 in. (6.35 mm) heavy duty flat washer with 0.060 in. (1.52 mm) minimum thickness by 0.50 in. (12.7 mm) minimum outer diameter on a 0.250-28 UNJF-3A bolt.
 - (c) For insert 1693M83P14, put a 0.375 in. (9.52 mm) heavy duty flat washer with 0.060 in. (1.52 mm) minimum thickness by 0.75 in. (19.0 mm) minimum outer diameter on a 0.375-24 UNJF-3A bolt.
 - (d) For insert 1693M83P15, put a 0.250 in. (6.35 mm) heavy duty flat washer with 0.060 in. (1.52 mm) minimum thickness by 0.50 in. (12.7 mm) minimum outer diameter on a 0.250-28 UNJF-3A bolt.
 - (e) For insert 1693M83P17, put a 0.3125 in. (7.938 mm) heavy duty flat washer with 0.060 in. (1.52 mm) minimum thickness by 0.62 in. (15.7 mm) minimum outer diameter on a 0.3125-24 UNJF-3A bolt.
 - (f) For insert 1693M83P18, put a 0.250 in. (6.35 mm) heavy duty flat washer with 0.060 in. (1.52 mm) minimum thickness by 0.50 in. (12.7 mm) minimum outer diameter on a 0.250-28 UNJF-3A bolt.

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- (g) For insert 1693M83P19, put a 0.250 in. (6.35 mm) heavy duty flat washer with 0.060 in. (1.52 mm) minimum thickness by 0.50 in. (12.7 mm) minimum outer diameter on a 0.250-28 UNJF-3A bolt.
- (h) Put the bolt and the flat washer in the insert.
- (i) Use a torque wrench to measure the torque of the insert.
- (j) Make sure that the torque range is as follows:

NOTE: The lock ring may rotate within the counter bore as long as the torque range is met.

- 1) For insert 1693M83P12, the minimum torque should be 14.2 in-lb (1.6 N·m) and the maximum torque should be 80.0 in-lb (9.04 N·m).
- 2) For insert 1693M83P13, the minimum torque should be 5.3 in-lb (0.60 N·m) and the maximum torque should be 30.0 in-lb (3.39 N·m).
- 3) For insert 1693M83P14, the minimum torque should be 14.2 in-lb (1.6 N·m) and the maximum torque should be 80.0 in-lb (9.04 N·m).
- 4) For insert 1693M83P15, the minimum torque should be 5.3 in-lb (0.6 N·m) and the maximum torque should be 30 in-lb (3.39 N·m).
- 5) For insert 1693M83P17, the minimum torque should be 9.7 in-lb (1.10 N·m) and the maximum torque should be 60.0 in-lb (6.78 N·m).
- 6) For insert 1693M83P18, the minimum torque should be 5.3 in-lb (0.60 N·m) and the maximum torque should be 30.0 in-lb (3.39 N·m).
- 7) For insert 1693M83P19, the minimum torque should be 5.3 in-lb (0.60 N·m) and the maximum torque should be 30.0 in-lb (3.39 N·m).

SUBTASK 70-48-02-080-002-G00

- (8) Remove the bolt and flat washer from the insert.

F. Put the Airplane Back to Its Usual Condition

SUBTASK 70-48-02-160-003-G00



MAKE SURE THAT CONTAMINATION DOES NOT FALL INTO THE ASSEMBLY THROUGH THE OPEN PADS. DAMAGE CAN OCCUR.

- (1) Remove all masking tapes, plugs, or covers used to keep contaminants from entering the assembly.

————— **END OF TASK** —————

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KEY-LOCK INSERT - MAINTENANCE PRACTICES

1. General

- A. This procedure has one task:
- (1) Key-Locked Insert Replacement.

TASK 70-48-13-960-801-G00

2. Key-Locked Insert Replacement

A. General

- (1) This task gives the instructions to replace the key-locked insert.
- (2) The key-locked inserts are used to lock screw in any material. The locking feature of the insert is dependent on the material. Low temperature inserts can use a plastic locking device while high temperature inserts generally have a crimped feature or ovalized part of the thread to provide locking ability.
- (3) The rotation of the insert inside the tapping is prevented by driving keys down into keyways broached in the insert and the workpiece at the insert upper section. In aluminum alloys, it is the keys themselves which broach the keyways as they are driven into the material of the workpiece.
- (4) Depending on the insert diameter of J1466, J1326, J970, and J971, either two or four keys are used as follows:
 - (a) Two keys on inserts with an inner diameter of less than 0.312 in. (7.92 mm).
 - (b) Four keys on inserts with an inner diameter equal to or more than 0.312 in. (7.92 mm).
- (5) Depending on the insert diameter of MS51830 and MS51831, either two or four keys are used as follows:
 - (a) Two keys on inserts with an inner diameter equal to or less than 0.250 in. (6.35 mm).
 - (b) Four keys on inserts with an inner diameter equal to or more than 0.312 in. (7.92 mm).
- (6) Depending on the insert diameter of MS51832, either two or four keys are used as follows:
 - (a) Two keys on inserts with an inner diameter equal to or less than 0.190 in. (4.83 mm).
 - (b) Four keys on inserts with an inner diameter equal to or more than 0.250 in. (6.35 mm).

B. Consumable Materials

Reference	Description	Specification
A50402 [CP2255]	Sealant - Plastic, Hylomar SQ32	CP2255
B00676 [CP1041]	Alcohol - Isopropyl	
B01058 [CP1039]	Solvent - Acetone, Reagent Grade	
D00599 [CP2442]	Oil - Engine	

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

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D. Key-Locked Insert Replacement

SUBTASK 70-48-13-020-001-G00

- (1) Remove the defective key-locked insert as follows:

NOTE: Inserts from different series are not interchangeable with one another unless called out in the IPC. Check the IPC for permitted replacement of key-locked inserts for oversize inserts if tappings are no longer fit for original inserts installation. Oversize replacements may not be available for every location or application.

- (a) Identify the defective key-locked insert.

**CAUTION**

BE CAREFUL WHEN YOU DRILL. BE CAREFUL WHEN YOU GRIND.
DAMAGE TO THE WORKPIECE CAN OCCUR.

- (b) Do one of these procedures to remove the keys:

- 1) Drilling

NOTE: Since it is not always possible to determine whether existing key-locked insert is original or oversize, drilling may be performed in two steps.

- a) Drill the insert. See Figure 201 for drill diameter and depth.
b) Check key outlines are visible from top to bottom. If not, drill to oversize insert diameter per Figure 201 (Sheet 1).

- 2) Grinding

- a) Grind keyways areas on insert tapping to disengage keys inward.

- (c) Bend keys inward per Figure 201 (Sheet 1).

- (d) Unscrew insert with a standard puller drill per Figure 201 (Sheet 1).

- (e) Clean the workpiece tapping to remove all foreign particles or tapping residue by acetone solvent, B01058 [CP1039]alcohol, B00676 [CP1041] and dry.

SUBTASK 70-48-13-220-001-G00

- (2) Examine the tapping and keyways as follows:

- (a) Do a check for good condition of tapping and, if it is necessary, dimension check to make sure an original size insert can be fitted into the tapping. See Figure 202 for tapping dimensions.

NOTE: If dimension check is not satisfactory, prepare for installation of an oversize insert.

- (b) In case of slight damage, restore tapping using same tap.

NOTE: Tappings have unified threads, class 2B, except for the modified internal thread diameters. Tapping is performed with standard taps.

- (c) Do a check of the keyways for impacts, burrs or any other visible damage.

NOTE: In case of serious damage, and only for inserts with two keys, broach two keyways at 90 degrees to the existing ones.

SUBTASK 70-48-13-300-001-G00

- (3) Rework the tapping for oversize insert installation as follows (Figure 201 (Sheet 2) and Figure 202 (Sheet 2)):

- (a) Drill guide hole.
(b) Rework lead-in chamfer.

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- (c) Retap using a standard tap.

SUBTASK 70-48-13-210-001-G00

- (4) Do a check of the parts.

- (a) The tappings must be clean and free from tears and foreign particles.
- (b) Insert threads and keys must be clean and free from burrs, roughness and other visible surface defects.

SUBTASK 70-48-13-390-001-G00

DO NOT USE HYLOMAR SQ32 / HYLOMAR PL32 AEROGRADE (CP2255) ON TITANIUM AND TITANIUM ALLOYS. DAMAGE TO THE EQUIPMENT CAN OCCUR.

- (5) Apply the HYLOMAR SQ32, A50402 [CP2255] to external threads and tapped hole.

NOTE: J1466 and J1326 series inserts are coated in dry film lubricant and can be installed without any additional product. However, engine oil, D00599 [CP2442] may be used to aid installation.

SUBTASK 70-48-13-420-001-G00

- (6) Install the new insert as follows:

NOTE: You can obtain a special tool from the inserts supplier to help with the insert installation. Use the installation tool to screw in the insert and drive in the keys (Figure 203 (Sheet 1)). If the installation tool is not available, You can use your hand to install the insert, and a soft faced punch to drive in the keys.

- (a) Do these steps to install the original size insert:
- 1) Screw insert into tapping with fingers or installation tool. See Figure 203 (Sheet 1).
 - 2) Line up keys with keyways of the previous insert.
 - 3) Check that insert depression below surface of workpiece conforms to tolerances specified in Figure 203 (Sheet 2). If not, replace by another insert until tolerance requirement is met.
 - 4) Use the installation tool per Figure 203 (Sheet 1) to press the keys down to depth specified in Figure 203 (Sheet 2), below the workpiece surface.
- (b) Do these steps to install the oversize size insert:
- 1) Screw insert into tapping with fingers or installation tool per Figure 203 (Sheet 1) until keys come against tapping.

NOTE: Adequate depression of the insert below workpiece surface is determined by the position of the keys. Insert depression tolerances are specified in Figure 203 (Sheet 2).

- 2) Use the installation tool per Figure 203 (Sheet 1) to press or strike the keys down below workpiece surface to depression specified in Figure 203 (Sheet 2).
- (c) Do a check for the insert depression (Figure 203 (Sheet 2)).
- (d) Do a check for the key depression (Figure 203 (Sheet 2)).
- (e) Do a check of the workpiece surface for absence of raised metal beads, incipient cracks or any other defect.
- (f) Remove any excess sealant.

———— **END OF TASK** ————

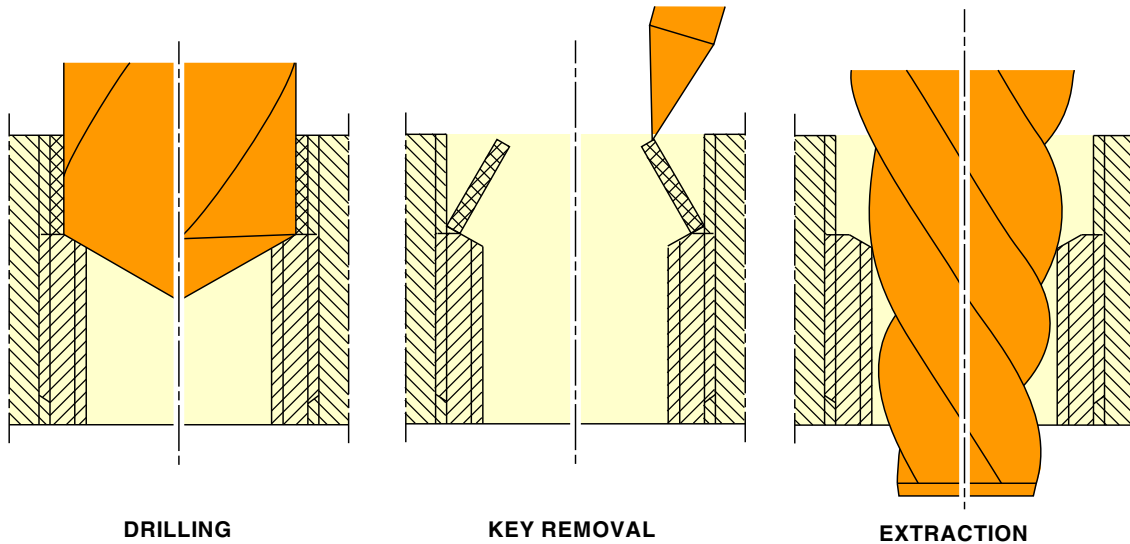
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DRILLING

KEY REMOVAL

EXTRACTION

	PART NO. IDENTIFICATION	EXT. THREAD DIA / PITCH	INT. THREAD DIA / PITCH	DRILL DIA	DRILL DEPTH
ORIGINAL FIT INSERTS J1466 SERIES	J1466P03	0.3125-18 (7,94)	0.1900-32 (4,83)	0.220 (5,58)	0.160 (4,064)
	J1466P04	0.3750-16 (9,52)	0.250-28 (6,35)	0.284 (7,21)	0.190 (4,826)
	J1466P05	0.4376-14 (11,17)	0.3125-24 (7,94)	0.345 (8,76)	
	J1466P06	0.5000-13 (12,70)	0.3750-24 (9,52)	0.407 (10,34)	
ORIGINAL FIT INSERTS J1326 SERIES	J1326P03	0.3750-16 (9,52)	0.1900-32 (4,83)	0.281 (7,10)	0.160 (4,064)
	J1326P04	0.4375-14 (11,17)	0.250-28 (6,35)	0.343 (8,70)	0.190 (4,826)
	J1326P05	0.500-13 (12,70)	0.3125-24 (7,94)	0.406 (10,30)	
	J1326P06	0.5625-12 (14,30)	0.3750-24 (9,52)	0.469 (11,90)	
ORIGINAL FIT INSERTS J970 SERIES	J970P03	0.3750-16 (9,52)	0.1900-32 (4,83)	0.281 (7,10)	0.220 (5,6)
	J970P04	0.4375-14 (11,17)	0.250-28 (6,35)	0.343 (8,70)	
	J970P05	0.500-13 (12,70)	0.3125-24 (7,94)	0.406 (10,30)	
	J970P06	0.5625-12 (14,30)	0.3750-24 (9,52)	0.469 (11,90)	
ORIGINAL FIT INSERTS J971 SERIES	J971P03	0.4375-14 (11,17)	0.190-32 (4,82)	0.343 (8,70)	0.220 (5,6)
	J971P04	0.500-13 (12,70)	0.250-28 (6,35)	0.406 (10,30)	
	J971P05	0.5625-12 (14,30)	0.3125-24 (7,94)	0.469 (11,90)	
	J971P06	0.6250-11 (15,87)	0.3750-24 (9,52)	0.531 (13,50)	

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Key-Locked Insert Extraction
Figure 201/70-48-13-990-801-G00 (Sheet 1 of 2)

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PART N° IDENTIFICATION	EXT. THREAD DIA / PITCH	INT. THREAD DIA / PITCH	DRILL DIA	DRILL DEPTH
MS51830CA201L	0.3125-18 (7.94)	0.190-32 (4.82)	0.219 (5.55)	0.156 (3.97)
MS51830CA202L	0.3750-16 (9.52)	0.250-28 (6.35)	0.281 (7.14)	0.188 (4.76)
MS51831CA201L	0.3750-16 (9.52)	0.190-32 (4.82)	0.281 (7.14)	0.125 (3.17)
MS51831CA202L	0.4375-14 (11.17)	0.250-28 (6.35)	0.344 (8.73)	0.188 (4.76)
MS51831CA204L	0.5625-12 (14.30)	0.3750-24 (9.52)	0.469 (11.90)	0.188 (4.76)
MS51832CA201L	0.4375-14 (11.17)	0.190-32 (4.82)	0.344 (8.73)	0.188 (4.76)
MS51832CA202L	0.500-13 (12.70)	0.250-28 (6.35)	0.406 (10.31)	0.188 (4.76)

NOTE:
DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES

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Key-Locked Insert Extraction
Figure 201/70-48-13-990-801-G00 (Sheet 2 of 2)

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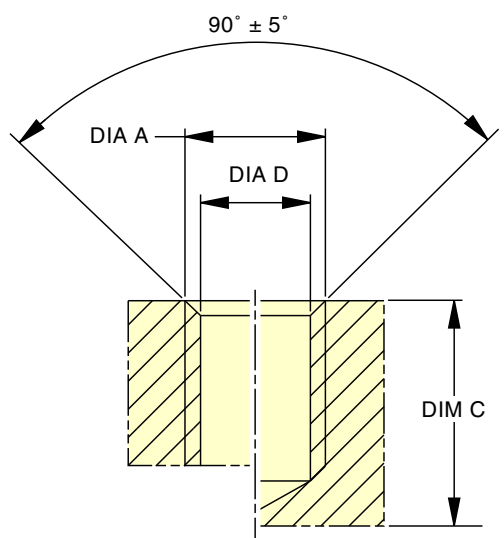
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		TAPPING DIMENSIONS				
		PART NO.	D UNC-2B (TAP DRILL DIAMETER)	A		C (MINIMUM FULL THREAD DEPTH)
				SINK DIAMETER		
			MAX	MIN		
ORIGINAL FIT INSERTS J1466 SERIES	J1466P03	0.2760-0.271 (7.01-6.88)	0.333 (8.46)	0.323 (8.20)	0.370 (9.40)	
	J1466P04	0.336-0.331 (8.53-8.41)	0.395 (10.03)	0.385 (9.77)	0.430 (10.92)	
	J1466P05	0.401-0.396 (10.19-10.06)	0.457 (11.60)	0.447 (11.35)	0.500 (12.70)	
	J1466P06	0.457-0.452 (11.61-11.48)	0.52 (13.20)	0.51 (12.95)	0.560 (14.22)	
ORIGINAL FIT INSERTS J970/J1326 SERIES	J970P03/ J1326P03	0.336-0.331 (8.53-8.41)	0.395 (10.03)	0.385 (9.77)	0.440 (11.18)	
	J970P04/ J1326P04	0.401-0.396 (10.19-10.06)	0.457 (11.60)	0.447 (11.35)	0.490 (12.45)	
	J970P05/ J1326P05	0.457-0.452 (11.61-11.48)	0.52 (13.20)	0.51 (12.95)	0.570 (14.48)	
	J970P06/ J1326P06	0.521-0.515 (13.23-13.08)	0.582 (14.78)	0.572 (14.52)	0.650 (16.51)	
ORIGINAL FIT INSERTS J971 SERIES	J971P03	0.401-0.396 (10.19-10.06)	0.457 (11.60)	0.447 (11.35)	0.440 (11.18)	
	J971P04	0.457-0.452 (11.61-11.48)	0.52 (13.20)	0.51 (12.95)	0.490 (12.45)	
	J971P05	0.521-0.515 (13.23-13.08)	0.582 (14.78)	0.572 (14.52)	0.570 (14.48)	
	J971P06	0.583-0.577 (14.81-14.66)	0.645 (16.38)	0.635 (16.12)	0.670 (17.02)	

NOTES:

- DIMENSIONS ARE IN INCHES WITH MILLIMETERS IN PARENTHESES.
- MAX. SURFACE ROUGHNESS 63 (1.6)

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Insert Tapping
Figure 202/70-48-13-990-802-G00 (Sheet 1 of 2)

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ORIGINAL FIT INSERT	TAPPING DIMENSIONS			
PART N°	D (TAP DRILL DIAMETER)	A (SINK DIAMETER)		C (MINIMUM FULL THREAD DEPTH)
		MAX	MIN	
MS51830CA201L	0.276-0.271 (7.01-6.88)	0.333 (8.46)	0.323 (8.20)	0.370 (9.40)
MS51830CA202L	0.336-0.331 (8.53-8.41)	0.395 (10.03)	0.385 (9.78)	0.430 (10.92)
MS51831CA201L	0.336-0.331 (8.53-8.41)	0.395 (10.03)	0.385 (9.78)	0.370 (9.40)
MS51831CA202L	0.401-0.396 (10.19-10.06)	0.457 (11.61)	0.447 (11.35)	0.430 (10.92)
MS51831CA204L	0.521-0.515 (13.23-13.08)	0.582 (14.78)	0.572 (14.53)	0.560 (14.22)
MS51832CA201L	0.401-0.396 (10.19-10.06)	0.457 (11.61)	0.447 (11.35)	0.370 (9.40)
MS51832CA202L	0.457-0.452 (11.61-11.48)	0.520 (13.21)	0.510 (12.95)	0.440 (11.18)

NOTE:
 DIMENSIONS ARE IN INCHES WITH
 MILLIMETERS IN PARENTHESES

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Insert Tapping
Figure 202/70-48-13-990-802-G00 (Sheet 2 of 2)

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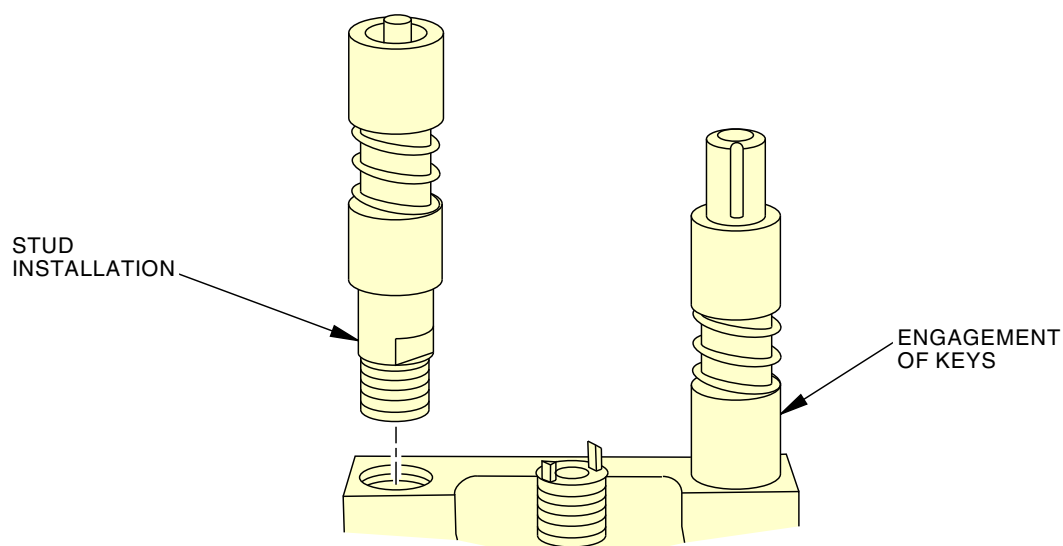
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	INSERT PART NUMBER	INSTALLATION TOOL PART NUMBER
J1466 SERIES	J1466P03 J1466P04 J1466P05 J1466P06	TD 1032L TD 428L TD 524L TD 624L
ORIGINAL FIT INSERTS J1326 SERIES	J1326P03 J1326P04 J1326P05 J1326P06	THD 1032L THD 428L THD 524L THD 624L
ORIGINAL FIT INSERTS J970 SERIES	J970P03 J970P04 J970P05 J970P06	THD 1032L THD 428L THD 524L THD 624L
OVERSIZE INSERTS J971 SERIES	J971P03 J971P04 J971P05 J971P06	THXHD 1032L THXHD 428L THXHD 524L THXHD 624L
MS SERIES	MS51830CA201L MS51830CA202L MS51831CA201L MS51831CA202L MS51831CA204L MS51832CA201L MS51832CA202L	TD 1032L TD 428L THD 1032L THD 428L THD 624L THXHD 1032L THXHD 428L

NOTE:

EQUIPMENT SUPPLIER - ALCOA FASTENING SYSTEM INDUSTRIAL DISTRIBUTION GROUP
HEADQUARTERS

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**Key-Locked Insert Installation
Figure 203/70-48-13-990-803-G00 (Sheet 1 of 2)**

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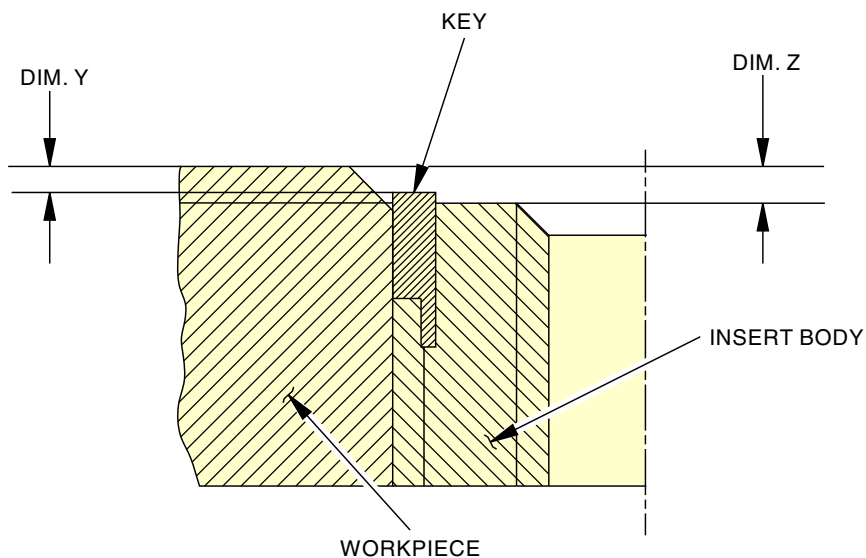
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KEY DEPRESSION DIM. Y	INSERT DEPRESSION DIM. Z
.010 to .030 (0,25) (0,76)	.010 to .030 (0,25) (0,76)



NOTE:
DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

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Key-Locked Insert Installation
Figure 203/70-48-13-990-803-G00 (Sheet 2 of 2)

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TIGHTENING TECHNIQUES AND TORQUE VALUES - MAINTENANCE PRACTICES

1. General

A. This procedure has two tasks:

- (1) Instructions for Torque (Miscellaneous)
- (2) Wrench Arc Method (Miscellaneous).

TASK 70-51-00-800-801-G00

2. Instructions for Torque (Miscellaneous)

(Figure 201, Figure 202, Figure 203, and Figure 204)

A. General

- (1) This task gives the instructions for torque.
- (2) These words in the torque procedure are defined as follows:
 - (a) Bolt
 - 1) A bolt is a fastener with an external thread.
 - (b) Breakaway-Torque
 - 1) The breakaway torque is the torque necessary to start the removal of a nut without an axial load on the nut.
 - (c) Gross Torque
 - 1) The gross torque is the torque value that the torque wrench applies.
 - a) Gross torque includes the run-on torque and the seated torque.
 - (d) Installed Nut
 - 1) The nut is installed when the chamfer plus a minimum of 1.5 threads extend through the nut and the correct torque is applied.
 - 2) It is not necessary for the bolt to extend through the top of the locknuts with a middle-length nylon lock (or other locks).
 - a) Make sure that the chamfer and 1.5 bolt threads extend through the lock.
 - (e) Maximum Installation Torque
 - 1) The maximum installation torque is the highest torque value specified for the bolt or nut.
 - (f) Minimum Prevailing Torque
 - 1) The minimum prevailing torque is the minimum removal torque of a fastener, during the second full turn.
 - (g) Removed Nut
 - 1) A self-locking nut is removed when the locking section is disengaged from the bolt. The nut can stay on the bolt.
 - (h) Run-On Torque
 - 1) The run-on torque is the torque necessary to turn a fastener before it is tightened against the seat.
 - (i) Seated Nut or Bolt
 - 1) The seated nut or bolt is one with the correct torque applied to tighten it.

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- a) A seated nut or bolt will apply the correct compression force on a spacing element.
 - <1> It will also apply the correct axial load to a bolt.
- (j) Spacer or Spacing Element
 - 1) The spacer or spacing elements are the parts that the fasteners hold together.
- (k) Unseated Nut or Bolt
 - 1) An unseated nut or bolt is a nut or a bolt that is not in the seated position.
 - a) An unseated nut or bolt does not apply an axial load on the fastener.
- (l) Unseating Torque
 - 1) The unseating torque is the torque necessary to remove a fastener from the bearing surface of a spacer.
 - a) There will be no axial load on the fastener after the unseating torque is applied.
- (m) Seating Torque
 - 1) The seating torque is the torque necessary to put the bearing surface of the fastener into the seated position.
 - a) You measure the seating torque in the direction used to tighten the fastener.
- (n) Acceptance Torque
 - 1) The acceptance torque is the torque that is necessary for the final assembly.
 - a) This includes the torque that is necessary to overcome the friction between the mating surface or the locking device.
 - b) You measure the acceptance torque in the direction used to tighten the fastener.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Tightening Procedures

SUBTASK 70-51-00-910-001-G00



BEFORE YOU APPLY THE LAST TORQUE, MAKE SURE THAT THE TEMPERATURE OF THE ASSEMBLY IS EQUAL TO THE ROOM TEMPERATURE. THE TORQUE VALUE WILL CHANGE WHEN YOU INCREASE OR DECREASE THE TEMPERATURE OF AN ASSEMBLY. A FASTENER CAN BECOME LOOSE WHEN A HOT PART BECOMES COOL. A FASTENER CAN BECOME TOO TIGHT WHEN A COOL PART BECOMES HOT. IF THE TEMPERATURE OF THE ASSEMBLY, AND ROOM TEMPERATURE ARE NOT THE SAME, DAMAGE TO THE ASSEMBLY CAN OCCUR.

- (1) Follow these steps when you tighten a part:
 - (a) Turn the fastener at a constant rate until you get the necessary torque.
 - (b) If the torque compresses a gasket or a part after you install it, then apply the torque again.
 - (c) When you install a part, do these steps:

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- 1) Tighten the parts to a torque value that is less than the necessary torque.
 - a) If you do not apply equal tension, you can cause a distortion or unwanted load.
- 2) Tighten the fasteners together, until the part touches the seat.
 - a) Tighten the opposite fasteners in pairs.
- 3) Loosen one fastener at a time.
- 4) Tighten the fastener to the necessary torque.
- 5) Do not tighten the fasteners to a value that is larger than the specified torque.

SUBTASK 70-51-00-910-002-G00

(2) Torque wrench selection

- (a) This procedure does not include torque multipliers for higher torques.
- (b) You can find the data for torque multipliers in the manufacturer's instructions.
- (c) Use Table 201 to make a selection of the correct torque wrench.
- (d) Use the correct size wrench for the work you will do. A torque wrench that is too large will have a tolerance too large to torque the fastener accurately.

TABLE

Table 201/70-51-00-993-801-G00 Torque Wrench Selection

Torque Wrench	Torque Limits	Tolerances
30 in-lb (3.39 N.m)	0-25 in-lb (0.000-2.82 N.m)	± 1 in-lb (0.11 N.m)
150 in-lb (16.94 N.m)	26-140 in-lb (2.93-15.82 N.m)	± 5 in-lb (0.56 N.m)
600 in-lb (67.79 N.m)	141-550 in-lb (15.83-62.14 N.m)	± 20 in-lb (2.26 N.m)
1800 in-lb (203.37 N.m)	360-1680 in-lb (40.87-189.81 N.m)	± 60 in-lb (6.78 N.m)
3000 in-lb (338.95 N.m)	1692-2880 in-lb (189.82-325.39 N.m)	± 120 in-lb (13.56 N.m)
12000 in-lb (1355.00 N.m)	2892-12000 in-lb (325.40-1355.00 N.m)	± 240 in-lb (27.12 N.m)

SUBTASK 70-51-00-910-003-G00

(3) These are the instructions to use an offset extension wrench (Figure 201 and Figure 202):

- (a) When you use an offset extension wrench (for example, a crowfoot extension), you can change the effective length of the torque wrench.
 - 1) The change to the effective length can cause the torque wrench to show an incorrect torque value.
- (b) Do these steps to calculate the correct torque indication for the extension wrench:
 - 1) The illustration shows the effective length of the torque wrench (L) and the effective length of the extension (E).
 - 2) The manufacturers instructions contain the effective length (L) of the torque wrench.
 - 3) Measure the effective length of an extension from the center of the drive opening to the center of the wrench opening.
 - 4) Calculate the total effective length.
 - a) When the extension points 90° from the torque wrench, the extension has no effect on the effective length of the torque wrench.

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- b) When the extension points in the same direction as the torque wrench, add the effective lengths of the extension and the torque wrench together (L + E).
 - c) When the extension points to the handle of the torque wrench, subtract the effective length of the extension from the effective length of the torque wrench (L - E).
- 5) Do these steps if the effective length of the torque wrench is changed by the extension.
- a) Multiply the necessary torque (T) by the effective length of the torque wrench (L).
 - b) Divide this result by (L + E) or (L - E).
 - c) This value is the indication of torque (Y) on the torque wrench, that gives the necessary torque on the fastener.

D. Standard Torque Values

SUBTASK 70-51-00-910-004-G00

(1) Steel nuts and bolts.

- (a) Use Table 202 for the standard torque limits for steel nuts and bolts.

NOTE: Use one half of the limits in the table for these fasteners. (1) Thin steel hexagonal nuts with a height that is less than 0.6 the pitch diameter for a nut without a lock. (2) Thin steel hexagonal nuts with a height of less than 0.8 the pitch diameter for a locknut. (3) Nuts and bolts of nonferrous alloys.

Table 202/70-51-00-993-802-G00 Standard Torque Limits for Steel Nuts and Bolts

Nominal Size	UNC and -8 Series		UNF and -12 Series	
	Threads per Inch	Torque	Threads per Inch	Torque
No. 4	40	3 - 5 in-lb 0.339 - 0.565 N.m	---	-----
No. 6	32	8 - 10 in-lb 0.904 - 1.130 N.m	40	10 - 12 in-lb 1.130 - 1.356 N.m
No. 8	32	13 - 16 in-lb 1.469 - 1.808 N.m	36	16 - 19 in-lb 1.808 - 2.147 N.m
No. 10	24	20 - 23 in-lb 2.260 - 2.599 N.m	32	33 - 37 in-lb 3.728 - 4.180 N.m
No. 12 (1/4 ")	20	40 - 60 in-lb 4.520 - 6.780 N.m	28	55 - 70 in-lb 6.215 - 7.910 N.m
5/16	18	70 - 110 in-lb 7.910 - 12.430 N.m	24	100 - 130 in-lb 11.300 - 14.690 N.m
3/8	16	160 - 210 lb-in 18.080 - 23.730 N.m	24	190 - 230 in-lb 21.470 - 25.990 N.m
7/16	14	250 - 320 in-lb 28.250 - 36.160 N.m	20	300 - 360 in-lb 33.900 - 40.680 N.m
1/2	13	420 - 510 in-lb 47.460 - 57.630 N.m	20	480 - 570 in-lb 54.240 - 64.410 N.m

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AIRCRAFT MAINTENANCE MANUAL

Table 202/70-51-00-993-802-G00 Standard Torque Limits for Steel Nuts and Bolts (Continued)

Nominal Size	UNC and -8 Series		UNF and -12 Series	
	Threads per Inch	Torque	Threads per Inch	Torque
9/16	12	575 - 685 in-lb 48 - 57 ft-lb 64.975-77.405 N.m	18	660 - 780 in-lb 55 - 65 ft-lb 74.580 - 88.140 N.m
5/8	11	840 - 960 in-lb 70 - 80 ft-lb 94.920-108.480 N.m	18	985 -1140 in-lb 82 - 95 ft-lb 111.300 - 128.820 N.m
3/4	10	1620-1800 in-lb 135 - 150 ft-lb 183.060 - 203.400 N.m	16	1800 - 2270 in-lb 150 - 165 ft-lb 203.400 - 256.510 N.m
7/8	9	2460 - 2750 in-lb 205 - 230 ft-lb 277.980 - 311.880 N.m	14	2820 - 3180 in-lb 235 - 265 ft-lb 318.660 - 359.340 N.m
1.000	8	3600 - 4080 lb-in 300 - 340 lb-ft 406.800 - 461.040 N.m	14	4200 - 4800 in-lb 350 - 400 ft-lb 474.600 - 542.400 N.m
1-1/8	7	5000 - 5720 in-lb 415 - 480 ft-lb 565.000 - 646.360 N.m	12	5820 - 6780 in-lb 485 - 565 ft-lb 657.660 - 766.140 N.m
1-1/4	7	7200 - 8400 in-lb 600 - 700 ft-lb 813.600 - 949.200 N.m	12	8280 - 9600 in-lb 690 - 800 ft-lb 935.640 -1084.800 N.m
1-3/8	6	9600 - 11100 lb-in 800 - 930 lb-ft 1084.800 -1254.300 N.m	12	10800 - 12720 in-lb 900 - 1060 ft-lb 1220.400 -1437.360 N.m
1-1/2	6	12000 - 14400 in-lb 1000 - 1200 ft-lb 1356.000 -1627.200 N.m	12	14400 - 16800 in-lb 1200 - 1400 ft-lb 1627.200 -1898.400 N.m
1-1/8	8	5280 - 6120 lb-in 440 - 510 lb-ft 596.640 - 691.560 N.m	---	-----
1-1/4	8	7500 - 8700 in-lb 625 - 725 ft-lb 847.500 - 983.100 N.m	---	-----
1-3/8	8	10100 - 12000 in-lb 840 - 1000 ft-lb 1138.872 -1356.000 N.m	---	-----
1-1/2	8	13800 - 16200 in-lb 1150 - 1350 ft-lb 1559.400 -1830.600 N.m	---	-----
		INCH-POUNDS * 0.113 OR FOOT-POUND *1.356 = N.m		

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Table 202/70-51-00-993-802-G00 Standard Torque Limits for Steel Nuts and Bolts (Continued)

Nominal Size	UNC and -8 Series		UNF and -12 Series	
	Threads per Inch	Torque	Threads per Inch	Torque

SUBTASK 70-51-00-910-005-G00

(2) Aluminum or magnesium bolts, studs, or a stepped stud

(a) Use Table 203 for the standard torque limits for the aluminum or magnesium bolts and studs, or stepped studs.

NOTE: You must tighten a stud with a different diameter on opposite ends to the torque limit of the smaller diameter.

Table 203/70-51-00-993-803-G00 Standard Torque Limits for the Aluminum or Magnesium Bolts and Studs, or Stepped Studs

Bolt or Stud Size	Inch-pounds	Newton-meters
3/16 - 24	35 - 40	(3.955 - 4.520)
1/4 - 20	75 - 80	(8.475 - 9.040)
5/16 - 18	135 - 145	(15.255 - 16.385)
3/8 - 16	240 - 250	(27.120 - 28.250)
7/16 - 14	370 - 380	(41.810 - 42.940)
1/2 - 13	580 - 600	(65.540 - 67.800)

SUBTASK 70-51-00-910-006-G00

(3) Flared Tubing and Hose Fittings

(a) Use Table 204 for the standard torque limits for flared tubing and hose fittings.

NOTE: (1) Use these limits when the internal seal surface is aluminum. The external connector and nut can be steel or aluminum.

NOTE: (2) Use these limits, when the brazed ferrule on a flared tube and its connector are steel. The external fitting and the nut can be steel or aluminum.

Table 204/70-51-00-993-804-G00 Standard Torque Limits for Flared Tubing and Hose Fittings

Tube OD (inch)	Thread Size (inch)-(No.)	All Aluminum Parts (Note 1)	Steel Tube Aluminum/Steel Nuts (Note 2)
1/8	5/16 - 24	-----	40 - 50 in-lb (4.520 - 5.650 N.m)
3/16	3/8 - 24	35 - 45 in-lb (3.954 - 5.084 N.m)	90 - 100 in-lb (10.170 - 11.300 N.m)
1/4	7/16 - 20	50 - 60 in-lb (5.649 - 6.779 N.m)	135 - 155 in-lb (15.253 - 17.513 N.m)
5/16	1/2 - 20	65 - 75 in-lb (7.344 - 8.474 N.m)	175 - 205 in-lb (19.772 - 23.169 N.m)
3/8	9/16 - 18	95 - 105 in-lb (10.734 - 11.863 N.m)	265 - 305 in-lb (29.941 - 34.460 N.m)
1/2	3/4 - 16	165 - 185 in-lb (18.642 - 20.902 N.m)	460 - 540 in-lb (51.973 - 61.012 N.m)
5/8	7/8 - 14	230 - 270 in-lb (25.986 - 30.506 N.m)	665 - 775 in-lb (75.135 - 87.563 N.m)
3/4	1-1/16- 12	330 - 385 in-lb (28 - 32 ft-lb)(37.285 - 43.499 N.m)	940 - 1100 in-lb (78 - 92 ft-lb)(106.206 - 124.283 N.m)

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Table 204/70-51-00-993-804-G00 Standard Torque Limits for Flared Tubing and Hose Fittings
(Continued)

Tube OD (inch)	Thread Size (inch)-(No.)	All Aluminum Parts (Note 1)	Steel Tube Aluminum/Steel Nuts (Note 2)
1.000	1-5/16- 12	555 - 645 in-lb (46 - 54 ft-lb)(62.707 - 72.875 N.m)	1325 - 1555 in-lb (110 - 130 ft-lb)(149.705 - 175.561 N.m)
1-1/4	1-5/8 - 12	720 - 840 in-lb (60 - 70 ft-lb)(81.349 - 94.907 N.m)	1550 - 1800 in-lb (130 - 150 ft-lb)(175.126 - 203.373 N.m)
1-1/2	1-7/8 - 12	720 - 840 in-lb (60 - 70 ft-lb)(81.349 - 94.907 N.m)	1900 - 2200 in-lb (158 - 183 ft-lb)(214.700 - 248.600 N.m)

SUBTASK 70-51-00-910-007-G00

(4) Plugs and Tube Fittings

(a) Use Table 205 for the standard torque limits for plugs and tube fittings:

Table 205/70-51-00-993-805-G00 Standard Torque Limits for Plugs and Tube Fittings

Fitting Size	Thread Size (inch) (pitch)	Torque Limits	Torque Unit
-2	5/16 - 24	40 - 50 (4.514 - 5.643)	in-lb (N.m)
-3	3/8 - 24	90 - 100 (10.158 - 11.387)	in-lb (N.m)
-4	7/16 - 20	135 - 155 (11.25 - 12.92) (15.253 - 17.513)	in-lb (ft-lb) (N.m)
-5	1/2 - 20	155 - 175 (12.91 - 14.66) (17.513 - 19.772)	in-lb (ft-lb) (N.m)
-6	9/16 - 18	175 - 205 (14.58 - 17.08) (19.772 - 23.162)	in-lb (ft-lb) (N.m)
-8	3/4 - 16	265 - 305 (22.08 - 25.42) (29.941 - 34.460)	in-lb (ft-lb) (N.m)
-10	7/8 - 14	350 - 410 (29.17 - 34.17) (39.545 - 46.324)	in-lb (ft-lb) (N.m)
-12	1-1/16- 12	555 - 645 (46.25 - 53.75) (62.607 - 72.875)	in-lb (ft-lb) (N.m)
-16	1-5/16- 12	720 - 850 (60.00 - 70.00) (81.349 - 94.907)	in-lb (ft-lb) (N.m)
-20	1-5/8 - 12	885 - 1035 (73.75 - 86.25) (99.992 - 116.939)	in-lb (ft-lb) (N.m)

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Table 205/70-51-00-993-805-G00 Standard Torque Limits for Plugs and Tube Fittings (Continued)

Fitting Size	Thread Size (inch) (pitch)	Torque Limits	Torque Unit
-24	1-7/8 - 12	995 - 1035 (82.92 - 97.08) (112.420 - 131.627)	in-lb (ft-lb) (N.m)

E. Plugs and Tube fittings

SUBTASK 70-51-00-910-008-G00

- (1) Follow these steps to install these three types of tube fittings (Figure 203).
 - (a) A non-positioning fitting that uses a preformed packing or a compression packing for a seal.
 - (b) A positioning fitting.
 - 1) The positioning fitting can use a backup washer.
 - (c) A universal bulkhead fitting with a locknut.

SUBTASK 70-51-00-910-009-G00

- (2) Assembly Procedures.
 - (a) These are the steps for the installation of a preformed packing on a fitting.
 - 1) Lubricate the preformed packing as specified in the maintenance manual.
 - 2) Do these steps when the ratio of the diameter to the cross-section of a preformed packing is larger than 20.
 - a) Install a conical sleeve on the fitting.
 - b) Roll the packing into the groove of the fitting.
NOTE: This prevents damage to the packing.
 - 3) Do these steps when the ratio is below 20.
 - a) Use a conical sleeve to roll the packing over a thread or spline.
 - b) Roll the packing into the groove of the fitting.
 - (b) Lubrication
 - 1) Do not use a lubricant on the threads or on the friction surfaces unless it is specified by the maintenance manual.
 - (c) Non-positioning Fittings
 - 1) Lightly lubricate the packing as specified in the maintenance manual.
NOTE: The lubrication can help to prevent damage to packing by the sharp edges of the threads.
 - a) Install the packing on the fitting.
 <1> Make sure that the packing is in the groove of the fitting
 - b) Install the fitting into the boss.
 - c) Tighten the fitting to the specified torque limits.
 - (d) Positioning Fittings (without backup washers)
 - 1) Install the locknut through the first section of the threads on the fitting.
 - a) Continue through the packing groove.
 - b) Continue to the second section of the threads on the fitting.
 - 2) Lubricate the packing as specified in the maintenance manual.

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- 3) Carefully install the packing over the first section of the threads and into the packing groove.
 - a) The packing must be adjacent to the second section of the threads.
 - 4) Turn the locknut until it touches the packing.
 - 5) Install the fitting in the boss until the packing touches the countersunk surface.
 - 6) Turn the fitting counterclockwise (not more than one turn) to get the necessary position.
 - 7) Hold the fitting while you tighten the locknut to the specified torque limit.
- (e) Positioning Fittings (with backup washers)
- 1) Install the locknut through the first section of the threads on the fitting.
 - a) Continue through the packing groove.
 - b) Continue to the second section of the threads of the fitting.
 - c) The washer recess must point in the direction of the packing groove.
 - 2) Tightly hold the backup washer by its outer edge to turn the fitting into the backup washer.
 - a) Do not use a lubricant.
 - b) Continue to turn the washer on the fitting until the washer is free in the packing groove.
 - c) Remove the pieces of plastic material that the fitting cut from the washer.
 - d) Push the edge of the washer into the recess in the locknut.
 - <1> Make sure that the washer is fully seated in the locknut.
 - <2> Make sure that the threads of the fitting do not keep the washer from its seat in the locknut.
 - 3) Lubricate the packing as specified in the maintenance manual.

NOTE: The lubrication can help to prevent damage to packing by the sharp edges of the threads.
 - 4) Carefully install the packing over the first section of the threads and into the packing groove.
 - a) The packing must be adjacent to the washer.
 - 5) Install the fitting in the boss until the packing touches the countersunk surface.
 - 6) Hold the locknut in its position with a wrench.
 - a) Turn the fitting into the boss 1.5 turns.
 - 7) Turn the fitting a maximum of one more turn into its correct position in the boss (total of 1.5 to 2.5 turns).
 - 8) Hold the fitting while you tighten the locknut to the specified torque limit.
- (f) Universal Bulkhead Fittings
- 1) Attach the bulkhead fitting to a bulkhead with the locknut.
 - a) Hold the fitting with a wrench and tighten the locknut to the specified torque limit.
 - 2) Connect the tube nuts or the hose nuts to the bulkhead fitting.
 - a) Hold the fitting with a wrench and tighten the tube nuts to the specified torque limit.

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F. Net Torque

SUBTASK 70-51-00-910-010-G00

- (1) The maintenance manual will give a net torque value when the axial force that you apply to a fastener is important.
- (a) Make sure that you use the net torque limits when they are specified (Figure 204).

SUBTASK 70-51-00-910-011-G00

- (2) Net torque is equal to the gross torque minus the run-on torque.
- (a) The steps that follow give an example to show how you find the net torque.
- 1) You must tighten a nut on a bolt to a net torque of 30 ± 10 in-lb (3.39 ± 1.13 N·m).
 - 2) Turn the nut on the bolt.
 - a) Find the torque that turns the nut before it touches its seat.
 - 3) Record this value as the run-on torque.
 - 4) Add the run-on torque value to the minimum and maximum specified torque values.

G. Torque Check for the Re-Use of Self Locking Nuts

NOTE: This data does not apply to nuts that you must use one time only (refer to the maintenance manual).

SUBTASK 70-51-00-910-012-G00

- (1) To reuse a self locking nut, the nut must have a specified minimum breakaway torque.

SUBTASK 70-51-00-910-013-G00

- (2) Do the breakaway torque check as follows:

**CAUTION**

DO NOT BEND A SELF-LOCKING NUT TO GET THE NECESSARY SELF-LOCKING TORQUE. FAILURE OF THE NUT CAN OCCUR.

- (a) Install the nut on a bolt until 2 to 5 threads show through the nut.
- 1) Measure the torque that is necessary when you turn the nut on the bolt.
- (b) Use Table 206 for the minimum breakaway torque for self locking nuts that are silver plated, have a dry film coating, or have a dry film lubricant.
- (c) Use Table 206 for the minimum breakaway-torque for the self locking nuts that do not have an axial load limit.
- (d) Replace all the nuts that do not meet the minimum torque values.

Table 206/70-51-00-993-806-G00 Minimum Breakaway Torque

Thread Size	Threads/Inch	Minimum Breakaway Torque
0.138 (6)	32/40	1.0 in-lb (0.11 N.m)
0.164 (8)	32/36	1.5 in-lb (0.17 N.m)
0.190 (10)	32	2.0 in-lb (0.22 N.m)
1/4	28	3.5 in-lb (0.40 N.m)
5/16	24	6.5 in-lb (0.73 N.m)
3/8	24	9.5 in-lb (1.07 N.m)
7/16	20	14.0 in-lb (1.58 N.m)

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Table 206/70-51-00-993-806-G00 Minimum Breakaway Torque (Continued)

Thread Size	Threads/Inch	Minimum Breakaway Torque
1/2	20	18.0 in-lb (2.03 N.m)
9/16	18	24.0 in-lb (2.71 N.m)
5/8	18	32.0 in-lb (3.62 N.m)
3/4	16	50.0 in-lb (5.65 N.m)
7/8	14	70.0 in-lb (7.91 N.m)
1.0	14	92.0 in-lb (10.39 N.m)
1-1/8	12	117.0 in-lb (13.22 N.m)
1-1/4	12	143.0 in-lb (16.16 N.m)

H. Torque Procedure for V-Band Clamps

SUBTASK 70-51-00-910-014-G00

- (1) Install the V-band clamp on the flanges of the duct.

SUBTASK 70-51-00-910-015-G00

- (2) Tighten the nut to 50 percent of the specified torque value.

SUBTASK 70-51-00-910-016-G00

- (3) Make sure that the V-band clamp is in its correct position on the flange.

- (a) If there is a seal between the duct flanges, make sure that the seal is installed correctly.

SUBTASK 70-51-00-910-017-G00

- (4) Lightly hit the outer surface of the V-band with a plastic mallet.

NOTE: This will cause the tension in the clamp to apply equally around the clamp.

SUBTASK 70-51-00-910-018-G00

- (5) Continue to hit the V-band clamp while you tighten the nut to the specified torque.

SUBTASK 70-51-00-910-019-G00

- (6) Lightly hit the outer surface of the V-band clamp.

SUBTASK 70-51-00-910-020-G00

- (7) Retighten the nut to the specified torque.

I. Acceptability Limits and Acceptance Torques

NOTE: These are the torque values you use to verify the parts that are assembled to the engine before the engine test.

SUBTASK 70-51-00-910-021-G00

- (1) You use these torque values during the inspection or audit to make sure that the correct torque was applied.

- (a) Use Table 207 for the acceptability limits.

Table 207/70-51-00-993-807-G00 Acceptability Limits

Thread Size	Seating Torque in-lb (N.m)	Acceptance Torque in-lb (N.m)
0.190-32	24-27 (2.71-3.05)	21-39 (2.37-4.41)
0.190-32	33-37 (3.73-4.18)	30-46 (3.39-5.20)
0.190-32	40-60 (4.52-6.78)	36-78 (4.07-8.81)

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Table 207/70-51-00-993-807-G00 Acceptability Limits (Continued)

Thread Size	Seating Torque in-lb (N.m)	Acceptance Torque in-lb (N.m)
0.250-28	28-35 (3.16-3.95)	24-46 (2.71-5.20)
0.250-28	55-70 (6.21-7.91)	50-91 (5.65-10.28)
0.250-28	110-120 (12.43-13.56)	100-156 (11.30-17.63)
0.3125-24	100-130 (11.30-14.69)	91-169 (10.28-19.09)
0.375-24	190-230 (21.47-25.99)	172-299 (19.43-33.78)
0.375-24	380-420 (42.93-47.45)	344-546 (38.87-61.69)
0.375-24	540-560 (61.01-63.27)	489-728 (55.25-82.25)

———— **END OF TASK** ————

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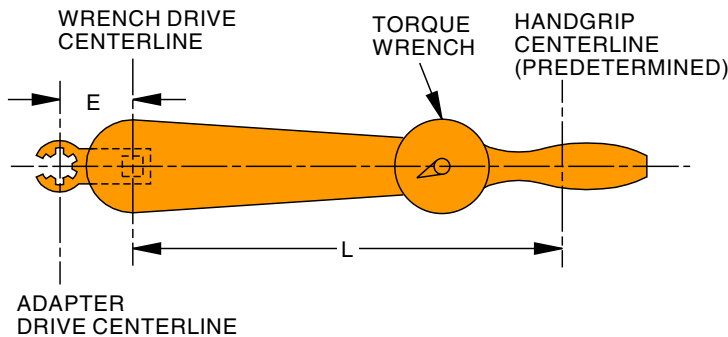
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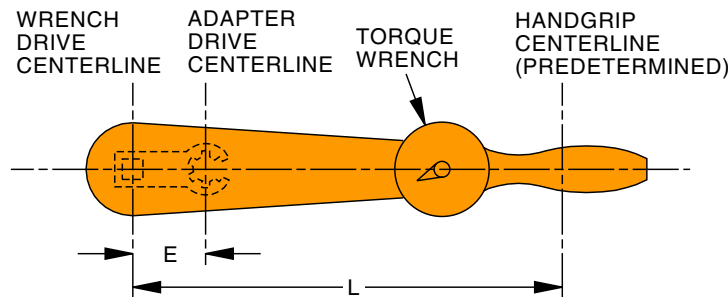
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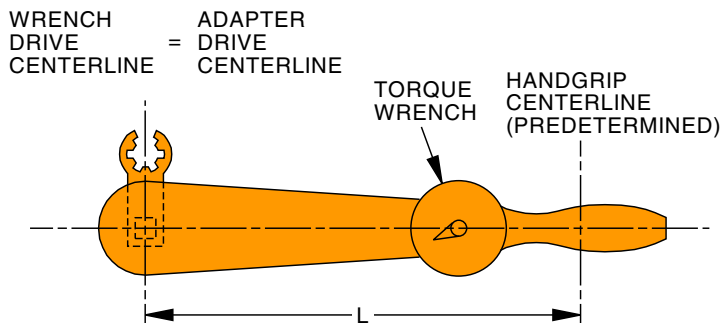
WHEN YOU USE A TORQUE WRENCH ADAPTER, YOU CAN CHANGE THE EFFECTIVE LENGTH OF THE TORQUE WRENCH. YOU APPLY THE FOLLOWING FORMULA TO OBTAIN THE CORRECTED TORQUE READING:

$$Y = \frac{T \times L}{L + E}$$



WHEN YOU USE A TORQUE WRENCH ADAPTER, YOU CAN CHANGE THE EFFECTIVE LENGTH OF THE TORQUE WRENCH. YOU APPLY THE FOLLOWING FORMULA TO OBTAIN THE CORRECTED TORQUE READING:

$$Y = \frac{T \times L}{L - E}$$



IF AN ADAPTER DOES NOT CHANGE THE EFFECTIVE LENGTH OF THE TORQUE WRENCH, A CORRECTED TORQUE READING IS NOT NECESSARY.

LEGEND:

T = ACTUAL (DESIRED) TORQUE
Y = APPARENT (INDICATED) TORQUE
L = EFFECTIVE LENGTH OF TORQUE WRENCH
E = EFFECTIVE LENGTH OF EXTENSION OR ADAPTER

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**Use of an Offset Extension Wrench
Figure 201/70-51-00-990-801-G00**

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GIVEN:

NECESSARY TORQUE (T) = 265 POUND-INCHES (29.94 NEWTON-METERS)

EFFECTIVE LENGTH OF THE TORQUE
WRENCH (L) = 8.4 INCHES (213.36 mm)

EFFECTIVE LENGTH OF THE
EXTENSION (E) = 1.5 INCHES (38.1 mm)

$$Y = \frac{T \times L}{L + E}$$

THEN:

(T)x(L) = 265x8.4 = 2226.0 POUND-INCHES
(29.94 NEWTON-METERS x 213.36 mm = 6388.00)

(L+E) = 8.4+1.5 = 9.9 INCH
(213.36 mm + 38.1 mm = 251.46 mm)

$$Y = \frac{2226.0}{9.9} = 224.85 \text{ POUND-INCHES}$$

$$\frac{6388.00}{251.46} = 25.404 \text{ NEWTON-METERS}$$

THUS: AN INDICATION OF TORQUE ON THE WRENCH OF
225 POUND-INCHES (25.42 NEWTON-METERS)
GIVES THE NECESSARY TORQUE OF
265 POUND-INCHES (29.94 NEWTON-METERS).

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**Torque Calculation on the Fastener
Figure 202/70-51-00-990-802-G00**

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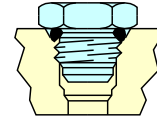
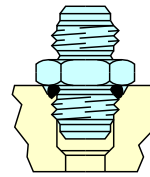
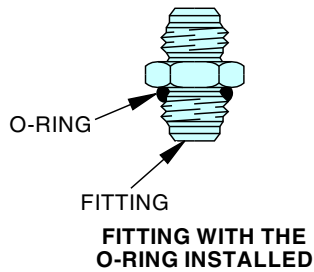
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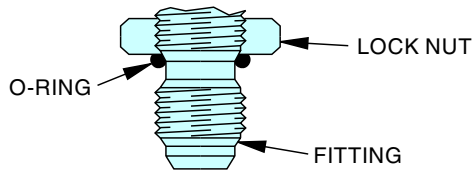
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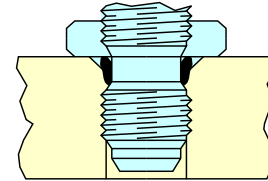


FITTINGS INSTALLED IN THE BOSS AND TIGHTENED WITH THE O-RING COMPRESSED

NON-POSITIONING FITTINGS

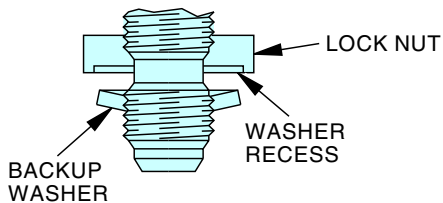


FITTING WITH THE LOCK NUT AND THE O-RING INSTALLED

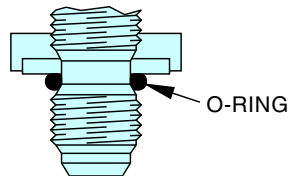


FITTING INSTALLED IN THE BOSS WITH THE LOCK NUT TIGHTENED AND THE O-RING COMPRESSED

POSITIONING FITTINGS (NO BACKUP WASHERS)

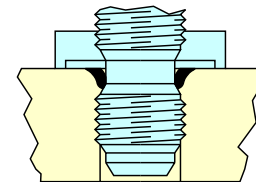


FITTING WITH THE LOCK NUT AND THE TEFLON BACKUP WASHER INSTALLED

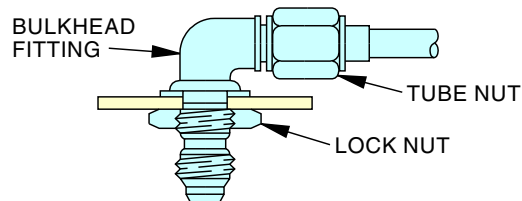


FITTING WITH THE WASHER PRESSED IN RECESS AND THE O-RING INSTALLED

POSITIONING FITTINGS (WITH THE BACKUP WASHERS)



FITTING INSTALLED IN THE BOSS WITH THE LOCK NUT TIGHTENED AND THE O-RING COMPRESSED



FITTING ATTACHED TO THE BULKHEAD WITH THE LOCK NUT TIGHTENED

BULKHEAD FITTINGS

CF8-6238-00-A
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Installation and Tightening of Plugs and Tube Fittings
Figure 203/70-51-00-990-803-G00

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EXAMPLE:

20 POUND-INCHES	(2.26 NEWTON-METERS)
+15 POUND-INCHES	+(1.69 NEWTON-METERS)
<u>35 POUND-INCHES</u>	<u>(3.95 NEWTON-METERS)</u>
+40 POUND-INCHES	+(4.52 NEWTON-METERS)
+15 POUND-INCHES	+(1.69 NEWTON-METERS)
<u>55 POUND-INCHES</u>	<u>(6.21 NEWTON-METERS)</u>

THUS: TO GET A NET TORQUE OF 20-40 POUND-INCHES (2.26-4.52 NEWTON-METERS), YOU MUST APPLY A GROSS TORQUE OF 35-55 POUND-INCHES (3.95-6.21 NEWTON-METERS) TO THE NUT.

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**Net Torque Calculation
Figure 204/70-51-00-990-804-G00**

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TASK 70-51-00-800-802-G00**3. Wrench Arc Method (Miscellaneous)**

(Figure 205)

A. General

- (1) This task provides the instructions for the wrench arc procedure to tighten the ball-nose fittings on engine components and tubing. The aim of the procedure is to get a total angle between the wrenches of 30 degrees. You will measure the angular displacement of the wrenches visually as an alternative to a torque measurement. There are two versions of the wrench arc procedure:
 - (a) The procedure to turn the B-nut. You use an open end wrench, crowfoot or tubing wrench.
 - (b) The procedure to use line of sight. You use a 15 degree offset open end wrench.

B. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

C. Procedure

SUBTASK 70-51-00-420-001-G00

- (1) Prepare to tighten the ball-nose fitting.
 - (a) Clean the threads and the mating surfaces of the fitting.
 - (b) Make sure that there are no nicks, burrs, or scratches on the threads or the mating surfaces.

SUBTASK 70-51-00-420-002-G00



USE A BACK-UP WRENCH TO MAKE SURE THAT THE HOSE DOES NOT TURN WHEN YOU TIGHTEN THE B-NUT. IF THE HOSE TURNS, DAMAGE TO THE HOSE CAN OCCUR.

- (2) Use the procedure to turn the B-nut to tighten the ball-nose fitting.

NOTE: No lubricant is necessary for the ball-nose fitting.

 - (a) Put the open end wrench, the crowfoot or the tubing wrench on the B-nut.
 - (b) Turn the B-nut until the resistance increases quickly.

NOTE: The resistance will increase quickly when the mating surfaces touch.
 - (c) Make sure that the ball-nose fitting is correctly installed and the threads engage correctly.
 - (d) Make sure that the mating surfaces of the ball-nose fitting are not loose.
 - (e) Set a reference point on the B-nut coupling.

NOTE: The reference point is always between the B-nut flat and the coupling.
 - (f) Use the open end wrench to tighten the B-nut through an arc 30 degrees.

NOTE: 1/2 flat turn of the B-nut is 30 degrees of a full arc.
 - (g) If this is a new part, loosen the B-nut and then tighten again through the 30 degree arc.

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SUBTASK 70-51-00-420-003-G00

**CAUTION**

USE A BACK-UP WRENCH TO MAKE SURE THAT THE HOSE DOES NOT TURN WHEN YOU TIGHTEN THE B-NUT. IF THE HOSE TURNS, DAMAGE TO THE HOSE CAN OCCUR.

- (3) Use the line of sight procedure to tighten the ball-nose fitting.

NOTE: No lubricant is necessary for the ball-nose fitting.

- (a) Put the open end wrench on the B-nut.
- (b) Turn the B-nut until the resistance increases quickly.

NOTE: The resistance will increase quickly when the mating surfaces touch.

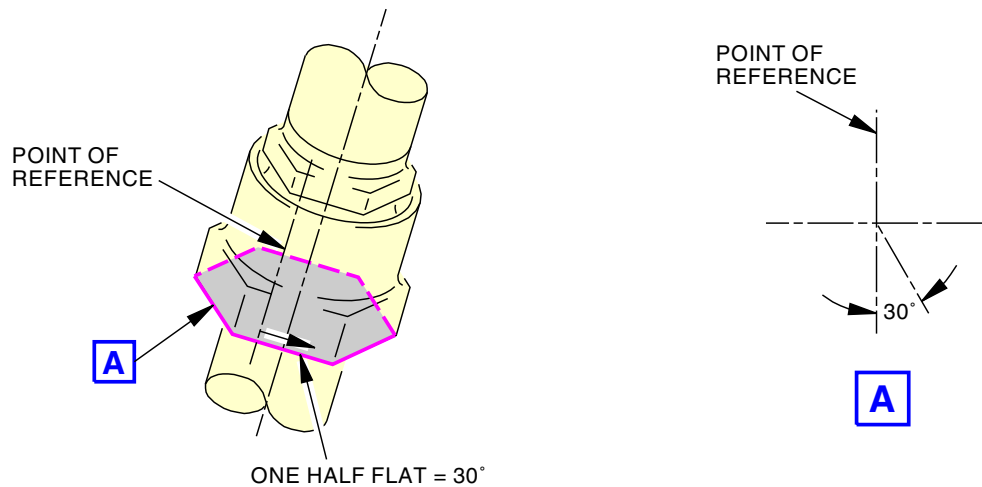
- (c) Make sure that the ball-nose fitting is correctly installed and the threads engage correctly.
- (d) Make sure that the mating surfaces of the ball-nose fitting are not loose.
- (e) Look at the position of the 15 degree open end wrench handle.
- (f) Set a reference point on the B-nut aligned with the handle.

NOTE: The reference point is always between the B-nut flats and the wrench handle.

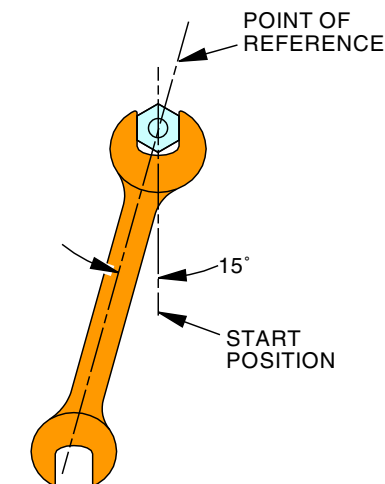
- (g) Tighten the B-nut 15 degrees.
- (h) Turn the wrench over.
- (i) Put the wrench on the same B-nut flats.
- (j) Tighten the B-nut 15 degrees more which aligns the wrench back to the start position.
- (k) If this is a new part, loosen the B-nut and then tighten again through the 30 degree arc.

———— **END OF TASK** ————

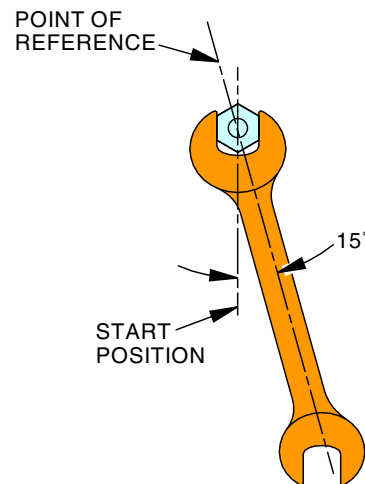
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TURN OF THE B-NUT METHOD



**TURN NUT 15° FROM
THE START POSITION**



**TURN WRENCH OVER (INVERT)
TURN NUT 15° BACK TO THE
START POSITION**

LINE OF SIGHT METHOD

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Tighten Ball-Nose Fittings with the Wrench Arc Method
Figure 205/70-51-00-990-805-G00

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PTFE LUBRICANT VARNISH DRY FILM APPLICATION - MAINTENANCE PRACTICES

1. General

A. This procedure has this task:

- (1) An application of the PTFE lubricant varnish dry film.

TASK 70-63-00-390-801-G00

2. PTFE Lubricant Varnish Dry Film Application

A. General



IF YOU APPLY THE PTFE LUBRICANT VARNISH ON ALUMINUM OR ALUMINUM ALLOY, MAKE SURE NOT TO HEAT THE PART ABOVE THE LIMITS. IF YOU DO NOT OBEY, DAMAGE TO THE PART CAN OCCUR.

- (1) The Polytetrafluoroethylene (Teflon) (PTFE) lubricant varnish, after application and setting, is a lubricant film very effective in preventing friction damage.
- (2) The following equipment is required for the application of this lubricant:
 - (a) Efficient ventilation system for extracting and neutralizing vapors.
 - (b) Oven capable of maintaining 356°F (180°C) maximum.
 - (c) Spray system capable of delivering lubricant varnish at 25 psi (172 kPa) - 40 psi (276 kPa) if varnish is applied by spraying.
 - (d) Brush of good quality if varnish is applied by brushing.
 - (e) Sharp blade.
 - (f) Clean cloth for cleaning and removing excess of lubricant varnish.
 - (g) Safety equipment such as rubber gloves, goggles, respirators, etc.

B. Consumable Materials

Reference	Description	Specification
A50568 [CP2233]	Tape - Masking - 3M 250	
B00676 [CP1041]	Alcohol - Isopropyl	
B01058 [CP1039]	Solvent - Acetone, Reagent Grade	
B50190 [CP1040]	Solvent - Methyl Ethyl Ketone (MEK)	ASTM D740
D50386 [CP2328]	Lubricant - Varnish, Bonderite L-GP D148A	

C. Location Zones

Zone	Area
411	Engine 1 - Engine
421	Engine 2 - Engine

D. PTFE Lubricant Varnish Dry Film Application

SUBTASK 70-63-00-220-001-G00

- (1) Process a test piece along with the part to be varnished for quality assurance.
 - (a) Dimensions of the test piece: 1.6 in. (41 mm) x 0.8 in. (20 mm) x (0.03 in. (0.8 mm) - 0.08 in. (2 mm)).

SUBTASK 70-63-00-220-002-G00

- (2) If a varnish thickness is required, measure thickness of test piece prior to varnish application.

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SUBTASK 70-63-00-100-001-G00



DO NOT GET CLEANING SOLVENT ON YOUR SKIN OR CLOTHING. MAKE SURE THAT THERE IS SUFFICIENT AIR FLOW IN THE WORK AREA. THE CLEANING SOLVENT IS FLAMMABLE AND POISONOUS. IF YOU DO NOT OBEY, INJURY TO THE PERSONNEL CAN OCCUR.

- (3) Unless otherwise specified, clean part and test piece with a clean cloth moist with acetone solvent, B01058 [CP1039], or solvent, B50190 [CP1040], or alcohol, B00676 [CP1041].
- (a) Apply lubricant within 15 minutes after cleaning.

SUBTASK 70-63-00-300-001-G00

- (4) Apply masking to part if specified.

SUBTASK 70-63-00-300-002-G00

- (5) Prepare the mixture of Bonderite L-GP D148A lubricant, D50386 [CP2328], as follows:



DO NOT GET LUBRICANT VARNISH ON YOUR SKIN OR CLOTHING. MAKE SURE THAT THERE IS SUFFICIENT AIR FLOW IN THE WORK AREA. THE LUBRICANT VARNISH IS FLAMMABLE AND POISONOUS. IF YOU DO NOT OBEY, INJURY TO THE PERSONNEL CAN OCCUR.

- (a) Stir the varnish and add the catalyst in the following proportions:
- NOTE: Varnish application should be performed within 24 hours after mixing of both parts.
- Varnish: 100 parts by weight
 - Catalyst: 17 parts by weight.
- (b) If varnish is applied by spraying, add solvent, B50190 [CP1040], to obtain the following viscosity: Ford Cup (Consistometer) No. 4 of 25 s ±5 s.

SUBTASK 70-63-00-300-003-G00

- (6) Apply varnish using a brush or by spraying as specified in the process document.

SUBTASK 70-63-00-100-002-G00

- (7) Remove any overspray or excess varnish with a clean cloth moist with solvent, B50190 [CP1040].

SUBTASK 70-63-00-020-001-G00

- (8) Remove masking if applied.

SUBTASK 70-63-00-300-004-G00

- (9) Allow the varnished parts to dry at room temperature for 30 minutes.

SUBTASK 70-63-00-640-001-G00

- (10) Dry lubricant varnish by one of the following methods:
- (a) Allow to dry at ambient temperature for 48 hours.
- (b) Oven dry at 140°F (60°C) for 2 hours.
- NOTE: Oven drying improves lubricant varnish hardness and strength.
- (c) Oven dry at 302°F (150°C) for 1 hour.
- NOTE: Oven drying improves lubricant varnish hardness and strength.
- (d) Oven dry at 356°F (180°C) for 30 minutes.
- NOTE: Oven drying improves lubricant varnish hardness and strength.

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AIRCRAFT MAINTENANCE MANUAL****SUBTASK 70-63-00-020-002-G00**

- (11) In case of oven drying, remove part from oven and allow to air cool at room temperature.

SUBTASK 70-63-00-220-003-G00

- (12) If a thickness of lubricant varnish is specified, measure test piece thickness and subtract initial measurement to ensure proper lubricant varnish thickness.

SUBTASK 70-63-00-640-002-G00

- (13) If more than one application is required to obtain the varnish lubricant thickness specified in the process document, repeat steps 2.D.(6) - 2.D.(12).

E. Inspection**SUBTASK 70-63-00-210-001-G00**

- (1) Make sure that the varnished surfaces are smooth, uniform, and free from sags, blisters, flakes, or foreign material.

- (a) Make sure that the coating is light green.

SUBTASK 70-63-00-210-002-G00

- (2) Perform the following test on the test piece that was processed with the part:

- (a) Scrape lubricant varnish with a sharp blade.

- 1) Make sure that scrapings appear as a powder.

- (b) Apply and press on a strip of pressure 3M 250 tape, A50568 [CP2233], to the test piece.

- 1) Make sure that lubricant varnish does not peel when tape is pressed and pulled off.

SUBTASK 70-63-00-020-003-G00

- (3) If the varnished surfaces fail any of these tests or examinations, remove the coating and reprocess the part.

———— **END OF TASK** ————

