CHAPTER

75

AIR

CHAPTER 75 - AIR SYSTEM

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AIR SYSTEM - DESCRIPTION AND OPERATION

1. General.

The engine air systems consist of a primary and bleed air systems.

2. Air System Components.

A. Anti-icing Valve.

The electrically energized anti-icing air valve controls the ON-OFF flow of anti-icing air to the front frame. A fail-safe feature in the valve assures air flow in the event of electrical power failure. The valve is located at the 10 o'clock position on the front frame.

B. Compressor Bleed Valves.

The amount of air being bled from the third, fourth and fifth stages of the compressor is controlled by two bleed valves which are mounted at three and nine o'clock on the compressor casing. Each valve has six openings or two for each stage. Each valve is operated by a single pushrod which moves two camplates in opposite directions inside the valve. Each camplate moves three gates which slide across the valve ports, opening or closing the bleed valve. The pushrod travels forward or aft in a direction parallel to the engine centerline. A rod end which threads onto each pushrod is connected by means of a clevis pin to a third arm on the bellcrank link.

C. Variable Vane Actuators.

The two actuators are operated by high pressure fuel, which is scheduled by the variable geometry servo in the main fuel control, and is introduced to either side of a piston inside the actuator, causing a shaft, which is attached to the piston, to either extend or retract. This shaft is connected, through linkage, to one arm on a master bellcrank link. There are two bellcrank links, one mounted and pivoting about a clevis pin on each actuator bracket. Each link has five arms, one of which is attached to the actuator piston shaft as described above. Another arm on each bellcrank is connected to the inlet guide vane actuator ring at three and nine o'clock.

3. Operation.

A. Engine Combustion Air Flow.

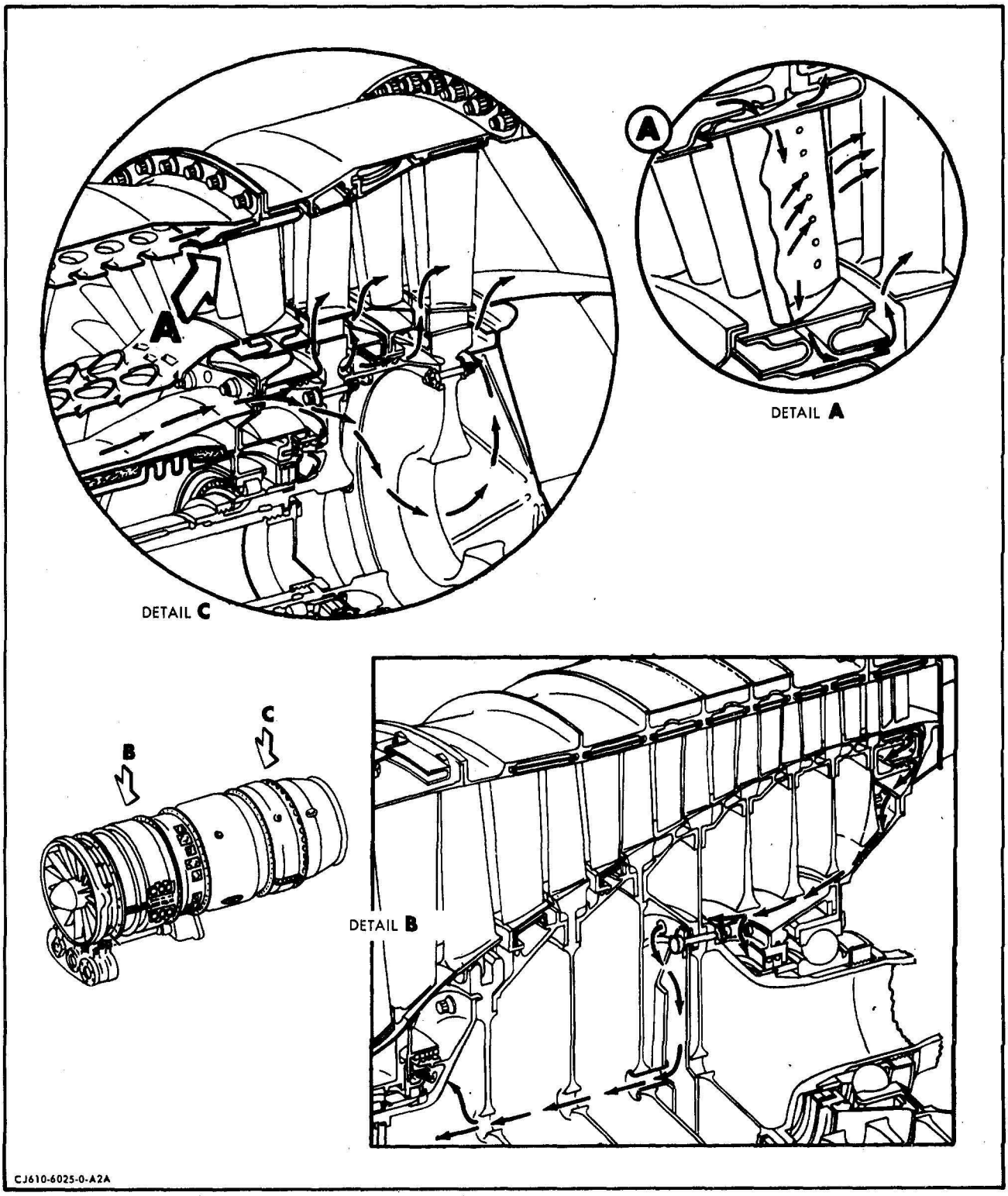
The combustion air is directly associated with combustion and thrust. The variable vanes in the front frame annulus guide the air into the

compressor for optimum airflow. The air passes through the compressor and is diffused in the mainframe. It is then mixed with fuel in the combustor and ignited. The combustion gases then pass through the turbine where the greater portion of available energy is used to drive the engine compressor, and the rest passes through the exhaust cone and tailpipe to provide thrust.

B. Engine Cooling and Pressurizing Air Flow. (See figure 1.)

Compressor discharge air which leaks across the eighth stage compressor air seal is used to pressurize the No. one, two, four and five carbon seals and the lube system. As the air leaves the seal it moves forward along the number two bearing housing and seal support and pressurizes the number two carbon seal. Seal leakage air also passes through holes, located in the compressor drive shaft mounting flange between the mounting bolts, into the rotor. It moves forward through the rotor and out through holes in the forward compressor shaft and pressurizes the number one carbon seal. The lube system itself is pressurized by this same air which leaks across the carbon seals. The pressure of the seal leakage air is controlled by two poppet valves which are mounted on the two and ten o'clock mainframe strut pads. Excess eighth stage seal leakage air, which passes through the poppet valves, is dumped overboard or ducted aft to the aft fan section. (Refer to 79-41-0 for poppet valve Maintenance Practices.)

Compressor discharge air that is not mixed into the fuel-air charge is used for cooling engine components in the combustion and turbine sections. This is necessary because of the high temperature generated by the burning process which is centered in the combustion section. Temperatures are so high that without provisions for cooling air, the life of the components in the combustion and turbine sections would be extremely short. Cooling of the inner walls of the combustion liner is accomplished by a pattern of louvers cut in the inner and outer liner shells. These perforations direct the flow of secondary combustion air or cooling air through the liner and along the liner inner skin to keep the flame away from both liner walls. The air flowing between the combustion liner and the outer combustion casing, cools the outer wall of the liner, and then passes inward through a series of holes in the aft outer flange of the liner. A portion of this air then flows outward through radial holes in the first stage turbine nozzle outer band and aft to cool the turbine casing and first stage turbine shroud at which point it re-enters the main gas stream. The remainder of the air flows through the hollow partitions in the first stage turbine nozzle, into the inner band of the nozzle, and is expelled aftward, through slots in the inner band, against the shanks of the first stage turbine blades. Some of the air, as it passes through the partitions, is expelled through small slots in the concave surface and cools the trailing edges of the partitions.



Engine Cooling and Pressurizing Air Flow
Figure 1

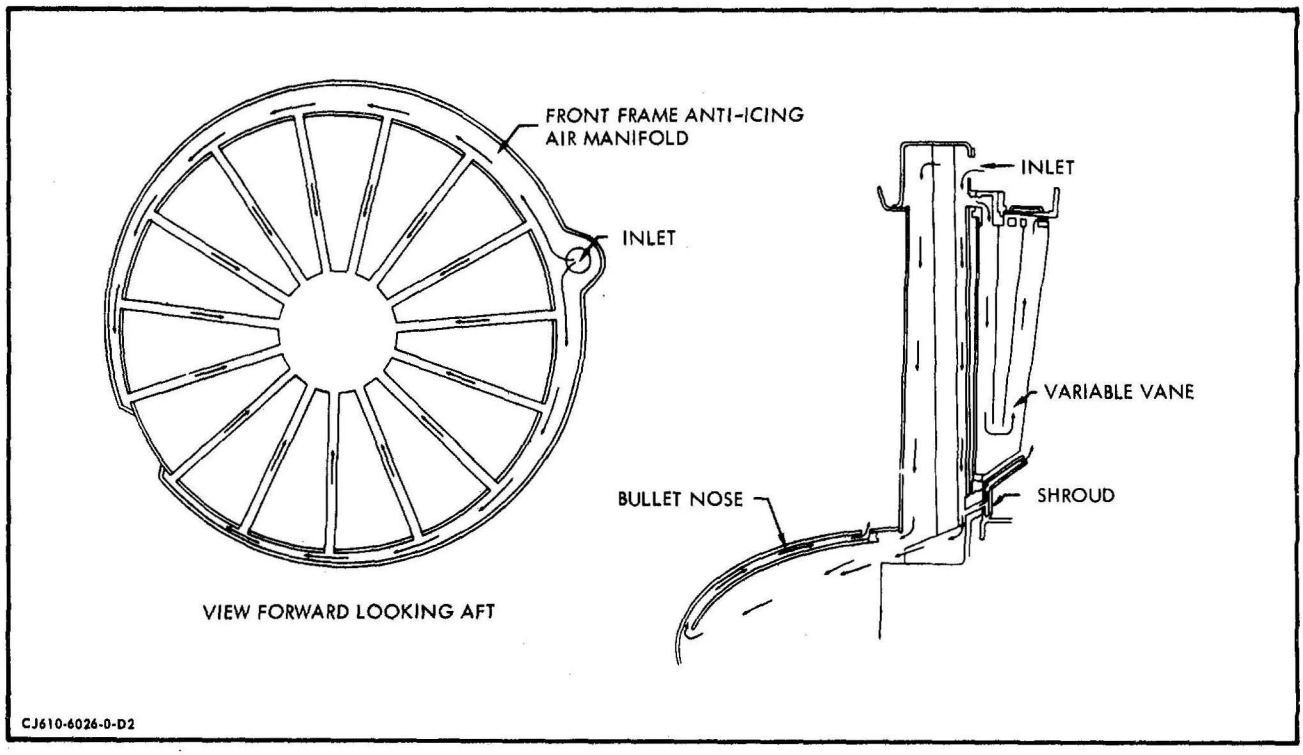
Secondary combustion air which flows between and cools the combustion liner and the inner combustion casing is directed into the balance piston chamber. This chamber is located just forward of the first stage turbine wheel. The air enters the chamber through a series of holes spaced between the bolt holes in the rear flange of the inner combustion casing. It pressurizes the chamber and acts on the forward face of the first stage turbine wheel, utilizing the wheel as a piston. This action offsets the forward thrust of the compressor rotor, reducing the thrust loading on the number two bearing. Balance piston air leaves the chamber through twelve holes in the first stage turbine wheel. These holes are located between the first stage turbine wheel-torque ring bolt holes. Six of the holes bleed air back toward the second stage turbine wheel cooling the aft side of the first stage wheel, the inner diameter of the torque ring and the forward face of the second stage wheel. This air passes through the inner diameter of the second stage wheel, cooling the aft side of this wheel, and re-enters the main gas stream. The other six holes in the first stage turbine wheel direct air to a chamber formed by the aft side of the first stage wheel and the baffle ring which is integral with the torque ring. A series of axial holes in the baffle ring allows the air to continue aft, through the turbine inter-stage seal and onto the second stage blade shanks and turbine wheel outer rim. Some of the air that passes through the baffle ring moves outward past the baffle on the stationary half of the interstage seal and cools the aft side of the first stage wheel outer rim and the blade shanks.

Air also leaves the balance piston chamber through the inner forward turbine labyrinth seal into a chamber at the root of the turbine forward shaft. At this point it pressurizes the number three carbon seal and passes aft through holes in the first stage turbine wheel. It combines with air between the two turbine wheels and aids in cooling this area and then passes through the bore of the second stage wheel and out into the main gas stream.

Some of the compressor-discharge air may be bled off through four mainframe ports for airframe use.

C. Anti-icing Air Flow. (See figure 2.)

Anti-icing air flow is controlled by an electrically operated valve which is mounted on the aft side of the manifold on the front frame at the 10 o'clock position. Compressor discharge air is bled from the eleven o'clock bleed port on the mainframe and ducted forward, through the anti-icing valve, into the manifold. Some of this air passes aft through slots cut in each of the IGV supporting bosses, through the hollowed out vane stems and into the hollow IGV's. Inside the IGV's the air flows radially inward, around baffles, then outward through holes in the outboard ends of the vanes and into the airstream. The rest of the anti-icing air passes through the struts into the inner hub. A



Anti-icing Air Flow
Figure 2

portion of this air is directed forward into the bulletnose, which has two skins, through a hole at the forward end of the inner skin, then aft between the two skins and out through radial holes at the aft end of the outer skin. The remainder of the air in the inner hub passes aft through internal passages and into the double skinned IGV shroud and seal. This air anti-ices the shroud ring and then passes out into the air stream through radial holes at the aft end of the shroud.

D. Compressor Bleed Air.

The air bled from the compressor at the third, fourth and fifth stages is metered overboard, as scheduled by the main fuel control, to maintain air flow stability within the compressor and to prevent compressor stalls.

E. Aft Fan Cooling and Pressurizing Air Flow.

The front and rear frames of the aft fan are cooled by air bled directly from compressor air flow. From the pads located over the fifth-stage of the upper compressor casing, the air flows through two tubes back to the

aft fan section. The right tube connects to the front frame. The left tube is routed under the engine, around the right side of the aft fan and into the rear frame. This air flows into the inner box structure of the front and rear frames by flowing through the No. 2 strut of the front and rear frames. A heat shield inside the front frame No. 2 strut prevents excessive cooling of the structural members, thereby equalizing the thermal expansion of all the struts. The air is fed into the center portion of the rear frame No. 2 strut which does not carry outer band heating air. To assure equal expansion of the rear frame six struts, hot primary air is fed into the space between the No. 2 cooling air strut and its fairing. The fifth-stage cooling air cools the inner box ring structure of both the front and rear frames. It also cools the space surrounding the rotor disc, rotor shafts and the No. 4 and No. 5 sump areas.

Eighth-stage leakage air that passes through the leakage air valves is used to heat the aft fan front frame. From the leakage air valves the air flows through ducts back to the forward mid-manifold on the front frame. The air flows all around the manifold except in the sector of the manifold between struts Nos. 2 and 3. From the manifold the air flows inward through all of the struts except strut No. 2. This cools the portion of the struts (except strut No. 2 which is cooled by air that is directly bled from the fifth-stage of the compressor) that is between the mid-cone and the inner manifold. The air then flows out through the four holes located in each side of the strut (except strut No. 2) into the space between the strut and the fairing. Here the air is heated by coming in contact with the fairing which is directly in the path of the hot primary air flow and by some of the hot primary air leaking into the space between the strut and fairing. From this space the heated air flows outward through 16 holes (2 holes adjacent to each strut) into the rear mid-manifold and outward through all the struts into the outer casing manifold. This heats the outer portion of the front frame struts and the manifold, providing uniform expansion for those areas of the front frame that are exposed to the much colder temperature of the secondary air flow. The heated air then flows around the outer casing manifold and is vented overboard through the eight vent holes (one hole between each strut) with a deflector over each of the holes.

To pressurize the No. 4 and No. 5 carbon seals in the aft fan, eighth-stage leakage air is bled from the eight o'clock strut of the engine mainframe. This air flows through a tube on the left side of the engine back to the aft fan section. Then the air flows through tubes inside the No. 6 strut of the front and the No. 5 strut of the rear frame. The air flows through the tubes into an internally drilled passageway in each bearing support. This passageway mates with another passageway in the seal support. From the passageway in the seal support, the air flows out and pressurizes the seal.

A speed limiter tube encircles the fan rear frame and is connected to the same air tube that supplies the fuel control with compressor discharge air (P_3). If the tube is broken (due to foreign object damage or broken fan rotor blade) the P_3 signal to the fuel control is lost and the control will then schedule only minimum fuel flow.

AIR SYSTEM - TROUBLE SHOOTING

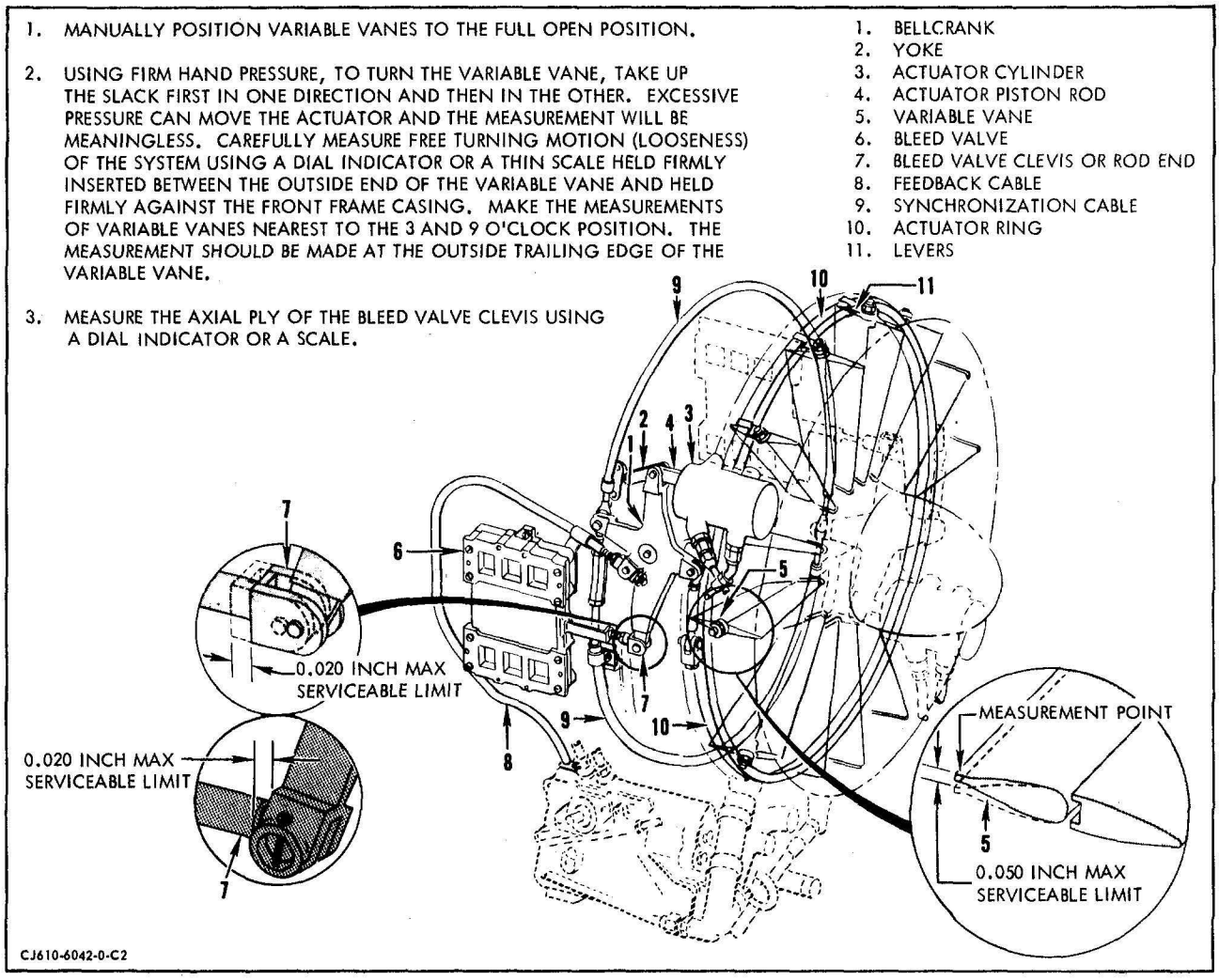
1. General. The air system troubleshooting must be accomplished in a systematic manner based on all available information. External air leaks may be found by visual inspection (discoloration around connecting parts) or during engine coastdown. A thorough knowledge of the engine air system, applied with logical reasoning, should solve any problems which may occur.

Trouble-Shooting information is furnished in Chapter 72-00.

AIR SYSTEM - MAINTENANCE PRACTICES

1. General. The following maintenance practices are the adjustments that can be made to the air system. For removal and replacement, refer to the individual component section.

   A. Inspect the parts of the variable geometry system for wear per figure 201 before disconnecting or removing any of them. Measure the amount of free movement (turning) or looseness of the variable vanes and the amount of axial play in the bleed valve clevis.



Variable Geometry System Inspection
Figure 201

(1) If the free motion of the variable vane is less than 0.05 inch total and the axial play in the bleed valve clevis is less than 0.020 inch, the variable geometry system is serviceable and no additional inspection is required.

(2) If the free motion of the variable vane exceeds 0.05 inch total and/or the axial play in the bleed valve clevis exceeds 0.020 inch, inspect and replace parts only as required to bring the system looseness and clevis play within serviceable limits. Reassemble the system and again measure the free motion in the system and the clevis axial play. Inspect and replace parts in the following order:

(a) The bellcranks of both actuators for wear in the bearing and pivot shaft.

(b) The actuator ring for wear in ring pivot pin holes and the lug pin holes.

(c) The levers for wear in the square holes.

(3) If the free motion in the system is not corrected by the above, the front frame assembly must be removed and replaced as instructed in 72-30, Maintenance Practices.

2. Adjustment/Test.

A. Initial Bleed Valve Adjustment. (See figure 202.)

(1) Disconnect the synchronizing cables (12), the feedback cable (9) and the bleed valves (2) from the actuator bellcranks (5).

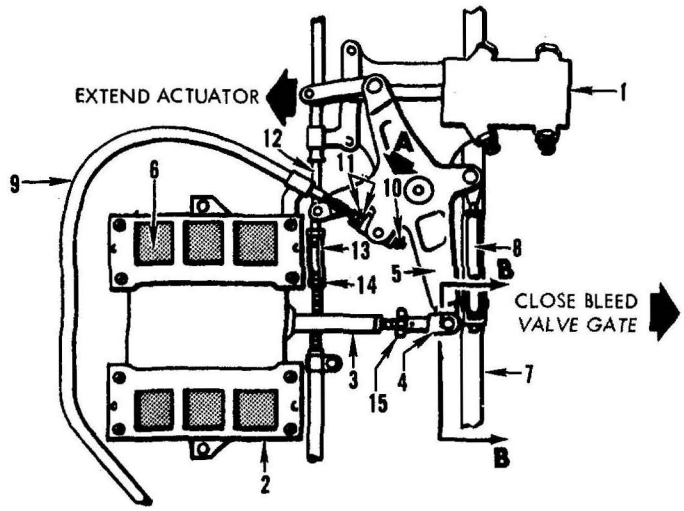
NOTE: On some engines the pin (head next to compressor casing) for the synchronizing cable cannot be removed until the actuator is removed. For this configuration, remove the outer synchronizing cable.

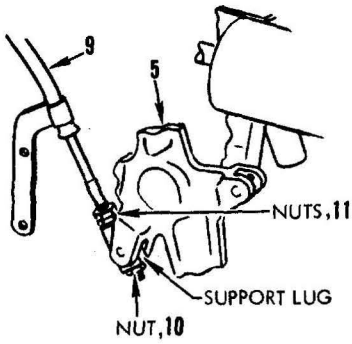
(2) Set and maintain the actuators (1) in the fully extended position. Take the linkage backlash out in the direction of retracting the actuator.

(3) Close the bleed valve gates (6) against their stops, fully extending the operating arm (3) to remove the backlash.

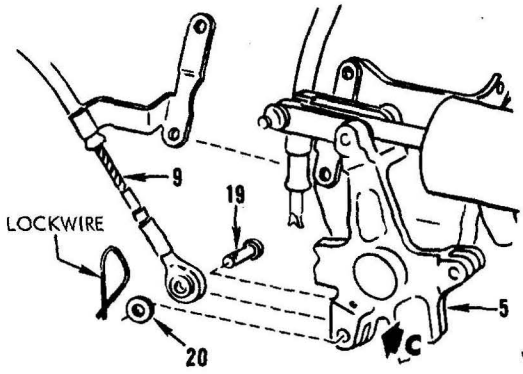
(4) Adjust the rod end (4) and insert the clevis pin (17) through the rod end and the bellcrank (5) arm to make sure that the parts are properly aligned.

1. ACTUATOR
2. BLEED VALVE
3. BLEED VALVE OPERATING ARM
4. ROD-END OR CLEVIS END
5. ACTUATOR BELLCRANK
6. BLEED VALVE GATE
7. VARIABLE VANE ACTUATOR RING
8. ADJUSTABLE LINK
9. FEEDBACK CABLE AND CONDUIT
10. NUT
11. NUT
12. SYNCHRONIZING CABLE
13. HEX TURNBUCKLE NUT
14. JAM NUT
15. JAM NUT
16. WASHER (SHIM)
17. CLEVIS PIN
18. COTTERPIN
19. PIN
20. WASHER

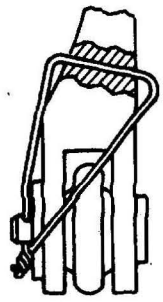




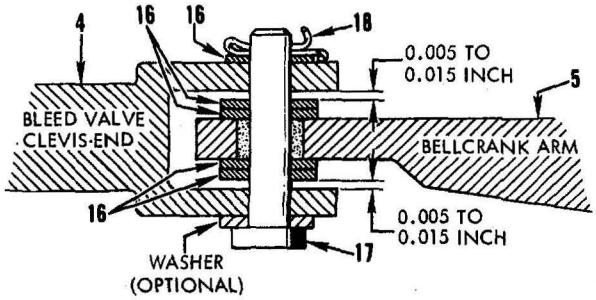
VIEW IN DIRECTION OF ARROW **A**



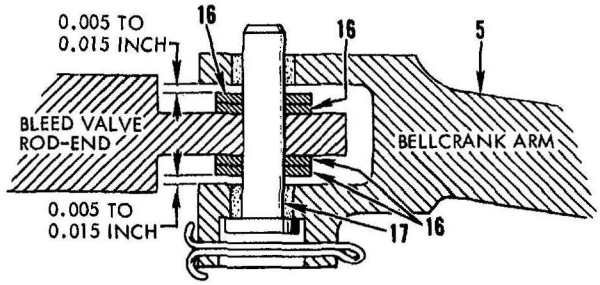
VIEW IN DIRECTION OF ARROW **A**



VIEW IN DIRECTION OF ARROW **C**
(WITH PARTIAL CUTAWAY)



SECTION **B-B**



SECTION **B-B**

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Bleed Valve and Variable Vane Adjustments
Figure 202

(5) Remove the clevis pin and rotate (counterclockwise) the rod end one turn away from the valve. Insert the clevis pin through the rod end and the bellcrank arm. Check to ensure that the valve gates no longer bottom against their stops.

NOTE: The gates should be fully-closed. No visual opening of gates should exist.

(6) Move the actuator piston by hand to its fully retracted position, with linkage backlash taken out in the direction of extending the actuator. (The bleed valve is now open.)

(7) Check the position of the bleed valve gates. They should not protrude more than 1/16 inch into the bleed valve opening. If the gates protrude into the bleed valve opening more than 1/16 inch, remove the clevis pin and rotate (counterclockwise) the rod end 1/2 turn.

(8) Repeat step (7) until the 1/16 inch dimension is met.

(9) Move the actuator piston by hand to its fully extended position (valve gates closed) and check to ensure that no visual opening exists.

(10) Move the actuator piston by hand to its fully retracted position (valve gates open).

(11) Remove the clevis pin and check to ensure that the valve gates can be opened further. If the valve gates cannot be opened further, make the following inspection checks:

(a) Actuator travel at the valve connection points is within limits of 1.64 to 1.66 inches.

(b) The valve operating arm (3) has a full travel of 1.73 inches (minimum).

(12) Replace the actuator if it is out of dimensional limits. If the valve gates do not open or operate properly, check the valve for proper assembly and replace it if it cannot be made to operate within limits.

(13) Shim each side of the actuator bellcrank arm that is connected to the bleed valve rod end. Insert the shims (16) to obtain a clearance of 0.005 to 0.015 inch between the shim and the inside surface of the rod end. Be sure not to apply a side load to the bleed valve operating arm by shimming. Connect the bellcrank arm to the rod end with the clevis pin, 2 washers and cotterpin. Torque the jam nut against the rod end to 95-125 lb-in. Be sure the operating arm is not twisted in its slot so that opposing corners can rub.

NOTE: Install one washer under the head of the clevis pin and one under the cotterpin. The axial movement of the clevis pin shall not exceed 0.022 inch.

(14) Inspect the valve gates for full closing as follows:

(a) Fully close the bleed valve. The openings must be completely covered. Apply finger pressure down on the upper gates and up on the lower gates to remove all play.

(b) Visually inspect with a good light to ensure that no gaps or cracks exist between the gate and bleed valve opening. Attempt to insert a strip of shim stock 0.001 inch thick between the top and bottom of the gate and the valve port. Attempt to insert the shim perpendicular to the gate along the entire edge including the corners. Replace the valve if the shim can be inserted.

(15) Deleted.

B. Initial Variable Vane Adjustment. (See figure 202.)

(1) Set the variable vanes in the zero-degree position (full open).

(2) Extend each actuator (1) until it reaches its stop. Remove all backlash as described in paragraph A.

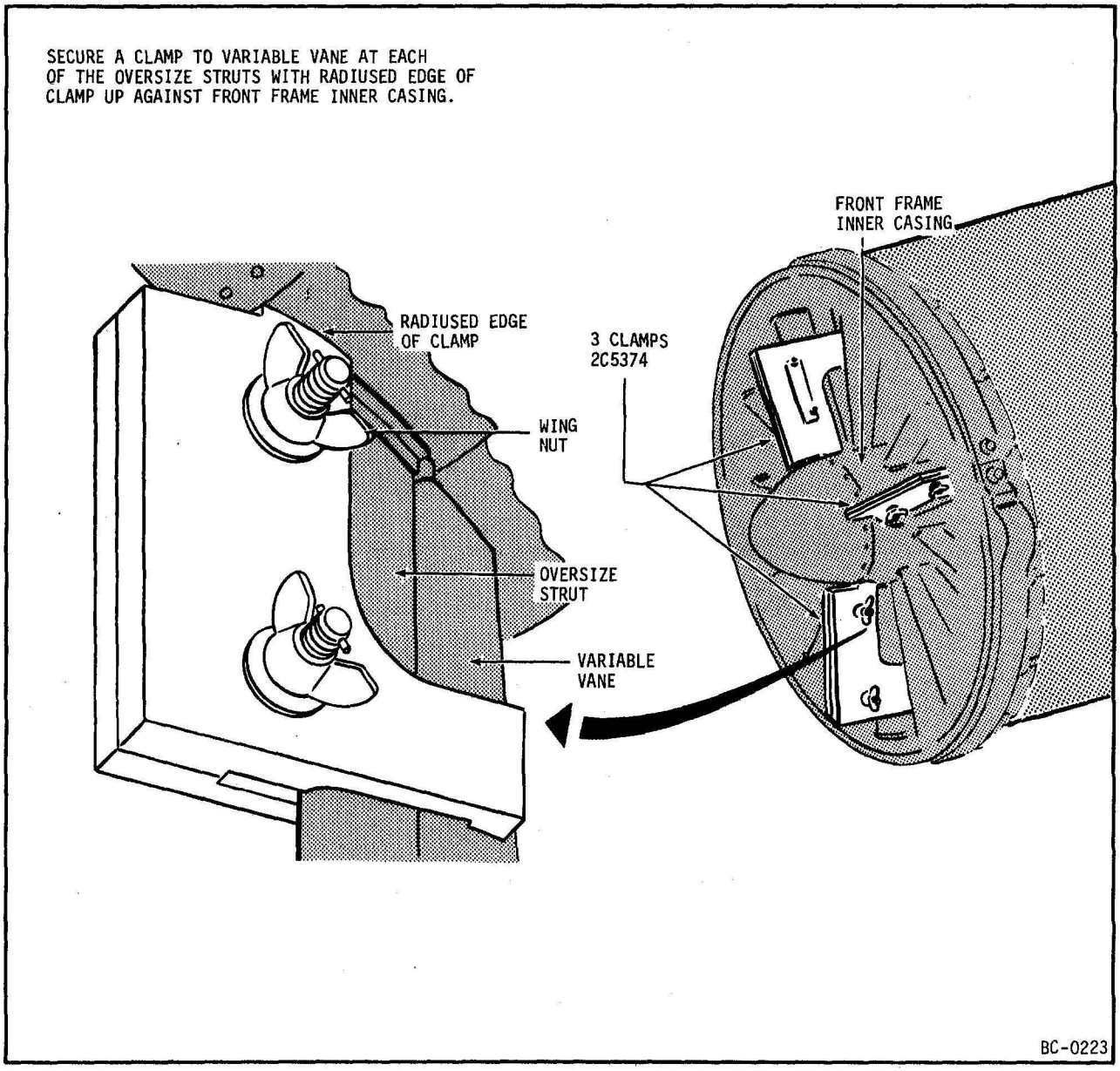
(3) Centralize the variable vane actuator ring (7) by moving it radially until the gaps between the ring and the front frame are approximately equal at the 6 and 12 o'clock positions.

(4) Adjust the adjustable link (8) (turnbuckle) so that the clevis pin can be inserted through the variable vane actuator ring lug and the ball joint of the adjustable link. Connect each adjustable link to each of the actuator ring lugs with a clevis pin, washer and cotterpin. The head of the clevis pin faces aft and the washer is installed under the cotterpin. Bend the cotterpins that secure the adjustable link clevis pins at each actuator bellcrank and at the actuator ring lugs. Torque the adjustable link jam nut to 6-8 lb-in.

(5) Loosen the two bolts that secure the upper and lower actuating ring halves together one full turn.

NOTE: Disregard steps (1) and (3) on engines without actuating ring plastic support buttons.

(6) Secure an alignment clamp, 2C5374, to each of the 3 oversize struts (located at the 2, 6 and 10 o'clock positions) on the front frame, as shown in figure 203. Tighten the wing nuts fingertight.



Setting Variable Vanes to Zero Position
Figure 203

(7) Tigthen the 2 bolts, that were loosened in step (5) to 28-32 lb-in. The vanes are now at the "zero degree" (full open) position.

NOTE: Check the scribe line on the actuating ring for alignment with the longest line (0° line) of the five lines on the front frame. If they do not align, paint dykem (blue) or equivalent on the actuating ring and rescribe actuating ring using alignment gage 2C5356 as a guide.

(8) Set and maintain the actuators in the full extended position. Remove backlash by exerting fingertip pressure against the bellcrank arm in direction of actuator retraction.

(9) Adjust the length of the adjustable links (8, figure 202) so they can be connected to the variable vane actuator ring lug without changing the "zero degree" setting. Secure using a clevis pin, washer and cotter pin.

(10) Torque the adjustable link jam nut to 6-8 lb-in.

(11) Remove the three alignment clamps, 2C5374.

(12) Manually retract the actuators, then move to the fully extended position and check alignment of the scribe lines for "zero degree" position. If lines do not align, repeat adjusting procedure.

C. Initial Fuel Control Feedback Cable Adjustment. (See figure 202.)

NOTE: Final adjustment is performed during engine runup per paragraph E.

(1) The feedback cable and conduit (9) must be connected and fastened at the main fuel control for this adjustment.

(2) Extend the actuators (1) until the stop is reached. (The bleed valves (2) should be in a full-closed position.)

(3) Loosen nut (10) and the 2 nuts (11) or remove pin (19). Bend the conduit mounting bracket, if necessary, to ensure that the feedback cable moves freely through the support lug at the actuator bellcrank (5). Final alignment is considered satisfactory when the cable continues to move freely through the lug, regardless of the bleed valve position (either in the full-open or the full-closed position). Return the bleed valves to the full-closed position after alignment is completed.

(4) Pull the feedback cable to bring the variable geometry feedback arm (on the fuel control) against its stop and tighten nut (10) or install pin (19).

(5) Loosen nut (10) exactly 2 turns or remove pin (19) and turn rod-end counterclockwise 2 full turns.

(6) Secure the assembly by installing pin (19) and washer (20) or torquing the 2 nuts (11) to 6-8 lb-in. Lockwire.

D. Synchronizing Cable Adjustment. (See figure 202.)

(1) Connect loosely the 2 synchronizing cables (12) to the clevis pins in each of the actuator bellcranks (5) with a cotter pin.

NOTE: On some bellcrank configurations, washers are used with the cotter pin. On these configurations, install the washer under the cotter pin and bend the cotter pin.

(2) Maintain the 2 actuators (1) in an extended position (the bleed valves should be fully-closed). Take the slack out of the linkage in the direction of opening the bleed valve (2).

(3) Record the actuator piston rod position of both actuators.

(4) Tighten the hex turnbuckle nut (13) finger-tight to take the slack out of the synchronizing cable and place it in tension. Pre-load the cable by tightening the hex turnbuckle 1/4 to 1/3 turn. Be sure to restrain the cable from turning with the turnbuckle.

(5) Ensure the ends of the cable and clevis end are properly engaged by checking inspection holes in the turnbuckles. Hold the hex turnbuckle nuts against rotation and secure them by torquing the jam nuts (14). Torque the sheet metal type locknut (not free running) to 6-8 lb-in. If the new free running locknut is used, torque to 25-30 lb-in. Lockwire the jam nuts.

(6) Check the actuator rod position. The measurement must fall within $\pm$ 0.015 inch of the original valve position in step (3).

(7) Check the bleed valve lag by comparing the size of the openings of the gates (6) of one bleed valve with the other. The difference between the sizes of bleed valve gate openings must not exceed 1/16 inch.

E. Final Adjustment of Variable Geometry System. (See figure 202.)

NOTE: See 72-00, figure 505 for proper schedule.

(1) If the plotted points on the bleed valve operating schedule in 72-00, Adjustment/Test are out of limits proceed with the following.

(2) If both recorded points fall above the maximum limit, increase the effective length of the fuel control feedback cable (where it connects to the right-hand actuator bellcrank) by one of the following, depending on feedback cable configuration.

(a) Back-off adjusting nut (10) and tighten locking nuts (11). Torque nuts to 6-8 lb-in. and lockwire.

(b) Remove pin (19) and turn rod-end to increase the length of the cable. Install pin, washer and lockwire.

(c) Recheck and adjust until points fall within limits of 72-00, Adjustment/Test.

(3) If both recorded points fall below the minimum limits, decrease the effective length of the fuel control feedback cable (where it connects to the right-hand actuator bellcrank) by one of the following, depending on feedback cable configuration.

CAUTION: USE CARE WHEN REDUCING THE EFFECTIVE LENGTH OF THE FEEDBACK CABLE. IF CABLE IS TOO SHORT IT WILL BOTTOM AGAINST THE STOP IN THE FUEL CONTROL WHEN ACTUATOR IS FULLY EXTENDED. WITH ACTUATOR FULLY EXTENDED A SMALL AMOUNT (0.015 INCH) OF SPRING LOADED END PLAY SHOULD BE EVIDENT IN THE CABLE.

(a) Back off locking nuts (11) and tighten adjusting nut (10). Torque nuts to 6-8 lb-in. and lockwire.

(b) Remove pin (19) and turn rod-end to decrease the length of the cable. Install pin, washer and lockwire.

(c) Recheck and adjust until points fall within limits of 72-00, Adjustment/Test.

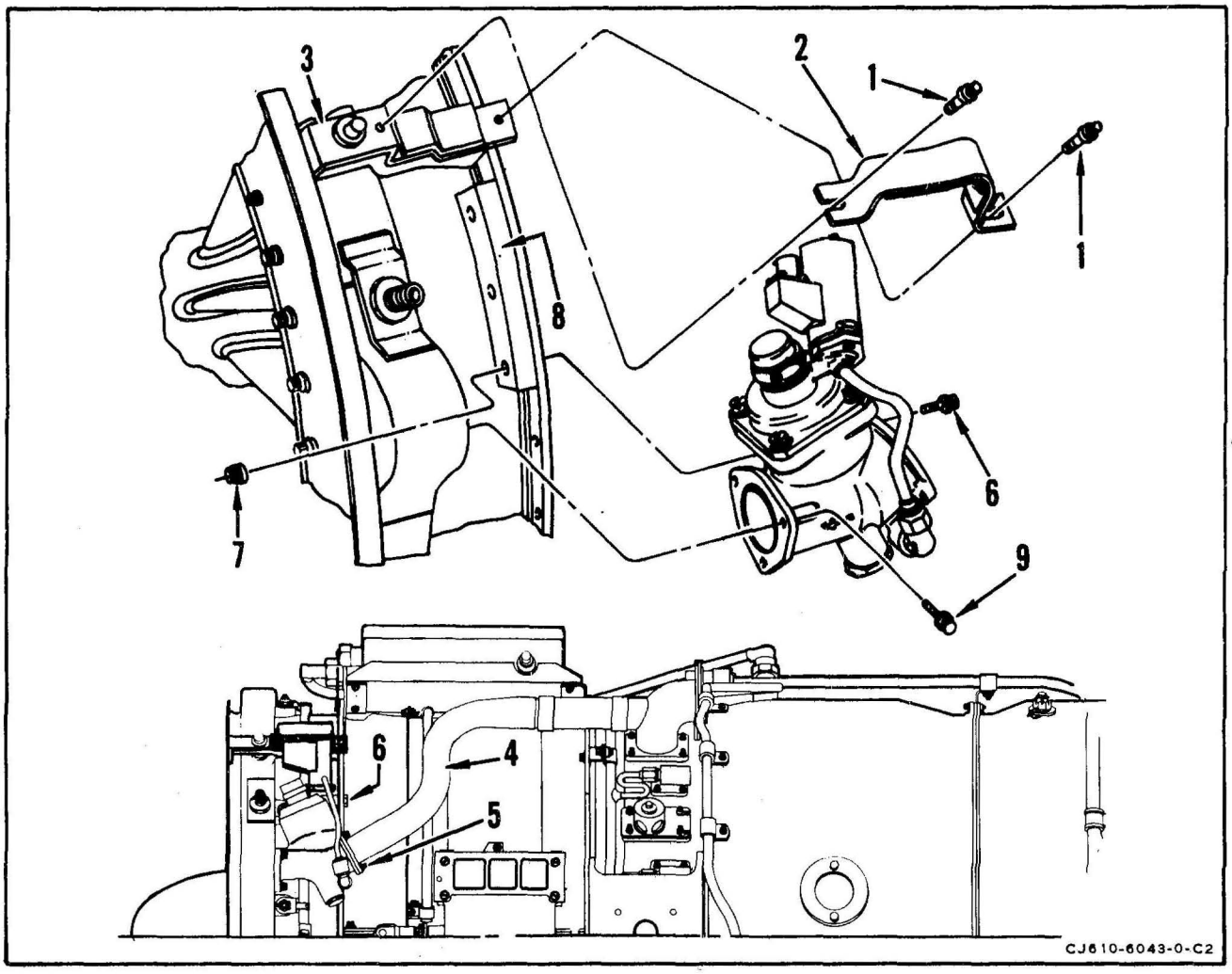
ANTI-ICING VALVE - MAINTENANCE PRACTICES

1. General. The following procedures are to be used when performing maintenance on the anti-icing valve.

2. Removal/Installation.

A. Removal.

(1) Disconnect the electrical lead from the anti-icing valve.



Anti-icing Valve Removal
Figure 201

(2) Remove the bolts (1, figure 201) that secures the clamp (2, figure 201) to the bracket (3, figure 201).

NOTE: Some engines may not have this clamp installed on the engine.

(3) Disconnect the tube (4, figure 201) from the rear pad of the anti-icing valve by removing the bolts (5, figure 201).

(4) Remove the bolts (6, figure 201) and nuts (7, figure 201) that secure the rear of the anti-icing valve. Remove the spacer (8, figure 201) and any shims that are used.

(5) Remove the bolts (9, figure 201) that secure the anti-icing valve to the anti-icing manifold. Use tool, 2C5322, for the inside bolt.

(6) Remove the anti-icing valve and discard the gasket.

B. Installation.

(1) Place a new gasket on the anti-icing valve front pad and assemble the valve to the manifold. Secure with bolts (9, figure 201). Use tool, 2C5322, for the inside bolt. Do not tighten the bolts at this time.

(2) Place the spacer (8, figure 201) between the valve and front frame rear flange. Use shims, as required, to fill any gap between spacer and valve. Secure the valve and spacer with bolts and nuts (6 and 7, figure 201). Do not tighten nuts at this time.

(3) Place a new gasket on the anti-icing valve rear pad and connect tube (4, figure 201) to valve. Secure with bolts (5, figure 201). Do not tighten bolts at this time.

(4) Install clamp (3, figure 201) over the valve. Secure to bracket (3, figure 201) with bolts (1, figure 201). Torque the bolts to 24-27 lb-in. and lockwire.

(5) Torque bolts (9, figure 201) to 20-25 lb-in. and lockwire.

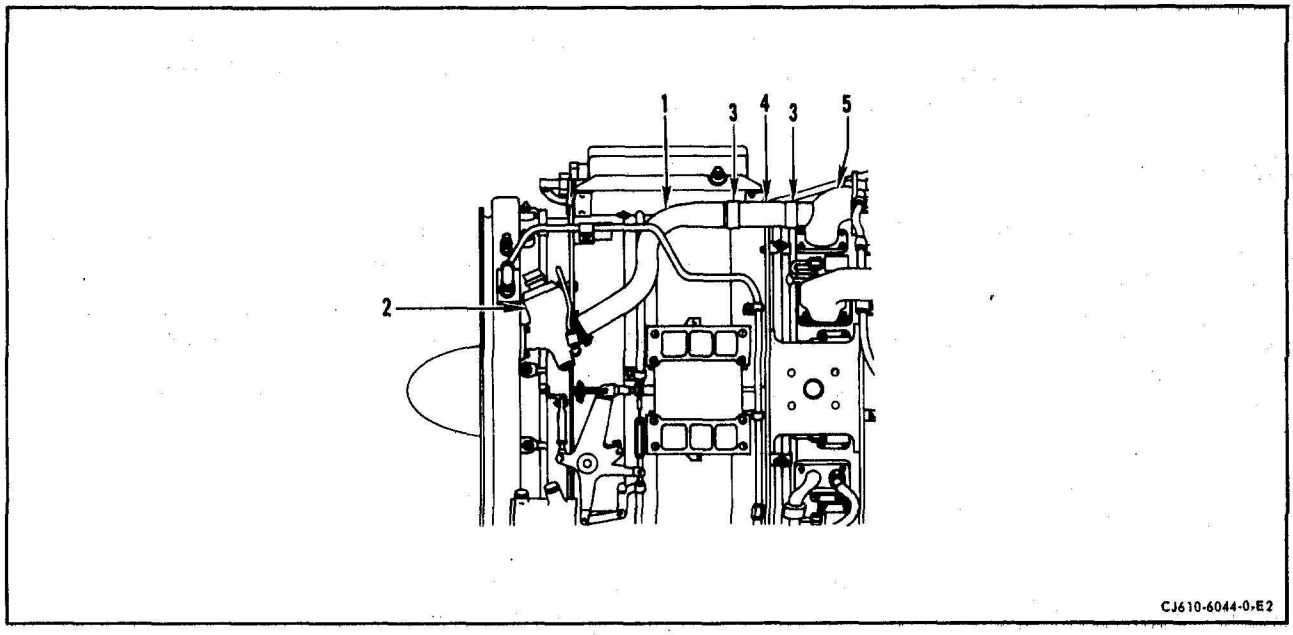
(6) Torque nuts (7, figure 201) to 35-40 lb-in.

(7) Torque bolts (5, figure 201) to 20-25 lb-in. and lockwire.

3. Inspection/Checks. Where serviceable limits are exceeded, parts may be required in accordance with Overhaul Manual Instructions.

Inspection/Check	Maximum Serviceable Limits	Remarks
A. Cracks.	Not serviceable.	Replace valve.
B. Damaged threads.	One full thread, cumulative or continuous, may be missing after chasing.	
C. Electrical connector for broken pins.	Not serviceable.	Replace valve.

ANTI-ICING TUBE - MAINTENANCE PRACTICES



Anti-icing Air Tube Removal
Figure 201

1. General. The following procedures are to be used when performing maintenance on the anti-icing air tube.

2. Removal/Installation.

   A. Removal.

      (1) Disconnect the tube (1, figure 201) from the rear pad of the anti-icing valve (2, figure 201).

      (2) Loosen air tube clamps (3, figure 201).

      (3) Remove air tube from hose (4, figure 201). Discard gasket from anti-icing valve end.

      (4) Remove tee (5, figure 201) by removing the bolts securing it to the mainframe. Discard gasket.

   B. Installation.

      (1) Install tee (5, figure 201) and new gasket on mainframe pad. Secure with bolts, lubricated with Ease-Off 990 (Texacone Co., Box 4236, Dallas, Texas) or G-392 Versilube (G.E. Products Co., Waterford, N.Y.), Torque bolts to 16-19 lb-in. and lockwire.

(2) Install air tube into hose (4, figure 201).

(3) Secure the anti-icing tube (1, figure 201) and a new gasket to the rear pad of the anti-icing valve with bolts. Torque the bolts to 20-25 lb-in. and lockwire.

(4) Tighten clamps (3, figure 201) to 30-40 lb-in. and lockwire.

3. Inspection/Check. Where serviceable limits are exceeded, parts may be repaired in accordance with Overhaul Manual Instructions.

Inspection/Check	Maximum Serviceable Limits	Remarks
A. Tube for splits or cracks.	Not serviceable.	Replace tube.
B. Nicks, chafing or scratches.	0.005 inch deep after removal of high metal.	
C. Dents.	Not over 1/5 of tube diameter, if the dent is not on the heel of a sharply-bent radius.	
D. Flatness or out-of-roundness.	Not over 1/4 of the tube diameter.	
E. Tube bolt flange for flatness.	Not to exceed 0.005 inch provided 3/4 of flange thickness remains after refacing.	Lap or reface to within 0.005 inch flatness or replace tube.

EIGHTH-STAGE LEAKAGE AIR TUBE - MAINTENANCE PRACTICES

WARNING: ASBESTOS

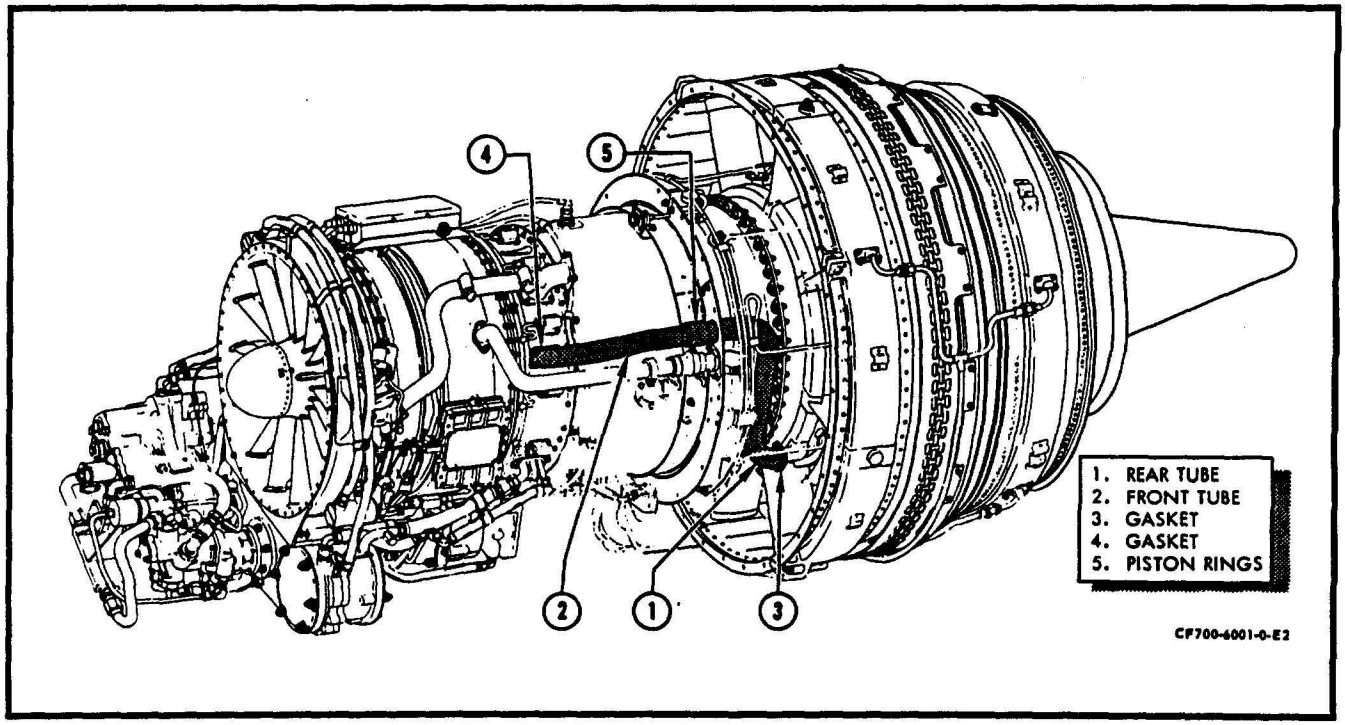
THIS ENGINE MAY CONTAIN SMALL AMOUNTS OF ASBESTOS. WHEN WORKING WITH THIS ENGINE, THE FOLLOWING PRECAUTIONS MUST BE RIGIDLY ADHERED TO:

BEFORE ANY MAINTENANCE ACTIVITIES ARE UNDERTAKEN, REVIEW THE ILLUSTRATED PARTS BREAKDOWN/CATALOG INDEX TO DETERMINE IF THE HARDWARE TO BE WORKED ON OR USED CONTAINS ASBESTOS.

WHENEVER MECHANICAL REMOVAL OF MATERIAL, SUCH AS MACHINING, GRINDING, BUFFING, DRILLING, SANDING OR ANY TYPE OF MATERIAL BUILD-UP ON PARTS THAT CONTAIN ASBESTOS IS NECESSARY, APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT MUST BE WORN, AND NATIONAL ENVIRONMENTAL CONTROLS REQUIRED FOR THE HANDLING OF ASBESTOS-CONTAINING MATERIAL MUST BE COMPLIED WITH.

BEFORE HANDLING, REPLACING, OR DISPOSING OF ASBESTOS-CONTAINING HARDWARE, APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT AND NATIONAL ENVIRONMENTAL CONTROLS MUST BE STRICTLY ADHERED TO FOR HANDLING ASBESTOS-CONTAINING HARDWARE.

1. General. The following procedures are to be used when performing maintenance on the air tube.



Eighth-Stage Leakage Air Tube Removal
Figure 201

2. Removal/Installation.

WARNING: ASBESTOS

THE FOLLOWING PROCEDURE MAY INVOLVE A PART THAT CONTAINS ASBESTOS, WHICH IS HIGHLY TOXIC TO SKIN, EYES, AND RESPIRATORY TRACT. READ GENERAL INFORMATION BEFORE PROCEEDING, AND ADHERE TO ALL SITE SAFETY AND ENVIRONMENTAL CONTROLS CONCERNING ASBESTOS. OTHERWISE, PERSONAL INJURY MAY RESULT.

A. Removal.

(1) Remove the nuts securing the rear air tube (1, figure 201) to the fan front frame.

(2) Remove the bolts securing the front tube (2, figure 201) to the mainframe.

(3) Remove the tubes from the engine and separate the tubes. Discard gasket (3 and 4, figure 201).

NOTE: When the front tube is removed the 8th-stage leakage air valve is exposed and should be insepected in accordance with 79-41-0.

B. Installation.

(1) Place new gaskets (3 and 4, figure 201) on mainframe and fan front frame. Inspect piston ring (5, figure 201) and replace if damaged.

NOTE: Lubricate piston rings with petrolatum and position splits 180 degrees apart.

(2) Assemble the rear tube (1, figure 201) into the front tube (2, figure 201).

(3) Place the tube on the engine.

WARNING: EASE OFF 990 ANTISEIZE COMPOUND

OVEREXPOSURE CAN LEAD TO CHRONIC HEALTH HAZARDS SUCH AS SEVERE DAMAGE TO BLOOD FORMING, NERVOUS, URINARY, AND REPRODUCTIVE SYSTEMS.

INHALATION MAY CAUSE IRRITATION OR BURNING OF RESPIRATORY SYSTEM.

CONTACT WITH EYES/FACE/SKIN MAY CAUSE IRRITATION OR BURNING.

INGESTION MAY CAUSE IRRITATION OR BURNING OF DIGESTIVE SYSTEM.

PERSONAL PROTECTIVE EQUIPMENT REQUIRED WHEN HANDLING OR USING THIS MATERIAL.

(4) Torque the bolts, lubricated with Ease-Off 990 (Texacone Co., Box 4236, Dallas, TX) or G-392 Versilube (G.E. Products Co., Waterford, NY), that secure the front tube, to 16-19 lb-in. and lockwire. Torque the nuts that secure the rear tube to 24-27 lb-in.

3. Inspection/Check. Where serviceable limits are exceeded, parts may be repaired in accordance with Overhaul Manual Instructions.

Inspect/Check	Maximum Serviceable Limits	Remarks
A. Tube for splits or cracks.	Not serviceable.	Replace tube.
B. Nicks, chafing or scratches.	0.005 inch deep after removal of high metal.	Replace tube.
C. Dents.	Not over 1/5 of tube diameter, if the dent is not on the heel of a sharply-bent radius.	Replace tube.
D. Flatness or out-of-roundness.	Not over 1/4 of the tube diameter.	Replace tube.
E. Tube bolt flange for flatness.	Not to exceed 0.005 inch provided 3/4 of flange thickness remains after refacing.	Lap or reface to within 0.005 inch flatness or replace tube.
F. Wear on ring land OD (ferrule).	1.356 inch minimum diameter (0.008 inch wear).	Replace ferrule per paragraph 4.

4. Replacement of Ferrule on Leakage Air Duct.

A. Machine off old ferrule in area shown per figure 202. Using a horizontal miller or equivalent with a slitting saw, remove ferrule end.

B. Locally manufacture an alignment rod per figure 203.

C. Locally manufacture a new ferrule per figure 205.

D. Assemble and line up new ferrule with duct and inspect the 16.600-16.640 inch dimension in figure 202. If total length is greater, remove material from the tapered end of the ferrule so the length is within specified limits.

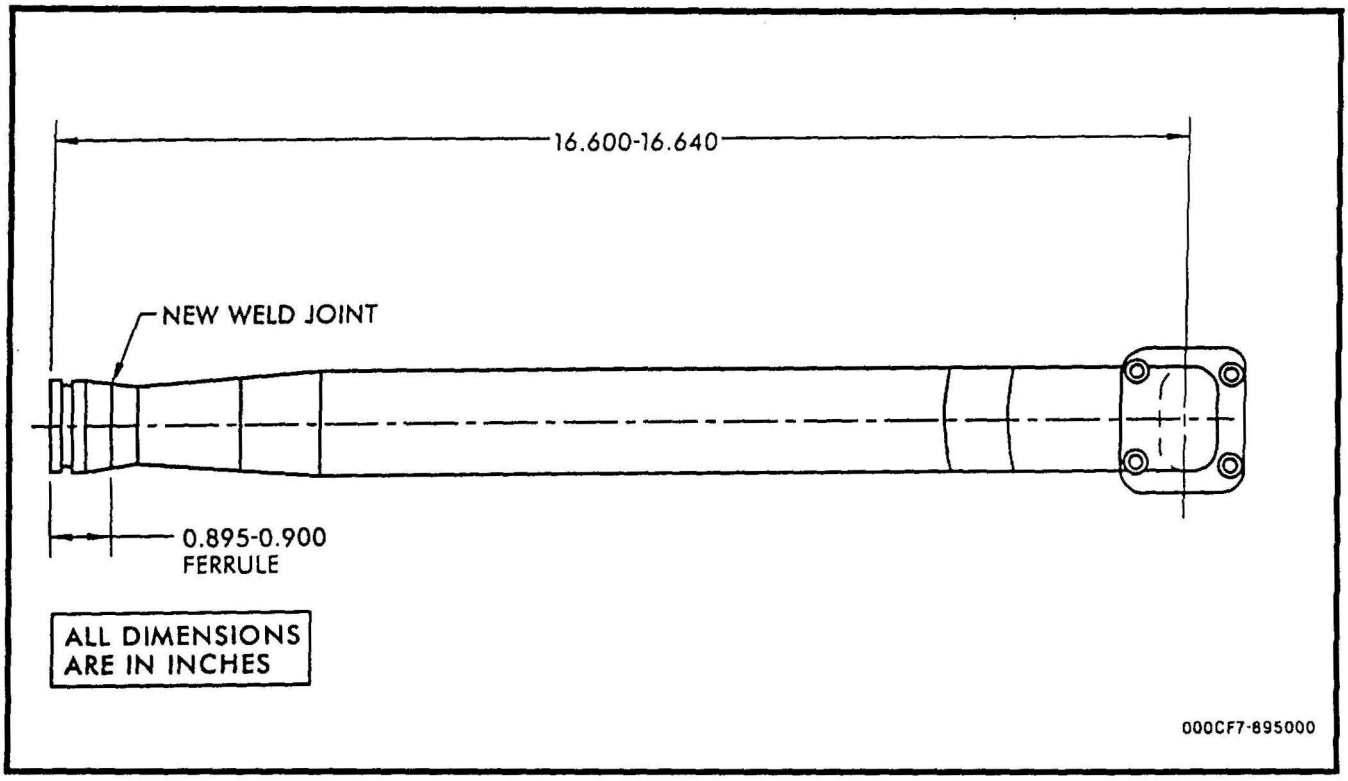
E. "V" prep ferrule weld joint (see figure 204) and vapor-degrease.

F. Assemble alignment rod, ferrule, and duct per figure 204.

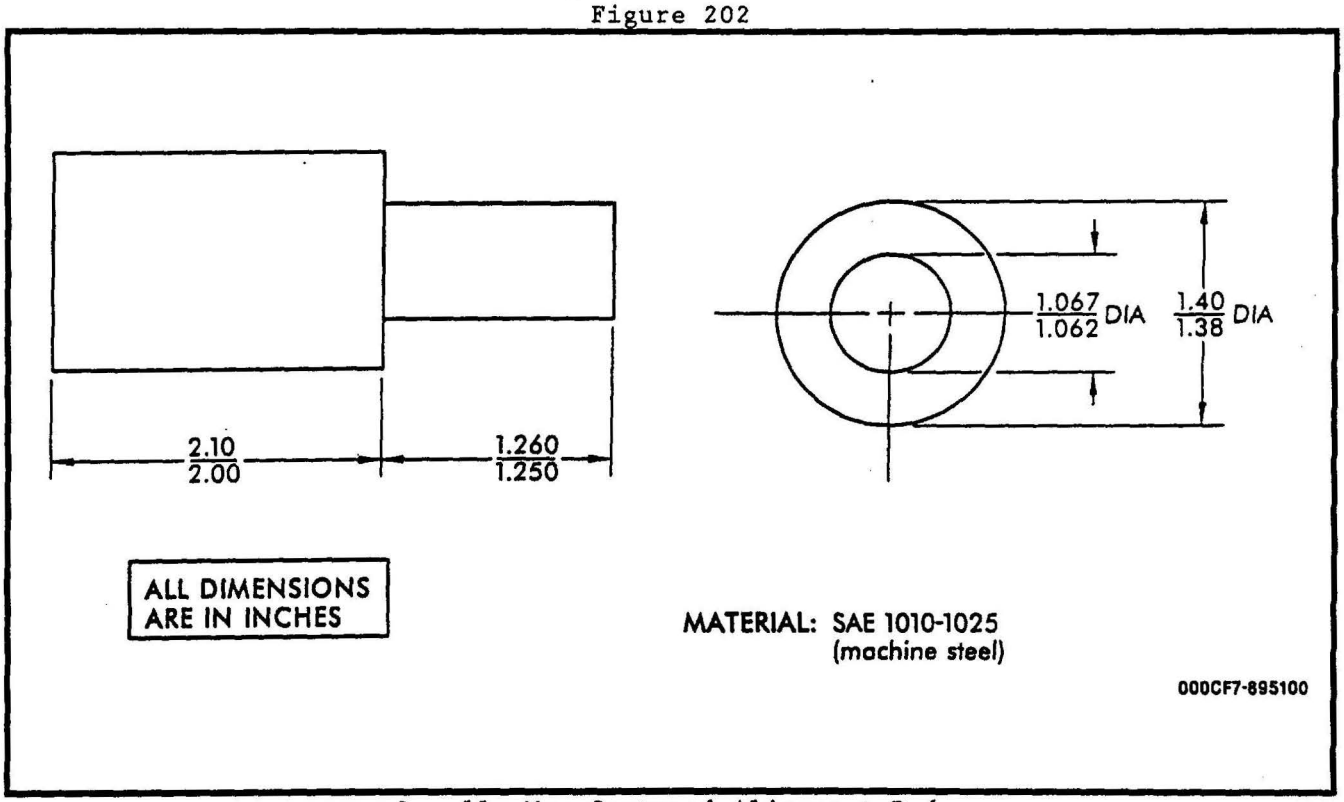
G. Tackweld ferrule to duct at four approximately equally spaced locations to hold in position.

H. Remove alignment rod.

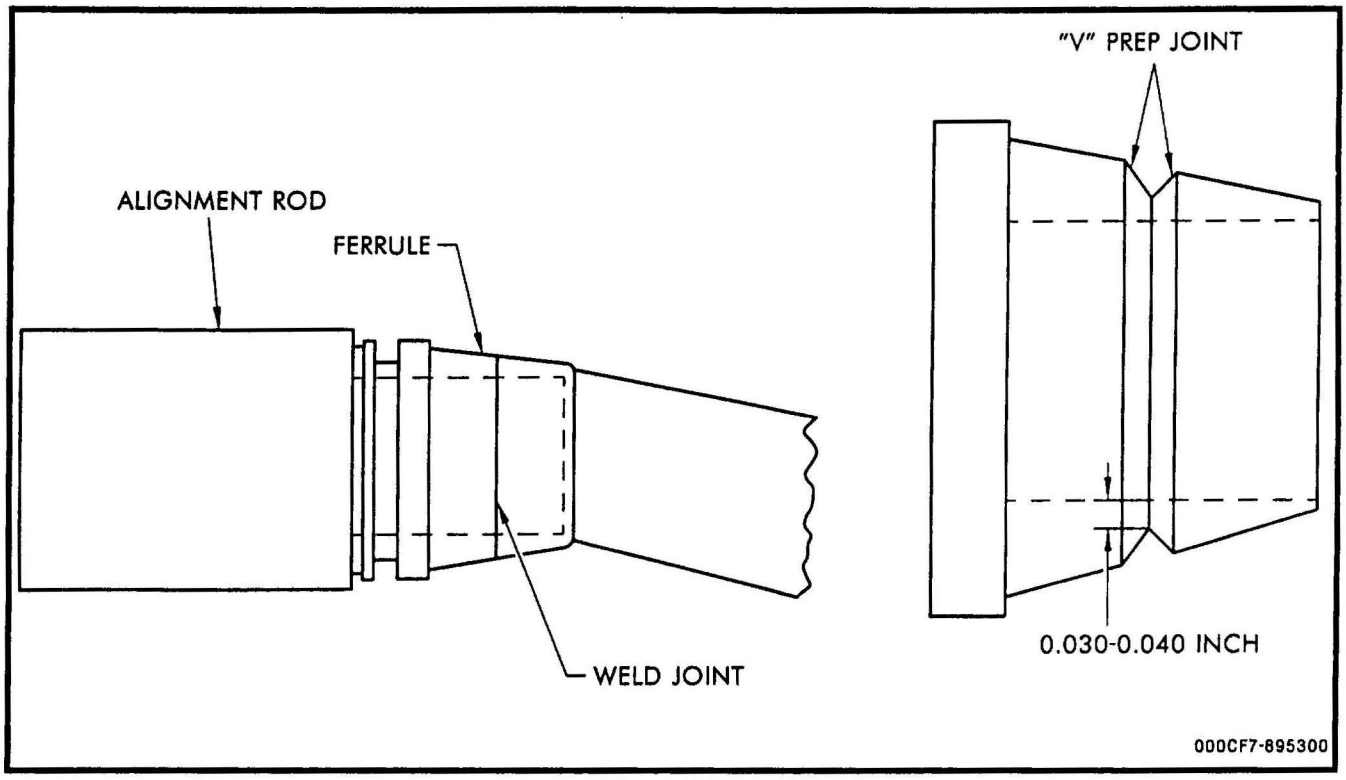
I. Gas back leakage duct with argon (5-10 CFH) by placing a gas tube in the flange end of the duct and sealing with aluminum tape. Seal ferrule end of tube with aluminum tape and purge duct vent ferrule end with a small hole to allow purge gases to escape.



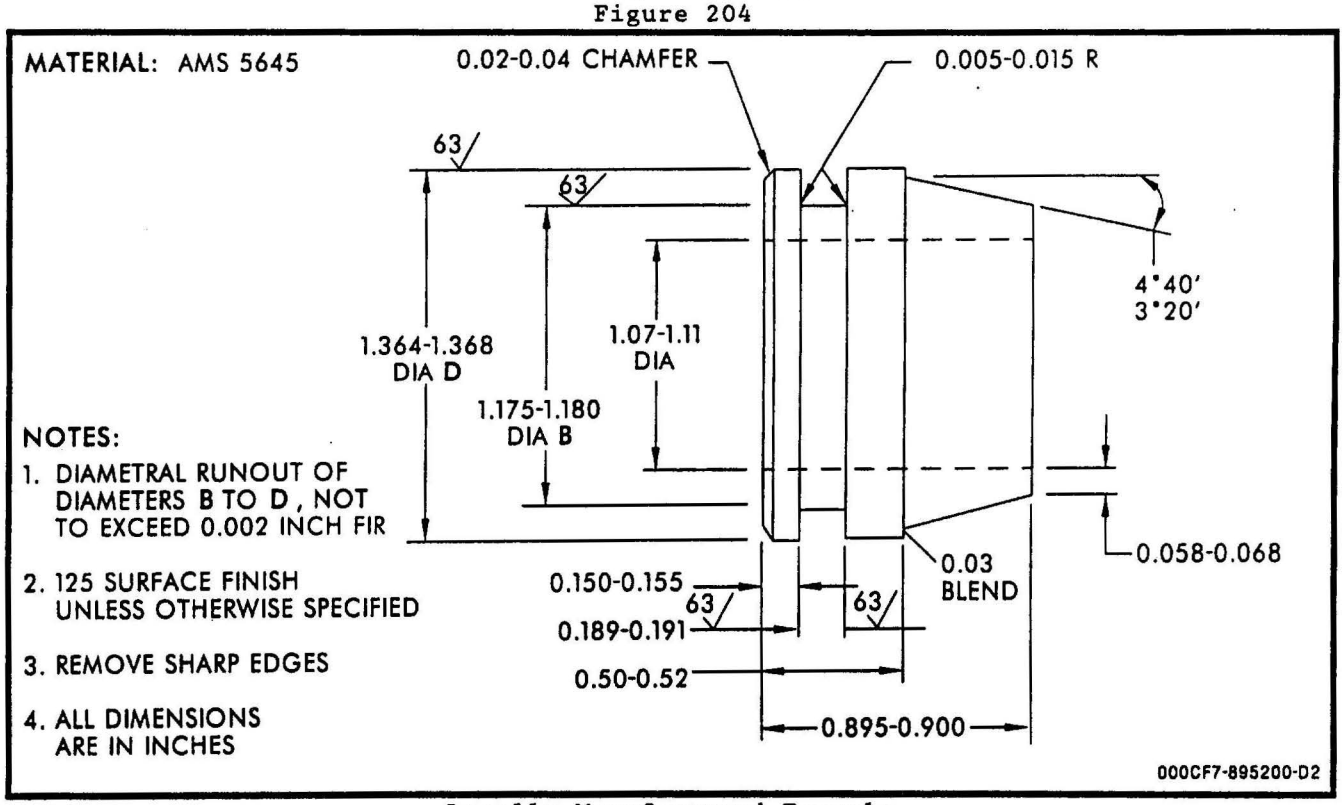
Machining of Leakage Air Duct
Figure 202



Locally Manufactured Alignment Rod
Figure 203



Assembly of Ferrule
Figure 204



Locally Manufactured Ferrule
Figure 205

WARNING: GENERAL WELDING

DO NOT LET FLAMMABLE SOLVENTS SUCH AS ACETONE AND METHYL ETHYL KETONE CONTACT HEATED WELDED PARTS.

CONTACT WITH FUMES MAY CAUSE SKIN IRRITATION, DERMATITIS, AND EYE IRRITATION. REPEATED INHALATION OF FUMES CAN CAUSE COUGHING, WHEEZING, AND PERMANENT LUNG DAMAGE.

IF FUMES CAUSE IRRITATION, GO TO FRESH AIR. IF COUGHING OR WHEEZING PERSISTS, GET MEDICAL ATTENTION.

WELDING SHOULD ONLY BE DONE IN AN AIR-EXHAUSTED ENCLOSED OR SHIELDED WORK AREA.

CONTACT WITH ULTRAVIOLET RAYS MAY CAUSE FATIGUE, NAUSEA, AND FEVER. REPEATED CONTACT MAY CAUSE PERMANENT SKIN AND TISSUE DAMAGE.

COVER ALL EXPOSED SKIN TO AVOID REDDENING OF SKIN. IF REDDENING OF SKIN OCCURS AFTER REPEATED USE OF WELDING MACHINE, GET MEDICAL ATTENTION.

ONLY EXPERIENCED TRAINED PERSONNEL SHOULD USE WELDING MACHINES. WHEN USING EQUIPMENT, FOLLOW APPROVED SAFETY PROCEDURES FOR SHIELDING AND PERSONAL PROTECTIVE EQUIPMENT.

J. Clean weld area prior to welding. Weld ferrule using argon torch gas (8-14 CFH), tungsten electrode 0.062 inch diameter, filler material AMS 5786 (Hastelloy W) 0.035 inch diameter, and a current of 25-35 amps DC straight polarity.

WARNING: PENETRANT METHOD OF INSPECTION

PROLONGED OR REPEATED INHALATION OF POWDERS AND VAPORS OF CLEANING SOLVENTS, DEVELOPERS, AND EMULSIFIERS USED IN FLUORESCENT PENETRANT INSPECTION CAN IRRITATE MUCOUS MEMBRANE AREAS OF THE BODY.

CONTINUAL EXPOSURE TO PENETRANT INSPECTION MATERIALS CAN IRRITATE THE SKIN. DIRECT EXPOSURE OF EYES TO BLACK LIGHT AND PROLONGED EXPOSURE OF SKIN TO BLACK LIGHT CAN INFLAME AND DAMAGE EYES AND SKIN.

WEAR NEOPRENE GLOVES WHEN HANDLING PENETRANT INSPECTION MATERIALS. KEEP INSIDES OF GLOVES CLEAN.

STORE ALL PRESSURIZED SPRAY CANS CONTAINING PENETRANTS, DEVELOPERS, AND EMULSIFIERS IN A COOL, DRY AREA PROTECTED FROM DIRECT SUNLIGHT, HEAT, AND OPEN FLAMES. TEMPERATURES HIGHER THAN 120°F (49°C) MAY CAUSE PRESSURIZED CAN TO BURST AND CAUSE INJURY.

IF DIRECT EYE CONTACT WITH BLACK LIGHT CAUSES EYE PROBLEMS, IMMEDIATELY GET MEDICAL HELP.

WHEN USING BLACK LIGHT FOR FLUORESCENT INSPECTIONS, WEAR SAFETY GLASSES.

K. Fluorescent-penetrant inspect. No cracks allowed.

L. Inspect 16.600-16.640 inch dimension per figure 202.

FIFTH-STAGE COOLING AIR TUBES - MAINTENANCE PRACTICES

WARNING: ASBESTOS

THIS ENGINE MAY CONTAIN SMALL AMOUNTS OF ASBESTOS. WHEN WORKING WITH THIS ENGINE, THE FOLLOWING PRECAUTIONS MUST BE RIGIDLY ADHERED TO:

BEFORE ANY MAINTENANCE ACTIVITIES ARE UNDERTAKEN, REVIEW THE ILLUSTRATED PARTS BREAKDOWN/CATALOG INDEX TO DETERMINE IF THE HARDWARE TO BE WORKED ON OR USED CONTAINS ASBESTOS.

WHENEVER MECHANICAL REMOVAL OF MATERIAL, SUCH AS MACHINING, GRINDING, BUFFING, DRILLING, SANDING OR ANY TYPE OF MATERIAL BUILD-UP ON PARTS THAT CONTAIN ASBESTOS IS NECESSARY, APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT MUST BE WORN, AND NATIONAL ENVIRONMENTAL CONTROLS REQUIRED FOR THE HANDLING OF ASBESTOS-CONTAINING MATERIAL MUST BE COMPLIED WITH.

BEFORE HANDLING, REPLACING, OR DISPOSING OF ASBESTOS-CONTAINING HARDWARE, APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT AND NATIONAL ENVIRONMENTAL CONTROLS MUST BE STRICTLY ADHERED TO FOR HANDLING ASBESTOS-CONTAINING HARDWARE.

1. General. The following procedures are to be used when performing maintenance on the air tubes.

2. Removal/Installation.

WARNING: ASBESTOS

THE FOLLOWING PROCEDURE MAY INVOLVE A PART THAT CONTAINS ASBESTOS, WHICH IS HIGHLY TOXIC TO SKIN, EYES, AND RESPIRATORY TRACT. READ GENERAL INFORMATION BEFORE PROCEEDING, AND ADHERE TO ALL SITE SAFETY AND ENVIRONMENTAL CONTROLS CONCERNING ASBESTOS. OTHERWISE, PERSONAL INJURY MAY RESULT.

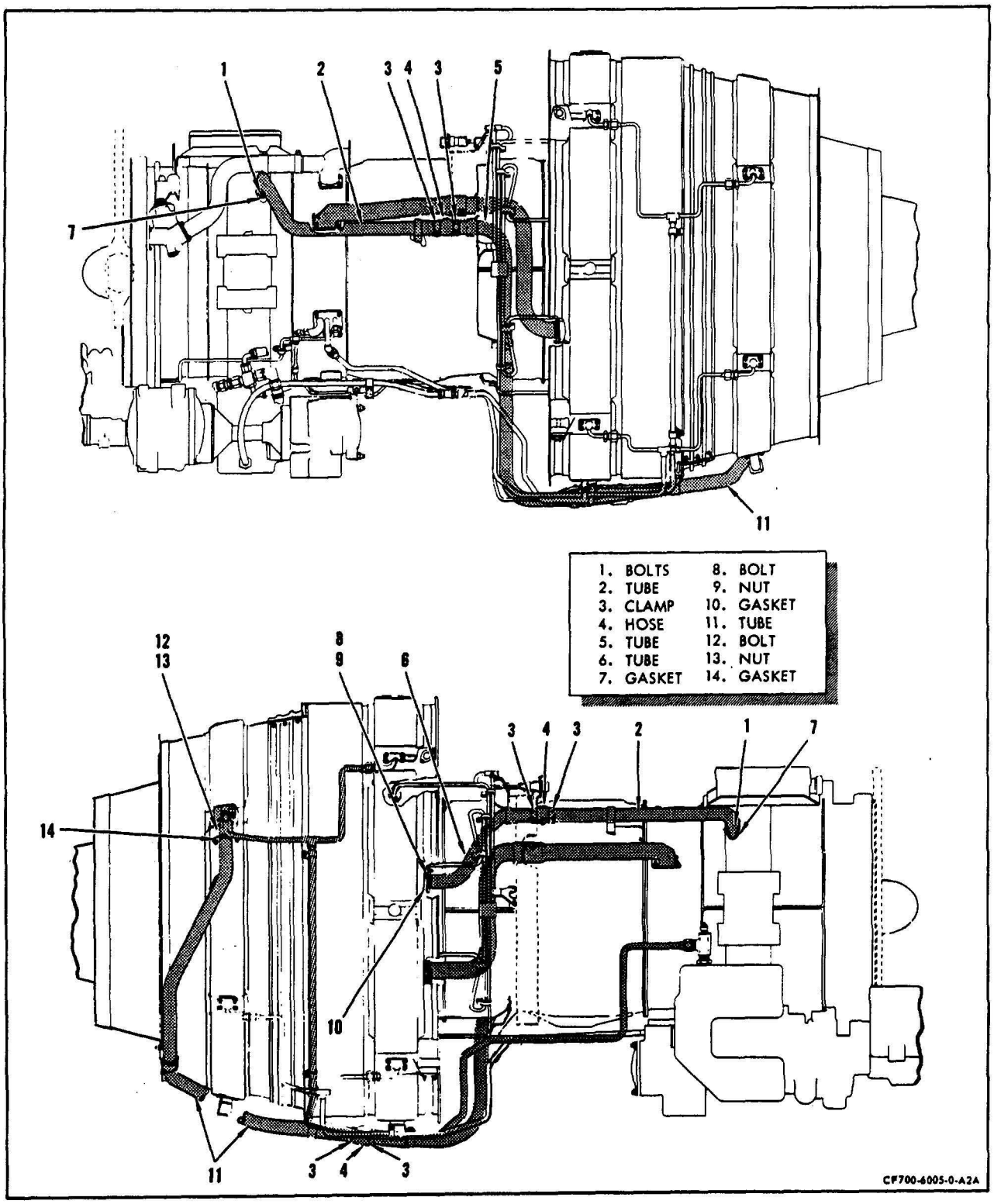
A. Removal.

NOTE: Identify all clamps and brackets that have to be removed so they can be correctly re-installed.

(1) Remove the bolts (1, figure 201) that secure the front tube (2, figure 201) to the compressor casing.

(2) Loosen the hose clamps (3, figure 201) that secure the hose connection (4, figure 201) to the front tube to the middle tube (5, figure 201) or rear tube (6, figure 201).

(3) Remove the front tube and discard gasket (7, figure 201).



Fifth-Stage Cooling Air Tubes - Removal
Figure 201

(4) Remove the rear tube (6, figure 201) as follows:

(a) Remove the bolts and nuts (8 and 9, figure 201) that secure the tube to the fan front frame.

(b) Remove and discard the gasket (10, figure 201).

(5) Remove the middle tube (5, figure 201) as follows:

(a) Loosen the hose clamps (3, figure 201) that secure the hose connection (4, figure 201) to the rear tube (11, figure 201).

(b) Remove the middle tube.

(6) Remove the rear tube (11, figure 201) as follows:

(a) Remove the bolts and nuts (11 and 12, figure 201) that secure the tube to the fan rear frame.

(b) Remove and discard the gasket (13, figure 201).

WARNING: ASBESTOS

THE FOLLOWING PROCEDURE MAY INVOLVE A PART THAT CONTAINS ASBESTOS, WHICH IS HIGHLY TOXIC TO SKIN, EYES, AND RESPIRATORY TRACT. READ GENERAL INFORMATION BEFORE PROCEEDING, AND ADHERE TO ALL SITE SAFETY AND ENVIRONMENTAL CONTROLS CONCERNING ASBESTOS. OTHERWISE, PERSONAL INJURY MAY RESULT.

B. Installation.

(1) Install rear tube (11, figure 201) as follows:

(a) Install a new gasket (14, figure 201) between tube and fan rear frame fitting.

(b) Secure tube to rear frame with bolts and nuts (12 and 13, figure 201). Torque nuts to 24-27 lb-in.

(2) Install clamps (3, figure 201) and hose connection (4, figure 201) to front of tube (11, figure 201).

(3) Install tube (5, figure 201) to hose connection on tube (11, figure 201).

(4) Install clamps (3, figure 201) and hose connection (4, figure 201) to front of tube (5, figure 201).

(5) Install left tube (2, figure 201) to hose connection on tube (5, figure 201).

(6) Place a new gasket (7, figure 201) on compressor casing fitting. Secure tube (2, figure 201) with bolts (1, figure 201). Torque bolts to 24-27 lb-in. and lockwire.

(7) Tighten all hose clamps (3, figure 201) and lockwire. Install all clamps or brackets that may have been removed.

(8) Install tube (6, figure 201) as follows:

(a) Place a new gasket (10, figure 201) on fan front frame.

(b) Secure the tube to the front frame with bolt and nuts (8 and 9, figure 201). Torque the bolts to 24-27 lb-in.

(9) Install the clamps (3, figure 201) and hose connection (4, figure 201) to the front of the tube (6, figure 201).

(10) Install right tube (2, figure 201) as follows:

(a) Install tube into hose connection on tube (6, figure 201).

(b) Place a new gasket (7, figure 201) on compressor casing fitting. Secure tube with bolts (1, figure 201). Torque to 24-27 lb-in. and lockwire.

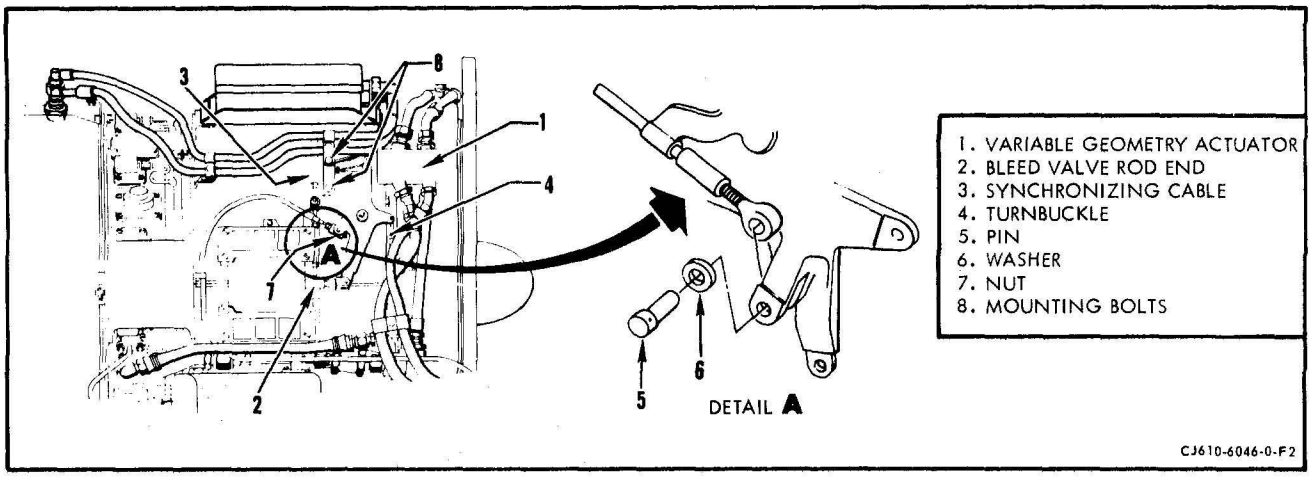
(11) Tighten all hose clamps (3, figure 201) and lockwire. Install all clamps or brackets that may have been removed.

3. Inspection/Check. Where serviceable limits are exceeded, parts may be repaired in accordance with Overhaul Manual Instructions.

Inspection/Check	Maximum Serviceable Limits	Remarks
A. Tube for splits or cracks.	Not serviceable.	Replace tube.
B. Nicks, chafing or scratches.	0.005 inch deep after removal of high metal.	
C. Dents.	Not over 1/5 of tube diameter, if dent is not on the heel of a sharply-bent radius.	
D. Flatness or out-of-roundness.	Not over 1/4 of the tube diameter.	Lap or resurface to within 0.005 inch flatness or replace tube.
E. Tube bolt flange for flatness.	Not to exceed 0.005 inch provided 3/4 of flange thickness remains after refacing.	
F. Hose coupling for cracks, breaks or holes.	Not serviceable.	

VARIABLE GEOMETRY ACTUATORS - MAINTENANCE PRACTICES

1. General. The following procedures are to be used when performing maintenance on the variable geometry actuators.



Variable Geometry Actuator Removal
Figure 201

2. Removal/Installation. (See figure 201.)

NOTE: The procedures in this paragraph apply to both the left and right-hand actuators except where otherwise noted.

A. Removal.

(1) Disconnect the hoses at the actuator housing (1). Move the actuator piston forward to the retracted position.

(2) Remove the cotterpins, washers, and clevis pins that secure the actuator to the bleed valve rod end (2) and to the synchronizing cable (3).

NOTE: On some engines (head of pin next to compressor casing) the clevis pin cannot be removed until the actuator is removed from its mount.

(3) Remove, at the variable vane actuator ring, the cotterpin, washer, and clevis pin that secure the turnbuckle to the actuator ring (4).

(4) For the right-hand actuator only, do the following:

(a) Remove the pin (5) and washer (6) or the nut (7) (depending on feedback cable configuration) from the end of the fuel control feedback cable at the actuator bellcrank lug.

NOTE: If necessary, disconnect the feedback cable conduit clamps to allow removal of the feedback cable from the bellcrank lug.

(5) Remove the 2 bolts that secure the actuator mount to the bosses on the compressor casing.

(6) Remove the 2 nuts and bolts that secure the actuator to the forward flange of the compressor casing.

(7) Remove the actuator (1).

B. Installation.

(1) Secure the variable geometry actuator (1) together with the assembled turnbuckle, to the forward flange of the compressor casing with 2 bolts and nuts. Torque the bolts to 35-40 lb-in.

NOTE: On some model engines (head of pin next to compressor casing) before securing the actuator, insert the clevis pin to secure one end of the synchronizing cable.

(2) Secure the actuator mount to the bosses on the compressor casing with 2 bolts (8). Torque the bolts to 24-27 lb-in. (The 2 rear bolts secure the synchronizing cable clamps also.)

NOTE: For the right-hand actuator only, the stand-off bracket for the igniter plug leads and feedback cable are secured by the top, rear bolt.

(3) Adjust and connect the actuator to the bleed valve, synchronizing cable, and variable vane actuator ring per 75-00, Maintenance Practices.

(4) If the right-hand actuator is being replaced, connect the feedback cable as follows:

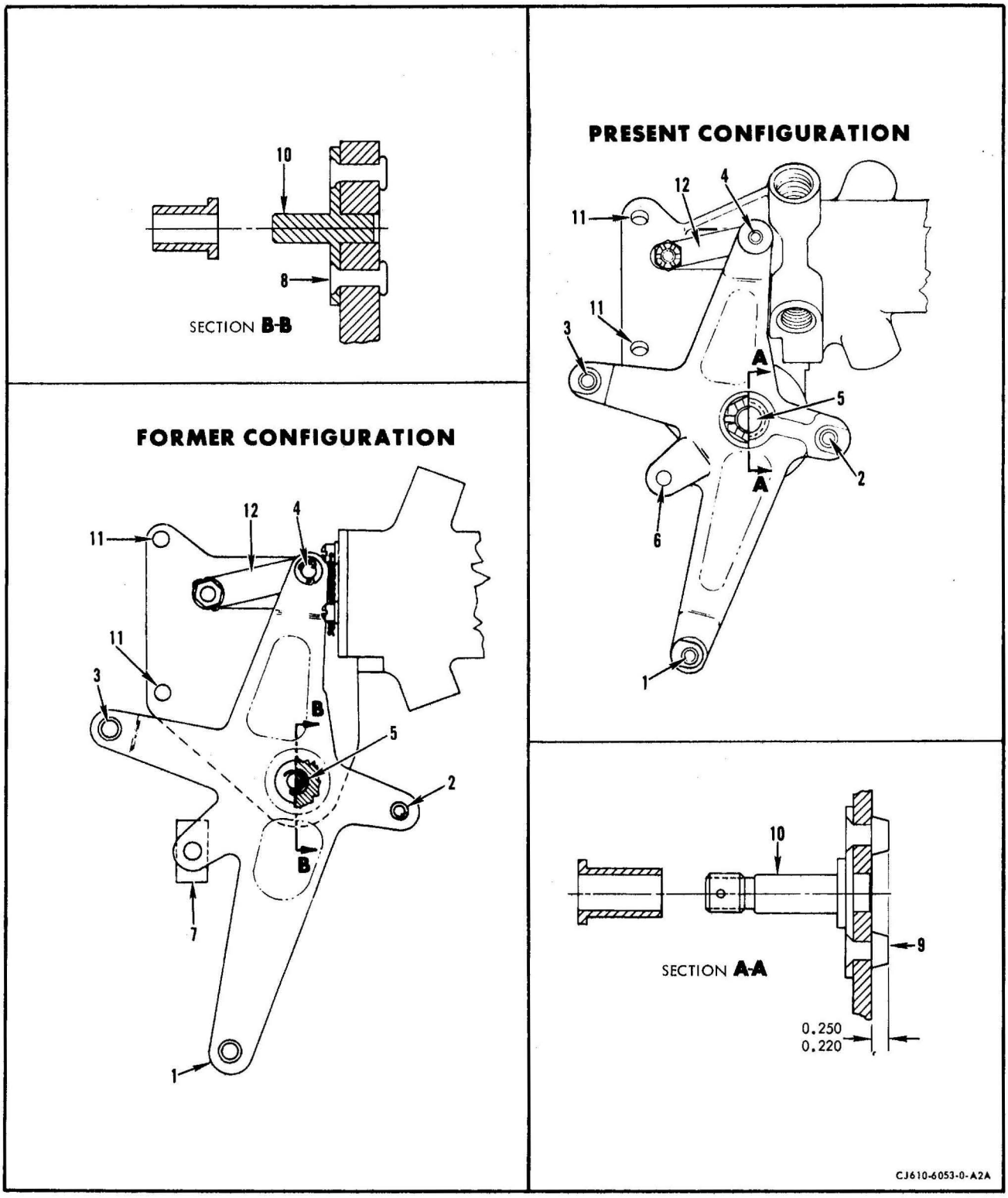
(a) Cycle the variable geometry feedback cable and check for freedom of movement.

(b) Adjust the feedback cable to the actuator per 75-00, Maintenance Practices.

(c) Connect the hoses to the variable geometry actuator fittings. Torque as specified in 73-25-0.

3. Inspection/Check. Where serviceable limits are exceeded, parts may be repaired in accordance with Overhaul Manual instructions.

Inspection/Check	Maximum Serviceable Limits		Remarks
	Former Configuration	Present Configuration	
A. Visually inspect the bellcranks for:			
(1) Loose bearings.	Not serviceable.		
(2) Bleed valve arm bearing wear (1, figure 202).	0.195 inch ID	0.195 inch ID	
(3) Variable vane arm bearing wear (2, figure 202).	0.134 inch ID	0.195 inch ID	
(4) Synchronizing cable arm bearing wear (3, figure 202).	0.195 inch ID	0.195 inch ID	
(5) Actuator arm bearing wear (4, figure 202).	0.195 inch ID	0.195 inch ID	
(6) Center pivot bearing wear (5, figure 202).	0.255 inch ID	0.380 inch ID	
(7) Feedback cable arm hole wear (6, figure 202).		0.255 inch ID	
(8) Feedback cable block for sticking (7, figure 202).	Block must be free to rotate 360 degrees when lockwire is removed.		



Variable Geometry Actuator Inspection
Figure 202

Inspection/Check	Maximum Serviceable Limits		Remarks
	Former Configuration	Present Configuration	
B. Visually inspect the actuator bracket for:			
(1) Loose or missing rivets or collars (8, 9, figure 202) in the bellcrank pivot shaft.	Not serviceable.		
(2) Wear on bellcrank pivot shaft (10, figure 202).	0.245 inch minimum OD.	0.369 inch minimum OD.	
(3) Mounting bolt holes for wear (11, figure 202).	0.225 inch minimum ID.	0.230 inch minimum ID.	
(4) Bends or cracks.	Not serviceable.		
C. Actuator body for damaged threads.	One full thread, continuous or cumulative may be missing after chasing.		
D. Visually inspect the actuator shaft for:			
(1) Dents, nicks and scratches in area of shaft seal.	0.001 inch deep after removal of all high metal.		
(2) Flaking chrome plate.	Not serviceable.		
(3) Yoke for wear (12, figure 202).	0.005 inch deep after removal of high metal.		
E. The pins used at connecting points (1-7, figure 202) for wear.	Not serviceable.		Replace pin.

AIR BLEED VALVE - MAINTENANCE PRACTICES

WARNING: ASBESTOS

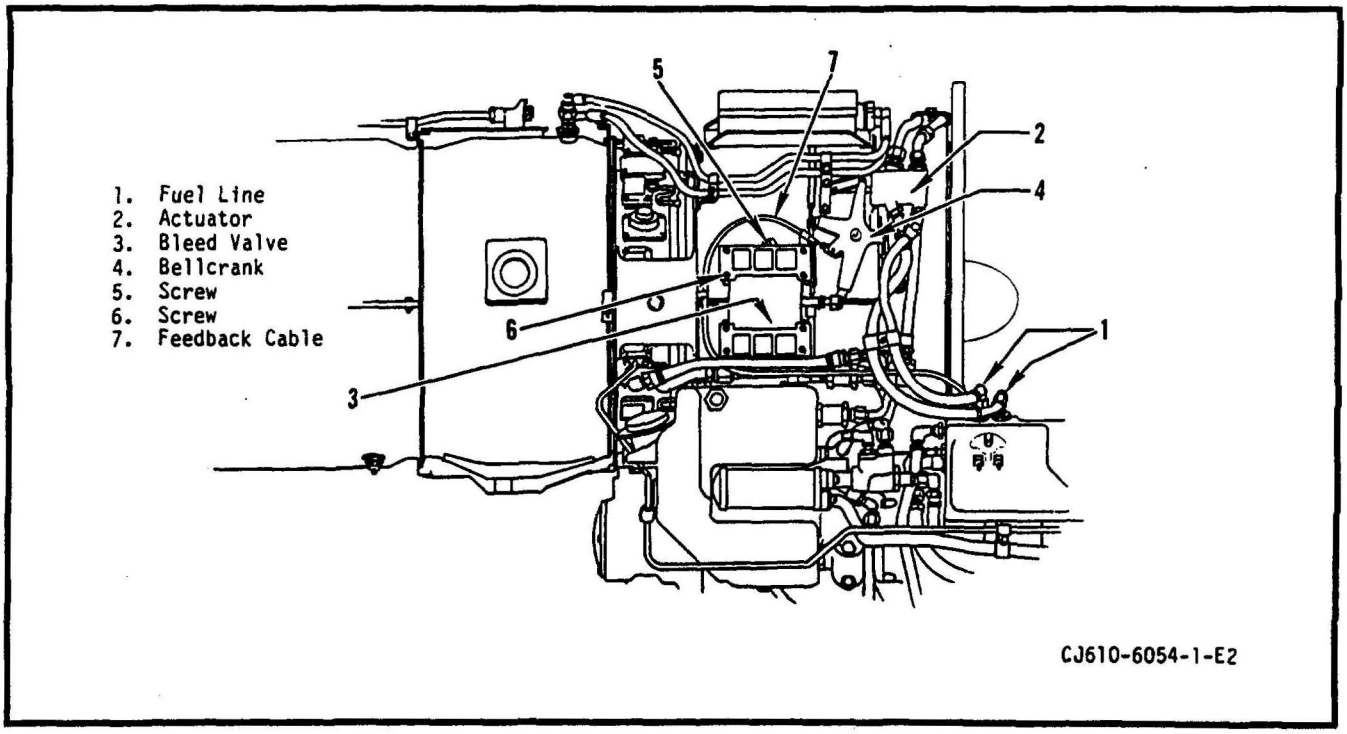
THIS ENGINE MAY CONTAIN SMALL AMOUNTS OF ASBESTOS. WHEN WORKING WITH THIS ENGINE, THE FOLLOWING PRECAUTIONS MUST BE RIGIDLY ADHERED TO:

BEFORE ANY MAINTENANCE ACTIVITIES ARE UNDERTAKEN, REVIEW THE ILLUSTRATED PARTS BREAKDOWN/CATALOG INDEX TO DETERMINE IF THE HARDWARE TO BE WORKED ON OR USED CONTAINS ASBESTOS.

WHENEVER MECHANICAL REMOVAL OF MATERIAL, SUCH AS MACHINING, GRINDING, BUFFING, DRILLING, SANDING OR ANY TYPE OF MATERIAL BUILD-UP ON PARTS THAT CONTAIN ASBESTOS IS NECESSARY, APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT MUST BE WORN, AND NATIONAL ENVIRONMENTAL CONTROLS REQUIRED FOR THE HANDLING OF ASBESTOS-CONTAINING MATERIAL MUST BE COMPLIED WITH.

BEFORE HANDLING, REPLACING, OR DISPOSING OF ASBESTOS-CONTAINING HARDWARE, APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT AND NATIONAL ENVIRONMENTAL CONTROLS MUST BE STRICTLY ADHERED TO FOR HANDLING ASBESTOS-CONTAINING HARDWARE.

1. General. The following procedures are to be used when performing maintenance on the bleed valve.



Bleed Valve Removal
Figure 201

2. Removal/Installation. (See figure 201.)

WARNING: ASBESTOS

THE FOLLOWING PROCEDURE MAY INVOLVE A PART THAT CONTAINS ASBESTOS, WHICH IS HIGHLY TOXIC TO SKIN, EYES, AND RESPIRATORY TRACT. READ GENERAL INFORMATION BEFORE PROCEEDING, AND ADHERE TO ALL SITE SAFETY AND ENVIRONMENTAL CONTROLS CONCERNING ASBESTOS. OTHERWISE, PERSONAL INJURY MAY RESULT.

NOTE: The procedure in this paragraph apply to both the right- and left- hand bleed valves except where otherwise noted.

A. Removal.

(1) Disconnect the actuator fuel lines (1) from the top of the fuel control to relieve hydraulic pressure. Position the acutator (2) pistons in the fully extended position.

(2) Remove the clevis pin that secures the bleed valve (3) rod end to the actuator bellcrank (4).

(3) Remove the bleed valve and gaskets from the compressor casing mounting pad by removing the screws (5 and 6) securing the valve to the casing. Discard gaskets.

NOTE: The channel nut holders are also held by the screws.

B. Replacement.

(1) Install 2 new gaskets and the bleed valve (3) on the compressor casing mounting pad.

(2) Secure the bleed valve with screws (6) and 4 channel-nut holders. Torque the screws to 25-30 lb-in.

(3) Secure the bleed valve with screws (5) (in the tapped holes in the compressor casing). Torque the screws to 25-30 lb-in. and lockwire them.

(4) Adjust the bleed valve per 75-00 Maintenance Practices.

NOTE: If the right-hand bleed valve is being installed, adjust the fuel control feedback cable (7) per 75-00, Maintenance Practices.

(5) Connect the actuator hoses (1) to the fuel control fitting per 73-25-0.

(6) Check the variable geometry system per 75-00, Maintenance Practices.

3. Inspection/Check. Where serviceable limits are exceeded, parts may be repaired in accordance with Overhaul Manual instructions.

Inspection/Check	Maximum Serviceable Limits	Remarks
A. Visually inspect the upstream and downstream cases for cracks.	Not serviceable.	
B. Visually inspect the covers or nameplate for:		
(1) Cracks.	Not serviceable.	
(2) Loose or missing drive screws.	Not serviceable.	Replace drive screw per paragraph 4.
C. Visually inspect the gates for cracks.	Not serviceable.	
D. Visually inspect the pushrod for:		
(1) Cracks.	Not serviceable.	
(2) Bent.	Not Serviceable.	
(3) Damaged threads.	One full thread within first ten threads, provided remaining threads are free of damage.	
E. Visually inspect the camplate for cracks.	Not serviceable.	
F. Roller and roller pin inspection.		
(1) Visually inspect rollers, using a 10x glass for:		
(a) Transverse surface wear.	Not serviceable.	

Inspection/Check	Maximum Serviceable Limits	Remarks
(b) Circumferential surface wear.	Not serviceable.	
(c) Flat spots.	Not serviceable.	
(d) Chips or cracks.	Not serviceable.	
(2) Deleted.		
G. Visually inspect the bleed valve rod-end or clevis for:		
(1) Damaged Threads.	Twenty-five percent of threads may be missing after chasing.	
(2) Wear in rod-end or clevis hole.	0.192 inch maximum width (axial direction).	Replace rod-end or clevis.
H. Fluorescent penetrant-inspect the pushrod assembly for cracks.	Not serviceable.	Replace pushrod assembly.

4. Approved Repairs.

A. Repair of loose or missing drivescrews:

(1) Separate the upstream case from the downstream case. Keep the bleed valve components with the case that is not being repaired. Refer to paragraph 5 for disassembly procedure.

(2) Remove loose drivescrew.

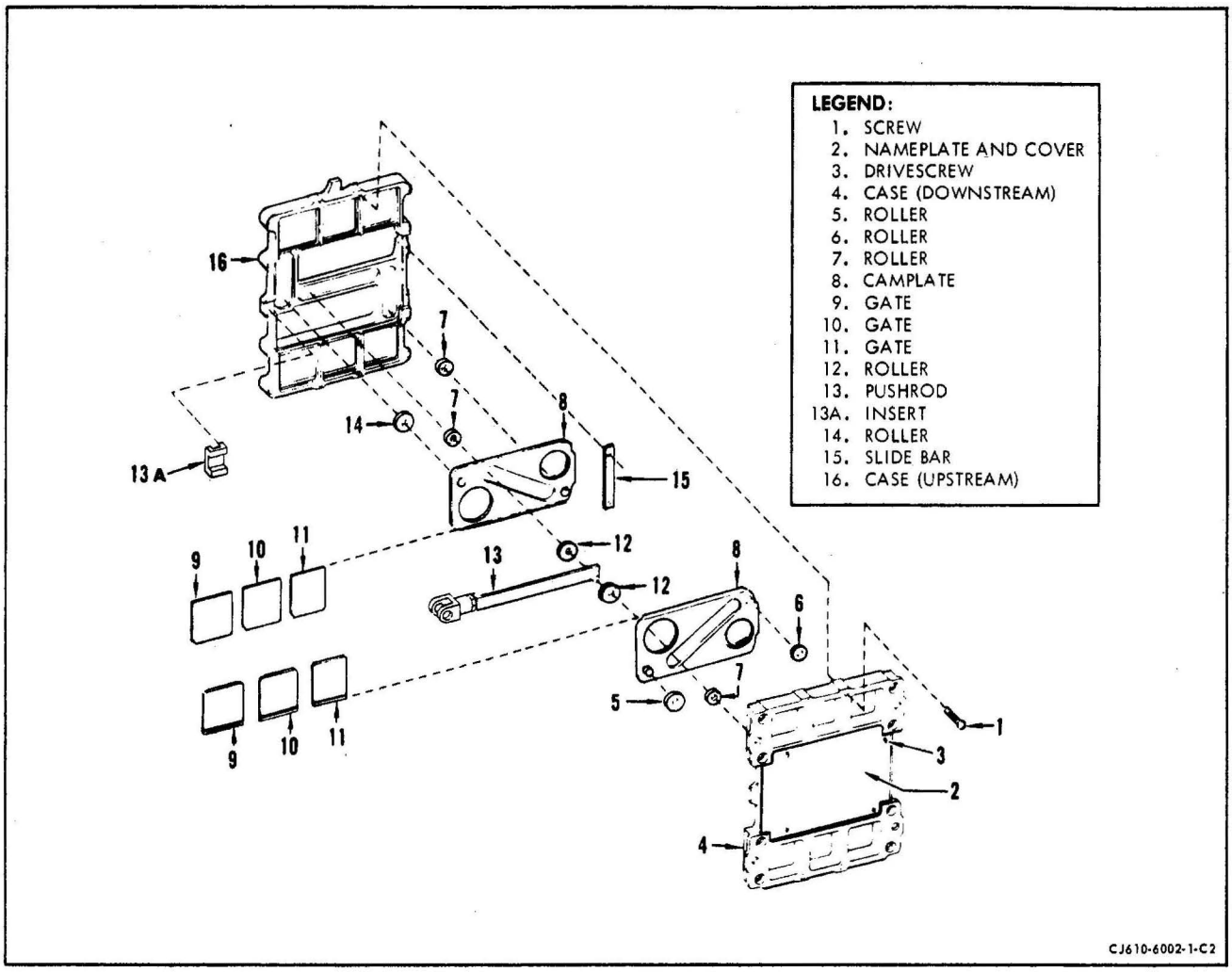
(3) Open up drivescrew hole with a No. 38 drill (0.1015 inch).

(4) Drill hole in cover and nameplate (or just cover) with a No. 32 drill (0.116 inch).

(5) Remove all burrs and chips.

(6) Install oversize drivescrew. Drivescrews in the downstream case must have their heads benched until they are 0.025-0.030 inch in height.

(7) Deleted.



Bleed Valve
Figure 202

B. Deleted.

5. Lubrication. (See figure 202.) During disassembly, inspect per paragraph 3.

A. Disassemble the bleed valve, except for items 2 and 3, in the sequence established by the item numbers of figure 202.

NOTE 1: Loctite compound was applied to the screws (1) when they were installed. Therefore, they may be difficult to remove. If difficulty is encountered removing screws, apply heat, 300°F maximum, to screw area of downstream case (4) to soften the Loctite. Be careful not to damage the slots in the screws when removing them.

NOTE 2: During disassembly of gates, note position and stages they were removed from, to assure correct assembly.

B. Using a moly disulphide spray, lubricate the rollers, gates, camplate assemblies, cam riding surfaces, gate riding surfaces, roller slots and push rod assembly to a thickness of approximately 0.0005 inch.

C. Assemble the bleed valve as follows: (See figure 202.)

(1) Place the upstream (inboard) case assembly (16) on a clean surface, with the mounting surface down and the pushrod grooves to the left.

(2) Insert 0.618 inch diameter roller (14) in the left-hand vertical slot, and place one of the three 0.455 inch diameter rollers (7) in the right-hand vertical slot.

(3) Assemble one camplate assembly (8) so that the pins fit into the holes of the 2 rollers which were assembled in paragraph (2).

(4) Assemble the slide bar assembly (15) on the upstream case by inserting the slide bar pins in the holes of the upstream case.

(5) Insert a second 0.455 inch diameter roller (7) in the center (horizontal) groove of the upstream case.

(6) Place one of the two 0.499 inch diameter rollers (12) on top of roller (7) assembled in paragraph (5). Line up the holes of the 2 rollers. Roller (12) is now located in the camplate slot.

(7) Assemble the pushrod assembly (13) so that the pin facing down will fit into the 2 rollers that were assembled in paragraphs (5) and (6). The shank fits into the pushrod insert (13A) with the offset down.

(8) Place second 0.499 inch diameter roller (12) and then the third 0.455 inch diameter roller (7) on the pin of the pushrod assembly.

(9) Assemble one set of gates (9, 10, and 11) so that the lips (grooves) are down and engage the camplate assembly. Assemble a second set of gates (9, 10, and 11) with the lips (grooves) up.

NOTE: To equalize gate wear, turn gates over from their previously installed position in each stage.

CAUTION: THE GATES ARE NOT INTERCHANGEABLE BETWEEN STAGES.

(10) Assemble the second camplate (8) (with pins up) to engage the lips of the "free" set of gates. Place pin of the pushrod in the slot of the camplate.

(11) Place 0.578 inch diameter roller (5) on the left-hand pin of the camplate assembly. Place 0.393 inch diameter roller (6) on the right-hand pin of the camplate.

(12) Install downstream case so that installed rollers are in their proper slots.

(13) After assembly, actuate the pushrod by hand a minimum of 10 cycles to remove excess lubricant from working parts.

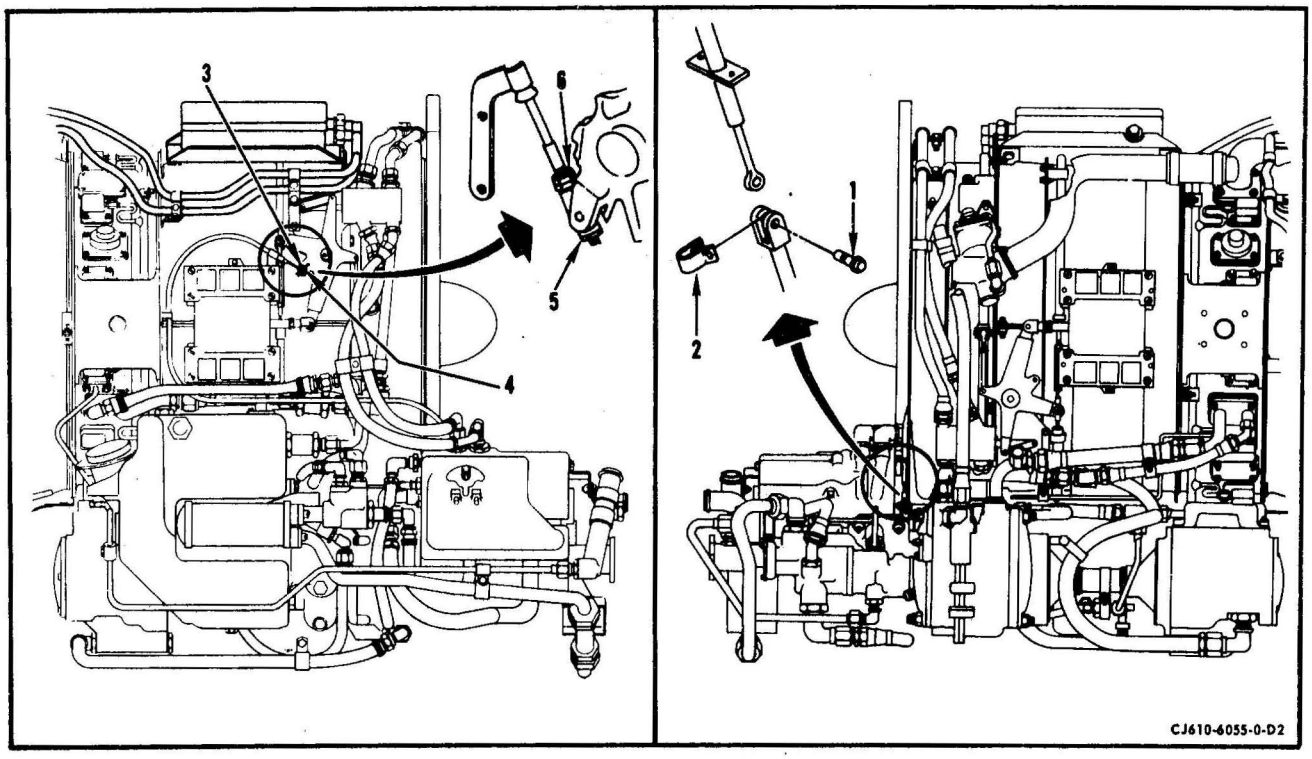
(14) Remove downstream case and carefully remove excess lubricant.

(15) Assemble the downstream and upstream case assemblies again and secure using 4 screws (1), after applying one drop of Loctite, Grade H, Military Specification MIL-P-11268D, or equivalent, to the threads. Tighten the screws to a torque value of 7 to 9 lb-in.

(16) To assure correct assembly, check for binding or internal piece part hangup by operating the push rod assembly to the full open and closed positions. The force to actuate the push rod shall not exceed 0.25 pound.

FEEDBACK CABLE - MAINTENANCE PRACTICES

1. General. The following procedures are to be used when performing maintenance on the feedback cable.



Feedback Cable Removal
Figure 201

2. Removal/Installation. (See figure 201.)

A. Removal.

(1) Disconnect the feedback cable from the fuel control by removing the pin (1) and clip (2) and the screws securing the cable housing to the control.

NOTE: To accomplish this on some engines it may be easier if the fuel control is removed. (Ref. 73-13-0.) If the control is removed it must be supported during removal to prevent damaging the feedback cable and other attaching lines.

(2) Disconnect the feedback cable from the bellcrank by removing the pin (3) and washer (4).

NOTE: On some engines the cable end is connected by nuts (5) and (6).

(3) Remove the feedback cable by removing the nuts and bolts securing the cable brackets to the engine.

B. Installation.

(1) Install the feedback cable on the engine and secure the cable brackets with bolts and nuts.

(2) Connect the bellcrank end to the bellcrank. Secure with pin (3) and washer (4) or with nuts (5) and (6), depending on cable configuration. Lockwire.

(3) Connect the fuel control end to the control and secure with pin (1) and clip (2). Secure the cable housing to the control with screws. Torque and lockwire the screws.

NOTE: If the fuel control was removed, install the feedback cable on the control before installing the fuel control on the engine.

(4) Adjust the cable per 75-00, Maintenance Practices.

3. Inspection/Check. Where serviceable limits are exceeded, parts may be repaired in accordance with Overhaul Manual instructions.

Inspection/Check	Maximum Serviceable Limits	Remarks
A. Visual Check.		
(1) Feedback cable for:		
(a) Kinks.	Minor kinks that do not interfere with cable actuation.	
(b) Bends.	Not serviceable.	
(c) The rod end hole (at fuel control) for wear.	0.127 inch diameter.	
(d) Rod end hole pick-up, galling or burrs.	Not serviceable.	Remove high metal.

Inspection/Check	Maximum Serviceable Limit	Remarks
(e) Bracket looseness.	Not serviceable.	
(f) Binding.	2.5 lb pull to move cable through travel range.	
(g) Bent rod end connector.	Any amount provided bent section does not affect assembly of cable.	
(h) Cracks on threaded section.	Not serviceable.	
(2) Feedback cable conduit for:		
(a) Nicks and chafing.	Any amount as long as nicked or chafed area is not through tube wall and cable binding is not apparent.	
(b) Dents.	Not over 1/5 of the tube diameter and cable does not bind.	