

CHAPTER

70

**STANDARD
PRACTICES**

(CFM56 ENGINES (CFM56-7))

737-600/700/800/900 AIRCRAFT MAINTENANCE MANUAL

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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 70-00-01-910-801-F00

2. Terms and Abbreviations

A. Terms

SUBTASK 70-00-01-910-001-F00

- (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 PROVIDE ADDITIONAL 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 70-00-01-910-002-F00

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

Table 201/70-00-01-993-801-F00

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 201/70-00-01-993-801-F00 (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 201/70-00-01-993-801-F00 (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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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 inch (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 201/70-00-01-993-801-F00 (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 hydro-carbons, 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 70-00-01-910-003-F00

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

Table 202/70-00-01-993-802-F00

ABBREVIATION	DEFINITION
A's	
AC	Alternating Current
AGB	Accessory Gearbox
APU	Auxiliary Power Unit
AVM	Airborne Vibration Monitoring
B's	
BAT	Battery
C's	
CBP	Compressor Bleed Pressure
CDP	Compressor Discharge Pressure
CG	Center of Gravity
CIT	Compressor Inlet Temperature

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Table 202/70-00-01-993-802-F00 (Continued)

ABBREVIATION	DEFINITION
CONT	Continuous
D's	
DC	Direct Current
DIA	Diameter
E's	
EEC	Electronic Engine Controller
EGT	Exhaust Gas Temperature
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	
HMU	Hydromechanical Unit
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	
KIAS	Knots, Indicated Air Speed
KPA	Kilo-Pascal
L's	
LP	Low Pressure
LPC	Low Pressure Compressor (Fan)

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Table 202/70-00-01-993-802-F00 (Continued)

ABBREVIATION	DEFINITION
LPT	Low Pressure Turbine
LRU	Line Replaceable Unit
LVDT	Linear Variable Differential Transformer
M's	
MAX	Maximum
MIN	Minimum
N's	
NGV	Nozzle Guide Vane
NLR	Corrected Fan Speed (Corrected N1)
Nm	Newton meter
N1	Low Pressure % RPM (Fan Speed)
N2	High Pressure % RPM (Core Speed)
O's	
OAT	Outside Air Temperature
OD	Outside Diameter
OGV	Outlet Guide Vane
P's	
PB	Bypass Pressure
PC	Regulated Servo Pressure
PCR	Regulated Case Pressure
PF	High Pressure Fuel (heated)
PLA	Power Lever Angle
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
TAI	Thermal Anti-Ice
TCCV	Turbine Clearance Control Valve
TC1	Turbine Clearance (stage 5)

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Table 202/70-00-01-993-802-F00 (Continued)

ABBREVIATION	DEFINITION
TC2	Turbine Clearance (stage 9)
TGB	Transfer Gearbox
TLA	Thrust Lever Angle
TRA	Thrust Resolver Angle
T12	Fan Inlet Temp (electrical sensor)
T2	Fan Inlet Temp (hydro-mech 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

1. General

A. This procedure has this task:

- (1) Water Types (Fluid).

TASK 70-00-07-910-801-F00**2. Water Types (Fluid)****A. General**

(1) This task defines all types of water used in the maintenance procedures:

- (a) Water (Tap Water)
 (b) Deionized Water.

B. Water (Tap Water)**SUBTASK 70-00-07-910-001-F00**

- (1) The term "water" is specified as available drinking water that has an average resistivity between 4000 and 5000 Ohm.cm.
 (a) Since the resistivity of tap water supplied by local water networks (filtered and treated surface water or approved by government spring water) is usually above the range, the actual resistivity values are of small importance.

SUBTASK 70-00-07-910-002-F00

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

C. Deionized Water**SUBTASK 70-00-07-910-003-F00**

- (1) Use deionized water to clean parts prone to contamination by mineral and organic impurities.

SUBTASK 70-00-07-910-004-F00

- (2) Deionized water must be supplied with a minimum resistivity of 50000 Ohm.cm.

NOTE: Deionized water is characterized by its resistivity.

SUBTASK 70-00-07-910-005-F00

- (3) For rinsing titanium and titanium alloys, deionized water used must be supplied with the following requirements:
 (a) Maximum of 50 Parts Per Million (PPM) in dissolved chlorine and chlorides.
 1) Chlorine/Chloride:
 a) Sum the total of the chloride ions and other ions derived from chlorine (sometimes known as residual chlorine).
 b) Chlorine analysis must be according to ASTM D1253, ASTM D512, or equivalent approved procedures.
 (b) Minimum resistivity of 50000 Ohm.cm or maximum conductivity of 20 μ S/cm.

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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL****D. Water Type Designation**

SUBTASK 70-00-07-910-006-F00

- (1) The water-type designations are aid to get satisfactory results in standard procedures and to supply the water-types.
- (a) Water of higher resistivity and/or purity can be used in the procedures.
 - (b) Water of lower resistivity and/or purity must not be used.

———— **END OF TASK** ————

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ULTRAVIOLET LIGHT TEST - MAINTENANCE PRACTICES

1. General

A. This procedure has this task:

- (1) Ultraviolet Light Test (Other Check).

TASK 70-00-08-910-801-F00

2. Ultraviolet Light Test (Other Check)

(Figure 201)

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 methods to do the analysis of the bulbs. The test is a check of the power lighting of Ultraviolet lamps and a check of lighting. The two methods 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 an indication of the paint peel.
- (4) Do the test in a darkened area with ambient background light levels at 20 lux or less.

B. Test Equipment

SUBTASK 70-00-08-700-001-F00

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

SUBTASK 70-00-08-700-002-F00

- (2) Test Two. Check of lighting.
 - (a) Ultraviolet Photometer with a sensor filtered and adapted to the spectral sensitivity of the human eye (Curve C, Figure 201).
 - (b) Inspection booth.

NOTE: For the supplied device, request that the photometer supplier for the Relative Spectral Intensity (Mean Values) Curve.

C. Test One - Check of Power Lighting of Ultraviolet Lamps

SUBTASK 70-00-08-700-003-F00

- (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-F00

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

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

SUBTASK 70-00-08-700-005-F00

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

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SUBTASK 70-00-08-700-006-F00

- (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-F00

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

D. Test Two - Check of Lighting

SUBTASK 70-00-08-700-008-F00

- (1) Close the inspection booth.

SUBTASK 70-00-08-700-009-F00

- (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-F00

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

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

SUBTASK 70-00-08-700-011-F00

- (4) Turn off all white lights.

SUBTASK 70-00-08-700-012-F00

- (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-F00

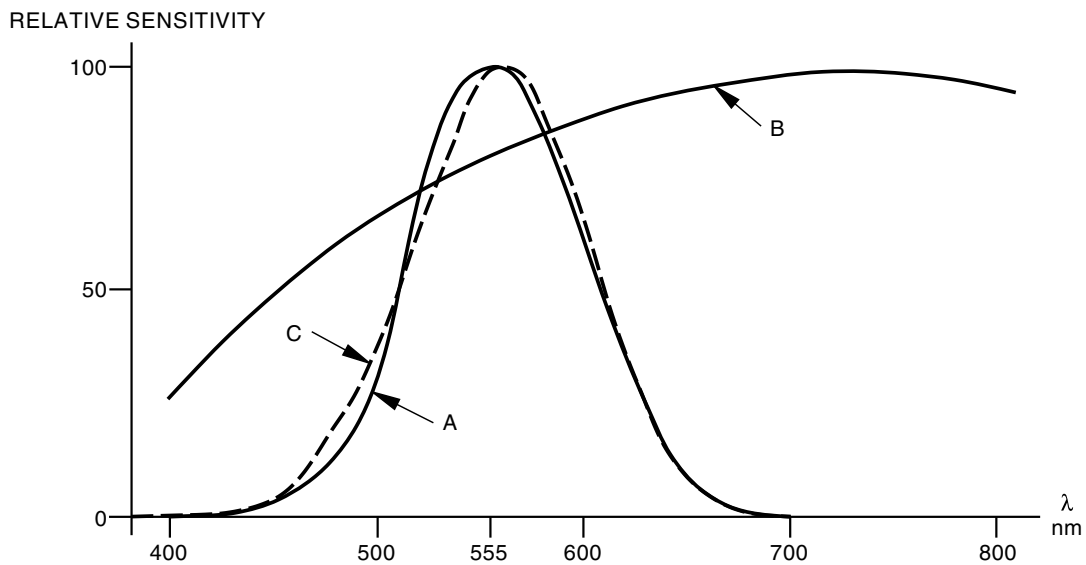
- (6) The maximum permitted value is 20 lux.

SUBTASK 70-00-08-700-014-F00

- (7) Do this test weekly.

————— **END OF TASK** —————

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

RELATIVE SPECTRAL INTENSITY (MEAN VALUES)
(EXAMPLE)

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Relative Spectral Intensity
Figure 201/70-00-08-990-801-F00

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**GENERAL PRECAUTIONS DURING THE REMOVAL AND INSTALLATION OF ENGINE COMPONENTS -
MAINTENANCE PRACTICES**

TASK 70-10-02-910-801-F00**1. General Precautions during the Removal and Installation of Engine Components****A. General**

- (1) You must be careful when you do maintenance operations in the engine critical areas.
- (2) Damage to the engine can occur from unwanted materials that go into the engine (FOD) or from engine parts that are not correctly attached.
- (3) It is very important that all critical areas of the engine be examined for cleanliness before each engine run.
- (4) It is very important that the area around the engine be examined for cleanliness before each engine run.

B. References

Reference	Title
70-30-01-910-802-F00	Seals (Preformed Packings and O-Rings) and Gaskets (P/B 201)

C. Consumable Materials

Reference	Description	Specification
D50186 [CP2691]	Fluid - Penetrating - Aerokroil	

D. Location Zones

Zone	Area
410	Subzone - Engine 1
420	Subzone - Engine 2

E. Precautions During the Removal and Installation of Engine Components**SUBTASK 70-10-02-910-002-F00**

- (1) Engine Critical Areas
 - (a) Air inlet cowl.
 - (b) Bleed valve compartments.
 - (c) Interfaces with engine bleeds.

SUBTASK 70-10-02-910-003-F00

- (2) General Precautions for Maintenance Tasks

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MAKE SURE THAT YOU USE THE APPLICABLE PERSONNEL PROTECTIVE EQUIPMENT (PPE) WHILE WORKING ON THE ENGINE. HEAVY METALS, SUCH AS HEXAVALENT CHROMIUM, CAN EXIST IN THE ENGINE COMPONENTS. PERSONNEL SHOULD CONSULT APPLICABLE MATERIAL SAFETY DATA SHEETS AND EXERCISE GOOD PERSONAL HYGIENE (I.E. WASH HANDS THOROUGHLY PRIOR TO EATING, DRINKING AND SMOKING) AFTER YOU PERFORM MAINTENANCE ACTIONS. HEAVY METALS ARE HAZARDOUS AND CAN CAUSE INJURY TO PERSONNEL.

- (a) This engine and attaching parts may have a greenish yellow residue present on their surfaces that may contain Hexavalent Chromium. When performing maintenance operations on the engine, you must obey the following precautions:

NOTE: The information that follows is intended to provide safe handling instructions while you do routine maintenance near hardware with possible hexavalent chromium residue. It is not necessary to do maintenance or cleaning operations if there is residue consistent in appearance with hexavalent chromium.

- 1) You must obey all applicable environmental, health and safety precautions before you move, touch, replace or discard hardware that contains Hexavalent Chromium.
- 2) The application of penetrating fluid, D50186 [CP2691] will prevent the residue from becoming airborne during routine engine maintenance.
 - a) If no penetrating oil is applied, or for maintenance operations involving physical processing (including, but not limited to, mechanical cleaning through grit or plastic media blasting, grinding, machining, buffing, drilling or sanding) of the affected area, consult your employer's health and safety expert to determine if additional engineering controls and/or personal protective equipment is appropriate.
- (b) Make sure that you do these steps before you do the maintenance:
 - 1) Remove the contents from your pockets of your work clothes.
 - 2) The bottom of your footwear is clean.
- (c) Make sure that you do these steps after you complete the maintenance:
 - 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) Make sure the area of the air inlet cowl and engine bleeds is clear of all unwanted material.
 - 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 70-10-02-910-004-F00



DO NOT TOUCH THE COMPONENTS OF THE OIL SYSTEM IF THE ENGINE IS HOT. THESE COMPONENTS STAY HOTTER THAN OTHER COMPONENTS. HOT COMPONENTS CAN BURN YOU.

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(WARNING PRECEDES)**WARNING**

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

**WARNING**

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

**WARNING**

DO NOT LET ENGINE OIL STAY ON YOUR SKIN. FLUSH THE OIL FROM YOUR SKIN WITH WATER. THE OIL IS POISONOUS AND CAN CAUSE INJURY.

**CAUTION**

DO NOT LET HOT OIL GET ON THE ENGINE OR OTHER COMPONENTS. IMMEDIATELY CLEAN THE COMPONENT IF OIL FALLS ON IT. OIL CAN CAUSE DAMAGE TO PAINT AND RUBBER.

**CAUTION**

DO NOT LET ALKALINE CLEANING FLUID GET IN THE ENGINE OIL. VERY SMALL QUANTITIES OF THIS FLUID CAN CHEMICALLY CHANGE THE OIL. THIS CAN CAUSE DAMAGE TO THE ENGINE.

- (3) Disconnect any and all oil system components.
- (a) You can find the maintenance practices for the seals and the gaskets in this task (TASK 70-30-01-910-802-F00).
 - (b) Do not let the metal tools hit the components and accessories.
 - (c) Use clean covers and caps to prevent damage to the engine openings.
 - (d) Use clean caps to prevent damage to the electrical connections when you disconnect the electrical systems.
 - (e) 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 70-10-02-910-006-F00

- (4) Removal of components and accessories.
- (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, collect the part number and the serial number through engine records.

SUBTASK 70-10-02-910-005-F00

- (5) Installation of Components and Accessories
- (a) Record the type and serial number before you install a component.
 - (b) Visually examine the general condition of the component.
 - 1) Make sure the component is not damaged before you install it.

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- (c) Make sure the mounting faces and seal grooves are clean and not worn.
- (d) Use only the tools made for the operation.
- (e) Make sure you see a minimum of one thread in the nuts and chambers after you tighten the last torque.

**CAUTION**

MAKE SURE THAT YOU USE TWO WRENCHES TO LOOSEN TUBE COUPLING NUTS. USE ONE WRENCH TO HOLD THE FITTING. USE THE OTHER WRENCH TO TURN THE COUPLING NUT. IF YOU DO NOT USE TWO WRENCHES, YOU CAN CAUSE DAMAGE TO THE EQUIPMENT.

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

———— **END OF TASK** ————

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TEMPORARY MARKING PROCEDURES - MAINTENANCE PRACTICES

1. General

- A. This procedure contains this task:
- (1) Temporary Marking Procedures

TASK 70-10-03-910-801-F00

2. Temporary Marking Procedures

A. General Information

SUBTASK 70-10-03-910-001-F00

- (1) This is general information for the use of temporary markers:
- (a) Use temporary marks for temporary identification only.
 - (b) Temporary marks are not intended to remain after engine operation unless you are given other instructions in the task.
 - (c) Remove the temporary marks before the operation of the engine unless you are given other instructions in the task.
 - (d) The temporary marks must not cause damage or failure of the parts, if you do not remove the marks.
 - (e) Temporary marks used to identify parts could go away after an engine run.
 - (f) Incorrect materials used to make temporary marks, when subjected to high temperatures, can cause chemical damage to the part and cause possible part failure.
 - (g) This procedure refers to the materials that were examined by CFM International, which you can use safely on engine parts.
 - (h) If more temporary marking compounds are necessary, refer to CFMI Standard Practices Manual, 70-10-02.

B. Procedure

SUBTASK 70-10-03-910-002-F00



WHEN IT IS NECESSARY, MAKE A MARK ON THE ENGINE PARTS. MAKE SURE THAT YOU USE ONLY APPROVED MARKING COMPOUNDS. MARKING COMPOUNDS THAT ARE NOT APPROVED CAN CAUSE DAMAGE TO THE ENGINE PARTS.



DO NOT USE A GREASE PENCIL OR A LEAD (GRAPHITE) PENCIL TO MAKE A MARK ON THE COMBUSTION SECTION OR A HOT SECTION PART. THESE MATERIALS AND HEAT CAN CAUSE DAMAGE TO THE COMPONENTS.



DO NOT PUT MARKS ON THE MATING SURFACES OF PARTS, ASSEMBLIES, OR CONNECTORS. THE MARKING MATERIALS CAN EFFECT THE CLEARANCES AND CONCENTRICITY OF THE PARTS.

- (1) Temporary marking can be done with 2 methods:
- (a) Labels can be attached to the part with wires, ties or adhesives.
 - (b) Ink marks can be made on the surface of the part.

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SUBTASK 70-10-03-910-003-F00

- (2) Make sure that the markings are legible.

SUBTASK 70-10-03-910-004-F00

- (3) Make sure that the labels will not fall off.

C. Temporary Marking Materials

SUBTASK 70-10-03-910-005-F00

- (1) These markers are acceptable and are commercially available to make a mark on the parts:
- (a) Marks-A-Lot (black or blue), Carter's Ink Corp, 239 First St, Cambridge, MA 02142 USA
 - (b) Comte 566 (blue, red, white, or green), Le Lys Rouge, 56 Rue Labrouste, 75015 Paris, France
 - (c) Dixon Markers (black or blue), Jos Dixon Crucible Corp, 167 Wayne St, Jersey City, NJ 07303, USA
 - (d) Tiflex Ink (XB824 black, XF160 blue, or XF160 green), Tiflex, 10 Route De Geneve, 01450 Poncin, France
 - (e) Eberhard Faber Colorbrite (silver 2101), Eberhard Faber Inc, Crestwood, Wilkes-Barre, PA 18703, USA
 - (f) Aircraft Marker Ln 9051 (blue or red), Ratioplast, Spitalwald Strasse BE 9, 8540 Schwabach, Germany
 - (g) Marco S-1141 (black), Marking Devices Manufacturing Co, 2708-10 5th St, Philadelphia, PA 19133, USA
 - (h) Action Marker (black or White with tips 33, 44, or 55), Mark Tex Corp, 161 Coolidge Ave, Englewood, NJ 07133, USA
 - (i) Dykem (steel blue DX100), ITW-Dykem Co, 3624 W. Lake Avenue, Glen View, IL 60025-1215

————— **END OF TASK** —————

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SPOT TOUCH-UP OF OXIDE FILM COATING ON ALUMINUM ALLOYS FOR PROTECTION - MAINTENANCE PRACTICES

1. General

- A. This procedure has one task:
- (1) A chemical touch-up for aluminum surfaces.

TASK 70-10-04-380-801-F00

2. Spot Touch-Up of Oxide Film Coating on Aluminum Alloys for Protection

A. General

- (1) This procedure is used to give instructions to touch-up or refinish an aluminum surface to put back the protective film.
- (2) Aluminum surfaces that have the original anodized protective finish removed must be touched-up or finished to put back the protective film.

B. Tools/Equipment

Reference	Description
STD-3939	Air Source - Regulated, Dry Filtered, 0 to 10 psig

C. Consumable Materials

Reference	Description	Specification
B00676 [CP1041]	Alcohol - Isopropyl	
B00682 [CP2011]	Solvent - Stoddard	MIL-PRF-680 Type I, II or III
B01058 [CP1039]	Solvent - Acetone, Reagent Grade	
C50203 [CP2640]	Coating - Chemical Conversion - Bonderite M-CR 1200S Aero (Formerly Alodine 1200S)	
C50204 [CP2641]	Coating - Chemical Conversion - Bonderite M-CR 1200S RTU Aero (Formerly Alodine 1200S)	
C50205 [CP2642]	Coating - Chemical Conversion - Bonderite M-CR 1201 Aero (Formerly Alodine 1201)	
C50208 [CP2659]	Coating - Chemical Conversion - Bonderite M-CR 1132 Aero Pen (Formerly Alodine 1132)	
C50421 [CP2925]	Coating - SurTec 650 RTU	
C50422 [CP2926]	Pen - SurTec 650	
C50431 [S1268]	Coating - Chemical Conversion - Bonderite M-CR ALCRM 1200BR AERO	
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	AMS3819 Class 1 Grade A or B Form 1 (Supersede BMS15-5 CL A)
G00291	Tape - Aluminum Foil, 3M 425	AMS-T-23397 / L-T-80
G02439	Brush - Nylon Bristle	
G50221	Abrasive - Wet/dry Silicon Carbide Sandpaper, 180 grit	

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D. Procedure

SUBTASK 70-10-04-100-001-F00



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.

- (1) Do these steps to clean the exposed areas:



DO NOT GET DEGREASING FLUID IN YOUR MOUTH OR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM DEGREASING FLUID. PUT PROTECTIVE SPLASH GOGGLES AND GLOVES ON WHEN YOU USE DEGREASING FLUID. KEEP DEGREASING FLUID AWAY FROM SPARKS, FLAMES AND HEAT. DEGREASING FLUID IS A POISONOUS AND FLAMMABLE SOLVENT WHICH CAN CAUSE INJURIES TO PERSONNEL OR DAMAGE TO EQUIPMENT.



BE CAREFUL NOT TO LET THE ACID SOLUTION TOUCH THE DEGREASE SOLVENT. THE MIXTURE OF THE ACIDS AND SOLVENTS ARE HIGHLY FLAMMABLE. IF YOU ARE NOT CAREFUL, YOU CAN DAMAGE THE FILM COATING AND OTHER METAL PARTS.

- (a) Use the clean brush, G02439, or cotton wiper, G00034, to clean the surface with solvent, B00682 [CP2011], acetone solvent, B01058 [CP1039], or alcohol, B00676 [CP1041].

SUBTASK 70-10-04-120-001-F00

- (2) Do these steps to prepare the exposed areas:

- (a) Use the 180 grit wet/dry silicon carbide sandpaper, G50221, to sand the area lightly.
- 1) Remove all scratches, pits or rough areas.
- (b) Flush the area with clear water.

SUBTASK 70-10-04-950-001-F00

- (3) Do these steps to give protection to the area and parts around the refinished area.



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.

- (a) Use 3M 425 Aluminum Foil Tape, G00291, to attach a mat, acid resistant plastic film, or cardboard to protect these areas:
- 1) The fan blades
 - 2) The abradable parts and areas of the fan case
 - 3) All mounting hardware

SUBTASK 70-10-04-110-003-F00

- (4) Prepare the oxide film solution with the manufacturer's instructions.

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- (a) Products listed in QPL-81706 can be used as alternatives. Products are not interchangeable from a chemical standpoint. Do not mix different materials.
- (b) Use the material at ambient temperature.

SUBTASK 70-10-04-110-002-F00

- (5) Do the applicable steps to apply the refinish film coat:
 - (a) If using Bonderite M-CR 1200S RTU Aero coating, C50204 [CP2641], or Bonderite M-CR 1201 Aero coating, C50205 [CP2642], or Bonderite M-CR 1200S coating, C50203 [CP2640], or Bonderite M-CR ALCRM 1200BR AERO coating, C50431 [S1268], do these steps:
 - 1) Apply the oxide film coating with an acid-resistant nylon-bristle brush or cellulose sponge.
 - 2) Keep the area wet with the solution until the film coating is fully formed in 1-10 minutes.
 - a) If it is necessary, do the procedure again. Follow the manufacturer's instructions.
 - (b) If using Bonderite M-CR 1132 Aero Pen, C50208 [CP2659], do these steps:
 - 1) Slightly rub the area with the pen.
 - 2) Overlap each stroke 50% for full coverage.
 - 3) Do the procedure again at a 90-degree angle and within 5 minutes after the first layer dries.
 - (c) If using oxide film coating, C50421 [CP2925], or oxide film pen, C50422 [CP2926], do these steps:
 - 1) Slightly rub the area with the pen, a brush or a plier and a cotton swab soaked with oxide film coating, C50421 [CP2925], or oxide film pen, C50422 [CP2926].
 - 2) Keep the surface wet for at least 6 minutes.
 - 3) If necessary, do the procedure again.
 - 4) If necessary, flush with clear water or wet cotton wiper, G00034.
 - 5) Let the coating dry at room temperature until the touched-up area is completely dried.

**CAUTION**

DO NOT USE WATER AT A HIGH-PRESSURE TO FLUSH THE SURFACE.
DAMAGE TO THE PROTECTIVE LAYER CAN OCCUR.

**CAUTION**

DO NOT LET LIQUIDS STAY IN THE HOLES OR CREASES IN THE PART.
DAMAGE TO THE PROTECTIVE LAYER CAN OCCUR.

- (d) Remove the remaining solution with one of these steps:
 - 1) Flush fully with clear water.
 - 2) Put the part fully in water at a temperature of 120-140 degrees F (49-60 degrees C).
 - 3) Use a wet sponge.
 - 4) You can use shop air to blow the unwanted solution off the part.

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WHEN WIPING, BE CAREFUL TO AVOID SCRATCHING OR RUBBING OFF COATING, WHICH IS DELICATE WHEN FRESHLY FORMED.

- (e) Dry the part with the 0 to 10 psig air source, STD-3939, or a clean soft cloth.

**CAUTION**

DO NOT PAINT THE PROTECTIVE LAYER OF THE PART IN LESS THAN 30 MINUTES. DAMAGE TO THE PROTECTIVE LAYER CAN OCCUR.

- (f) You can paint the surface after the protective coating dries for a minimum of 30 minutes.

———— **END OF TASK** ————

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APPLICATION OF MOLYBDENUM DISULFIDE AND OTHER LUBRICANTS DISPERSED IN AN INORGANIC BINDER AND NON-FLAMMABLE SOLVENT- MAINTENANCE PRACTICES

TASK 70-10-05-600-801-F00

1. Application Of Molybdenum Disulfide And Other Lubricants Dispersed In An Inorganic Binder And Non-Flammable Solvent - Maintenance Practices

A. General

- (1) Molybdenum disulfide and other lubricants dispersed in an inorganic binder and non-flammable solvent compose a dry film lubricant varnish or solid lubricant paste which is applied with an aerosol can or a brush. The lubricant cures at ambient temperature in contact with ambient humidity.
- (2) You must do this procedure in an area with an efficient ventilation system for extracting and neutralizing vapors.

B. Consumable Materials

Reference	Description	Specification
B00676 [CP1041]	Alcohol - Isopropyl	
B01058 [CP1039]	Solvent - Acetone, Reagent Grade	
B50046	Solvent - Methyl Ethyl Ketone, Technical Grade	ASTM D740 (Supersedes TT-M-261)
D00640 [CP2104]	Lubricant - Molybdenum Disulfide, Solid - Molykote G Rapid Plus	
D00641 [CP5062]	Lubricant - Corrosion Inhibiting, Dry Film - Molykote D 321 R or Dow Corning 321	
D50019 [CP2444]	Lubricant - Molydisulfide Solid Film, Paste - Molykote G-n Plus	
D50308 [CP 2171]	Lubricant - MOS2 Solid	MIL-L-8937
G00270	Tape - Scotch Flatback Masking 250	ASTM D6123 (Supersedes A-A-883)
G00834	Cloth - Lint-free Cotton	

C. Application Of Molybdenum Disulfide And Other Lubricants Dispersed In An Inorganic Binder And Non-Flammable Solvent

SUBTASK 70-10-05-840-001-F00

- (1) Process a test piece (strip of sheet metal) along with the part to be dry lubricant coated for quality assurance purposes.

SUBTASK 70-10-05-840-002-F00

- (2) If the process document specifies thickness of applied lubricant, measure thickness of test piece before you apply the lubricant.

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SUBTASK 70-10-05-110-001-F00



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.

- (3) Unless specified in the process document, clean the part and test piece with a lint-free cloth, G00834, saturated with one of the solvents:
- (a) acetone solvent, B01058 [CP1039]
 - (b) technical grade methyl ethyl ketone, B50046
 - (c) alcohol, B00676 [CP1041]

SUBTASK 70-10-05-640-001-F00

- (4) For spray application, apply Molykote D321 R, or Dow Corning 321 lubricant, D00641 [CP5062], in less than 15 minutes after you clean the part.
- (a) Keep the spray nozzle approximately 8 in. (20 cm) from the surface of the part.
 - (b) Unless specified in the process document, the coating thickness shall be approximately 0.0003 in. (0.008 mm) - 0.0005 in. (0.013 mm).
 - (c) Let the lubricant air cure at ambient temperature for ten minutes minimum before part installation.
 - (d) If more than one application is required to get the lubricant thickness specified in the process document, apply successive layers as necessary and let air-dry between applications.

SUBTASK 70-10-05-640-003-F01

- (5) For brush application, apply one of these lubricants in less than 15 minutes after you clean the part.
- (a) Molykote G-n Plus lubricant, D50019 [CP2444], or Lubricant, D50308 [CP 2171], or Molykote G Rapid Plus lubricant, D00640 [CP2104].
 - 1) Unless specified in the process document, the coating thickness shall be approximately 0.004 in. (0.10 mm) - 0.008 in. (0.20 mm).
 - 2) Bond stress can be improved with by burnishing (leather stroking) or with a sponge, a brush or by rubbing with smooth friction.

SUBTASK 70-10-05-950-001-F00



DO NOT TOUCH THE PREPARED AREA OF THE PART WITH YOUR BARE HANDS OR EXPOSE THE PART TO OTHER CONTAMINATION. MAKE SURE THAT YOU APPLY THE LUBRICANT LESS THAN 15 MINUTES. IF YOU DO NOT FOLLOW INSTRUCTIONS, YOU WILL HAVE TO PREPARE THE PART AGAIN. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT CAN OCCUR.

- (6) Apply masking to the part per the process document if specified.

SUBTASK 70-10-05-220-001-F00

- (7) If the process document specifies the thickness of the applied lubricant, measure the test piece thickness after application and subtract the initial measurement to make sure you have the correct lubricant thickness.

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SUBTASK 70-10-05-110-002-F00



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.

- (8) Remove any over-spray or excess lubricant with a lint-free cloth, G00834, dampened with one of the listed solvents.

SUBTASK 70-10-05-950-002-F00

- (9) Remove the masking, if applied.

D. Quality Assurance For Dry Film Lubricant

SUBTASK 70-10-05-280-001-F00

- (1) Do the tests that follow on the test piece which was processed with the part:
- (a) Apply a press on a strip of pressure sensitive Scotch Flatback Masking Tape 250, G00270, to test the piece.
 - 1) The coating shall not peel when the tape is pressed on and pulled off.
 - (b) Scratch the coating on the test piece with your fingernail.
 - 1) Scratching shall not remove the coating.

SUBTASK 70-10-05-210-001-F00

- (2) Examine the coating on the processed part.
- (a) There should be no sags, blisters, flakes, or foreign material and the coating should be smooth and uniform.
 - (b) The coating should be dark gray.

SUBTASK 70-10-05-350-001-F00

- (3) If the coating fails any of these tests or examinations, remove the coating and re-process the part.

E. Quality Assurance For Solid Lubricant Paste

SUBTASK 70-10-05-210-002-F01

- (1) Examine the coating on the processed part.
- (a) It should be smooth and uniform without any foreign material.
 - (b) The coating should be dark gray.

————— END OF TASK —————

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APPLICATION OF EPOXY ADHESIVE HYSOL - REPAIRS

1. General

A. This procedure has these tasks:

- (1) Application of two part epoxy adhesive hysol EA 934 NA (Bond)
- (2) Application of epoxy adhesive hysol EA 9394 (Bond).

TASK 70-10-05-360-801-F00

2. Application of Two Part Epoxy Adhesive Hysol EA 934 NA (Bond)

A. General

- (1) This task defines the conditions for application of a two part epoxy adhesive providing a semirigid joint after polymerization.
- (2) Operating temperature range: -65°F (-54°C) - 250°F (121°C).
- (3) The following equipment is required for the application:
 - (a) The bonding workshop must consist of a well ventilated, dust-free, closed room reserved for bonding operations only. It must be kept clean through frequent washing of the floor, walls, and work surfaces.
 - (b) The ventilation air must be supplied to maintain a slight overpressure in the workshop and must not contain water, solvent, aerosol, silicone, or oil vapors emanating from adjoining workshops.
 - (c) Limits to ambient conditions are as follows:
 - 1) Temperature: 60°F (16°C) - 85°F (29°C).
 - 2) Relative humidity: 30 - 70 percent.
 - (d) Forced draft oven with capability for extraction of volatile product from polymerization process.
 - 1) Maximum temperature: 390°F (199°C), constant within $\pm 10^\circ\text{F}$ ($\pm 5^\circ\text{C}$).
 - (e) Cooling cabinet, 0°F (-18°C) to store adhesive products.
 - (f) Work table with extracting hood.
 - (g) A balance for weighing products.
 - 1) Accuracy ± 2 percent of actual weight.
 - (h) Standard equipment available in any bonding workshop, such as spatulas, scalpels, refuse bins, safety containers.
 - (i) Safety equipment, such as rubber gloves, goggles, respirators, etc.

B. Consumable Materials

Reference	Description	Specification
A50586 [CP2288]	Adhesive - Two-component (Hysol EA 934NA)	

C. Location Zones

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

D. Prepare for the Application

SUBTASK 70-10-05-910-005-F00

- (1) Prepare the surfaces to be joined.

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SUBTASK 70-10-05-910-006-F00

**WARNING**

EPOXY ADHESIVE IS TOXIC. DO NOT LET THIS MATERIAL TOUCH YOU. USE PERSONAL PROTECTION EQUIPMENT. USE VAPOR/FUME CONTROL OR A RESPIRATOR. IF YOU DO NOT, IT CAN CAUSE INJURIES.

- (2) Prepare a mixture of Hysol EA 934NA adhesive, A50586 [CP2288], in the following proportions:
- (a) Resin: 100 parts by weight
 - (b) Hardener: 33 parts by weight.

SUBTASK 70-10-05-340-005-F00

**WARNING**

DO NOT GET EPOXY PASTE ADHESIVE ON YOUR SKIN, IN YOUR MOUTH OR IN YOUR EYES. YOU MUST USE THE APPLICABLE GLOVES, EYE PROTECTION AND A RESPIRATOR.

- (3) Carefully mix the two components of Hysol EA 934NA adhesive, A50586 [CP2288], until a paste of uniform color and consistency is obtained.

NOTE: The pot life of the mixture, once it is prepared in a minimum quantity of 4 oz (113 g), is 30 min at an ambient temperature of 60°F (16°C) - 85°F (29°C).

E. Application of Two Part Epoxy Adhesive Hysol EA 934 NA (Bond)

SUBTASK 70-10-05-340-006-F00

**WARNING**

EPOXY ADHESIVE IS TOXIC. DO NOT LET THIS MATERIAL TOUCH YOU. USE PERSONAL PROTECTION EQUIPMENT. USE VAPOR/FUME CONTROL OR A RESPIRATOR. IF YOU DO NOT, IT CAN CAUSE INJURIES.

- (1) Apply Hysol EA 934NA adhesive, A50586 [CP2288], at room temperature 60°F (16°C) - 85°F (29°C) using a spatula.
- (a) Make sure that the correct covering of the areas to be bonded.
 - (b) Do not apply too much Hysol EA 934NA adhesive, A50586 [CP2288].
 - (c) Make sure that there are no presence of air pockets or bubbles.

SUBTASK 70-10-05-340-007-F00

- (2) Put the pieces in the bonding fixtures, at the same time applying contact pressure.
- (a) Make sure that the joint thickness is 0.004 in. (0.10 mm) - 0.12 in. (3.05 mm).

SUBTASK 70-10-05-100-002-F00

**WARNING**

EPOXY ADHESIVE IS TOXIC. DO NOT LET THIS MATERIAL TOUCH YOU. USE PERSONAL PROTECTION EQUIPMENT. USE VAPOR/FUME CONTROL OR A RESPIRATOR. IF YOU DO NOT, IT CAN CAUSE INJURIES.

- (3) Remove unwanted Hysol EA 934NA adhesive, A50586 [CP2288], with a clean rag.

SUBTASK 70-10-05-340-008-F00

- (4) Perform polymerizing cycle for 1 hours at 185°F (85°C) - 205°F (96°C).

SUBTASK 70-10-05-020-002-F00

- (5) Remove bonding tools.

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F. Inspection

SUBTASK 70-10-05-910-007-F00

- (1) Under 10 power magnification, check that edge of the bonded joint shows an even bead of Hysol EA 934NA adhesive, A50586 [CP2288], without cracks or discontinuities.

SUBTASK 70-10-05-910-008-F00

- (2) Make sure that Hysol EA 934NA adhesive, A50586 [CP2288], is uniform in color.

————— **END OF TASK** —————

TASK 70-10-05-360-802-F00**3. Application of Epoxy Adhesive Hysol EA 9394 (Bond)****A. General**

- (1) This task defines the conditions for application of epoxy adhesive providing a semirigid joint after polymerization.
- (2) Operating temperature range: -65°F (-54°C) - 250°F (121°C).
- (3) The following equipment is required for the application:
 - (a) The bonding workshop must consist of a well ventilated, dust-free, closed room reserved for bonding operations only. It must be kept clean through frequent washing of the floor, walls, and work surfaces.
 - (b) The ventilation air must be supplied to maintain a slight overpressure in the workshop and must not contain water, solvent, aerosol, silicone, or oil vapors emanating from adjoining workshops.
 - (c) Limits to ambient conditions are as follows:
 - 1) Temperature: 60°F (16°C) - 85°F (29°C)
 - 2) Relative humidity: 30 - 70 percent.
 - (d) Forced draft oven with capability for extraction of volatile product from polymerization process.
 - 1) Maximum temperature: 390°F (199°C), constant within $\pm 10^\circ\text{F}$ ($\pm 5^\circ\text{C}$).
 - (e) Work table with extracting hood.
 - (f) A balance for weighing products.
 - 1) Accuracy ± 2 percent of actual weight.
 - (g) Standard equipment available in any bonding workshop, such as spatulas, scalpels, refuse bins, safety containers.
 - (h) Safety equipment, such as rubber gloves, goggles, respirators, etc.

B. Consumable Materials

Reference	Description	Specification
A50491 [CP2526]	Resin - Epoxy - LOCTITE EA 9394	

C. Location Zones

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

D. Prepare for the Application

SUBTASK 70-10-05-910-001-F00

- (1) Prepare the surfaces to be joined.

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SUBTASK 70-10-05-910-002-F00

**WARNING**

EPOXY ADHESIVE IS TOXIC. DO NOT LET THIS MATERIAL TOUCH YOU. USE PERSONAL PROTECTION EQUIPMENT. USE VAPOR/FUME CONTROL OR A RESPIRATOR. IF YOU DO NOT, IT CAN CAUSE INJURIES.

- (2) Prepare a mixture of LOCTITE EA 9394 adhesive, A50491 [CP2526], in the following proportions:
- (a) Resin (Part A): 100 parts by weight
 - (b) Hardener (Part B): 17 parts by weight.

SUBTASK 70-10-05-340-001-F00

**WARNING**

DO NOT GET EPOXY PASTE ADHESIVE ON YOUR SKIN, IN YOUR MOUTH OR IN YOUR EYES. YOU MUST USE THE APPLICABLE GLOVES, EYE PROTECTION AND A RESPIRATOR.

- (3) Carefully mix the two components of LOCTITE EA 9394 adhesive, A50491 [CP2526], until a paste of uniform color and consistency is obtained.

NOTE: The pot life of the mixture, once it is prepared in a minimum quantity of 4 oz (113 g), is 2 hours at an ambient temperature of 60°F (16°C) - 85°F (29°C).

E. Application of Epoxy Adhesive Hysol EA 9394 (Bond)

SUBTASK 70-10-05-340-002-F00

**WARNING**

EPOXY ADHESIVE IS TOXIC. DO NOT LET THIS MATERIAL TOUCH YOU. USE PERSONAL PROTECTION EQUIPMENT. USE VAPOR/FUME CONTROL OR A RESPIRATOR. IF YOU DO NOT, IT CAN CAUSE INJURIES.

- (1) Apply LOCTITE EA 9394 adhesive, A50491 [CP2526], at room temperature 60°F (16°C) - 85°F (29°C) using a spatula.
- (a) Make sure that the correct covering of the areas to be bonded.
 - (b) Do not apply too much LOCTITE EA 9394 adhesive, A50491 [CP2526].
 - (c) Make sure that there are no presence of air pockets or bubbles.

SUBTASK 70-10-05-340-003-F00

- (2) Put the pieces in the bonding fixtures, at the same time applying contact pressure.
- (a) Make sure that the joint thickness is 0.006 in. (0.15 mm) - 0.01 in. (0.25 mm).

SUBTASK 70-10-05-100-001-F00

**WARNING**

EPOXY ADHESIVE IS TOXIC. DO NOT LET THIS MATERIAL TOUCH YOU. USE PERSONAL PROTECTION EQUIPMENT. USE VAPOR/FUME CONTROL OR A RESPIRATOR. IF YOU DO NOT, IT CAN CAUSE INJURIES.

- (3) Remove unwanted LOCTITE EA 9394 adhesive, A50491 [CP2526], with a clean rag.

SUBTASK 70-10-05-340-004-F00

- (4) Perform polymerization as follows:
- (a) Cycle 1: 4 days at room temperature
 - (b) Cycle 2: 1 hours at 175 ±10°F (79 ±6°C).

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SUBTASK 70-10-05-020-001-F00

- (5) Remove bonding tools.

F. Inspection

SUBTASK 70-10-05-910-003-F00

- (1) Under 10 power magnification, check that edge of the bonded joint shows an even bead of LOCTITE EA 9394 adhesive, A50491 [CP2526], without cracks or discontinuities.

SUBTASK 70-10-05-910-004-F00

- (2) Make sure that LOCTITE EA 9394 adhesive, A50491 [CP2526], is uniform in color.

———— **END OF TASK** ————

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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL****HAND BLENDING PROCEDURE****1. General**

- A. This procedure contains this task:
(1) Hand Blending Procedure.

TASK 70-10-07-800-801-F00**2. Hand Blending - Maintenance Practices****A. General**

DO NOT BREATHE THE PARTICLES, OR GET THEM IN YOUR MOUTH, EYES, OR ON YOUR SKIN. PUT ON A RESPIRATOR, GOGGLES, AND GLOVES AND OTHER EQUIPMENT FOR PROTECTION. THESE PARTICLES CAN CAUSE INJURIES TO PERSONNEL, AND DAMAGE TO EQUIPMENT.



THIS PROCEDURE IS NOT APPLICABLE TO CRITICAL AREAS, FOR EXAMPLE DISK DOVETAIL AREAS, CRITICAL BOLT HOLES AND CRITICAL EMBOSSEMENTS. REFER TO THE SPECIFIED PROCESS DOCUMENT AND REPAIRS FOR THOSE LOCATIONS. OPERATION OF THIS PROCEDURE ON CRITICAL AREAS COULD CAUSE THE STRUCTURAL INTEGRITY FAILURE. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL CAN OCCUR.



USE A MASK OR SHIELD TO PREVENT CONTACT WITH SPARKS FROM TITANIUM MATERIAL REMOVED FROM PARTS. IF YOU DO NOT OBEY, INJURY TO PERSONNEL AND DAMAGE FROM SPARKS THAT HIT TITANIUM CAN OCCUR.



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.



USE ALL APPLICABLE SAFETY PRECAUTIONS WITH TITANIUM PARTS. PERSONNEL WHO PERFORM THE BLENDING PROCEDURES MUST HAVE TRAINING AND HAVE APPROVAL TO WORK WITH TITANIUM MATERIALS. DO NOT OPERATE COMPOUNDS TO CLEAN THAT CONTAIN HALOGEN, OR TOOLS THAT CONTAIN CADMIUM. YOU MUST CHEMICALLY CLEAN AND REMOVE THE ADHESIVES WHEN YOU ARE COMPLETE. IF NOT, CONTAMINATION OF THE TITANIUM PARTS COULD OCCUR.

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(CAUTION PRECEDES)



MAKE SURE THAT POWER BLENDING DOES NOT SUPPLY TO MUCH HEAT THAT CAUSES THERMAL STRESS. START THE BLEND WITH COARSER GRADES OF ABRASIVES FOR THE FAST INITIAL REMOVAL OF MATERIAL. COMPLETE THE BLEND WITH FINER GRADES OF ABRASIVES OR A CROCUS CLOTH UNTIL THE SURFACE IS AS SMOOTH AS OR SMOOTHER THAN THE ADJACENT SURFACES. IF YOU DO NOT OBEY THESE INSTRUCTIONS, DAMAGE TO THE MATERIAL 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.



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.



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.

- (1) This task contains general information for hand blending procedures.
- (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 critical parts. Removal of the material around the stress concentration, until the sharp edges are blended into a smooth contour, relieves the stress concentration and permits further use of the part by decreasing the danger of cracking. Hand blending decreases thermal stress to parts which are blended.
- (3) High metal is caused by the displacement of metal above a surface. It is found around indications like nicks and scratches. This procedure allows removing the displacement of metal above a surface; not touching the surface of the part.

B. Consumable Materials

Reference	Description	Specification
G00363	Abrasive - Coated Cloth, Crocus	
G00744	Cloth - Emery	
G50784 [OMat 5/112]	Abrasive - Silicon Carbide Abrasive Stone	

C. General Hand Blending

SUBTASK 70-10-07-320-008-F00

- (1) Start the blend with coarser grades of the abrasive tools for fast initial removal of material but not coarser than necessary.

NOTE: Only abrasive tools of silicon carbide grit or corundum grade 150 or finer are allowed.

NOTE: Do not let the abrasive to become loaded up with the removed material.

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SUBTASK 70-10-07-320-009-F00

- (2) Avoid excessive removal of metal from the leading and trailing edges of part sections. The edges could become thin or sharp. Blend the edges so that the original contour is maintained.

NOTE: Refer to the inspection and repair limits for specific instructions on blending limits applicable to each part of the engine.

SUBTASK 70-10-07-320-003-F00

- (3) Finish the blend with finer grades of abrasive or an abrasive cloth, G00363 until the surface is as smooth as the adjacent surfaces.

D. Hand Blending of Rotating Parts

SUBTASK 70-10-07-320-004-F00

- (1) If the blended area intersects a corner, break the sharp edges to the appropriate specification below:

NOTE: All transitions from blended to non-blended areas must be smooth and continuous.

NOTE: The surface finish of the blended area must be as smooth or smoother than the adjacent non-blended surfaces.

- (a) Blend to match the general radius of the corner.

NOTE: Refer to a nearby, non-blended location of the corner or a similar part if necessary to determine the original radius.

- (b) If the first specification is not possible, blend the corner to a radius of 0.015 in. (0.381 mm) - 0.030 in. (0.762 mm).

SUBTASK 70-10-07-320-005-F00

- (2) If the blended area intersects a curved feature, restore the general shape of the original contour.

NOTE: Refer to a nearby, non-blended location of the corner or a similar part if necessary to determine the original radius.

NOTE: All transitions from blended to non-blended areas must be smooth and continuous.

NOTE: The surface finish of the blended area must be as smooth or smoother than the adjacent non-blended surfaces.

SUBTASK 70-10-07-320-010-F00



MAKE SURE THAT YOU DO NOT FINISH THE BLEND BY POWER BLENDING. MAKE SURE THAT YOU HAND BLEND THE PART TO FINISH. IF YOU DO NOT OBEY, YOU CAN CAUSE DAMAGE TO THE PARTS.

- (3) If the rotating part is made of titanium do as follows:
- (a) Finish the blend by hand and not by power blending.

SUBTASK 70-10-07-320-006-F00

- (4) Examine the blend area for any signs of discoloration. If there is discoloration, the blend area has overheated and the part must be replaced.

E. General Removal of High Metal

SUBTASK 70-10-07-320-007-F00

- (1) Remove the high metal as follows:

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- (a) Use coarse grades of abrasive stone, G50784 [OMat 5/112], abrasive cloth, G00363, or emery cloth, G00744 to remove the high metal.

NOTE: Remove only the material that has projected above the original surface contour.

- (b) Finish the blend with finer grades of abrasives or an abrasive cloth, G00363.

NOTE: The surface finish of the blended area must be as smooth or smoother than the adjacent non-blended surfaces.

———— **END OF TASK** ————

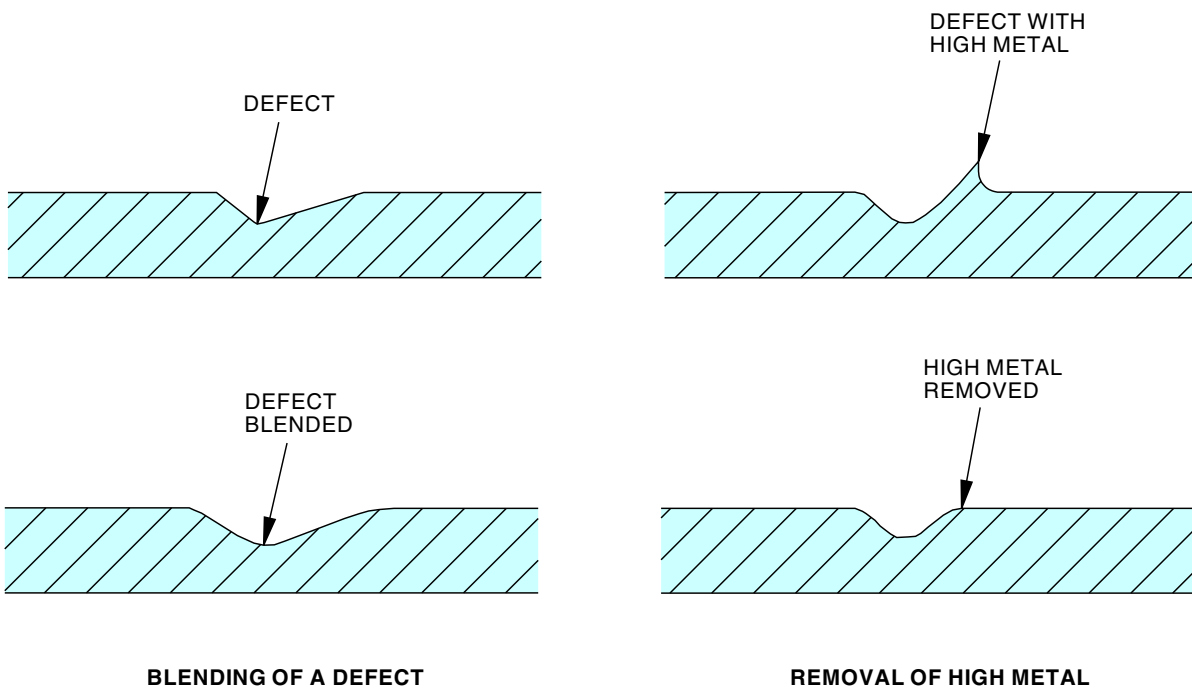
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Defect - Blending and High Metal - Removal
Figure 201/70-10-07-990-801-F00

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MACHINING - MAINTENANCE PRACTICES

1. General

- A. This procedure has this task:
- (1) Machining (material removal).

TASK 70-10-08-320-801-F00**2. Machining (Material Removal)**

(Figure 201)

A. General

- (1) Machineability is a term used to describe the amount of effort required to cut or remove material.
 - (a) Factors that affect the machineability of any material are the following:
 - 1) Hardness
 - 2) Strength
 - 3) Heat dissipation
 - 4) Work hardening
 - 5) Abrasiveness
 - 6) Tool wear.
- (2) The degree of machinability of different metals can only be accurately determined by testing. Use the same cutting conditions and cutting tools with the same characteristics.
 - (a) Cutting speeds are experimentally determined using a lathe.
- (3) The principle metals currently used in the manufacture of jet engines are the following:
 - (a) Nickel
 - (b) Cobalt
 - (c) Titanium
 - (d) Iron
 - (e) Aluminum base alloys.
- (4) Currently vacuum cast nickel base alloys are the most difficult to machine.
- (5) Machining technology has not been able to keep up with the decreasing machinability of new materials. As a result, studies are underway to find new cutting tool materials and methods.
NOTE: Nonconventional machining methods are also being explored.
- (6) Based on studies of industry practices and machinability, machining recommendations were correlated to provide the nominal initial approach for each machining operation and material.
 - (a) Making any machining operation as effective and functional as possible requires more than average data recommendations on speeds and feeds.
 - (b) Variations from average machining data values must depend upon the total relationship between the following:
 - 1) Machine tool equipment
 - 2) Fixturing
 - 3) Part configuration
 - 4) Part tolerances

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- 5) Surface integrity requirements
 - 6) Cutting tool material and design
 - 7) Rigidity of setup.
- (7) A machinability index shows the degree of machinability of each material as a ratio of the cutting speed used for the material compared to the speed used for the reference material (AISI B1112 (Index 100)), expressed in percentage, to obtain the same cutting tool life (Figure 201).

B. Location Zones

Zone	Area
410	Subzone - Engine 1
420	Subzone - Engine 2

C. Machining Characteristics of Different Materials

SUBTASK 70-10-08-800-001-F00

- (1) Cast materials
- (a) Cast materials are more difficult to machine than those that are wrought.
 - (b) The degree of machinability may vary for the same material depending on how it is formed.

SUBTASK 70-10-08-800-002-F00

- (2) Stainless steel
- (a) Stainless steels are the primary steels used in jet engines.
- NOTE:** It is important to distinguish between austenitic and martensitic stainless steels to determine the proper machining conditions.
- 1) Austenitic Steel
 - a) Can work harden causing the formation of hard layers in front of the cutting tool.
 - b) Poor thermal conductivity resulting in concentrated high temperatures at the tip of the cutting tool that is detrimental to tool life.
 - c) High coefficient of friction that results in a strong tendency to stick and seize causing a more rapid destruction of cutting tools.
 - 2) Martensitic Steel
 - a) Structure that is characterized by abrasive carbides (chromium carbide).
 - b) The carbides are responsible for greater wear of the cutting tools.

SUBTASK 70-10-08-800-003-F00

- (3) Nickel-base alloys
- (a) Nickel-base alloys are characterized by a high elastic limit, a resistance to shear, and a tendency to work harden and seize under certain conditions.
- NOTE:** The conditions for machining nickel-base alloys are the same as those used for machining stainless austenitic steels.
- (b) Powerful machines and solid cutting tools, capable of supporting the forces, and dissipating heat rapidly, are required to machine nickel-base alloys.
 - (c) Machining of nickel-base alloys develops high pressures between the work and cutting tool that create a layer of deformed metal on the surface of the work.
 - 1) The deformation leads to a hardening that makes further machining more difficult.

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- 2) If deformation occurs, a stress-relieve heat treatment may be recommended following the machining operation.
- (d) Well sharpened tools that produce a positive cut rather than push metal, combined with sufficiently high feeds and cut depths are required to reduce work hardening of the metal.

SUBTASK 70-10-08-800-004-F00**(4) Cobalt-base alloys**

- (a) Cobalt-base alloys are similar to nickel-base alloys in machining characteristics.
 - 1) Cobalt-base alloys have properties of high elasticity and a tendency to work-harden and stick.
- (b) Cobalt-base alloys require the use of high power equipment that is free of vibrations.
- (c) Cutting tools must be solid and rigidly held reducing deflection of the tool through reduction of the cantilever and use of strong tool holding systems.

SUBTASK 70-10-08-800-005-F00**(5) Titanium-base alloys**

- (a) Titanium-base alloys are more difficult to work than steels.

NOTE: These alloys may be machined with no difficulty in shops equipped to machine stainless steels.
- (b) Titanium-base alloys require the use of abundant cooling fluid and limitation of machine speed to reduce high tool temperatures caused by poor thermal conductivity.
- (c) The low modulus of elasticity of titanium-base alloys (close to one-half that of steels) gives rise to vibrations and chattering if the work is insufficiently held, if the cutting tools are not rigidly held, and/or if the machines are not powerful enough.
- (d) During heat treatments in air, a superficial layer of very hard oxides or nitrides may form on some alloys.
 - 1) The removal of this very hard layer by machining, is a delicate operation.
 - 2) It is preferable to sand blast or chemically strip prior to machining.

SUBTASK 70-10-08-800-006-F00**(6) Aluminum-base alloys**

- (a) Aluminum-base alloys are generally easily machined with cutting tools.
- (b) Machining characteristics particular to aluminum are as follows:
 - 1) Aluminum-base alloys have a low modulus of elasticity (close to one-third that of steel).
 - 2) Care must be necessary, supporting devices (steady rests) and taken in securing the work to prevent deflection.
 - 3) If reduced cutting forces may be employed, in accordance with the geometry.
- (c) Some aluminum alloys have a noticeable abrasive effect on the cutting tool.
 - 1) This is a function of the hardness of the part, its structure, and/most of all, its silicon content.

SUBTASK 70-10-08-800-007-F00**(7) Thermal sprayed metals**

- (a) Thermal sprayed metals differ from the original metal in many physical properties as follows:
 - 1) Hardness

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- 2) Density
 - 3) Ductility
 - 4) Tensile strength.
- (b) Different machining parameters are used for thermal sprayed materials.
- 1) Inclusions are abrasive and reduce tool life.

———— END OF TASK ————

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






















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

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MATERIAL DESIGNATION AFNOR	AMS	COMMERCIAL DESIGNATION	HARDNESS	MACHINABILITY INDEX
IRON BASE ALLOYS				
	5010	AISI B1112	HB 200	100
15CDV6 		VASCOJET 90	HB 341	40
16NCD13 	6263	AISI 9315	HB 241	50
40CDV12 	-	GH4	HB 285	40
10NCD13 	6265	AISI 9310	HRC 32	50
Z2NKD18-8-4 	-	MARAGING 200	HRC 32	40
Z2NKD18-8-5 	-	MARAGING 250	HRC 54	15
Z3NK38 	-	INCOLOY 903	HRC 42	12
Z5CNU17  	5342	17-4 PH	HRC 38	40
Z5CNU17 	5643	17-4 PH	HRC 40	20
Z6NCT25 	5525	A286	HB 200	25
Z6NCT25	5732	A286	HB 340	20
Z8CMN38 	-	NITRONIC 32	HB 207	30
Z10CNNb18  	5646	AISI 347	HB 220	40
Z10CNT18 	5645	AISI 321	HB 217	45
Z12CNDV12 	5718	JETHETE M152	HB 310	40
Z12CNDV12		JETHETE M152	HB 388	30
Z17CWN13 	5616	GREEK ASCOLOY	HRC 48	35
E40NCD7 	6414	AISI 4340	HRC 45	25
80DCV40 	6490	M50	HRC 55	10
Z12C13  	5350	AISI 410	HRC 35	40
Z12C13 	5613	AISI 410	HRC 35	40
30CD4 	6370	AISI 4130	HRC 35	40
COBALT BASE ALLOYS				
KC25NW 	5382	X40	HB 330	6
KC20WN 	5537	L605	HB 330	15
KCN22W	5608	HS 188	HRC 32	10
ALUMINUM BASE ALLOYS				
AU2GN	4132	2618-T61	HB 150	275
AU4G	4118	2017	HB 150	230
AGSU	4027	6061-T6	HB 150	200
AZ5GU	4045	7075-T6	HB 150	200
AS7G06 	4219	A357	HB 150	200

-  CAST ALLOY
 MARTENSITIC STEEL
 AUSTENITIC STEEL

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Machinability of Materials
Figure 201/70-10-08-990-801-F00 (Sheet 1 of 2)

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MATERIAL DESIGNATION AFNOR	AMS	COMMERCIAL DESIGNATION	HARDNESS	MACHINABILITY INDEX
<u>NICKEL BASE ALLOYS</u>				
NC22DNb	5599/ 5666	INCONEL 625	HRC 20	11
NC14K10	-	RENE 95	HB 415	7
NC19FeNb	5662	INCONEL 718	HB 277	14
NC19FeNb	5662	INCONEL 718	HB 400	10
NC19FeNb 1	5383	INCONEL 718C	HBC 44	6
NC19KDT	5712	RENE 41	HRC 36	8
NC20K14	5706	WASPALOY	HB 385	13
NC22FeD	5536	HASTELLOY X	HB 255	18
NCK20D	5872	NIMONIC C263	HB 284	20
NK15CADT 1		RENE 77	HRC 36	3
NK15CATU 1	5397	IN 100 MOD.	HRC 35	6
NK10CWA 1	-	RENE 125	HRC 37	3
NK17CDAT	-	ASTROLOY	HRC 36	9
NC15Fe	5540	INCONEL 600	HRB 75	12
NFe37CNb	5605	INCONEL 706	HRC 30	15
<u>TITANIUM BASE ALLOYS</u>				
T40	4902	A 40	HB 166	35
TA6V	4928	Ti 6-4	HB 352	25
TA6Zr4DE	4976	Ti 6-2-4-2	HRC 36	20
TA5CD4EZC2	-	Ti 17	HRC 37	17
TA8DV	4915	Ti 8-1-1	HRC 35	20

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**Machinability of Materials
Figure 201/70-10-08-990-801-F00 (Sheet 2 of 2)**

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BORE/DRILL/REAM - MAINTENANCE PRACTICES

1. General

A. This procedure has this task:

- (1) Drilling.

TASK 70-10-10-320-801-F00

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 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
70-21-00-100-802-F00	Hand Wipe Solvent Degreasing With Chemical Agent (P/B 201)

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 70-10-10-800-001-F00

- (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 70-10-10-800-002-F00

- (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 70-10-10-800-003-F00

- (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 70-10-10-800-004-F00



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 70-10-10-300-001-F00

- (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 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 70-10-10-700-001-F00

- (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. Inspection

SUBTASK 70-10-10-700-002-F00

- (1) Check the machined part to make sure that the drilled holes are properly positioned and are of the correct diameter.

SUBTASK 70-10-10-100-001-F00



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 70-21-00-100-802-F00).

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SUBTASK 70-10-10-700-003-F00

- (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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HOLE MAKING PROCESS	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		
	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 BAR) 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)
REAM / END-MILL SIZE (L/D > 4)	358.2 (9.1)	0.0015 (0.038)	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.
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 201/70-10-10-990-801-F00 (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 BAR) 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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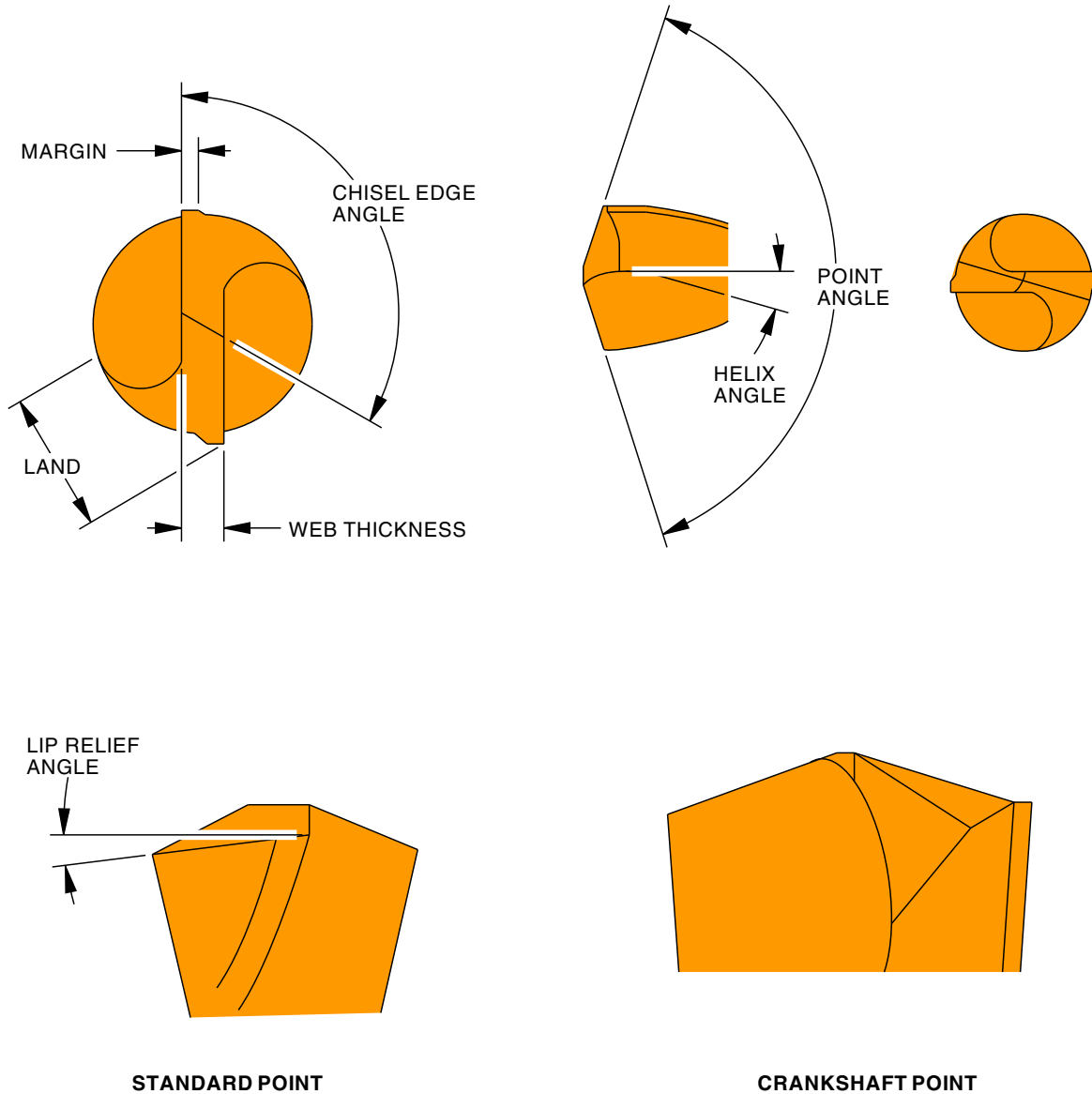
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Twist Drill Point Nomenclature
Figure 202/70-10-10-990-802-F00

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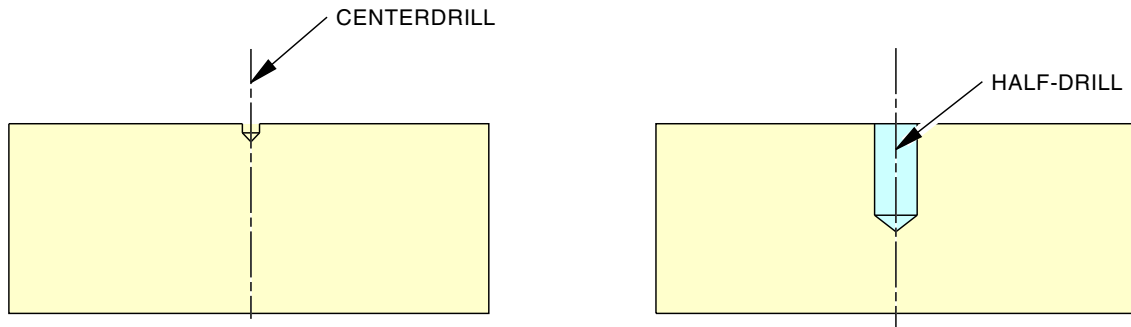
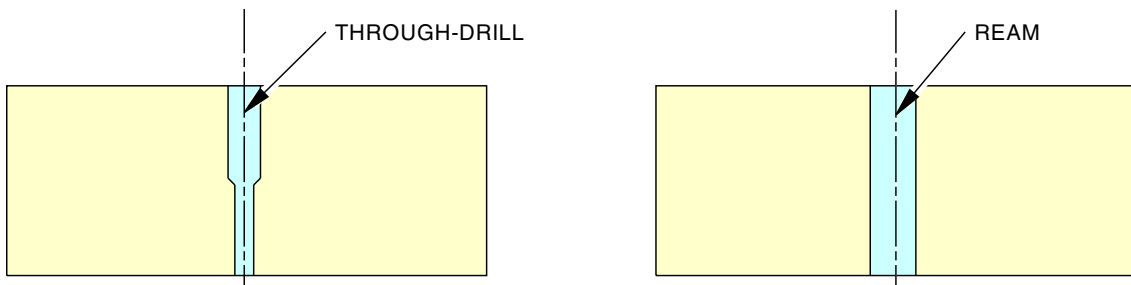
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**STEP 1****STEP 2****STEP-DRILLING DEEP HOLES IN INCONEL 718**

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Two-Step Drilling
Figure 203/70-10-10-990-803-F00

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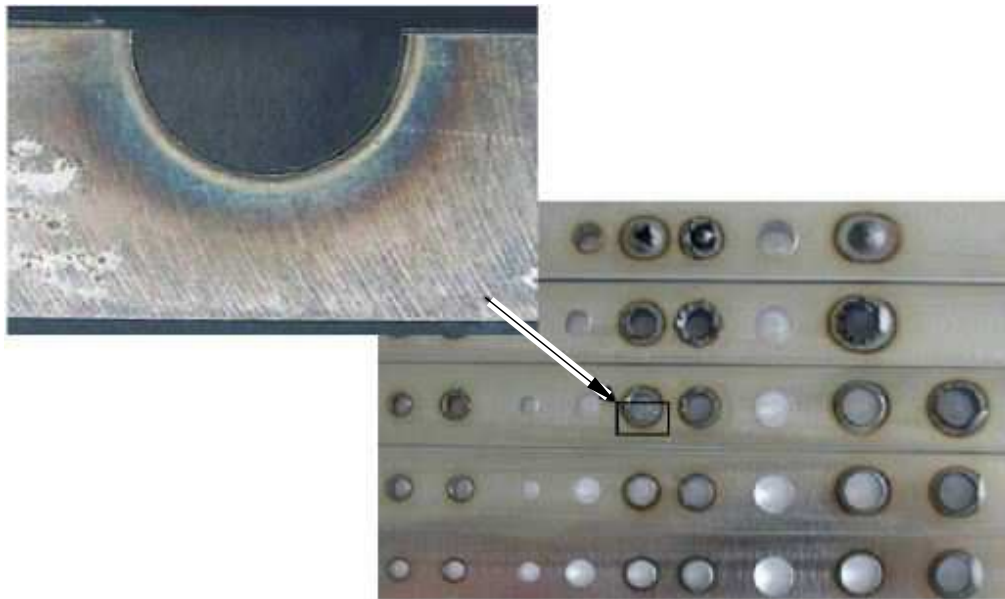
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**COLORING FOR DIFFERENT DEGRADED CONDITIONS IN THE DRILLING OF INCONEL 718
(EXAMPLE)**



**COLORING 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
Figure 204/70-10-10-990-804-F00 (Sheet 1 of 3)**

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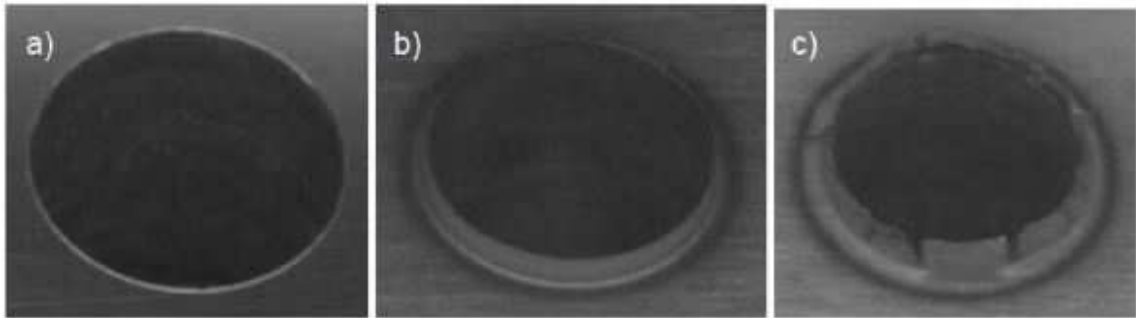
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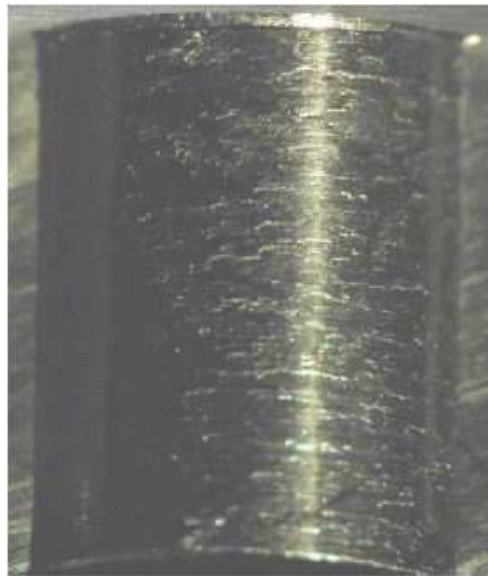
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**UNUSUAL BURRS (B AND C) IN COMPARISON WITH A BURR AFTER
DRILLING IN REFERENCE CONDITIONS (A)
(EXAMPLE)**



**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
Figure 204/70-10-10-990-804-F00 (Sheet 2 of 3)**

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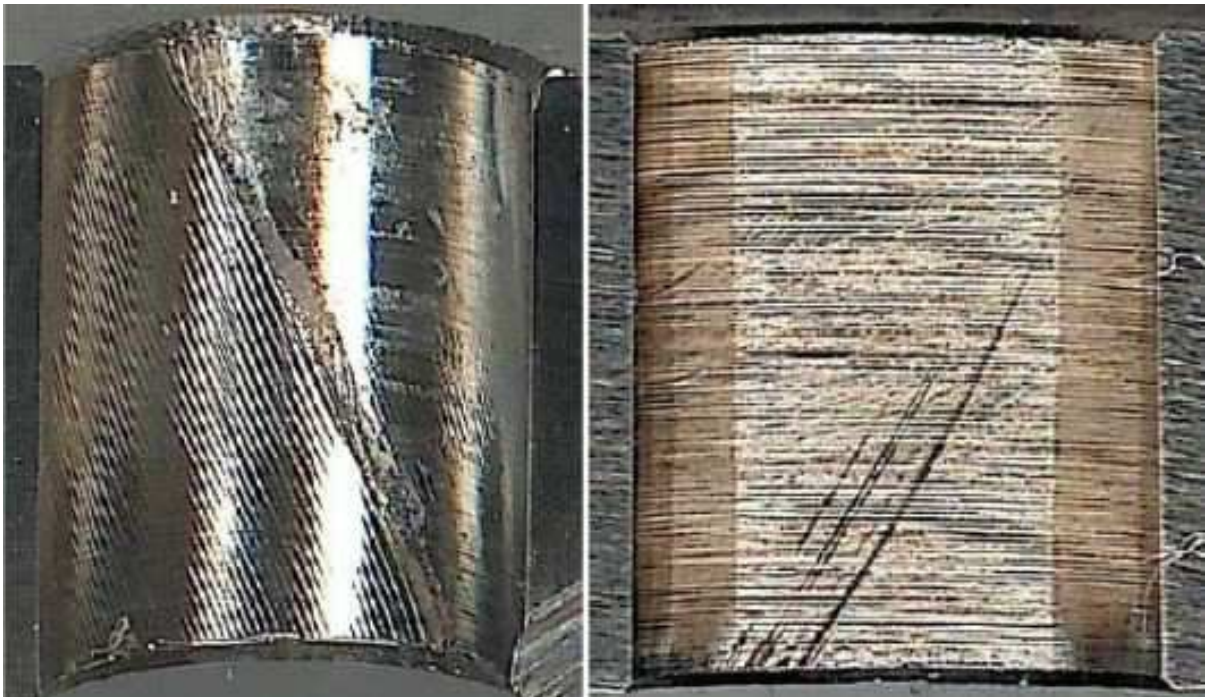
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**VIBRATION MARKS AND OF ABNORMAL STRIATIONS OF UPWELLING
(EXAMPLE)**

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 204/70-10-10-990-804-F00 (Sheet 3 of 3)**

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ETCHING - MAINTENANCE PRACTICES

1. General

- A. This procedure has one task:
- (1) A swab etching procedure.

TASK 70-10-11-800-801-F00

2. Local Swab Etching - Maintenance Practices

A. General

- (1) This procedure describes the materials and process for swab etching. These etchants are used as described herein or with exceptions as specified for individual parts in the parts specific manual.
- (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) Each container of stock solution must be labelled with the Class identification of the contents, and the expiration date of the shelf-life period. A supply of distilled water must be available for mixing etchants, and for rinsing them from the etched area of the work.

B. 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	

C. Location Zones

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

D. Equipment

SUBTASK 70-10-11-110-005-F00

- (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).

SUBTASK 70-10-11-160-003-F00

- (2) The materials for the procedure are as follows:

Table 201/70-10-11-993-802-F01 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
D	carbon steel etchant, G51628 [S1095]	Carbon and Low Alloys Steels	6 Months
E	aluminum alloy etchant, G51478 [S1096]	All Aluminum Alloys	1 Year

E. Local Swab Etching

SUBTASK 70-10-11-100-001-F00

- (1) All surfaces to be etched must be free from oil, grease, scale or other extraneous material.

SUBTASK 70-10-11-160-001-F00

- (2) If necessary, mask the areas that you will not etch.

NOTE: Masking will keep the etching solution within defined boundaries of the area to be etched.

SUBTASK 70-10-11-110-002-F00



DO NOT LET THE ACIDS TOUCH YOU. YOU MUST WEAR A FACE SHIELD, GLOVES, PROTECTIVE CLOTHING AND SHOES. IF THE ACID GOES INTO YOUR EYES, FLUSH YOUR EYES WITH COOL WATER. GET MEDICAL AID IMMEDIATELY. ACIDS ARE POISONOUS AND CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.



DO NOT BREATHE THE FUMES FROM THIS MATERIAL. PUT ON A RESPIRATOR WHEN YOU USE THIS MATERIAL. MAKE SURE THAT THERE IS SUFFICIENT AIRFLOW. THIS MATERIAL CAN CAUSE INJURIES TO PERSONNEL OR DAMAGE TO EQUIPMENT.

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(WARNING PRECEDES)



WARNING

DO NOT ADD WATER TO ACID BECAUSE THE HEAT WILL CAUSE THE ACID TO COME OUT OF THE CONTAINER. TO MAKE THE SOLUTION, YOU MUST ADD THE ACID TO THE WATER WHILE YOU CONTINUOUSLY MIX IT. MAKE SURE THAT YOU WEAR THE 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. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL CAN OCCUR.

- (3) Unless otherwise specified in the parts specific manual, etch the part as follows:
- Get the etching time from the Table 202 for the etchant class and material type.
 - 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.



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.

- Saturate a cotton swab with the working solution and swab the surface to be etched.
- Etch the area for the time specified in Table 202 for the etchant class and material type.
 - Keep fresh solution in contact with the metal surface at all times by dipping the swab into the working solution periodically.

NOTE: Localized pitting may occur if the solution becomes weakened due to lack of periodic swabbing.

 - Rub the swab continuously over the surface of the metal being etched, to prevent the formation of an inert sludge.

Table 202/70-10-11-993-801-F00

Guideline for Etching Time, Etchant Class, and Material Time ^[2]					
Material ^[1]	Time	Etchant Class			
		A	B	D	E
All Titanium Alloys	60-90 seconds	X			
Carbon Steels and Low Alloy Steels	60-90 seconds			X	
All Aluminum Alloys	60-90 seconds				X
Maraging Steels (Maraging 250, etc.)	60-90 seconds		X		
Low Expansion Alloys (Incoloy 903, 909, etc.)	2.5-3 minutes		X		

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Table 202/70-10-11-993-801-F00 (Continued)

Guideline for Etching Time, Etchant Class, and Material Time ^{*[2]}					
Material ^{*[1]}	Time	Etchant Class			
		A	B	D	E
All Stainless Steels (PH, etc.)	4-5 minutes		X		
Iron superalloys (A286, etc.)	4-5 minutes		X		
Turbine Airfoil Nickel Superalloys (Rene 77, 95, 125, etc.)	60-90 seconds		X		
Non Turbine Airfoil Nickel Superalloys (Inconel 600, 625, 718, Udimet 500, 700, etc.) ^{*[3]}	4-5 minutes		X		
Cobalt Superalloys (X40, L605, HS188, etc.) ^{*[3]}	4-5 minutes		X		

*[1] The materials listed in parentheses are examples only. The lists are not intended to be all inclusive.

*[2] When etching surfaces containing two different alloys with different etching times specified, use the shortest etching time specified.

*[3] 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 70-10-11-110-003-F00

- (4) After etching, blot up etching solution from the metal surface with a clean paper towel or cloth.

SUBTASK 70-10-11-110-004-F00



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.

- (5) 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 70-10-11-160-002-F00

- (6) Discard the used work solution.
- (a) Do not pour working solution back into the stock container.
 - (b) Obey local regulations for the procedures to discard etchants.
 - (c) Rinse and dry the plastic container for future use.

SUBTASK 70-10-11-110-006-F00

- (7) 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 ASSEMBLIES RIVET - MAINTENANCE PRACTICES

1. General

- A. This procedure has this task:
- (1) Blind Assemblies Rivet Repair.

TASK 70-10-12-300-801-F00

2. Blind 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, 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) Riveting is a method of making joints normally used during repair whenever joining by means of welding cannot be used for the following reasons:
 - (a) There is an alloy that is difficult to weld.
 - (b) The sheet metal is too thin to be fusion welded.
 - (c) The component operates at high temperature and/or under conditions of vibration.
- (5) The use of riveting for making joints is also frequently used in the design of engines for the production of fabricated assemblies or for attaching components on to larger components (anchor nuts, etc.).
 During repair, this involves the replacement of attachment rivets, as a result of the replacement of the component itself, or of rivets that become defective during service.
 The joints may be made either with solid rivets or with "blind" rivets.
- (6) 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.
- (7) Pneumatic guns can be fitted with straight, offset or right angle riveting heads depending on the part shape and the required riveting position.

B. Tools/Equipment

Reference	Description
STD-6626	Grinder - Right Angle, Air Driven

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- (1) For the rivet holes, do the following:
 - (a) Unless otherwise specified, drill the holes (Figure 203).
 - (b) Whenever possible, perform drilling with the sheets clamped together to avoid offset holes.

SUBTASK 70-10-12-300-002-F00

- (2) For the countersinks, do the following:
 - (a) Unless otherwise specified, perform countersinks (Figure 204).
 - (b) Make sure that the machining does not create flats on countersinks.

SUBTASK 70-10-12-300-003-F00

- (3) For the deburring, do the following:
 - (a) After drilling, assemble the deburr sheets, as follows:
 - 1) If sheets are drilled separately or disassembled before rivet installation, perform deburring (Figure 205).
 - 2) If sheets are drilled when assembled and no disassembly occurs before rivet installation, only deburr external faces (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 shown in Figure 206.

SUBTASK 70-10-12-220-001-F00

- (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 and Figure 210).

D. Rivet Installation**SUBTASK 70-10-12-200-001-F00**

- (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.

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SUBTASK 70-10-12-210-001-F00

**CAUTION**

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).

(b) Unacceptable surface defects on rivet body are as follows:

- 1) Make sure that the rivet body and stem have not surface defects such as cracks, fissures, encrusted unwanted particles and wrinkles on visible parts.

NOTE: Circular scores are not permitted in the postformed area.

SUBTASK 70-10-12-400-001-F00

(3) To form the bulb on the blind side, make sure that the mating surface of sheets is in contact during the rivet installation.

SUBTASK 70-10-12-400-002-F00

**CAUTION**

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 (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.

E. Rivets Replacement

SUBTASK 70-10-12-000-002-F00

(1) Make sure that you take necessary precautions not to damage rivets or sheets.

SUBTASK 70-10-12-000-001-F00

**CAUTION**

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.
 - a) Use the pin drift to remove the locking collar.

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- 2) Remove the rivets with the drill (Figure 212).
 - a) Remove rivet stem with the pin drift.
 - b) If rivets are installed in thin sheets, drill the stem out.
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.
 - d) Drill rivet head as close to sheets as possible with the drill of diameter equal to rivet diameter.
 - e) Use pin draft as a lever, to remove rivet.
 - f) Remove rivet body with the pin drift of the diameter equal to rivet diameter.
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 70-10-12-200-002-F00

- (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 in the tolerances (Figure 203).
 - (b) If rivet holes meet above the requirements, install original fit rivets.
 - (c) If rivet holes do not meet above the requirements, install oversize rivets.
NOTE: You can use oversize rivets specified for each particular case in the applicable task.

SUBTASK 70-10-12-200-003-F00

- (4) If countersinks have to be enlarged, make sure that the thickness of sheets is acceptable.

SUBTASK 70-10-12-400-003-F00

- (5) Install the new rivet according to the steps above.

F. Rivet Heads Inspection

SUBTASK 70-10-12-200-004-F00

- (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 gap does not more than 0.004 in. (0.1 mm) for protruding heads.
 - 2) 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 40% of the circumference.

SUBTASK 70-10-12-200-005-F00

- (2) Check the flushness of countersunk heads (Figure 214).



DO NOT SHAVE THE LOCKING COLLAR OR COUNTERSUNK HEADS TO MAKE THEM FLUSH. IF YOU DO NOT OBEY, DAMAGE CAN OCCUR.

- (a) A 0.004 in. (0.1 mm) protruding countersunk head is permitted.

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AIRCRAFT MAINTENANCE MANUAL****G. Stem and Collar Protrusion Check**

SUBTASK 70-10-12-200-006-F00

- (1) For CHERRY-LOCK rivet, stem and collar protrusion must meet requirements (Figure 214).

SUBTASK 70-10-12-200-007-F00

- (2) For CHERRY-MAX rivet, stem protrusion must meet requirements (Figure 215).

- (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.

H. Rivets Visual Inspection

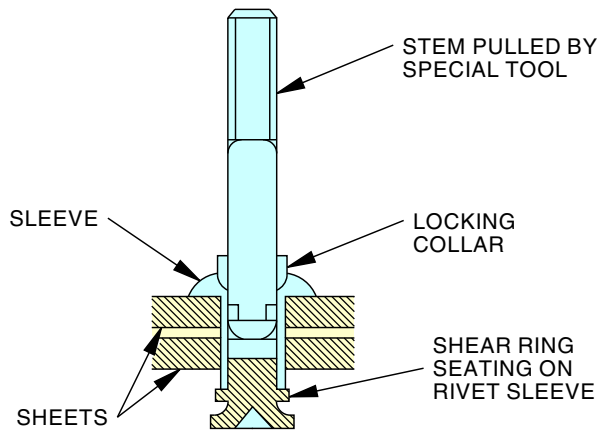
SUBTASK 70-10-12-200-008-F00

- (1) Check the limits for the slight burr on the locking collar, caused by the pressure exerted by the installation tool (Figure 216).

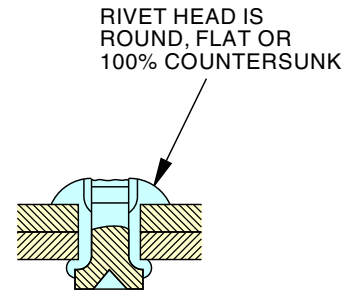
NOTE: When visible, the riveting may show fine surface cracks which are not detrimental to rivet strength and which are therefore acceptable.

———— **END OF TASK** ————

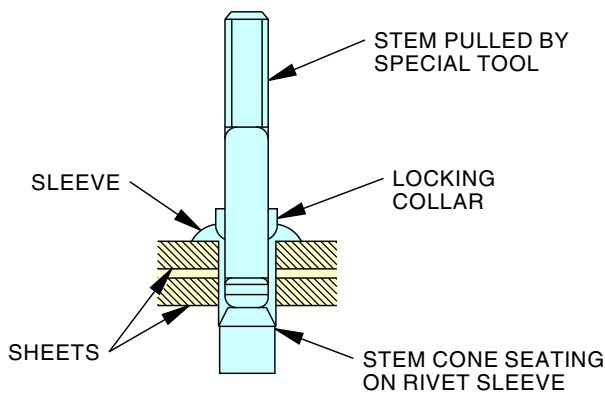
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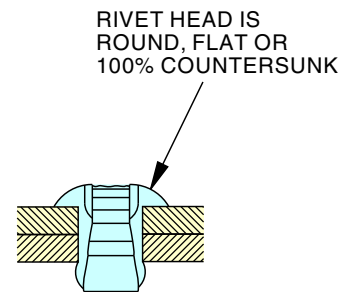
BULBED RIVET BEFORE INSTALLATION



BULBED RIVET INSTALLED



**STANDARD RIVET BEFORE
 INSTALLATION**



STANDARD RIVET INSTALLED

2954691 S0000731937_V1

Description of Cherrylock Rivets
Figure 201/70-10-12-990-801-F00

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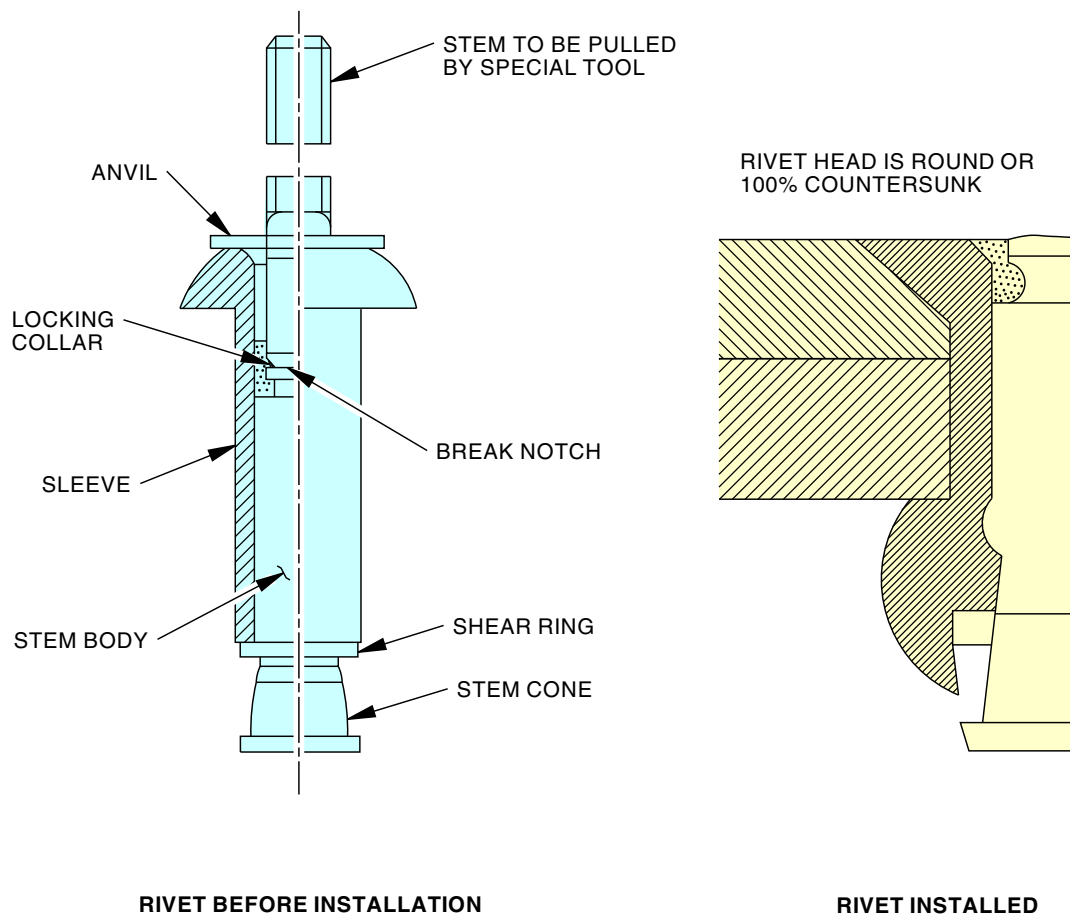
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2954696 S0000731938_V1

Description of Cherrymax Rivets
Figure 202/70-10-12-990-802-F00

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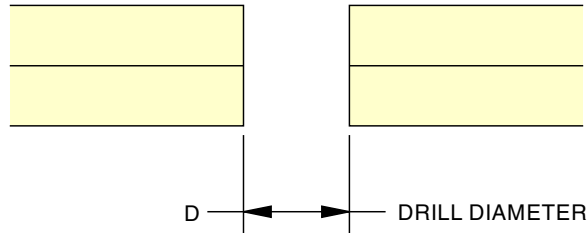
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1ST DASH NUMBER OF PART NUMBER	STANDARD CHERRYLOCK RIVETS NAS 1398 - NAS 1399		BULBED CHERRYLOCK RIVETS NAS 1738 - NAS 1739	
	NOMINAL DIAMETER	DRILL DIAMETER	NOMINAL DIAMETER	DRILL DIAMETER
- 3	0.094 (2.39)	0.100 (2.54) 0.097 (2.46)		
- 4	0.125 (3.18)	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).

2954701 S0000731939_V1

**Rivet Hole Drilling Data
Figure 203/70-10-12-990-803-F00**

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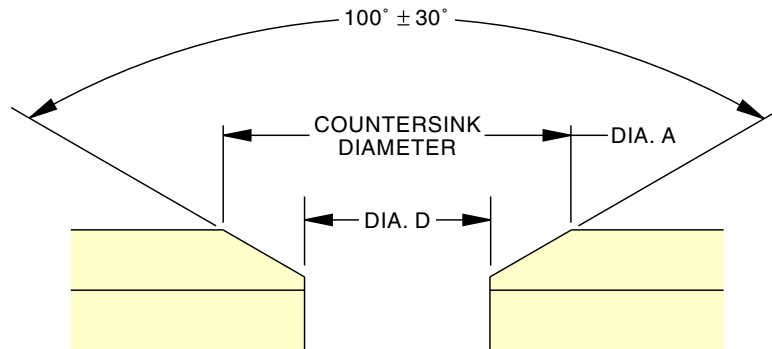
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1ST DASH NUMBER OF PART NUMBER	STANDARD CHERRYLOCK RIVET		BULBED CHERRYLOCK RIVET	
	NOMINAL DIAMETER	COUNTERSINK DIAMETER	NOMINAL DIAMETER	COUNTERSINK DIAMETER
- 3	0.094 (2.39)	0.183 (4.65) 0.175 (4.45)		
- 4	0.125 (3.18)	0.229 (5.82) 0.221 (5.62)	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).

2954705 S0000731940_V1

Countersink Data
Figure 204/70-10-12-990-804-F00

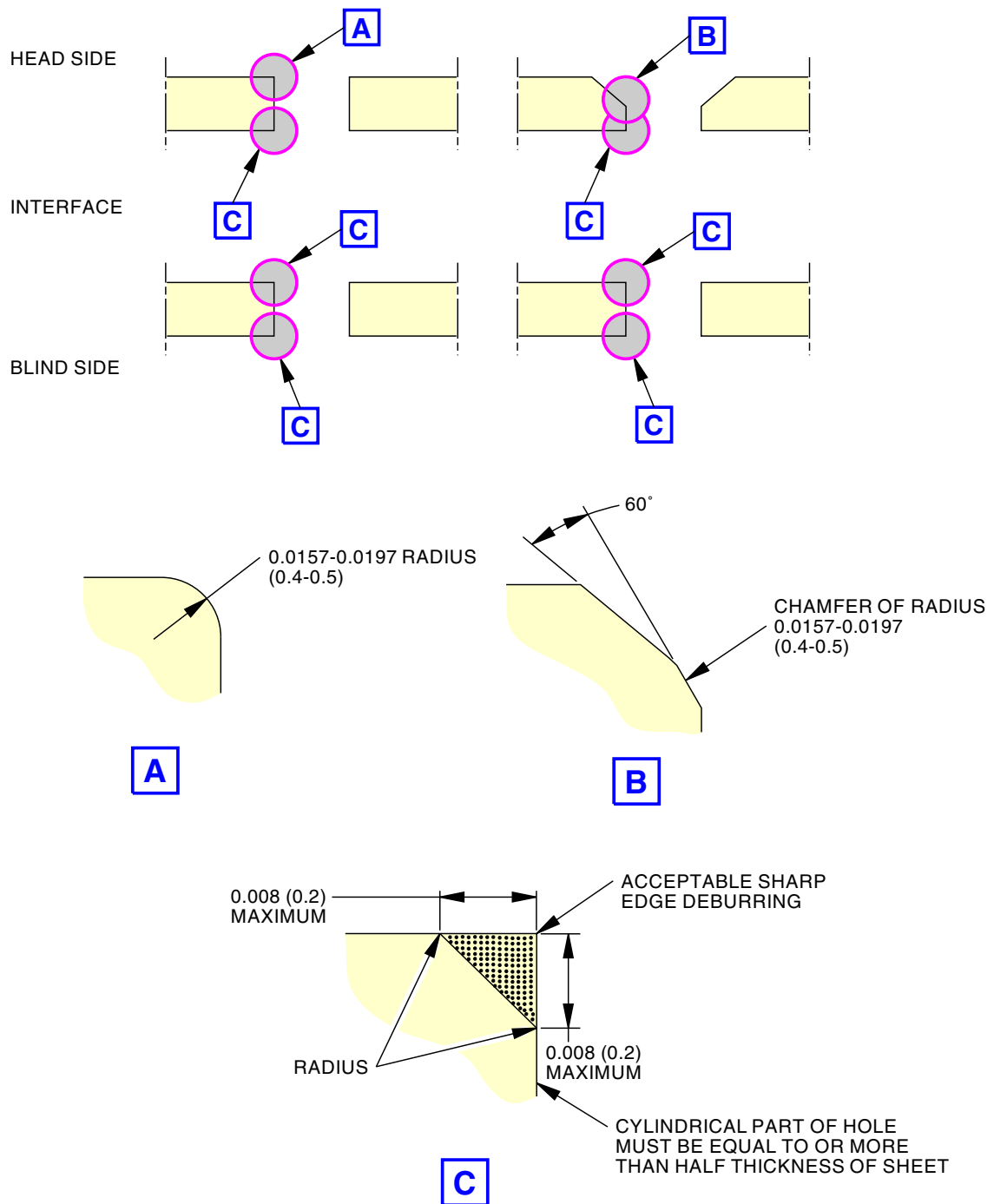
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**NOTE:**

ALL DIMENSIONS ARE IN INCHES (mm).

2954711 S0000731941_V1

Sheet Deburring
Figure 205/70-10-12-990-805-F00

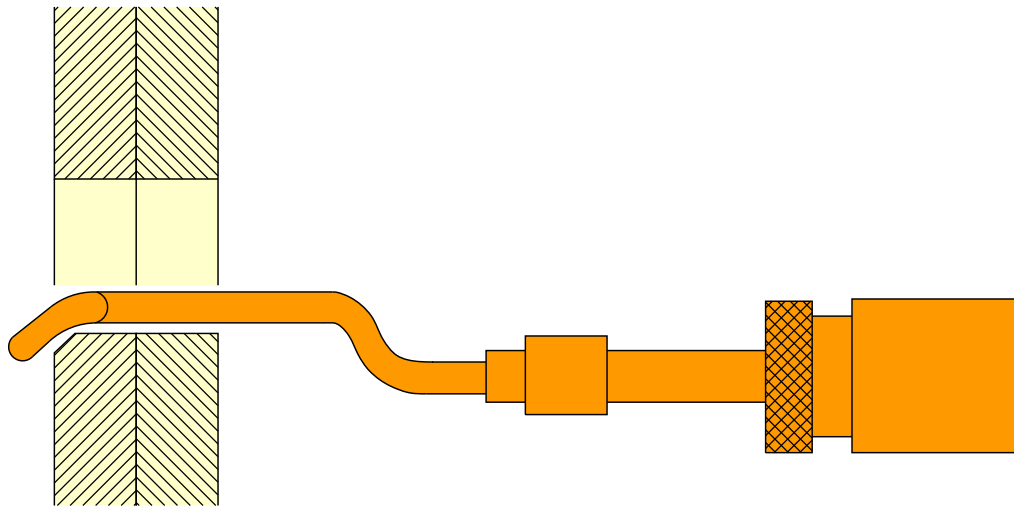
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Deburring of Inaccessible Faces
Figure 206/70-10-12-990-806-F00

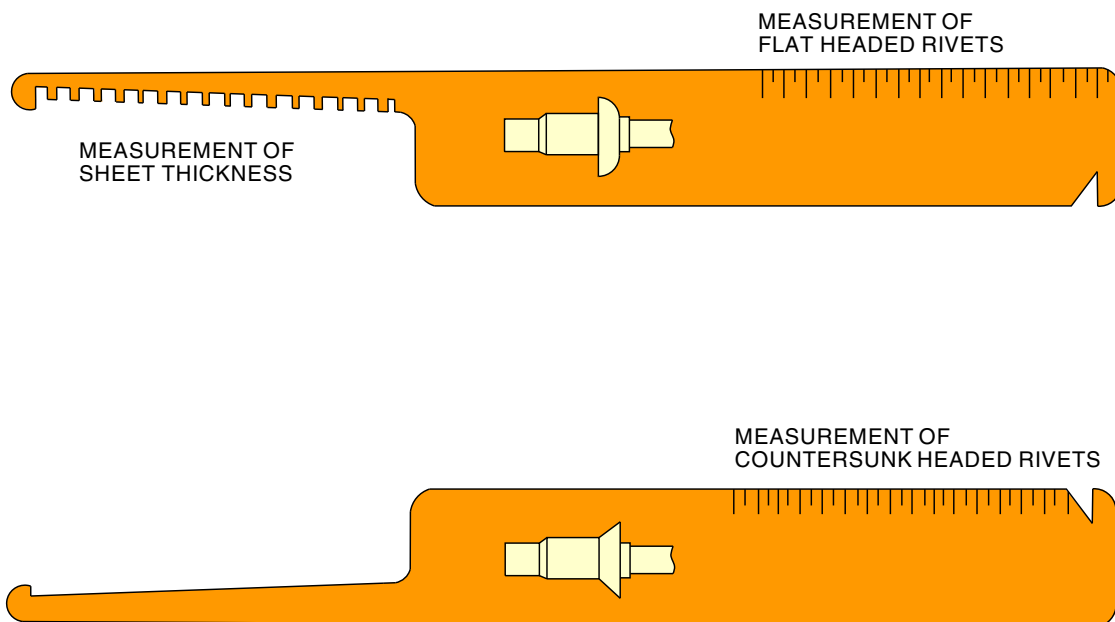
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Thickness Measurement Gage
Figure 207/70-10-12-990-807-F00

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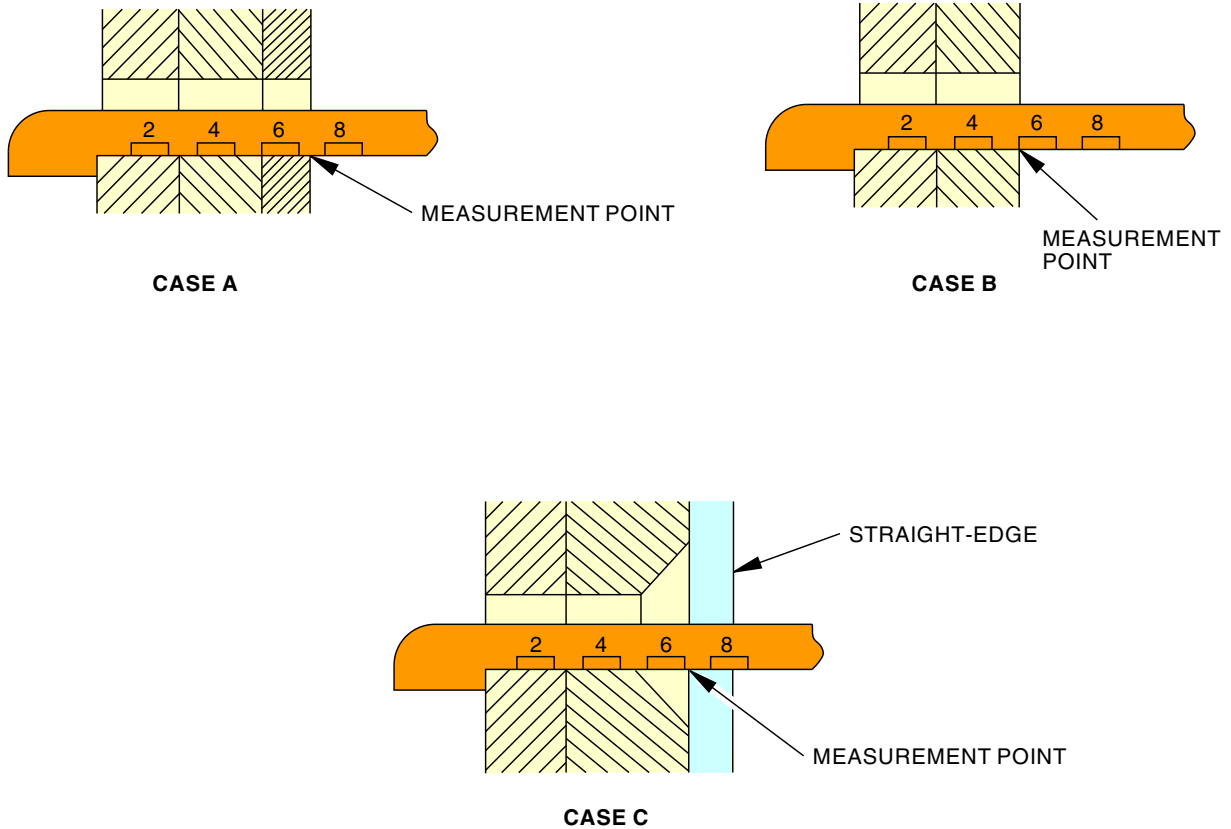
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CASE A: THE MEASUREMENT POINT IS LOCATED BETWEEN TWO MARKS. SELECT A RIVET HAVING A GRIP LENGTH IMMEDIATELY BELOW FIRST READABLE MARK. (IN THIS CASE THE RIVET GRIP LENGTH MUST BE 7/16 INCH).

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).

2954715 S0000731944_V1

**Measurement of Assembled Sheet Thickness
Figure 208/70-10-12-990-808-F00**

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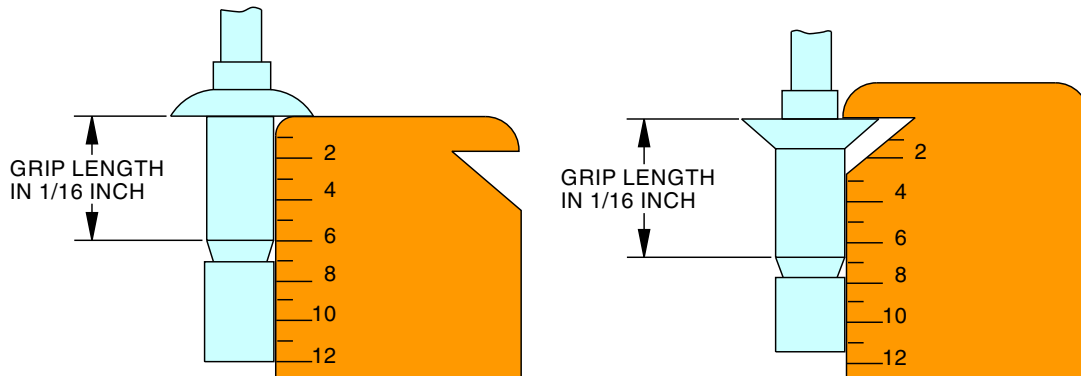
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CLAMPING CAPACITY		DASH NUMBERS IN PART NUMBER					RIVET DIAMETER	MIN. CLAMP CAPACITY
MINIMUM	MAXIMUM	DIA. 0.094 (2.38)	DIA. 0.125 (3.17)	DIA. 0.156 (3.96)	DIA. 0.187 (4.75)	DIA. 0.250 (6.35)		
(1)	0.062 (1.57)	-3-1	-4-1	-5-1	-6-1		0.094 (2.38)	0.020 (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.

2954992 S0000731945_V1

Rivet Grip Length vs Clamping Capacity
Figure 209/70-10-12-990-809-F00 (Sheet 1 of 5)

EFFECTIVITY
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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.

2955234 S0000731946_V1

Rivet Grip Length vs Clamping Capacity Figure 209/70-10-12-990-809-F00 (Sheet 2 of 5)

EFFECTIVITY
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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).

2955239 S0000731947_V1

Rivet Grip Length vs Clamping Capacity Figure 209/70-10-12-990-809-F00 (Sheet 3 of 5)

EFFECTIVITY
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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).

2955260 S0000731948_V1

Rivet Grip Length vs Clamping Capacity
Figure 209/70-10-12-990-809-F00 (Sheet 4 of 5)

EFFECTIVITY
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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).

2955263 S0000731949_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	1398 MW 1398 D	MONEL 2017-T4	CADMIUM PLATING ANODIZING
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

2955267 S0000731950_V1

**Identification of Blind Rivets
Figure 210/70-10-12-990-810-F00**

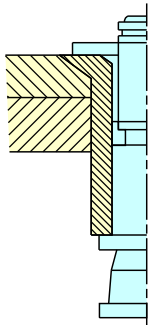
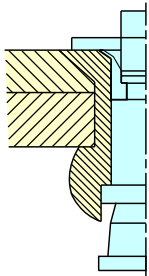
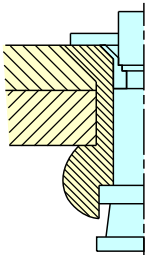
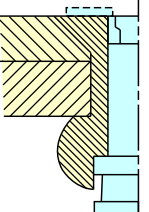
EFFECTIVITY
LOM ALL

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	<p>LEGEND:</p> <p>1. ENGAGE STEM SERRATIONS IN TOOL PULLING HEAD UNTIL ANVIL COMES AGAINST RIVETING TOOL HEAD.</p>
	<p>2. STEM IS PULLED INSIDE RIVET SLEEVE. THRUST RING FORCES RIVET BLIND HEAD TO FORM A WIDE BULBED 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.</p>
	<p>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.</p>
	<p>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.</p>

CHERRYMAX RIVETS

2955468 S0000731951_V1

**Installation of Cherry Rivets
Figure 211/70-10-12-990-811-F00 (Sheet 1 of 3)**

EFFECTIVITY
LOM ALL

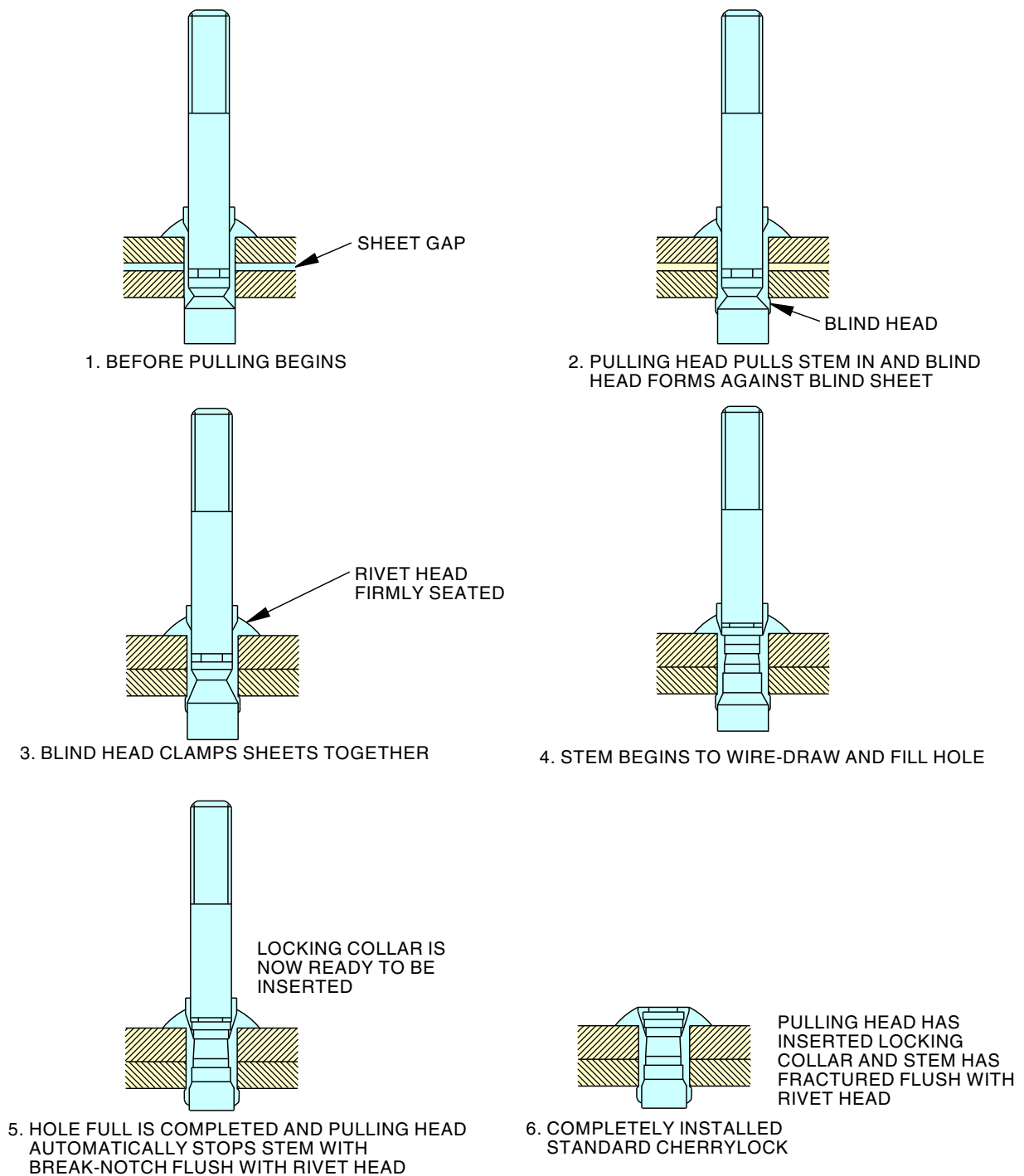
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STANDARD CHERRYLOCK RIVETS

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**Installation of Cherry Rivets
Figure 211/70-10-12-990-811-F00 (Sheet 2 of 3)**

EFFECTIVITY
LOM ALL

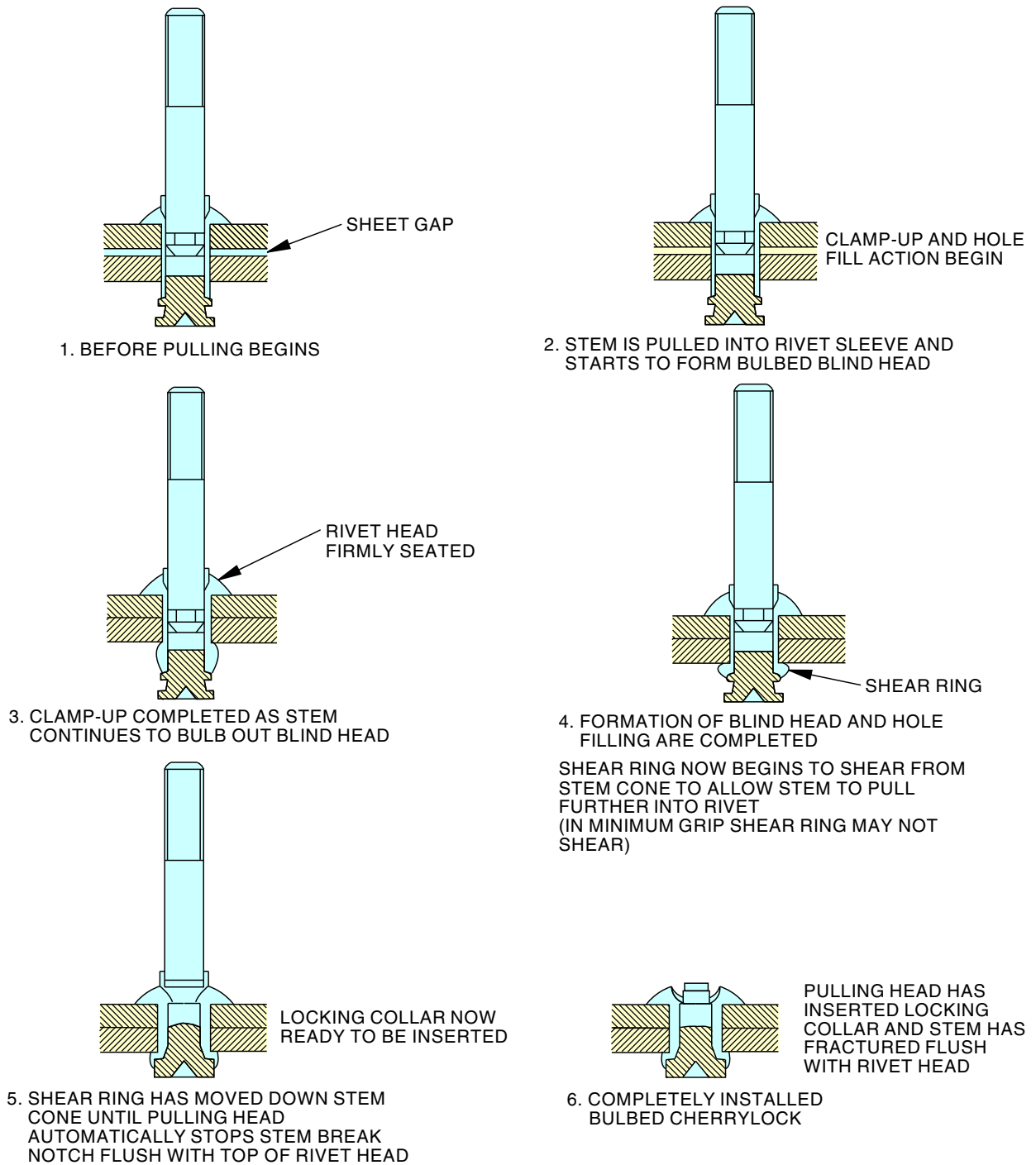
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BULBED CHERRYLOCK RIVETS

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**Installation of Cherry Rivets
Figure 211/70-10-12-990-811-F00 (Sheet 3 of 3)**

EFFECTIVITY
LOM ALL

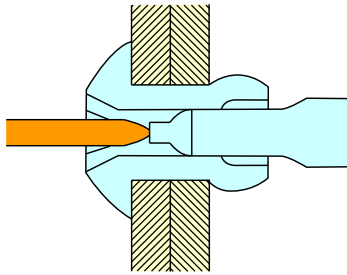
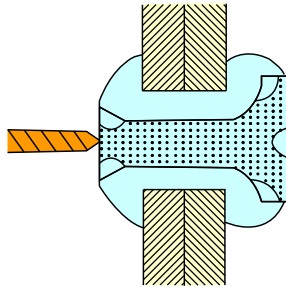
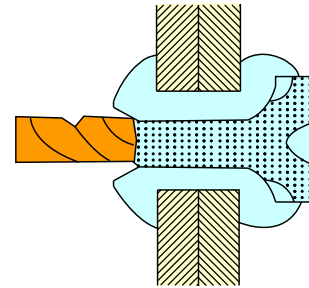
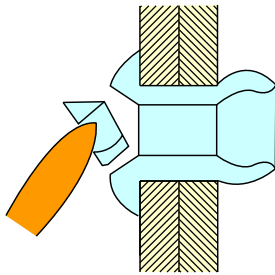
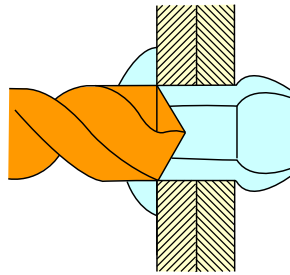
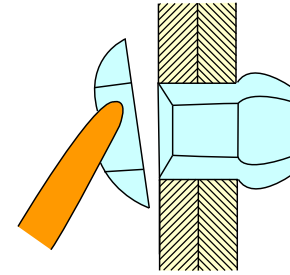
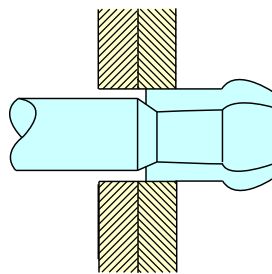
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**A****B****C****D****E****F****G**

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Replacement of Cherrylock Rivets
Figure 212/70-10-12-990-812-F00

EFFECTIVITY
LOM ALL

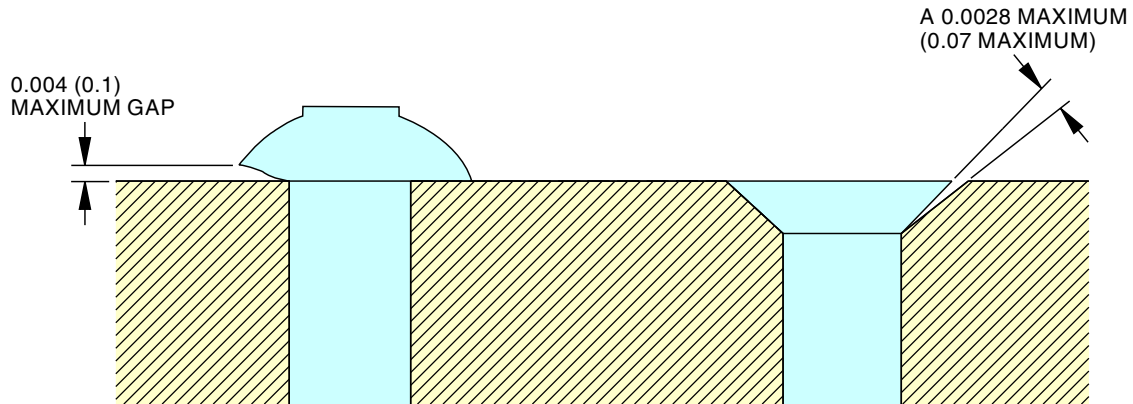
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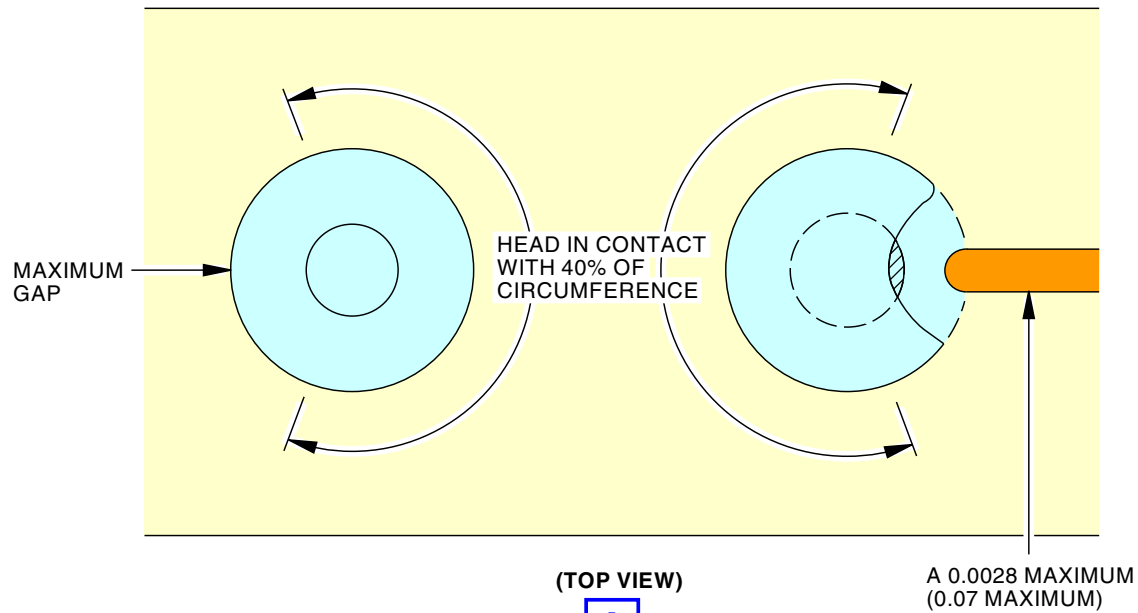
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A



(TOP VIEW)

A

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2955375 S0000731955_V1

Head Seating Check
Figure 213/70-10-12-990-813-F00 (Sheet 1 of 2)

EFFECTIVITY
LOM ALL

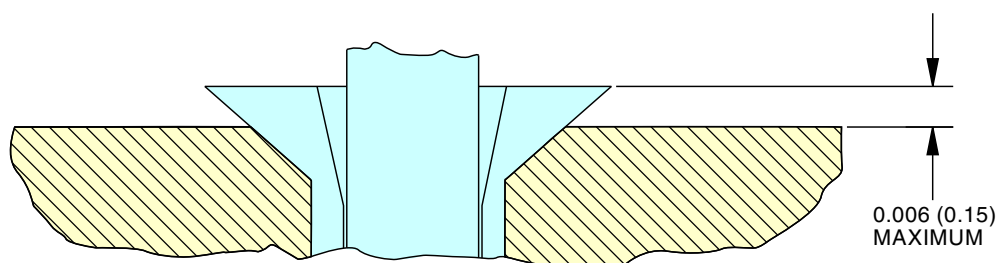
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**NOTE:**

ALL DIMENSIONS ARE IN INCHES (mm).

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Head Seating Check
Figure 213/70-10-12-990-813-F00 (Sheet 2 of 2)

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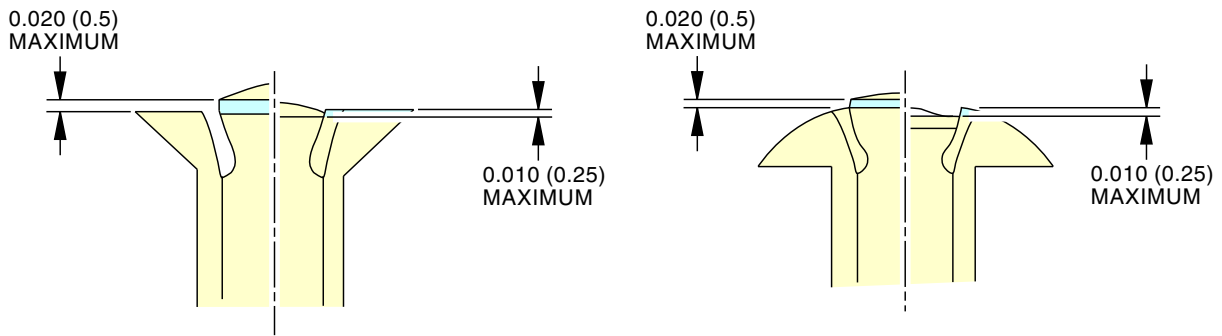
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

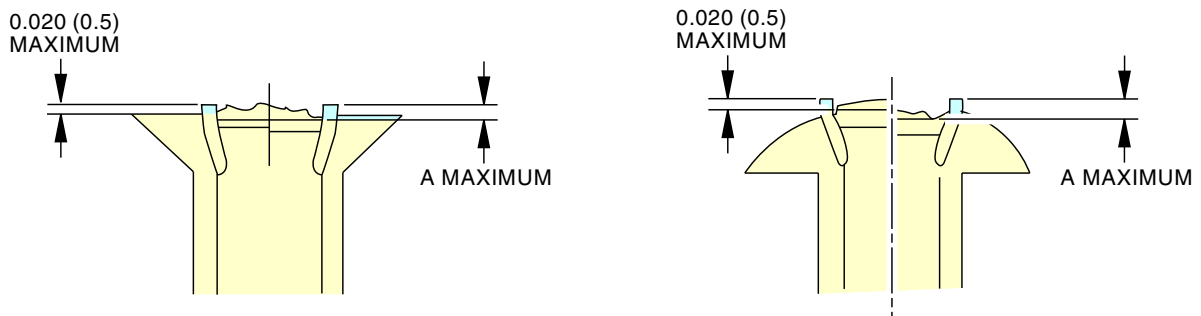
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STEM PROTRUSION LIMITS



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).

2955331 S0000731957_V1

Stem and Collar Flushness
Figure 214/70-10-12-990-814-F00

EFFECTIVITY
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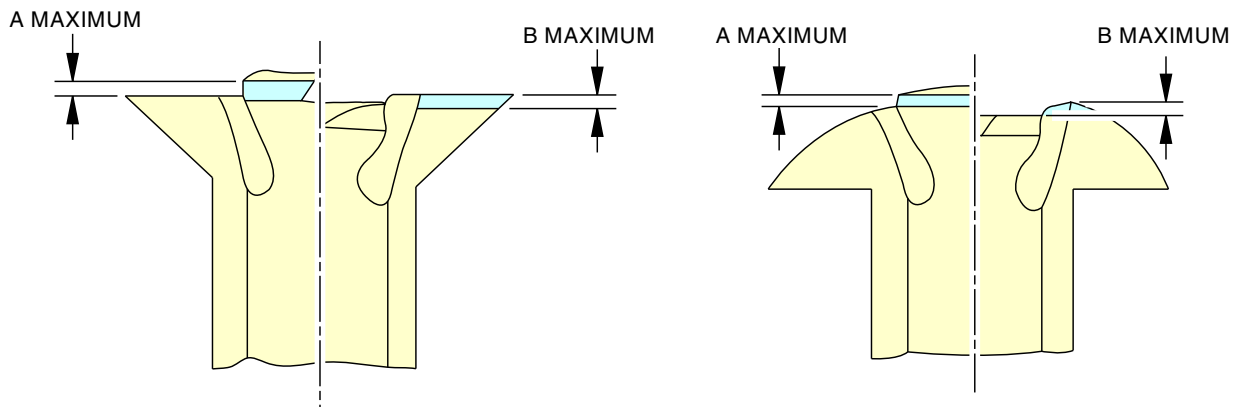
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NOMINAL DIAMETER	0.125 (3.2)	0.156 (4)	0.190 (4.8)
MAX A	0.010 (0.25)	0.010 (0.25)	0.010 (0.25)
MAX B	0.015 (0.38)	0.020 (0.50)	0.020 (0.50)

STEM PROTRUSION LIMITS

NOTE:

ALL DIMENSIONS ARE IN INCHES (mm).

2955272 S0000731958_V1

**Stem flushness for CHERRY-MAX rivet
Figure 215/70-10-12-990-815-F00**

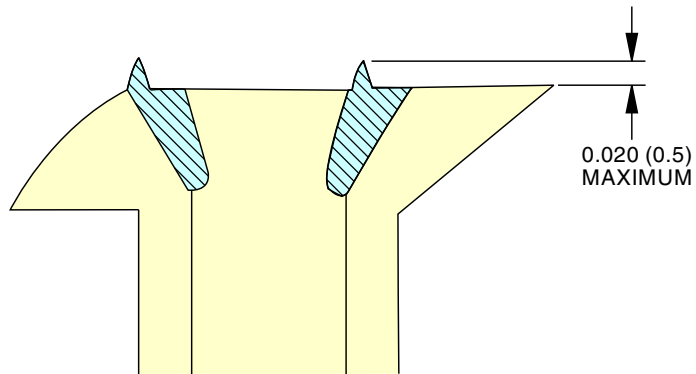
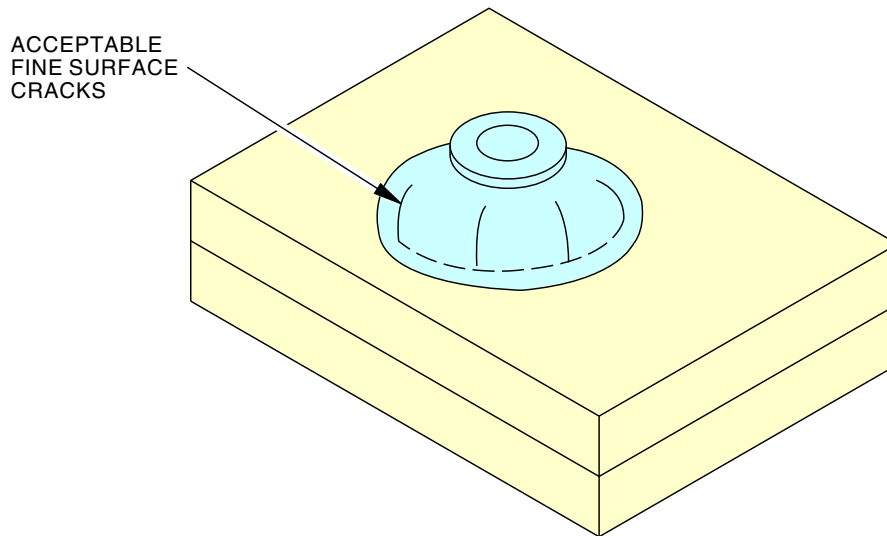
EFFECTIVITY
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**LOCKING COLLAR****RIVETING****NOTE:**

ALL DIMENSIONS ARE IN INCHES (mm).

2955270 S0000731959_V1

**Visual Check of Rivet
Figure 216/70-10-12-990-816-F00**
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TURNING - MAINTENANCE PRACTICES

1. General

A. This procedure has this task:

- (1) Turning - Turn.

TASK 70-10-13-320-801-F00

2. Turning - Turn

(Figure 201, Figure 202)

A. General

- (1) Turning is the machining operation whereby an external cylindrical or conical surface is generated through the direct action of a rotating workpiece and the longitudinal travel of a single point cutting tool.
- (2) Boring is the turning operation that is applied to generate an internal surface.
- (3) Facing is a special type of turning where the cutting tool moves perpendicular to the axis of rotation of the workpiece, generating a flat surface.
- (4) For general requirements and instructions on machining process refer to Machining (Material Removal), TASK 70-10-08-320-801-F00.

B. Preparation

- (1) Equipment for turning must have the capability to hold and rotate the workpiece while holding the tool stationary except for linear movement.
 - (a) Most turning is done on lathes.
 - (b) There are several types of lathes but the most common is the engine lathe.
 - 1) Engine lathe is a heavy duty machine tool that utilizes typical lathe components:
 - Lathe bed
 - Headstock assembly
 - Tail stock assembly
 - Carriage assembly (includes tool holding block or post)
 - Speed and feed change gearboxes
 - Lead screw
 - Feed rod
 - Cooling system.
- (2) Additional requirements for critical metallic rotating parts:
 - (a) The facility must be equipped in order to satisfy a continuous supply of cutting fluid during the turning operation at least in the tool/material contact area, for example by satisfying one of the following conditions:
 - Injection of fluid upstream of the working area of the tool
 - Injection of fluid through the tool
 - Abundant feeding of turning area.

NOTE: The use of fixed cutting fluid delivery nozzles in adequacy with the machined area is recommended.

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- (b) The machine used for turning must be capable of measuring or complying with the following parameters, within the indicated tolerances, over the entire utilization range of the machine:
 - 1) The variation in the spindle speed must not exceed $\pm 10\%$ of the nominal value fixed at the maximum speed enabled by the machine.
 - 2) The variation of the feed rate on each axis must not exceed $\pm 15\%$ of the nominal value fixed at the maximum speed enabled by the machine.
- (c) In case of high pressure coolant turning operations or if required by the process document, the machines must be equipped with a system for monitoring the cutting fluid delivery and capable of reducing in a few seconds (from 0 to 5 seconds) the cutting speed (m/min) to the lowest value authorized in conventional turning in the case of (Table 201 and Table 202):
 - Failure of the high pressure system
 - Obstruction of the coolant delivery system
 - Significant leaks of lubricant in the lubrication system.
- (d) These events may be monitored separately but usually maintaining pressure within a target range is sufficient to control the process to avoid damaging the material.
- (3) Elements (tools, temporary protections, dampers, etc.) maintained in temporary contact with the part using glue or adhesives are authorized providing that the glue or adhesive does not alter the chemical, physical, or mechanical characteristics of the parts to be machined.
- (4) Cutting tools (Figure 201)
 - (a) Four types of material are used for cutting tools:
 - High speed steels, designated by AISI specifications
 - Metal carbides
 - CBN (Cubic Boron Nitride)
 - Ceramics designated by ISO specifications.
 - (b) The use of high speed steels is limited by its hot hardness. The cobalt grade of HSS can be used for turning of work materials that have a hardness below HRC52.
 - 1) Metal carbides and ceramics are used as tools for turning most materials, but are required with materials having hardness of HRC52 or harder.
 - 2) Care must be exercised in the use of carbides since they have poor impact resistance.
 - (c) The ability to maintain sharp cutting edges on tools reduces work-hardening, excessive cutting forces, and potential distortion of the work piece.
 - 1) A cutting tool is subject to wear on the side clearance face and side rake face.
 - 2) For given machining conditions, wear increases with time and reaches a level that requires replacement or grinding of the tool.
 - 3) Considering an evenly distributed wear on the clearance face, the level of acceptance is a tool wear of 0.012 in. (0.305 mm) (Figure 202).
 - (d) Carbide tool materials are used for turning thermal spray coatings and more critical limits are placed on the range of cutting speeds, depth of cut, feed rates, and geometry of the cutting tool.
- (5) Turning Fluids
 - (a) Turning fluids are used for cooling and lubricating the cutting tool and work piece.

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- 1) There are four classes of turning fluids:
 - Straight cutting fluids
 - Water soluble oils
 - Semi-synthetic fluids
 - Synthetic fluids.
 - a) For titanium parts, turning fluids must not contain chloride.
 - b) For critical metallic rotating part, choose one of the turning fluids listed in the (CP5086) CUTTING FLUID according to compatibilities with the base material part.
 - c) For the other part, the turning fluids must be inactive or must not cause any chemical reaction with the workpiece especially those used with the machining of aluminum and copper alloys.
- (b) The addition of an extreme pressure additive containing 10% chlorine produces straight cutting fluid of a higher lubricating value.

NOTE: Straight cutting fluids that utilize chlorine additives may be used only in operations where the fluids may be completely flushed and cannot become entrapped in liquid or residue form.

C. References

Reference	Title
70-10-08-320-801-F00	Machining (Material Removal) (P/B 201)

D. Turning

SUBTASK 70-10-13-320-001-F00

- (1) These steps are only applicable for critical metallic rotating part.



WARNING

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.

- (a) The restrictive machining conditions in the tables below are recommended for conventional turning:

Table 201/70-10-13-993-801-F00 Conventional Coolant Turning

	CUTTING CONDITIONS ALLOWED PER TYPE OF TOOLS MATERIAL					
	CARBIDE (COATED OR NOT)		CERAMIC (COATED OR NOT)		CBN	
	CUTTING SPEED V_c IN/MIN (M/MIN)	FEED RATE f IN/REV (MM/ REV)	CUTTING SPEED V_c IN/MIN (M/ MIN)	FEED RATE f IN/REV (MM/ REV)	CUTTING SPEED V_c IN/MIN (M/ MIN)	FEED RATE f IN/REV (MM/ REV)
WROUGHT Ti-BASED ALLOYS (TYPE TA6V, Ti17, ETC.)	788 - 3936 (20 - 1000)	0.0008 - 0.0119 (0.02 - 0.30)	N/A ^{*(1)}	N/A ^{*(1)}	N/A ^{*(1)}	N/A ^{*(1)}

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Table 201/70-10-13-993-801-F00 Conventional Coolant Turning (Continued)

		CUTTING CONDITIONS ALLOWED PER TYPE OF TOOLS MATERIAL					
WROUGHTNI-BASED ALLOYS	LOW GAMMA PRIME NICKEL ALLOYS	394 - 2204 (10 - 56)	0.0008 - 0.0098 (0.02 - 0.25)	2363 - 15590 (60 - 369)	0.0008 - 0.0098 (0.02 - 0.25)	2363 - 15590 (60 - 396)	0.0008 - 0.0098 (0.02 - 0.25)
	HIGH GAMMA PRIME NICKEL ALLOYS	394 - 2204 (10 - 56)	0.0008 - 0.0098 (0.02 - 0.25)	2363 - 11968 (60 - 304)	0.0008 - 0.0098 (0.02 - 0.25)	2363 - 11968 (60 - 304)	0.0008 - 0.0098 (0.02 - 0.25)

*[1] N/A means the use of this tool material is not permitted without CFMI approval.

Table 202/70-10-13-993-802-F00 High Pressure Coolant Turning

CUTTING CONDITIONS ALLOWED PER TYPE OF TOOLS MATERIAL						
	CARBIDE (COATED OR NOT)		CERAMIC (COATED OR NOT)		CBN	
	CUTTING SPEED V _c IN/MIN (M/MIN)	FEED RATE f IN/REV (MM/REV)	CUTTING SPEED V _c IN/MIN (M/MIN)	FEED RATE f IN/REV (MM/REV)	CUTTING SPEED V _c IN/MIN (M/MIN)	FEED RATE f IN/REV (MM/REV)
WROUGHT Ti-BASED ALLOYS (TYPE TA6V, Ti17, ETC.)	3150 - 7086 (80 - 180)	0.0008 - 0.0119 (0.02 - 0.30)	N/A*[1]	N/A*[1]	N/A*[1]	N/A*[1]

*[1] N/A means the use of this tool material is not permitted without CFMI approval.

(b) For management of special cause events refer to the table below:

Table 203/70-10-13-993-803-F00

Description of the Special Event	Essential Actions on the Treatment of the Part
Tool breakage during turning	Stop all turning operation with the tool Collect and keep the pieces of the tool Contact CFMI
Lubrication failure	Stop all machining operation on this equipment Contact CFMI

E. Inspection

SUBTASK 70-10-13-210-001-F00

(1) Check machined parts.

(a) Make sure that the edges are free of burrs and rolled metal.

SUBTASK 70-10-13-200-001-F00

(2) Surface anomalies only applicable for critical metallic rotating part:

(a) Method:

1) Perform a direct visual inspection on 100 % of parts using a maximum magnification of x10.

(b) Criteria:

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- 1) Make sure that search for surface quality anomalies is carried out on the part.
- 2) Make sure that there is no rebonded material on the surface, or unusual surface appearance (orange peel, waviness, etc.).

———— **END OF TASK** ————

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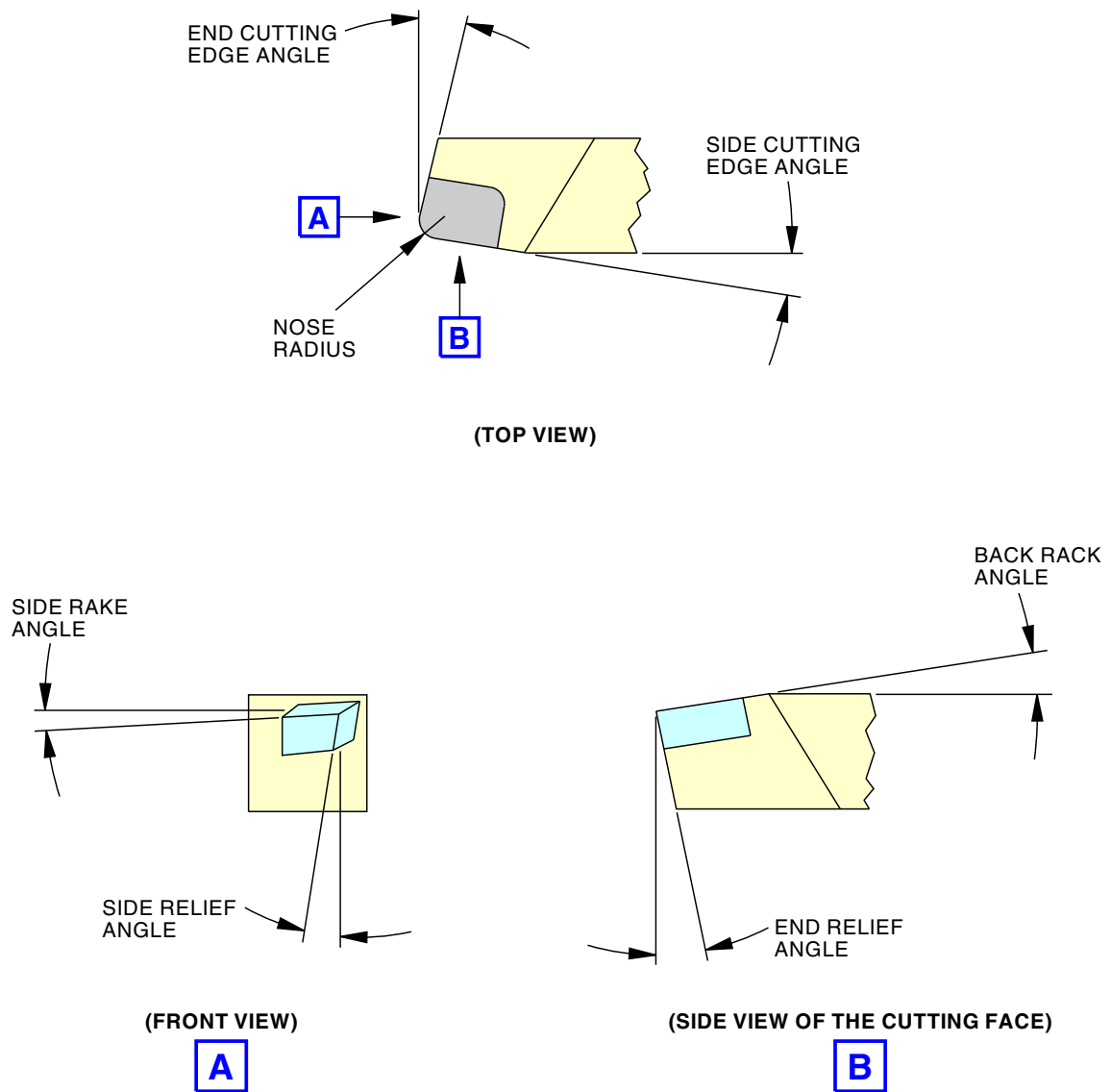
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Tool Nomenclature
Figure 201/70-10-13-990-801-F00

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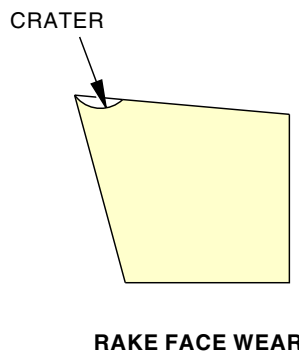
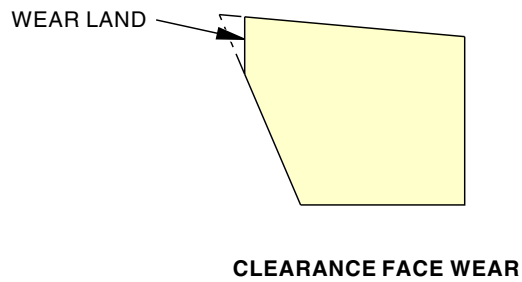
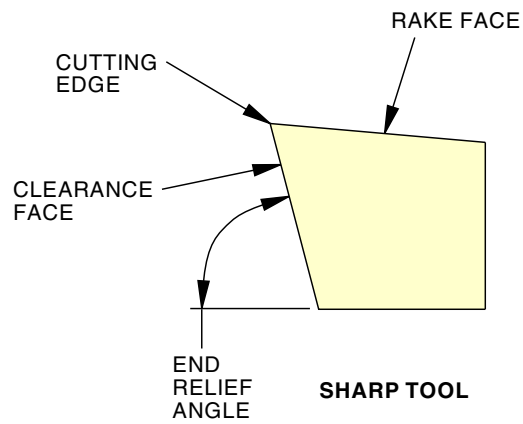
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Tool Wear
Figure 202/70-10-13-990-802-F00

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GRINDING - MAINTENANCE PRACTICES

1. General

A. This procedure has this task:

- (1) Grinding.

TASK 70-10-14-300-801-F00

2. Grinding

(Figure 201, Figure 202, Figure 203, Figure 204)

A. General

- (1) Grinding is the machining operation whereby a fine surface finish is generated by the cutting action of a very large number of small irregularly shaped abrasive particles bonded into a cutting wheel (belt grinding is not covered here). Small multipoint cutting edges cut simultaneously to produce very fine surfaces and close dimensional control while providing the capability to machine extremely hard materials.
- (2) Grinding practices used for jet engine alloys is unlike the grinding practices used for most other metals. The requirements and specifications controlling the permissible grinding conditions are very similar to those used for the preparation of laboratory fatigue and tensile specimens. Such necessary stringency results from the fact the conventional grinding practices can induce residual stresses that significantly lower the fatigue strength of highly stressed parts such as compressor and turbine blades.
- (3) The following general grinding information is to establish the background for application of the practices used in the grinding of jet engine materials:

NOTE: It is difficult to recommend a set of conditions that will accurately meet all grinding situations.

(a) Grit sizes

- 1) You should use a grit as coarse as the finish and form holding requirements of the job permit.

(b) Grade selection

- 1) As the area of contact increases, the wheel hardness grade should decrease.
- 2) For cylindrical grinding, one grade harder wheel than that required for surface grinding should be used.
- 3) For internal grinding, one grade softer wheel than that required for surface grinding should be used.

(c) G-ratio

- 1) G-ratio is the relationship of the volume of metal removed to the volume of wheel worn away.

(d) Stress conditions

- 1) Where the grinding G-ratio is more important than a low stress surface, the friability of the grit may be reduced and the wheel speeds increased.

(e) Grit sharpness is of great importance to the grinding of high temperature materials. Other than wheel dressing, a sharp grit is obtained by one of the following means:

- 1) A friable grit that will fracture under grinding pressure to expose sharp new edges.
- 2) A wheel just soft enough to break down under grinding pressure to expose new grains.

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- (f) Wheel loading must be avoided to prevent stress build-up. Frequent wheel dressing is essential.

B. Preparation

- (1) There are 2 major categories of grinding machines:

NOTE: These machines may be equipped with either vertical or horizontal spindles. The work table for either grinding machine may be either reciprocating or rotary.

- (a) Surface grinding machines
- (b) Cylindrical grinding machines.

- (2) Interpretation of grinding wheel markings is shown on Figure 201.

C. Location Zones

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

D. Grinding

SUBTASK 70-10-14-800-003-F00

- (1) To achieve minimum residual stress in parts, make sure to follow the recommended parameters for grinding specific alloys, essential facts to identify grinding wheel grade and speed, workspeed, downfeed, crossfeed and grinding coolant used (Figure 202).

SUBTASK 70-10-14-800-004-F00

- (2) There are an effect of low stress, conventional, and abusive grinding conditions and a summary of high cycle fatigue response at room temperature for a number of alloys (Figure 203, Figure 204).

NOTE: All of materials can be successfully ground and retain high levels of surface integrity providing the proper procedures are employed and adequate controls are enforced.

SUBTASK 70-10-14-800-005-F00

- (3) The results of a large number of controlled grinding tests indicate that abusive grinding practices for nickel-base alloys result when the following are used:
- (a) High grinding wheel speeds, more than 4000 sfm (1200 m/min)
 - (b) Slow work speeds, less than 15 sfm (5 m/min)
 - (c) Hard bonded grinding wheels, higher than letter J
 - (d) Heavy down feeds, more than 0.0005 in/pass (0.013 mm/pass)
 - (e) Improper grinding fluid (sulfo-chlorinated oil being desirable for nickel, cobalt, and iron-base alloys, and water-base coolant for titanium) or improper applications of the fluid during grinding.



CAUTION

BE CAREFUL WHEN YOU GRIND CHROME PLATE. DAMAGE OF THE SUBSTRATE IS NOT EASY TO FIND THROUGH THE CHROME PLATE. IF YOU DO NOT OBEY, DAMAGE TO THE SUBSTRATE CAN OCCUR.

- (f) Improper or infrequent dressing of the grinding wheel.

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SUBTASK 70-10-14-800-006-F00

- (1) A copious flow of grinding fluid at low pressure will generally provide good results for grinding operations.

NOTE: Where application of a large volume of fluid results in undue splashing, it is recommended to install splash guards on the machine than to reduce the coolant flow.

SUBTASK 70-10-14-800-007-F00

- (2) If it is necessary, special nozzles that will force the fluid through the air film and on to the wheel can be designed.

NOTE: The normal methods of applying fluids to grinding operations remove little heat until it has dissipated into the mass of the workpiece. Because of the high surface speeds involved, an entrained film of air usually encloses the grinding wheel surface, and this prevents penetration of the fluid into the cutting zone.

- (a) Place these nozzles as close as possible to the workpiece to prevent complete loss of the fluid by the centrifugal force of the wheel.

F. Inspection

SUBTASK 70-10-14-800-008-F00

- (1) Make sure that the edges of the machined part are free of burrs or rolled metal.

———— **END OF TASK** ————

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VITRIFIED EXAMPLE:												
INDIVIDUAL MANUFACTURER'S MARKINGS	STANDARD ABRASIVE TYPE DESIGNATION	GRAIN SIZES				GRADES			STRUCTURE		PROCESS	IND MFG MARKS
		CRS	MDM	F	V/F	S	MDM	F	DNS	TO OPN		
ALUMINUM OXIDE REGULAR - NONE SEMI FRIABLE 29 18 26	ALUMINUM OXIDE A	10	36	70	220	A	I	Q	1	9	V - VITRIFIED	VITRIFIED
		12	46	80	240	B	J	R	2	10	S - SILICATE	
		14	54	90	280	C	K	S	3	11	B - RESINOID	
		16	60	100	320	D	L	T	4	12	BF - RESINOID REINFORCED	
		20		120	400	E	M	U	5	13	R - RUBBER	
		24		150	500	F	N	V	6	14	RF - RUBBER REINFORCED	
SILICON CARBIDE				180	600	G	O	W	7	15	E - SHELLAC	2 3 4 5 6 4 8
REGULAR - NONE GREEN G						H	P	X	8	ETC. (USE OPTIONAL)	O - OXYCHLORIDE	
								Y				
								Z				

RESINOID EXAMPLE:												
FRIABLE NORDON CORUNDUM 31	SILICON CARBIDE C	10	36	70	220	A	I	Q	1	9	V - VITRIFIED	VITRIFIED
		12	46	80	240	B	J	R	2	10	S - SILICATE	
		14	54	90	280	C	K	S	3	11	B - RESINOID	
		16	60	100	320	D	L	T	4	12	BF - RESINOID REINFORCED	
		20		120	400	E	M	U	5	13	R - RUBBER	
		24		150	500	F	N	V	6	14	RF - RUBBER REINFORCED	
SILICON CARBIDE				180	600	G	O	W	7	15	E - SHELLAC	2 3 4 5 6 4 8
REGULAR - NONE GREEN G						H	P	X	8	ETC. (USE OPTIONAL)	O - OXYCHLORIDE	
								Y				
								Z				

NOTE:

THIS IS MERELY AN EXAMPLE AND IS NOT MEANT TO BE A RECOMMENDATION OF ANY PARTICULAR COMPANY'S PRODUCT IT IS IMPORTANT THAT COMPLETE MARKINGS ARE SHOWN IN REORDERING, INCLUDING MANUFACTURER'S MARKINGS.

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**Interpretation of Grinding Wheel Markings
Figure 201/70-10-14-990-801-F00**

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COMMERCIAL DESIGNATION	HEAT TREAT HARDNESS	OPERATION	WHEEL GRADE	WHEEL SPEED SFM (M/MIN)	WORK SPEED SFM (M/MIN)	DOWN FEED IN/PASS (MM)	CROSS FEED IN/PASS (MM)	"G" RATIO	GRIND FLUID
<u>NICKLE BASE ALLOYS</u>									
RENE'95 (NC14K8)	AGED HRC 48	ROUGH FINISH	A46J8V A46J8V	3500 (1100) 3500 (1100)	60 (18) 60 (18)	0.0010 (0.02) 0.0005 (0.01)	0.050 (1.2) 0.050 (1.2)	3.0 3.5	S & CL OIL
RENE'41 (NC19KDT)	AGED HRC 36	ROUGH FINISH	A60I6V A60I6V	4000 (1200) 4000 (1200)	60 (18) 60 (18)	0.0010 (0.02) 0.0005 (0.01)	0.050 (1.2) 0.050 (1.2)	17 17	S & CL OIL
INCONEL 718 (NC19FeNb)	AGED HRC 43	ROUGH FINISH	A46I8V A46I8V	3000 (930) 4000 (1200)	75 (23) 50 (15)	0.0010 (0.02) 0.0002 (0.01)	0.050 (1.2) 0.050 (1.2)	10 10	S & CL OIL
IN 100 MOD. (NK15 CATu)	AGED HRC 35	ROUGH FINISH	A60H6V A60H6V	3000 (930) 3000 (930)	50 (15) 50 (15)	0.0010 (0.02) 0.0002 (0.01)	1/5 WHEEL WIDTH 1/10 WHEEL WIDTH		S & CL OIL
HASTEELLOY X (NC22FeD)	ANNEAL HRC 24	ROUGH FINISH	A60I6V A60I6V	4500 (1400) 4500 (1400)	60 (18) 60 (18)	0.0020 (0.05) 0.0005 (0.01)	0.050 (1.2) 0.050 (1.2)	--- 15	S & CL OIL
RENE'80	AGED HRC 36	ROUGH FINISH	A60H6V A60H6V	3000 (930) 3000 (930)	60 (18) 60 (18)	0.0020 (0.05) 0.0002 (0.01)	0.050 (1.2) 0.050 (1.2)	2.0 3.0	S & CL OIL
RENE'125	AGED HRC 37	ROUGH FINISH	A46H6V A46H6V	3000 (930) 3000 (930)	60 (18) 60 (18)	0.0020 (0.05) 0.0002 (0.01)	0.050 (1.2) 0.050 (1.2)	1.6 3.0	S & CL OIL
RENE'77 (NK15CADT)	AGED HRC 36	ROUGH FINISH	A46J8V A46J8V	3000 (930) 3000 (930)	60 (18) 60 (18)	0.0010 (0.02) 0.0005 (0.01)	0.050 (1.2) 0.050 (1.2)	13 13	S & CL OIL
NIMONIC C263 (NCK20D)	AGED HRC 38	ROUGH FINISH	A46J8V A46J8V	3000 (930) 3000 (930)	60 (18) 60 (18)	0.0010 (0.02) 0.0005 (0.01)	0.050 (1.2) 0.050 (1.2)	13 13	S & CL OIL

(AFNOR DESIGNATION)

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Surface Grinding Test Data
Figure 202/70-10-14-990-802-F00 (Sheet 1 of 4)

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COMMERCIAL DESIGNATION	HEAT TREAT HARDNESS	OPERATION	WHEEL GRADE	WHEEL SPEED SFM (M/MIN)	WORK SPEED SFM (M/MIN)	DOWN FEED IN/PASS (MM)	CROSS FEED IN/PASS (MM)	"G" RATIO	GRIND FLUID
<u>TITANIUM BASE ALLOYS</u>									
Ti 6-4 (TA6V)	A-B HRC 38	ROUGH FINISH	C46J-V C46J-V	3000 (930) 3000 (930)	10 (3) 10 (3)	0.0010 (0.02) 0.0002 (0.01)	0.050 (1.2) 0.050 (1.2)	7.0 7.5	WATER BASE
Ti 6-2-4-2 (TA6Zr4DE)	STAB'L HRC 36	ROUGH FINISH	C46J-V C46J-V	3000 (930) 3000 (930)	10 (3) 10 (3)	0.0010 (0.02) 0.0002 (0.01)	0.050 (1.2) 0.050 (1.2)	7.0 7.5	WATER BASE
<u>IRON BASE ALLOYS</u>									
A286 (Z6NCT25)	AGED HRC 36	ROUGH FINISH	A60I6V A60I6V	4500 (1400) 4500 (1400)	50 (15) 50 (15)	0.0020 (0.05) 0.0005 (0.01)	0.050 (1.2) 0.050 (1.2)	15 15	S & CL OIL
MARAGING 250 (Z2NKD 18-8-5)	AGED HRC 52	ROUGH FINISH	A46J8V A46J8V	6000 (1800) 4000 (1200)	75 (23) 40 (12)	0.0020 (0.05) 0.0005 (0.01)	0.060 (1.5) 0.050 (1.2)	10	S & CL OIL
AISI 347 (Z10CNNb18)	ANNEAL HB 220 HRA 60	ROUGH FINISH	A46J8V A46J8V	6000 (1800) 6000 (1800)	75 (23) 75 (23)	0.0020 (0.05) 0.0005 (0.01)	0.060 (1.5) 0.040 (1.0)	40 40	S & CL OIL OR WATER BASE
17-4PH (Z5CNU17)	AGED HRC 38	ROUGH FINISH	A46H6V A46H6V	6000 (1800) 6000 (1800)	75 (23) 75 (23)	0.0020 (0.05) 0.0005 (0.01)	0.060 (1.5) 0.040 (1.0)	--- 40	S & CL OIL OR WATER BASE
INCOLOY 903 (Z3NK38)	AGED HRC 42	FINISH	A46I6V	3500 (1100)	50 (15)	0.0020 (0.01)	NONE		S & CL OIL
AISI 321 (Z10CNT18)	ANNEAL HRC 60	ROUGH FINISH	A60J6V A60J6V	6000 (1800) 6000 (1800)	50 (15) 50 (15)	0.0020 (0.05) 0.0005 (0.01)	0.060 (1.5) 0.050 (1.2)	40 40	S & CL OIL OR WATER BASE
NIMONIC C263 (NCK20D)	AGED HRC 38	ROUGH FINISH	A60J6V A60M5V	6000 (1800) 6000 (1800)	50 (15)	0.0020 (0.05)	0.060 (1.5)		S & CL OIL OR WATER BASE

(AFNOR DESIGNATION)

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COMMERCIAL DESIGNATION	HEAT TREAT HARDNESS	OPERATION	WHEEL GRADE	WHEEL SPEED SFM (M/MIN)	WORK SPEED SFM (M/MIN)	DOWN FEED IN/PASS (MM)	CROSS FEED IN/PASS (MM)	"G" RATIO	GRIND FLUID
<u>IRON BASE ALLOYS (CONT.)</u> GH4 (40CDV12)	HRC 28	ROUGH FINISH	A60M5V A60M5V	6000 (1800) 6000 (1800)					S & CL OIL OR WATER BASE
	TEMPER HRC 45	ROUGH FINISH	A60I6V A60I6V	6000 (1800) 4000 (1200)	40 (12) 40 (12)	0.0030 (0.07) 0.0005 (0.01)	0.100 (2.5) 0.045 (1.1)	225 225	S & CL OIL OR WATER BASE
	HRA 25	ROUGH FINISH	A60M5V A60M5V	6000 (1800) 6000 (1800)					S & CL OIL OR WATER BASE
<u>COBALT BASE ALLOYS</u> X40 (KC25NW) L605 (KC20WN)	AGED HRC 35	ROUGH FINISH	A60I6V A60H6V	3000 (930) 3000 (930)	50 (15) 50 (15)	0.0020 (0.05) 0.0005 (0.01)	0.070 (1.8) 0.050 (1.2)	12 20	S & CL OIL
	AGED HRC 35	ROUGH FINISH	A46G8V A46G8V	3000 (930) 3000 (930)	75 (23) 75 (23)	0.0090 (0.02) 0.0005 (0.01)	0.070 (1.8) 0.050 (1.2)	12 20	S & CL OIL
	T6 HRA 50	ROUGH FINISH	A46K8V A46K8V	6000 (1800) 6000 (1800)	75 (23) 75 (23)	0.0030 (0.07) 0.0001 (0.02)	1/3 WHEEL WIDTH		WATER BASE
<u>ALUMINUM BASE ALLOYS</u> 6061 (AGSU)									

(AFNOR DESIGNATION)

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MATERIAL	OPERATION	WHEEL GRADE	WHEEL SPEED SFM (M/MIN)	DOWN FEED IN/PASS (MM)	CROSS FEED IN/PASS (MM)	WORK SPEED SFM (M/MIN)	GRIND FLUID
<u>PLATED COATINGS</u>							
CHROME PLATE	FINISH	A6016V	3500 (1100)	0.0004 (0.01)	1/8 WHEEL WIDTH	75	WATER BASE FLOOD
<u>THERMAL SPRAYED COATINGS</u>							
TUNGSTEN CARBIDE 10% COBALT	FINISH	C46JV	3000 (930)	0.0005 (0.01)	0.050 (1.2)	100 (30)	WATER BASE FLOOD
TUNGSTEN CARBIDE 17% COBALT	FINISH	C46JV	3000 (930)	0.0005 (0.01)	0.050 (1.2)	100 (30)	WATER BASE FLOOD
COBALT, CHROME, NICKEL, TUNGSTEN	FINISH	A46J8V	3000 (930)	0.001 (0.02)	0.030 (0.8)	50 (15)	WATER BASE
NICKEL, 18% ALUMINUM	FINISH	A46J8V	3000 (930)	0.001 (0.02)	0.030 (0.8)	50 (15)	WATER BASE
NICKEL, CHROME 5% ALUMINUM	FINISH	A46J8V	3000 (930)	0.001 (0.02)	0.030 (0.8)	50 (15)	WATER BASE
NICKEL, 5% ALUMINUM	FINISH	A46J8V	3000 (930)	0.001 (0.02)	0.030 (0.8)	50 (15)	WATER BASE
AL ₂ O ₃	FINISH	A46J8V	3000 (930)	0.001 (0.02)	0.030 (0.8)	50 (15)	WATER BASE

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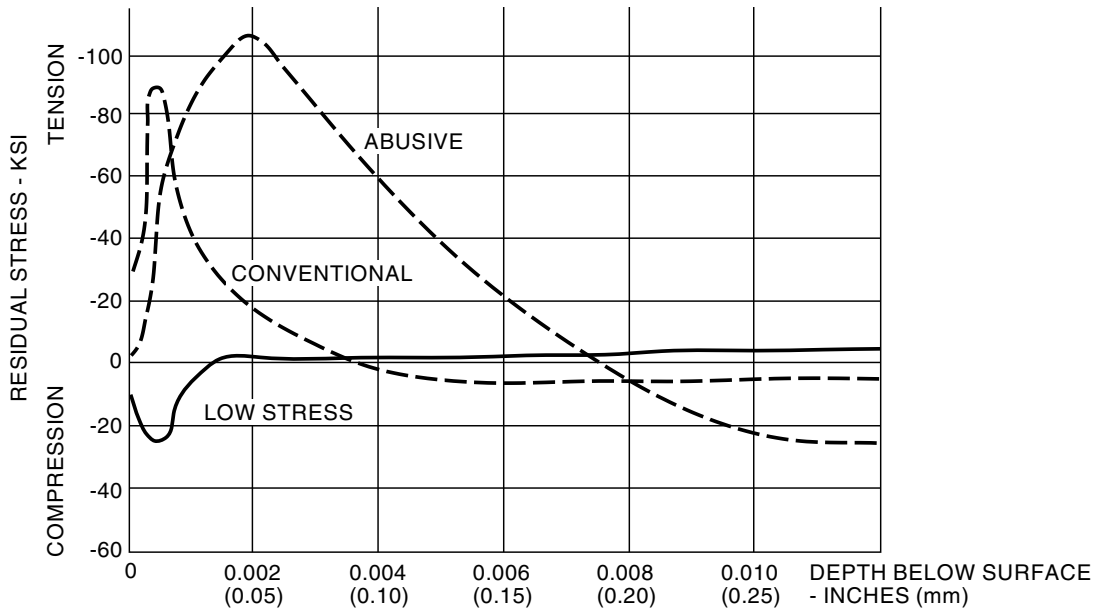
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GRINDING CONDITIONS

WHEEL	GENTLE	CONVEN.	ABUSIVE
WHEEL	A46HV	A46KV	A46MV
WHEEL SPEED	2000	6000	6000
FT (M)/MIN	(609.6)	(1808.8)	(1808.8)
DOWN FEED	0.0002	0.001	0.002
IN(mm)/PASS	(0.01)	(0.025)	(0.05)
GRINDING	SULF.	SOL.	DRY
FLUID	OIL	OIL (1:20)	

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**Grinding Conditions
Figure 203/70-10-14-990-803-F00**

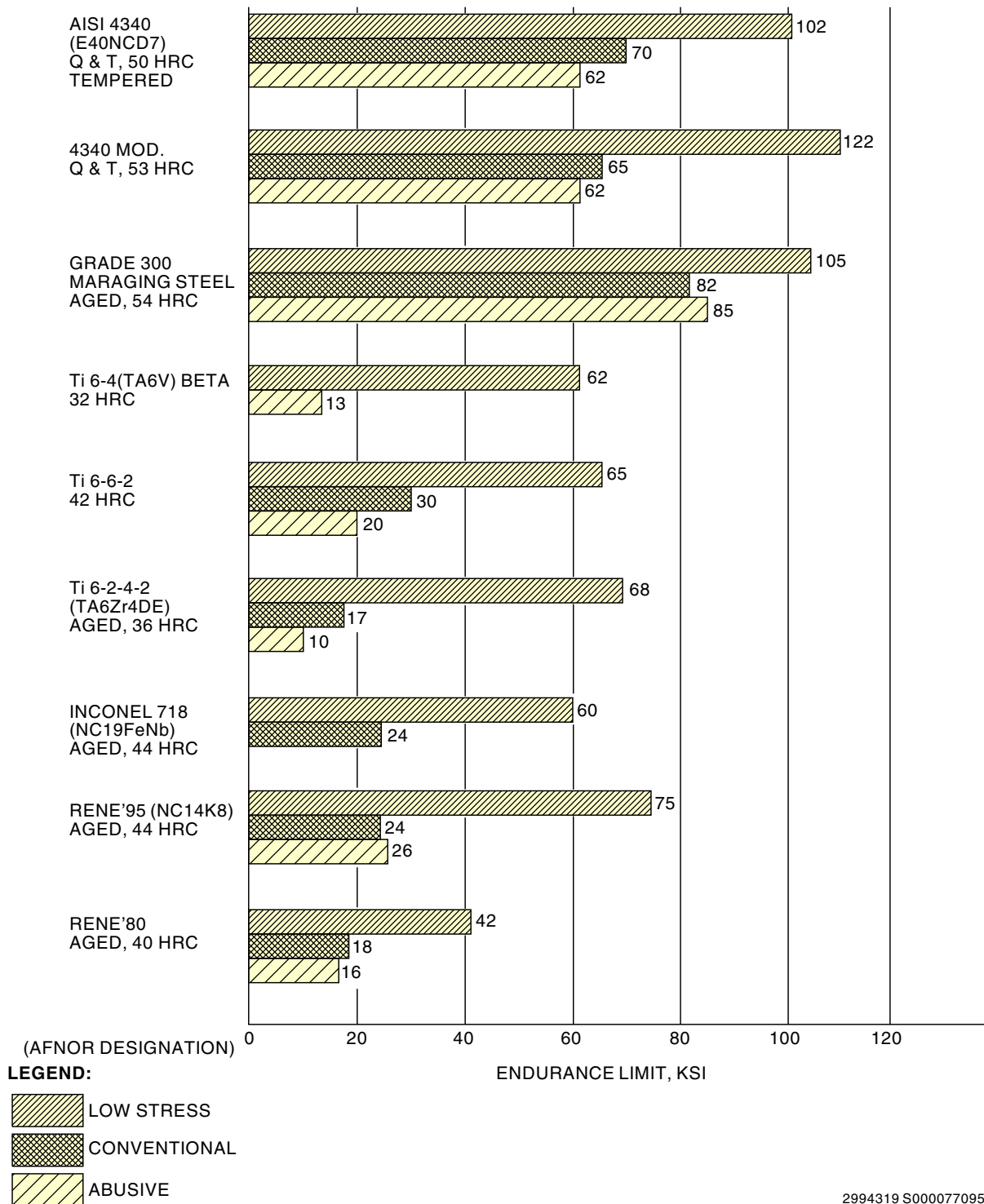
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Summary of High Cycle Fatigue Response to Surface Grinding
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POLYSULFIDE ELASTOMER SEALANT APPLICATION - REPAIRS

1. General

A. This procedure has this task:

- (1) A polysulfide elastomer sealant application (bond).

TASK 70-10-15-300-801-F00

2. Polysulfide Elastomer Sealant Application (Bond)

A. General

- (1) This task gives the instructions for the application of the elastomer sealant that consists of a base and catalyst.
- (2) The elastomer sealant is applied in the form of beads to seal tanks, structures, etc.
- (3) The elastomer sealant can withstand temperatures -67°F (-55°C) - 350°F (177°C) and is unaffected by jet fuels, oils, and hydraulic fluids.
- (4) The following equipment is required for the elastomer sealant:
 - (a) A dry, dust-free, well ventilated room, temperature regulated at 68°F (20°C) used solely for applying assembly products or coatings.
 - (b) Gun type applicator equipped with a 0.12 in. (3 mm) - 0.23 in. (6 mm) diameter nozzle.
 - (c) Spatula.
 - (d) Sharp cutting edge.
 - (e) Vacuum degassing facility.
 - (f) Scale.
 - (g) Mechanical device for adjoining or squeezing parts.
 - (h) Oven for curing the sealing product.
 - 1) It must be equipped with a controllable electric heater capable of heating the parts at 130°F (54°C) and temperature adjustment from 0 to 100 percent.

NOTE: Temperature accuracy: plus or minus 25 °F (14 °C).

B. Consumable Materials

Reference	Description	Specification
A50490 [CP2243]	Sealant - Elastomer - PR 1750 Class B2	
G51760 [CP2673]	Release Agent - Sansil Lubritene PA Mold Release Agent, Non-CFC	

C. Location Zones

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

D. Prepare for the Repair

SUBTASK 70-10-15-910-001-F00

- (1) Prepare sealant, A50490 [CP2243], as follows:
 - (a) Allow temperature of product to stabilize at ambient.
 - (b) Prepare mixture immediately before use as follows:
 - 1) Base: 10 parts by weight

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- 2) Catalyst: 1 part by weight.
- (c) When mixture is prepared, degas it in the vacuum facility at pressure of 0.78 in/Hg (2.64 kPa) - 0.118 in/Hg (0.40 kPa) (0.79 in. (20 mm) - 1.18 in. (30 mm)) for a few minutes.
 - 1) If vacuum degas is not available, remove air bubbles and voids from the sealant mixture.

E. Polysulfide Elastomer Sealant Application (Bond)

SUBTASK 70-10-15-020-001-F00

- (1) Remove sealant from vacuum facility.
 - (a) Use a gun type applicator fitted with the correct diameter nozzle to apply a bead of sealant, A50490 [CP2243], onto the surface to be sealed.

SUBTASK 70-10-15-390-001-F00

- (2) Use a spatula to dress the bead.

NOTE: The useful life of catalyzed mixture spans 2 hours approximately, but is reduced when relative humidity is above 50% or temperature is above 76°F (24°C).

 - (a) Apply sealant, A50490 [CP2243], onto one face only to permit disassembly.
 - (b) Before assembly, apply Sansil Lubritene PA release agent, G51760 [CP2673], on the other surface.

SUBTASK 70-10-15-910-002-F00

- (3) Use an appropriate mechanical device to keep parts adjoined.

SUBTASK 70-10-15-390-002-F00

- (4) Allow sealant, A50490 [CP2243], to polymerize as follows:
 - (a) 30 hours to 48 hours at temperature comprised between 68°F (20°C) - 76°F (24°C).
 - (b) Nominal relative humidity: 50 percent.

NOTE: Polymerization is slowed when the relative humidity factor is low. It may be accelerated by heating in oven at 130°F (54°C) for 2 hours following a temperature hold at 68°F (20°C) - 76°F (24°C) for 4 hours.

NOTE: A high rate of polymerization is obtained within 14 days at temperature comprised between 68°F (20°C) - 76°F (24°C).
 - (c) Make sure that the parts are adjoined throughout the curing time.

F. Inspection

SUBTASK 70-10-15-210-001-F00

- (1) Make sure that the seal bead is uniform in color.

SUBTASK 70-10-15-210-002-F00

- (2) Make sure that the parts are free from defects such as bubbles, blisters, discontinuities, etc.

SUBTASK 70-10-15-210-003-F00

- (3) Make sure that the seal joint is elastic, and no longer sticky when touched.

————— **END OF TASK** —————

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MASKING WITH WAX - REPAIRS

1. General

A. This procedure has this task:

- (1) Masking with Wax (Surfaces Protection).

TASK 70-10-16-330-801-F00

2. Masking with Wax (Surfaces Protection)

A. General

- (1) Masking with wax is used for parts with a zone or portion of that is to be processed by electrolytic surface treatment.

NOTE: The use of wax masking is limited to solutions that are below 135°F (57°C).

- (2) The following equipment is required for the application of this task:
 - (a) Efficient ventilation system for extracting and neutralizing vapors.
 - (b) The masking station should consist of a stainless steel tank, heated by an oil bath.
 - (c) A water rinse tank made from stainless steel.
 - (d) An oven to heat parts to 210°F (99°C).

B. Consumable Materials

Reference	Description	Specification
C50446 [CP2159]	Coating - Bonderite S-MA 522 Aero (Turcoform Mask 522)	
G50143 [CP2208]	Tape - Glass Cloth with Silicone Adhesive, High Temperature, Abrasive Resistant - 3M 361	
G51738 [CP2158]	Tape - Masking, Cloth Adhesive - tesa 4651	
G51756 [CP1046]	Powder - Calcium Carbonate	
G51757 [CP2078]	Abrasive - Pumice, Powder	
G51758 [S1117]	Solution - Calcium Carbonate	
G51759 [S1115]	Solution - Wax, Chemical	

C. Masking with Wax (Surfaces Protection)

SUBTASK 70-10-16-100-001-F00



USE SOLVENTS THAT DO NOT HAVE HALOGEN ON TITANIUM OR TITANIUM ALLOY PARTS. SOLVENTS THAT CONTAIN HALOGEN CAN CAUSE DAMAGE TO TITANIUM OR TITANIUM ALLOY PARTS.

- (1) Clean the part immediately before masking.

SUBTASK 70-10-16-390-001-F00

- (2) Delimit the zone to be wax masked using one of the following:
 - (a) 3M 361 tape, G50143 [CP2208]
 - (b) tesa 4651 tape, G51738 [CP2158]
 - (c) Bonderite S-MA 522 Aero coating, C50446 [CP2159]
 - (d) wax solution, G51759 [S1115].

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AIRCRAFT MAINTENANCE MANUAL****SUBTASK 70-10-16-390-002-F00**

- (3) Use a brush to apply a light coat of calcium carbonate solution, G51758 [S1117], on the area to be processed by electrolytic surface treatment.

NOTE: The calcium carbonate solution, G51758 [S1117], intended to carefully remove the wax when applied against the edge of the adhesive tape.

SUBTASK 70-10-16-390-007-F00

- (4) Make sure that the large parts are preheated to a temperature close to that of wax solution, G51759 [S1115].

SUBTASK 70-10-16-390-003-F00

- (5) Put fully the part in molten wax solution, G51759 [S1115], until the temperature has stabilized.
(a) Make sure that the wax flows freely over the part.

SUBTASK 70-10-16-020-001-F00

- (6) Remove the part from the solution and let the wax solidify.
(a) If it is required, repeat the dipping cycle until a sufficiently thick film of wax is obtained.
1) Put fully the part in molten wax solution, G51759 [S1115], until the temperature has stabilized.
a) Make sure that the wax flows freely over the part.
(b) Make sure that sharp edges are covered with wax.

SUBTASK 70-10-16-390-004-F00

- (7) Use the sharp blade to cut between the two adhesive tapes to strip the wax from the area to be electrolytically processed before the wax has completely cooled.

SUBTASK 70-10-16-100-002-F00

- (8) Use a clean, lint-free cloth to clean the exposed area.
(a) To touchup of the masking, apply wax with a brush.
(b) In the case of a delicate touchup operation, use Bonderite S-MA 522 Aero coating, C50446 [CP2159], as alternative.

SUBTASK 70-10-16-390-005-F00

- (9) Rub the part with calcium carbonate, G51756 [CP1046], or pumice powder, G51757 [CP2078].

SUBTASK 70-10-16-390-006-F00

- (10) To flush the part, put fully the part in water.

SUBTASK 70-10-16-160-001-F00

- (11) Dry the part with clean, dry air.

D. Inspection**SUBTASK 70-10-16-210-001-F00**

- (1) Make sure that the waxed zone is free from blow holes, voids.

SUBTASK 70-10-16-210-002-F00

- (2) Make sure that the area to be processed is clean and free of grease.

SUBTASK 70-10-16-210-003-F00

- (3) Make sure that the edge of the wax is not extended into the area to be processed more than the limit determined by the adhesive tape.

———— **END OF TASK** ————

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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL****LOCKING PROCEDURES - MAINTENANCE PRACTICES****1. General**

- A. This procedure gives the usual task to install this lock device:
 - (1) The installation of the self-locking, hexagonal and castellated nut
- B. This procedure gives the tasks to lock parts with the use of these devices:
 - (1) Cotter Pins
 - (2) Tab Washers
 - (3) Lockwire
 - (4) Safety Cable.
- C. The lock devices are safety devices to keep the fasteners and other parts engaged.
- D. The lock devices prevent all opposite forces that can cause the fasteners to disengage.
- E. Do not use the lock devices to apply or keep a torque.
- F. The lock devices are related to safety and you must install them with the best shop procedures.

TASK 70-20-01-800-801-F00**2. Self-locking, Hexagonal and Castellated Nut Installation**

(Figure 201)

A. Procedure

SUBTASK 70-20-01-910-001-F00

- (1) You must examine the new or used nuts and compare them with the assembly specifications.
 - (a) You must discard the nuts that do not agree with the specification.
 - (b) Make sure the threads of a stud or bolt shank come out of the nuts with a minimum of one thread (unless otherwise specified).
 - (c) Use a torque wrench to apply the correct torque values.

———— **END OF TASK** ————

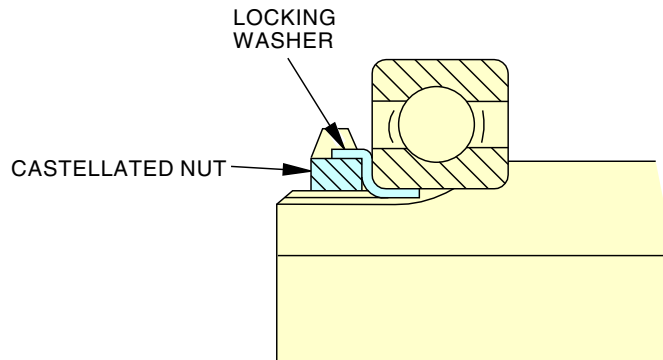
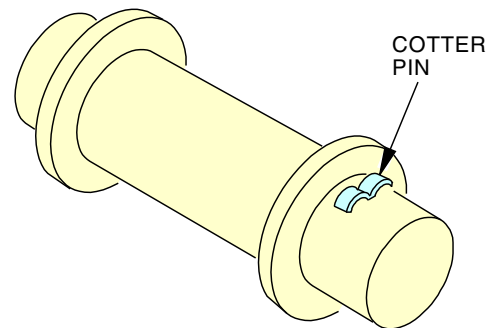
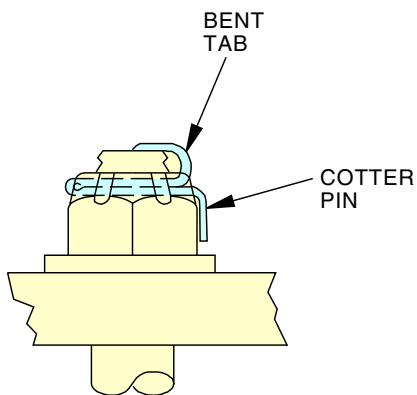
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CASTELLATED NUT INSTALLATION

COTTER PIN INSTALLATION

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**Nut and Cotter Pin Installation
Figure 201/70-20-01-990-801-F00**

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TASK 70-20-01-800-802-F00**3. Cotter Pin Installation**

(Figure 201)

A. Procedure

SUBTASK 70-20-01-910-002-F00



DO NOT USE THE SAME COTTER PINS AGAIN. USE NEW COTTER PINS FOR EACH ASSEMBLY OPERATION. WHEN YOU TIGHTEN THE FASTENERS, DO NOT USE MORE THAN THE MAXIMUM TORQUE VALUE. DAMAGE TO THE EQUIPMENT COULD OCCUR.

- (1) After you apply the minimum torque to a castellated nut, do these steps:
 - (a) Tighten the castellated nut until the one slot on the nut is aligned with the hole for the cotter pin.
 - (b) If you cannot align the nut and the hole, then loosen the nut by one-half turn.
 - 1) Tighten the castellated nut again.
 - (c) If you cannot correctly align the castellated nut again, then replace the nut.
 - (d) Install the cotter pin with the head engaged tightly in the slot of the nut.
 - (e) Bend the points of the cotter pin until the head and the top point are tightly engaged against the bolt.

————— **END OF TASK** —————

TASK 70-20-01-800-803-F00**4. Tab Washer Installation**

(Figure 202)

A. Procedure

SUBTASK 70-20-01-910-003-F00



DO NOT USE THE TAB WASHERS AGAIN. USE NEW TAB WASHERS FOR EACH ASSEMBLY OPERATION. DAMAGE TO THE EQUIPMENT CAN OCCUR.

- (1) Install the tab washer in the correct position.
 - (a) Install the lock tab so it cannot get loose.
 - (b) Bend the lock tab tightly against the flat side of the nut.
 - 1) Make sure that the lock tab is correctly bent.

————— **END OF TASK** —————

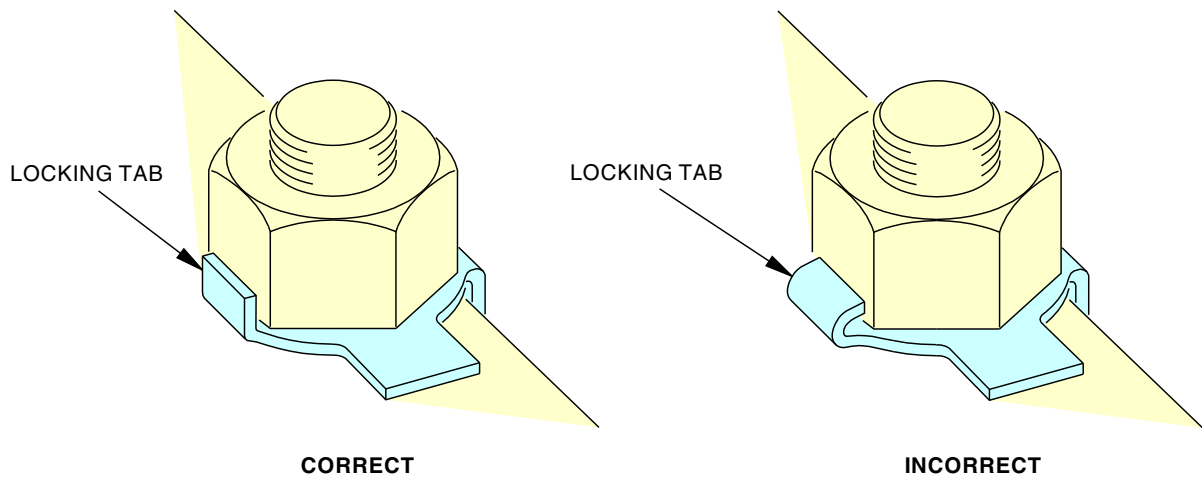
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Tab Washer Installation
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TASK 70-20-01-800-804-F00**5. Lockwire Installation**

(Figure 203)

A. Procedure**SUBTASK 70-20-01-400-001-F00**

- (1) The lockwire is a safety device to make sure two or more parts stay together.
- (a) If the part starts to become loose, then the lockwire would tighten more to oppose the part in the opposite direction.
 - (b) When you install a lockwire, use the general instructions and the specified procedures that follow.

SUBTASK 70-20-01-400-002-F00

- (2) General Instructions for installing Lockwire.
- (a) Unless specified differently, the lockwire must be a NC15Fe wire with a 0.032 inch (0.81 mm) diameter.
 - (b) Twist together the two strands with the double-twist procedure to install the lockwire.
 - 1) You get one twist when you turn the wires through an arc of 180 degrees and is equal to one-half turn.
 - 2) You can use the single-strand procedure only when it is specified.

NOTE: This is illustrated in (View C) (Figure 203).
 - (c) Do not install the lockwire to cause the wire to wear, fatigue through vibration or become tighter.

NOTE: Use the lockwire to keep the parts engaged.
 - (d) You must install the lockwire only through the holes given.
 - 1) When you do not have a hole, attach the wire to a part adjacent to the wire.

NOTE: Make sure the lockwire does not hit other parts as illustrated in (Views F and G) (Figure 203).
 - (e) The maximum length of the lockwire between tension points is 6 inches (152 mm), unless specified differently.
 - 1) The double twist or single strand method is acceptable if 3 or more fasteners make a group that must be lockwired together.

NOTE: The double twist method is the preferred method unless specified differently in the instructions.

 - 2) A limit in the number of units you can connect with a 24-inch (610 mm) length of wire is the maximum number of units in a sequence.
 - 3) Use the double twist method to lockwire items that are far apart.
- NOTE: Do not install the lockwire to more than three units in a sequence as illustrated in (Views H and I) (Figure 203).



DO NOT TURN THE LOCKWIRE MORE THAN 15 TIMES FOR EACH INCH (25.4 MM). IF YOU DO NOT OBEY, DAMAGE TO THE EQUIPMENT CAN OCCUR.

- (f) Pull the lockwire tight while you twist it.
- 1) The lockwire must have a specific number of twists for the diameter of the wire:

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- a) 9 to 12 twists for each inch (25.4 mm) for 0.020 inch (0.51 mm) diameter wire
- b) 7 to 10 twists for each inch (25.4 mm) for 0.032 inch (0.81 mm) diameter wire.
- (g) Lockwire the hose and the electrical coupling nuts the same as the tube coupling nuts.
NOTE: This is illustrated in (Views F, G, J, K, L and M) (Figure 203).
- (h) Be careful when you twist the wire.
 - 1) Keep the lockwire tight.
- NOTE: Do not overstress the wire or permit it to have nicks, kinks or damage.
- (i) Correct and incorrect procedures for lockwire practices are shown (Figure 203).
- (j) Use the twist tools that are recommended and locally available to install the lockwire (Figure 204).

SUBTASK 70-20-01-910-006-F00

- (3) Procedures to Lockwire (Figure 205).

**CAUTION**

DO NOT USE THE SAME LOCKWIRE AGAIN. USE NEW LOCKWIRE FOR EACH ASSEMBLY OPERATION. DAMAGE TO THE EQUIPMENT CAN OCCUR.

- (a) Examine the lockwire holes to the parts to make sure the holes are aligned correctly.
 - 1) If a part is tightened to the correct torque value, but is not correctly aligned, replace it with a different part.
- NOTE: Install lockwire in holes that are correctly aligned so that the lockwire will not let the part become loose. Do not tighten the part beyond the torque limits to make sure the holes are aligned.
- (b) Put the lockwire through the first part, and bend the top end of the wire along the head of the part or around it.
 - 1) If bent around it, the direction and twist of the strands must come around the part and below the strands that point out of the hole.
 - 2) If you do this, the loop will stay down and will not move up and become a loose.
- NOTE: This is illustrated in (Steps 1 and 2) (Figure 205).
- (c) Twist the strands while they are tight until the twisted part is near a hole in the subsequent part.
 - 1) The end of the twisted wire must be equal to or less than 0.125 inch (3.18 mm) away from the hole in the other part.
- NOTE: This is illustrated in (Steps 3 and 4) (Figure 205).
- (d) If you bend the free strand around the head of the second part, put the top strand through the hole in this part.
 - 1) Put the lockwire through the first part, and bend the top end of the wire along the head of the part or around it.
 - a) If bent around it, the direction and twist of the strands must come around the part and below the strands that point out of the hole.
 - b) If you do this, the loop will stay down and will not move up and become a loose.
 - 2) If you bend the free strand on the unit, the direction of the twist is not important.

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- 3) If there are more than two units in the sequence, do these steps again.

NOTE: This is illustrated in (Steps 5 and 6) (Figure 205).

- (e) Do these steps after you connect the last part:

- 1) Continue to turn the wires to make a pigtail which has 3 to 6 twists and is 0.250-0.50 inch (6.4-12.7 mm) in length.
- 2) Cut off the unwanted wire.
- 3) Bend the end of the lockwire into the part to prevent damage.

NOTE: The lockwire installations will usually agree with the examples on the illustration; however, not all possible combinations of lockwire are illustrated.

- (f) Make sure that the lockwire is correctly installed:

NOTE: These steps will make sure that the lockwire is tight.

- 1) Apply light, finger-pressure to the middle position of the lockwire span.
 - a) Push the lockwire in the two directions.
- 2) Measure the maximum flex of the lockwire at the midpoint and compare the measurement to the limits in (Table 201).

Table 201/70-20-01-993-808-F00

LENGTH OF THE LOCKWIRE (BETWEEN THE PARTS)	MAXIMUM FLEX PERMITTED (AT THE CENTER)
0.5 inch (12.7 mm)	0.125 inch (3.2 mm)
1.0 inch (25.4)	0.250 inch (6.4 mm)
2.0 inches (50.8 mm)	0.375 inch (9.5 mm)
3.0 inches (76.2 mm)	0.500 inch (12.7 mm)
4.0 inches (101.6 mm)	0.750 inch (19.1 mm)
5.0 inches (127.0 mm)	0.750 inch (19.1 mm)
6.0 inches (152.4 mm)	0.750 inch (19.1 mm)

- 3) If the lockwire does not agree with these limits, do these steps:

- a) Remove the lockwire.
- b) Install a new lockwire.

- (g) Always cut, rather than break, the lockwire so the lockwire holes are not torn or damaged.

———— **END OF TASK** ————

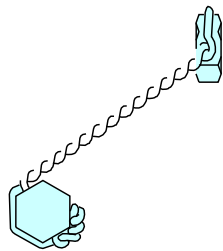
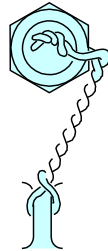
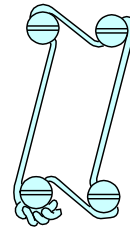
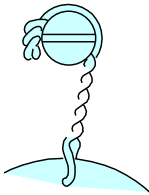
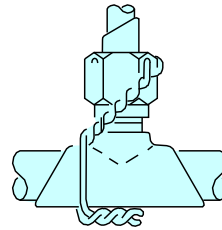
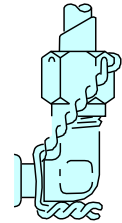
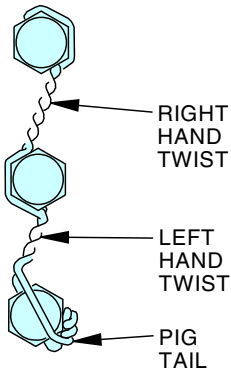
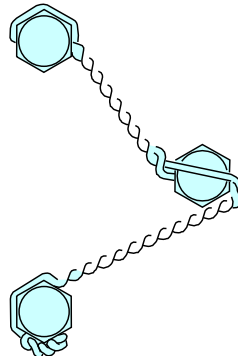
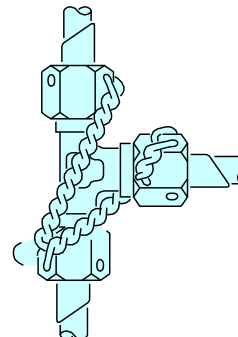
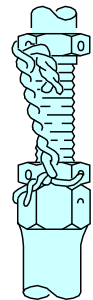
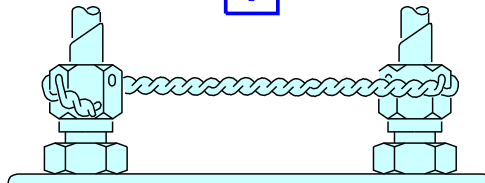
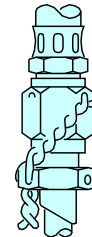
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**A****B****C****D****E****F****G****H**RIGHT
HAND
TWISTLEFT
HAND
TWISTPIG
TAIL**I****J****K****L****M**

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Lockwire Installation Examples
Figure 203/70-20-01-990-803-F00 (Sheet 1 of 2)

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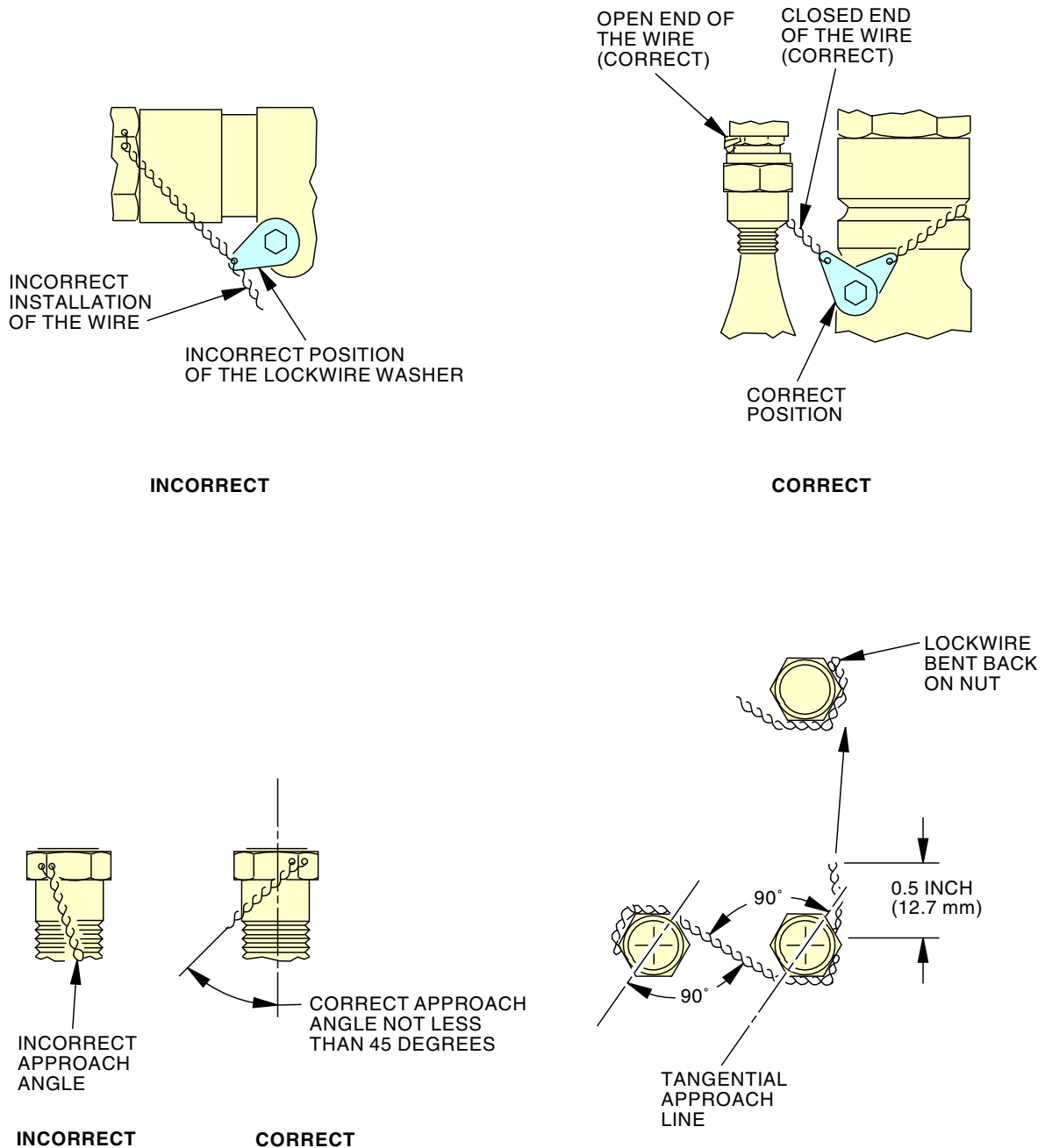
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**Lockwire Installation Examples
Figure 203/70-20-01-990-803-F00 (Sheet 2 of 2)**

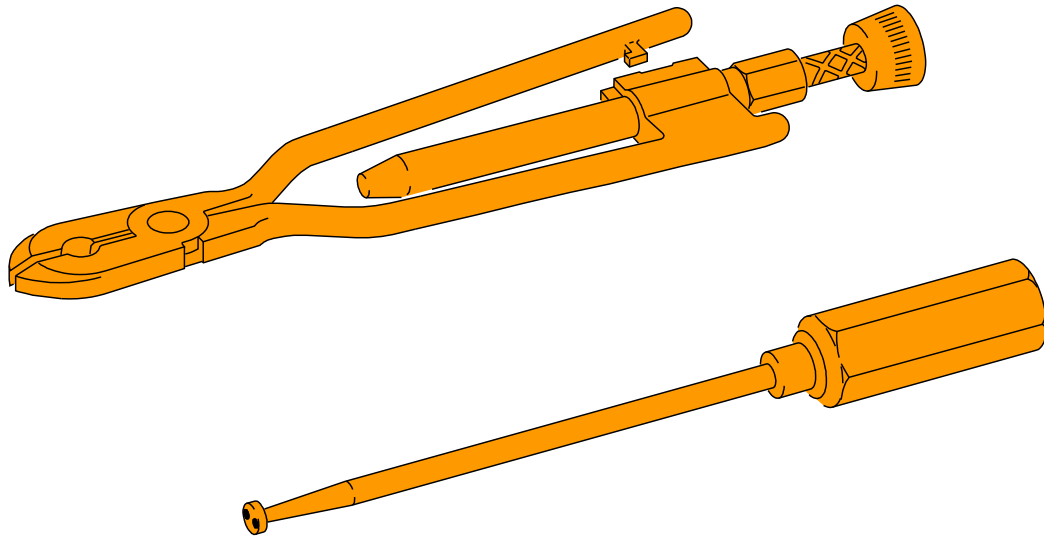
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Lockwire Twisting Tools (Example)
Figure 204/70-20-01-990-804-F00

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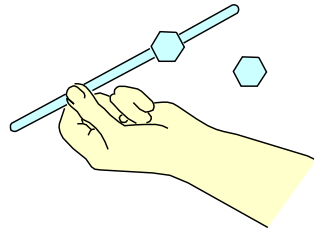
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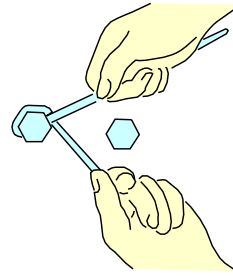
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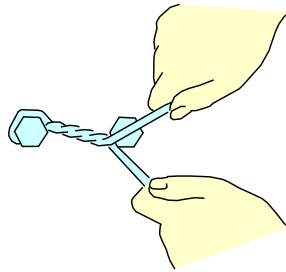
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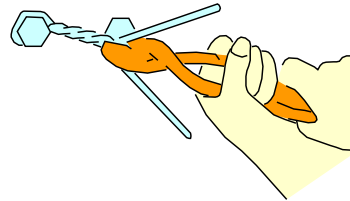
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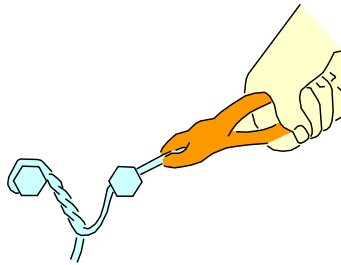
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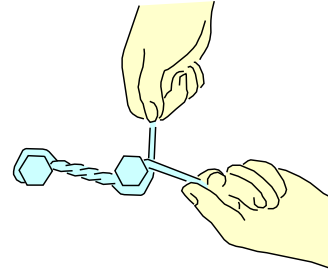
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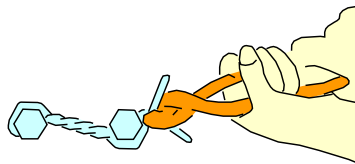
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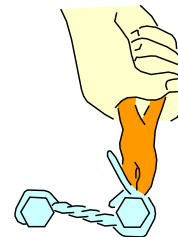
STEP 5



STEP 6



STEP 7



STEP 8

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Lockwire Installation Techniques
Figure 205/70-20-01-990-805-F00

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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL****TASK 70-20-01-800-805-F00****6. Safety Cable Installation**

(Figure 206)

A. Procedure

SUBTASK 70-20-01-400-003-F00

**DO NOT USE THE SAFETY CABLE AGAIN. ALWAYS USE NEW SAFETY CABLE.**

- (1) Examine the safety-wire holes of the parts to be safe tied for correct alignment.
 - (a) If the component is tightened to the correct torque and is not correctly aligned, replace the component.

SUBTASK 70-20-01-910-008-F00

- (2) Obey these limits, unless specified differently in the engine manual:
 - (a) The maximum length of the safety cable between cabled parts is 6.0 inches (152.4 mm).
 - (b) Do not safety more than three bolts with one safety cable.
 - (c) Do not use safety cable on titanium fasteners.

SUBTASK 70-20-01-910-009-F00

- (3) Do the steps that follow to install the safety cable (Figure 206):

NOTE: Correct alignment means that the safety cable holes are aligned so that the installed safety cable will prevent disengagement of the part. Do not exceed torque limits of any part in an attempt to align the holes.

- (a) Put the cable through parts to be safe tied (step 1).
- (b) Put the ferrule on the cable (step 2 and step 3).
- (c) Tighten the cable by putting the head of the tool in contact with the last bolt head to be wired (step 4).
- (d) Activate the tool to tighten the assembly to the correct tension and automatically crimp the ferrule at the same time (step 5).
- (e) Cut off the excess wire.
 - 1) The overlap must not exceed 0.06 inch (1.6 mm)
- (f) No notches or no frays are permitted.

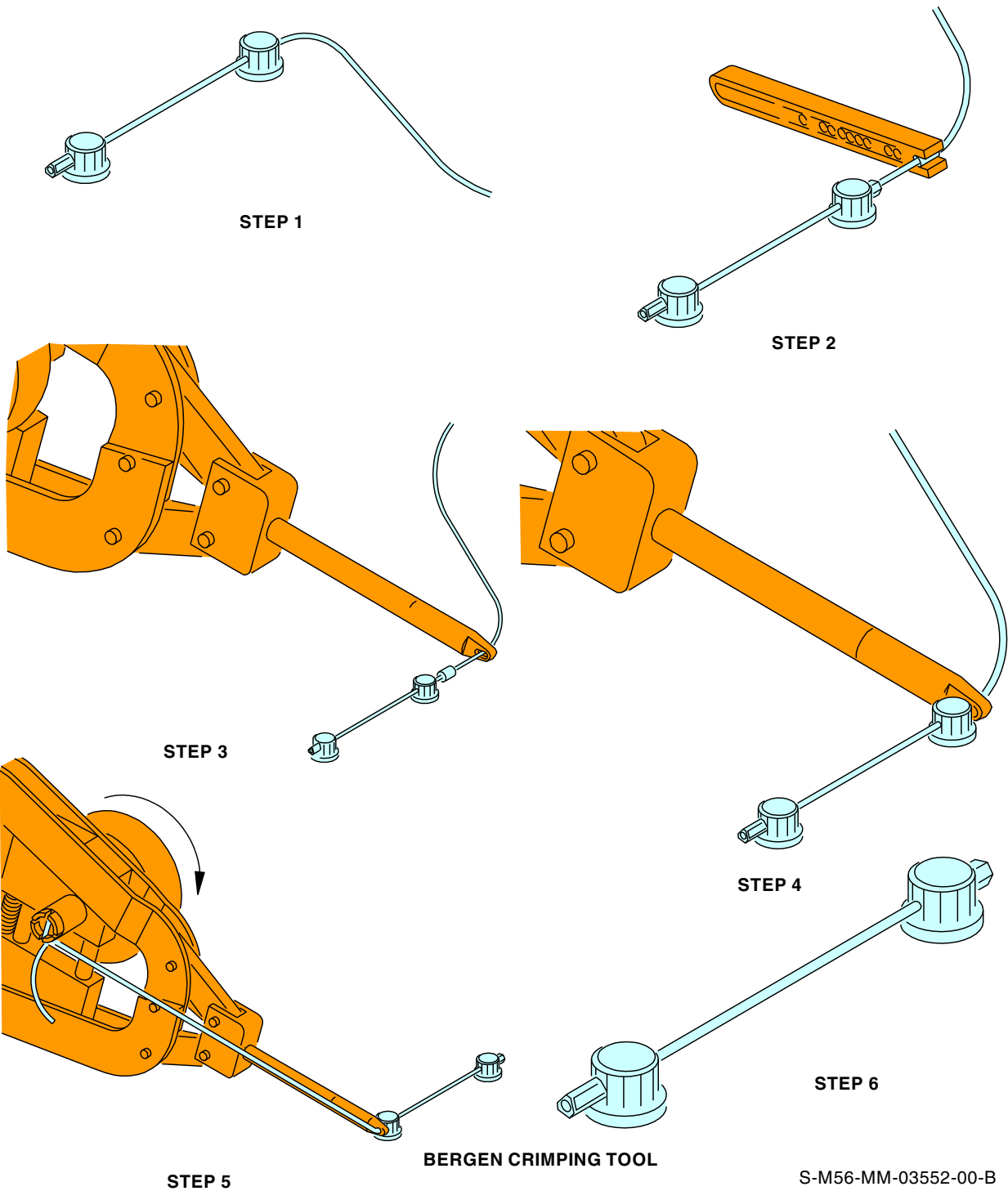
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Safety Cable Installation
Figure 206/70-20-01-990-806-F00 (Sheet 1 of 2)

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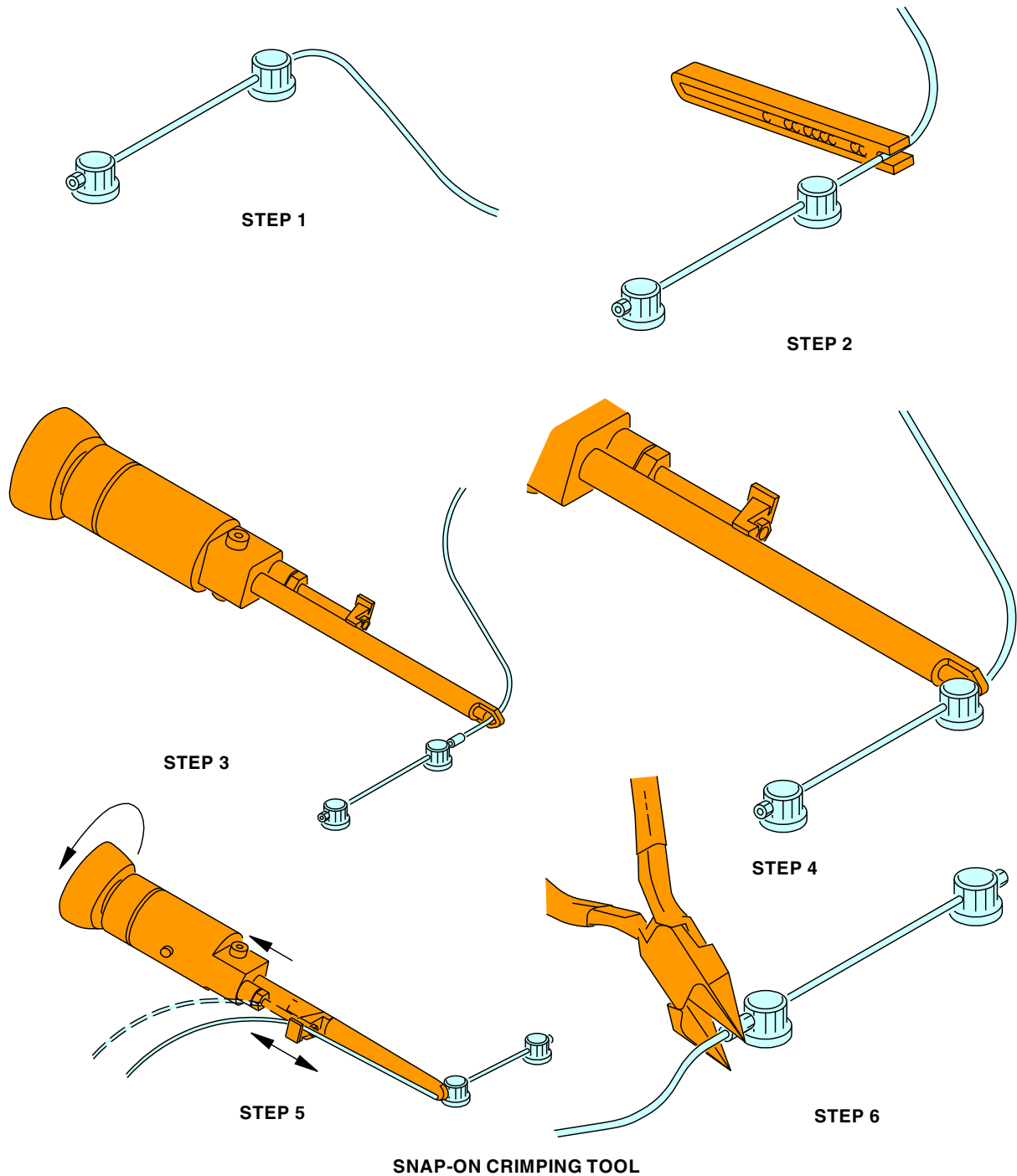
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Safety Cable Installation
Figure 206/70-20-01-990-806-F00 (Sheet 2 of 2)

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TASK 70-20-01-710-801-F00**7. Crimping Tool Verification**

(Figure 207)

A. Procedure**SUBTASK 70-20-01-400-004-F00**

- (1) Do a pull off load test often, to make sure that the crimping tool meets the necessary requirements.

NOTE: It recommended you do three pull off load tests after you install the component.

SUBTASK 70-20-01-910-010-F00

- (2) Do the pull off load test as follows (Figure 207):

- (a) If it is necessary, set up the test block.

NOTE: Refer to manufacturer's instructions for set up information.

- (b) Make sure the pivot joint is in the forward direction.

- (c) Install the safety cable in the test block:

- 1) Move the cable stop at the end of the test block.
- 2) Install the safety cable through the hole that was covered by the cable stop.
- 3) Pull the safety cable through the hole in the safety block and then put it through the hole in the pivot joint.
- 4) Pull the cable through the hole in the pivot joint.

- (d) Use the crimping tool to install the safety cable in the test block.

- (e) Use light finger pressure at the center of the safety cable to push the center of the safety cable toward the wall on the test block.

- 1) Make sure that the safety cable does not touch the wall.

- (f) Do these steps if the safety cable touches the wall.

- 1) The safety cable is not serviceable, remove it from the test block.
- 2) Install a new safety cable and start the pull off load test again.
- 3) If the cable touches the wall again, the crimping tool is not serviceable.
 - a) Remove the crimping tool from service.

- (g) Move the torque wrench handle counter-clockwise until the torque wrench clicks or the ferrule moves.

- 1) If the ferrule moves before you hear the torque wrench click, the crimping tool is not serviceable.

- a) Remove the crimping tool from service.

- (h) Use light finger pressure and push the center of the safety cable toward the wall on the test block.

- 1) If the safety cable does not touch the wall, the crimping tool is serviceable.

- 2) Do these steps if the safety cable touches the wall:

- a) Cut and remove the safety cable from the test block.
- b) Do the pull off load test again with a new cable.
- c) If the new safety cable is not in the limits, remove the crimping tool from service.

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SUBTASK 70-20-01-910-011-F00

- (3) Do these steps to find the exact amount of pressure which is necessary to cause the crimped ferrule or safety cable to fail:

NOTE: CFMI recommends that you do this test at least once a month for each of your crimping tools.

- (a) If it is necessary, set up the safety cable tester.
(b) Use the instruction from the manufacturer of the safety cable tester to do this test.

NOTE: This test can also be used as an alternative to the test block procedure.

———— **END OF TASK** ————

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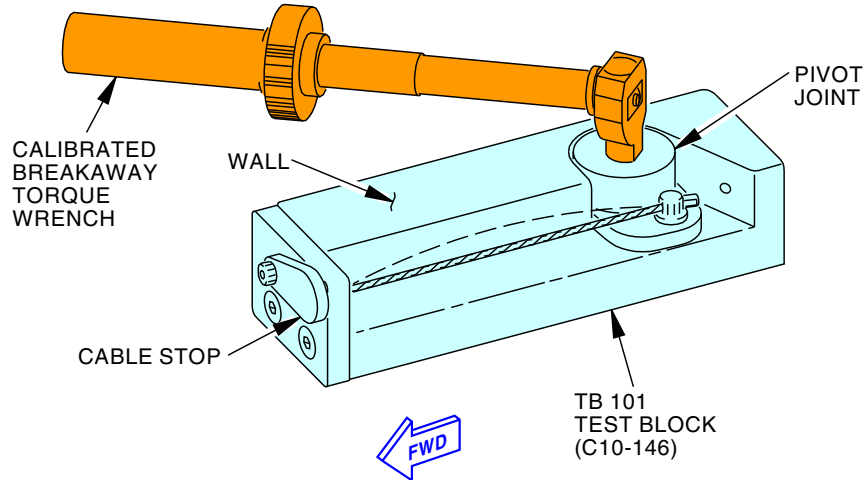
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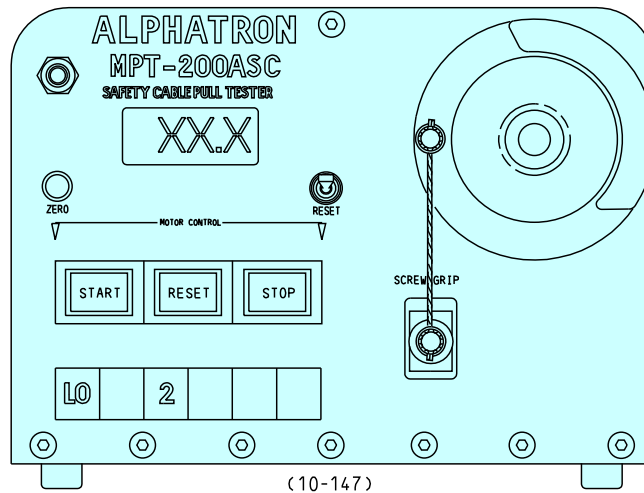
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**NOTE:**

WHEN CRIMPED, WIRE CAN NOT TOUCH WALL WITH LIGHT FINGER PRESSURE.



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Safety Cable Verification
Figure 207/70-20-01-990-807-F00 (Sheet 1 of 2)

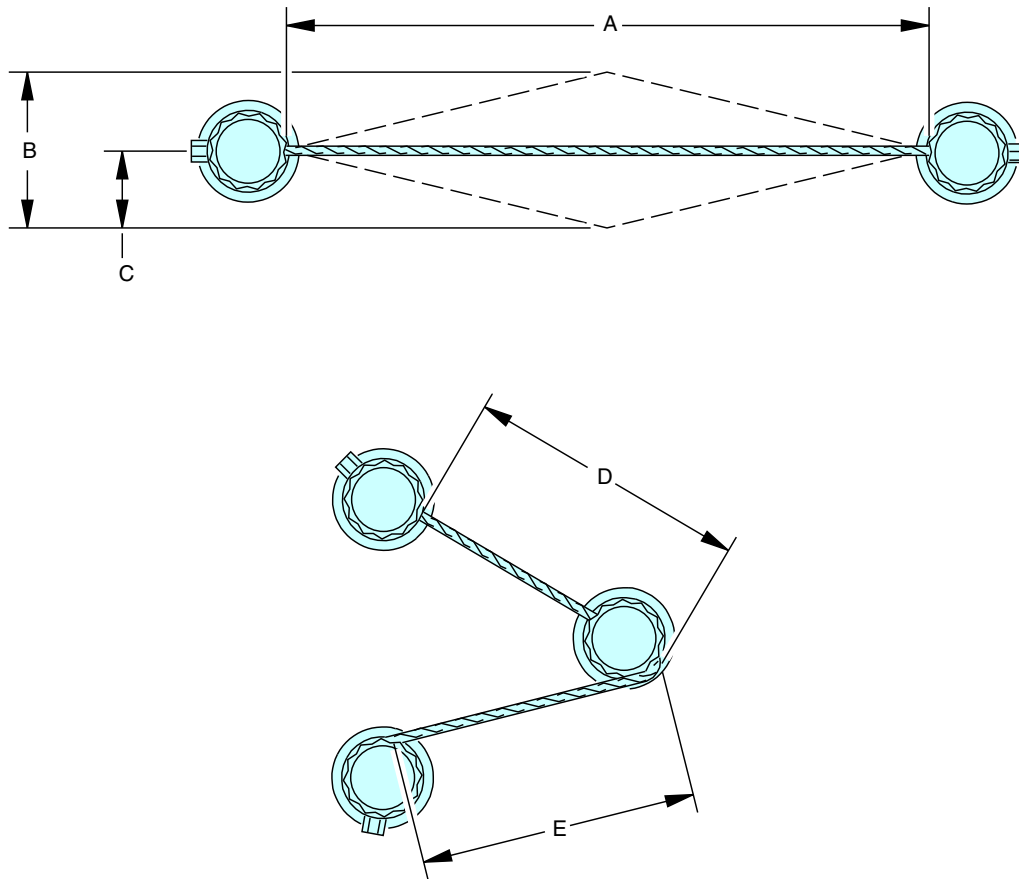
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**NOTE:**

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

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Safety Cable Verification
Figure 207/70-20-01-990-807-F00 (Sheet 2 of 2)

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TIGHTENING PRACTICES AND TORQUE VALUES - MAINTENANCE PRACTICES

1. General

A. This procedure has one task:

- (1) To give the correct torque tightening assembly instructions.

TASK 70-20-02-400-801-F00

2. Tightening Practices and Torque Values

(Figure 201, Figure 202)

A. References

Reference	Title
20-50-11-910-801	Standard Torque Values (P/B 201)

B. Location Zones

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

C. General

SUBTASK 70-20-02-910-001-F00

- (1) This procedure gives the instructions to torque and to tighten the fasteners (bolts, nuts, and fittings).

NOTE: Use this procedure when you do not see a torque value in the applicable maintenance manual procedure.

- (a) Use this task (TASK 20-50-11-910-801) for the torque values of part numbered fasteners (bolts, nuts, and fittings).

SUBTASK 70-20-02-910-002-F00

- (2) Torque is the turn force that you apply to the fastener to install a part.

- (a) The units of torque are in pound-inches (lb-in) or Newton meters (Nm).
 (b) This torque correctly attaches the part.
 (c) This torque is not more than the strength in tension of the material.
 (d) This torque is also not more than the strength (in shear) of the threads.
 (e) When you turn a fastener around the axis of the fastener, you cause torque.
 (f) Use the torque value that the applicable maintenance manual procedure gives you.

SUBTASK 70-20-02-910-003-F00

- (3) This procedure will show you how to tighten and calculate the torque values to apply to the fasteners.

- (a) One pound-inch (lb-in) or one Newton meter (Nm) of torque is the turn force when you apply one pound (one Newton) to a one inch (one meter) lever.
 (b) Torque is the result when you multiply a force in pounds (kilograms) by the length of a lever in inches (millimeters).

NOTE: Torque values have the units of lb-in (Nm). This is different from work, that applies a force in a straight line for a distance. Units of work are the inch-pound (in-lb), foot-pound (ft-lb), or the joule (j). One ft-lb (j) of work is the energy to lift one pound (0.45 kg) through a distance of one foot (0.305 m).

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SUBTASK 70-20-02-910-004-F00

- (4) These are the names or the properties of a part:
- (a) Bolt
 - 1) A bolt is a fastener with an external thread.
 - (b) Breakaway-torque
 - 1) This torque is the necessary torque to start the removal of a nut without an axial load on the nut.
 - (c) Gross torque
 - 1) Gross torque is the actual torque value that the torque wrench applies. Gross torque includes the run-on torque and the seated torque.
 - (d) Installed nut
 - 1) You install a nut, when the chamfer plus a minimum of 1.5 bolt threads extends through the nut.
 - 2) It is not necessary for the bolt to extend above 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) This is the highest torque, when you initially install a nut, and the bolt expands the nut.
 - (f) Minimum prevailing-torque
 - 1) This is the minimum removal torque of a fastener, during the second full turn.
 - (g) Remover nut
 - 1) You remove a self-locking nut, when you disengage the locking section from the bolt (the nut can stay on the bolt).
 - (h) Run-on torque
 - 1) This is the torque that turns a fastener, before you tighten it against the seat.
 - (i) Seated-nut/bolt
 - 1) This is the torque that is necessary to correctly tighten a fastener.
 - a) It must apply a necessary compression force on a spacing element or an axial load or elongation to a bolt.
 - (j) Seating-torque
 - 1) This is the necessary torque the drawing or specification to bring the bearing faces into the seated position.
 - a) This measures only the tighten direction of the fastener.
 - (k) Spacer/spacing elements
 - 1) These are parts of all functions, dimensions, shapes, and materials, that the fasteners with threads hold together.
 - (l) Unseated-nut/bolt
 - 1) This is a nut or a bolt that you removed a one turn minimum from the seated position.

NOTE: This removes the axial load from the fastener.
 - (m) Unseated-torque

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- 1) This is the torque that is necessary to remove a fastener from the bearing surface of a spacer.

NOTE: This removes the axial load from the fastener.

D. Tightening Procedures

SUBTASK 70-20-02-910-005-F00

(1) Procedure to tighten a part

- (a) Turn the fastener at a constant rate, until you get the necessary torque.
 - 1) If the torque compresses a gasket or a part after you install it, then apply the torque again.
- (b) When you install a part, do these steps:
 - 1) Tighten the parts to less torque than the necessary torque.
 - a) Tension that is not equal can cause a distortion or too much 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 more than the specified torque of the maintenance manual.

SUBTASK 70-20-02-910-006-F00

(2) Torque-wrench selection

- (a) The table that follows recommends the best torque wrench size for different torque limits (Table 201).
- (b) A larger wrench has a larger tolerance that causes more error.

NOTE: Wrench sizes are specified with a combination Newton meter (Nm), pound-inch (lb-in) and pound-feet (lb-ft) torque wrenches.

Table 201/70-20-02-993-803-F00

TORQUE WRENCH SIZE	TORQUE LIMITS	TOLERANCE
30 lb-in (3.5 N.m)	0-25 lb-in (0-3.0 N.m)	±1 lb-in (±0.1 N.m)
150 lb-in (17.0 N.m)	25-120 lb-in (3.0-14.0 N.m)	±5 lb-in (±0.6 N.m)
600 lb-in (60 N.m)	120-480 lb-in (14-50 N.m)	±20 lb-in (±2.3 N.m)
175 lb-ft (230 N.m)	40-140 lb-ft (50-190 N.m)	±5 lb-ft (±6.8 N.m)
250 lb-ft (340 N.m)	140-200 lb-ft (190-280 N.m)	±10 lb-ft (±14 N.m)
1000 lb-ft (1360 N.m)	200-1000 lb-ft (280-1360 N.m)	±20 lb-ft (±27 N.m)

SUBTASK 70-20-02-910-007-F00

(3) Offset Extension Wrench:

- (a) When you use an offset extension wrench (example: crowfoot extension), you change the effective length of the torque wrench.
 - 1) Refer to the illustration that shows the effective length of the torque wrench (A) and the effective length of the extension (B) (Figure 201).
 - 2) When the extension points in the same direction as the torque wrench, add their effective lengths together (A + B).

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- 3) When the extension is pointed to the handle of the torque wrench, subtract the effective length of the extension (A - B).
- 4) When the extension points 90 degrees from the torque wrench, it has no effect on the effective length of the torque wrench.
- 5) The manual of the manufacturer gives the effective length (A) of the torque wrench.
- 6) Measure the effective length of an extension from the center of the drive opening to the center of the wrench opening.
- 7) Multiply the necessary torque (T) by the effective length of the torque wrench (A).
- 8) Divide this result by (A + B) or (A - B).
- 9) This value is the indication of torque (T) on the torque wrench, that gives the necessary torque on the fastener.
 - a) Example:

Table 202/70-20-02-993-809-F00

Example:	Necessary torque = 265 pound-inches (30 N.m) Effective length of torque wrench = 8.4 inches (213mm) Effective length of the extension = 1.5 inches (38mm)
	Then: (Necessary torque) x (A) = 265 x 8.4 = 2226 (30 x 213 = 6390)
	(A+B) = 9.9 inches (251 mm) 2226/9.9 = 225 pound-inches (6390/251 = 25.5 N.m)
	Thus: A gage value of 225 pound-inches makes for a necessary torque of 265 pound-inches. (A gage value of 25.5 N.m makes for a necessary torque of 30 N.m)

E. Standard Torque Values

SUBTASK 70-20-02-910-008-F00

(1) Steel nuts and bolts

- (a) The table that follows shows the standard torque limits for steel nuts and bolts (Table 203):

NOTE: Use one half of the limits in the table for these fasteners: (1) Thin steel hexagonal nuts with one of these properties: A height that is less than 0.6 the pitch-diameter for a nut without a lock, or a height of less than 0.8 the pitch-diameter for a locknut. (2) Nuts and bolts of nonferrous alloys.

Table 203/70-20-02-993-804-F00

Nominal Size	UNC and -8 Series		UNF and -12 Series	
	Threads per Inch	Torque	Threads per Inch	Torque
No. 4	40	3 - 5 lb-in. 0.339 - 0.565 N.m	---	-----
No. 6	32	8 - 10 lb-in. 0.904 - 1.130 N.m	40	10 - 12 lb-in. 1.130 - 1.356 N.m
No. 8	32	13 - 16 lb-in. 1.469 - 1.808 N.m	36	16 - 19 lb-in. 1.808 - 2.147 N.m

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Table 203/70-20-02-993-804-F00 (Continued)

Nominal Size	UNC and -8 Series		UNF and -12 Series	
	Threads per Inch	Torque	Threads per Inch	Torque
No. 10	24	20 - 23 lb-in. 2.260 - 2.599 N.m	32	33 - 37 lb-in. 3.728 - 4.180 N.m
No. 12 (1/4 ")	20	40 - 60 lb-in. 4.520 - 6.780 N.m	28	55 - 70 lb-in. 6.215 - 7.910 N.m
5/16	18	70 - 110 lb-in. 7.910 - 12.430 N.m	24	100 - 130 lb-in. 11.300 - 14.690 N.m
3/8	16	160 - 210 lb-in. 18.080 - 23.730 N.m	24	190 - 230 lb-in. 21.470 - 25.990 N.m
7/16	14	250 - 320 lb-in. 28.250 - 36.160 N.m	20	300 - 360 lb-in. 33.900 - 40.680 N.m
1/2	13	420 - 510 lb-in. 47.460 - 57.630 N.m	20	480 - 570 lb-in. 54.240 - 64.410 N.m
9/16	12	575 - 685 lb-in. 48 - 57 lb-ft 64.975 - 77.405 N.m	18	660 - 780 lb-in. 55 - 65 lb-ft 74.580 - 88.140 N.m
5/8	11	840 - 960 lb-in. 70 - 80 lb-ft 94.920 - 108.480 N.m	18	985 - 1140 lb-in. 82 - 95 lb-ft 111.300 - 128.820 N.m
3/4	10	1620 - 1800 lb-in. 135 - 150 lb-ft 183.060 - 203.400 N.m	16	1800 - 2270 lb-in. 150 - 165 lb-ft 203.400 - 256.510 N.m
7/8	9	2460 - 2750 lb-in. 205 - 230 lb-ft 277.980 - 311.880 N.m	14	2820 - 3180 lb-in. 235 - 265 lb-ft 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 lb-in. 350 - 400 lb-ft 474.600 - 542.400 N.m
1-1/8	7	5000 - 5720 lb-in. 415 - 480 lb-ft 565.000 - 646.360 N.m	12	5820 - 6780 lb-in. 485 - 565 lb-ft 657.660 - 766.140 N.m
1-1/4	7	7200 - 8400 lb-in. 600 - 700 lb-ft 813.600 - 949.200 N.m	12	8280 - 9600 lb-in. 690 - 800 lb-ft 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 lb-in. 900 - 1060 lb-ft 1220.400 - 1437.360 N.m
1-1/2	6	12000 - 14400 lb-in. 1000 - 1200 lb-ft 1356.000 - 1627.200 N.m	12	14400 - 16800 lb-in. 1200 - 1400 lb-ft 1627.200 - 1898.400 N.m

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Table 203/70-20-02-993-804-F00 (Continued)

Nominal Size	UNC and -8 Series		UNF and -12 Series	
	Threads per Inch	Torque	Threads per Inch	Torque
1-1/8	8	5280 - 6120 lb-in. 440 - 510 lb-ft 596.640 - 691.560 N.m	---	-----
1-1/4	8	7500 - 8700 lb-in. 625 - 725 lb-ft 847.500 - 983.100 N.m	---	-----
1-3/8	8	10100 - 12000 lb-in. 840 - 1000 lb-ft 1138.872 - 1356.000 N.m	---	-----
1-1/2	8	13800 - 16200 lb-in. 1150 - 1350 lb-ft 1559.400 - 1830.600 N.m	---	-----
		POUND-INCHES * 0.113 OR POUND-FEET * 1.356 = N.m		

(b) For the torque values of reduced head bolts, do this task: Standard Torque Values, TASK 20-50-11-910-801.

SUBTASK 70-20-02-910-010-F00

(2) Aluminum or magnesium bolts, studs, or a stepped-studs

(a) The table that follows shows the standard torque limits for the aluminum or magnesium bolts, studs, or a stepped-studs (Table 204):

NOTE: You must tighten the studs with a different thread on opposite ends to the torque limit of the smaller diameter.

Table 204/70-20-02-993-805-F00

Bolt or Stud Size	Pound-inches	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)

F. Tighten Plugs and Tube Fittings

SUBTASK 70-20-02-910-011-F00

(1) This procedure gives instructions for the installation of three types of tube fittings (Figure 202).

- (a) You can install a non-positioning fitting that uses a preformed-packing or a compression-packing for a seal.
- (b) You can install a positioning-fitting that can use a backup-washer.
- (c) You can install a universal bulkhead fitting with a locknut.

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SUBTASK 70-20-02-910-012-F00

(2) Assembly Procedures**(a) Installation of a preformed packing or a O-ring on a fitting**

- 1) When the ratio of the diameter to the cross-section of a preformed-packing is larger than 20, do this:

- 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.

- 2) When the ratio of the diameter to the cross-section of a preformed-packing is below 20, do this:

- a) A conic sleeve is not necessary, unless the packing must be rolled over threads or splines.
- b) Lubricate the preformed-packing with petrolatum to roll it into the groove on the fitting.
- c) Make sure that there is no lubrication on the threads or friction surfaces.

(b) Lubrication

- 1) Do not use lubricant on threads or friction surfaces, unless it specified by the maintenance manual.

(c) Non-positioning fittings.

- 1) Lubricate the packing lightly to prevent damage by the sharp threads.
 - a) Install the packing on the fitting, until 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 (Table 205).

(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) Then continue to the second section of the threads on the fitting.
- 2) Lubricate the packing to prevent damage by sharp threads.
- 3) Install it carefully through the first section of the threads into the packing groove.
 - a) It must be against 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) Then continue to the second section of the threads of the fitting.
 - c) The washer recess must point to the packing-groove.

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- 2) Hold the backup washer tightly 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 on the packing groove.
 - c) Remove the pieces of plastic material that the fitting cut from the washer.
- 3) Push the edge of the washer into the recess in the locknut, until they fully seat.
- 4) Make sure the threads of the fitting do not keep the washer from its seat.
- 5) Lubricate the packing to prevent damage by the sharp threads.
- 6) Install it carefully through the first section of the threads into the packing groove.
 - a) It must be against the washer.
- 7) Install the fitting in the boss, until the packing touches the countersunk surface.
- 8) Hold the locknut in its position with a wrench.
 - a) Turn the fitting into the boss by 1.5 turns.
- 9) Turn the fitting a maximum of one more turn into its correct position in the boss (total 1.5 to 2.5 turns).
- 10) Hold the fitting, while you tighten the locknut to the specified torque limit.
- (f) Universal bulkhead fittings.
 - 1) Attach the bulkhead fitting to the bulkhead with a locknut.
 - 2) Connect and tighten the tube nut or hose nut.
 - 3) Hold the fitting with a wrench and tighten the locknut to the specified torque limit.

SUBTASK 70-20-02-910-013-F00

(3) Plugs and Tube Fittings Torque Values

- (a) The table that follows shows the standard torque limits for plugs and tube fittings (Table 205):

Table 205/70-20-02-993-806-F00

Fitting Size	Thread Size (inch) (pitch)	Torque Limits	Torque Unit
-2	5/16 - 24	40 - 50 4.514 - 5.643	lb-in. N.m
-3	3/8 - 24	90 - 100 10.158 - 11.387	lb-in. N.m
-4	7/16 - 20	135 - 150 11.25 - 12.50 15.012 - 16.930	lb-in. lb-ft N.m
-5	1/2 - 20	155 - 175 12.91 - 14.66 17.474 - 19.751	lb-in. lb-ft N.m
-6	9/16 - 18	180 - 200 15.00 - 16.66 20.316 - 22.574	lb-in. lb-ft N.m

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Table 205/70-20-02-993-806-F00 (Continued)

Fitting Size	Thread Size (inch) (pitch)	Torque Limits	Torque Unit
-8	3/4 - 16	270 - 300 22.50 - 25.00 30.475 - 33.861	lb-in. lb-ft N.m
-10	7/8 - 14	360 - 400 30.00 - 33.32 40.633 - 45.148	lb-in. lb-ft N.m
-12	1-1/16- 12	540 - 600 45.00 - 50.00 60.950 - 67.722	lb-in. lb-ft N.m
-16	1-5/16- 12	700 - 850 58.31 - 70.80 79.010 - 95.940	lb-in. lb-ft N.m
-20	1-5/8 - 12	900 - 1050 75.00 - 87.56 101.584 - 118.515	lb-in. lb-ft N.m
-24	1-7/8 - 12	1000 - 1200 83.30 - 100.00 112.870 - 135.445	lb-in. lb-ft N.m

SUBTASK 70-20-02-910-014-F00

(4) Flared Tubing and Hose Fittings Torque Limits

- (a) The table that follows shows the standard torque limits for the flared tubing and the hose fittings (Table 206).

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 their connector are steel. The external fitting and the nut can be steel or aluminum.

Table 206/70-20-02-993-807-F00

Tube OD (inch)	Thread Size (inch)- (number)	All Aluminum Parts (Note 1)	Steel Tube Aluminum/Steel Nuts (Note 2)
1/8	15/16 - 24	-----	40 - 50 lb-in. 4.520 - 5.650 N.m
3/16	3/8 - 24	30 - 50 lb-in. 3.390 - 5.650 N.m	90 - 100 lb-in. 10.170 - 11.300 N.m
1/4	7/16 - 20	40 - 65 lb-in. 4.520 - 7.345 N.m	135 - 150 lb-in. 15.255 - 16.950 N.m
5/16	1/2 - 20	60 - 80 lb-in. 6.780 - 9.040 N.m	180 - 200 lb-in. 20.340 - 22.600 N.m
3/8	9/16 - 18	75 - 125 lb-in. 8.475 - 14.125 N.m	270 - 300 lb-in. 30.510 - 33.900 N.m
1/2	3/4 - 16	150 - 200 lb-in. 16.950 - 22.597 N.m	450 - 550 lb-in. 50.850 - 62.150 N.m

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Table 206/70-20-02-993-807-F00 (Continued)

Tube OD (inch)	Thread Size (inch)-(number)	All Aluminum Parts (Note 1)	Steel Tube Aluminum/Steel Nuts (Note 2)
5/8	7/8 - 14	200 - 300 lb-in. 22.600 - 33.895 N.m	650 - 774 lb-in. 73.450 - 87.450 N.m
3/4	1-1/16- 12	300 - 475 lb-in. 25 - 35 lb-ft 33.900 - 53.667 N.m	900 - 1090 lb-in. 75 - 91 lb-ft 101.700 - 123.170 N.m
1.000	1-5/16- 12	490 - 700 lb-in. 41 - 58 lb-ft 55.362 - 79.089 N.m	1340 - 1540 lb-in. 112 - 128 lb-ft 151.420 - 174.000 N.m
1-1/4	1-5/8 - 12	600 - 900 lb-in. 50 - 75 lb-ft 67.800 -101.700 N.m	1600 - 1800 lb-in. 133 - 150 lb-ft 180.800 - 203.400 N.m
1-1/2	1-7/8 - 12	600 - 900 lb-in. 50 - 75 lb-ft 67.800 -101.700 N.m	1900 - 2200 lb-in. 158 - 183 lb-ft 214.700 - 248.600 N.m

G. Net Torque

SUBTASK 70-20-02-910-015-F00

- (1) Maintenance procedures will give a net torque value, when the axial force that you apply to a fastener is very important.
- (a) Make sure that you use these smaller limits for the specified extension or the axial force.

SUBTASK 70-20-02-910-016-F00

- (2) Net torque is equal to the gross torque minus the run-on torque.
- (a) Find the net torque as follows:
- 1) You must tighten a nut on a bolt to a net torque of 20-40 pound-inches (2.3-4.5 Newton meters).
 - 2) Turn the nut on the bolt.
 - a) Find the torque that turns the nut, before it touches its seat.
 - 3) Write this value down as the run-on torque.

NOTE: For this example the run-on torque value will be 15 pound-inches (1.7 Newton meters).
 - 4) Add the run-on torque value to the minimum and maximum specified torque values.

NOTE: Therefore; 20 pound-inches (2.3 Newton meters) + 15 pound-inches (1.7 Newton meters) = 35 pound-inches (4.0 Newton meters) and 40 pound-inches (4.5 Newton meters) + 15 pound-inches (1.7 Newton meters) = 55 pound-inches (6.2 Newton meters).

H. Torque-Check for the Re-Use of Self-Locking Nuts

SUBTASK 70-20-02-910-017-F00

- (1) Self-Locking nuts must have a specified minimum breakaway-torque if you use them again.
- NOTE: This data does not apply to nuts that you must use one time only (refer to the applicable maintenance procedures).

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SUBTASK 70-20-02-910-018-F00

(2) The torque-check procedure follows:

**CAUTION**

DO NOT BEND A SELF-LOCKING NUT TO GET THE NECESSARY SELF-LOCKING TORQUE. FAILURE OF THE NUT CAN OCCUR.

- (a) To get the minimum breakaway-torque, install the nut on a bolt with 2 to 5 threads through the nut.
- (b) Measure the torque necessary to turn the nut on or off the bolt.
- (c) The table that follows gives the minimum breakaway-torque for the self-locking nuts (Table 207).
 - 1) It applies to self-locking nuts that have a silver plate, a dry-film cover, or a lubricant.
 - 2) The table that follows gives the values for the nuts without an axial load (Table 207).
- (d) Replace all the nuts that do not have these minimum torque values.

Table 207/70-20-02-993-808-F00

THREAD SIZE	THREADS PER INCH	MINIMUM BREAKAWAY TORQUE POUND-INCHES (N.m)
NO. 6	32/40	1.0 (0.11)
NO. 8	32/36	1.5 (0.17)
NO. 10	32	2.0 (0.23)
NO. 12 (1/4)	28	3.5 (0.40)
5/16	24	6.5 (0.73)
3/8	24	9.5 (1.1)
7/16	20	14.5 (1.6)
1/2	20	18.0 (2.0)
9/16	18	24.0 (2.7)
5/8	18	32.0 (3.6)
3/4	16	50.0 (5.6)

I. Torque-Procedure for V-Band Clamps

SUBTASK 70-20-02-910-019-F00

- (1) Install the V-band clamp on the flanges of the duct.

SUBTASK 70-20-02-910-020-F00

- (2) Tighten the V-band nut to 50 percent of the necessary torque.

SUBTASK 70-20-02-910-021-F00

- (3) Make sure that the V-band clamp has the correct fit on the flange.
 - (a) If seal is installed, make sure that its installation is correct.

SUBTASK 70-20-02-910-022-F00

- (4) Lightly hit the outer surface of the V-band with a plastic mallet to cause equal tension.

SUBTASK 70-20-02-910-023-F00

- (5) While you continue to hit the V-band clamp, tighten the nut to the necessary torque.

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SUBTASK 70-20-02-910-024-F00

(6) Hit (again lightly) the outer surface of the V-band clamp.

SUBTASK 70-20-02-910-025-F00

(7) Tighten the nut to the necessary torque.

———— **END OF TASK** ————

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$$T_1 = \frac{TA}{A+B}$$

A = LENGTH OF THE TORQUE WRENCH (AND HANDLE EXTENSION IF USED)

B = EFFECTIVE LENGTH OF THE ADAPTER

T = APPROVED TORQUE (SHOWN IN TORQUE TABLE)

T₁ = ADJUSTED TORQUE (SHOWN ON TORQUE WRENCH)

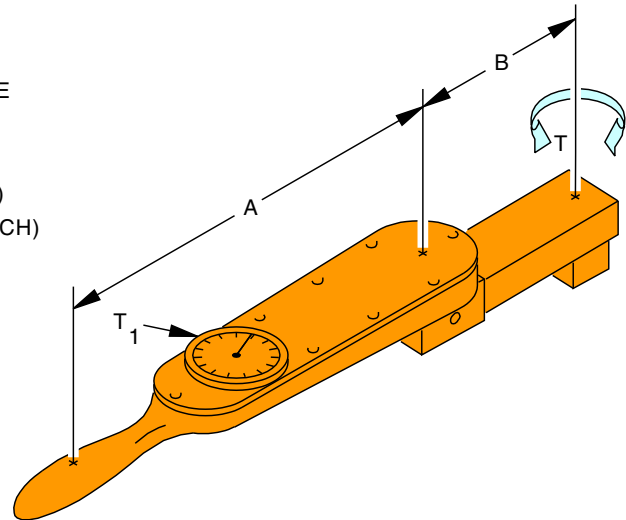
EXAMPLE: A = 12 INCHES (304.8 mm)

B = 3 INCHES (76.2 mm)

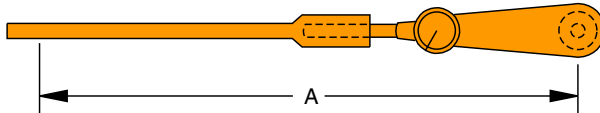
T = 160 POUND-INCHES (18.078 Nm)

$$T_1 = \frac{160 \times 12}{12+3}$$

T₁ = 128 POUND-INCHES (14.462 Nm)

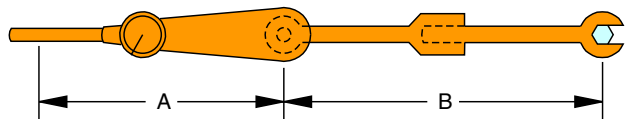


METHOD 1



HANDLE EXTENSION ONLY.
NO CORRECTION NECESSARY.

METHOD 2



ADAPTER WITH THE EXTENSION BETWEEN THE
ADAPTER AND THE WRENCH. BOTH ARE IN LINE
WITH THE WRENCH. INDICATED TORQUE T₁:

$$T_1 = \frac{TA}{A+B}$$

METHOD 3

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Finding Torque Values for a Torque Wrench with an Adapter
Figure 201/70-20-02-990-801-F00 (Sheet 1 of 2)

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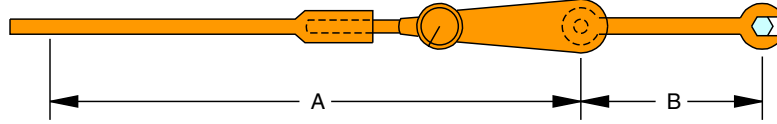
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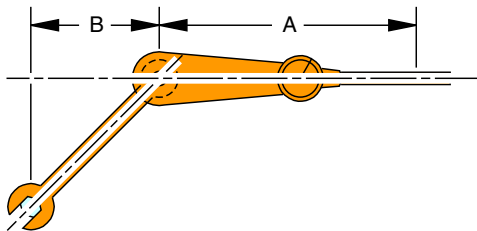
BOTH HANDLE EXTENSION AND ADAPTER,
INDICATED TORQUE T_1 :

$$T_1 = \frac{TA}{A+B}$$

METHOD 4

IF POSSIBLE, METHODS 5 AND 6 SHOULD NOT BE USED. WHEN IT IS NECESSARY TO USE THESE METHODS, THE CONDITIONS THAT FOLLOW MUST BE APPLICABLE.

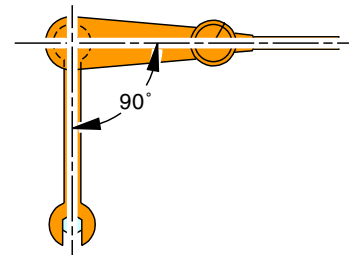
1. THE ADAPTER PLUS ALL EXTENSIONS USED BETWEEN THE WRENCH AND THE ADAPTER MUST NOT BE MORE THAN THE LENGTH OF THE WRENCH.
2. WHEN A FORCE IS APPLIED AT 90 ± 3 DEGREES TO THE HANDLE OF THE WRENCH, IT IS RECOMMENDED THAT A STIRRUP-TYPE HANDLE WITH A POINTER (INDICATING ANGLE OF LOADING) BE USED TO MAKE SURE LOADING IS AT THE CORRECT ANGLE.



ADAPTER AT ANGLE OTHER THAN
 90° . INDICATED TORQUE T_1 :

$$T_1 = \frac{TA}{A+B}$$

METHOD 5



ADAPTER AT RIGHT ANGLE TO THE
WRENCH. NO CORRECTION NECESSARY.

METHOD 6

G29092 S0006581657_V2

Finding Torque Values for a Torque Wrench with an Adapter
Figure 201/70-20-02-990-801-F00 (Sheet 2 of 2)

EFFECTIVITY
LOM ALL

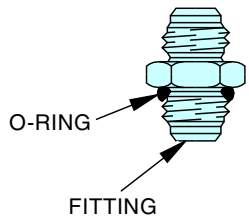
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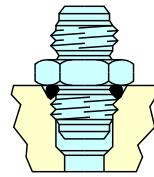
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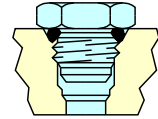
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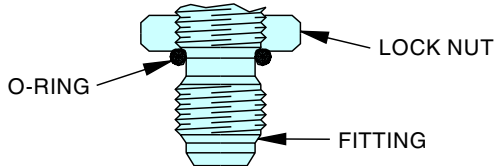
**FITTING WITH THE
O-RING INSTALLED**



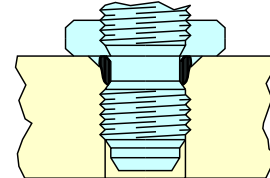
**FITTINGS INSTALLED IN THE
BOSS AND TIGHTENED WITH
THE O-RING COMPRESSED**



NON-POSITIONING FITTINGS

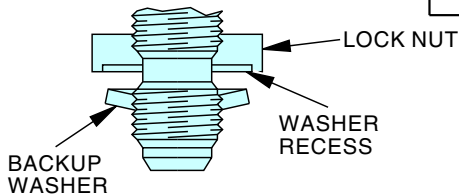


**FITTING WITH THE LOCK
NUT AND THE O-RING
INSTALLED**

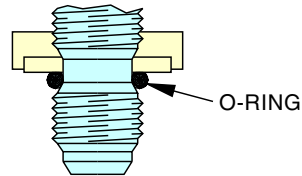


**FITTING INSTALLED
IN THE BOSS
WITH THE LOCK NUT
TIGHTENED AND THE
O-RING COMPRESSED**

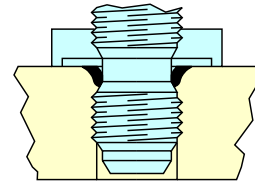
**POSITIONING FITTINGS
(NO BACKUP WASHERS)**



**FITTING WITH THE
LOCK NUT AND THE
TEFLON BACKUP
WASHER INSTALLED**

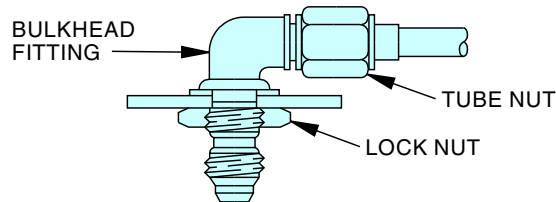


**FITTING WITH THE WASHER
PRESSED IN RECESS AND
THE O-RING INSTALLED**



**FITTING INSTALLED
IN THE BOSS
WITH THE LOCK NUT
TIGHTENED AND THE
O-RING COMPRESSED**

**POSITIONING FITTINGS
(WITH THE BACKUP WASHERS)**



**FITTING ATTACHED TO THE BULKHEAD
WITH THE LOCK NUT TIGHTENED**

BULKHEAD FITTINGS

CF8-6238-00-A

G29099 S0006581658_V2

Installation and Tightening of Plugs and Tube Fittings
Figure 202/70-20-02-990-802-F00

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CLAMP - MAINTENANCE PRACTICES

1. General

A. This procedure has two tasks:

- (1) The installation instructions for the clampshell type of clamps
- (2) The instructions to open and close the hinged type clamps.

LOM ALL POST SB CFM56-7B-72-062

- (3) The instructions to replace hinged clamp cushions for wiring harnesses attachment.

LOM ALL

TASK 70-20-03-910-801-F00

2. Installation of the Clampshell Type Clamp

A. General

- (1) This task gives the installation instructions for the clampshell type clamps.
- (2) These are the components you attach with clampshell type clamps:
 - (a) Power plant pneumatic tubes
 - (b) Oil tubes
 - (c) Hydraulic tubes
 - (d) Fuel system tubes.

B. Procedure

SUBTASK 70-20-03-200-001-F00

- (1) Do a check of the inner surface of the clamp and the outer surface of each of the two clampshell.
 - (a) Broken clamps are not permitted.
 - (b) A worn area on a component of the clampshell clamp assembly is not permitted
 - 1) Replace the clampshell clamp assembly.

SUBTASK 70-20-03-910-001-F00

- (2) The clampshell clamp assemblies have three parts:
 - (a) Two halves of the same type of clampshell.
 - (b) One of two types of clamps (cushioned or uncushioned).

SUBTASK 70-20-03-020-001-F00

- (3) Use the correct type of the clampshell clamp assemblies:
 - (a) Unplated clampshells
 - 1) Only used in high vibration and temperature environments of 800°F (427°C).
NOTE: These clamps are used to hold fluid system tubing.
 - (b) Cadmium plated clampshells
 - 1) Only used with aluminum tubing and applies to a temperature limit of 400°F (204°C).

SUBTASK 70-20-03-420-001-F00

- (4) Install a clampshell type clamp (Figure 201):

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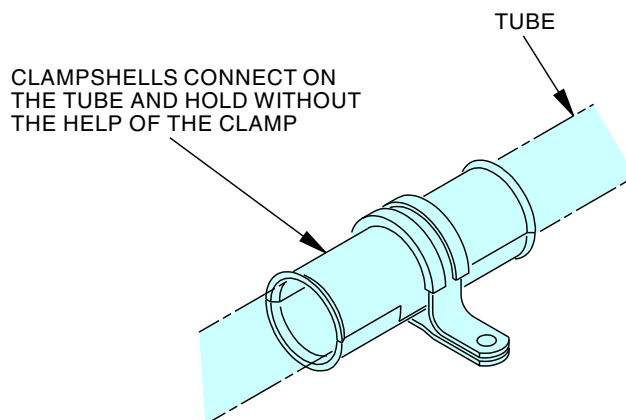
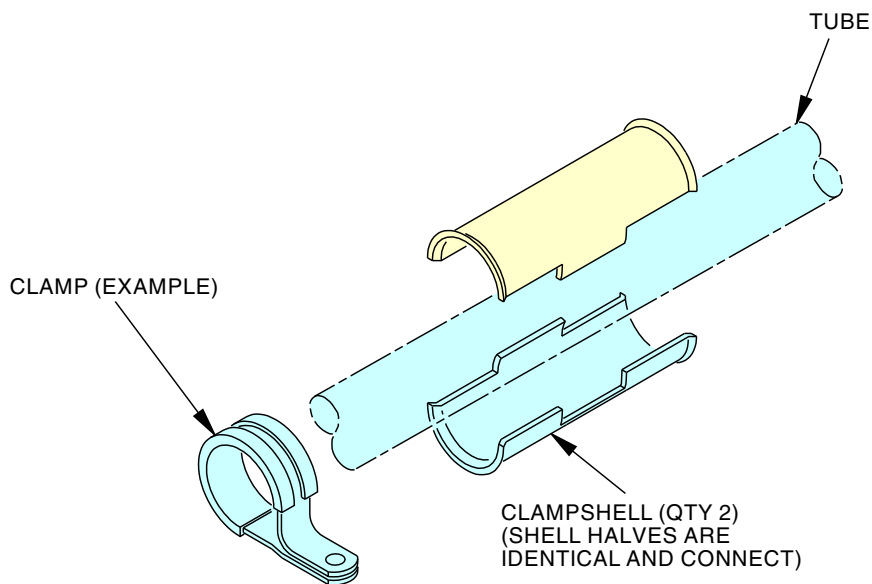
**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL****CAUTION**

DO NOT PUT THE CLAMPSHELLS ON A TUBING BEND. CLAMPSHELLS CAN CAUSE DAMAGE TO THE TUBE.

- (a) Attach the clampshell clamp assembly on the tube where the tube is straight and free of bends and damage.
 - (b) Connect the clampshells on the tube.
 - 1) Make sure that the two halves of the clampshells are correctly interlocked.
- NOTE: The clampshell halves are the same.
- a) Install the clamp in the center of the clampshell.
 - b) You can put the clamp between the clampshell shoulders, if the adjacent installations prevent the placement of the clamp.
- (c) Attach the clampshell clamp assembly to the engine with the fastener.

———— **END OF TASK** ————

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Clampshell Type Clamp Installation
Figure 201/70-20-03-990-801-F00

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AIRCRAFT MAINTENANCE MANUAL**

TASK 70-20-03-910-802-F00**3. Opening and Closing The Hinged Type Clamp**

(Figure 202)

A. General

- (1) This task gives the instructions for the opening and closing of the hinged type clamps.
- (2) These are the components you attach with hinged type clamps:
 - (a) The power plant wiring harnesses
 - (b) The nacelle wiring harnesses.

B. Procedure**SUBTASK 70-20-03-200-002-F00**

- (1) Do a check of the inner surface of the clamp and the outer surface of each of the two hinged halves.
 - (a) Broken clamps are not permitted.
 - (b) A worn area on a component of the hinged clamp assembly is not permitted.
 - 1) Replace the hinged clamp assembly.

SUBTASK 70-20-03-910-002-F00

- (2) There are five parts of the hinged clamp assembly:
 - (a) Two hinged halves of the clamp with a spring
 - (b) One cushion
 - (c) One special bolt
 - (d) One special nut.

SUBTASK 70-20-03-910-003-F00

- (3) Open the Hinge Type Clamp:
 - (a) Loosen the bolt from the clamp.
NOTE: Stop when the square nut is at the end of the bolt.

**CAUTION**

DO NOT APPLY TOO MUCH PRESSURE ON THE BOLT. DO NOT APPLY TORQUE TO LOOSEN THE BOLT WHEN THE NUT STOPS AT THE BOLT END. IF YOU APPLY TOO MUCH PRESSURE TO LOOSEN THE BOLT, DAMAGE TO THE BOLT AND NUT CAN OCCUR.

- (b) Do these steps to disengage the bolt and nut from the lower half of the clamp:
 - 1) Apply sufficient pressure to push the bolt down.
NOTE: Only apply sufficient pressure to permit the square nut to turn.
 - 2) Turn the bolt 1/4 of a turn to align the square nut with the opening in the lower clamp half.

**CAUTION**

DO NOT OPEN THE HINGED CLAMP BEYOND THE SIZE OF THE HARNESS. OPEN THE HINGED CLAMP SUFFICIENTLY TO REMOVE THE HARNESS. IF YOU OPEN THE HINGED CLAMP TOO WIDE, DAMAGE TO THE CUSHION CAN OCCUR.

- (c) Open the hinged clamp.

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SUBTASK 70-20-03-910-004-F00

(4) Close the Hinged Type Clamp**CAUTION**

DO NOT OPEN THE HINGED CLAMP BEYOND THE SIZE OF THE HARNESS. OPEN THE HINGED CLAMP SUFFICIENTLY TO INSTALL THE HARNESS. IF YOU OPEN THE HINGED CLAMP TOO WIDE, DAMAGE TO THE CUSHION CAN OCCUR.

- (a) Close the hinged clamp.
- (b) Do these steps to engage the bolt and square nut into the lower half of the clamp:

**CAUTION**

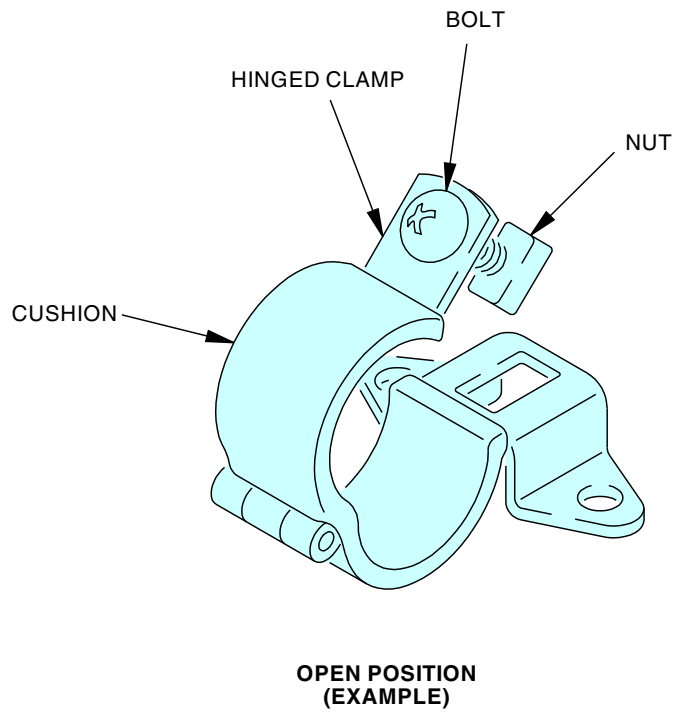
DO NOT APPLY TOO MUCH PRESSURE ON THE BOLT. DO NOT APPLY TORQUE TO LOOSEN THE BOLT WHEN THE NUT STOPS AT THE BOLT END. IF YOU APPLY TOO MUCH PRESSURE TO LOOSEN THE BOLT, DAMAGE TO THE BOLT AND NUT CAN OCCUR.

- 1) Apply sufficient pressure to move the square nut through the lower half of the clamp.
- 2) Keep sufficient pressure on the bolt.
- 3) Turn the bolt 1/4 of a turn clockwise.
- 4) Release the pressure on the bolt.

NOTE: This will set the square nut in the lower clamp half.

- (c) Tighten the bolt.
- (d) Apply the specified torque to the bolt.

———— **END OF TASK** ————



G54864 S0006581664_V2

**Hinged Type Clamp Installation
Figure 202/70-20-03-990-802-F00**

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LOM ALL POST SB CFM56-7B-72-062

TASK 70-20-03-910-803-F00

4. Replacement of Hinged Clamp Cushions

(Figure 203)

A. General

- (1) This task gives the instructions to replace the hinged clamp cushions for the wiring harness clamps.

B. Location Zones

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

C. Procedure

SUBTASK 70-20-03-020-002-F00

- (1) Open the hinge type clamp (TASK 70-20-03-910-802-F00).

SUBTASK 70-20-03-020-003-F00

- (2) Remove the wiring harness from the hinged clamp.

SUBTASK 70-20-03-900-001-F00

- (3) Do these steps to replace the clamp cushions:
- (a) Pull the cushion from the clamp.
 - (b) Open two sides of slot to put the replacement clamp cushion on the hinged clamp.

NOTE: Make sure that the position of the cushion is correct on the clamp.

SUBTASK 70-20-03-420-002-F00

- (4) Put the wiring harness into the hinged clamp.

SUBTASK 70-20-03-020-004-F00

- (5) Close the hinged type clamp (TASK 70-20-03-910-802-F00).
- (a) Apply 62.5 ± 2.5 in-lb (7.1 ± 0.3 N·m) torque to the bolt.

NOTE: Make sure the harness is not stressed or twisted.

— END OF TASK —

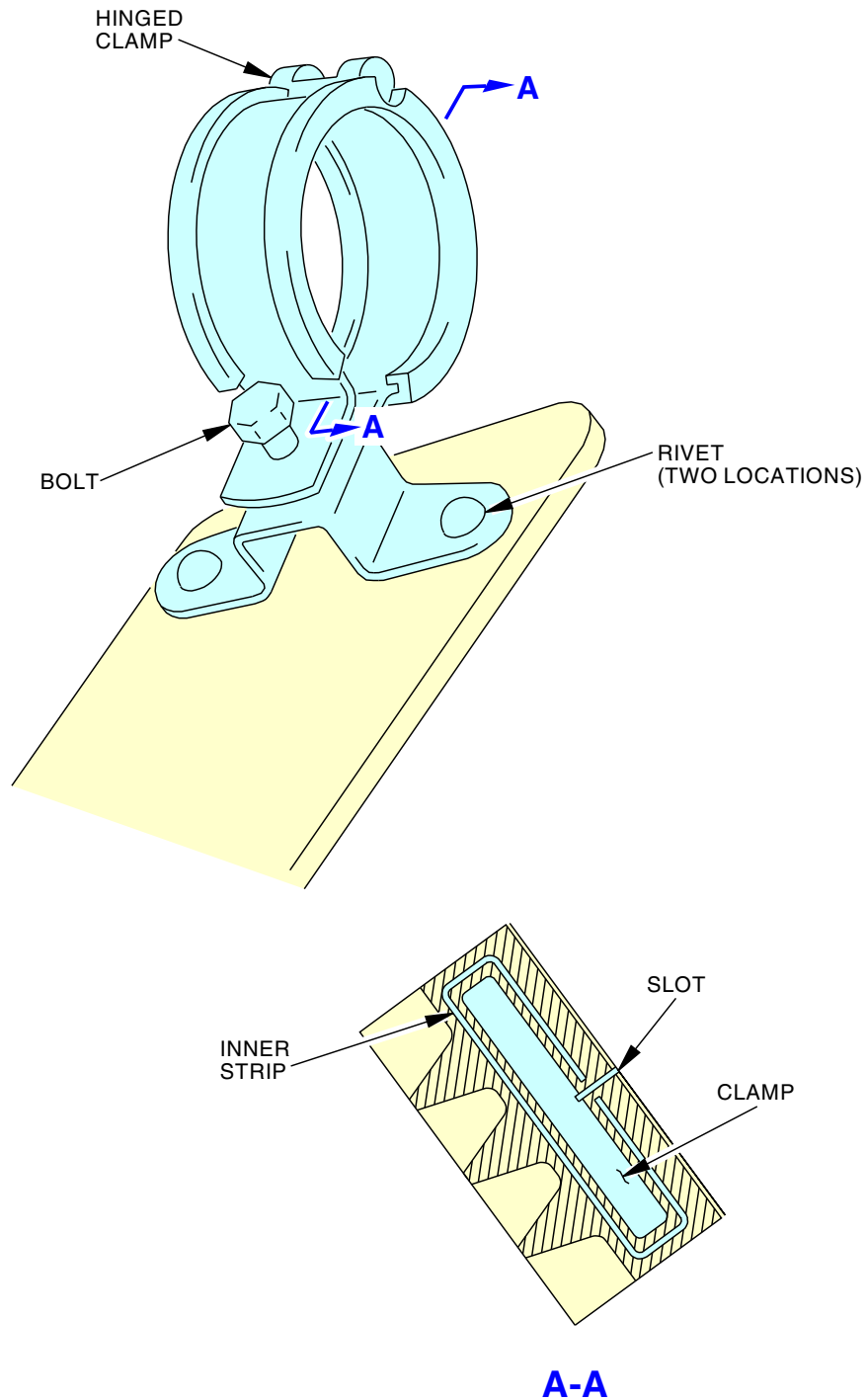
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L25889 S0006581666_V2

Replacement of Hinged Clamp Cushion
Figure 203/70-20-03-990-803-F00

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LOM ALL POST SB CFM56-7B-72-062

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AIRCRAFT MAINTENANCE MANUAL**

CLEANING AND DEGREASING – MAINTENANCE PRACTICES

1. General

A. This procedure has these tasks:

- (1) Chemical Cleaning Process
- (2) Hand Wipe Solvent Degreasing With Chemical Agent
- (3) Light Duty Aqueous Cleaning (Immersion) with Chemical Agent
- (4) Light Duty Aqueous Cleaning (Zestron) with Chemical Agent
- (5) Light Duty Aqueous Cleaning (Spray) with Chemical Agent
- (6) All Materials Solvent Degreasing with Chemical Agent
- (7) Steam Cleaning with Chemical Agent
- (8) Vapor Degreasing with Chemical Agent.

TASK 70-21-00-100-801-F00

2. Chemical Cleaning Process

(Figure 201)

A. General

- (1) This task gives the instruction to remove the surface contaminants such as oil, grease, carbon deposits, oxidizing agents and corrosion. It is used to clean surfaces prior to visual inspection, prior to crack detection using fluorescent penetrant or magnetic particle inspection methods, and prior to making repairs.
 - (a) Obey all applicable safety warnings for the cleaning task including warnings regarding contact with skin, eyes, and clothing.

NOTE: The effectiveness of the cleaning task may be improved by manually assisting the process using different types of fiber bristle brushes and/or polishing pads.
- (2) The chemical cleaning task must be used in conjunction with any requirements specified to the particular part in which this cleaning task applies to.

B. Drying and Degreasing the Parts

SUBTASK 70-21-00-800-001-F00

- (1) Any drying procedure is allowed as long as the surface temperature of the part does not exceed 158°F (70°C) by default.
 - (a) The drying procedure must not cause any contamination or stains.

SUBTASK 70-21-00-800-002-F00

- (2) Different types of bristle brushes for part configuration or cleaning pads can be used in addition to the wiping cloths, clean, white, lint-free cotton cloths, or unsized cheesecloth.

SUBTASK 70-21-00-800-003-F00

- (3) Parts made entirely or partially out of titanium must be degreased with non-halogenated solvents.

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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL****C. Material Compatibility**

SUBTASK 70-21-00-110-001-F00



DO NOT GET THIS MATERIAL IN YOUR MOUTH, EYES, OR ON YOUR SKIN. CLEAN BARE SKIN FULLY AFTER YOU USE THIS MATERIAL. THIS MATERIAL CAN CAUSE INJURIES TO PERSONNEL OR DAMAGE TO EQUIPMENT.

- (1) Use the organic solvents for cleaning shown in the Figure 201.

———— **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	A	A	A	A	A	A	A	A
CP2687	B50333	DIESTONE DLS	A	A	A	A	A	A	NA	NA
CP2726	B50344	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										

2993374 S0000770172_V1

**Organic Solvents
Figure 201/70-21-00-990-801-F00**

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TASK 70-21-00-100-802-F00**3. Hand Wipe Solvent Degreasing With Chemical Agent****A. General**

- (1) This task gives the instruction to clean parts contaminated with oil, grease, or different slightly adherent deposits by a reduction in viscosity and/or dissolution in the solvent.
- (2) Cleaners must be applied to the wipe cloths from dispensers that prevent contamination of the working fluid.
- (3) For general requirements and instructions on cleaning task, refer to Chemical Cleaning Process, TASK 70-21-00-100-801-F00.

B. 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	

C. Hand Wipe Solvent Degreasing With Chemical Agent

SUBTASK 70-21-00-100-001-F00



SOLVENTS ARE POISONOUS. DO NOT LET SOLVENTS TOUCH SKIN OR BREATHE FUMES. YOU MUST WEAR GLOVES AND AN APRON MADE OF RUBBER. 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.

- (1) Wipe the parts with a clean cloth soaked with one of the solvents:
 - (a) acetone solvent, B01058 [CP1039]
 - (b) solvent, B50190 [CP1040]
 - (c) alcohol, B00676 [CP1041]
 - (d) degreasing solvent, B50333 [CP2687]
 - (e) solvent, B50344 [CP2726]
 - (f) Ardrex 5503, B50290 [CP2559]
 - (g) solvent, B50345 [CP2727]
 - (h) White Spirit, B50295 [CP2010]
 - (i) solvent, B50347 [CP2947].

NOTE: All materials are used at ambient temperature.

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SUBTASK 70-21-00-100-002-F00

**CAUTION**

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 wiping cloths, clean, white cloths, lint-free cotton cloths, or unsized cheesecloth.
 - (a) You can also use bristle brushes or cleaning pads, according to the part configuration.

SUBTASK 70-21-00-100-003-F00

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

D. Inspection

SUBTASK 70-21-00-210-001-F00

- (1) Visually check the part.
 - (a) Make sure that the part is uniform and free of runs, stains, chips, and dry residues.

SUBTASK 70-21-00-110-002-F00

- (2) If it is necessary, do the degreasing procedure again.

————— **END OF TASK** —————

TASK 70-21-00-100-803-F00**4. Light Duty Aqueous Cleaning (Immersion) with Chemical Agent****A. General**

- (1) Light duty aqueous cleaning is a water-based cleaning task that is intended to offer an alternative to mineral oil and hydrocarbon-based solvent cleaners.
- (2) This task can be used as an alternate to Vapor Degreasing with Chemical Agent, TASK 70-21-00-100-808-F00 when used as a general cleaning task prior to visual, Fluorescent Penetrant Inspection (FPI), Magnetic Particle Inspection (MPI), or electronic inspections. It can also be used as a precleaner task before the heavy duty cleaning tasks. This is recommended to preserve the effective life of the deruster and descaler baths.

NOTE: Unless specified differently, the tasks that follow are considered equivalent alternatives to this task for appropriate sized metallic parts:

- Steam Cleaning with Chemical Agent, TASK 70-21-00-100-807-F00
 - Light Duty Aqueous Cleaning (Spray) with Chemical Agent, TASK 70-21-00-100-806-F00
 - Light Duty Aqueous Cleaning (Zestron) with Chemical Agent, TASK 70-21-00-100-805-F00.
- (3) This task can be safely used on all engine components. Full post rinsing is emphasized for all parts, and especially for hollow hot section components.
 - (4) The cleaning efficiency of this task can be highly improved by manually assisting the process using various types of bristle brushes and/or polishing pads.
 - (5) The following equipment is required for the task application:
 - (a) Safety equipment and devices that are standard equipment in surface treatment shops, as follows:
 - 1) Eye bath

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- 2) Emergency showers
 - 3) Protective clothing against electroplating products
 - 4) Means for neutralizing acid or alkaline splashing.
- (b) Processing plant for neutralizing waste and used solutions.
- (c) Efficient ventilation system for extracting and neutralizing vapors.
- (d) An alkaline degreasing tank made of stainless steel with a heating coil capable of heating the solution to 210°F (99°C).
- (e) A water tank made from stainless steel and a spray gun that are used after alkaline degreasing.
- (f) A hot water rinse tank made from stainless steel with heat coil in tank capable of heating the solution to 150°F (66°C) - 200°F (93°C) and an air/hot water spray gun.
- (g) A drying oven capable of warming parts to 220°F (104°C), if the cleaning task is used before the FPI.

B. Consumable Materials

Reference	Description	Specification
B50391 [CP2720]	Cleaner - Bioact 280E	
G51761 [S1222]	Solution - Chemical, Bonderite C-AK LS NP-LT AERO	
G51762 [S1140]	Solution - Chemical, Bonderite C-AK 4215 NC-LT AERO	
G51763 [S1186]	Solution - Chemical, Bonderite C-AK 5948 DPM AERO	
G51764 [S1221]	Solution - Chemical, Mag-Chem Soluwax	
G51765 [S1185]	Solution - Chemical, Cee-Bee 7X7NC	
G51770 [S1183]	Solution - Chemical, Ardrex 6333/A	
G51771 [S1184]	Solution - Chemical, Blue Gold	
G51772 [S1220]	Solution - Chemical, Super Bee 300LF	
G51773 [S1266]	Solution - Chemical, Super Bee 300LFG	
G51774 [S1240]	Solution - Chemical, Ardrex 6376	
G51782 [S1211]	Solution - Chemical, Brulin 815 GD	
G51783 [S1187]	Solution - Chemical, Daraclean 282	

C. Light Duty Aqueous Cleaning (Immersion)

SUBTASK 70-21-00-110-003-F00

- (1) Immerse the part(s) in a tank containing one of the light duty cleaning solutions listed in the table below:

Table 201/70-21-00-993-802-F00 Light Duty Tank Cleaners

Material	Solution/Product (No)	Operating, °F	Temperature, °C
1	Ardrex 6333A chemical solution, G51770 [S1183]	150 - 170	66 - 77
2	Blue Gold chemical solution, G51771 [S1184]	130 - 150	54 - 66
3	S1185 Cee-Bee chemical solution, G51765 [S1185]	130 - 150	54 - 66
4	S1186 Bonderite chemical solution, G51763 [S1186]	150 - 175	66 - 80
5	Daraclean 282 chemical solution, G51783 [S1187]	130 - 150	54 - 66

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Table 201/70-21-00-993-802-F00 Light Duty Tank Cleaners (Continued)

Material	Solution/Product (No)	Operating, °F	Temperature, °C
6	S1221 Mag-Chem chemical solution, G51764 [S1221]	140 - 170	60 - 77
7	S1140 Bonderite chemical solution, G51762 [S1140]	110 - 130	43 - 54
8	Brulin 815 GD chemical solution, G51782 [S1211]	140 - 180	60 - 82
9	Super Bee 300LF chemical solution, G51772 [S1220]	120 - 160	50 - 70
10	Super Bee 300LFG chemical solution, G51773 [S1266]	122 - 150	50 - 66
11	S1222 Bonderite chemical solution, G51761 [S1222]	90 - 190	32 - 88
12	Bioact 280E cleaner, B50391 [CP2720]	190 - 205	88 - 96
13	Ardrox 6376 chemical solution, G51774 [S1240]	150 - 170	66 - 77

- (a) Maintain the solution at the recommended temperature.
- (b) Dwell time in the bath: 15 minutes - 60 minutes.

SUBTASK 70-21-00-020-002-F00

- (2) Remove part(s) from cleaning tank and rinse by spraying with a water jet and by dipping in room temperature water.

SUBTASK 70-21-00-110-004-F00

- (3) Rinse part(s) by dipping in hot water.
 - (a) Rinse water temperature should be at 150°F (66°C) - 200°F (93°C).

SUBTASK 70-21-00-110-005-F00

- (4) Do the steps above again if parts are not clean.

SUBTASK 70-21-00-100-006-F00

- (5) Blow dry parts with compressed clean, dry air or by dwell time in heated enclosure.
 - (a) Use a thermal exposure if FPI is performed within 12 hours of cleaning.

D. Inspection

SUBTASK 70-21-00-210-003-F00

- (1) Visually check parts to make sure that they are clean.

SUBTASK 70-21-00-210-004-F00

- (2) Make sure that cleaning and hot water rinse tanks are operating at recommended temperatures.

SUBTASK 70-21-00-210-005-F00

- (3) Do not let the surface scum from being redeposited on the cleaned parts while they are pulled out of the tank.
 - (a) Skim floating residue off of the surface of the cleaning tank at an interval.

SUBTASK 70-21-00-210-006-F00

- (4) Change rinse waters frequently if continuous flow tanks are not used to ensure proper part surface rinsing.

— END OF TASK —

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TASK 70-21-00-100-805-F00**5. Light Duty Aqueous Cleaning (Zestron) with Chemical Agent****A. General**

- (1) Light duty cleaning uses a spray wash.
- (2) Light duty aqueous cleaning is a water-based cleaning task that is intended to offer an alternative to mineral oil and hydrocarbon-based solvent cleaners.
- (3) This task can be used as an alternate to Vapor Degreasing with Chemical Agent, TASK 70-21-00-100-808-F00, as a degreaser task before the heavy duty cleaning tasks. It is recommended to preserve the effective life of the deruster and descaler baths.

NOTE: Unless specified differently, tasks that follow are considered equivalent alternatives to this task for appropriate sized metallic parts:

- Steam Cleaning with Chemical Agent, TASK 70-21-00-100-807-F00
 - Light Duty Aqueous Cleaning (Immersion) with Chemical Agent, TASK 70-21-00-100-803-F00
 - Light Duty Aqueous Cleaning (Spray) with Chemical Agent, TASK 70-21-00-100-806-F00.
- (4) This task can be safely used on all engine components. Full post rinsing is emphasized for all parts, and especially for hollow hot section components described in Light Duty Aqueous Cleaning (Immersion) with Chemical Agent, TASK 70-21-00-100-803-F00.
 - (5) This task can be accomplished by using a dip tank (immersion method) or by utilizing a spray wash cabinet for a spray wash cleaning.
 - (6) The following equipment is required for the application of this task:
 - (a) Safety equipment and devices that are standard equipment in surface treatment shops, as follows:
 - 1) Eye bath
 - 2) Emergency showers.
 - (b) An industrial spray wash machine.
 - 1) Preferably made from stainless steel, with water jets and turbulators that will direct streams or cleaning solution and rinsing solution against the parts inside the wash area of the cabinet.

NOTE: The spray machine must be equipped with recycling unit.

NOTE: Contact Zestron Company to obtain the list of compatible machines:

ZESTRON

Dr. O.K.Wack Chemie GmbH

Bunsenstrasse 6

85053 INGOLSTADT - GERMANY

PHONE : + 49 841 635 27

FAX: + 49 841 635 80

- (c) Suitable controls to allow for programmed washing cycles to include prerinse (optional), wash, post rinse, and drying (optional) cycles.

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B. Consumable Materials

Reference	Description	Specification
B50392 [CP2665]	Solvent - Degreasing, Zestron VD 200	

C. Light Duty Aqueous Cleaning (Zestron)

SUBTASK 70-21-00-110-006-F00

- (1) Load parts onto cleaning rack for input into parts washer.
 - (a) Load parts so that adjacent parts will not cause masking of part surfaces from the spray jets and result in ineffective cleaning.
 - (b) Do not overload parts washer.

SUBTASK 70-21-00-110-007-F00

- (2) Load basket into parts washer and start cycle.

NOTE: In general, an industrial parts washer has programmable washing cycles incorporating wash, rinse, and dry.

NOTE: The cycles will change based on the machine used and the types and numbers of parts in the machine.

SUBTASK 70-21-00-110-008-F00

- (3) A recommended cleaning cycle is as follows:
 - (a) A minimal 15 min wash cycle with degreasing solvent, B50392 [CP2665], at 113°F (45°C).
 - (b) A minimal 5 min rinse cycle with degreasing solvent, B50392 [CP2665], at 113°F (45°C).
 - (c) A drying cycle of 15 min to 30 min at 194°F (90°C) - 212°F (100°C).

SUBTASK 70-21-00-210-008-F00



PARTS MUST BE FULLY DRY BEFORE THE FPI INSPECTION. WATER ON THE PARTS CAN DECREASE THE SENSITIVITY OF THE PROCEDURE, ESPECIALLY FOR THE WATER-WASHABLE PENETRANT PROCEDURE. IF YOU DO NOT OBEY, THIS CAN CAUSE DAMAGE TO EQUIPMENT.

- (4) Make sure that parts are clean after cycle is completed.
 - (a) If parts are not clean, repeat the cycle.

SUBTASK 70-21-00-020-003-F00

- (5) Remove parts from washer and route to next process.

D. Cleaning Control

SUBTASK 70-21-00-110-009-F00

- (1) The cleaning and rinsing solutions are used in closed loops, a treatment system is necessary (incorporated in the spray wash machine).

SUBTASK 70-21-00-220-001-F00

- (2) Check regularly the concentration of the bathes with a refractometer:
 - (a) $1,3404 < nD < 1,3449$ for a concentration between 7% and 11%.

SUBTASK 70-21-00-110-010-F00

- (3) Use demineralised or deionized water to dilute degreasing solvent, B50392 [CP2665], concentrate.

NOTE: Presence of water spots may cause undesirable fluorescent background in the penetrant inspection task.

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E. Inspection

SUBTASK 70-21-00-210-007-F00

- (1) Visually check parts to make sure that they are clean.

SUBTASK 70-21-00-210-009-F00

- (2) Make sure that the cleaning and hot drying steps are operating at the recommended temperatures.

————— **END OF TASK** —————

TASK 70-21-00-100-806-F00**6. Light Duty Aqueous Cleaning (Spray) with Chemical Agent****A. General**

- (1) Light duty cleaning uses a spray wash.
- (2) Light duty aqueous cleaning is a water-based cleaning task that is intended to offer an alternative to mineral oil and hydrocarbon-based solvent cleaners.
- (3) This task can be used as an alternate to Vapor Degreasing with Chemical Agent, TASK 70-21-00-100-808-F00, as a general cleaning task prior to visual, Fluorescent Penetrant Inspection (FPI), Magnetic Particle Inspection (MPI), or electronic inspections.
 - (a) It may also be used as a precleaner task before the heavy duty cleaning tasks. This is recommended to preserve the effective life of the deruster and descaler baths.

NOTE: Unless specified differently, tasks that follow are considered equivalent alternatives to this task for appropriate size metallic parts:

- Steam Cleaning with Chemical Agent, TASK 70-21-00-100-807-F00
 - Light Duty Aqueous Cleaning (Immersion) with Chemical Agent, TASK 70-21-00-100-803-F00
 - Light Duty Aqueous Cleaning (Zestron) with Chemical Agent, TASK 70-21-00-100-805-F00.
- (4) This task can be safely used on all engine components. Full post rinsing is emphasized for all parts, and especially for hollow hot section components described in Light Duty Aqueous Cleaning (Immersion) with Chemical Agent, TASK 70-21-00-100-803-F00.
 - (5) Cleaning efficiency of this task can be highly improved by manually assisting the cleaning using various types of fiber bristle brushes and/or polishing pads.
 - (6) The following equipment is required for this task:
 - (a) Safety equipment and devices that are standard equipment in surface treatment shops as follows:
 - 1) Eye bath
 - 2) Emergency showers
 - 3) Protective clothing against electroplating products
 - 4) Means for neutralizing acid or alkaline splashing.
 - (b) Processing plant to neutralize waste and used solutions.
 - (c) Efficient ventilation system for extracting and neutralizing vapors.
 - (d) An industrial spray wash machine.

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- 1) Preferably made from stainless steel, with water jets and turbulators that will direct streams or cleaning solution and rinse water against the parts inside the wash area of the cabinet.
- (e) Metering controls to allow correct amount of cleaning material to be metered into the water during the wash cycle.
- (f) Suitable controls to allow for programmed washing cycles to include prerinse (optional), wash, post rinse, and drying (optional) cycles.
- (7) The following cleaning solutions may be used for this task:

Table 202/70-21-00-993-804-F00 Light Duty Cleaners

Material	Consumable	Concentrate	Operating, °F	Temperature, °C
1	Ardrox 6333A cleaner, B50393 [CP2440]	(5-10% v/v)	113 - 167	45 - 75
2	DG-KLEEN aqueous degreaser, B50395 [CP2565]	(8-10% v/v)	155 - 165	68 - 74
3	Bonderite C-AK LS NP-LT AERO cleaner, B50396 [CP2580]	(10% max)	170 - 190	77 - 88
4	BONDERITE C-AK 5948DPM AERO cleaner, B50196 [CP2470]	(5-10% v/v)	150 - 175	65 - 80
5	Super Bee 300LF cleaner, B50394 [CP2615]	(5-15% v/v)	120 - 160	50 - 70

B. Consumable Materials

Reference	Description	Specification
B50196 [CP2470]	Cleaner - BONDERITE C-AK 5948DPM AERO (TURCO 5948 DPM)	
B50393 [CP2440]	Cleaner - Alkaline, Low Foam - Ardrox 6333A	
B50394 [CP2615]	Cleaner - Mild Alkaline - Super Bee 300LF	
B50395 [CP2565]	Degreaser - Aqueous - Mag-Chem DG-Kleen	
B50396 [CP2580]	Cleaner - Bonderite C-AK LS NP-LT AERO	

C. Light Duty Aqueous Cleaning (Spray)

SUBTASK 70-21-00-110-011-F00

- (1) Load parts onto cleaning rack for input into parts washer.
 - (a) Load parts so that adjacent parts will not cause masking of part surfaces from the spray jets and result in ineffective cleaning.
 - (b) Do not overload parts washer.

SUBTASK 70-21-00-110-013-F00

- (2) Load basket into parts washer and start cycle.

NOTE: In general, an industrial parts washer has programmable washing cycles incorporating prerinse, wash (with detergent), post rinse, and possibly dry.

NOTE: The cycles will vary based on the machine used and the types and numbers of parts in the machine.

SUBTASK 70-21-00-110-014-F00

- (3) A recommended cleaning cycle is as follows:
 - (a) A two minute prerinse to wet the parts.

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- (b) Wash cycle of 30 minutes - 45 minutes.

NOTE: The wash cycle is where the soap is loaded into the machine and recirculated as the machine "cleans" the parts.



PARTS MUST BE FULLY DRY BEFORE THE FPI INSPECTION. WATER ON THE PARTS CAN DECREASE THE SENSITIVITY OF THE PROCEDURE, ESPECIALLY FOR THE WATER-WASHABLE PENETRANT PROCEDURE. IF YOU DO NOT OBEY, THIS CAN CAUSE DAMAGE TO EQUIPMENT.

- (c) A post rinse cycle of 5 minutes - 10 minutes.

NOTE: A post rinse cycle is where the soap and dirt laden water is removed from the cabinet and the parts are rinsed with fresh water to remove soap and dirt residue

NOTE: It is not recommended to use a rust inhibitor in this cycle. If old machinery is used and inhibitors are required as part of the machine maintenance, remove the inhibitor from the part surfaces. If the parts are routed to FPI after the spray wash cleaning process.

- 1) This rinse should be at least one-half cycle of hot water.

SUBTASK 70-21-00-210-011-F00

- (4) Make sure that parts are clean after cycle is completed.

- (a) If parts are not clean, repeat cycle.

SUBTASK 70-21-00-020-004-F00

- (5) Remove parts from washer and route to next process.

SUBTASK 70-21-00-110-015-F00

- (6) If it is necessary, the parts can be dried in an oven at a temperature of 150°F (66°C) - 200°F (93°C).

D. Cleaning Control

SUBTASK 70-21-00-210-012-F00

- (1) The detergent solution is fresh with each cycle.

- (a) It is not necessary to maintenance the solution.

SUBTASK 70-21-00-211-001-F00

- (2) Make sure that the solution metering valve is operating properly and supplying the correct amount of detergent per volume of water.

SUBTASK 70-21-00-100-007-F00

- (3) It is recommend to switch to demineralized or deionized water, if persistent water spotting is noticed on parts.

NOTE: Presence of water spots may cause undesirable fluorescent background in the penetrant inspection task.

E. Inspection

SUBTASK 70-21-00-210-013-F00

- (1) Visually check parts to make sure that they are clean.

SUBTASK 70-21-00-210-014-F00

- (2) Make sure that the cleaning and hot water rinse steps are operating at the recommended temperatures.

————— **END OF TASK** —————

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TASK 70-21-00-100-804-F00

7. All Materials Solvent Degreasing with Chemical Agent

A. General

- (1) This task gives the instruction to clean parts contaminated with oil, grease, or different slightly adherent deposits by a reduction in viscosity and/or dissolution in the solvent.
- (2) Immersion is generally accompanied by a mechanical stirring of the bath, brushing, or ultrasonic action.
- (3) The following equipment is required for the application of this task:
 - (a) Processing plant for neutralizing waste and used solutions.
 - (b) Efficient ventilation system for extracting and neutralizing vapors.
 - (c) The solvent degreasing station shall consist of a stainless steel tank with a polypropylene lining.

B. Consumable Materials

Reference	Description	Specification
B00676 [CP1041]	Alcohol - Isopropyl	
B00682 [CP2011]	Solvent - Stoddard	MIL-PRF-680 Type I, II or III
B01058 [CP1039]	Solvent - Acetone, Reagent Grade	
B50290 [CP2559]	Solvent - degreasing, Ardrex 5503	
B50291 [CP2560]	Solvent - cleaning - BONDERITE C-SO IND 79 AERO (TURCO IND79)	
B50292 [CP2566]	Solvent - Degreasing - MAG-CHEM DIESTONE MTK	
B50293 [CP2584]	Solvent - Cleaning - Degreasol 99R	
B50294 [CP2656]	Solvent - Cleaning - MAGCHEM DIESTONE M-SK	
B50333 [CP2687]	Solvent - Degreasing, Diestone DLS	
B50345 [CP2727]	Solvent - Lotoxane Fast	
B50397 [CP2719]	Cleaner - Solvent - BIOACT 105	

C. All Materials Solvent Degreasing with Chemical Agent

SUBTASK 70-21-00-100-005-F00

- (1) Immerse in the solution as follows:



WARNING

STODDARD SOLVENT IS FLAMMABLE. DO NECESSARY PRECAUTIONS AGAINST FIRE. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL CAN OCCUR.

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(WARNING PRECEDES)



DO NOT GET SOLVENTS IN YOUR MOUTH, IN YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. PUT ON PROTECTIVE SPLASH GOGGLES AND GLOVES WHEN YOU USE SOLVENTS. KEEP SOLVENTS AWAY FROM SPARKS, FLAME, AND TEMPERATURES ABOVE THE FLASH POINT. SOLVENTS ARE A POISONOUS AND FLAMMABLE MATERIAL WHICH CAN CAUSE INJURY PERSONS AND DAMAGE TO EQUIPMENT.

- (a) Immerse the parts slowly into the tank containing one of the solvents, listed in the table below:

Table 203/70-21-00-993-803-F00 Solvent Solution/Product

Material	Product No
1	solvent, B00682 [CP2011]
2	acetone solvent, B01058 [CP1039]
3	alcohol, B00676 [CP1041]
4	Ardrox 5503, B50290 [CP2559]
5	BONDERITE C-SO IND 79 AERO solvent, B50291 [CP2560]
6	MAG-CHEM DIESTONE MTK solvent, B50292 [CP2566]
7	Degreasol 99R solvent, B50293 [CP2584]
8	MAGCHEM DIESTONE M-SK solvent, B50294 [CP2656]
9	degreasing solvent, B50333 [CP2687]
10	BIOACT 105 cleaner, B50397 [CP2719]
11	solvent, B50345 [CP2727]

NOTE: All materials are used at ambient temperature.



DO NOT GET SOLVENTS IN YOUR MOUTH, IN YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. PUT ON PROTECTIVE SPLASH GOGGLES AND GLOVES WHEN YOU USE SOLVENTS. KEEP SOLVENTS AWAY FROM SPARKS, FLAME, AND TEMPERATURES ABOVE THE FLASH POINT. SOLVENTS ARE A POISONOUS AND FLAMMABLE MATERIAL WHICH CAN CAUSE INJURY PERSONS AND DAMAGE TO EQUIPMENT.

- (b) Stir the solution through mechanical or ultrasonic action, or brush by hand.

SUBTASK 70-21-00-020-001-F00

- (2) Remove the part and allow it to drip over the tank.

SUBTASK 70-21-00-100-004-F00

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

D. Inspection

SUBTASK 70-21-00-210-002-F00

- (1) Visually check for the removal of all initial contamination.

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- (a) Make sure that no local build-up of contaminants was produced on the part during dripping and drying.

————— **END OF TASK** —————

TASK 70-21-00-100-807-F00

8. Steam Cleaning with Chemical Agent

A. General

- (1) 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 soils from parts.
- (a) This task is used when the part is too big for a soak tank or for component parts or different materials that cannot be put into acid or alkaline tanks.

NOTE: Unless specified differently, tasks that follow are considered equivalent alternatives to this task for appropriate sized metallic parts:

- Light Duty Aqueous Cleaning (Immersion) with Chemical Agent, TASK 70-21-00-100-803-F00
- Light Duty Aqueous Cleaning (Spray) with Chemical Agent, TASK 70-21-00-100-806-F00
- Light Duty Aqueous Cleaning (Zestron) with Chemical Agent, TASK 70-21-00-100-805-F00.



CAUTION

DO NOT APPLY STEAM CLEANING ON THE THERMOSET MATERIALS AT TEMPERATURE ABOVE 212°F (100°C). CRACKS CAN BE OBSERVED AT THE SURFACE OF THERMOSET MATERIALS WHEN EXPOSED TO STEAM AT TEMPERATURE ABOVE 212°F (100°C). IF YOU DO NOT OBEY, THIS CAN CAUSE DAMAGE TO EQUIPMENT

- (2) An alternative to this task is to use steam cleaning at temperatures greater than 212°F (100°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.
- (3) This task can be used on all materials except thermoplastic materials.
- (4) The following equipment is required for the application of this task:
- (a) Safety equipment and devices that are standard equipment in surface treatment shops as follows:
 - 1) Eye bath
 - 2) Emergency showers
 - 3) Protective clothing
 - 4) Means for neutralizing acid or alkaline splashing.
 - (b) Processing plant for neutralizing waste and used solutions.
 - (c) Efficient ventilation system for extracting and neutralizing vapors.
 - (d) Two types of steam cleaning equipment are generally available:

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1) Portable Equipment:

NOTE: Principle of operation of portable equipment requires only an external source of electric power to generate the steam from the water contained within the equipment. Separate tanks of detergent solution are mixed with the steam by metering valve controls. The detergent solution is premixed in the tank to the desired concentration. The equipment produces either pure steam or a steam/solution mixture.

- a) Contains tanks for water.
- b) Contains tanks for detergent solutions.
- c) Contains heat source to generate steam.
- d) Contains controls for temperature, flow mixing, to supply steam to 90 psi (621 kPa) - 100 psi (689 kPa) at a flow rate to 20 cu.ft/hr (600 l/h) - 40 cu.ft/hr (1200 l/h).

2) Fixed Equipment:

NOTE: Principle of operation of fixed equipment is to mix steam, cold water and detergent and deliver hot detergent solution combined with vapor under pressure through a spray gun to the surface to be cleaned. Impingement is directly related to steam pressure. The concentrated detergent is mixed with incoming water by means of an eductor and the concentration is controlled by orifice tips. Detergent supply line can be dosed for hot water rinse without stopping flow of water and steam.

- a) Requires external supply of water at 20 psi (138 kPa) minimum.
- b) Requires external supply of steam at 40 psi (276 kPa) - 150 psi (1034 kPa).
- c) Requires external supply of concentrated liquid detergent.
- d) Contains controls to mix the water, steam, and detergent in desired concentrations to regulate water temperature and cleaning action.
- e) Typical fixed equipment is listed in the table below:

Table 204/70-21-00-993-806-F00

Name	Address
STEAMALL II No. 910-445 DUBOIS CHEMICALS	DUBOIS CHEMICALS DUBOIS TOWER CINCINNATI, OHIO 45202 USA
KARCHER HDS No. 3000 KARCHER	KARCHER VAPORAPID Z.A.C. des Petits Carreaux 94380 BONNEUIL-SUR-MARNE FRANCE

(e) Manually assisting:

- 1) Cleaning efficiency can be highly improved by manually assisting this task with various types of fiber bristle brushes and/or polishing pads.

(5) The following cleaning solutions can be used for this task:

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Table 205/70-21-00-993-805-F00 Alkaline Cleaning Solution

Materials	Solution/Product (No)	Operating, °F	Temperature, °C
1	Dubois C-1102 chemical solution, G51776 [S1255]	160 - 220	70 - 105
2	Intex 8201 chemical solution, G51777 [S1256]		
3	Super Bee 300LF chemical solution, G51778 [S1257]		
4	Ardrox 6333A chemical solution, G51779 [S1258]		
5	Super Bee 300LFG chemical solution, G51780 [S1264]		
6	Mag-Chem DG-Kleen chemical solution, G51781 [S1265]		

NOTE: The solution operating temperature corresponds to the temperature of the spray exiting the gun.

B. Tools/Equipment

Reference	Description
STD-9077	Spray Gun

C. Consumable Materials

Reference	Description	Specification
G51776 [S1255]	Solution - Chemical, Dubois C-1102	
G51777 [S1256]	Solution - Chemical, Intex 8201	
G51778 [S1257]	Solution - Chemical, Super Bee 300LF	
G51779 [S1258]	Solution - Chemical, Ardrox 6333A	
G51780 [S1264]	Solution - Chemical, Super Bee 300LFG	
G51781 [S1265]	Solution - Chemical, Mag-Chem DG-Kleen	

D. Steam Cleaning

SUBTASK 70-21-00-110-012-F00



DO NOT GET SOLVENTS IN YOUR MOUTH, IN YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. PUT ON PROTECTIVE SPLASH GOGGLES AND GLOVES WHEN YOU USE SOLVENTS. KEEP SOLVENTS AWAY FROM SPARKS, FLAME, AND TEMPERATURES ABOVE THE FLASH POINT. SOLVENTS ARE A POISONOUS AND FLAMMABLE MATERIAL WHICH CAN CAUSE INJURY PERSONS AND DAMAGE TO EQUIPMENT.

(1) To perform steam cleaning, do these steps:

- (a) Adjust the appropriate water, steam, solution, temperature control to the required setting to obtain a proper cleaning action.

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

- (b) Hold a spray gun, STD-9077, about 10 in. (254 mm) - 12 in. (305 mm) from surface and inclined at about 45 degrees to the surface.
- (c) Rinse the part with unheated water (optional).
- (d) Rinse the parts with hot water with the spray gun, STD-9077 with the cleaning solution supply shut off.
- (e) Carefully dry with clean, dry air.

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E. Inspection

SUBTASK 70-21-00-210-010-F00

- (1) Visually check the parts to make sure that there are clean and no residues are trapped in holes and recesses.

————— END OF TASK —————

TASK 70-21-00-100-808-F00

9. Vapor Degreasing with Chemical Agent

A. General



DO NOT APPLY THE VAPOR DEGREASING TO TITANIUM ALLOY PARTS, BALL BEARINGS, OR TO RUBBER OR PLASTICS PARTS. THESE MATERIALS CAN CAUSE CHLORINATED HYDROCARBONS OR VAPORS TEMPERATURES TO DAMAGE EQUIPMENT.



DO NOT INTRODUCE MOIST PARTS IN THE SOLVENT FUMES. IF YOU DO NOT OBEY, WATER IN THE BATH DECREASES ITS EFFICIENCY AND CAN CAUSE ACIDIFICATION DAMAGE OF THE PARTS.

- (1) Vapor degreasing removes greasy substances. The continuous distillation means the parts are only in contact with clean solvent, thereby improving the degreasing efficiency and speed. The condensation of the solvent vapor on the parts during the initial phase also promotes the dissolution of greases and oils.
- (2) After condensation, a spray of cold solvent can be used. The spray bar must operate below the vapor level and avoid excessive turbulence that may cause vapor in the tank to escape.
- (3) Task Light Duty Aqueous Cleaning (Immersion) with Chemical Agent, TASK 70-21-00-100-803-F00 can be used as an alternate for this task to reduce solvent use prior to other cleaning tasks. It may also be used prior to Nondestructive Test (NDT) inspections.

NOTE: Unless specified differently, the tasks that follow are considered equivalent alternatives to this task for appropriate sized metallic parts:

- Steam Cleaning with Chemical Agent, TASK 70-21-00-100-807-F00
- Light Duty Aqueous Cleaning (Spray) with Chemical Agent, TASK 70-21-00-100-806-F00
- Light Duty Aqueous Cleaning (Zestron) with Chemical Agent, TASK 70-21-00-100-805-F00.

- (4) The following equipment is required for the application of this task:
 - (a) Safety equipment and devices that are standard equipment in surface treatment shops as follows:
 - 1) Eye bath
 - 2) Emergency showers
 - 3) Protective clothing against electroplating products
 - 4) Means for neutralizing acid or alkaline splashing.
 - (b) Processing plant for neutralizing waste and used solutions.
 - (c) Efficient ventilation system for extraction and neutralizing vapors.

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- (5) The vapor degreasing station requires conditions as follows:
 - (a) A solvent tank, that is in contact with the solvent, must be zinc-plated for protection or be made from stainless steel.
 - (b) A heating coil in tank capable of heating the solution to 265°F (129°C).
 - (c) Water must be supplied to the cooling coil in sufficient amount to provide for efficient cooling of vapor in the condensation zone.
 - (d) Provide a hinged and balanced cover to enable the tank to be closed.
- (6) Only approved solvents can be used in the vapor degreasing.
 - (a) Contact the engine manufacturer for additional assistance.

B. Vapor Degreasing

SUBTASK 70-21-00-110-016-F00



YOU MUST USE PERSONAL PROTECTION EQUIPMENT WHEN YOU CLEAN WITH TOXIC SOLVENTS. USE VAPOR/FUME CONTROL OR A RESPIRATOR. DO NOT LET THIS MATERIAL TOUCH YOU. IF YOU DO NOT OBEY, INJURY TO PERSONNEL CAN OCCUR

- (1) To immerse the parts in the degreasing tank, do these steps:
 - (a) Slowly immerse the parts in the tank until they are below the condensation level of vapors.

NOTE: The tank must be maintained at the specified temperature and contain a degreasing solutions following requirements.
 - (b) Hold the parts in this position at least until the condensation stops.
 - (c) If it is necessary, spray the parts with a jet (atomized or not) of cold solvent.
 - 1) Leave to condense.
 - (d) Raise the parts slowly above the condensation level to permit drying and evaporation of the solvent.
 - 1) Drain any liquid solvent entrapped in cavities.

NOTE: These steps may be repeated with the part in various positions, particularly for parts having intricate shapes.

SUBTASK 70-21-00-020-005-F00



DO NOT GET SOLVENTS IN YOUR MOUTH, IN YOUR EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM SOLVENTS. PUT ON PROTECTIVE SPLASH GOGGLES AND GLOVES WHEN YOU USE SOLVENTS. KEEP SOLVENTS AWAY FROM SPARKS, FLAME, AND TEMPERATURES ABOVE THE FLASH POINT. SOLVENTS ARE A POISONOUS AND FLAMMABLE MATERIAL WHICH CAN CAUSE INJURY PERSONS AND DAMAGE TO EQUIPMENT.

- (2) To remove the parts from the degreasing tank, do these steps:
 - (a) Remove parts from the degreasing tank.
 - (b) Dry the parts using clean, dry air.

C. Inspection of the Parts

SUBTASK 70-21-00-210-015-F00

- (1) Make sure that all of the initial contamination has been eliminated.

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SUBTASK 70-21-00-210-016-F00

- (2) Make sure that no local build-up of contaminants has occurred during drainage and drying.

SUBTASK 70-21-00-210-017-F00

- (3) Make sure that periodic checks are made of acidity and oil content of solution per the solution sheet.

————— **END OF TASK** —————

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SPECIFICATIONS AND MATERIALS - MAINTENANCE PRACTICES

1. General

- A. This procedure contains one task:
- (1) Specifications and Materials

TASK 70-30-00-800-801-F00

2. Specifications and Materials

A. General

- (1) Specifications and materials sections contain lists of consumable materials that can be necessary during regular maintenance of the engine.
- (2) Whenever possible, consumable materials will be referenced in the Maintenance Manual by a material specification. In many cases the engine manufacture's consumable product reference number has been provided. Specifications beginning with "CP" followed by a numeric sequence (such as CP2198 or CP05-003) refer to the CFM56 Consumable Products manual. Specifications beginning with "C" followed by a numeric sequence (such as C05-003) refers to the GE Aircraft Engines Commercial Standard Practice Manual (70-80-0 - Consumable Product Section).
- (3) In the event a material is shown with no material specification, the material will be a specific vendor product or it will be commercially available.
- (4) For specific vendor information on a product, you should refer to the U-File or the IPC Specification Cross-reference Index. Or, you should refer to the qualified products list of the applicable material specification.

B. References

Reference	Title
20-30-11-910-801	Adhesives, Cements, and Sealants (P/B 201)
20-30-21-910-801	Lubricants (P/B 201)
20-30-31-910-801	Cleaners and Polishes (P/B 201)
20-30-41-910-801	Finishing Materials (P/B 201)
20-30-51-910-801	Miscellaneous Materials (P/B 201)
20-30-61-910-801	Welding Materials (P/B 201)
20-30-71-910-801	Strippers (P/B 201)
70-30-11-910-801-F00	Adhesives, Cements, and Sealants (P/B 201)
70-30-21-910-801-F00	Lubricants (P/B 201)
70-30-31-910-801-F00	Cleaners and Polishes (P/B 201)
70-30-41-910-801-F00	Finishing Materials (P/B 201)
70-30-51-910-801-F00	Miscellaneous Materials (P/B 201)

C. Procedure

SUBTASK 70-30-00-800-001-F00

- (1) Use these tasks for information on airframe consumable materials:
 - (a) Adhesives, Cements, and Sealers (TASK 20-30-11-910-801)
 - (b) Cleaners and Polishes (TASK 20-30-31-910-801)
 - (c) Finishing Materials (TASK 20-30-41-910-801)
 - (d) Lubricants (TASK 20-30-21-910-801)
 - (e) Strippers (TASK 20-30-71-910-801)

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- (f) Miscellaneous Materials (TASK 20-30-51-910-801)
- (g) Welding Materials (TASK 20-30-61-910-801)

SUBTASK 70-30-00-800-002-F00

- (2) Use these tasks for information on General Electric/CFMI engine consumable materials:
 - (a) Adhesives, Cements, and Sealers (TASK 70-30-11-910-801-F00)
 - (b) Cleaners and Polishes (TASK 70-30-31-910-801-F00)
 - (c) Finishing Materials (TASK 70-30-41-910-801-F00)
 - (d) Lubricants (TASK 70-30-21-910-801-F00)
 - (e) Miscellaneous Materials (TASK 70-30-51-910-801-F00)

———— **END OF TASK** ————

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

1. General

- A. The data in this procedure is applicable to all installations that use seals or gaskets.
- (1) Seal removal, installation and lubrication instructions are given in this procedure.
 - (2) This procedure tells you when you can continue to use a gasket.

TASK 70-30-01-910-802-F00

2. Seals (Preformed Packings and O-Rings) and Gaskets

(Figure 201)

A. Procedure

SUBTASK 70-30-01-910-001-F00

(1) Removal of the Seal.

- (a) Do not remove the seals with a sharp or pointed tool (knife-blade or a scribe) which could cause damage to the surface of the parts.

SUBTASK 70-30-01-910-002-F00

(2) Lubrication of Seals.

- (a) Lubricate the seals with lubricants recommended in the installation procedure.
- (b) Apply a light layer of the lubricant to the O-rings.
 - 1) If you apply too much lubricant, you can prevent the correct seal installation and can cause contamination.

SUBTASK 70-30-01-910-003-F00

(3) Installation of the Seal.

- (a) Use only new seals and rubber items during installation operations.
- (b) Make sure the seals are in good condition and free from cuts or gouges.
- (c) During the seal installation, be careful to install the seal correctly.
 - 1) Make sure the seal groove (recess) does not have burrs or sharp edges that can cause damage to the seal.
- (d) If an O-ring must be installed over threads or splines, use a conical sleeve to install it.
 - 1) Make sure that the conical sleeve does not have burrs or sharp edges, that can cause damage to the seal.

SUBTASK 70-30-01-910-004-F00

(4) Continued use of the Aluminum Gaskets.



CAUTION

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.

- (a) If the aluminum gasket has an imbedded flexible seal material, look for these problems:
 - 1) Look for nicks, cuts, gouges or openings across the surface of the seal material.
 - a) These are not permitted.
 - 2) Look for hard or brittle seal material.
 - a) This is not permitted.

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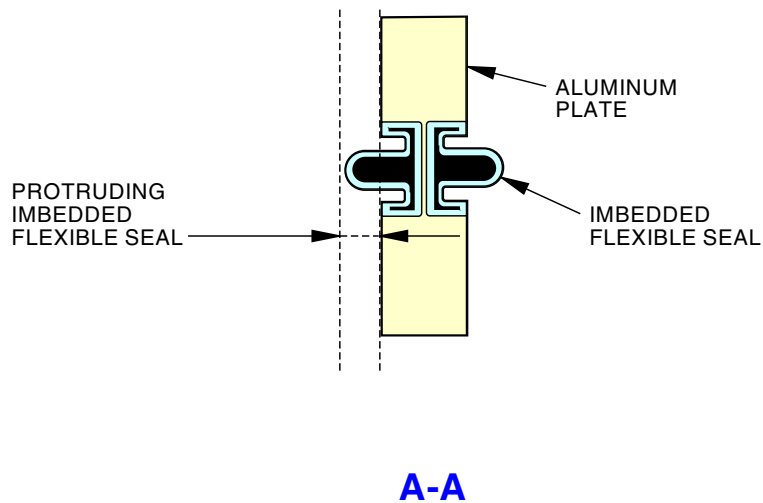
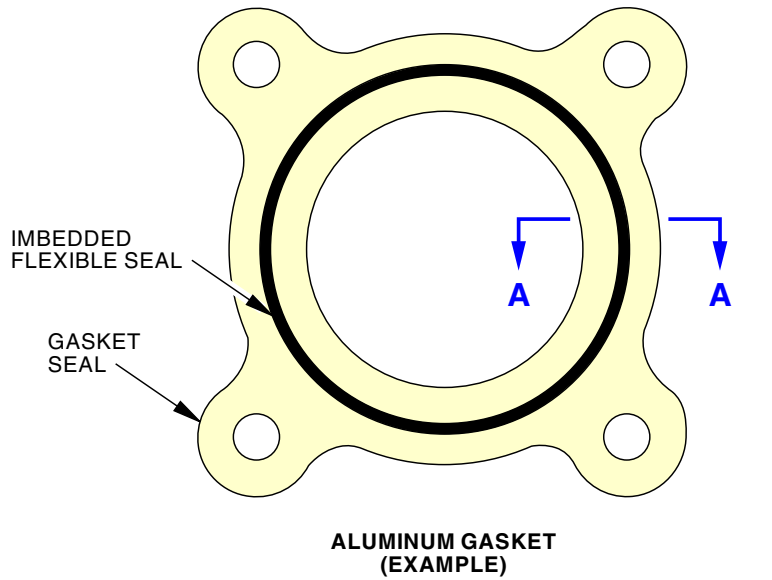
- 3) Examine the surface of the seal material for deformation that could cause a blockage of the seal.
 - a) These are not permitted.
- 4) Examine the full length of the seal surface.
- 5) Examine the imbedded flexible seal for signs of compression.
 - a) This is not permitted.
 - b) Make sure that the flexible seal extends out more than the aluminum plate level (View A-A, Figure 201).

SUBTASK 70-30-01-910-005-F00

- (5) Maintenance of the Aluminum Gaskets.
 - (a) Remove the lifted metal in the bolt hole area with a fine polishing stone or equivalent.
 - 1) Be careful not to cause damage to the seal material.
 - (b) Cut all thin, lacy seal material that extends beyond the normal seal material on the aluminum surfaces.
 - 1) Be careful not to cut or loosen the bottom of the material.

———— **END OF TASK** ————

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Aluminum Gaskets Imbedded Flexible Seal Inspection
Figure 201/70-30-01-990-801-F00

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AIRCRAFT MAINTENANCE MANUAL****ADHESIVES, CEMENTS, AND SEALANTS - MAINTENANCE PRACTICES****1. General**

- A. This procedure lists adhesives, cements, and sealants for General Electric/CFMI engine maintenance. There are no procedural steps in this procedure. Specific CP numbers are listed in the CFMI CFM56 Consumable Products Manual.

TASK 70-30-11-910-801-F00**2. Adhesives, Cements, and Sealants****A. Procedure**

SUBTASK 70-30-11-800-001-F00

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— **END OF TASK** ————

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LUBRICANTS - MAINTENANCE PRACTICES

1. General

- A. This procedure contains a list of lubricants for General Electric/CFMI engine maintenance. There are no procedural steps in this procedure. Specific CP numbers are listed in the CFMI CFM56 Consumable Products Manual.

TASK 70-30-21-910-801-F00

2. Lubricants

A. Procedure

SUBTASK 70-30-21-800-001-F00

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— **END OF TASK** ————

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AIRCRAFT MAINTENANCE MANUAL****CLEANERS AND POLISHES - MAINTENANCE PRACTICES****1. General**

- A. This procedure contains a list of cleaners and polishes for General Electric/CFMI engine maintenance. There are no procedural steps in this procedure. Specific CP numbers are listed in the CFMI CFM56 Consumable Products Manual.

TASK 70-30-31-910-801-F00**2. Cleaners and Polishes****A. Procedure**

SUBTASK 70-30-31-800-001-F00

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— **END OF TASK** ————

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AIRCRAFT MAINTENANCE MANUAL****FINISHING MATERIALS - MAINTENANCE PRACTICES****1. General**

- A. This procedure lists finishing materials for General Electric/CFMI engine maintenance. There are no procedural steps in this procedure. Specific CP numbers are listed in the CFMI CFM56 Consumable Products Manual.

TASK 70-30-41-910-801-F00**2. Finishing Materials****A. Procedure**

SUBTASK 70-30-41-800-001-F00

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— **END OF TASK** ————

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AIRCRAFT MAINTENANCE MANUAL****MISCELLANEOUS MATERIALS - MAINTENANCE PRACTICES****1. General**

- A. This procedure lists miscellaneous consumable materials for General Electric/CFMI engine maintenance. There are no procedural steps in this procedure. Specific CP numbers are listed in the CFMI CFM56 Consumable Products Manual.

TASK 70-30-51-910-801-F00**2. Miscellaneous Materials****A. Procedure**

SUBTASK 70-30-51-800-001-F00

- (1) The data contained in this task has been moved to the Introduction section of the AMM.

———— **END OF TASK** ————

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AIRCRAFT MAINTENANCE MANUAL**

FLUORESCENT PENETRANT INSPECTION - MAINTENANCE PRACTICES

1. General

- A. This procedure includes two tasks on how to do a fluorescent penetrant inspection (FPI).
 - (1) The first task is a portable post-emulsifiable inspection.
 - (2) The second task is a water washable inspection.
- B. CFMI recommends the operators use the portable post-emulsifiable system because the water washable inspection can remove the penetrant indication if too much water is used.
 - (1) Do the water washable inspection if the portable post-emulsifiable system is not available.
- C. It is permitted to substitute a penetrant system with a higher sensitivity (i.e. - substitute a level 3 or 4 for a level 2 as recommended) if the inspectors that do the inspection have a higher training, knowledge, techniques and experience in the interpretation of indications. The higher sensitivity level gives a higher background fluorescence contrast that can lead to irrelevant indications.

NOTE: Qualified products listed in QPL-AMS-2644 (Qualified Products Lists) are considered acceptable alternate products.

TASK 70-40-01-230-801-F00

2. Fluorescent Penetrant Inspection (Portable Post-Emulsifiable)

A. General

- (1) This is a portable post-emulsifiable fluorescent penetrant inspection process intended for inspection at remote locations.
 - (a) 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.
 - (b) It is convenient to use for inspection of welded or other localized repair areas.
 - (c) The penetrant is applied only to a local area that needs to be inspected.
- (2) If visible non-fluorescent color dye penetrant has been used on parts which are to be subsequently inspected with fluorescent penetrants, the contamination by the dye may prevent reliable fluorescent penetrant inspection.
- (3) Any color dye indications evident by white light visual inspection shall be considered valid indications even if not detectable by ultraviolet light.
- (4) 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.
 - (b) When using water for processing parts made of titanium or titanium alloy, deionized water should be used when it is possible.

NOTE: Deionized water is used for cleaning parts prone to contamination by mineral and organic impurities. It must be supplied with a minimum resistivity of 50000 ohm.cm or maximum conductivity of 20 μ S/cm.

- (5) Make sure you obey these instructions:
 - (a) Make sure the parts are clean before you start the inspection process.
 - (b) Plug or cap all tubes or holes in parts in the area being inspected to prevent penetrant or other material becoming entrapped.

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- (c) Fluorescent penetrants and developers used together in an inspection system should be products of one manufacturer, except when using solvent (non-aqueous) wet developer. It is permissible to use the approved solvent wet developer, Tracer-Tech D499C, with any product system.

B. Tools/Equipment

Reference	Description
STD-123	Brush - Soft Bristle
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-1070	Lens - Magnifying, 10X, Hand Held
STD-3940	Air Source - Regulated, Dry Filtered, 0-150 psig
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

C. Consumable Materials

Reference	Description	Specification
B00676 [CP1041]	Alcohol - Isopropyl	
B01058 [CP1039]	Solvent - Acetone, Reagent Grade	
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	

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Reference	Description	Specification
G50198 [CP3308]	Developer - Non-aqueous Wet Developer - Sherwin D 100	MIL-I-25135
G50199 [CP3206]	Remover - Hydrophilic Remover , Liquid - Fluro-Check E41 LF	
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	
G50203 [CP3004]	Penetrant - Fluorescent Post-emulsified Penetrant - Ardrex 985 P12	
G50204 [CP3009]	Emulsifier - Hydrophilic Emulsifier - Ardrex 9 PR12	
G50205 [CP3010]	Developer - Developer in Powder Form - Ardrex 9 D4A	

D. Prepare for the Inspection

SUBTASK 70-40-01-230-009-F00

- (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 regulated air source, STD-3940 to dry the parts.
 - 1) The air supply must have filters to remove oil and moisture to prevent the contamination of the parts or inspection materials.
 - (c) Use an ultraviolet black light, STD-569 to find the fluorescent indications.
 - (d) Use a white light, STD-572 for the visual inspection of the parts.
 - (e) Use an analog or digital timer - seconds (stop watch), STD-3943 to measure the time to do the operations.
 - (f) 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 or equivalent gages to measure the dimension of the fluorescent indications.
 - 4) Use a small, fine-hair, soft bristle brush, STD-123 or cotton swabs to apply the solvent to make an analysis of the indications that you are not sure of.

SUBTASK 70-40-01-230-010-F00

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

NOTE: All materials are used at ambient temperature. The materials that follow may be used for this class of inspection.

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(a) Penetrant (Oil Soluble)

- 1) Ardrex 985 P12 - post-emulsified penetrant, G50203 [CP3004]
- 2) post-emulsified penetrant - Britemor 555, G50182 [CP3405]
- 3) post-emulsifying penetrant - Met-L-Chek FP93A, G50191 [CP3313]
- 4) post-emulsified penetrant - Sherwin RC 50, G50195 [CP3300]
- 5) liquid penetrant - Zyglo ZL 2C, G50186 [CP3107]

(b) Hydrophilic Removers

NOTE: Hydrophilic remover concentration is 20% maximum value unless otherwise noted for the dip method. Hydrophilic remover concentration is 5% maximum for the spray application method.

- 1) Ardrex 9 PR12 - hydrophilic emulsifier, G50204 [CP3009]
- 2) Hydrophilic remover - Britemor H91-A, G50183 [CP3404]
- 3) Hydrophilic remover - Fluro-Check E41 LF, G50199 [CP3206]
- 4) Hydrophilic emulsifier - Met-L-Chek E-58D, G50192 [CP3316]
- 5) Sherwin ER 83A emulsifier liquid, G50196 [CP3306]
- 6) hydrophlic remover - Zyglo ZR 10A, G50187 [CP2137] or hydrophilic remover - Zyglo ZR 10B, G50188 [CP3105]

(c) Dry Powder Developers:

- 1) Ardrex 9 D4A - powder developer, G50205 [CP3010]
- 2) F.P.I. developer - Britemor PD 3, G50184 [CP3401] or F.P.I. developer - Britemor PD 4, G50185 [CP3406]
- 3) powder developer - Fluro-Check DD 2A, G50200 [CP3203] or powder developer - Fluro-Check DD 2B, G50201 [CP3204]
- 4) dry powder developer - Met-L-Chek D-72A, G50193 [CP3317]
- 5) developer powder - Sherwin D 90 G, G50197 [CP3307]
- 6) powder developer - Zyglo ZP 4B, G50189 [CP3102]

(d) Non-Aqueous Wet Developers

NOTE: Non-aqueous wet develops rare approved for use in aerosol spray only. Tracer-Tech solvent mixed developer 499C is approved for bulk use with any penetrant system. A developer from one manufacturer may be substituted for another manufacturer's developer.

- 1) Ardrex 9 D4A - powder developer, G50205 [CP3010]
- 2) aerosol powder developer - Fluro-Check NAD-NF, G50202 [CP2146]
- 3) wet developer - Met-L-Chek D-70, G50194 [CP3318]
- 4) wet developer - Sherwin D 100, G50198 [CP3308]
- 5) Zyglo ZP-9E/ZP-9F developer powder, G50190 [CP3106]

(e) Solvents

NOTE: It is necessary to use non-halogenated solvents on titanium parts.

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

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E. Procedure

SUBTASK 70-40-01-100-001-F00

- (1) Prepare the part for the inspection.
 - (a) You must clean the parts before the inspection procedure.
 - (b) Put a plug or cap on all the tubes holes in the area you examine.

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

SUBTASK 70-40-01-230-011-F00

- (2) Apply the penetrant.



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) Apply the penetrant with a spray gun or brush.
- (b) Allow 20 to 60 minutes for penetration.

SUBTASK 70-40-01-230-012-F00

- (3) Remove the excess penetrant (Preferred)
 - (a) Remove excess penetrant with a hydrophilic remover provided it belongs to the same family as the penetrant used.
 - 1) Do not exceed 90 seconds contact time.
 - (b) If hydrophilic remover is applied manually, do not scrub the surface of the part with the applicator.
 - (c) Use applicator only to deliver fluid to the part surface.
 - (d) Spray rinse the part with water from a squeeze bottle or spray gun.
 - 1) As an alternate, you can wipe the part with a clean dry cloth or clean cloth dampened with water.
 - a) Removal of excess penetrant done by wiping can remove the penetrant indication if excessive amount of solvent is applied.
 - b) Be careful not to affect the sensitivity of the FPI.

SUBTASK 70-40-01-230-013-F00

- (4) Remove the excess penetrant (Recommended).
 - (a) Wipe the excess penetrant with a clean dry cloth.



WARNING

CLEANING SOLVENTS ARE HIGHLY FLAMMABLE. USE PROPER PRECAUTIONS. AVOID PROLONGED INHALATION OF FUMES.

- (b) Remove background fluorescence by wiping with a clean cloth dampened with solvent.
- (c) Look at the part under ultraviolet light to make sure excess penetrant has been removed.
- (d) If excessive background fluorescence continues, apply solvent as a fine mist while you look under the ultraviolet light.
 - 1) Point the spray at an angle and spray over the area only once.

NOTE: Indications of defects can be lost by too much solvent spraying.

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SUBTASK 70-40-01-230-014-F00

- (5) Apply the developer.

**WARNING**

AVOID BREATHING VAPORS FROM FORCE-CURE OPERATION.

- (a) Apply developer by spray only to a dry part at ambient temperature.

NOTE: When you use an aerosol container, follow the manufacturer's directions.

- 1) Hold the spray nozzle about 8-10 inches (200-250 mm) from the part surface and apply a fine thin coating.
- 2) Normally two passes are adequate.
- 3) Coverage should be uniform and a metallic background should be visible through the developer.

- (b) Allow ten minutes for developer to absorb penetrant.

SUBTASK 70-40-01-230-015-F00

- (6) Do an inspection of the parts.

**CAUTION**

THE USE OF HIGH INTENSITY (125 WATT) 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.

- (a) Point the ultraviolet light on the part while in the inspection booth or darkroom.
- (b) Inspect to limits specified for the parts.
- (c) Inspect questionable indications as follows:

**WARNING**

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.

- 1) Wipe area once with solvent using a cotton swab or fine-hair art brush.
 - 2) Apply developer to suspected area after solvent has dried.
 - 3) Inspect under ultraviolet light.
 - a) Indications that show again in two minutes shall be considered as valid indications.
 - 4) If indications do not show again, inspect the part under white light with a 10-power magnifying lens.
- (d) Identify the location of defects with approved marking method.

SUBTASK 70-40-01-230-016-F00

- (7) Clean the parts after the inspection.

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ALL RESIDUAL PENETRANTS AND DEVELOPER MATERIAL MUST BE REMOVED FROM PART AS SOON AS POSSIBLE. MATERIAL NOTE REMOVED CAN CAUSE SEVERE CORROSION OF PARTS AT HIGH TEMPERATURES AND PROBLEMS DURING WELDING.

WHEN YOU CLEAN PARTS MADE OF TITANIUM OR TITANIUM ALLOYS WITH SOLVENT, USE ONLY SOLVENTS THAT DO NOT INCLUDE HALOGENS.

WHEN YOU CLEAN PARTS MADE OF TITANIUM OR TITANIUM ALLOYS WITH WATER, USE ONLY DEIONIZED WATER.

IF YOU DO NOT OBEY THESE INSTRUCTIONS, DAMAGE TO THE PARTS CAN OCCUR.

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



CLEANING SOLVENTS ARE HIGHLY FLAMMABLE. USE PROPER PRECAUTIONS. AVOID PROLONGED INHALATION OF FUMES.

- (b) Remove penetrant residue by spraying or by soaking in solvent.
- (c) Make sure that all internal passages and recesses are completely cleaned and dry.
- 1) Blow out passages and recesses with dry air.

SUBTASK 70-40-01-230-017-F00

- (8) Examine the part under ultraviolet light to make sure all penetrants and developer materials are removed.

SUBTASK 70-40-01-230-018-F00

- (9) Make sure that the residues of processing compounds are completely removed from titanium and titanium alloy parts.

————— **END OF TASK** —————

TASK 70-40-01-910-801-F00

3. Fluorescent Penetrant Inspection (Water Washable)

A. General

- (1) This procedure is for a water-washable, fluorescent-penetrant inspection procedure at the remote locations.
- (a) A portable, fluorescent-penetrant inspection is a localized procedure that is kept to small areas or a spot inspection of specified areas of parts.
- (b) Use this procedure for the inspection of welded or other confined repair areas.
- (c) Apply the penetrant only to a local area that must be examined.
- (2) CFM recommends the operators use the portable post-emulsifiable system because the water washable inspection can remove the penetrant indication if too much water is used.
- (3) If you use a nonfluorescent, color-dyed penetrant on parts that you will do an inspection with fluorescent penetrants, the contamination by the dye can prevent the correct fluorescent-penetrant inspection.
- (a) All color-dye indications shown by a white light visual inspection are correct indications, even if they are not found by ultraviolet light.

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- (4) Titanium alloy parts can get stress corrosion cracks that are caused by residues that contain halogen compounds.

NOTE: The heat from welding, heat treating or engine operation can cause the halogen compounds to combine with the titanium and cause the stress cracks.

- (a) To prevent cracks and possible component failures, use a nonhalogen cleaning compound if you think there was halogen contamination.
- (b) You must use deionized water to process the parts made of titanium or titanium alloy.
- (5) You must clean the parts before the inspection procedure.
- (6) Put a plug or cap on all the tubes or holes in the parts in the area you examine.
- NOTE:** This will keep the penetrant or other material out of the tubes and holes.
- (7) Use the fluorescent-penetrants and developers from the same manufacturer.
- NOTE:** They should be products of one manufacturer, unless you use solvent (nonaqueous) wet developer.
- (a) It is permitted to use the approved solvent-wet developer, Tracer-Tech D499C, with all product systems.

B. Tools/Equipment

Reference	Description
STD-123	Brush - Soft Bristle
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-1070	Lens - Magnifying, 10X, Hand Held
STD-1104	Bottle - HDPE Polyethylene, Capacity 500ml, with LDPE Polyethylene Internal Plug and Self Seal Polypropylene Screw Cap
STD-3940	Air Source - Regulated, Dry Filtered, 0-150 psig
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

C. Consumable Materials

Reference	Description	Specification
G00034	Cotton Wiper - Process Cleaning Absorbent Wiper (Cheesecloth, Gauze)	AMS3819 Class 1 Grade A or B Form 1 (Supersede BMS15-5 CL A)

D. Prepare for the Inspection

SUBTASK 70-40-01-230-001-F00

- (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 regulated air source, STD-3940 to dry the parts.

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- 1) The air supply must have filters to remove oil and moisture to prevent the contamination of the parts or inspection materials.
- (c) Use an ultraviolet black light, STD-569 to find the fluorescent indications.
- (d) Use a white light, STD-572 for the visual inspection of the parts.
- (e) Use an analog or digital timer - seconds (stop watch), STD-3943 to measure the time to do the operations.
- (f) 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 or equivalent to measure the dimension of the fluorescent indications.
 - 4) Use a small, fine-hair, soft bristle brush, STD-123 or cotton swabs to apply the solvent to make an analysis of the indications that you are not sure of.

SUBTASK 70-40-01-230-002-F00

- (2) Prepare the Part for the Inspection.
 - (a) You must clean the parts before the inspection procedure.
 - (b) Put a plug or cap on all the tubes and holes in the area you examine.

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

SUBTASK 70-40-01-230-003-F00

- (3) Apply the Penetrant.



KEEP THE PENETRANT AWAY FROM SPARKS, FLAME AND HEAT. THE FLASH POINT OF THE PENETRANT IS VERY LOW WHEN YOU USE IT AS A FINE SPRAY. THE PENETRANT IS FLAMMABLE WHICH CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

- (a) Apply the penetrant with a brush or with a spray gun.
- (b) Let the penetrant go into the material for 20 to 60 minutes.

SUBTASK 70-40-01-230-004-F00

- (4) Remove the Unwanted Penetrant.
 - (a) Remove the unwanted penetrant with a clean, dry cotton wiper, G00034.
 - (b) Remove the background fluorescence with a clean cloth that is moist with water.
 - (c) Examine the part with the ultraviolet light to make sure you remove the unwanted penetrant.
 - (d) If you continue to get too much unwanted fluorescence, apply the water with a squeeze polyethylene bottle (500ml), STD-1104 to clean the part.

NOTE: You must be careful to apply a minimum quantity of water because too much water will remove the indication penetrant.

SUBTASK 70-40-01-230-005-F00

- (5) Apply the Developer.

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**WARNING**

DO NOT BREATHE THE FUMES FROM THE DEVELOPER. THE DEVELOPER CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

- (a) Apply the developer with a spray, only to a dry part at ambient temperature.
 - 1) Hold the spray nozzle approximately 8-10 inches (200-250mm) from the part surface.
 - 2) Apply a fine, thin, layer of developer.
 - 3) Usually 2 layers are sufficient.
 - 4) Apply a constant layer.
 - 5) You must see a metallic background through the developer.

NOTE: When you use an aerosol container, follow the manufacturer's directions.

- (b) Let the developer absorb the penetrant for 10 to 60 minutes.

SUBTASK 70-40-01-230-006-F00

- (6) Do an Inspection of the Parts.
 - (a) Point the ultraviolet light on the part while in the inspection booth or darkroom or below a black-cloth hood.
 - (b) Examine the parts for compliance with the limits.
 - (c) Examine all indications you are not sure of as follows:

**WARNING**

DO NOT GET CLEANING SOLVENTS 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. CLEANING SOLVENT IS A POISONOUS AND FLAMMABLE SOLVENT WHICH CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

- 1) Use a cotton swab or a fine-hair, art brush to rub the area, one time, with a solvent from the consumable materials shown.
- 2) Let the solvent dry.
 - a) Apply the developer to the area you think is damaged.
- 3) Examine the part with the ultraviolet light.
 - a) Indications that come into view in less than two minutes are correct indications.
- 4) If the indications do not come into view again, examine the part below the white light with a 10-power magnifying lens.
- (d) Identify the location of the defects.
 - 1) Make a mark on the location of the defects with an approved marking procedure.

SUBTASK 70-40-01-230-007-F00

- (7) Clean the Parts after the Inspection.

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REMOVE ALL THE REMAINING PENETRANTS AND DEVELOPER MATERIAL FROM THE PART WHEN YOU CAN. WHEN YOU CLEAN THE PARTS MADE OF TITANIUM OR TITANIUM ALLOYS WITH SOLVENT, USE ONLY THE SOLVENTS THAT DO NOT CONTAIN HALOGENS. WHEN YOU CLEAN THE PARTS MADE OF TITANIUM OR TITANIUM ALLOYS WITH WATER, USE ONLY DEIONIZED WATER. MATERIAL THAT YOU DO NOT REMOVE CAN CAUSE BAD CORROSION OF THE PARTS AT THE HIGHER TEMPERATURES.

- (a) Clean the part with a water spray or with a brush and water to remove the developer and the penetrant.



DO NOT GET CLEANING SOLVENTS IN YOU 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. CLEANING SOLVENT IS A POISONOUS AND FLAMMABLE SOLVENT WHICH CAN CAUSE INJURIES TO PERSONS OR DAMAGE TO EQUIPMENT.

- (b) Apply solvent with a spray gun or soak the part in solvent to remove the remaining penetrant.
- (c) Make sure that all the internal areas and recesses are fully clean and dry.
- 1) Blow out the internal areas and recesses of the part with dry air.

SUBTASK 70-40-01-230-008-F00

- (8) Quality Assurance.

- (a) Examine the part below the ultraviolet light.
- 1) Make sure you remove all the penetrants and developer materials.
- (b) Make sure you remove the remaining compounds fully from the parts made of titanium and the titanium alloy.

————— **END OF TASK** —————

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FAN BLADE LEADING EDGE EDDY CURRENT INSPECTION

1. General

A. This procedure includes one task:

- (1) The Fan Blade Leading Edge Eddy Current Inspection.

TASK 70-40-02-200-801-F00

2. Fan Blade Leading Edge Eddy Current Inspection

(Figure 201 and Figure 202)

A. General

- (1) This procedure gives the instructions to do the inspection of the fan blade leading edge with the high-frequency MHz manual eddy current.
- (2) The inspection personnel requirements are as follows:
 - (a) The personnel who perform this inspection must be certified to one of the these: NAS410 / EN4179 level 2 minimum or of equivalent standard as recognized by the Airworthiness Authority of the personnel.
 - (b) The personnel who perform this inspection must receive practical training in the use of this procedure and must demonstrate proficiency in the calibration and evaluation routines before accept or reject authority is delegated.
 - (c) Training per this procedure does not imply personnel certification per NAS-410, or SNT-TC-1A, or COSAC, Procedure EN4179.
- (3) The documents that follow shall form a part of this procedure to the extent specified herein. Unless a specific issue is specified, the latest revision shall apply.
 - (a) Appropriate equipment instruction manuals.
 - (b) NAS-410, SNT-TC-1A, COSAC, EN4179, or ATA 105.
 - (c) Appropriate Manual procedure.

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-8469	Test Instrument - Eddy Current
	Part #: ELOTEST B300 Supplier: C3090
	Part #: ELOTEST M3 Supplier: C3090
	Part #: NORTEC 600C Supplier: 29192
	Part #: NORTEC 600D Supplier: 29192
	Part #: NORTEC 600S Supplier: 29192
	Part #: NORTEC WORKSTATION Supplier: 29192
	Part #: PHASEC 2 & 3 SERIES (S&D) Supplier: 1KY21
	Part #: PHASEC 2200 Supplier: 1KY21
	Opt Part #: ELOTEST B1 Supplier: C3090
	Opt Part #: ELOTEST B1V4 Supplier: C3090
	Opt Part #: ELOTEST M2 Supplier: C3090
	Opt Part #: NORTEC 1000S+ Supplier: 29192
	Opt Part #: NORTEC 2000D+ Supplier: 29192
	Opt Part #: NORTEC 2000S & S+ Supplier: 29192
	Opt Part #: NORTEC 500 Supplier: 29192

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Reference	Description
SPL-8468	Inspection Kit - Eddy Current Part #: 856A2682G01 Supplier: 58828

C. Consumable Materials

Reference	Description	Specification
B00148	Solvent - Methyl Ethyl Ketone (MEK)	ASTM D740
G02449 [CP2189]	Cloth - Abrasive, Silicone Carbide, 150 Grit - Durite G422	
G02450 [CP2191]	Cloth - Abrasive, Silicone Carbide, 180 Grit - Durite G421	

D. Location Zones

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

E. Prepare for the Eddy Current Inspection

SUBTASK 70-40-02-840-001-F00

- (1) Prepare the leading edge.
 - (a) Clean the edge of the blade with solvent, B00148.
 - (b) If it is necessary, lightly remove the small surface defects with Durite G422 cloth, G02449 [CP2189] or Durite G421 cloth, G02450 [CP2191].
- (2) Prepare for the calibration.
 - (a) Initial calibration:
 - 1) Frequency: 3.0 MHz
 - 2) Rotation: To be adjusted to have a vertical screen indicator
 - 3) Low-Pass Filter: 100.0 Hz
 - 4) High-Pass Filter: Off
 - 5) Gain: To be adjusted during calibration procedure (ELOTES -35.0 dB, NORTEC -50 dB).
 - (b) Calibration procedure with the 9970 958 389P01 or 9970 958 390P01 probe from eddy current inspection kit, SPL-8468.
 - 1) Install the probe on the eddy current test instrument, COM-8469.
NOTE: Make sure that the teflon is changed at regular time.
 - (c) Apply a new small piece of teflon tape on the coil of each probe.
 - (d) Calibration.
NOTE: You must do the calibration at the beginning and at the end of the inspection, every fifth blade and at any change of any component. You must perform the calibration of the instrumentation when it has been turned off.
 - 1) Put the coil away from the notch of the Electro Discharge Machining (EDM) on the "not blended" area.
 - 2) Set the EDM to zero.
NOTE: The point is in the middle of the screen.

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- 3) Examine the surface along the "not blended" area with the probe and adjust the gain and rotation to have a peak to peak on full screen with a vertical indication when the coil touches the EDM notch.
- 4) Keep the same parameters and put the coil away from the notch of the EDM.
- 5) Set the EDM to zero on the blended area.
- 6) Examine the bottom of the blended area with the EDM notch.
- 7) If the indication is equal to or less than a half of full screen, adjust the parameters that follow:
 - a) Hand position, movement of examination, gain and rotation to have a full screen indication on the EDM notch of the "not blended" area and more than a half of full screen in the "blended" area.

F. Procedure

SUBTASK 70-40-02-250-001-F00

- (1) Do a first inspection of the leading edge of the blade with the 9970 958 389P01 probe from eddy current inspection kit, SPL-8468.

NOTE: You must perform two inspections with two different probes because of the design of the blade (shape and different thickness), especially in the blended areas.

NOTE: The 9970 958 389P01 probe is included in the eddy current inspection kit.

- (a) Put the probe in position with its coil in contact with the pressure face with the same adjustment than for calibration.

- 1) Make sure that the coil is always in contact with the inspected area.

- (b) Move the probe to examine the surface along the leading edge.

NOTE: You can perform this inspection a second time if it is not sufficient.

- (c) Put the probe in position with its coil in contact with the suction face with the same adjustment than for calibration.

- 1) Make sure that the coil is always in contact with the inspected area.

- (d) Move the probe to examine the surface along the leading edge.

NOTE: You can perform this inspection a second time if it is not sufficient.

NOTE: You can move the probe three times or more across the blade section to make sure that the indication is not a malfunction.

- (e) Set to zero each time the probe touches a blended area.

SUBTASK 70-40-02-250-002-F00

- (2) Do a second inspection of the leading edge of the blade with the 9970 958 390P01 probe from eddy current inspection kit, SPL-8468.

NOTE: The 9970 958 390P01 probe is included in the eddy current inspection kit.

- (a) Put the probe in position with its coil in contact with the pressure face with the same adjustment than for calibration.

- 1) Make sure that the coil is always in contact with the inspected area.

- (b) Move the probe to examine the surface along the leading edge.

NOTE: You can perform this inspection a second time if it is not sufficient.

- (c) Put the probe in position with its coil in contact with the suction face with the same adjustment than for calibration.

- 1) Make sure that the coil is always in contact with the inspected area.

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- (d) Move the probe to examine the surface along the leading edge.

NOTE: You can perform this inspection a second time if it is not sufficient.

NOTE: You can move the probe three times or more across the blade section to make sure that the indication is not a malfunction.

- (e) Set to zero each time the probe touches a blended area.

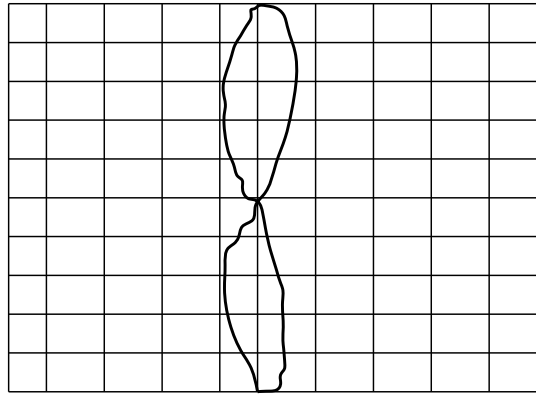
SUBTASK 70-40-02-869-001-F00**(3) Inspection Criteria**

- (a) If you measure an indication equal to or more than 25 percent of full screen in a blended or non-blended area, you must do the evaluation of the indication.
- (b) If you measure an indication equal to or more than 50 percent of full screen in a blended or non-blended area, you must discard the part.

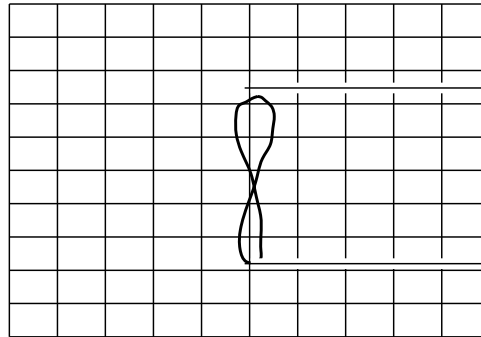
SUBTASK 70-40-02-869-002-F00**(4) Evaluation of the Indication**

- (a) Make sure that the calibration procedure was done correctly.
- (b) Make sure that two checks were done with the two probes on the suction and pressure faces around the area you examine.
- (c) If the indication is equal to or more than 25 percent of full screen, discard the part.
- (d) If you have no indication or an indication less than 25 percent of full screen, the part is acceptable.

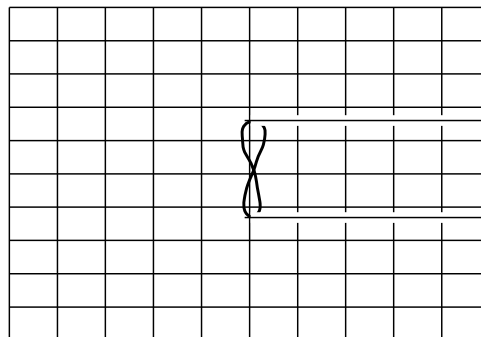
———— **END OF TASK** ————



FULL SCREEN



50% OF FULL SCREEN



25% OF FULL SCREEN

S-M56-SP-00315-00-B

1427222 S0000258216_V3

Monitor Indications (Typical)
Figure 201/70-40-02-990-801-F00

EFFECTIVITY
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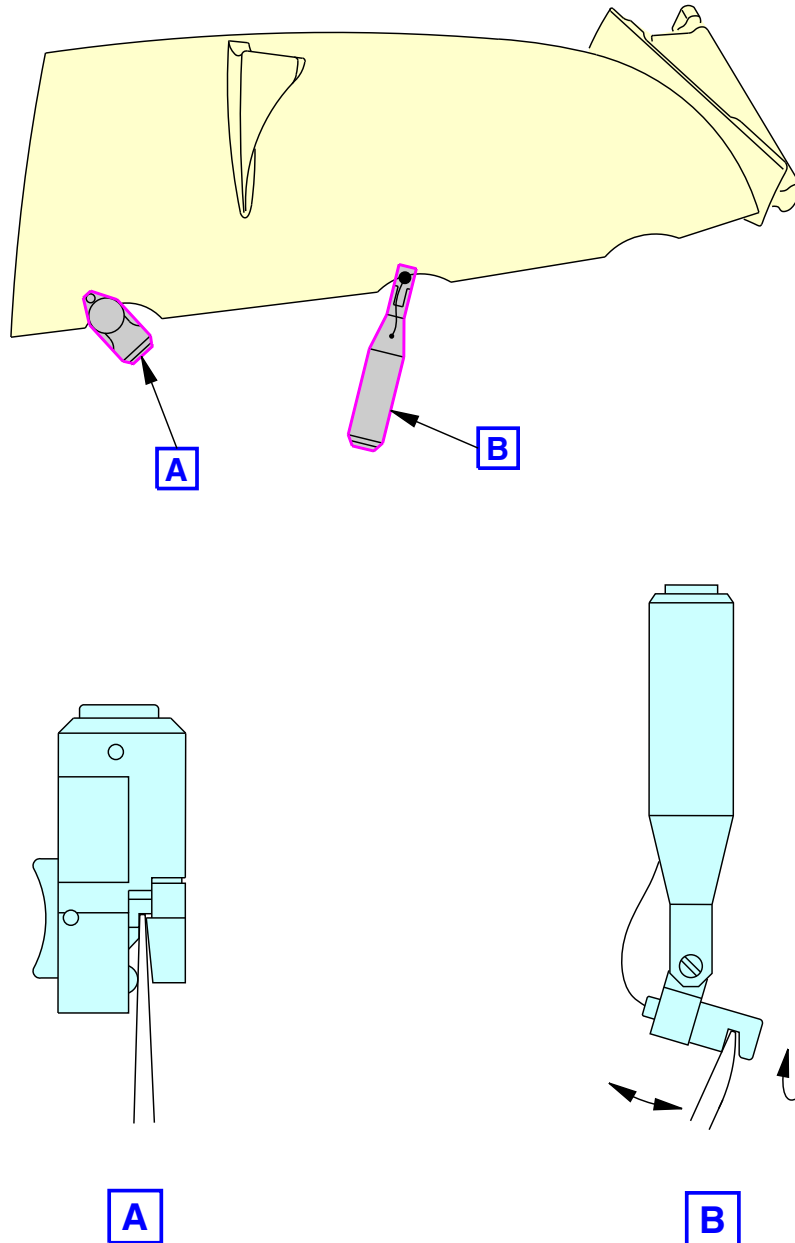
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

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**NOTE:**

THE INSPECTION IS DONE ON THE TWO SUCTION
AND PRESSURE FACES

S-M56-SP-00314-00-B
1427335 S0000258217_V3

Probe Position
Figure 202/70-40-02-990-802-F00

EFFECTIVITY
LOM 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 70-43-02-910-801-F00

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 CFM-56 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 70-43-02-910-001-F00

- (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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SUBTASK 70-43-02-910-002-F00

- (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 70-43-02-910-003-F00

- (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 70-43-02-910-004-F00

- (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 70-43-02-910-005-F00

- (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 70-43-02-910-006-F00

- (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 70-43-02-910-007-F00

(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 70-43-02-910-008-F00

(1) The acceptance limits for rivets are defined in each standard practice specific to a rivet type.

D. Rivet Installation

SUBTASK 70-43-02-910-009-F00

(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 70-43-02-910-010-F00

(1) Identification of solid shank rivets.

Table 201/70-43-02-993-801-F00

REFERENCE	TYPE OF HEAD	MATERIAL	MARKING	IDENTIFICATION	COLOR
21215DB	FLAT ROUND	AG5MC			GREEN
21217DB	100° COUNTERSUNK		IN RELIEF	(View A, Figure 210)	
21215CA	FLAT ROUND	Z2CN18-10			YELLOW
21217CA	100° COUNTERSUNK		RECESSED	(View B, Figure 210)	
21215TC	FLAT ROUND	NC15Fe			
21217TC	100° COUNTERSUNK		IN RELIEF	(View C, Figure 210)	

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SUBTASK 70-43-02-910-011-F00

(2) Identification of blind bold rivets (Figure 203).

Table 202/70-43-02-993-802-F00

REFERENCE	MANUFACTURER	HEAD	MATERIAL	EQUIVALENTS
PLT 200 PLT 221*[1]	NATIONAL SCREW	HEXAGONAL	Z6 NCT 25	NAS 1671 NAS 1753*[1]
PLT 1005 PLT 1006*[1]	NATIONAL SCREW	100° COUNTERSUNK	Z6 NCT 25	

*[1] Series with repair dimensions.

SUBTASK 70-43-02-910-012-F00

(3) Identification of Hi-Lok bolt rivets (Figure 209).

Table 203/70-43-02-993-803-F00

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 70-43-02-910-013-F00

(4) Identification of CHERRYLOCK Rivets.

(a) Standard CHERRYLOCK rivets (Figure 204).

Table 204/70-43-02-993-804-F00

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 205).

SUBTASK 70-43-02-910-014-F00

(5) Identification of CHERRYMAX rivets (Figure 206).

SUBTASK 70-43-02-910-015-F00

(6) Identification of HUCK rivets (Figure 207).

Table 205/70-43-02-993-805-F00

PART NO.	HEAD TYPE	MATERIAL
NAS 1919 B	PROTRUDING	ALU 5056
NAS 1921 B	COUNTERSUNK	ALU 5056

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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL****Table 205/70-43-02-993-805-F00 (Continued)**

PART NO.	HEAD TYPE	MATERIAL
NAS 1919 M	PROTRUDING	MONEL
NAS 1921 M	COUNTERSUNK	MONEL

NOTE: No identification for aluminium.

SUBTASK 70-43-02-910-016-F00

(7) Identification of HUCK bolt rivets (Figure 208).

———— **END OF TASK** ————

EFFECTIVITY
LOM ALL

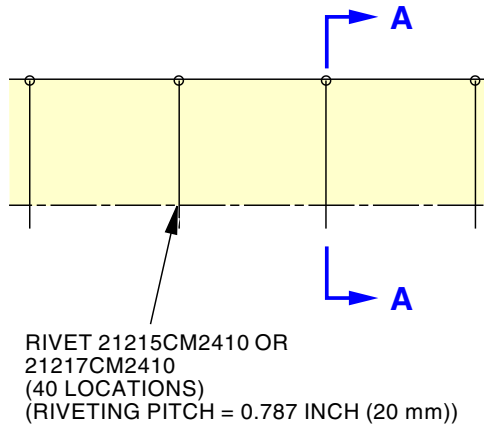
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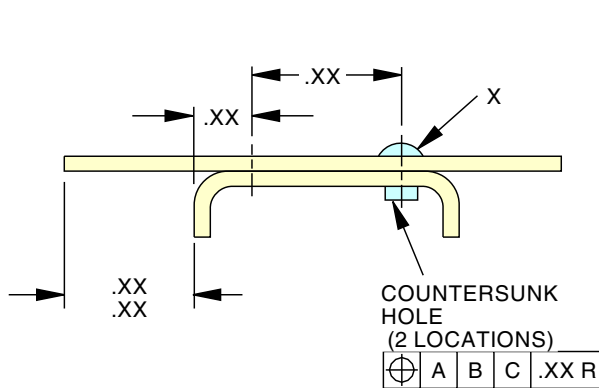
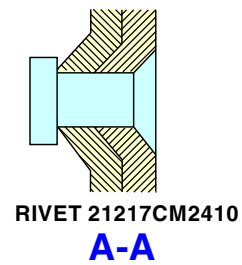
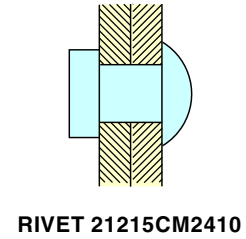
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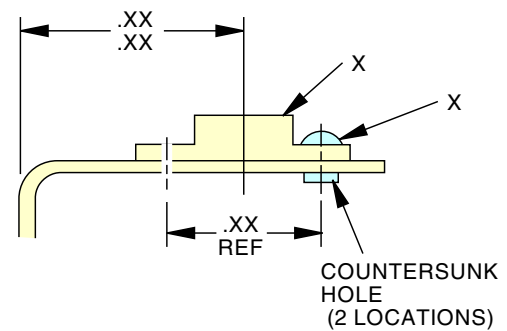
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AIRCRAFT MAINTENANCE MANUAL**



A



TWO PARTS MADE BY CFMI



**PART MADE BY CFMI USED ON A
COMMERCIALY AVAILABLE PART**

2995749 S0000772135_V1

**Method of Representing Rivets
Figure 201/70-43-02-990-801-F00**

**EFFECTIVITY
LOM ALL**

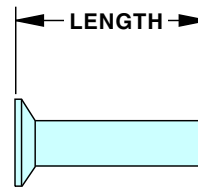
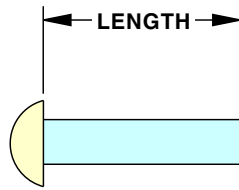
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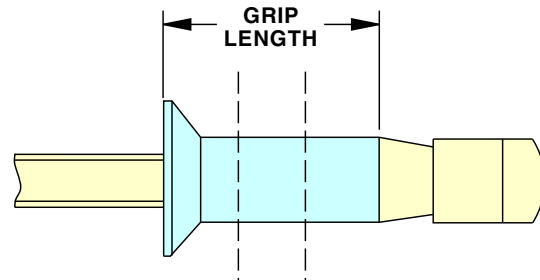
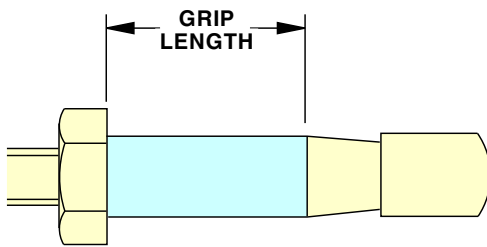
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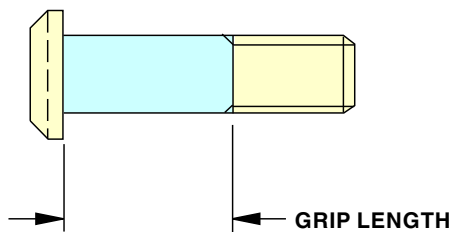
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FULL SHANK RIVET

A

BLIND BOLT RIVETS

B

HI-LOK BOLT RIVETS

C

2995751 S0000772137_V1

Effective Length Definition
Figure 202/70-43-02-990-802-F00 (Sheet 1 of 2)

EFFECTIVITY
LOM ALL

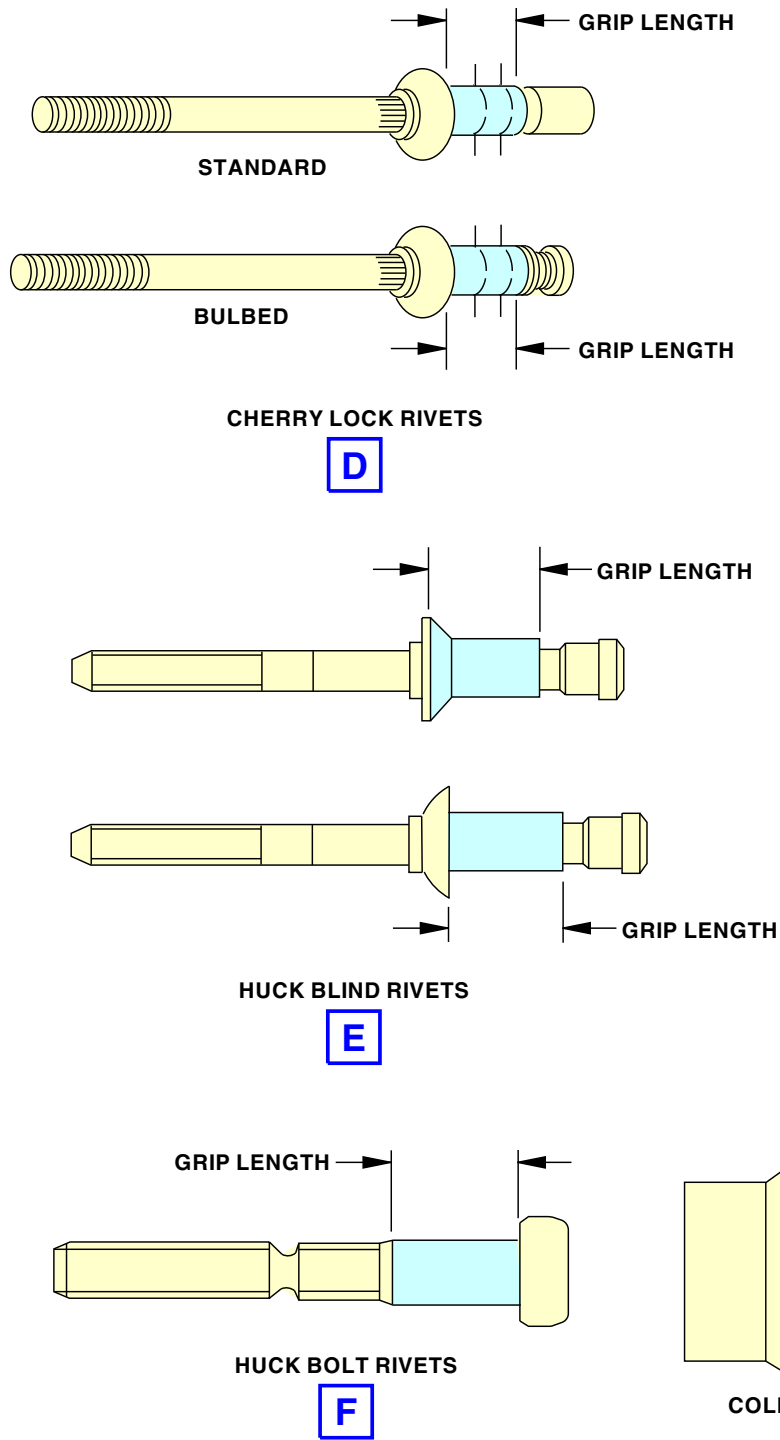
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2995753 S0000772138_V1

Effective Length Definition
Figure 202/70-43-02-990-802-F00 (Sheet 2 of 2)

EFFECTIVITY
LOM ALL

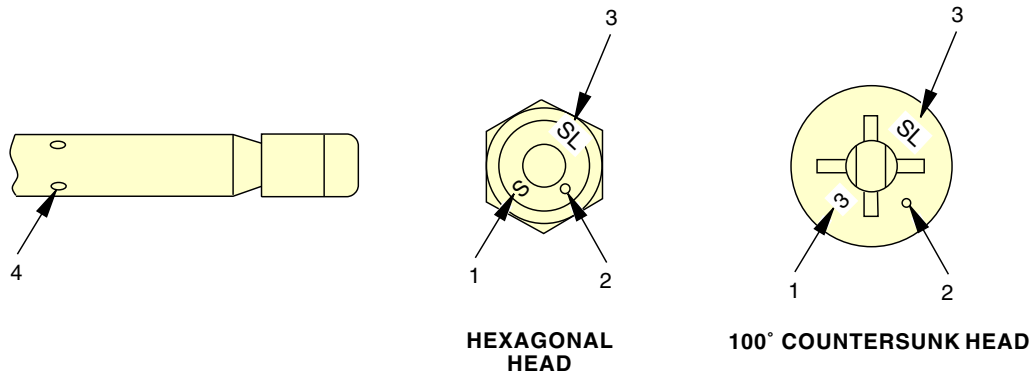
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**LEGEND:**

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

2995758 S0000772139_V1

**Blind Rivets Identification
Figure 203/70-43-02-990-803-F00**

EFFECTIVITY
LOM ALL

D633A101-LOM

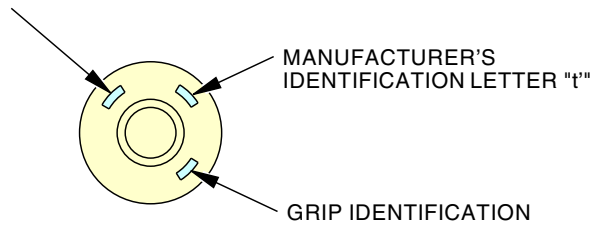
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MATERIAL CODE:

M: MONEL
C: A286
X: INCONEL X 750



2995759 S0000772140_V1

Standard Cherrylock Rivets Identification
Figure 204/70-43-02-990-804-F00

EFFECTIVITY
LOM ALL

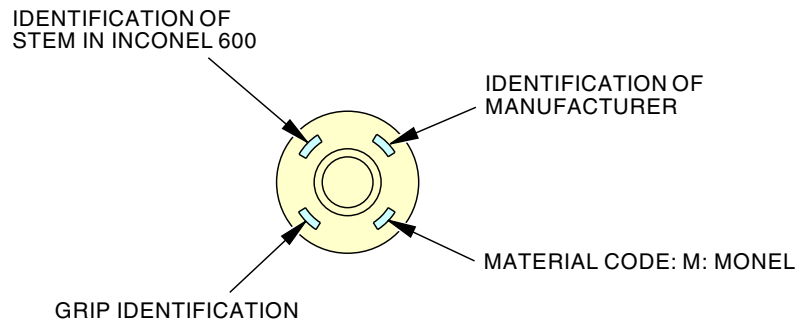
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2995760 S0000772141_V1

**Bulbed Cherrylock Rivets Identification
Figure 205/70-43-02-990-805-F00**

EFFECTIVITY
LOM ALL

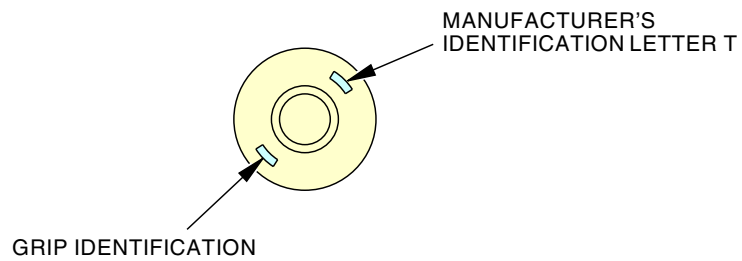
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2995761 S0000772142_V1

Cherrymax Rivets Identification
Figure 206/70-43-02-990-806-F00

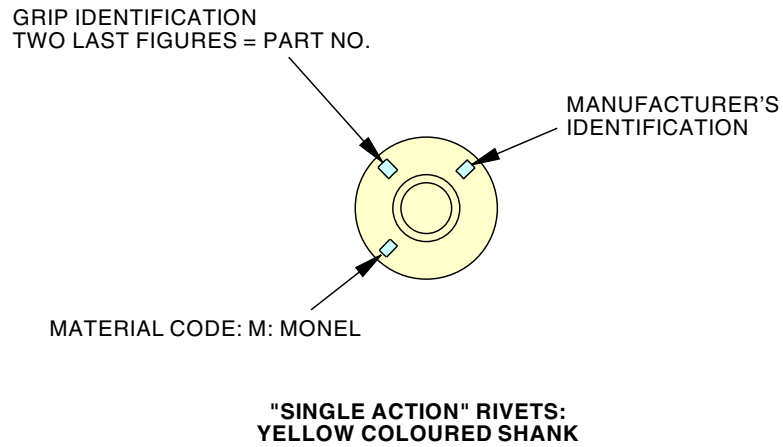
EFFECTIVITY
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2995762 S0000772145_V1

**Huck Rivets Identification
Figure 207/70-43-02-990-807-F00**

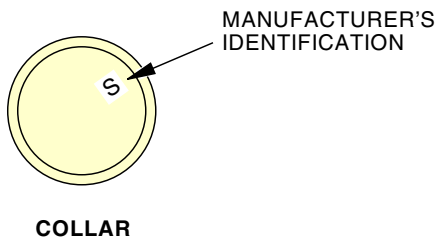
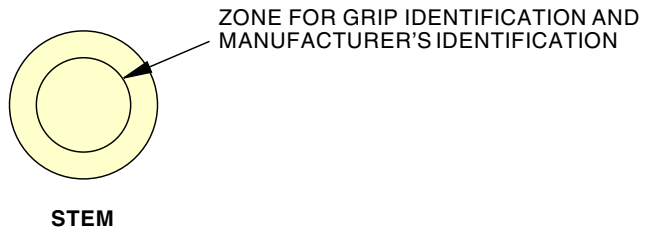
EFFECTIVITY
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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL****NOTE:**

FOR STANDARD RIVETS, MARKING IS ENGRAVED.

FOR REPAIR RIVETS, MARKING ZONE IS
RECESSED WITH INDICATIONS IN RELIEF

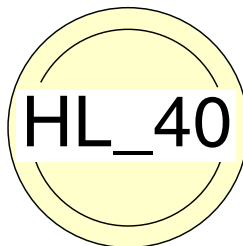
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**Huck Bolt Rivet Collars Identification
Figure 208/70-43-02-990-808-F00****EFFECTIVITY**
LOM ALL

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2995769 S0000772147_V1

Hi-lok Bolt Rivets Identification
Figure 209/70-43-02-990-809-F00

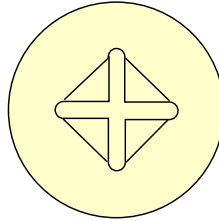
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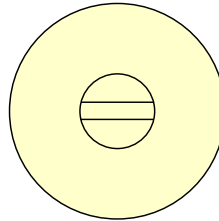
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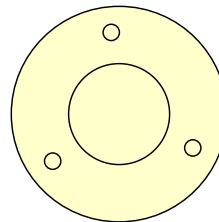
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A



B



C

2995770 S0000772148_V1

Solid Shank Rivets Identification
Figure 210/70-43-02-990-810-F00

EFFECTIVITY
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SPOT TOUCH UP - REPAIRS

1. General

- A. This procedure has this task:
- (1) Spot Touch Up of Sulfuric Anodizing.

TASK 70-43-07-300-801-F00

2. Spot Touch Up of Sulfuric Anodizing

(Figure 801)

A. **General**

- (1) This task gives instructions to spot touch-up of sulfuric anodizing on the containment case.
- (2) This task is only applicable for two or less areas of 0.31 in² (200 mm²).
- (3) You can use equivalent alternatives for tools, equipment, and consumable materials.

B. **References**

Reference	Title
70-10-04-380-801-F00	Spot Touch-Up of Oxide Film Coating on Aluminum Alloys for Protection (P/B 201)
70-10-16-330-801-F00	Masking with Wax (Surfaces Protection) (P/B 801)
71-11-02-010-801-F00	Open the Fan Cowl Panels (P/B 201)
71-11-02-410-801-F00	Close the Fan Cowl Panels (P/B 201)
78-31-00-010-801-F00	Open the Thrust Reverser (Selection) (P/B 201)
78-31-00-010-804-F00	Close the Thrust Reverser (Selection) (P/B 201)
78-31-00-040-802-F00	Thrust Reverser Deactivation For Ground Maintenance (P/B 201)
78-31-00-440-803-F00	Thrust Reverser Activation After Ground Maintenance (P/B 201)

C. **Tools/Equipment**

Reference	Description
STD-858	Tag - DO NOT OPERATE

D. **Location Zones**

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

E. **Prepare for the Spot Touch up of Sulfuric Anodizing**

SUBTASK 70-43-07-860-001-F00

- (1) For Engine 1, open this circuit breaker and install a safety tag:

CAPT Electrical System Panel, P18-2

Row	Col	Number	Name
B	8	C01103	ENGINE 1 START VALVE

SUBTASK 70-43-07-860-002-F00

- (2) For Engine 2, open this circuit breaker and install a safety tag:

F/O Electrical System Panel, P6-2

Row	Col	Number	Name
C	4	C00154	ENGINE 2 START VALVE

EFFECTIVITY
LOM ALL

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SUBTASK 70-43-07-040-001-F00

- (3) Make sure that the START switches are in the OFF position.
- (a) Install a DO NOT OPERATE tag, STD-858, on the applicable START switch.

SUBTASK 70-43-07-010-001-F00

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

**WARNING**

DO THE DEACTIVATION PROCEDURE FOR THE THRUST REVERSER IN THE FORWARD THRUST POSITION. INSTALL THE THRUST REVERSER LOCKS. THE ACCIDENTAL OPERATION OF THE THRUST REVERSER CAN CAUSE INJURIES TO PERSONNEL AND DAMAGE TO EQUIPMENT.

- (a) Do this task: Thrust Reverser Deactivation For Ground Maintenance, TASK 78-31-00-040-802-F00.
- (b) Open the left and right fan cowl panels (TASK 71-11-02-010-801-F00).

**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 left and right thrust reversers TASK 78-31-00-010-801-F00.

F. Spot Touch Up of Sulfuric Anodizing

NOTE: You can disassemble the Fan Frame Module to get the accessibility necessary to do the repair.

SUBTASK 70-43-07-330-001-F00

**WARNING**

TRICHLOROETHYLENE IS TOXIC AND INJURIOUS TO SKIN. USE TRICHLOROETHYLENE IN A WELL-VENTILATED AREA WITH APPROVED SAFETY EQUIPMENT.

- (1) If it is necessary, apply masking on the Hi-Lite bolts, on the Hi-Lite nuts, on the riveted self-locking nuts, on the gang channel nuts and on areas to mask (Figure 801, Masking with Wax (Surfaces Protection), TASK 70-10-16-330-801-F00).

SUBTASK 70-43-07-380-001-F00

- (2) Do a spot touch up (TASK 70-10-04-380-801-F00).

SUBTASK 70-43-07-020-001-F00

- (3) If it is necessary, remove the masking.

G. Put the Airplane Back to Its Usual Condition

SUBTASK 70-43-07-480-001-F00

- (1) Make sure that you remove all tools, parts and unwanted material from the fan frame shroud.

SUBTASK 70-43-07-480-002-F00

- (2) Remove the DO NOT OPERATE tag from the START switch.

EFFECTIVITY
LOM ALL

70-43-07

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SUBTASK 70-43-07-860-003-F00

- (3) For Engine 1, remove the safety tag and close this circuit breaker:

CAPT Electrical System Panel, P18-2

<u>Row</u>	<u>Col</u>	<u>Number</u>	<u>Name</u>
B	8	C01103	ENGINE 1 START VALVE

SUBTASK 70-43-07-860-004-F00

- (4) For Engine 2, remove the safety tag and close this circuit breaker:

F/O Electrical System Panel, P6-2

<u>Row</u>	<u>Col</u>	<u>Number</u>	<u>Name</u>
C	4	C00154	ENGINE 2 START VALVE

SUBTASK 70-43-07-410-001-F00



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

- (5) Do these tasks in sequence to safely close the left and right thrust reversers.
- (a) Do this task: Close the Thrust Reverser (Selection), TASK 78-31-00-010-804-F00.
 - (b) Do this task: Close the Fan Cowl Panels, TASK 71-11-02-410-801-F00.
 - (c) Do this task: Thrust Reverser Activation After Ground Maintenance, TASK 78-31-00-440-803-F00.

———— **END OF TASK** ————

EFFECTIVITY
LOM ALL

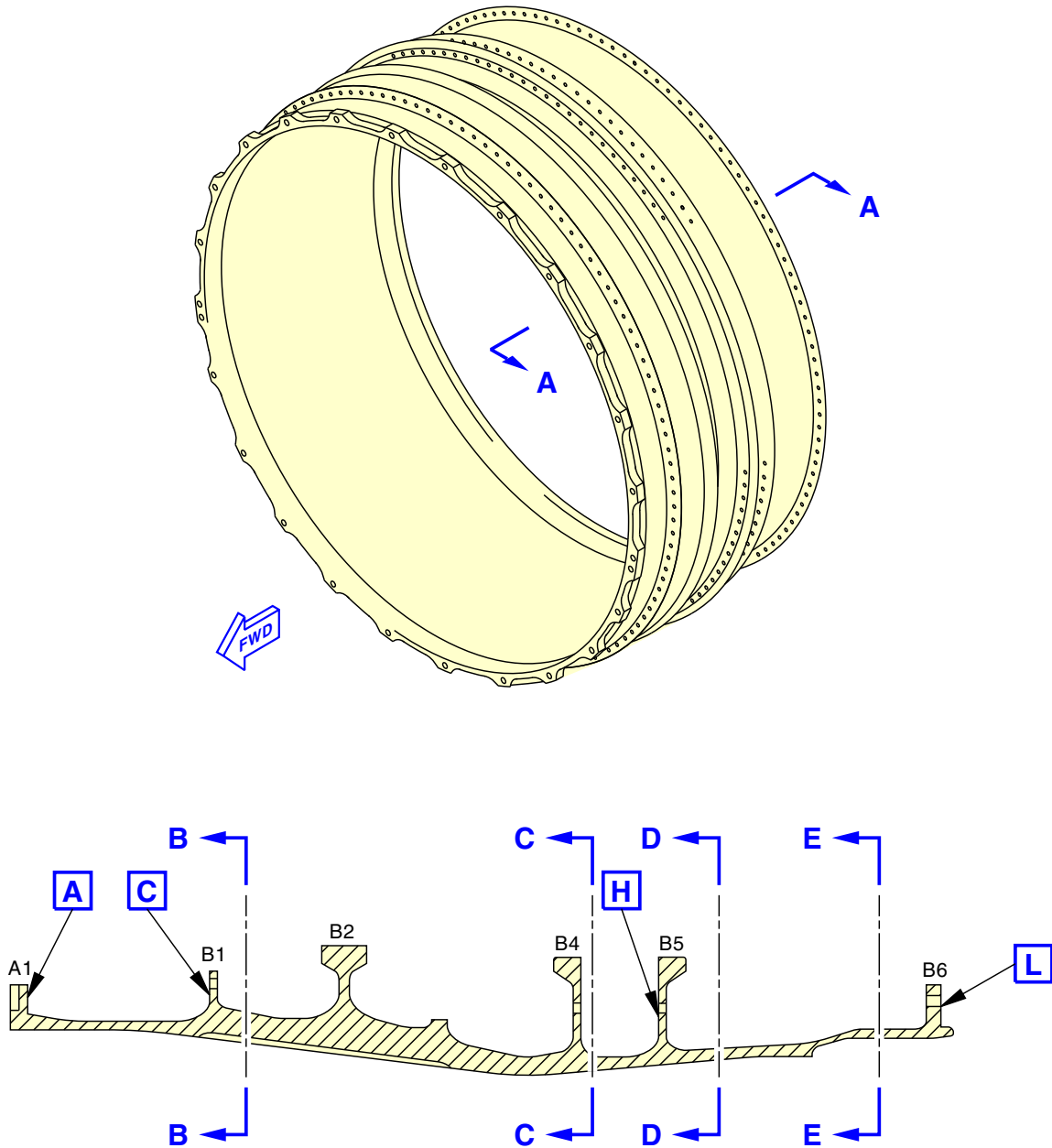
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AIRCRAFT MAINTENANCE MANUAL



MATERIAL: 6061 (AGSU T6)
COATING: SULFURIC ANODIZATION

A-A

2993528 S0000770288_V1

Definition of Areas not Anodized
Figure 801/70-43-07-990-802-F00 (Sheet 1 of 9)

EFFECTIVITY
LOM ALL

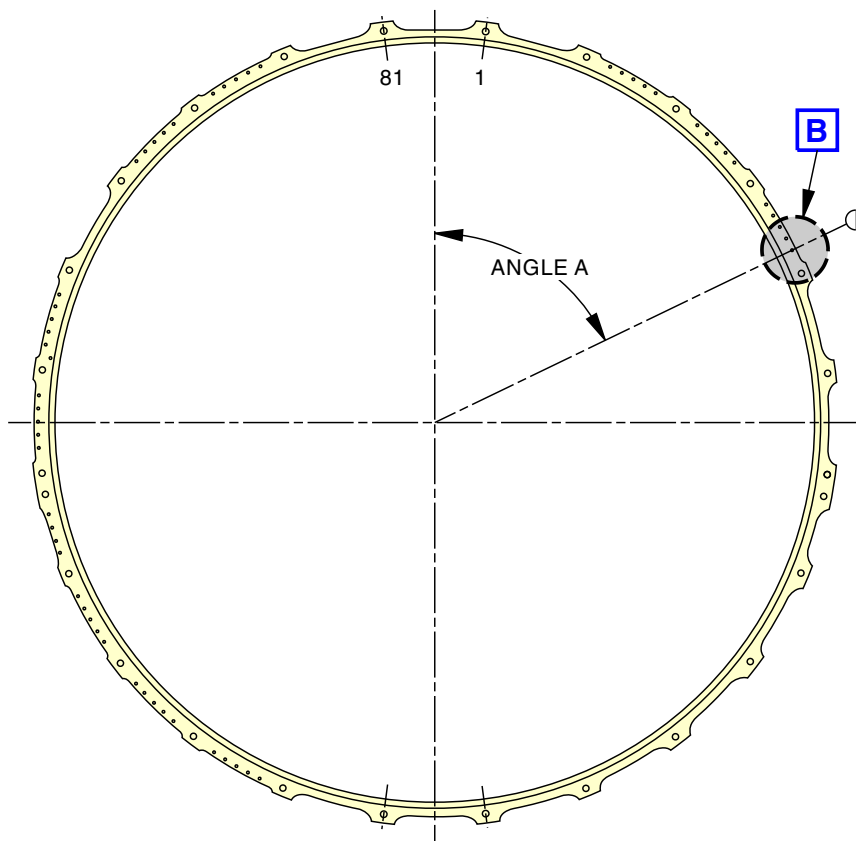
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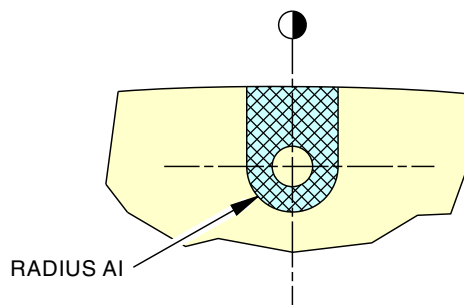
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AIRCRAFT MAINTENANCE MANUAL



(VIEW IN THE FORWARD DIRECTION)

A



LEGEND:



AREA NOT ANODIZED



MISSING PROTECTIVE COATING (ANODIZATION)

B

2993626 S0000770289_V1

Definition of Areas not Anodized
Figure 801/70-43-07-990-802-F00 (Sheet 2 of 9)

EFFECTIVITY
LOM ALL

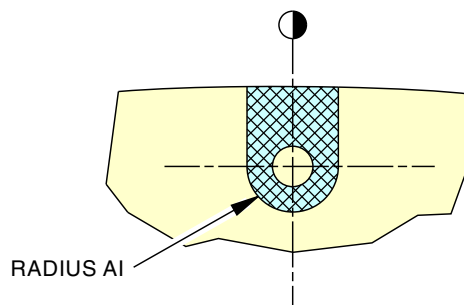
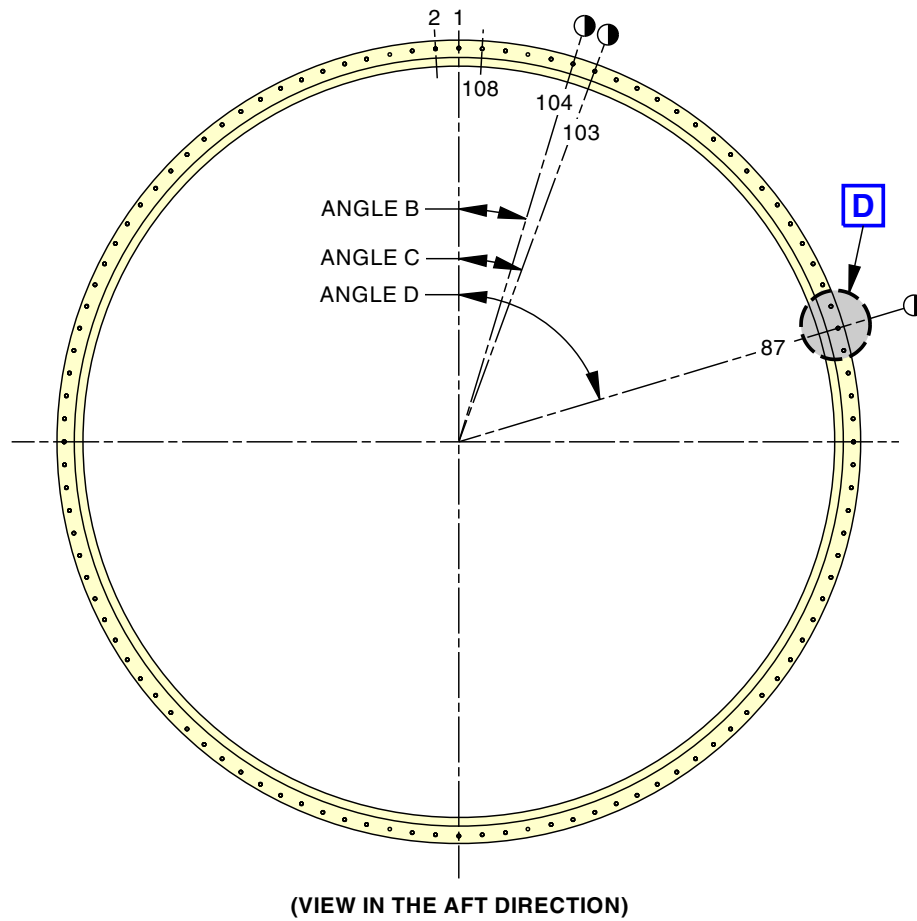
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**LEGEND:**

AREA NOT ANODIZED



MISSING PROTECTIVE COATING (ANODIZATION)

2993729 S0000770290_V1

Definition of Areas not Anodized
Figure 801/70-43-07-990-802-F00 (Sheet 3 of 9)

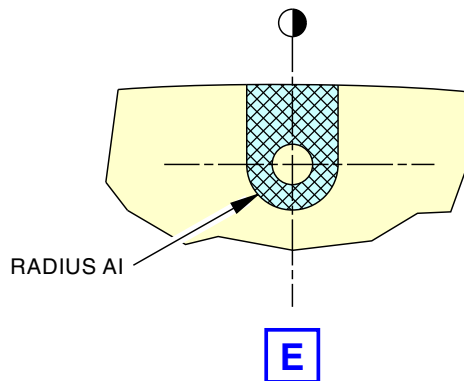
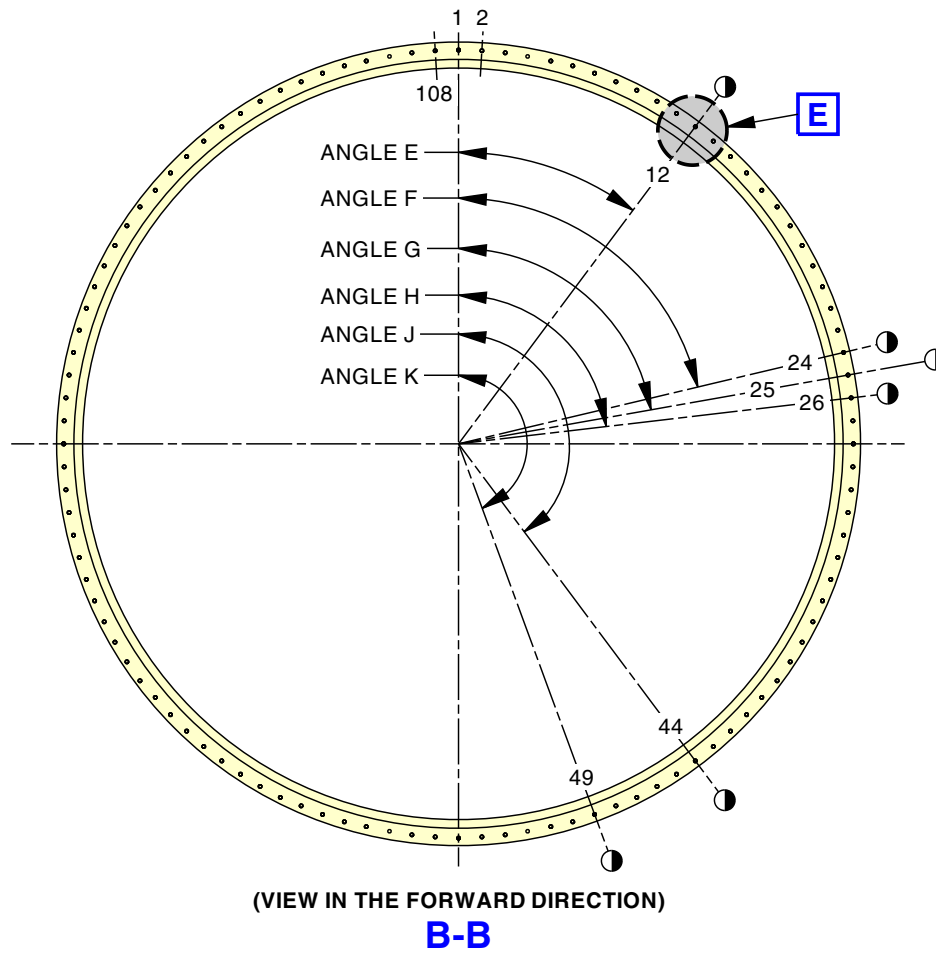
EFFECTIVITY
 LOM ALL

D633A101-LOM

ECCN 9E991 BOEING PROPRIETARY - See title page for details

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**LEGEND:**

AREA NOT ANODIZED



MISSING PROTECTIVE COATING (ANODIZATION)

2993743 S0000770291_V1

Definition of Areas not Anodized
Figure 801/70-43-07-990-802-F00 (Sheet 4 of 9)

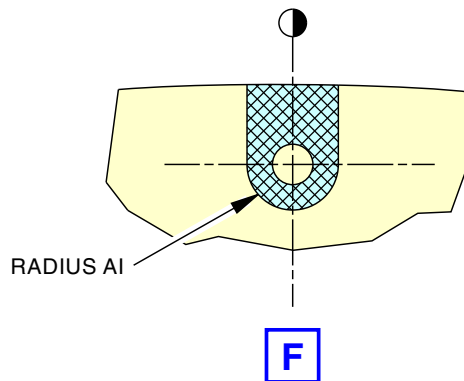
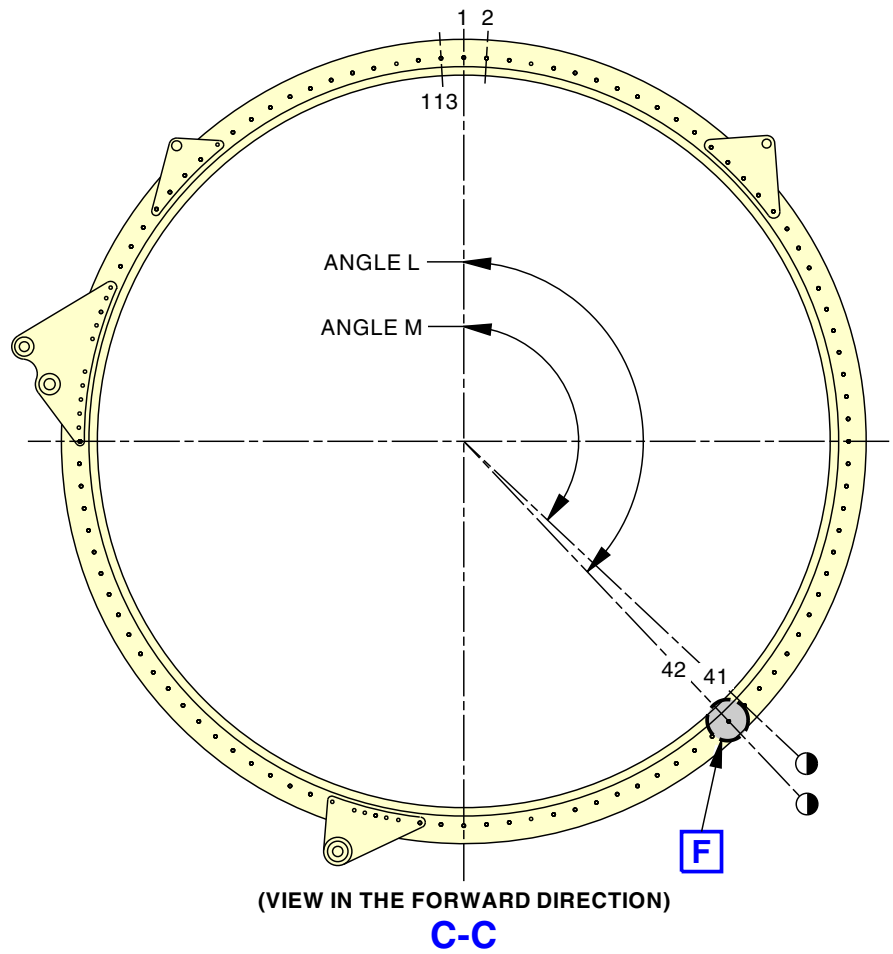
EFFECTIVITY
 LOM ALL

D633A101-LOM



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LEGEND:

-  AREA NOT ANODIZED
 MISSING PROTECTIVE COATING (ANODIZATION)

2993747 S0000770292_V1

Definition of Areas not Anodized
Figure 801/70-43-07-990-802-F00 (Sheet 5 of 9)

— EFFECTIVITY
LOM ALL

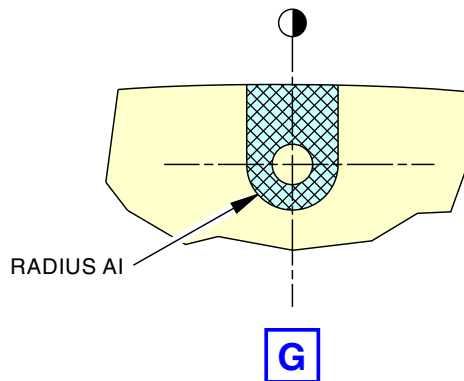
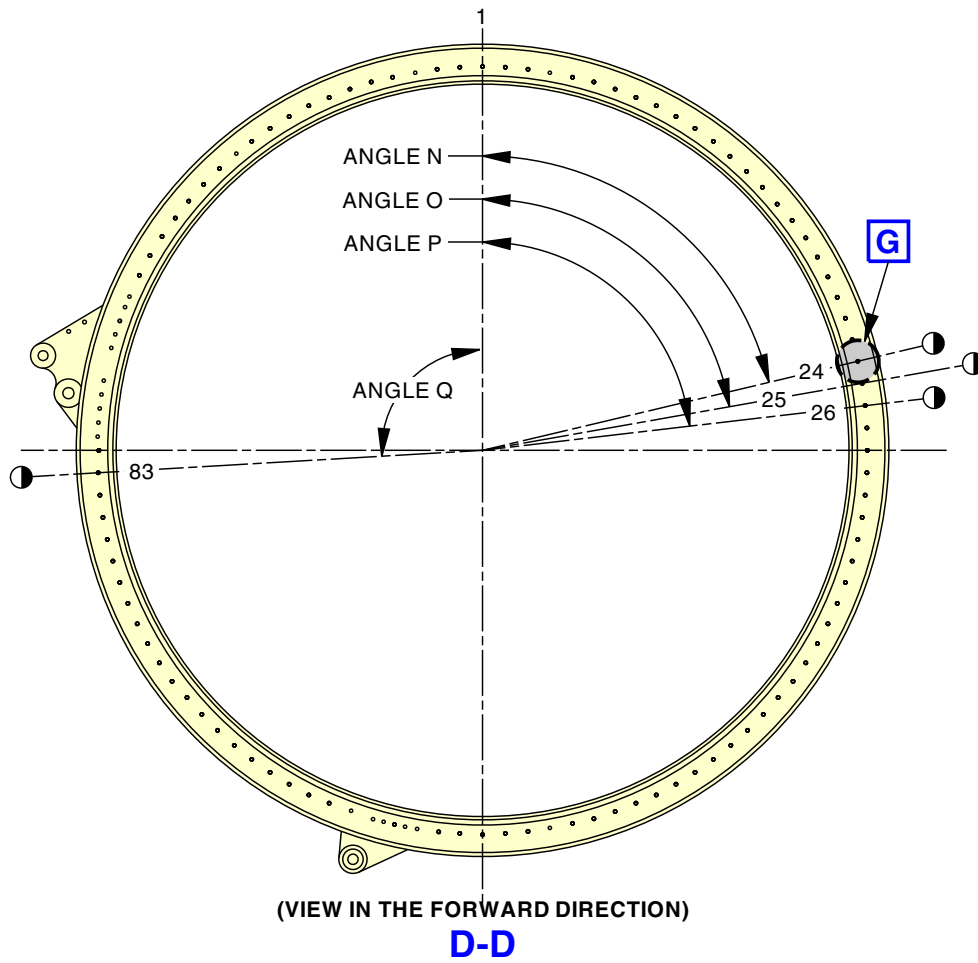
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**LEGEND:**

AREA NOT ANODIZED



MISSING PROTECTIVE COATING (ANODIZATION)

2993750 S0000770293_V1

Definition of Areas not Anodized
Figure 801/70-43-07-990-802-F00 (Sheet 6 of 9)

EFFECTIVITY
LOM ALL

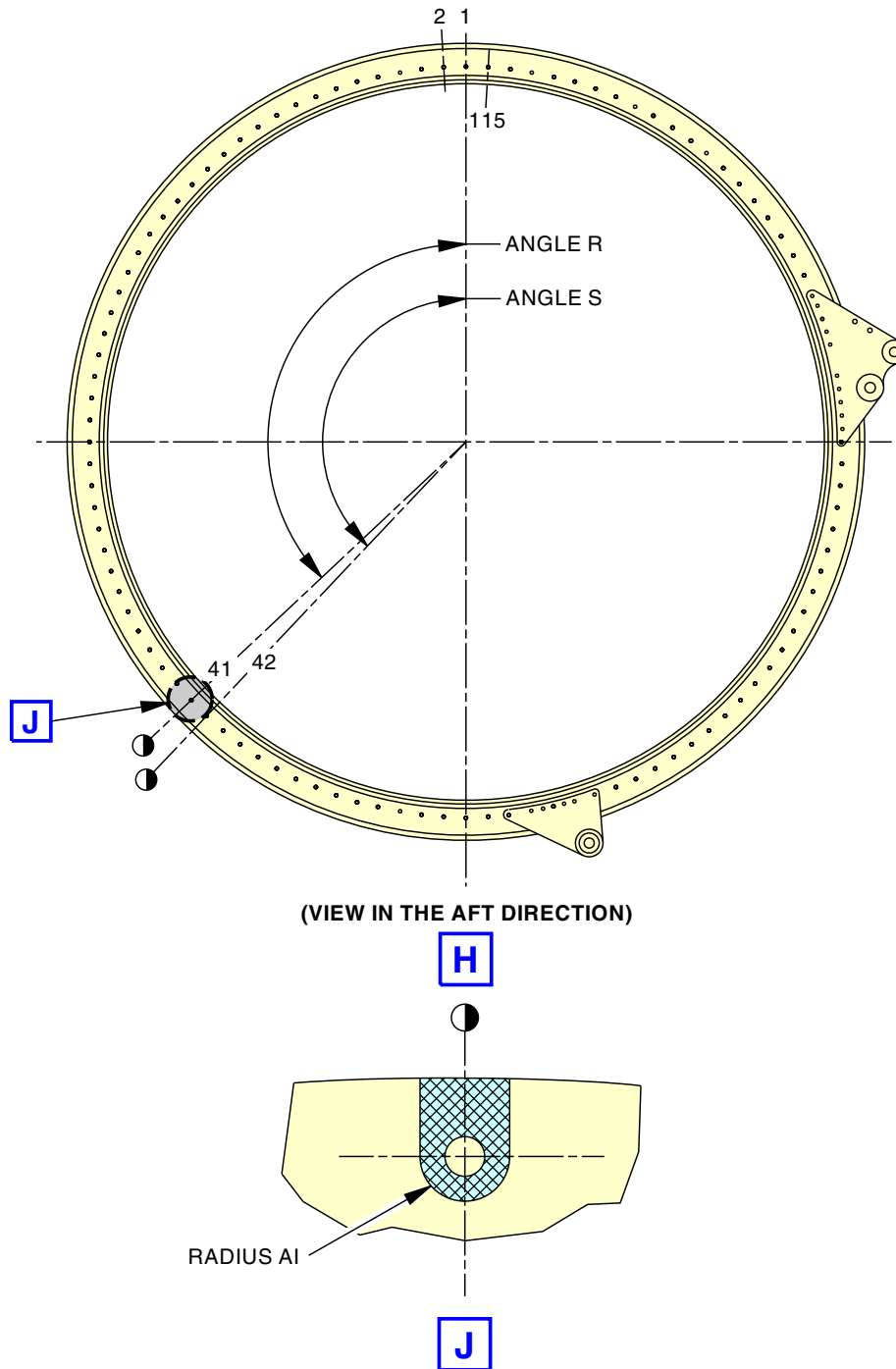
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

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**LEGEND:**

AREA NOT ANODIZED



MISSING PROTECTIVE COATING (ANODIZATION)

2993755 S0000770294_V1

Definition of Areas not Anodized
Figure 801/70-43-07-990-802-F00 (Sheet 7 of 9)

EFFECTIVITY
LOM ALL

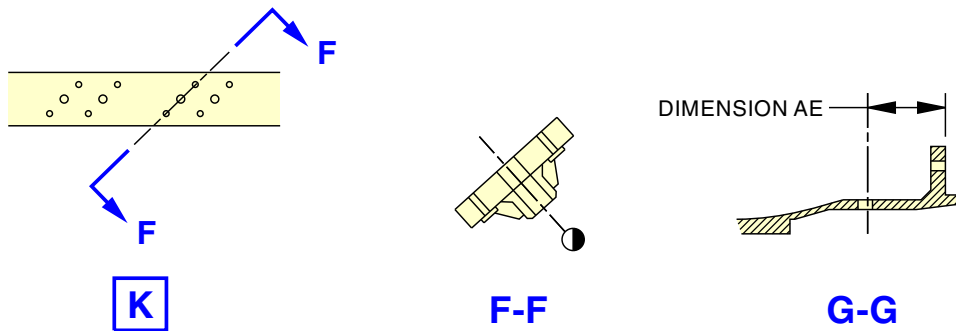
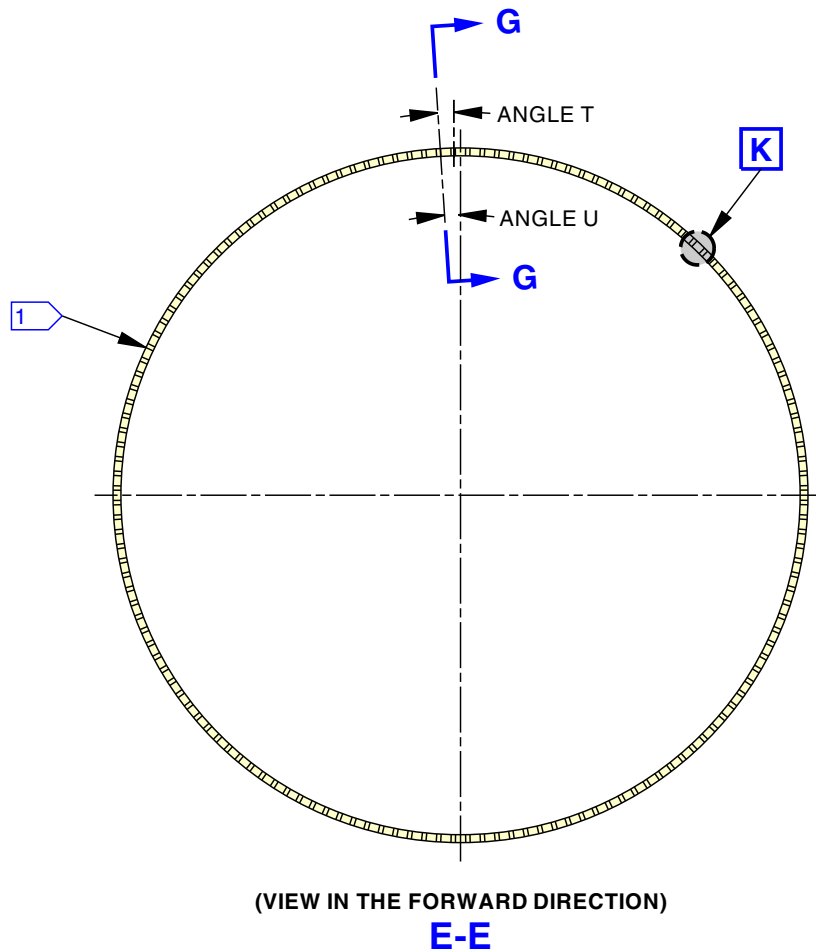
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**LEGEND:**

MISSING PROTECTIVE COATING (ANODIZATION)



76 GROUPS OF 2 HOLES ON THE BASIS OF 360°/76 AT EQUAL DISTANCE

2993757 S0000770295_V1

Definition of Areas not Anodized
Figure 801/70-43-07-990-802-F00 (Sheet 8 of 9)

EFFECTIVITY
LOM ALL

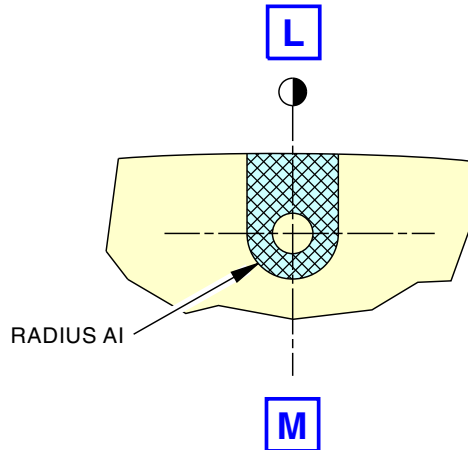
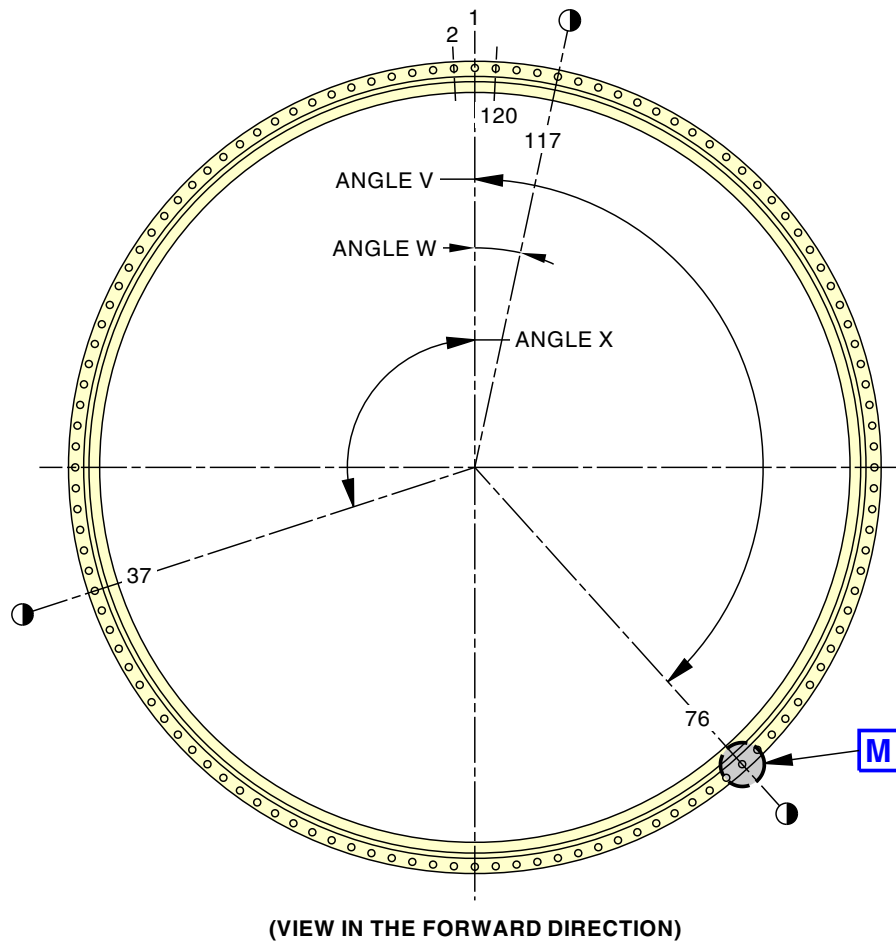
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**LEGEND:**

AREA NOT ANODIZED



MISSING PROTECTIVE COATING (ANODIZATION)

2993763 S0000770296_V1

Definition of Areas not Anodized
Figure 801/70-43-07-990-802-F00 (Sheet 9 of 9)

EFFECTIVITY
LOM ALL

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AIRCRAFT MAINTENANCE MANUAL
FORMED RIVET ASSEMBLIES - REPAIRS

1. General

- A. This procedure has this task:
- (1) Formed Rivet Assemblies Repair.

TASK 70-43-11-300-801-F00**2. Formed Rivet Assemblies Repair**

(Figure 801, Figure 802, Figure 803, Figure 804, Figure 805, Figure 806, Figure 807, Figure 808, Figure 809, Figure 810, Figure 811, Figure 812, Figure 813, Figure 814, Figure 815, Figure 816)

A. General

- (1) Formed rivets are available in aluminum, titanium, nickel alloy, and steel. Unless otherwise indicated, the limits specified are applicable to all kinds of formed rivets. Except for flush head rivets, the manufactured head may be placed either side of the material unless otherwise specified.
- (2) Design of Riveted Assemblies.
 - (a) The recommendations for the distance from the edge and rivet pitch when doing the riveting are shown on Figure 801.
 - (b) The rivets must be as near as possible to the bend radii without interfering with them. The recommended distance to be observed is shown on Figure 802.
 - (c) The permissible taper on surfaces to be riveted together is shown on Figure 803.
 - (d) Use of washers.
 - 1) On thin sheet metal, it is recommended to place a washer under the rivet head to avoid damaging the sheet metal with the postformed head. The washers may also be used as vibration dampers and are then placed under both heads.
- (3) Rivet Installation Tools.
 - (a) Unless otherwise specified, the method of cold forming rivet heads is not restricted. They may be formed by one of the following methods:
 - 1) Percussion.
 - a) Hammer.
 - b) Pneumatic impact tool.
 - 2) Continuous pressure.

NOTE: Hot riveting is only used under specification.
 - (b) Unless otherwise specified, rivets can be removed with a pneumatic or hand drill machine.

B. References

Reference	Title
70-43-02-910-801-F00	Rivet Identification (P/B 201)

C. Consumable Materials

Reference	Description	Specification
B01058 [CP1039]	Solvent - Acetone, Reagent Grade	

EFFECTIVITY
 LOM ALL

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D. Prepare for the Repair

SUBTASK 70-43-11-300-001-F00

- (1) For rivet holes, do the following steps:
 - (a) Unless otherwise specified, drill the holes (Figure 804).
 - (b) Whenever possible, perform the final drilling with the sheets clamped together to avoid offset holes.

SUBTASK 70-43-11-300-002-F00

- (2) For countersinking, do the following steps:
 - (a) Unless otherwise specified, perform countersinks (Figure 805).
 - (b) Make sure that the machining does not cause facets on the countersink holes.

SUBTASK 70-43-11-300-003-F00

- (3) For dimpling, do the following steps:
 - (a) Unless otherwise specified, perform dimpling (Figure 806).
 - (b) Make sure that the components are drilled or rereamed after dimpling.

SUBTASK 70-43-11-300-004-F00

- (4) For deburring, do the following steps:
 - (a) After drilling, deburr sheets to be assembled, as follows:
 - 1) If sheets are drilled separately or disassembled before rivet installation, perform deburring (Figure 807).
 - 2) If sheets are drilled when assembled and no disassembly occurs before rivet installation, only deburr external faces (Figure 807).
 - a) Make sure that the sheets are thoroughly squeezed to prevent introduction of chips in interface.

SUBTASK 70-43-11-300-005-F00

- (5) Selection of rivets.
 - (a) Do the formed rivets identification (TASK 70-43-02-910-801-F00).
 - (b) Use the applicable rivets during the riveting process.
 - 1) Make sure that the thickness of sheet to be assembled is compatible for recommended rivet grip length.

NOTE: Measurement of assembly thickness must be performed with sheets fully squeezed.
 - (c) If the measured thickness is not compatible with the grip length of rivets recommended, select rivets meeting measured thickness requirements (Figure 808).

NOTE: If rivets, except aluminum rivets, are cut to get correct length, annealing is necessary to remove work hardening.

SUBTASK 70-43-11-300-006-F00



DO NOT POLISH TITANIUM COMPONENTS. IF YOU DO NOT OBEY,
DAMAGE TO EQUIPMENT CAN OCCUR

737-600/700/800/900 AIRCRAFT MAINTENANCE MANUAL

(CAUTION PRECEDES)



DO NOT USE HAMMER RIVETING ON TITANIUM RIVETS. IF YOU DO NOT OBEY, DAMAGE TO EQUIPMENT CAN OCCUR.

(6) Choose the riveting process, as follows:

- (a) For rivets with a diameter equal to or less than 0.189 in. (4.8 mm) and unless otherwise specified, use the preferred choice per Figure 809.
- (b) For rivets with a diameter larger than 0.189 in. (4.8 mm), use the method specified in the applicable task.

SUBTASK 70-43-11-300-007-F00

(7) Test on test-specimens for cold and hot riveting.

NOTE: Before carrying out a repair by means of riveting it is necessary to check, on test-pieces, the machine settings controlling the quality of the riveting carried out.

NOTE: For each type of rivet fitted (rivets of the same dimensions and of the same material) one test-piece is submitted to the inspection. The test-piece is produced again at each change of riveting die.

(a) Material of test-pieces:

- Z 10 CNT 18 AMS 5510 for stainless steel and nickel alloy rivets
- AG5 AMS 4015 for light alloy rivets
- T40 AMS 4902 for titanium rivets.

NOTE: The test-pieces may also be produced in the same material of the component being repaired.

(b) Dimensions of test-pieces:

- 1) Use the dimensions of the test-pieces per Figure 810.

NOTE: The thicknesses of the sheet metal for the test-pieces, rivet dimensions, diameter of the hole and deburring, are made to the same standard as the assembly to be repaired. For components having a bending radius equal to or above 15.748 in. (400 mm), flat test-pieces are acceptable. For components having a bend radius of less than 15.748 in. (400 mm) formed test-pieces are used.

(c) Examine the test-pieces according to inspection below.

E. Formed Rivet Assemblies Repair

SUBTASK 70-43-11-300-008-F00

(1) Make sure that the rivets have a satisfactory appearance.

- (a) If it is necessary, reject the rivets not conforming to specification in inspection below.
- (b) Clean the rivets that are marked by coloring with acetone solvent, B01058 [CP1039].
- (c) Put the components perfectly into abutment before fitting the rivets.
- (d) Make sure that the heads of the riveting dies are dimensioned as defined in inspection below.
- (e) Install rivets with the process defined above.
- (f) Inspect riveting per inspection below.
 - 1) Replace rivets that are out of defect acceptance limits.

EFFECTIVITY
LOM ALL

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F. Formed Rivet Assemblies Replacement

SUBTASK 70-43-11-960-001-F00

- (1) Replace the rivet that is loose, damaged, or missing from an assembly by the identical rivet if the rivet hole satisfies the following conditions:
 - (a) Diameter of the rivet hole is within the permissible tolerances (Figure 804).
 - (b) Ovalization of the hole is 0.0079 in. (0.2 mm) or less.

SUBTASK 70-43-11-960-002-F00

- (2) If the rivet hole does not satisfy the above conditions, re-ream the hole to the next larger diameter.

NOTE: This step is applicable only to rivets with a diameter included between 0.062 in. (1.6 mm) and 0.156 in. (4.0 mm).

SUBTASK 70-43-11-960-003-F00

- (3) Make sure that the repair size rivets in a continuous series of more than 5 holes are not used.

SUBTASK 70-43-11-960-004-F00

- (4) Recommendations:
 - (a) Make sure that dimpling is not increased, unless the operation is approved in the repair section of the applicable task.
 - (b) Hold the sheets tightly together by means of clamps when rereaming the holes.
NOTE: The presence of burrs will be avoided that could cause a notch in the rivet.
 - (c) If the countersinks have to be enlarged, make sure that this operation is permissible, bearing in mind the thickness of the sheet metal.

G. Inspection

NOTE: Inspection on test samples is required before riveting of components for the development of repair method.

NOTE: Defect acceptance criteria are for standard rivets.

SUBTASK 70-43-11-220-001-F00

- (1) Inspection of test samples.

NOTE: The riveting operation on the component must only commence when inspection on test samples is considered satisfactory.

- (a) Do a dimensional inspection of the post-formed heads refer to inspection of repaired components below.
- (b) Do a visual inspection of the post-formed heads refer to inspection of repaired components below.
- (c) Make sure that the shank of the rivet correctly fills the space formed by the hole.
- (d) Make sure that the rivet heads are in contact with the faces of the metal sheets.

SUBTASK 70-43-11-220-002-F00

- (2) Inspection of repaired components.
 - (a) Lack of flushness of preformed countersunk heads.
 - 1) Make sure that the amount of protrusion of the preformed countersunk heads above the level of the metal sheet is in acceptance limits (Figure 811).
 - a) If shaving is necessary, make sure that the head in acceptance limits (Figure 811).
 - <1> Make sure that the rivet head is flush with the surface.

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LOM ALL

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SUBTASK 70-43-11-220-003-F00

(3) Dimensions of postformed heads.

- (a) Make sure that the dimensions of the postformed heads are within the limits (Figure 812).

NOTE: In certain cases, heads having smaller dimensions may be produced.

SUBTASK 70-43-11-210-001-F00

(4) Visual inspection of postformed heads.

- (a) Head shape defects.

- 1) Make sure that the shape and dimensions of the formed heads are in accordance with Figure 812.

NOTE: The defects are acceptable as shown on Figure 815.

NOTE: Marks from the die and counterdie, on the preformed and postformed heads, or on one of the sheets of the assembly, are permissible provided within the limits (Figure 815).

- (b) Surface defects.

- 1) Inspect surface defects (Figure 813).

NOTE: On preformed heads, defects such as circular scratches, porousness, metal folds, are not a result of installation but are due to rivet manufacturing.

SUBTASK 70-43-11-200-001-F00

(5) Material defects inspection.

- (a) Indentations.

- 1) Make sure that the bottom is rounded and the depth does not exceed 10 percent of rivet diameter of indentations with excess material (Figure 814).
- 2) Make sure that the edge of the hole is not visible outside of the offset heads (View A, Figure 815).
- 3) Make sure that the cocked or beveled heads are in the acceptable limits (View B, Figure 815).
- 4) Make sure that there are no bulged heads that do not contact the stock on all sides (View C, Figure 815).
- 5) Make sure that the cuts or sharp tool marks around a rivet head due to excessive pressure of rivet gun or tooling are in the acceptable limits (View D and View G, Figure 815).
- 6) Make sure that the deformation of sheet due to pressure on the rivet is in acceptable limits (View E, Figure 815).
- 7) Make sure that if a washer is used under the driven head, it is in firm contact with the sheet and in the acceptable limits (View F, Figure 815).
- 8) Make sure that there are no hanging chips or flakes at the edge of the driven head, and feathered edges.

SUBTASK 70-43-11-200-002-F00

(6) Inspection of preformed head seating.

- (a) Inspect head seating (Figure 816).

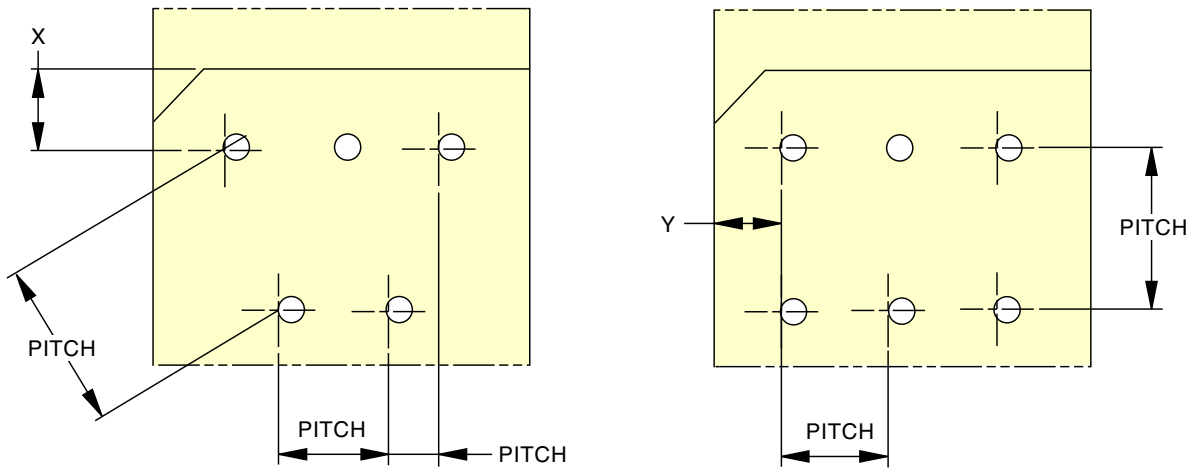
———— **END OF TASK** ————

EFFECTIVITY
LOM ALL

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**737-600/700/800/900
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HOLE LOCATION TOLERANCE: WITHIN 0.020 (0.5) OF TRUE POSITION

NOMINAL DIAMETER	DISTANCE FROM EDGES = X			PITCH
	SHEET THICKER THAN 0.31 (0.8) FLAT ROUND HEAD	COUNTERSUNK HEAD	SHEET EQUAL TO OR LESS THAN 0.031 (0.8) ROUND, FLAT OR COUNTERSUNK HEAD	
0.062 (1.6)	0.197 (5)	0.236 (6)	0.315 (8)	0.433 (11)
0.094 (2.4)	0.236 (6)	0.275 (7)	0.354 (9)	0.472 (12)
0.125 (3.2)	0.275 (7)	0.315 (8)	0.394 (10)	0.512 (13)
0.142 (3.6)	0.315 (8)	0.354 (9)	0.433 (11)	0.590 (15)
0.156 (4.0)	0.315 (8)	0.354 (9)	0.433 (11)	0.630 (16)
0.188 (4.8)	0.394 (10)	0.472 (12)	0.472 (12)	0.787 (20)
0.220 (5.6)	0.433 (11)	0.512 (13)	0.512 (13)	0.906 (23)

NOTE:

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

2994410 S0000771129_V1

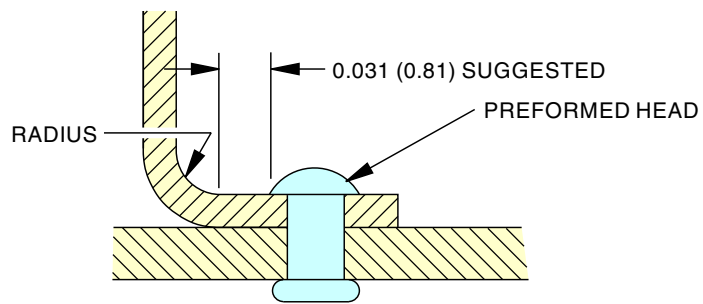
**Recommended Distances from Edges and Pitches
Figure 801/70-43-11-990-801-F00**

EFFECTIVITY
LOM ALL

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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL****NOTE:**

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

2994413 S0000771130_V1

Distance to a Bending Radius
Figure 802/70-43-11-990-802-F00

EFFECTIVITY
LOM ALL

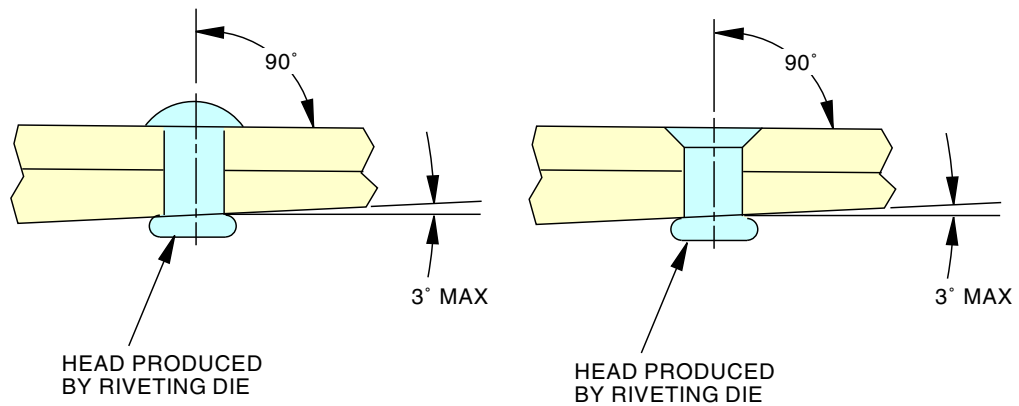
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Permissible Taper on Surfaces to be Riveted Together
Figure 803/70-43-11-990-803-F00

EFFECTIVITY
LOM ALL

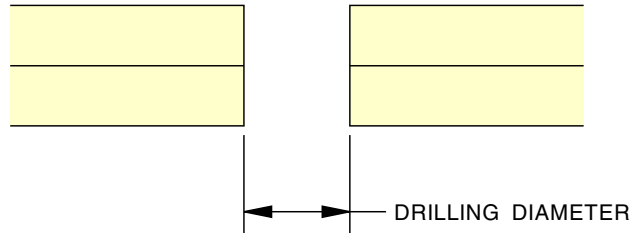
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RIVET NOMINAL DIAMETER		DRILLING DIAMETER
	0.062 (1.6)	0.064 - 0.066 (1.65 - 1.70)
1	0.094 (2.4)	0.096 - 0.100 (2.45 - 2.55)
1	0.125 (3.2)	0.128 - 0.132 (3.25 - 3.35)
1 2	0.142 (3.6)	0.144 - 0.148 (3.65 - 3.75)
	0.157 (4.0)	0.159 - 0.163 (4.05 - 4.15)
	0.188 (4.8)	0.191 - 0.195 (4.85 - 4.95)
2	0.220 (5.6)	0.222 - 0.226 (5.65 - 5.75)

NOTE:

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

- 1 FOR THESE DIAMETERS, IT IS RECOMMENDED THAT THE TOLERANCE ON THE DRILLING BE REDUCED TO 0.0020 (0.05).
- 2 THESE DIAMETERS ARE NOT COVERED BY THE NAS OR THE MS STANDARDS

2994415 S0000771133_V1

Drilling of Rivet Holes
Figure 804/70-43-11-990-804-F00

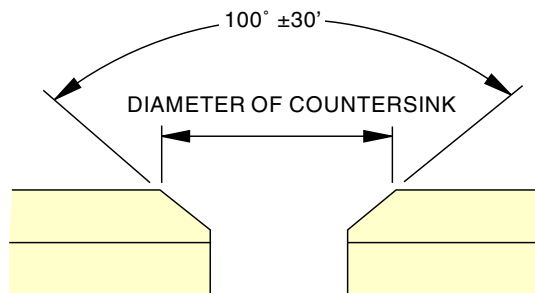
EFFECTIVITY
LOM ALL

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NOMINAL DIAMETER	DIAMETER OF COUNTERSINK	MINIMUM THICKNESS OF THE SHEET
0.062 (1.6)	0.104 - 0.110 (2.65 - 2.80)	0.024 (0.6)
0.094 (2.4)	0.169 - 0.175 (4.30 - 4.45)	0.039 (1)
0.125 (3.2)	0.214 - 0.220 (5.45 - 5.60)	0.047 (1.2)
1 0.142 (3.6)	0.254 - 0.260 (6.45 - 6.60)	0.055 (1.4)
0.157 (4.0)	0.275 - 0.283 (7.00 - 7.02)	0.063 (1.6)
0.188 (4.8)	0.342 - 0.350 (8.70 - 8.72)	0.078 (2)
1 0.220 (5.6)	0.405 - 0.413 (10.30 - 10.32)	0.098 (2.5)
0.250 (6.35)	0.466 - 0.474 (17.85 - 17.87)	0.098 (2.5)

NOTE:

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

1 THESE DIAMETERS ARE NOT COVERED BY THE NAS AND MS STANDARDS

2994419 S0000771132_V1

**Dimensions of Countersinks
Figure 805/70-43-11-990-805-F00**

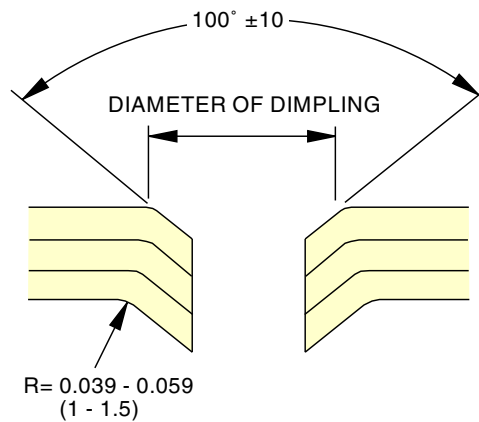
EFFECTIVITY
LOM ALL

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ECCN 9E991 BOEING PROPRIETARY - See title page for details

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**737-600/700/800/900
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NOMINAL DIAMETER		DIAMETER OF DIMPLING	MINIMUM THICKNESS OF THE SHEET
	0.094 (2.4)	0.169 - 0.175 (4.30 - 4.45)	0.031 (0.8)
	0.125 (3.2)	0.214 - 0.220 (5.45 - 5.60)	0.039 (1)
1	0.142 (3.6)	0.254 - 0.260 (6.45 - 6.60)	0.039 (1)
	0.157 (4.0)	0.275 - 0.283 (7.00 - 7.02)	0.039 (1)
	0.188 (4.8)	0.342 - 0.350 (8.70 - 8.72)	0.047 (1.2)

NOTE:

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.



THIS DIAMETER IS NOT COVERED BY THE NAS AND MS STANDARDS

2994420 S0000771134_V1

**Dimpling Diameters
Figure 806/70-43-11-990-806-F00**

EFFECTIVITY
LOM ALL

D633A101-LOM

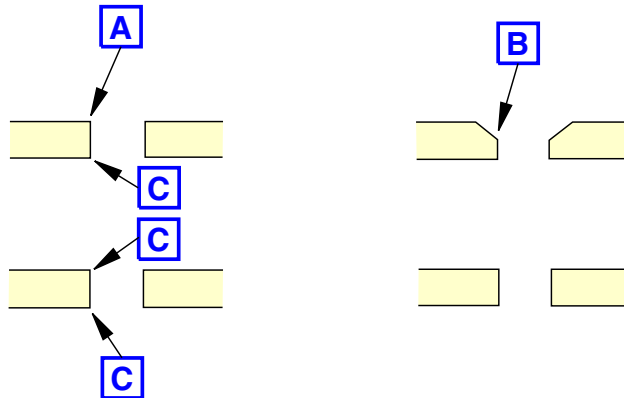
ECCN 9E991 BOEING PROPRIETARY - See title page for details

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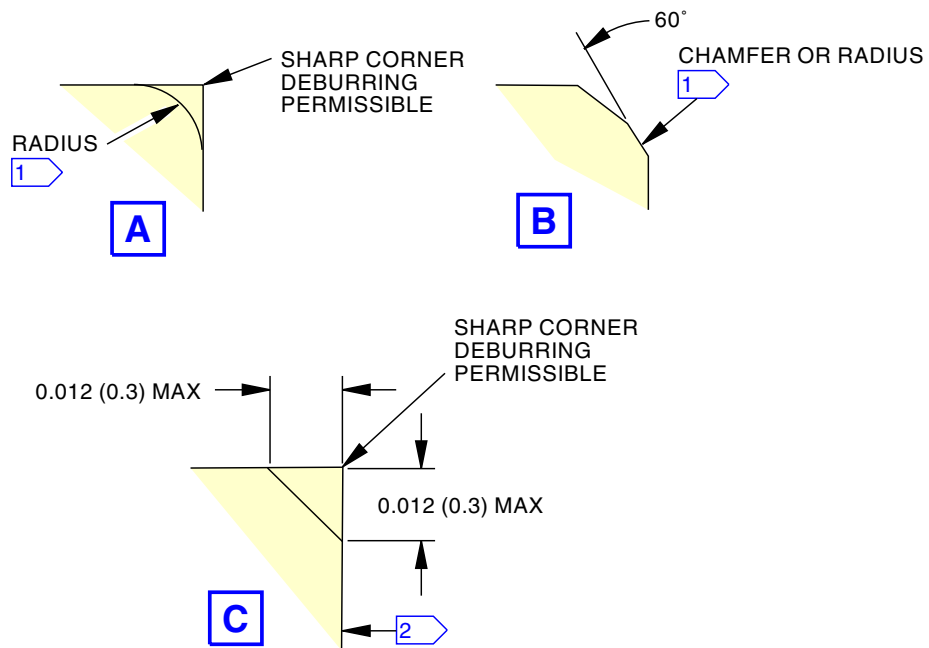
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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL**

SIDE WITH THE PREFORMED HEAD



SIDE WHERE THE RIVETING DIE IS USED



NOTE:

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

- 1** FOR SHEETS OF LESS THAN 0.063 (1.6), RADIUS 0.004 TO 0.012 (0.1 TO 0.3)
FOR SHEETS EQUAL TO OR THICKER THAN 0.063 (1.6) RADIUS 0.008 TO 0.016 (0.2 TO 0.4)
- 2** THE CYLINDRICAL PART OF THE HOLE MUST BE EQUAL TO OR GREATER THAN 1/2 THE THICKNESS OF THE SHEET.

2994421 S0000771135_V1

**Deburring of Holes
Figure 807/70-43-11-990-807-F00**

EFFECTIVITY
LOM ALL

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RIVET DIA	0.062 (1.6)	0.094 (2.4)	0.125 (3.2)	0.142 (3.6)	0.157 (4.0)	0.188 (4.8)	0.220 (5.6)
RIVET LENGTH	GRIP LENGTH						
0.236 (6)	0.107 - 0.140 (2.74 - 3.56)	0.070 - 0.102 (1.8 - 2.61)	0.033 - 0.065 (0.85 - 1.67)				
0.275 (7)	0.143 - 0.176 (3.65 - 4.47)	0.106 - 0.138 (2.7 - 3.52)	0.069 - 0.101 (1.76 - 2.58)	0.050 - 0.082 (1.29 - 2.10)	0.032 - 0.064 (0.81 - 1.63)		
0.314 (8)	0.179 - 0.212 (4.56 - 5.38)	0.142 - 0.174 (3.61 - 4.43)	0.105 - 0.137 (2.67 - 3.49)	0.086 - 0.118 (2.20 - 3.01)	0.067 - 0.1 (1.72 - 2.54)		
0.354 (9)	0.215 - 0.247 (5.47 - 6.29)	0.178 - 0.210 (4.52 - 5.34)	0.141 - 0.173 (3.58 - 4.40)	0.122 - 0.154 (3.10 - 3.92)	0.103 - 0.136 (2.63 - 3.45)		
0.393 (10)	0.251 - 0.283 (6.38 - 7.2)	0.213 - 0.246 (5.43 - 6.25)	0.176 - 0.208 (4.49 - 5.30)	0.158 - 0.190 (4.01 - 4.83)	0.139 - 0.171 (3.54 - 4.36)	0.102 - 0.134 (2.60 - 3.41)	0.065 - 0.097 (1.65 - 2.47)
0.433 (11)	0.287 - 0.319 (7.29 - 8.1)	0.249 - 0.282 (6.34 - 7.16)	0.212 - 0.244 (5.40 - 6.21)	0.193 - 0.226 (4.92 - 5.74)	0.175 - 0.207 (4.45 - 5.27)	0.137 - 0.170 (3.50 - 4.32)	0.100 - 0.133 (2.56 - 3.38)
0.472 (12)	0.323 - 0.354 (8.2 - 9.01)	0.285 - 0.317 (7.25 - 8.07)	0.248 - 0.280 (6.30 - 7.12)	0.230 - 0.261 (5.83 - 6.65)	0.211 - 0.243 (5.36 - 6.18)	0.173 - 0.206 (4.41 - 5.23)	0.136 - 0.169 (3.47 - 4.29)
0.551 (14)			0.284 - 0.352 (7.21 - 8.94)	0.265 - 0.333 (6.74 - 8.47)	0.247 - 0.315 (6.27 - 8.0)	0.209 - 0.277 (5.32 - 7.05)	0.172 - 0.240 (4.38 - 6.10)
0.629 (16)			0.355 - 0.423 (9.03 - 10.76)	0.337 - 0.405 (8.56 - 10.29)	0.318 - 0.386 (8.09 - 9.81)	0.045 - 0.349 (1.14 - 8.87)	0.244 - 0.311 (6.20 - 7.92)
0.708 (18)				0.408 - 0.476 (10.38 - 12.10)	0.389 - 0.447 (9.90 - 11.36)	0.352 - 0.421 (8.96 - 10.69)	0.315 - 0.383 (8.01 - 9.74)
0.787 (20)				0.480 - 0.548 (12.20 - 13.92)	0.461 - 0.529 (11.72 - 13.45)	0.424 - 0.492 (10.78 - 12.3)	0.387 - 0.455 (9.83 - 11.56)
0.866 (22)						0.496 - 0.563 (12.6 - 14.32)	0.458 - 0.526 (11.65 - 13.38)
0.944 (24)						0.567 - 0.635 (14.41 - 16.14)	0.530 - 0.598 (13.47 - 15.20)
1.023 (26)						0.639 - 0.707 (16.23 - 17.96)	0.602 - 0.669 (15.29 - 17.01)
1.102 (28)						0.710 - 0.778 (18.05 - 19.78)	0.673 - 0.741 (17.10 - 18.83)
1.181 (30)							0.745 - 0.813 (18.92 - 20.65)
1.259 (32)							0.816 - 0.884 (20.74 - 22.47)

NOTE:

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

2994422 S0000771136_V1

**Rivet Grip Length (Rivet per NF-L Standard)
Figure 808/70-43-11-990-808-F00 (Sheet 1 of 2)**

EFFECTIVITY
LOM ALL

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RIVET DIA	0.061 (1.57)	0.094 (2.39)	0.124 (3.17)	0.156 (3.96)	0.187 (4.77)	0.250 (6.35)
RIVET LENGTH	GRIP LENGTH					
0.124 (3.17)	0.015 - 0.038 (0.38 - 0.97)					
0.156 (3.962)	0.039 - 0.061 (0.99 - 1.57)	0.009 - 0.035 (0.25 - 0.91)				
0.187 (4.77)	0.063 - 0.085 (1.60 - 2.18)	0.037 - 0.063 (0.94 - 1.60)	0.009 - 0.033 (0.25 - 0.84)			
0.216 (5.5)	0.087 - 0.109 (2.21 - 2.79)	0.063 - 0.087 (1.62 - 2.23)	0.033 - 0.059 (0.86 - 1.52)	0.009 - 0.078 (0.25 - 0.71)		
0.248 (6.3)	0.111 - 0.133 (2.82 - 3.38)	0.089 - 0.113 (2.26 - 2.89)	0.061 - 0.087 (1.55 - 2.21)	0.029 - 0.056 (0.74 - 1.42)	0.009 - 0.022 (0.25 - 0.56)	
0.281 (7.14)	0.134 - 0.157 (3.40 - 3.99)	0.115 - 0.140 (2.92 - 3.56)	0.087 - 0.113 (2.23 - 2.89)	0.057 - 0.083 (1.45 - 2.11)	0.022 - 0.048 (0.58 - 1.24)	
0.311 (7.92)	0.158 - 0.180 (4.01 - 4.57)	0.141 - 0.166 (3.58 - 4.22)	0.115 - 0.141 (2.92 - 3.58)	0.083 - 0.109 (2.13 - 2.79)	0.05 - 0.078 (1.27 - 1.98)	
0.344 (8.74)	0.181 - 0.205 (4.60 - 5.21)	0.167 - 0.192 (4.24 - 4.88)	0.142 - 0.168 (3.61 - 4.27)	0.111 - 0.139 (2.82 - 3.53)	0.078 - 0.107 (2.00 - 2.72)	0.009 - 0.039 (0.25 - 0.99)
0.376 (9.57)	0.206 - 0.228 (5.23 - 5.79)	0.193 - 0.218 (4.90 - 5.54)	0.168 - 0.194 (4.29 - 4.95)	0.140 - 0.165 (3.56 - 4.21)	0.107 - 0.135 (2.74 - 3.43)	0.040 - 0.067 (1.02 - 1.70)
0.406 (10.31)	0.229 - 0.252 (5.82 - 6.40)	0.219 - 0.244 (5.56 - 6.20)	0.196 - 0.222 (4.98 - 5.64)	0.167 - 0.193 (4.24 - 4.92)	0.135 - 0.163 (3.45 - 4.14)	0.067 - 0.094 (1.72 - 2.39)
0.437 (11.12)	0.253 - 0.276 (6.42 - 7.01)	0.244 - 0.270 (6.22 - 6.86)	0.222 - 0.25 (5.66 - 6.35)	0.194 - 0.222 (4.95 - 5.64)	0.163 - 0.191 (4.16 - 4.85)	0.094 - 0.122 (2.41 - 3.12)
0.468 (11.91)		0.270 - 0.296 (6.88 - 7.52)	0.250 - 0.276 (6.37 - 7.03)	0.222 - 0.248 (5.66 - 6.32)	0.192 - 0.219 (4.88 - 5.56)	0.124 - 0.15 (3.15 - 3.81)
0.500 (12.70)		0.296 - 0.322 (7.54 - 8.18)	0.278 - 0.304 (7.06 - 7.72)	0.25 - 0.276 (6.35 - 7.03)	0.220 - 0.246 (5.59 - 6.27)	0.150 - 0.178 (3.83 - 4.52)
0.531 (13.49)		0.322 - 0.348 (8.20 - 8.84)	0.305 - 0.331 (7.75 - 8.41)	0.278 - 0.304 (7.06 - 7.72)	0.248 - 0.274 (6.30 - 6.98)	0.179 - 0.205 (4.55 - 5.21)
0.561 (14.27)		0.348 - 0.372 (8.86 - 9.47)	0.331 - 0.357 (8.43 - 9.09)	0.306 - 0.331 (7.77 - 8.41)	0.276 - 0.303 (7.01 - 7.70)	0.206 - 0.233 (5.23 - 5.92)
0.594 (15.09)		0.374 - 0.40 (9.50 - 10.16)	0.359 - 0.385 (9.12 - 9.80)	0.331 - 0.360 (8.43 - 9.14)	0.304 - 0.331 (7.72 - 8.43)	0.233 - 0.261 (5.94 - 6.63)
0.624 (15.85)		0.40 - 0.511 (10.18 - 12.99)	0.387 - 0.411 (9.83 - 10.46)	0.361 - 0.387 (9.17 - 9.83)	0.333 - 0.359 (8.46 - 9.14)	0.261 - 0.289 (6.65 - 7.34)

NOTE:

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

2994516 S0000771137_V1

**Rivet Grip Length (Rivet per NF-L Standard)
Figure 808/70-43-11-990-808-F00 (Sheet 2 of 2)**

EFFECTIVITY
LOM ALL

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MATERIAL		COLD RIVETING BY PERCUSSION		COLD RIVETING BY CONTINUOUS PRESSURE
STANDARD	USUAL	HAMMER (MANUAL)	MULTIPLE PERCUSSION HAMMER	
AG5MC	MONEL 304SS	PERMISSIBLE	PERMISSIBLE	RECOMMENDED
NU30		PERMISSIBLE	PERMISSIBLE	RECOMMENDED
Z6CN18-10		PERMISSIBLE	PERMISSIBLE	RECOMMENDED
Z6NCT25		PERMISSIBLE	PERMISSIBLE	RECOMMENDED
NC15Fe	INCONEL 600	PERMISSIBLE	PERMISSIBLE	RECOMMENDED
T40		PERMISSIBLE	PERMISSIBLE	RECOMMENDED
NC22FeD	HASTELLOY X	PERMISSIBLE	PERMISSIBLE	RECOMMENDED

NOTE:

HOT RIVETING IS ONLY USED IN THE PARTICULAR
CASES MENTIONED IN THE APPLICABLE TASK.

2994716 S0000771138_V1

**Choice of Riveting Processes
Figure 809/70-43-11-990-809-F00**

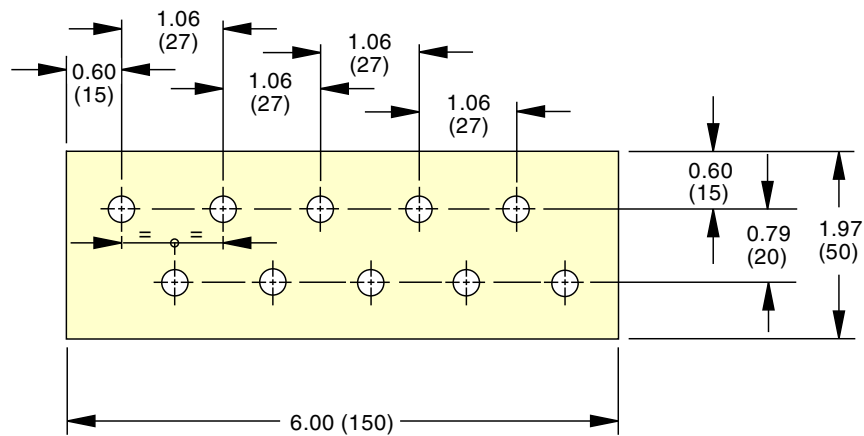
EFFECTIVITY
LOM ALL

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**NOTE:**

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

2994717 S0000771139_V1

**Definition of the Riveting Test Piece
Figure 810/70-43-11-990-810-F00**

EFFECTIVITY
LOM ALL

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**NOTE:**

DIMENSIONS ARE IN INCHES WITH
 MILLIMETERS IN PARENTHESES.

2994718 S0000771140_V1

Inspection of the Amount of Protrusion for the Preformed Countersunk Heads
Figure 811/70-43-11-990-811-F00

EFFECTIVITY
 LOM ALL

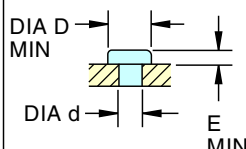
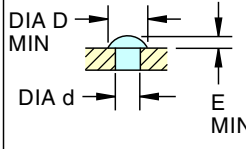
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DESCRIPTION OF HEADS TO BE FORMED		d	0.063 (1.6)	0.079 (2)	0.094 (2.4)	0.098 (2.5)	0.118 (3)	0.126 (3.2)	0.141 (3.6)	0.157 (4)	0.189 (4.8)	0.197 (5)	0.220 (5.6)
HEAD C		D	0.094 (2.4)	0.118 (3)	0.142 (3.6)	0.150 (3.8)	0.177 (4.5)	0.189 (4.8)	0.212 (5.4)	0.236 (6)	0.287 (7.3)	0.303 (7.7)	0.338 (8.6)
		E	0.031 (0.8)	0.039 (1)	0.047 (1.2)	0.049 (1.25)	0.059 (1.5)	0.063 (1.6)	0.071 (1.8)	0.079 (2)	0.094 (2.4)	0.098 (2.5)	0.110 (2.8)
HEAD U		D	0.102 (2.6)	0.126 (3.2)	0.153 (3.9)	0.157 (4)	0.193 (4.9)	0.209 (5.3)	0.232 (5.9)	0.260 (6.6)	0.311 (7.9)	0.327 (8.3)	0.362 (9.2)
		E	0.031 (0.8)	0.039 (1)	0.047 (1.2)	0.049 (1.25)	0.059 (1.5)	0.063 (1.6)	0.071 (1.8)	0.079 (2)	0.094 (2.4)	0.098 (2.5)	0.110 (2.8)

NOTE:

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

2994721 S0000771141_V1

**Dimensions of Postformed Heads
Figure 812/70-43-11-990-812-F00**

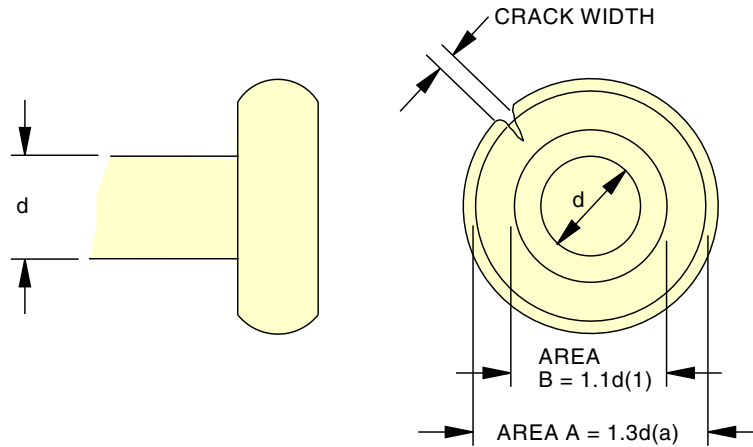
EFFECTIVITY
LOM ALL

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**NOTE:**

IN THIS AREA B, NO DEFECTS ARE ACCEPTABLE OUTSIDE OF THIS AREA, 3 DEFECTS ARE ACCEPTABLE IF THEY ARE NOT WIDER THAN 0.062 d (SEE TABLE BELOW)

OUTSIDE OF THIS AREA ALL DEFECTS ARE ACCEPTABLE

THE DEFECTS MUST BE NEARLY RADIAL AND MUST NOT INTERSECT

d	0.063 (1.6)	0.094 (2.4)	0.126 (3.2)	0.142 (3.6)	0.157 (4)	0.189 (4.8)	0.220 (5.6)	0.250 (6.35)	0.312 (7.93)	0.375 (9.53)
AREA B	0.071 (1.8)	0.102 (2.6)	0.138 (3.5)	0.157 (4.)	0.173 (4.4)	0.209 (5.3)	0.244 (6.2)	0.275 (7)	0.324 (8.7)	0.413 (10.5)
AREA A	0.083 (2.1)	0.122 (3.1)	0.165 (4.2)	0.185 (4.7)	0.205 (5.2)	0.244 (6.2)	0.287 (7.3)	0.327 (8.3)	0.405 (10.3)	0.488 (12.4)
CRACK WIDTH	0.004 (0.1)	0.006 (0.15)	0.008 (0.20)	0.010 (0.25)	0.010 (0.25)	0.012 (0.30)	0.014 (0.35)	0.016 (0.40)	0.020 (0.50)	0.024 (0.60)

NOTE:

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

2994722 S0000771145_V1

Surface Defects
Figure 813/70-43-11-990-813-F00

EFFECTIVITY
LOM ALL

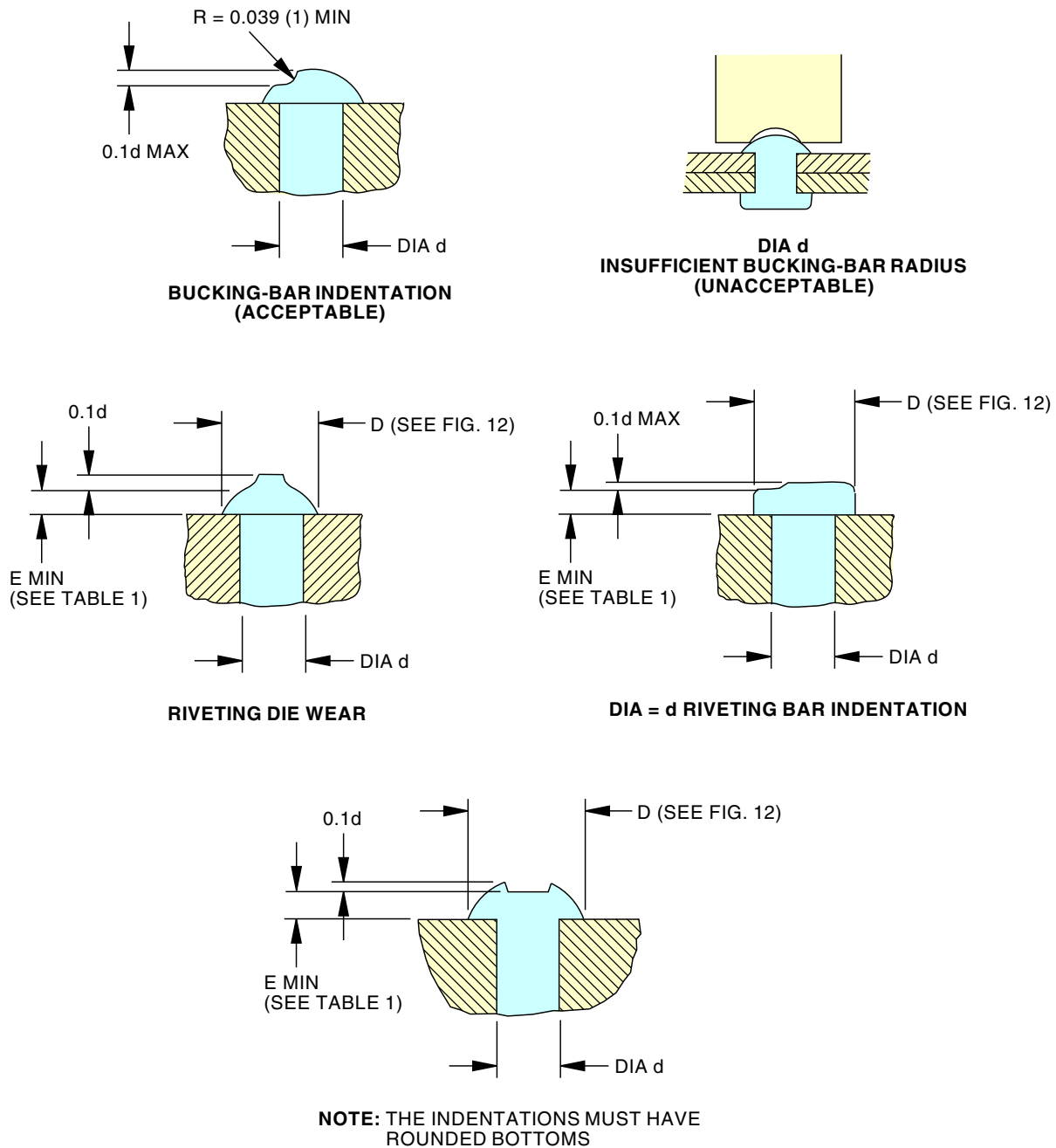
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**NOTE:**

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

2994837 S0000771146_V1

Defects Limits for Preformed and Postformed Heads Figure 814/70-43-11-990-814-F00

EFFECTIVITY
LOM ALL

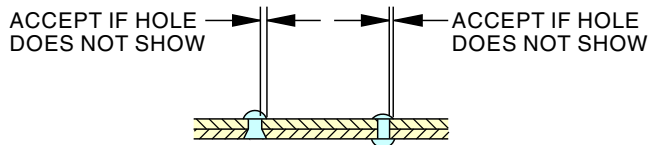
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ECCN 9E991 BOEING PROPRIETARY - See title page for details

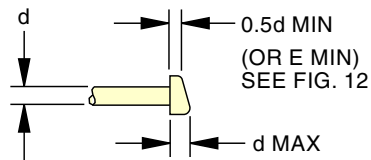
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**737-600/700/800/900
AIRCRAFT MAINTENANCE MANUAL**

**OFFSET HEAD****A**

SHARP TOOL MARKS
CUTS DUE TO SHAVING
HEAD
NOT ACCEPTABLE

CUTS OR SHARP TOOL MARKS**D****COCKED OR BEVELED HEAD****B**

SHEET DEFORMED BY
RIVET TOOL
PRESSURE

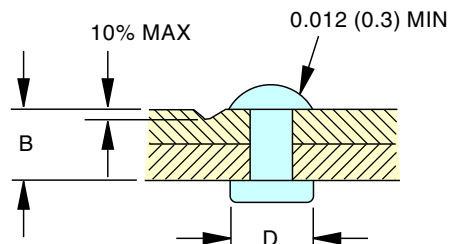
LOCAL DEFORMATION LIMITS (1.5mm) 0.020 INCH
(MEASURED FROM SURFACE CONTOUR): MAX

E**BULBED HEAD****ACCEPT****MUST CONTACT SHEET****REJECT****OPEN HEAD****C**

ACCEPT SHARP TOOL
MARKS OR MARS

1.5d

WASHER MUST BE IN
FIRM CONTACT WITH
SHEET WITHIN 1.5d
OF RIVET HEAD

WASHER DEFORMATION**F**

ALLOWED ON 30% OF D

G**NOTE:**

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

2994857 S0000771147_V1

**Formed Rivet Head Defect Limits
Figure 815/70-43-11-990-815-F00**

EFFECTIVITY
LOM ALL

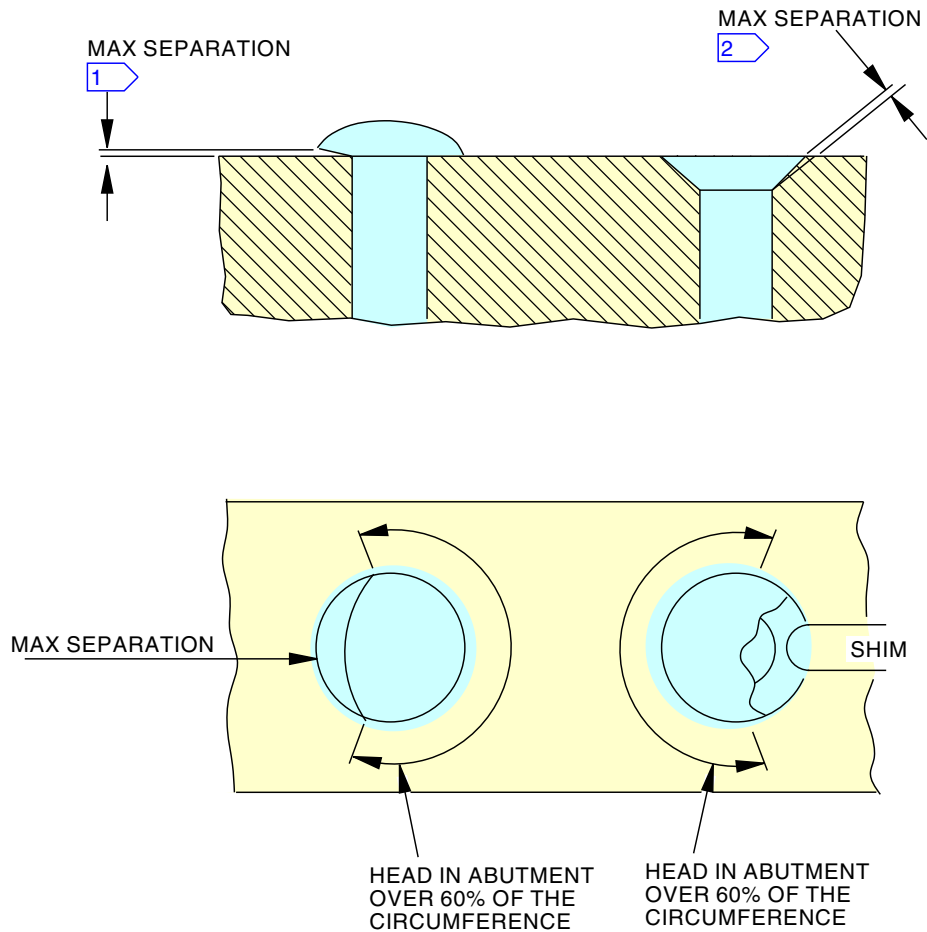
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**737-600/700/800/900
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**NOTE:**

DIMENSIONS ARE IN INCHES WITH
MILLIMETERS IN PARENTHESES.

- 1** A 0.0039 (0.1) SHIM [RIVETS UP TO 0.197 (5)]
0.006 (0.15) SHIM [RIVETS OVER 0.197 (5)]
MUST NOT PENETRATE UP TO THE SHANK.
- 2** A 0.0027 (0.07) SHIM [RIVETS UP TO 0.197 (5)]
0.0039 (0.1) SHIM [RIVETS OVER 0.197 (5)]
MUST NOT PENETRATE UP TO THE SHANK.

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**Defects Limits on Preformed Heads
Figure 816/70-43-11-990-816-F00**

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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 70-43-42-300-801-F00

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. The 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) A V-shaped depression in the part made by a sharp-edged object pushing the metal inward.
 - 2) Pit
 - a) A round, sharp-edged hole with a rounded bottom caused by corrosion.

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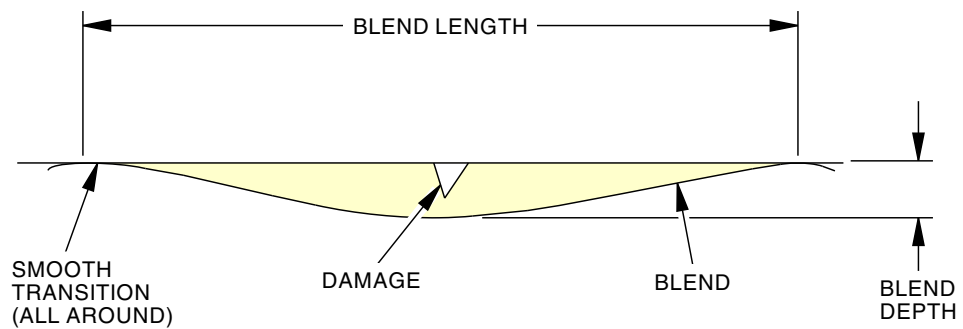
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- 3) Scratch
 - a) A V-shaped line or furrow in the part, such as it would be made by dragging a sharp object across the surface.
- 4) Dent
 - a) A smooth, rounded depression in the part made by impact with a rounded object. If there is a noticeable 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) 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) 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 201/70-43-42-990-801-F00

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TASK 70-43-42-300-802-F00

3. Blending Procedures - Hand Blending

(Figure 202)

A. General

- (1) For general requirements concerning blending, refer to Blending Procedures - General, TASK 70-43-42-300-801-F00.
- (2) Hand blending task 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, that lowers the danger of cracking. Hand blending does not give a thermal stress to parts that are blended.
 - (a) For hand blending procedures, refer to "General hand blending (non-rotating parts)" and "Hand blending on rotating parts" in the task.
- (3) High metal is caused by the displacement of metal above a surface. It is found around indications equivalent to nicks and scratches. This task 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 task.

B. Equipment

- (1) Unless otherwise specified in the applicable repair task, the following equipment is required for hand blending:
 - Assorted hand files
 - Abrasive stones.

C. Materials



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 the applicable repair 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.

D. Hand Blending

SUBTASK 70-43-42-320-001-F00



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.

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(WARNING PRECEDES)



WARNING

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.



WARNING

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.



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 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.

- (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.

- (a) To blend out the sharp edges and rough-out indications using abrasive tools, refer to the materials section.
- 1) If it is necessary, start the blend with grade 120 or a finer for fast initial removal of material 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.
 - 3) Keep the abrasive tool clean from removed material for correct tool operation.
 - 4) Do not remove metal from the leading and trailing edges of part sections that can cause the edges to become thin or sharp.
 - 5) Blend the material to keep approximately the initial contour.

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SUBTASK 70-43-42-320-002-F00

(2) Hand blending on rotating parts.

NOTE: This procedure may 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.
- (b) If it is not specified, do one of the following steps:
 - 1) Blend the corner to a radius to 0.015 in. (0.38 mm) - 0.03 in. (0.76 mm).
 - 2) Blend to align the general radius of the corner.
 - 3) If it is necessary to find the initial radius, refer to an adjacent, non-blended location of the corner or an equivalent part.
- (c) If the blended area and a curved feature connects, restore the general shape of the initial contour.
 - 1) If it is necessary to find the initial contour, refer to an adjacent, non-blended location of the curved feature or an equivalent part.
- (d) To blend out the sharp edges and rough-out indications using abrasive tools refer to the materials section.
 - 1) If it is necessary, start the blend with grade 120 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 with grade 150 or a finer abrasive material or crocus cloths until the surface is as smooth as or smoother than the adjacent surfaces.
 - 3) Keep the abrasive tool clean from removed material for tool correct operation.
 - 4) Do not remove metal from the leading and trailing edges of part sections, which can cause the edges to become thin or sharp.
 - 5) Blend the material to keep approximately the initial contour.

SUBTASK 70-43-42-320-003-F00

(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).
 - 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.

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AIRCRAFT MAINTENANCE MANUAL****E. Hand Blending Check**

SUBTASK 70-43-42-200-001-F00

- (1) Make sure that the surface condition of the blending is equivalent to that of the adjacent areas.

NOTE: Areas must be smooth and continuous.

SUBTASK 70-43-42-200-002-F00

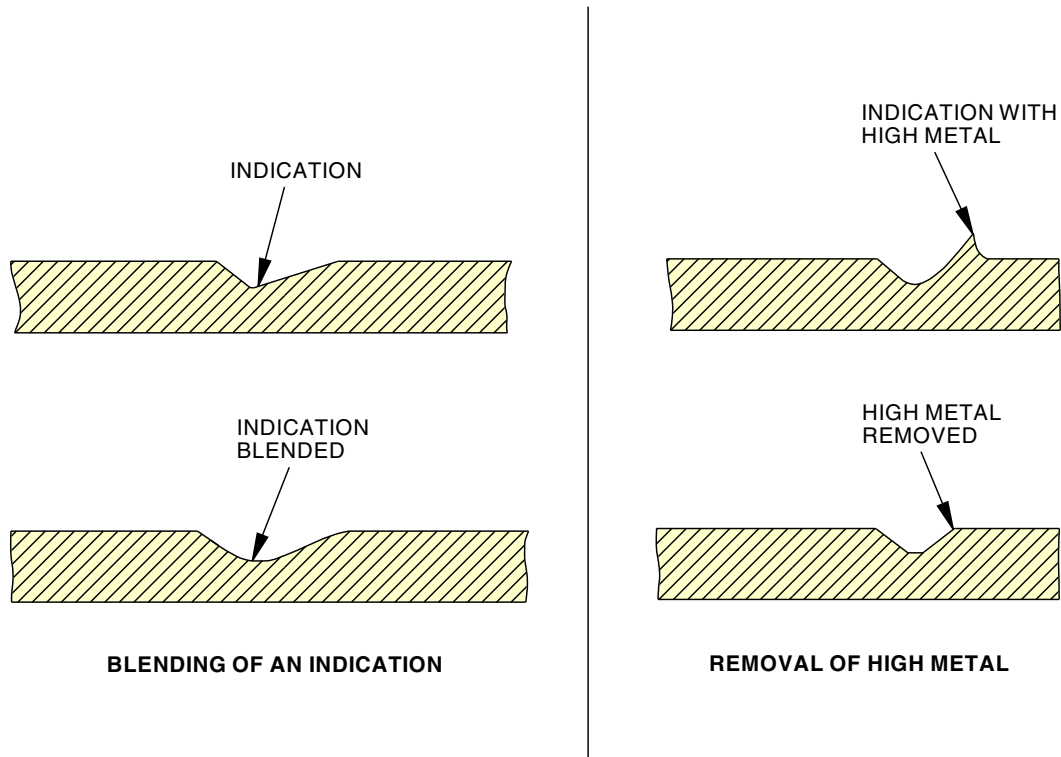
- (2) Complete a visual check of edges on all parts and edges for each of adjusted shapes or zones with a lighting intensity of a minimum of 1000 Lux:

- (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 70-43-42-200-003-F00

- (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 202/70-43-42-990-802-F00

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TASK 70-43-42-300-803-F00**4. Blending Procedures - Power Blending**

(Figure 203)

A. General

- (1) For general requirements concerning blending, refer to Blending Procedures - General, TASK 70-43-42-300-801-F00.
- (2) Power blending task is a fast removal of the metal that is used to remove metal deposits, unwanted weld metal, rough surfaces, cracks, nicks, scratches, or other sharp-edged damage marks on the parts.
- (3) The application of this task requires a power tool (Electric or Air).

B. Equipment

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 tools.

NOTE: Abrasive tools are an alternative to each other.

- (a) Flexible abrasive tools or hard abrasive tools made of silicon carbide or alumina (corundum) (Figure 202).

C. Power Blending

SUBTASK 70-43-42-320-004-F00



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.



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.

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(CAUTION PRECEDES)



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.



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.



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.



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.

(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) To blend out the sharp edges and rough-out indications first using abrasive tools refer to the materials section.

- 1) If it is necessary, start the blend with coarser grades of abrasives files for fast initial removal of material but not coarser than necessary for the removal of the material.
- 2) Complete the blend with grade 150 or finer abrasives tools until the surface is as smooth as or smoother than the adjacent surfaces.
- 3) Keep the abrasive tool clean from removed material for tool correct operation.
- 4) Do not remove metal from the leading and trailing edges of part sections, that can cause the edges to become thin or sharp.
- 5) Blend the material to keep approximately the initial contour.

SUBTASK 70-43-42-320-005-F00

(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.

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- (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.
- (b) If it is not specified, do one of the following steps:
 - 1) Blend the corner to a radius to 0.015 in. (0.38 mm) - 0.03 in. (0.76 mm).
 - 2) Blend to align the general radius of the corner.
 - a) If it is necessary to find the initial radius, refer to an adjacent, non-blended location of the corner or an equivalent part.
- (c) If the blended area and a curved feature connects, restore the general shape of the initial contour.
 - 1) If it is necessary to find the initial contour, refer to an adjacent, non-blended location of the curved feature or an equivalent part.
- (d) To blend out the sharp edges and rough-out indications first using abrasive tools refer to the materials section.
 - 1) If it is necessary, start the blend with coarser grades of abrasives files 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-F00.

NOTE: Power blending cannot be used to complete the blend.

 - 3) Keep the abrasive tool clean from removed material for tool correct operation.
 - 4) Do not remove metal from the leading and trailing edges of part sections that can cause the edges to become thin or sharp.
 - 5) Blend the material to keep approximately the initial contour.

D. Power Blending Check

SUBTASK 70-43-42-200-004-F00

- (1) Make sure that the surface condition of the blending is equivalent to that of the adjacent areas.

NOTE: Areas must be smooth and continuous.

SUBTASK 70-43-42-200-005-F00

- (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.
 - (c) Make sure that there are no stuck chips, incrustations, residues, or pollution.

SUBTASK 70-43-42-200-006-F00

- (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
	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 Tools for Power Blending
Figure 203/70-43-42-990-803-F00**

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STANDARD REPAIR

1. General

A. This procedure has these tasks:

- (1) Repair practice to rework on holes and other process to remove material.
- (2) Removal of the broken bolts.

TASK 70-50-00-350-801-F00

2. Repair Practices for Holes Rework - Other Process To Remove Material

A. **General**

- (1) This procedure gives the process to repair the holes in rotor components and critical static parts.
- (2) This repair includes the removal of damaged material, nicks, dents, gouges, etc., also the enlargement of holes for life extension purposes.
- (3) This procedure may also be used to make new holes with a length (L) to depth (D) ratio (L/D) of less than 1.
- (4) For holes with L/D ratio greater than or equal to 1, contact the local CFMI representative.
- (5) This procedure includes steps to make sure that the rework of a hole does not result in damage to the substrate and subsequent loss in design life for that component.

B. **Consumable Materials**

Reference	Description	Specification
G51554	Fluid - General purpose multi-metal coolant (TRIMSOL)	
G51555	Fluid - VHP 210, chlorine-free - Coolant	

C. **Documented Operator Awareness Training**

SUBTASK 70-50-00-350-011-F00

- (1) Documented annual operator awareness training is necessary for operators who do this procedure.
 - (a) The operator training program must include the subjects that follow:
 - 1) Awareness of the effect on the part life using this standard practice.
 - 2) The significance of the speed, the coolant application, and the tool wear controls.
 - 3) The significance of edge-break requirements.
 - 4) The procedure to record unusual events or part defects.
 - 5) Provision for annual retraining.

NOTE: Please contact your local CFMI representative to get a copy of this training presentation from CFMI.

D. **Tool Definition and Control**

SUBTASK 70-50-00-350-012-F00

- (1) Keep a tool control system to control the tooling used for this procedure.
- (2) This system includes the following at a minimum:
 - (a) Detailed tool drawings.
 - (b) Supplier control.
 - (c) The procedure to issue the tools.

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- (d) Regrind control.
- (e) The procedure to handle the tool geometry variations.

E. Equipment Speed and Feed Verification

SUBTASK 70-50-00-350-013-F00

- (1) Measure machine tool spindle-speeds at no load conditions to make sure that actual speeds are ± 10 percent of nominal speeds.
- (2) Measure the spindle speeds across the applicable range of spindle speeds for the operations done on a specific machine.
- (3) Measure machine tool feed-rates using no load conditions to make sure that actual feed-rates are ± 10 percent of nominal feed-rates.
- (4) Measure the feed-rates across the applicable range of feed-rates for the operations done on a specific machine.

NOTE: Take measurements at regular intervals. Initially, it is recommended that these checks are completed and documented every six months, and annually thereafter.

- (5) Keep records of the inspections as per the repair shop's calibration system requirements.

F. Multi-step Process Requirements

SUBTASK 70-50-00-350-014-F00

- (1) When machining new holes, use a multistep process such as drilling followed by reaming or boring.
 - (a) A minimum of 0.006 in. (0.15 mm) must be removed by the secondary reaming or boring pass.
 - (b) Measure this 0.006 in. (0.15 mm) radially, 0.012 in. (0.30 mm) on the diameter.
- (2) When you rework holes, the depth of the cut (measured radially) must be no more than 0.015 in. (0.38 mm) for each pass.
- (3) For both processes above (both machining new holes and reworking holes) the last 0.002 in. (0.05 mm) must be removed by honing.
 - (a) Measure this 0.002 in. (0.05 mm) radially 0.004 in. (0.10 mm) on the diameter.

G. Maximum Cutting Speeds and Feed-rates

SUBTASK 70-50-00-350-015-F00

- (1) The following table gives maximum cutting speeds and feed-rates:

Table 801/70-50-00-993-801-F00

Machining Process	Hole Length/ Diameter	Tool Diameter	Max Cutting Speed (SFM) Power Met./All Others		Maximum Chip Load
Drilling	3	0.150	35	45	0.0015
	3	0.150	30	40	0.0015
	3		30	35	0.0015
Coolant Fed			60	80	0.0015
Gun Drilling			60	80	0.0006
Gun Reaming			30	45	0.0005
Drillbore			30	45	0.0015

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Table 801/70-50-00-993-801-F00 (Continued)

Machining Process	Hole Length/ Diameter	Tool Diameter	Max Cutting Speed (SFM) Power Met./All Others		Maximum Chip Load
Ream and End Mill Hole Sizing			20	30	0.0010
Single Point Boring			100	120	0.0030
Counter bore Spotfacing			30	45	0.0015
Peripheral Milling			40	50	0.0010
Plunge Milling			30	35	0.0010
Chamfer Milling			60	60	0.0010
Countersink			60	60	0.0010
Hand Fed Radius			30	30	0.0010
or Countersink			30	30	0.0010

H. Coolant Application Instructions

SUBTASK 70-50-00-350-016-F00

- (1) You must use a continuous flow of coolant fluid, G51555 or coolant fluid, G51554 throughout the machining process except for manual edge-break operations.
- (2) Direct the coolant fluid, G51555 or coolant fluid, G51554 toward the tool cutting edge along the tool shank or submerge the part in coolant fluid, G51555 or coolant fluid, G51554.

I. Tool Wear Limits

SUBTASK 70-50-00-350-017-F00

- (1) Method of Measuring Tool Wear:

- (a) Use a hand held Bauch & Lomb Brinell glass or equivalent to estimate the width and length of the tool wear land at the cutting edge.

NOTE: A Bausch & Lomb (B & L) Brinell glass is used to measure the diameter of the ball impression from a Brinell hardness test. The B & L eyepiece has a graduated scale with gaps between lines at 0.004 in. (0.10 mm). Any equivalent 7 to 50x magnifier with a 0.003 in. (0.08 mm) to 0.005 in. (0.13 mm) gap between lines is also acceptable.

- (2) Use the maximum tool wear values listed below to determine tool change points.

Table 802/70-50-00-993-803-F00

Tool Type	Wear Land Length
Drill	0.008 in. (0.20 mm)
Gun-Drill	0.006 in. (0.15 mm)
Gun-reamer	0.006 in. (0.15 mm)
Bore portion of drill-bore	0.010 in. (0.25 mm)
Reamer	0.006 in. (0.15 mm)
End mill (hole sizing)	0.005 in. (0.13 mm)

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Table 802/70-50-00-993-803-F00 (Continued)

Tool Type	Wear Land Length
Single point bore (hole sizing)	0.004 in. (0.10 mm)
Counterbore/spotface	0.008 in. (0.20 mm)
Peripheral mill	0.005 in. (0.13 mm)
Plunge mill	0.008 in. (0.20 mm)
Chamfer mill	0.005 in. (0.13 mm)
Counter sink	0.005 in. (0.13 mm)
Radius Cutter	0.005 in. (0.13 mm)

J. Edge-break, Hand-benching Definition

SUBTASK 70-50-00-350-018-F00

(1) Edge-break:

NOTE: Contact your local CFMI representative to obtain the process document(s).

- (a) Make sure that the edge-breaks of holes are done in accordance with the process document, unless otherwise specified.
- (b) Make sure that the edge-breaks of holes are free of burrs and high metal.
- (c) Do the chamfer corner rounding as the last metal removal operation when making the holes.
- (d) Make sure that corners are chamfered by milling (unless otherwise specified in the process document) and that the corners are free of burrs and high metal.

NOTE: Chamfer corner rounding must be done with soft tools.

(2) Hand-benching:

- (a) Use of tools, to remove surface imperfections in holes.

NOTE: The use of hard tools (i.e. abrasive stones) is allowed only when specified in the process document.

K. Post-finish Machining Requirements

SUBTASK 70-50-00-350-019-F00

- (1) Post-finish reworked holes by honing, jig-grinding, or abrasive flow processes to remove 0.002 in. (0.05 mm) minimum radial material after conventional machining is performed.
- (2) The following requirements apply to the processes used for post-finishing:
 - (a) Abrasive Flow.
 - 1) Maximum grit size shall be 710 micron (36 grit).
 - 2) Grit type shall be silicon carbide or aluminum oxide.
 - (b) Honing.
 - 1) Maximum grit size shall be 122 micron (150 grit).
 - 2) Maximum tool expansion rate shall be 90 microns/minute.
 - 3) Minimum stroke rate shall be 120/minute.
 - (c) Jig-Grinding.
 - 1) Maximum grit size shall be 66 micron (220 grit).
 - 2) Maximum tool speed shall be 3500 SFM.

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- 3) Minimum feed rate shall be 150 microns/minute.

L. Shotpeen Requirements

SUBTASK 70-50-00-350-020-F00

- (1) Re-shotpeen all the holes reworked per the process document.

NOTE: Contact your local CFMI representative to obtain the process document(s).

M. Process Approval Responsibility

SUBTASK 70-50-00-350-021-F00

- (1) Internal approval is required for this task, it is based upon the factors that follow:
- (a) Documentation of the Operator Training Program.
 - (b) Definition of Tooling Control System.
 - (c) Results of calibration of the machine tool as defined in the procedure.
 - (d) Documentation of the speeds and feeds used for the rework of the hole(s).

————— **END OF TASK** —————

TASK 70-50-00-350-802-F00

3. Removal of Broken Bolts

A. General

- (1) This procedure is for the removal of broken bolts when the bolt head has separated from the bolt shank.

B. Tools/Equipment

Reference	Description
STD-322	Extractor Kit - Screw
STD-4933	Drill Bit
STD-6470	Wheel - Abrasive, 2 inch (51 mm)

C. Prepare for the Repair

SUBTASK 70-50-00-350-002-F00



MAKE SURE CADMIUM-PLATED PARTS ARE NOT USED IN ENGINE HOT SECTIONS. THIS WILL PREVENT DAMAGE TO THE PARTS AND THE ENGINE.

- (1) Do an inspection of the tools to find cadmium, if you think that a tool could be cadmium plated.

D. Removal Procedure

SUBTASK 70-50-00-350-003-F00

- (1) Measure the diameter of the bolt shank, and use an applicable screw extractor from the screw extractor kit, STD-322 and drill bit, STD-4933 size.
- (a) The diameter of the drill bit, STD-4933 must be smaller than the diameter of the bolt shank so that damage to the part does not occur.

SUBTASK 70-50-00-350-004-F00



DO NOT OPERATE THE GRINDER WITHOUT SAFETY GOGGLES AND OTHER GUARDED EQUIPMENT. FLYING PARTICLES CAN CAUSE INJURY.

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PUT A COVER ON THE OPENINGS OF THE COMPONENT. IF YOU DO NOT PUT A COVER ON THE OPENINGS, THE CONTAMINATION CAN CAUSE DAMAGE TO THE COMPONENT.

- (2) If the bolt extends above the surface of the part, use an abrasive wheel, STD-6470 to make the broken end flat.

SUBTASK 70-50-00-350-005-F00

- (3) To align the drill bit correctly, do a center-punch dimpling at the center of the bolt shank.

SUBTASK 70-50-00-350-006-F00

- (4) Tighten the drill bit, STD-4933 in the chuck, and install a drill stop to make sure that the hole depth is correct.

SUBTASK 70-50-00-350-007-F00

- (5) Drill into the center of the bolt to a depth sufficient for the screw extractor.

- (a) Do not drill more than the depth of the bolt.

SUBTASK 70-50-00-350-008-F00

- (6) Put the screw extractor into the hole, and apply torque in a counter-clockwise direction to remove the bolt.

E. Quality Assurance Check

SUBTASK 70-50-00-350-009-F00

- (1) Do an inspection of the part threads after the bolt removal.
- (a) Compare the hole with the detail part specification to make sure that they agree.
- (b) If you see damaged threads, use the applicable tap to correct the contour of the threads.
- (c) Remove all the tool marks, scratches, or other surface defects, refer to TASK 70-50-00-350-801-F00.

———— **END OF TASK** ————

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STANDARD TOOLS AND EQUIPMENT - MAINTENANCE PRACTICES

1. General

- A. This procedure contains the approved tools and equipment you use in the maintenance of the CFM56 engine.

TASK 70-60-01-910-801-F00

2. Standard Tools and Equipment

A. General

- (1) The tools and equipment listed in these steps are in addition to the standard tools listed in the aircraft maintenance manual.

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-2477	Tools - Vacuum Cleaner Set Part #: AVQ250-2 Supplier: U1761 Opt Part #: 02146A Supplier: 0A5X2 Opt Part #: 44SPEC Supplier: 0Y8U0 Opt Part #: 655406-7M Supplier: 0Y8U0 Opt Part #: C-39485-41 Supplier: 16893 Opt Part #: R80 Supplier: \$0373 Opt Part #: WD80 Supplier: \$0373
STD-442	Gun - Heat, 180 deg. F (82 deg. C) Maximum Output Temperature
STD-1107	Gauge - Feeler, 0.0 - 0.5 Inch, Readable to 1/1000th
STD-3935	Screwdriver, Phillips ACR PSC-1204-3-R

C. List of Approved Tools and Equipment

SUBTASK 70-60-01-910-001-F00

- (1) Description and Supplier
- (a) vacuum cleaner tool set, COM-2477 - Local Purchase
 - (b) 180 deg. F (82 deg. C) maximum output temperature heat gun, STD-442 - Local Purchase
 - (c) 0.0 - 0.5 Inch feeler gauge, STD-1107 - Local Purchase

Table 201/70-60-01-993-801-F00

TOOLS	COMPANY AND ADDRESS
Soft Nose Pliers Model Souriau 8498-03	Souriau Inc. 765 Kester Avenue Van Nuys, CA 91405 USA
Soft Nose Pliers Model Souriau 8498-03	Souriau Et Cie 9-13 Rue Gallieni 92103 Boulogne-Billancourt France
Crowfoot Wrench Model Snap-On TMRX1	Snap-On Tools Company 8049 28th Avenue Kenosha, WI 53140 USA

- (d) Wrench, clawsfoot, AN8508-14A
- (e) Phillips ACR PSC-1204-3-R screwdriver, STD-3935

————— **END OF TASK** —————

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STANDARD ENGINE WIRING AND EQUIPMENT CHECK - MAINTENANCE PRACTICES

TASK 70-70-01-200-801-F00

1. Standard Engine Wiring and Equipment Check

A. General

- (1) This task has four topics:
- (a) The general instructions for the routing of the wiring harnesses
 - (b) The visual examination of the wiring harnesses
 - (c) A visual check of engine component receptacles and harness connectors
 - (d) The retention test for the connector sockets.

B. References

Reference	Title
70-70-01-350-801-F00	Engine Wiring Harnesses Repair (P/B 801)
73-21-06-000-801-F00	Fan Wiring Harness Removal (P/B 401)
73-21-06-400-801-F00	Fan Wiring Harness Installation (P/B 401)
73-21-10-000-801-F00	HMU Removal (P/B 401)
73-21-10-400-801-F00	HMU Installation (P/B 401)

C. Tools/Equipment

Reference	Description
STD-123	Brush - Soft Bristle
STD-127	Brush - Nylon

D. Consumable Materials

Reference	Description	Specification
B00676 [CP1041]	Alcohol - Isopropyl	

E. Location Zones

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

F. General Instruction on the Routing of The Wiring Harnesses

SUBTASK 70-70-01-210-001-F00

- (1) Wire harness routing.
- (a) Make sure that all clamps are in their correct position and installed correctly.
 - (b) Make sure that the wire bundle length is equally distributed between the attach parts and is not stressed.
 - (c) Make sure that there is no unwanted force that is applied to the wire bundle.
 - (d) Harnesses that touch a metal component are not permitted.
 - (e) The routing of the different wire bundles can touch each other in some areas.
NOTE: Wire bundles that go across and touch different wire bundles are permitted.
 - (f) It is permitted to let the wire bundles touch when they are parallel.
 - 1) Only if the bundles are of the same flexible conduit.

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G. Visually Examine the Wiring Harnesses

SUBTASK 70-70-01-210-002-F00

NOTE: You must be very careful when you do a visual inspection. Try to not cause more damage to the worn areas.

- (1) Visually examine the wire harness for damage:
 - (a) Cuts, abrasions, chafing, rupture or damage to the outer cable sheath.
 - 1) If you find one worn area between the two loop clamps or below the loop clamp.
 - a) Do this task: Engine Wiring Harnesses Repair, TASK 70-70-01-350-801-F00.
 - 2) If you find more than one worn area between the two loop clamps, the harness is not serviceable.
 - a) Replace the harness.

SUBTASK 70-70-01-210-003-F00

- (2) Look for damage to the engine component receptacles and harness connectors:
 - (a) Thread damage.
 - 1) One lead-in thread of more than 30 percent damage, or two lead-in threads with 20 percent damage or more:
 - a) Chase the threads if they meet the specified limits.
 - 2) If the thread damage is more than the specified limits, replace the connector or engine component.
 - a) Install a replacement harness or engine component.
 - (b) Connector and related receptacle pin damage.
 - 1) Make sure that the pin-to-socket connections are satisfactory, and the sockets are tightly attached in the connector or the receptacle.
 - a) Do a retention test of the connector socket.
 - 2) If the pins or sockets are broken, eroded, bent, or corroded, replace the engine component or connector.
 - (c) Contamination inside the connector and receptacle well.
 - 1) None permitted.



WARNING

DO NOT GET ISOPROPYL ALCOHOL IN YOUR MOUTH, EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM THE ISOPROPYL ALCOHOL. KEEP THE ISOPROPYL ALCOHOL AWAY FROM SPARKS, FLAME, AND HEAT. ISOPROPYL ALCOHOL IS POISONOUS AND FLAMMABLE, WHICH CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

- a) Clean the area with a soft bristle brush, STD-123 and alcohol, B00676 [CP1041].
- b) This task is permitted on these wiring harnesses and connectors:
 - <1> J9 wiring harness connectors DP0901 and DP0905
 - CJ9 wiring harness connectors DP0912 and DP0913
 - J10 wiring harness connectors DP1001 and DP1005
 - CJ10 wiring harness connectors DP1012 and DP1013

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<2> Clean the connector socket with a nylon brush, STD-127 (type 81-AY 1.5 mm) and alcohol, B00676 [CP1041].

<a> Do not put the connector fully in the alcohol.

NOTE: Do not use cleaner lubricant. The core wiring harness is in a high temperature (150 degrees to 400 degrees Celsius) area. The lubricant can coke and release dangerous particles.

<3> Put the nylon brush in the alcohol momentarily.

<4> Tightly hold the brush near bristles, with the connector in the down position. Fully put and remove the brush in the socket for 10 times at a maximum rate of one removal/second.

<5> To clean the brush, put it in the alcohol momentarily and shake to remove particles.

<a> Do the step to clean the brush again, two more times.

<6> Let the sockets dry for a few minutes before you re-connect them.

NOTE: Do not blow pressurized air in the plug shell or the socket contacts. It can cause damage at the internal ring sockets then socket retention force will be loose.

(d) Fuel wetting and leakage.

1) The fuel wetting at J5 and J6 HMU connectors when removed or installed.

a) It is serviceable.

NOTE: The wetting is a moderate wet that does not increase in time.

2) The fuel leakage at J5 and J6 HMU connectors when removed.

a) It is serviceable.

<1> Dry connectors with soft air.

<2> Clean the connectors with alcohol, B00676 [CP1041].

NOTE: The leakage is a continuous flow of drops.

3) The fuel leakage at J5 and J6 HMU connectors when installed.

a) It is not serviceable.

b) Do these tasks to remove and replace the cable and HMU.

<1> Do this task: HMU Removal, TASK 73-21-10-000-801-F00.

<2> Do this task: Fan Wiring Harness Removal, TASK 73-21-06-000-801-F00.

<3> Do this task: Fan Wiring Harness Installation, TASK 73-21-06-400-801-F00.

<4> Do this task: HMU Installation, TASK 73-21-10-400-801-F00.

H. Retention Test of the Connector Socket

SUBTASK 70-70-01-220-001-F00

(1) Do a check of the retention of the connector sockets:

NOTE: This test is not used for a new connector socket.

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BE CAREFUL WHEN YOU DO A CHECK OF THE CONTACTS. INCORRECT USE OF THE RETENTION TEST TOOL COULD CAUSE DAMAGE TO THE CONNECTORS, CONTACTS OR TEST TOOL.

- (a) Select the applicable tool size to fit the connector socket (Figure 201).

NOTE: There are two sizes of sockets for the engine connectors; a gauge 16 and a gauge 20.



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- (b) Clean the contact retention tester with alcohol, B00676 [CP1041].

NOTE: No traces of lubricant are permitted.

- (c) Install the applicable pin of the contact retention tester in the connector socket.
 (d) Hold the connector vertically so the socket contacts point to the ground.
 (e) Put the contact retention tester into the socket.
 (f) With the connector and contact retention tester in this position, the connector socket must not let the contact retention tester drop out.
 1) If the contact retention tester drops out, replace the harness.
 (g) Do the steps again for all the other contacts in the connector.
 (h) When the connector test is complete, install the connector to the specified receptacle.
 1) Tighten the connector with your hand.
 2) Tighten the coupling nut one-eighth of a turn.

NOTE: With the soft connector pliers.

SUBTASK 70-70-01-810-001-F00

- (2) If this procedure was done as a step from the fault isolation manual, continue with the fault isolation procedure.

————— **END OF TASK** —————

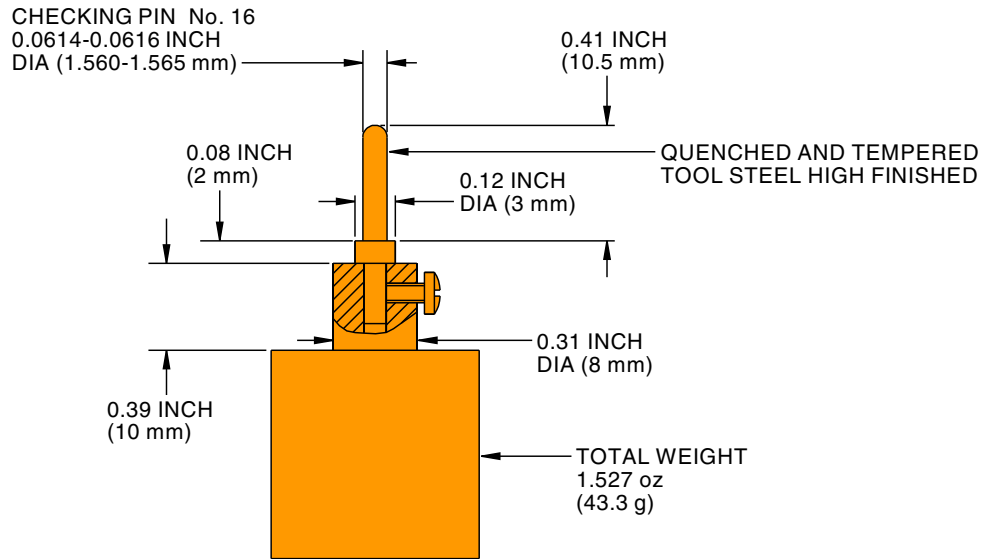
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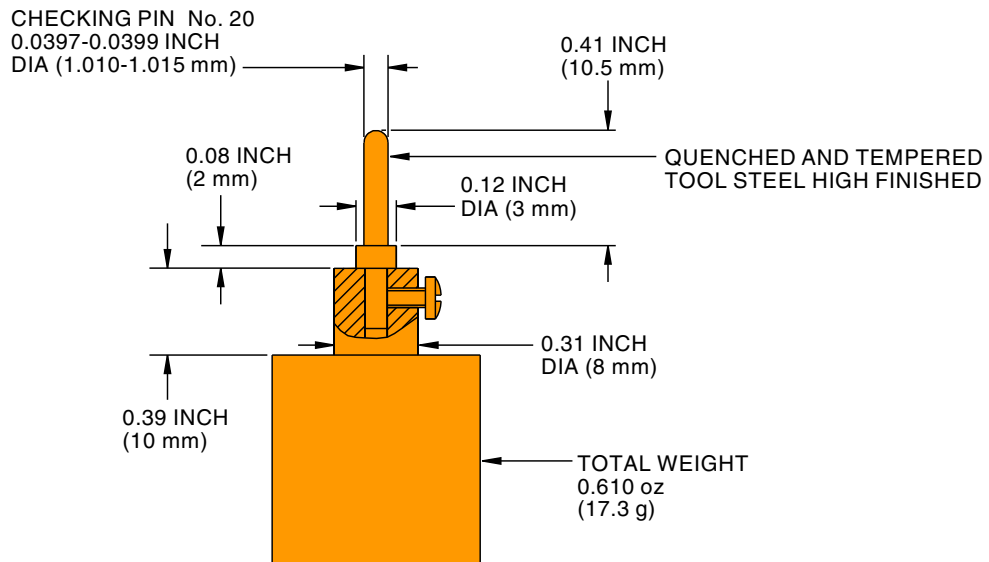
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CHECKING PIN No. 16



CHECKING PIN No. 20

S-M56-MM-03695-00-B
G16592 S0006581708_V3

Connector Socket Retention Checking Tools Figure 201/70-70-01-990-801-F00

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ENGINE WIRING HARNESSSES - REPAIR

1. General

- A. This procedure has one task:
- (1) Engine Wiring Harnesses Repair.

TASK 70-70-01-350-801-F00

2. Engine Wiring Harnesses Repair

(Figure 801, Figure 802, Figure 803, and Figure 804)

A. General

- (1) This procedure gives instructions on how to repair a wiring harness that is worn.
- (2) There are three types of the outer sheath of the harnesses repair:
 - (a) Fiberglass tape with lockwire repair
 - (b) Aluminum tape with lockwire repair
 - (c) Silicone tape repair.
- (3) This repair is temporary until the next engine shop visit. It is applicable if the damaged area of the harness is in the dimensions of the permitted limits.
- (4) It is not permitted to have more than one damaged area between two loop clamps to do this repair procedure.

NOTE: Except for the MW0325 and MW0326 harnesses post-CFM SB 72-0759 for which the repair is permitted for more than one worn area between two bushings.

- (5) The repair is permitted for damage under the loop clamp and/or only one damaged area between two loop clamps with the dimensions in the limits.

NOTE: Except for the MW0325 and MW0326 harnesses post-CFM SB 72-0759 for which the repair is permitted for worn area under the bushings and/or with worn areas between two bushings without dimension limits.

- (6) It is permitted to start the wrapping on the crimped band clamp found on the wiring harness branch tapping.
- (7) The fiberglass tape with lockwire or aluminum tape with lockwire repair is applicable for:
 - (a) The engine fan fire detection harnesses MW0315 and MW0316 (TASK 26-11-02-000-801 and TASK 26-11-02-400-801)
 - (b) The nacelle wiring harnesses MW0301, MW0302, MW0303, MW0304, MW0311, MW0312 and MW0313 (TASK 71-51-03-000-801-F00 and TASK 71-51-03-400-801-F00)
 - (c) The fan wiring harnesses J5, J6, J7 and J8 (TASK 73-21-06-000-801-F00 and TASK 73-21-06-400-801-F00)
 - (d) The fan 3:00 o'clock strut harnesses J9 and J10 (TASK 73-21-06-000-802-F00 and TASK 73-21-06-400-802-F00)
 - (e) The engine core fire detection Harnesses MW0325 and MW0326 (TASK 26-11-02-000-802 and TASK 26-11-02-400-802)
 - (f) The core engine harnesses CJ9 and CJ10 (TASK 73-21-06-000-803-F00 and TASK 73-21-06-400-803-F00).
- (8) The silicone tape repair is applicable for:
 - (a) The engine fan fire detection harnesses MW0315 and MW0316 (TASK 26-11-02-000-801 and TASK 26-11-02-400-801)

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- (b) The nacelle wiring harnesses MW0301, MW0302, MW0303, MW0304, MW0311, MW0312 and MW0313 (TASK 71-51-03-000-801-F00 and TASK 71-51-03-400-801-F00)
NOTE: To remove the MW0311, do this task: 3 O'clock Strut Harness Removal, TASK 73-21-06-000-802-F00
- (c) The fan wiring harnesses J5, J6, J7 and J8 to (TASK 73-21-06-000-801-F00 and TASK 73-21-06-400-801-F00)
- (d) The fan 3:00 o'clock strut harnesses J9 and J10 (TASK 73-21-06-000-802-F00 and TASK 73-21-06-400-802-F00).
- (e) This repair is not permitted on the engine core fire detection harnesses (MW0325 and MW0326) and the core engine wiring harnesses (CJ9 and CJ10).
- (9) To do this repair procedure, remove fully or partially the wiring harness to get access to the damaged area. Thus, refer to the applicable task to remove and install the wiring harness and to take all precautions necessary to do this repair procedure.

B. References

Reference	Title
26-11-02-000-801	Fan Fire Detection Harness Removal (P/B 401)
26-11-02-000-802	Core Fire Detection Harnesses - Removal (P/B 401)
26-11-02-400-801	Fan Fire Detection Harness Installation (P/B 401)
26-11-02-400-802	Core Fire Detection Harness - Installation (P/B 401)
71-51-03-000-801-F00	Nacelle Wiring Harnesses Removal (P/B 401)
71-51-03-400-801-F00	Nacelle Wiring Harnesses Installation (P/B 401)
73-21-06-000-801-F00	Fan Wiring Harness Removal (P/B 401)
73-21-06-000-802-F00	3 O'clock Strut Harness Removal (P/B 401)
73-21-06-000-803-F00	Core Engine Harness Removal (P/B 401)
73-21-06-400-801-F00	Fan Wiring Harness Installation (P/B 401)
73-21-06-400-802-F00	3 O'clock Strut Harness Installation (P/B 401)
73-21-06-400-803-F00	Core Engine Harness Installation (P/B 401)

C. 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-6457	Meter - Insulation (Range: 1-1,000 VDC or equivalent, select meter per test requirements) Part #: 1864-9700 Supplier: 62015 Part #: 1865PLUS Supplier: 62015 Part #: 1865PLUSCE Supplier: 62015 Part #: 2471F Supplier: 21844 Opt Part #: 1865-00-CE Supplier: 62015
STD-762	Scissors - Electrical
STD-10670	Pliers

D. Consumable Materials

Reference	Description	Specification
B00676 [CP1041]	Alcohol - Isopropyl	
G00834	Cloth - Lint-free Cotton	

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(Continued)

Reference	Description	Specification
G50142	Lockwire - MS20995C15, Corrosion Resistant Steel - 0.015 Inch (0.381 mm) Diameter	NASM20995
G50143 [CP2208]	Tape - Glass Cloth with Silicone Adhesive, High Temperature, Abrasive Resistant - 3M 361	
G50145 [CP2628]	Tape - High Temperature Aluminum Foil with Glass Cloth, Silicone Adhesive - 3M 363	
G50651 [CP2682]	Tape - Silicone Rubber (Arlon MOX Tape)	

E. Location Zones

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

F. Prepare for the Repair

SUBTASK 70-70-01-210-006-F00

- (1) Examine the clamp areas of the worn harness as follows:

NOTE: The repair is permitted for one damaged area between the two loop clamps with the dimensions in the limits. Except for the MW0325 and MW0326 harnesses post-CFM SB 72-0759 for which the repair is permitted for more than one worn area between two bushings without dimension limits.

NOTE: Be careful when you do the visual inspection. Make sure that you do not cause more damage to the worn areas of the sheath clamp. Removal can also cause more damage.

- (a) Remove the harness from the clamp locations.

NOTE: If you remove fully or partially the wiring harness to get access to the area, refer to the applicable task. Read all precautions necessary to remove and install the wiring harness.

- (b) Examine the harness along the clamp contact areas for damage.

- (c) If the sheath is not worn, do these steps:

- 1) Replace the clamps.
- 2) Attach the harness with the clamps.

- (d) If you find only one worn area between the two loop clamps, do the repair task.

- (e) If you find more than one worn area between the two loop clamps, replace the electrical harness. Except for the MW0325 and MW0326 harnesses post-CFM SB 72-0759 for which the repair is permitted for more than one worn area between two bushings.

SUBTASK 70-70-01-760-001-F00

- (2) Measure the insulation resistance of the harness as follows.

NOTE: You can use 50 up to 125 Vdc range input to measure the insulation resistance.

- (a) Disconnect the connectors at each end of the harness.

NOTE: Make sure that you disconnect the connector at each end of the harness. If you do not, this can cause unsatisfactory resistance indications and possible damage to the circuits.

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- (b) Use an insulation meter, COM-6457 to measure the insulation resistance between each wire.
 - 1) The resistance must be equal to or more than 20 Megohms.
- (c) Use an insulation meter, COM-6457 to measure the insulation resistance between each wire and the ground.
 - 1) The resistance must be equal to or more than 20 Megohms.
- (d) If the resistance is out of the limits, replace the electrical harness.

G. Fiberglass Tape with Lockwire or Aluminum Tape with Lockwire Repair

SUBTASK 70-70-01-210-007-F00

- (1) Do this inspection of the worn area before you do the repair.

NOTE: Be careful when you do the visual inspection. Make sure that you do not cause more damage to the worn areas of the sheath clamp. Removal can also cause more damage.

- (a) Make sure that the strands of metallic sheath are not cut or burnt.
- (b) Measure the damaged area to make sure that it is less than the maximum defective area of Dimension C which is 1.25 inches (31.75 mm) (Table 801).

NOTE: This paragraph is not applicable for MW0325 and MW0326 harnesses post-CFM SB 72-0759.

- 1) If the area is more than the maximum defective area dimension C, replace the electrical harness.

SUBTASK 70-70-01-110-001-F00



DO NOT GET ISOPROPYL ALCOHOL IN YOUR MOUTH, EYES, OR ON YOUR SKIN. DO NOT BREATHE THE FUMES FROM THE ISOPROPYL ALCOHOL. KEEP THE ISOPROPYL ALCOHOL AWAY FROM SPARKS, FLAME, AND HEAT. ISOPROPYL ALCOHOL IS POISONOUS AND FLAMMABLE, WHICH CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO EQUIPMENT.

- (2) Clean the outer sheath, in and around the damaged area of the harness with the lint-free cloth, G00834 wet with alcohol, B00676 [CP1041].

SUBTASK 70-70-01-350-001-F00

- (3) Do these steps to repair the harness:

NOTE: Do not penetrate the harness CU-IN. It can cause an incorrect insulation of the harness.

- (a) Cut off all the loose strands in the damaged area with end-cutting pliers, STD-10670.

NOTE: This step is for harnesses with metallic sheath.

- (b) Examine the repair areas of the harness for any penetration into the harness.
- (c) Apply 3M 361 tape, G50143 [CP2208] or 3M 363 tape, G50145 [CP2628] to the damaged area as follows:

NOTE: For MW0325 and MW0326 harnesses post-CFM SB 72-0759, use only aluminum 3M 363 tape, G50145 [CP2628]

- 1) Apply the tape around the braid through the damaged area (Table 801).

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Table 801/70-70-01-993-801-F00 Fiberglass Tape or Aluminum Tape Repair Dimensions

Description	Minimum Finish Dimension	Maximum Finish Dimension
Dimension A	0.5 inch (12.7 mm)	
Dimension B	0.5 inch (12.7 mm)	
Dimension C (For all engine wiring harnesses, except MW0325 and MW0326 wiring harnesses post-CFM SB 72-0759)		1.25 inch (31.75 mm)
For MW0325 and MW0326 wiring harnesses post-CFM SB 72-0759		Braid missing or any amount of worn/ missing braid between two bushings is allowed. Cable surface finish dent: Any amount if insulation resistance check meets criterion in paragraph 2.F.(2).

- 2) Start at Dimension A and do these steps:
 - a) Wind the tape one-half width before the cut away.
 - b) Stop one-half width after the cut away area to Dimension B.
- 3) Apply the tape in the same direction with one-half width overlay at each turn.
- 4) Cut the tape with an electrical scissors, STD-762.
- (d) Do these steps to install MS20995C15 lockwire, G50142 around the outer sheath:
 - 1) Make sure that the length of the wire is sufficient to make an overlap on the tape and outer sheath at each end of the repair.
 - 2) Hold the wire along the length of the worn area that starts from the left side.
 - 3) Start at the opposite end and apply the wire tightly and equally above the outer sheath to cover the repair area.
 - 4) Make sure that the dimensions are correct.
 - 5) Let the short end of the loop stay exposed when approximately 2/3 of the wound wire length is completed.
 - a) Continue to wind the wire to complete the remaining distance shown as 1/3 X.
 - 6) Put the wire A into the loop after the last turn.
 - 7) Cut off the end of wire B until its length is approximately 1/3 of the repair length.
 - 8) Pull the loop end of the wire C until the wire A goes through the wound wire and the wire B goes out of the view below the last turn.
 - 9) Cut off the end of the wire C flush.

SUBTASK 70-70-01-210-008-F00

- (4) Examine the repaired areas of the wire harness for correct repair.
 - (a) A bad wire wind up is not permitted, do the repair again.

SUBTASK 70-70-01-970-001-F00

- (5) If it is necessary, record this repair in the engine log book.

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H. Silicone Tape Repair

SUBTASK 70-70-01-210-011-F00

- (1) Make sure that you do the silicone tape repair on the fan wire harnesses only.

NOTE: Do not do the silicone tape repair on the core wire harnesses.

SUBTASK 70-70-01-210-009-F00

- (2) Do this inspection of the worn area before the repair.

NOTE: Be careful when you do the visual inspection. Make sure that you do not cause more damage to the worn areas of the sheath clamp. Removal can also cause more damage.

NOTE: The silicone tape repair is a temporary repair. Make sure that the wire harness is in the repair limits. If it is not in the limits, you must replace the damaged wire harness. Send the damaged harness to the repair shop.

- (a) Make sure that the strands of metallic sheath are not cut or burnt.
- (b) Measure the damaged area to make sure that it is less than the maximum defective area of Dimension C which is 1.25 inches (31.75 mm) and does not extend 90° (Table 802).
 - 1) If the area is more than the Dimension C, replace the electrical harness.
- (c) Measure the distance between two adjacent damaged areas to make sure that it is more than 1.0 inch (25.4 mm).
 - 1) If the distance is less than 1.0 inch (25.4 mm), replace the electrical harness.
- (d) Measure the cumulated length of the damaged areas to make sure that it is less than 1.0 inch (25.4 mm) for each 3.0 inches (75 mm) length of the harness.
 - 1) If the cumulated length is more than 1.0 inch (25.4 mm), replace the electrical harness.

SUBTASK 70-70-01-110-002-F00



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- (3) Clean the outer sheath, in and around the damaged area of the harness with the lint-free cloth, G00834 wet with alcohol, B00676 [CP1041].

SUBTASK 70-70-01-350-002-F00

- (4) Do these steps to repair the harness.

NOTE: Do not penetrate the harness CU-IN. It can cause an incorrect insulation of the harness.

- (a) Cut off all the loose pieces of the outer sheath in the damaged area with end-cutting pliers, STD-10670.

NOTE: This step is for harnesses with metallic sheath.

- (b) Examine the repair areas of the harness for a penetration into the harness.
- (c) Apply the silicone tape Arlon MOX Tape, G50651 [CP2682] to the damaged area as follows:
 - 1) Apply the tape around the sheath through the damaged area (Table 802).

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Table 802/70-70-01-993-802-F00 Silicon Tape Repair Dimensions

Description	Minimum Finish Dimension	Maximum Finish Dimension
Dimension A	0.5 inch (12.7 mm)	1.0 inch (25.4 mm)
Dimension B	0.5 inch (12.7 mm)	1.0 inch (25.4 mm)
Dimension C		1.25 inch (31.75 mm)
Angle D		90°

- 2) Start at the Dimension A.
 - a) Wind the tape one-half width before the cut away
 - b) Stop one-half width after the cut away area to Dimension B.
- 3) Apply the tape in the same direction with one-half width overlay at each turn.
- 4) Cut the tape with an electrical scissors, STD-762.

SUBTASK 70-70-01-210-010-F00

- (5) Examine the repaired areas of the worn harness for correct repair:
 - (a) A bad tape bond on the parent material with lift off is not permitted, do the repair again.
 - (b) A bad tape wind up with nicks and dents is not permitted, do the repair again.

SUBTASK 70-70-01-970-002-F00

- (6) If it is necessary, record this repair in the engine log book.

————— END OF TASK —————

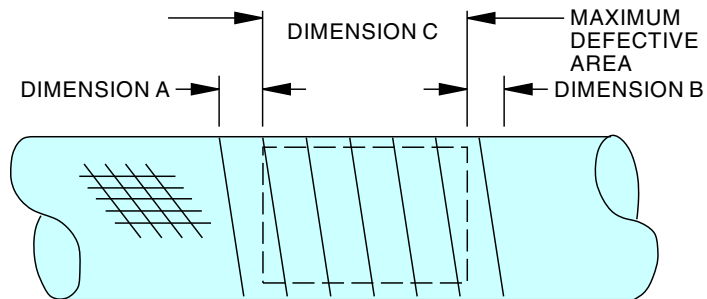
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**Fiberglass Tape or Aluminum Tape Repair
Figure 801/70-70-01-990-802-F00**

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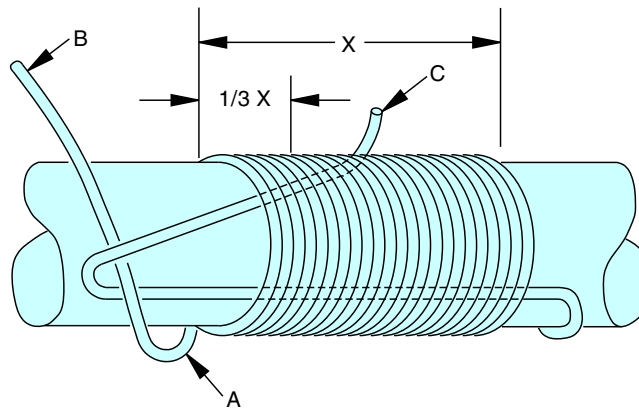
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Stainless Steel Wire Repair
Figure 802/70-70-01-990-805-F00

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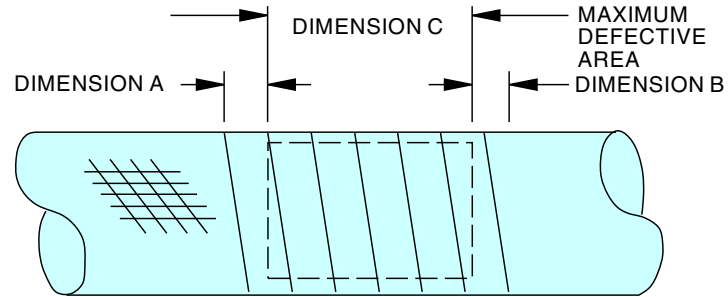
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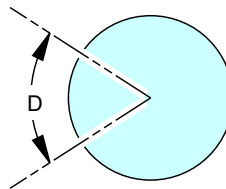
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MAXIMUM
DEFECTIVE
AREA ANGLE D



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Silicone Tape Repair
Figure 803/70-70-01-990-806-F00

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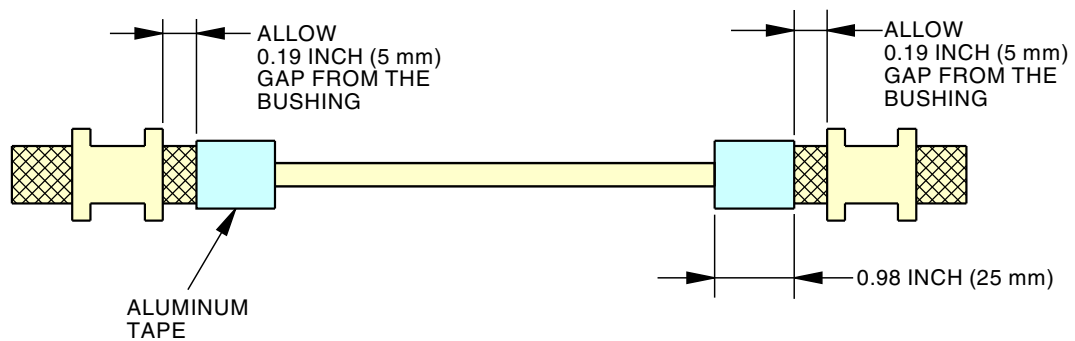
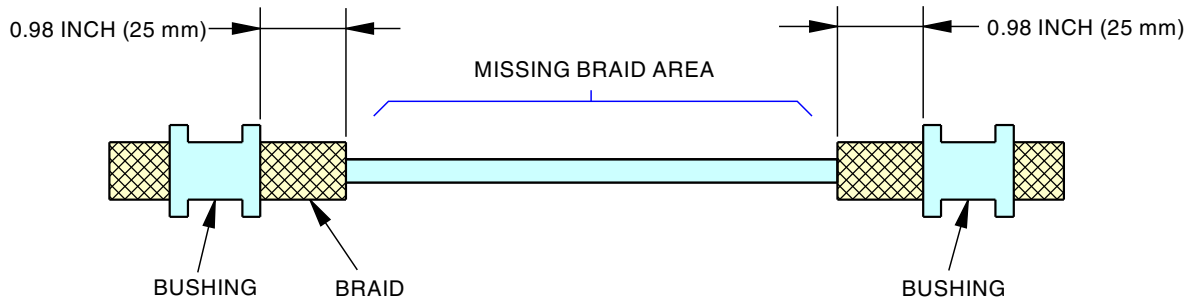
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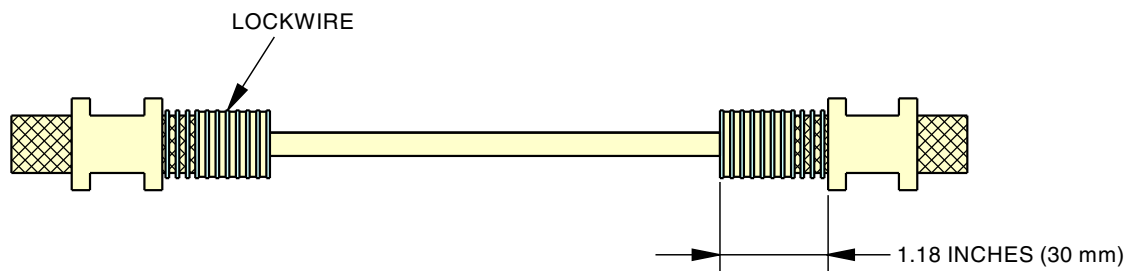
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APPLICATION OF ALUMINUM TAPE



INSTALLATION OF LOCKWIRE

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**MW0325 and MW0326 Harnesses Post-CFM SB 72-0759 Repair
Figure 804/70-70-01-990-807-F00**

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