CHAPTER

78

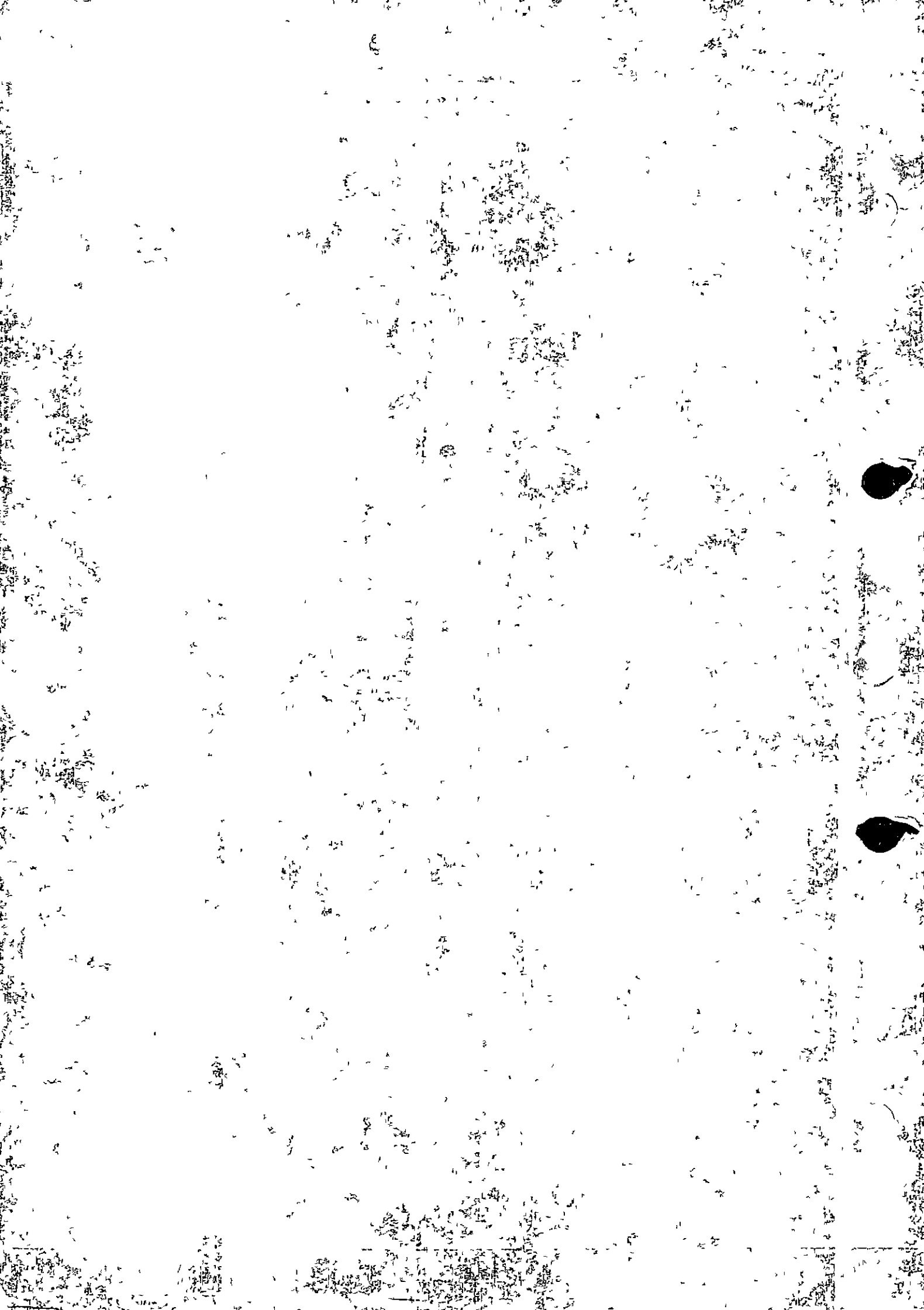
BOEING Intercontinental 707

MAINTENANCE MANUAL

CHAPTER 78

EXHAUST

TABLE OF CONTENTS



THRUST REVERSER - DESCRIPTION AND OPERATION

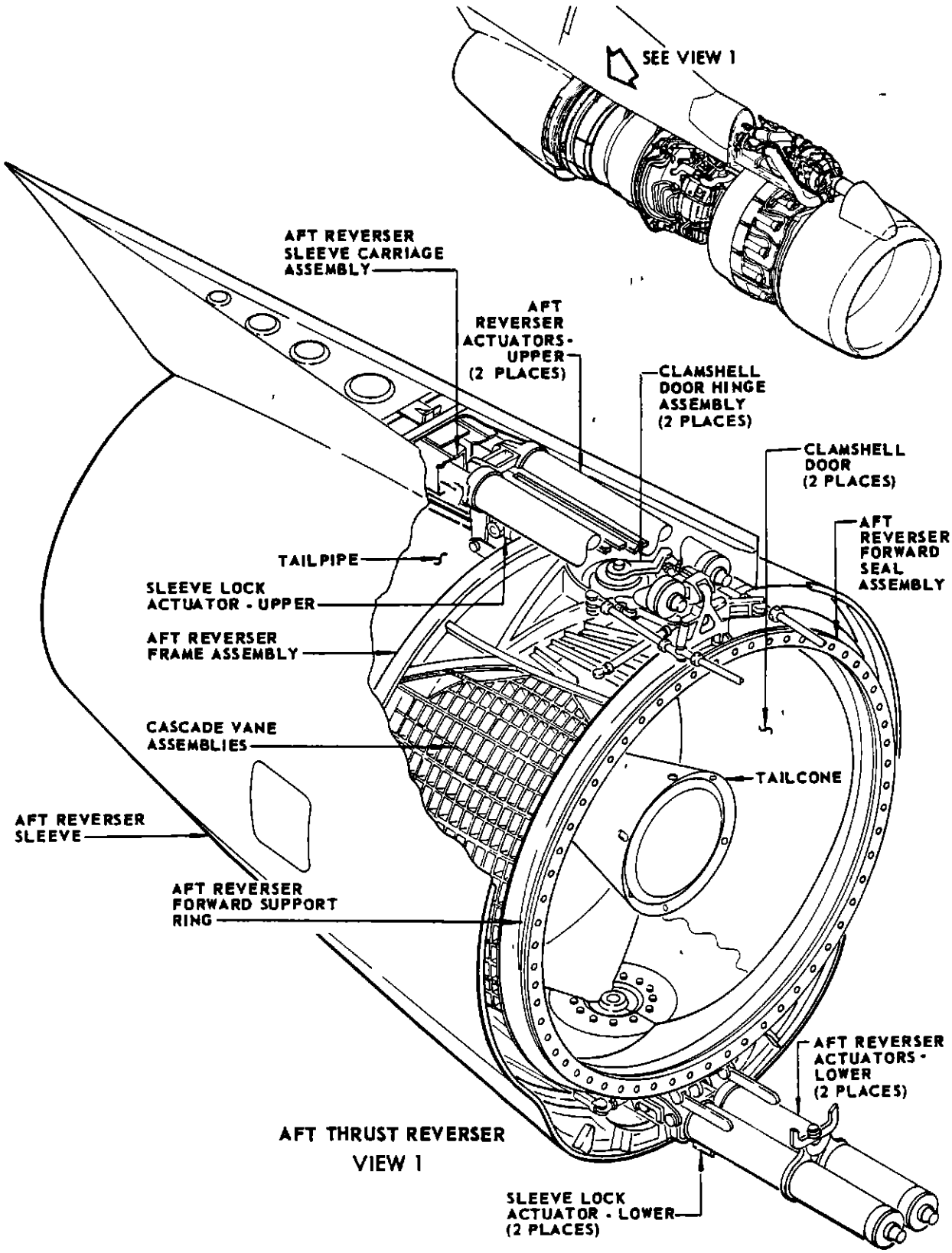
1. General

A. The thrust reverser on the JT3D turbofan engine (figure 1) is used to reduce the length of the landing roll and consists of an aft thrust and a forward thrust reverser. The thrust reverser on each engine operates independently. Flow reversing components on the forward thrust reverser are located circumferentially around the first stage compressor case. During forward thrust operation the exhaust air from the fan section of the first stage compressor is discharged in an aft direction from a duct created by the power plant diaphragm and the cowl ring assembly. The aft thrust reverser, during forward thrust operation, is an intermediate path for exhaust gas flow between the engine and the tailpipe. During reverse thrust operations the forward thrust reverser actuators move the cowl ring aft and reposition the blocker doors, lower vane assemblies, and baffle assemblies to discharge the fan exhaust air in a forward direction. The aft thrust reverser actuators move the aft thrust reverser sleeve aft uncovering the cascade vane assemblies. Movement of the sleeve causes the clamshell doors to close through the action of a hinge drive mechanism connecting the sleeve and the clamshell door hinge arm. The aft thrust reverser actuates simultaneously with the forward thrust reverser. Engine exhaust gases are diverted through the cascade vane assemblies.

2. Aft Thrust Reverser

A. General

(1) The aft thrust reverser consists of the aft thrust reverser frame assembly, two clamshell doors, twenty cascade vane assemblies, two door hinge assemblies, the aft thrust reverser sleeve, and tracks and carriage assemblies. (See figure 1.) The tailpipe is mounted to the aft mounting ring of the frame assembly and lies within the sleeve. The thrust reverser installations for each engine are identical except for the cascade vane assemblies. The deflectors for various vane assemblies on each side of each engine are oriented at different angles in order to prevent exhaust gas ingestion by the adjacent engine. Seals are installed on the clamshell door aft edges, the door hinges, and the aft thrust reverser forward support ring to minimize exhaust gas leakage during forward thrust operation.



AFT THRUST REVERSER
VIEW 1

Fan Engine Thrust Reverser
Figure 1 (Sheet 1 of 2)

(10)
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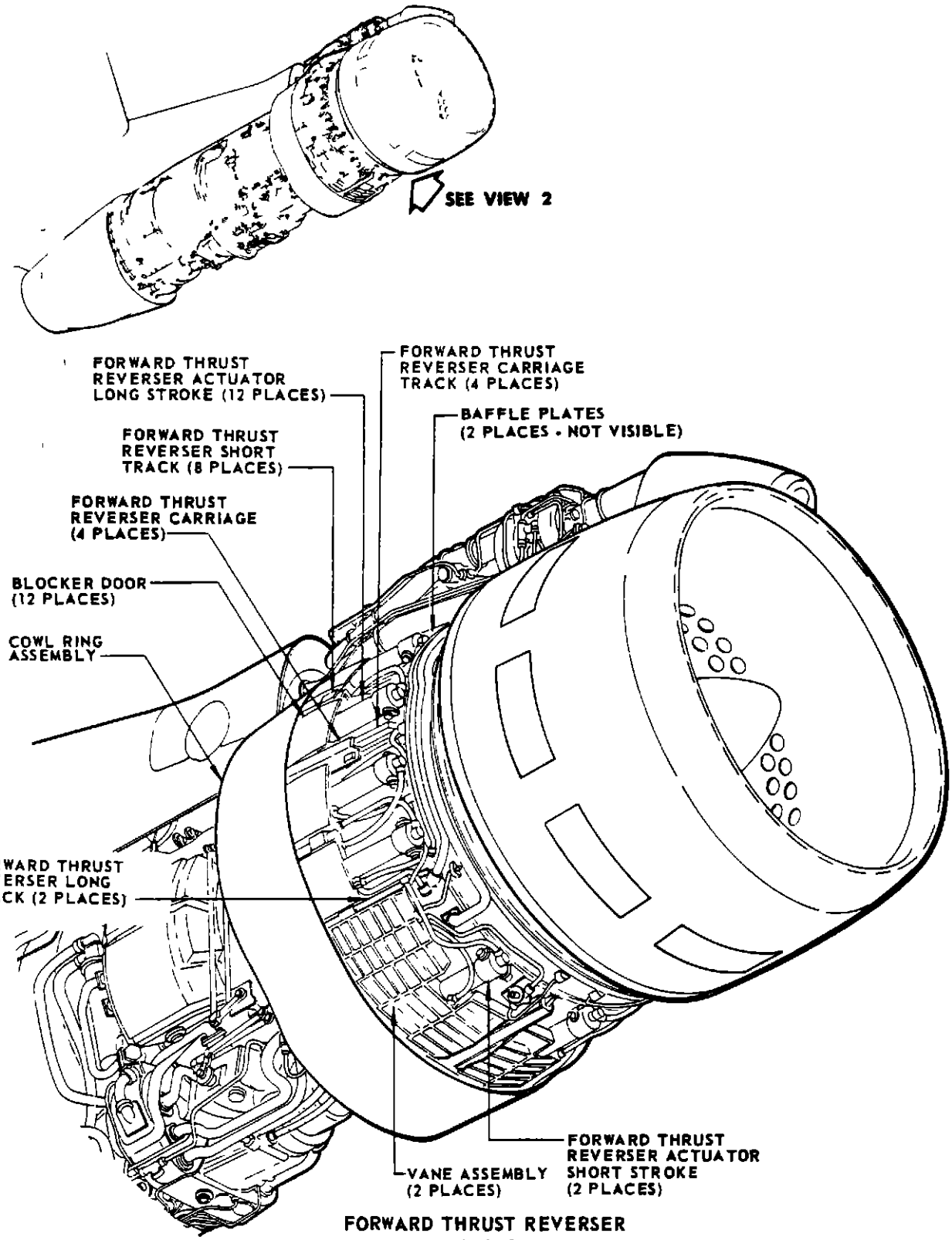


FORWARD THRUST REVERSER
VIEW 2

(2) The aft thrust reverser is pneumatically operated by bleed air from the high pressure compressor section. The thrust reverser control system directs pneumatic air to the sleeve lock actuators and reverser actuators. For reverse thrust operation, air is directed to the sleeve lock actuators and reverser actuators in sequence, releasing the sleeve and moving it aft, causing the clamshell doors to rotate aft and toward the engine centerline by the action of the hinge drive mechanism connecting the sleeve and the clamshell door hinge arms. For forward thrust operation, the reverser actuators move the sleeve and clamshell doors forward. The sleeve fairs with the engine cowling and covers the cascade vane assemblies.

B. Aft Thrust Reverser Frame Assembly

(1) The thrust reverser frame is a welded structure to which the clamshell doors, upper actuator assemblies, cascade vane assemblies and tailpipe are attached (figure 1). It consists of an aft mounting ring, a forward mounting ring and connecting structure. The frame assembly is attached to the rear of the engine. The tailpipe is attached to the aft mounting ring of the frame assembly. The cascade vane assemblies are attached to the frame between the forward and aft rings. Hinge support assemblies at the upper and lower vertical centerlines provide for attachment of the clamshell door hinge assemblies.

C. Clamshell Doors

(1) The thrust reverser clamshell doors are located inside the aft thrust reverser frame assembly and are attached to the clamshell door hinge assemblies at the upper and lower vertical centerlines of the reverser frame. (See figure 1.) The clamshell door assemblies are welded structures to which are attached hub seals and an aft seal. Holes are provided on the hub seal for mounting the doors on the hinge arms. The aft seal insures an even fit between the door and the frame assembly when the doors are in the open position.

D. Cascade Vane Assemblies

(1) Ten cascade vane assemblies are mounted on eacn side of the aft reverser frame assembly, except for the right side of engines No. 1 and 3 and the left side of engines No. 2 and 4 (figure 1). There are eight cascade vane assemblies and two blocker assemblies on these sides. Each vane assembly is a casting with a row of built-in turning vanes. The forward end of the vane assembly is bolted to the forward end of the reverser frame. The aft end is inserted in the aft ring of the frame. On later installations, in addition to being bolted at the forward end, several of the vane and blocker assemblies are bolted at the thrust reverser aft mounting ring and tailpipe flange. There are several different cascade vane assemblies with turning vanes installed at different angles to achieve the desired direction of exhaust gas deflection during reverse thrust. The olocker assemblies are metal channels with end plates for attachment to the reverser frame. No exhaust gas flows through the blocker assemblies.

E. Clamshell Door Hinge Assemblies

(1) A clamshell door hinge assembly is installed through the top and bottom surfaces of the thrust reverser frame assembly. (See figure 1.) Each hinge assembly consists of an inner and outer shaft with flanges to which the clamshell door hinge drive mechanism and aft follow-up rods are attached A roller bearing and a ball bearing are installed between the shafts, and a roller bearing is installed between the outer shaft and the frame. The inner shaft rotates within the outer shaft and the outer shaft within the frame assembly during clamshell door actuation.

F Aft Thrust Reverser Sleeve

(1) The aft thrust reverser sleeve is a mechanically actuated one piece cowl and fairing that rides on roller truck mechanisms and tracks (See figure 1) The aft thrust reverser actuators move the sleeve aft for reverse thrust operation and forward for forward thrust operation. During forward thrust operation the sleeve encloses and covers all other thrust reverser components and the tailpipe, fairing with the engine cowl panels and the strut fairing A roller assembly which rides in the track between the two upper actuators, and attachments for the upper actuator rod ends are at the top of the sleeve A roller truck assembly at the bottom of the sleeve attaches to the lower actuator rod end. Four support links at the top and bottom and right and left hand sides of the sleeve attach the sleeve to roller trucks on the tailpipe Attachments for the hinge drive mechanism rod assemblies are at the upper and lower forward edges of the sleeve.

G. Tailpipe

(1) The tailpipe consists of a cylindrical cone with support tracks for the aft sleeve roller trucks welded to the surface at the upper and lower vertical centerlines and the left and right horizontal centerlines (See figure 1) The tailpipe is bolted to the aft mounting ring of the reverser frame and lies entirely within the aft reverser sleeve during both forward and reverse thrust operations.

3. Forward Thrust Reverser

A General

(1) The forward thrust reverser consists of twelve blocker doors, two vane assemblies, two baffle assemblies, a cowl ring assembly, tracks and carriage assemblies (See figure 1.) The cowl ring assembly is a two piece structure joined at the top and bottom. Each section has a seal attached to the forward inner edge with screws.

(2) The forward thrust reverser is pneumatically operated by bleed air from the high pressure compressor section. The thrust reverser control system positions the blocker doors and cowl ring assembly for the forward or reverse thrust positions. For forward thrust operation the blocker doors lay flat around the compressor case, allowing the fan air to be discharged in an aft direction from a duct created by the power plant diaphragm and the cowl ring assembly. For reverse thrust operation, the forward thrust reverser actuators move the cowl ring, vane assemblies and baffle assemblies aft and rotate the blocker doors aft and inward to block the aft flow of the fan air. This action eliminates the fan air duct and causes fan air to be discharged in a forward direction.

B. Cowl Ring Assembly

(1) The cowl ring assembly is a two-piece assembly surrounding the engine immediately aft of the fan section of the first stage compressor. (See figure 1.) It forms the outer wall of the fan air duct during forward thrust operation. The right and left-hand cowl ring assemblies are attached together by bolts through structure at the upper and lower vertical centerlines. Each assembly consists, basically, of an outer skin which fairs with the engine cowling, an inner skin which is curved to form a duct with the power plant diaphragm, web assemblies joining the inner and outer skin, and supporting ribs and structure. Attachment provisions for the blocker door links, baffle assemblies, and vane assemblies are on the web structure. Openings for the forward thrust reverser track assemblies are also located in the web structure. The cowl ring assembly rides on four carriage assemblies, located on the upper and lower vertical centerlines, and left and right horizontal centerlines. These carriage assemblies are attached to the web structure and ride on tracks mounted forward of the cowl ring assembly. A gas seal is attached to a seal angle at the junction of the inner skin and the web structure.

C. Blocker Doors

(1) Twelve blocker doors, six on each side of the engine, deflect fan air exhaust in a forward direction during reverse thrust operation. Each door is a rectangular, curved casting of magnesium alloy (aluminum alloy on later airplanes). (See figure 1.) Attachment provisions on the door allow it to be connected to the door links and the forward thrust reverser actuator rod ends. A roller bearing (slide block on later airplanes) installed on the outer side of each blocker door rides in an engine mounted guide track to stabilize the blocker door in reverse and cruise positions.

(2) Additionally on later airplanes, the aluminum alloy blocker doors at the upper four locations each incorporate two cam follower rollers. These rollers, in conjunction with turning cams on the upper six short tracks, eliminate blocker door delay during movement of the cowl ring assembly to the reverse thrust position.

D Vane Assemblies

(1) In the lower fan exhaust area two turning vane assemblies are installed to direct the fan exhaust air flow forward during reverse thrust operation. They are located on either side of the lower sleeve carriage (6·00 o'clock position) and are bolted to the carriage Ball bearing rollers, or slide blocks on later airplanes, mounted on the upper side of the vane assembly ride in the grooves of engine mounted guide tracks to provide for translation of the vane assemblies A fixed vane installation is possible due to the accessory section bulge at the lower area of the engine nacelle This permits sealing of this portion in reverse since the clearance between the power plant diaphragm and the cowl ring assembly is nominally 0.02 inch in this area Vanes are installed in such a manner as to provide the optimum fan exhaust gas direction for reverse thrust and to minimize self ingestion or cross ingestion.

E Baffle Assemblies

(1) Two baffle plate assemblies, one on each side of the upper sleeve carriage assembly (12:00 o'clock position) prevent fan air exhaust from impinging on the strut seal panel area during reverse thrust operation. (See figure 1.) On the upper side the baffle plates are bolted directly to the sleeve carriage. Ball bearing rollers, or slide blocks on later airplanes, on the lower side of the baffles ride in the grooves of engine mounted guide tracks to provide for translation of the baffles The baffle plate is a solid one-piece casting with a flat undersurface in the area of gas impingement.

F. Tracks and Carriage Assemblies

(1) Engine mounted guide tracks, twelve short tracks and four long tracks, provide grooves for the ball bearing rollers or slide blocks on the flow reversing components and carriages of the forward thrust reverser to ride in during thrust reverser translation The tracks are mounted around the circumference of the fan section of the forward compressor case just forward of the cowl ring assembly The long tracks are located at the 3:00, 6:00, 9:00, and 12:00 o'clock positions and are the guide tracks for the four sleeve carriage assemblies. The sleeve carriage assemblies are mounted over the tracks and have four internally mounted rollers which ride on the guide tracks The carriages are bolted directly to the forward web of the cowl ring assimbly and provide the main support for the cowl ring. The carriages at the 3:00 and 9:00 o'clock positions have slotted holes on either side to allow the roller on one side of each of the blocker doors at this location to ride in the respective long track groove The other blocker doors and the other side of the blocker doors adjacent to the side carriages ride in the short tracks One side of each of the baffle assemblies and each of the turning vane assemblies ride in short track grooves

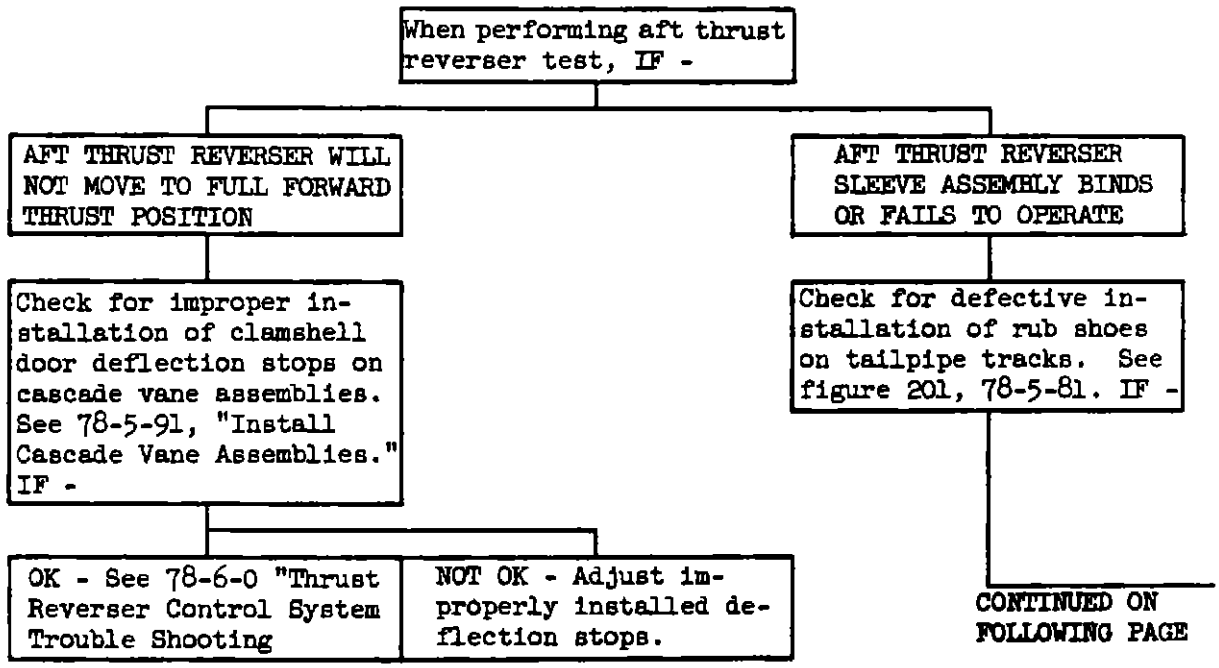
(2) On later airplanes, the short tracks at the upper six locations each incorporate a turning cam. These cams, in conjunction with cam follower rollers on the upper four blocker doors, eliminate blocker door relay during movement of the cowl ring assembly to the reverse thrust position.

THRUST REVERSER - TROUBLE SHOOTING

1. General

   A. If the cause of the trouble is not isolated using the trouble chart, the trouble probably lies in the thrust reverser control system. Perform trouble-shooting of the control system per 78-6-0, "Thrust Reverser Control System Trouble Shooting."

2. Aft Thrust Reverser Trouble Chart



CONTINUED FROM
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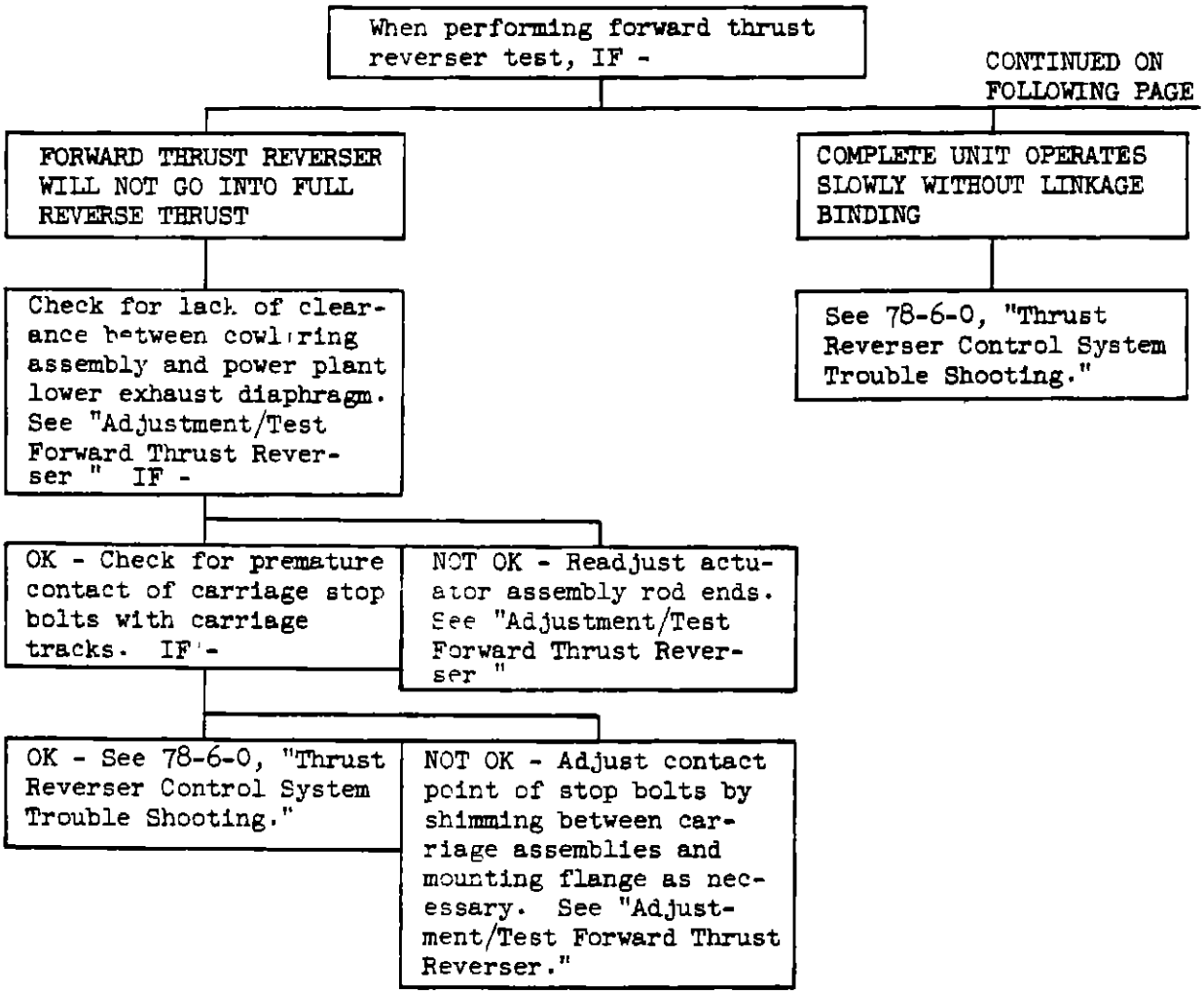
NOT OK - Replace defective rub shoes.	OK - Check for defective installation of rub strips on aft thrust reverser sleeve. See 78-5-71, "Install Aft Thrust Reverser Sleeve." IF -
NOT OK - Adjust rub strip installation	OK - Check for defective rigging of lower actuator eyebolt support which may be causing misalignment of sleeve with actuators. IF -
NOT OK - Rig lower actuator installation	OK - Check for defective rollers on aft track roller installations (4 places). See 78-5-71, figure 201. IF -
NOT OK - Replace defective rollers.	OK - Check for defective splice plate installation at upper and lower forward rings of aft reverser sleeve. IF -
NOT OK - Adjust splice plate installations.	OK - Inspect aft thrust reverser assembly for defects. IF -
NOT OK - Repair damage or replace damaged assembly.	OK - Trouble shoot thrust reverser control system

2. Forward Thrust Reverser Trouble Chart



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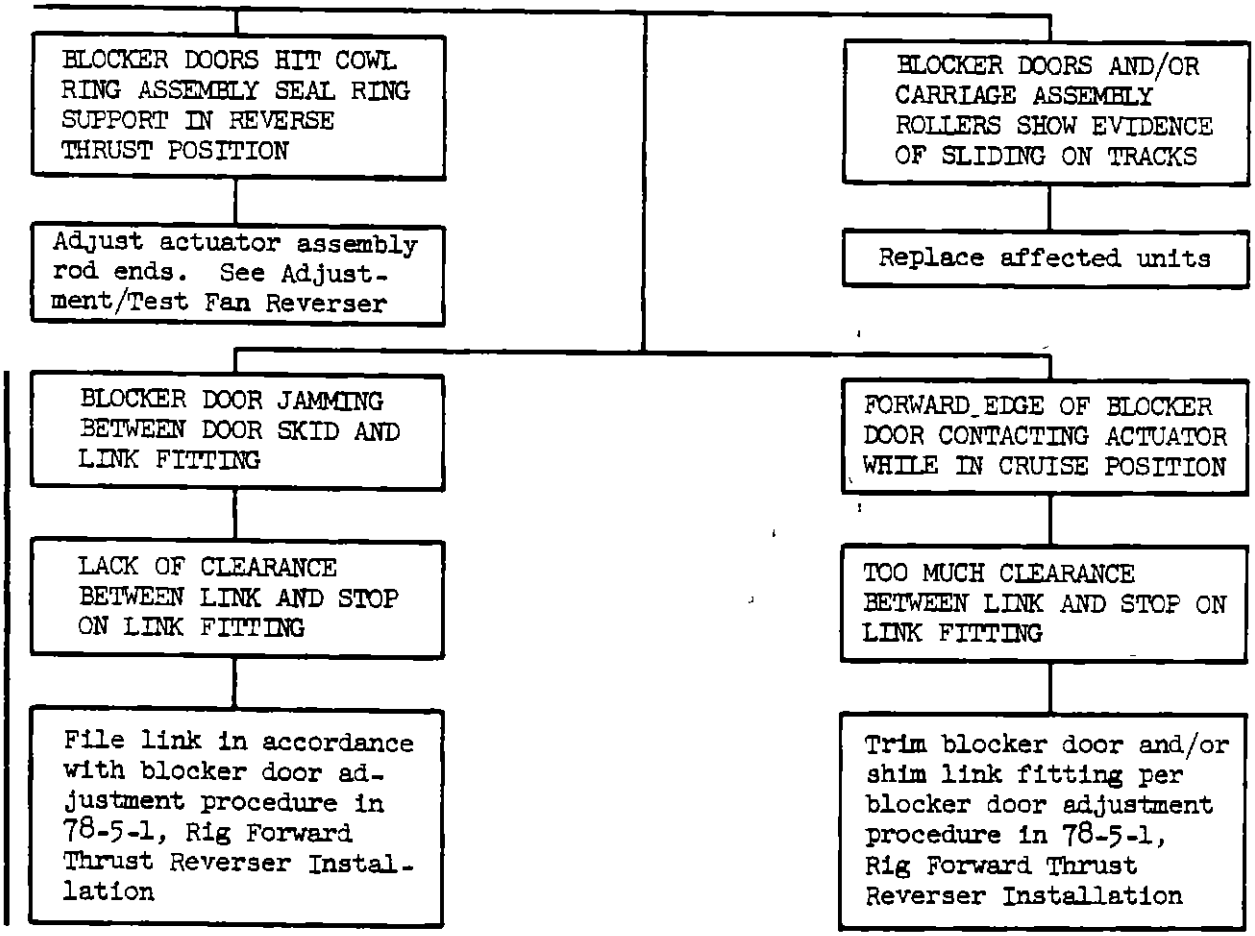


THRUST REVERSER - MAINTENANCE PRACTICES

1. General

A This page block (201-299 page block) contains procedures for deactivating and reactivating the thrust reverser on turbofan engines.

B. The maintenance practices included in this section (201-299 page block) are general maintenance instructions that do not definitely fall within a specific category. Any maintenance practices that fall within a specific category will be provided in the applicable page blocks.

2. Thrust Reverser Deactivation/Reactivation

A. Equipment and Materials

(1) Forward reverser lockout bar, 2 required (steel or aluminum, 0.60 x 0.375 x 9.75 inches)

B. Deactivate Thrust Reverser (See figure 201.)

(1) Open left and right fan cowl panels and side cowl panels. Refer to Chapter 71, Power Plant.

(2) With thrust reversers in cruise position, disconnect and cap pneumatic line (9) at forward end of lower lock actuator (8) on aft reverser.

(3) Lockwire (double twist method) lower sleeve hook (4) in down and locked position to lock roller (6) located on lower truck (7).

(4) Remove forward thrust reverser carriage stop bolts (1) from both side carriages (2).

(5) Insert forward reverser lockout bar (3) between track stop lug and carriage stop bolt hole (1) on each side carriage (2).

(6) Reinstall carriage stop bolt (1) in both side carriages (2).

(7) Close left and right side cowl panels and fan cowl panels.

(8) Placard reverser at aisle stand in control cabin as inoperative.

C. Reactivate Thrust Reverser (See figure 201.)

(1) Open left and right fan cowl panels and side cowl panels. Refer to Chapter 71, Power Plant.

(2) Remove forward thrust reverser carriage stop bolts (1) from both side carriages (2).

(3) Remove forward reverser lockout bar (3) inserted between track stop lug and carriage stop bolt hole (1) on each side carriage (2).

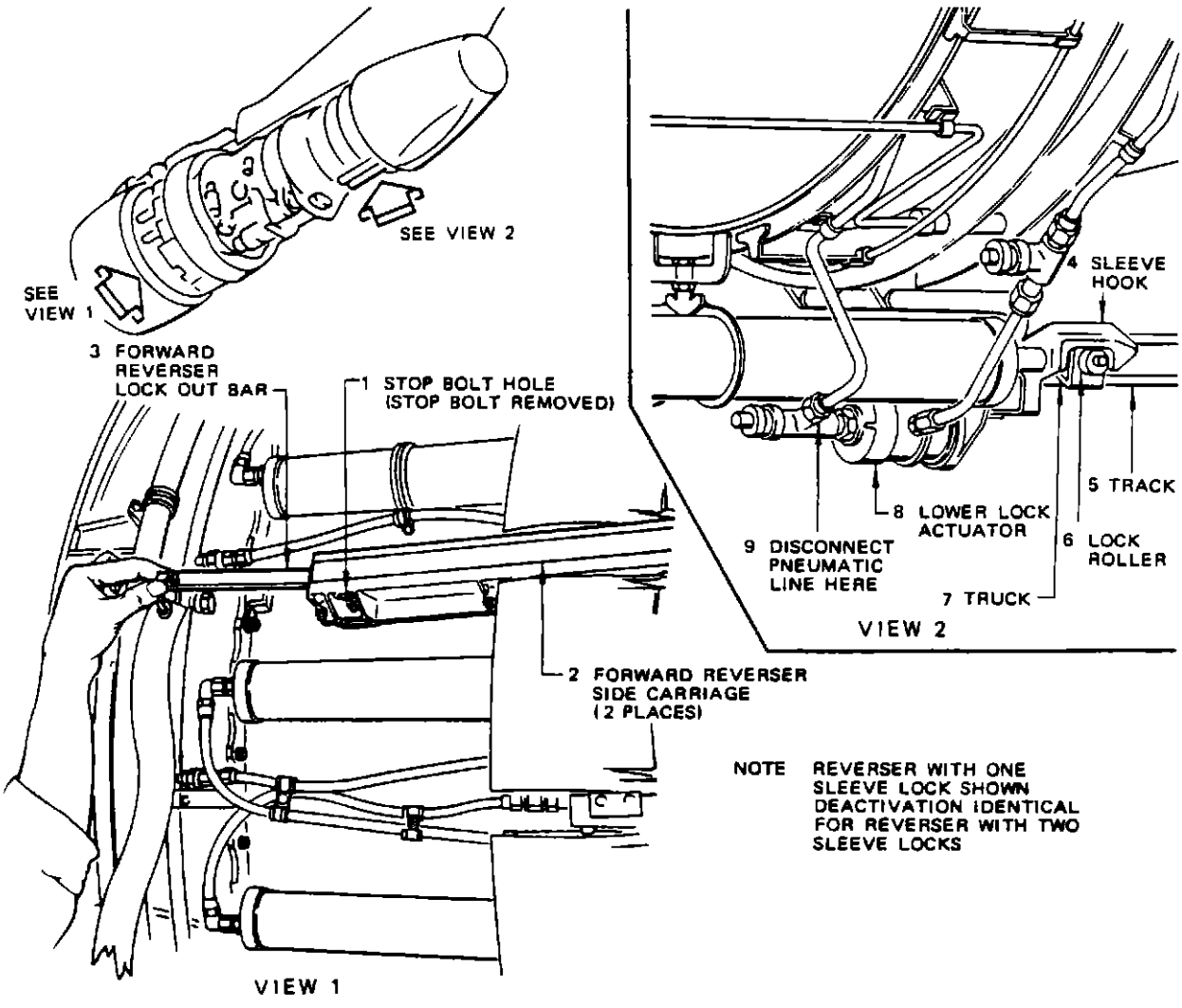
(4) Reinstall carriage stop bolt (1) in both side carriages (2).

(5) Remove lockwire securing lower sleeve hook (4) to lock roller (6) on aft reverser.

(6) Remove cap and connect pneumatic line (9) at forward end of lower lock actuator (8).

(7) Close left and right side cowl panels and fan cowl panels.

(8) Remove thrust reverser inoperative placard from aisle stand in control cabin.



Thrust Reverser Deactivation
Figure 201

3. Fan Reverser Blocker Door Deactivation/Reactivation

A. Equipment and Materials (per door)

(1) BACP11K5, 2 each

(2) MS21913-5S, 2 each (optional MS21913-5J or -5K)

B. Deactivate Blocker Door

NOTE: Blocker door deactivation may be accomplished within the conditions of the B-707-329C, Minimum Equipment List, reference Flight Manual Chapter 11.
In such a case, reverser is considered as operative.
Fault correction and door reactivation must be forecasted during next aircraft 'B' check.

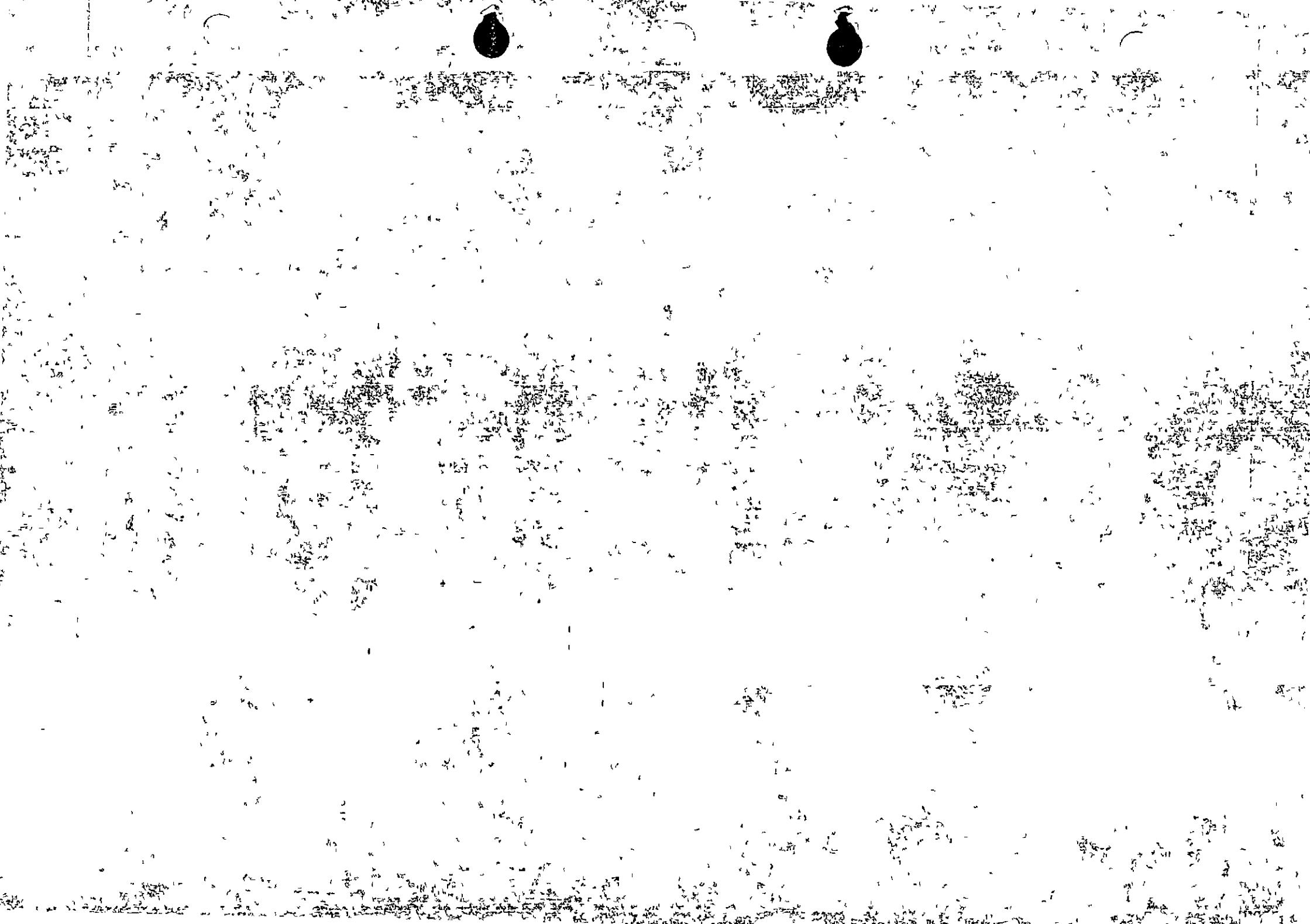
(1) Remove blocker door, Refer to Chapter 78-5-21 Pages 401-403.

(2) Remove actuator and hoses, Refer to Chapter 78-6-31 Pages 401-403.

(3) Plug fittings at both pneumatic manifolds with cap MS21913-5S and packing BACP11K5.

C. Reactivate Blocker Door

(1) Proceed in reverse order than for deactivation.
Same chapter references apply for actuator and door installation.



FORWARD THRUST REVERSER - REMOVAL/INSTALLATION

1. General

A. The forward thrust reverser components are located around the circumference of the first stage compressor case of the engine and cannot, therefore, be removed from the engine as a unit. Removal and installation of the forward thrust reverser components, consisting of the cowl ring assembly, blocker doors, vane assemblies, tracks and carriage assemblies are covered in the respective components maintenance practices. See Sections 78-5-11 through 78-5-51.

FORWARD THRUST REVERSER - ADJUSTMENT/TEST

1. Forward Thrust Reverser Adjustment

A. Equipment and Materials

(1) Air pressure source - 0 to 60 psig, using dry air.

B. Adjust Forward Thrust Reverser Installation

(1) Adjust alignment of carriage assemblies and cowl ring.

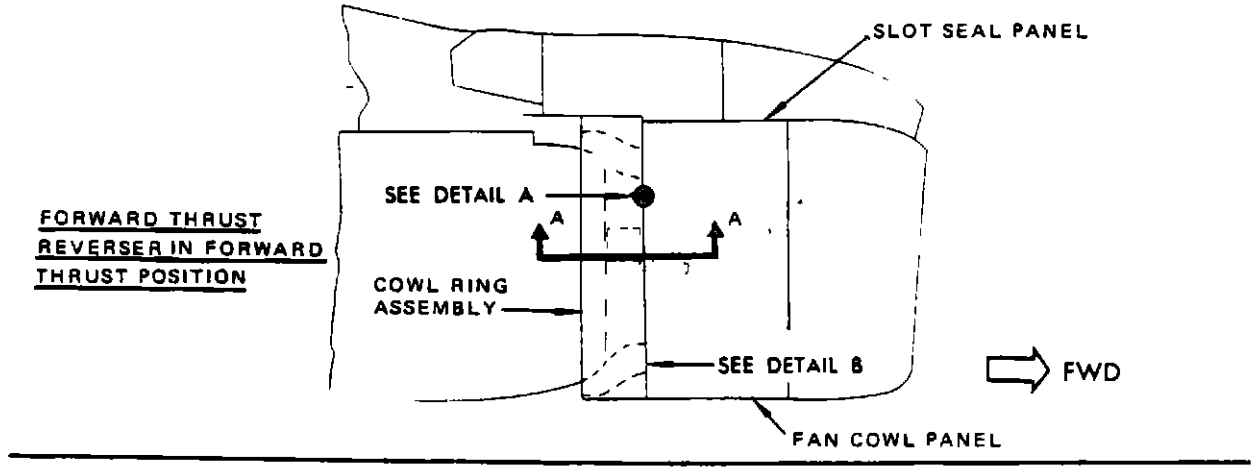
(a) Manually move cowl ring aft 7.50 (+0.00/-0.15) inches from forward thrust position. Add shims as necessary between carriage flanges (four places) and cowl ring so that carriage stop bolts on all four carriages engage simultaneously with bosses on carriage tracks. (See view 2, figure 501.)

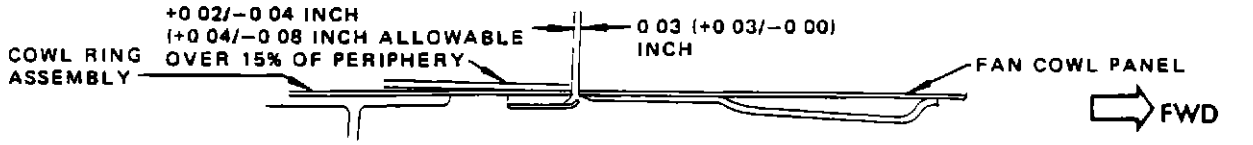
NOTE: If tapered shim is required, fabricate as follows:
Material -- 2024-T3 sheet per QQ-A-355
Thickness -- 0.063 inch maximum
Length and Width -- same as laminated shims used
Taper -- 0.010 inch per inch maximum
Finish -- Skydrol Resistant Finish 2.30

(b) With cowl ring restrained in full reverse position per paragraph 1.B.(1)(a), the clearance between the diaphragm and the sleeve at the dimple in the lower section of the sleeve shall be 0.02 to 0.08 inches at the closest point. (See detail C.) When installing cowl ring, required gap can be obtained by shimming fan air exhaust diaphragm as described below.

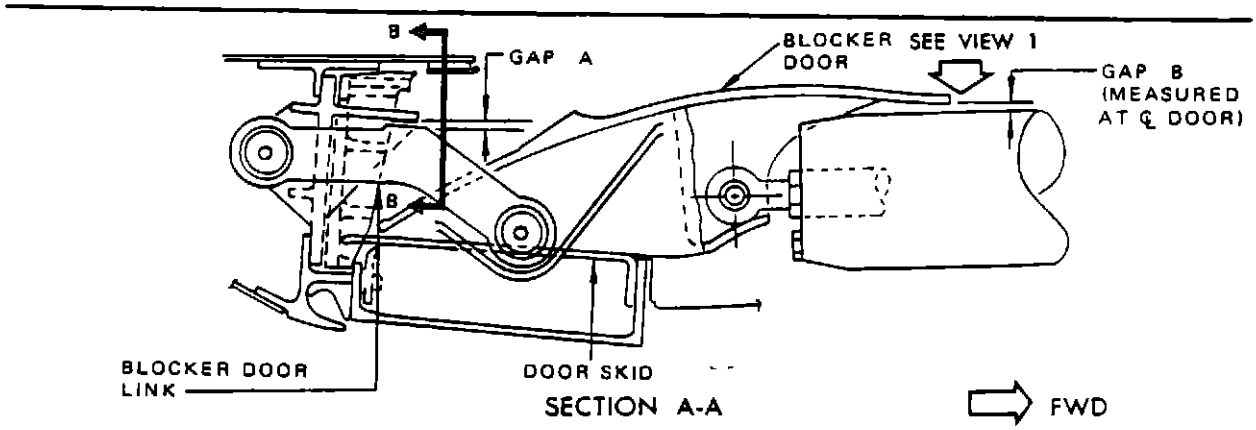
1) Remove antirotation clips (two places) from exhaust diaphragm and from engine flange. (See section D-D.)

2) Add laminated shim between clip and exhaust diaphragm (two places) and remove laminations as necessary to obtain required gap.

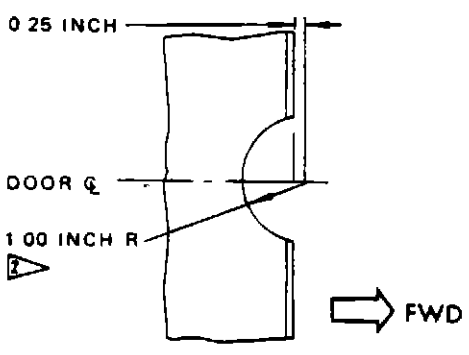




DETAIL A

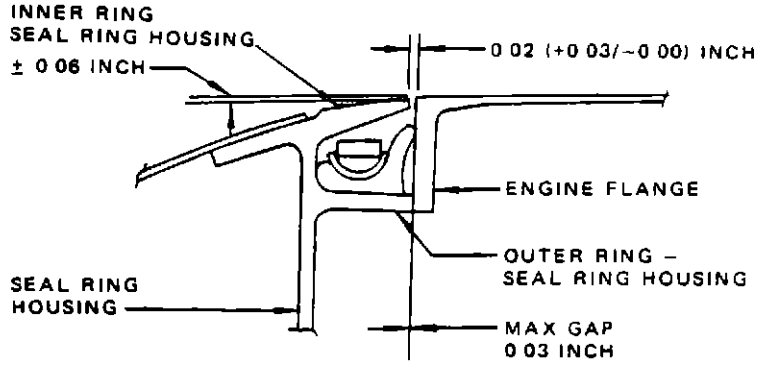


SECTION A-A

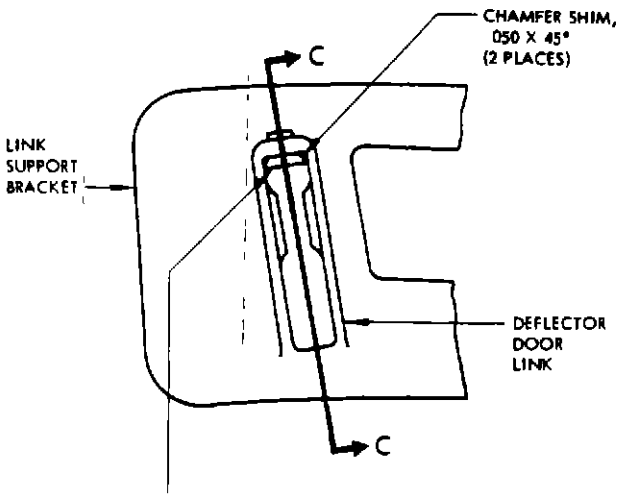


2 RESTORE FINISH TO TRIMMED EDGE

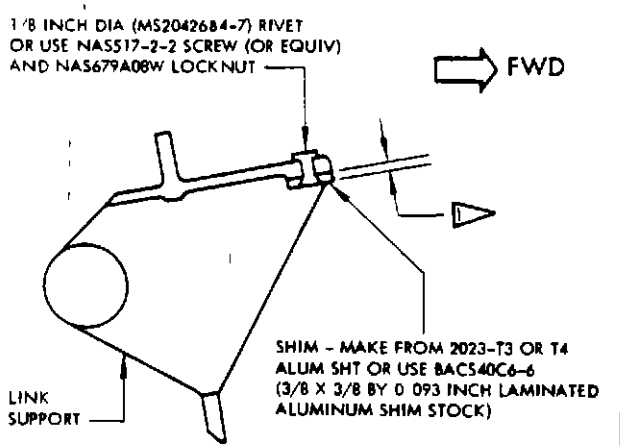
BLOCKER DOOR TRIMMING
VIEW 1



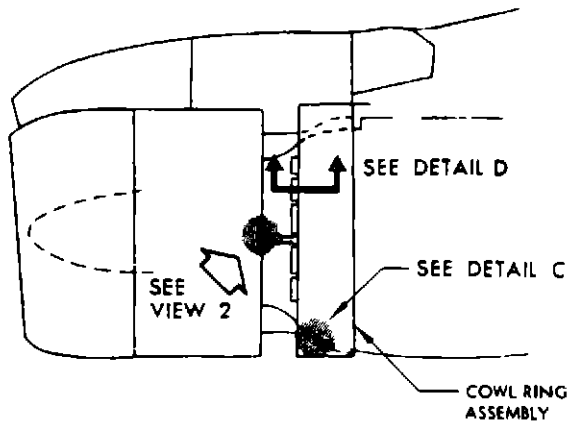
DETAIL B



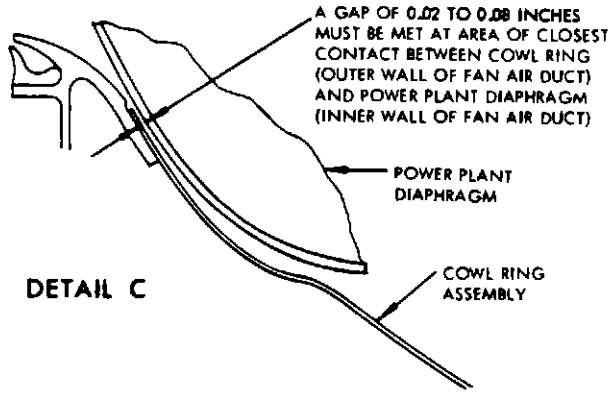
SECTION B B



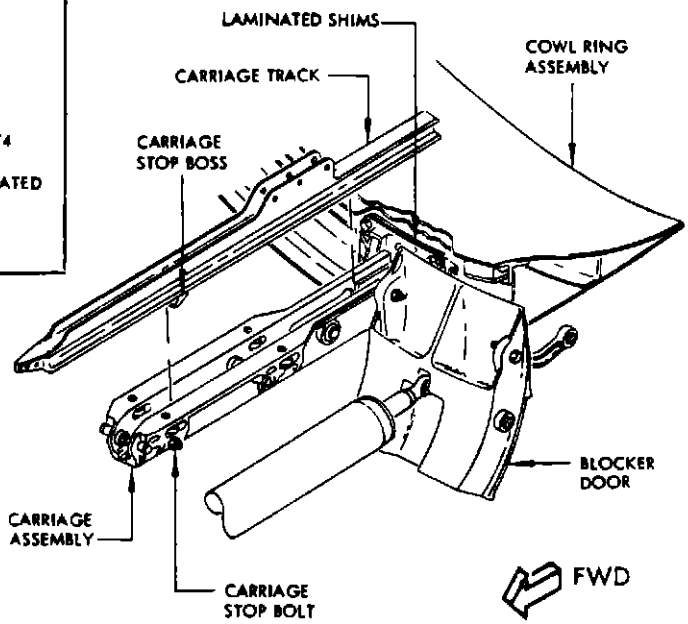
SECTION C-C



FORWARD THRUST REVERSER IN REVERSE THRUST POSITION

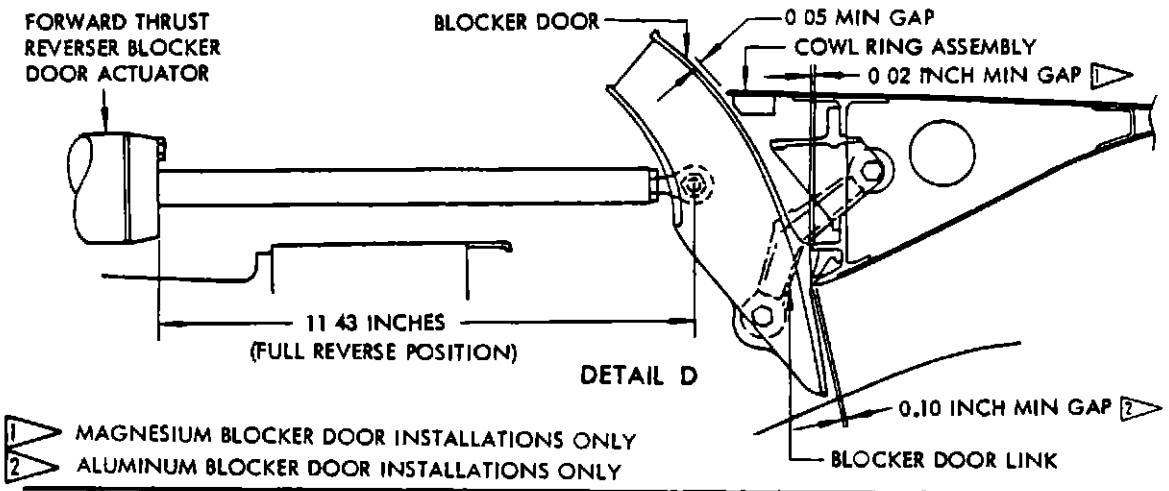


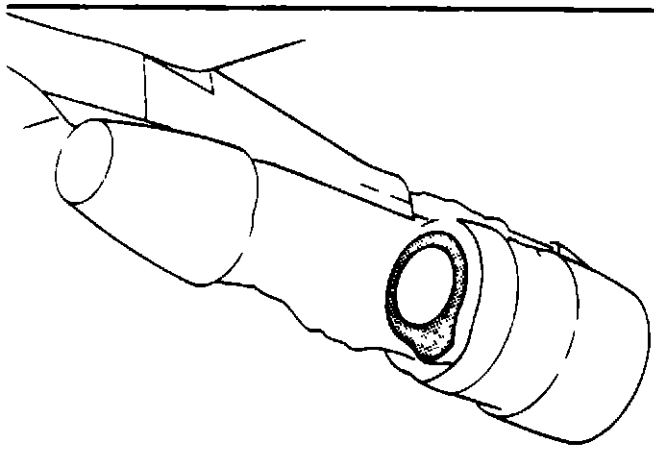
DETAIL C

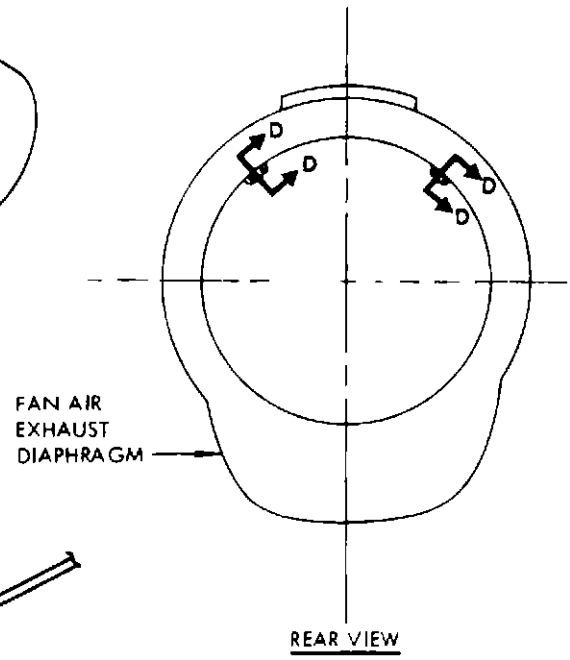


VIEW 2

1 DETERMINE SHIM THICKNESS AS FOLLOWS WITH SLEEVE IN THE FORWARD POSITION PUSH THE AFT END OF BLOCKER DOOR INWARD AGAINST THE DOOR AND MEASURE GAP "A" PER SECTION VIEW A-A REQUIRED SHIM THICKNESS EQUAL GAP "A" MINUS 0 03 INCH SHIMMING NEED BE DONE AT ONLY ONE LINK FITTING LOCATION PER DOOR


FORWARD THRUST
REVERSER BLOCKER
DOOR ACTUATOR
BLOCKER DOOR
0 05 MIN GAP
COWL RING ASSEMBLY
0 02 INCH MIN GAP
11 43 INCHES
(FULL REVERSE POSITION)
DETAIL D
0.10 INCH MIN GAP
BLOCKER DOOR LINK
1 MAGNESIUM BLOCKER DOOR INSTALLATIONS ONLY
2 ALUMINUM BLOCKER DOOR INSTALLATIONS ONLY

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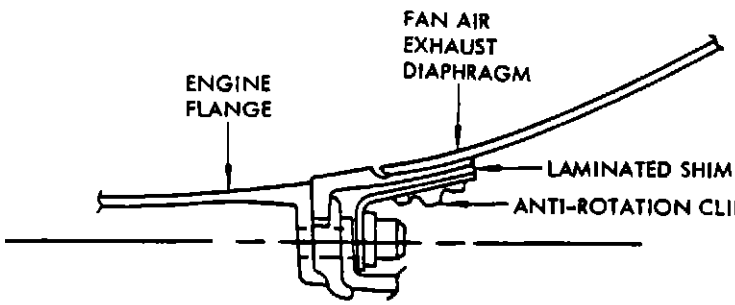
FAN AIR
EXHAUST
DIAPHRAGM
REAR VIEW


FAN AIR
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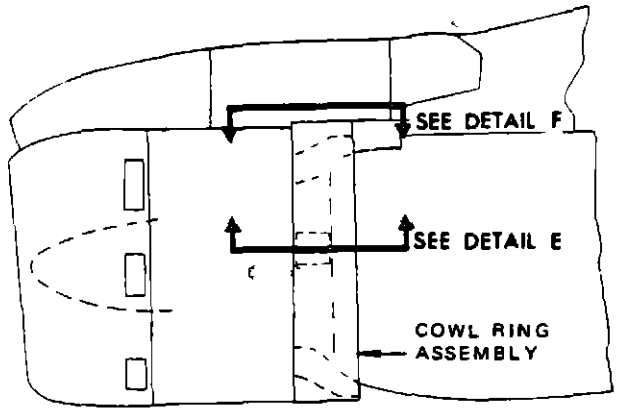
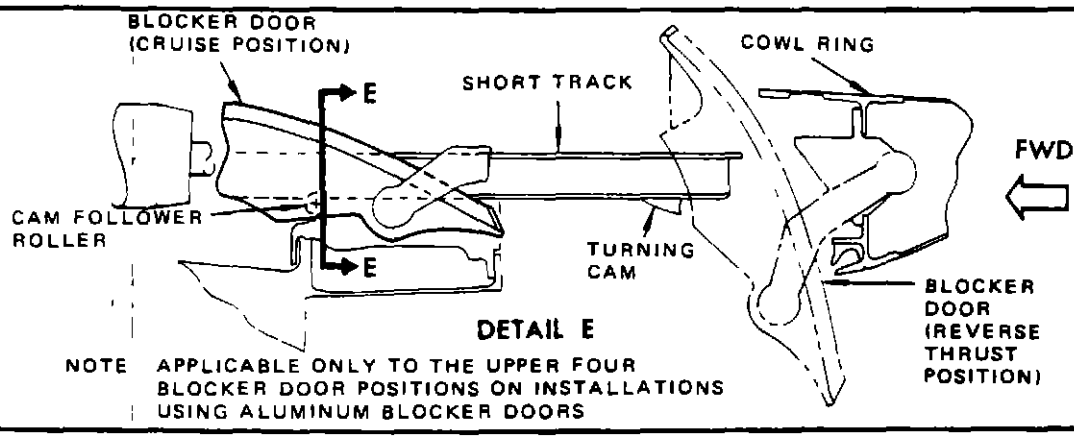
ANTI-ROTATION CLIP

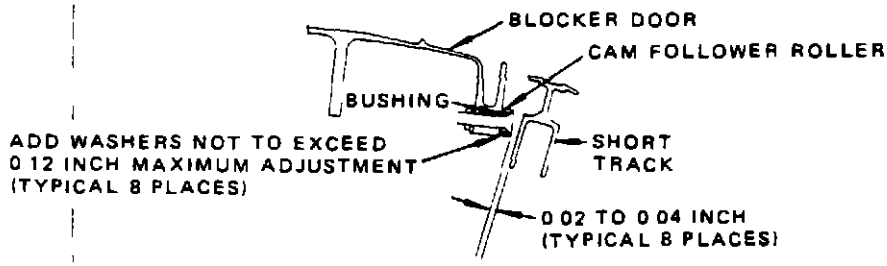
SECTION D-D

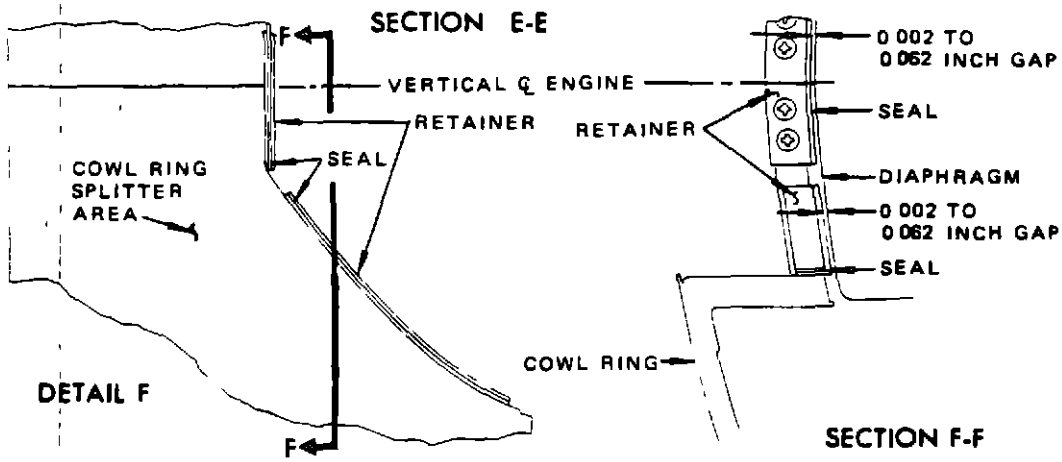
FORWARD THRUST REVERSER IN FORWARD THRUST POSITION





NOTE APPLICABLE ONLY TO THE UPPER FOUR BLOCKER DOOR POSITIONS ON INSTALLATIONS USING ALUMINUM BLOCKER DOORS





Forward Thrust Reverser Adjustment
Figure 501 (Sheet 4)

3) Be sure that clips are firmly secured at engine flange and diaphragm ring attachment when shimming is completed.

(c) On airplanes with adjustable seal at cowl splitter area (detail F), perform following:

1) Adjust seal to obtain 0.002 to 0.062 inch gap between cowl ring and diaphragm with cowl ring in cruise position.

2) Move cowl ring to full reverse position and check that seal clears diaphragm by 0.002 inch minimum throughout travel.

(d) Adjust cowl ring and carriage assemblies so that cowl ring moves aft freely by hand from forward thrust position to full reverse thrust position.

(2) Adjust blocker door installation as follows:

(a) Remove fan cowl panels. See Chapter 71.

(b) Remove slot seal panels.

1) Remove nacelle forward fairing. See Chapter 12, Access Doors and Panels.

2) Remove two screws securing each slot seal panel.

(c) Rotate the blocker doors so that they will clear the door skids, then move the cowl ring all the way forward.

1) For installations using aluminum blocker doors, check that door installation permits full engagement of contact surfaces of slide blocks with tracks when door is in cruise position. Adjust, if necessary, by adding washers in equal increments, not to exceed 0.20 inch maximum total (0.10 inch maximum per side), between slide block and slide block retaining bolt bushing in door. After adjustment, tighten slide block retaining bolts to 20-28 pound-inches torque.

2) To prevent bolt head from scoring track, do not exceed 0.016 inch washer thickness between bolt head and slide block. (Applicable to all installations.)

(d) Push the aft end of the door inward against the door skid and check that gap A, figure 501, section A-A, is 0.03 inch minimum. If filing is required, then gap A shall be held to 0.03 (+0.02/-0.00) inch.

(e) With thrust reverser and controls in forward thrust position apply 80 to 100 psig to the forward thrust lines of reverser pneumatic system. See 78-6-0, Test Thrust Reverser, for instructions on connection of ground air source.

(f) Check that at least one of the link assemblies for each door contacts the link fitting stop and that gap B of figure 501, section A-A, is 0.15 (± 0.10) inch.

1) If gap B is less than 0.05, trim the forward edge of blocker door per view 1 and/or shim the link fitting per section B-B of figure 501.

2) If gap B is greater than 0.25 inch, file boss on link assembly as necessary to obtain 0.25 inch gap. This maximum dimension is to ensure that the blocker door will clear the fan cowl panel.

(g) For installations using aluminum blocker doors, perform the following at the upper four locations only:

1) With blocker door in cruise position, adjust each cam follower roller and bushing to maintain 0.02 to 0.04 inch clearance between short track and roller. (See detail E.) Add washers, not to exceed 0.12 inch maximum adjustment, under cam follower roller and bushing to obtain specified clearance between track and roller.

(3) With cowl ring against reverse stops, check for clearance between blocker doors and cowl ring. (See detail D.) On installations using magnesium blocker doors, the minimum clearance is 0.02 inch. On installations using aluminum blocker doors, the minimum clearance is 0.10 inch. If specified clearance is not present at locations shown, check actuators for proper extended length measured from rod end bearing centerline to aft face of bushing retainer plate (detail D). All doors shall clear leading edge of cowl ring by 0.05 inch minimum.

(4) Adjust rod ends on both vane assembly actuators so that actuators do not bottom in either forward or reverse thrust positions.

C. Test Forward Thrust Reverser Installation

(1) Place forward thrust reverser in reverse thrust position manually by sliding cowl ring aft until it stops. Check that cowl ring has moved aft to full reverse thrust position without binding.

(2) Check that carriage stop bolts (four places) engage with stop bosses on carriage tracks. (See view 2, figure 501.)

(3) Check that minimum gap of 0.02 inch exists at point of closest contact between inner cowl ring duct skin and diaphragm at lower vertical centerline as shown in detail C.

(4) Place forward thrust reverser in forward thrust position manually by sliding cowl ring forward till it stops.

(5) Check cowl ring - engine flange alignment. (See detail B.)

(a) Make this check with ground air source connected at ground service connection and regulated at 25 psig. See 78-6-0 for instructions on connection of ground air source.

(b) Check that inner ring of seal ring housing of cowl ring meets inner diameter of engine flange within ± 0.06 inches maximum.

(c) Check that gap of 0.02 (+0.03/-0.00) inch exists between face of inner ring of seal ring housing and face of engine flange.

(d) Check for maximum gap of 0.030 inch between face of engine flange and face of outer ring of seal ring housing.

(6) On airplanes with adjustable seal at cowl splitter area, check for 0.002 to 0.062 inch gap between cowl ring and diaphragm with cowl ring in cruise position and 0.002 inch minimum clearance throughout cowl ring full travel. (See detail F.)

(7) Check alignment of cowl ring and fan cowl panel as shown in detail A.

(8) Check blocker door alignment.

(a) Check that each blocker door moves freely by hand on the links and tracks.

(b) On aluminum blocker door installations, check that contact surfaces of slide blocks fully engage tracks.

(c) With forward thrust reverser manually positioned aft to reverse thrust position, check that blocker door actuator rod end bearings mate with blocker door attachment bosses with no preload.

(d) At upper four door locations on installations with cams and rollers installed, check for 0.02 to 0.04 inch clearance between short tracks and rollers. (See section E-E.)

(e) With thrust reverser in forward thrust position, check that a gap of 0.03 inch minimum exists between link and link support fitting. (See section A-A.)

(9) Check actuator rigging.

(a) Check that piston rods of blocker door actuators (12 places) bottom when cowl ring is manually positioned aft to reverse thrust position.

(b) Check that piston rods of vane assembly actuators do not bottom in either reverse or forward thrust positions.

FORWARD THRUST REVERSER - INSPECTION/CHECK

1. General

A Inspection of the forward thrust reverser consists mainly of the following checking the cowl ring assembly for missing or loose rivets, skin cracks, and freedom of travel, checking door linkage for freedom of travel, actuators for damaged piston rods, and fan exhaust diaphragm upper turning vanes for cracks.

2 Examine Cowl Ring Assembly

A Check for missing or loose rivets. A maximum of two rivets in adjoining holes is permissible or four rivets in 15 inches in any one row is permissible before repair is required. For repair procedures, see Structural Repair Manual.

B Check for skin cracks. Cracks up to 4 inches are tolerable providing the crack does not go through more than two fastener holes. For repair procedures, see Structural Repair Manual.

C. Check for freedom of travel. Cycle cowl ring and check roller travel of carriages. Check for rubbing at top baffle plates and bottoming on chimney fairing of strut.

D Check follow-up installation.

(1) Check rods for distortion.

(2) Check rod end bearings for freedom and wear.

E. Check blocker doors.

(1) With cowl ring in reverse position, all doors shall operate freely without sticking or binding throughout full travel.

F. Check actuators

(1) Check alignment of actuator to blocker doors by disconnecting door and guiding piston rod to its recess.

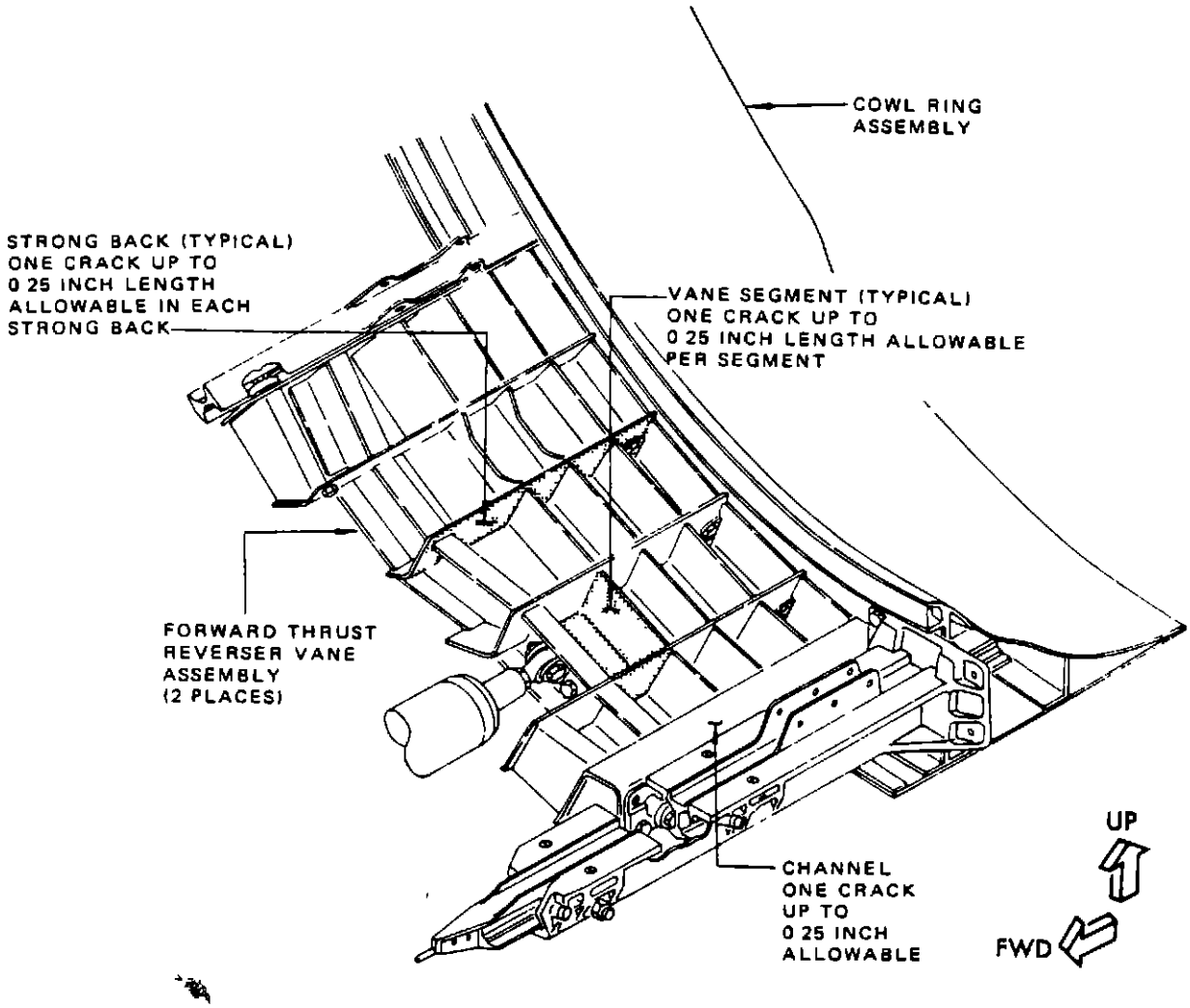
(2) While actuator is disconnected, check movement of piston. Check rod for evidence of galling. Loss of plating on rod will cause rust.

(3) Check pneumatic flexible hoses to see if they are causing side loads or down loads on actuators and thereby restraining movement.

(4) With cowl ring at full reverse travel and carriage stop bolts in contact with track lug, check to see if the 12 long actuators are bottomed without blocker doors contacting outer lip of cowl ring.

G. Check Lower Vane Assemblies for Cracks

(1) One crack up to 0 25 inch in length is allowable in each of the individual vane segments of the vane assembly and in each support channel and strongback. (See figure 601.)



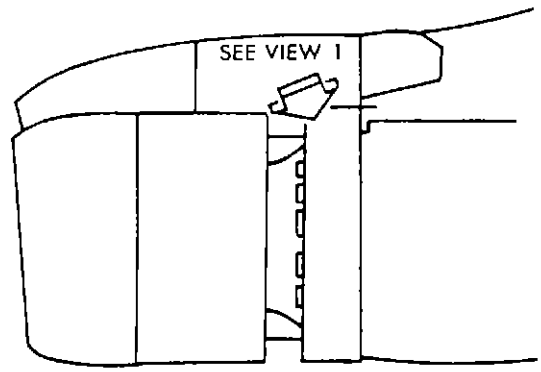
Forward Reverser Vane Assembly Crack Limits
Figure 601

Examine Fan Exhaust Diaphragm Upper Turning Vanes

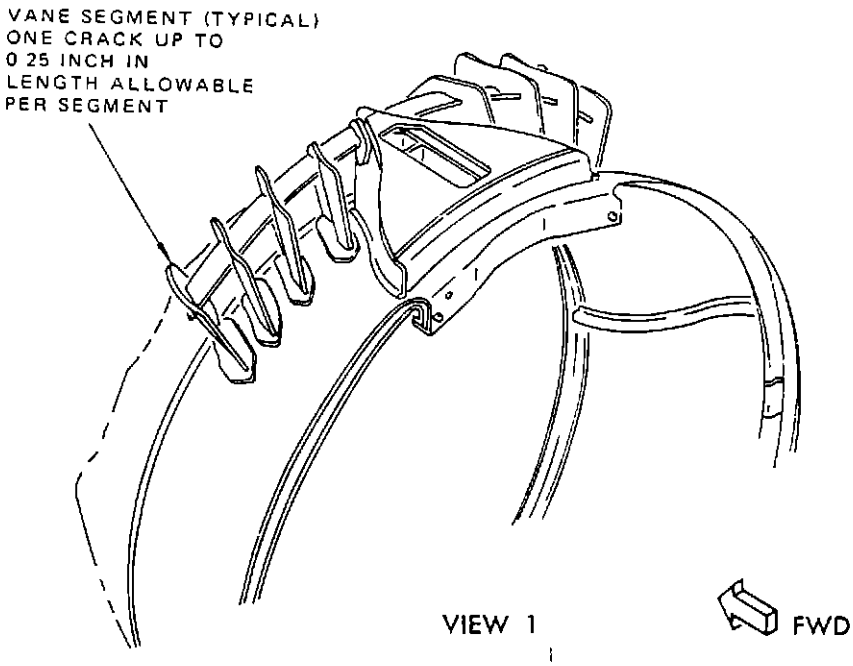
A. Check vane assemblies for cracks (see figure 602.)

(1) One crack up to 0.25 inch in length is allowable in each of the individual vane segments of the vane assemblies before weld repair is required.

(2) If weld repair is required, refer to Forward Thrust Reverser - Approved Repairs.



FORWARD THRUST REVERSER
IN REVERSE THRUST POSITION



Fan Exhaust Diaphragm Upper Turning Vanes Crack Limits
Figure 602

FORWARD THRUST REVERSER - APPROVED REPAIRS

1 Repair Fan Exhaust Diaphragm Upper Turning Vanes

A General

(1) Weld repair of the fan exhaust diaphragm upper turning valves, as specified in this procedure, is accomplished using applicable welding procedure in the Overhaul Manual

B Weld Repair Turning Vanes

(1) Repair cracks as follows

(a) Stop drill crack

(b) Route out crack.

(c) Weld crack using Hastelloy W rod Base material is either AISI 321 or 347 stainless steel No stress relief is required after welding.

(d) After welding, hand work any distorted parts to contour

COWL RING ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation Cowl Ring Assembly

A General

(1) The cowl ring assembly is a two-piece assembly and may be removed from the engine by disconnecting the blocker doors, vane assemblies, and baffle assemblies from the cowl ring and then removing the bolts and screws holding the two halves of the ring assembly together at the upper and lower vertical centerline of the cowl ring.

(2) Individual cowl ring assembly halves are not interchangeable with units of other serial numbers. The sleeve assemblies are fabricated in matched sets to match the fan exhaust area and are serialized as a set.

B Remove Cowl Ring Assembly

(1) Disconnect blocker doors from cowl ring assembly. (See view 4, figure 201.)

(a) Disconnect actuator from blocker door by removing actuator rod-to-blocker door attachment bolt.

(b) Remove bolt, nut, washer and cotter pin (two places) at blocker door connections to cowl ring links (two places each door on 12 blocker doors).

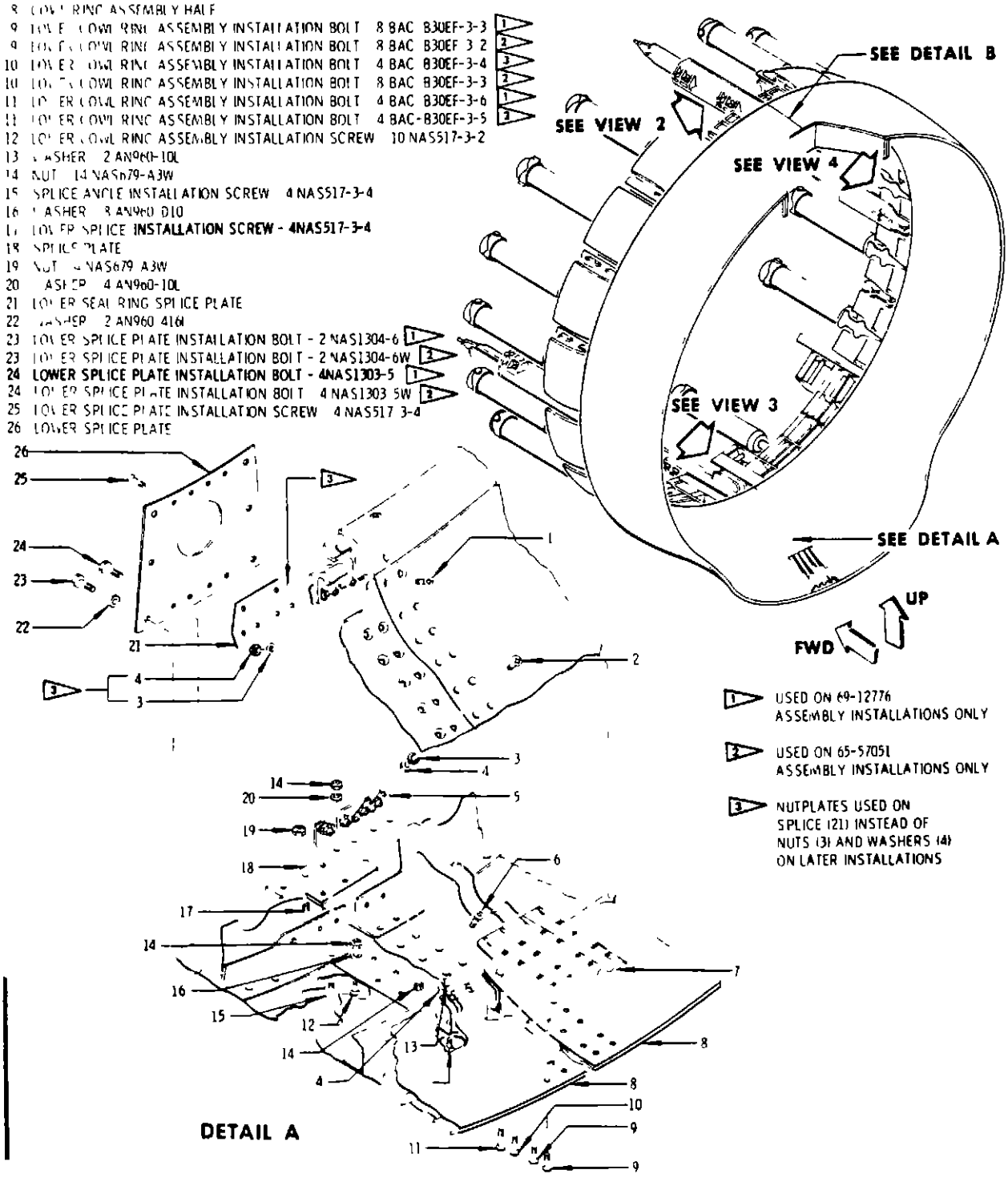
(2) Disconnect four carriage assemblies, located at upper and lower vertical centerlines, and left and right horizontal centerlines.

(a) Remove four bolts attaching carriage assemblies at upper and lower vertical centerlines to cowl ring. (See views 2 and 3.)

NOTE Cowl ring assembly upper splice plate (36, detail B) is held to cowl ring assembly by carriage assembly on upper vertical centerline.

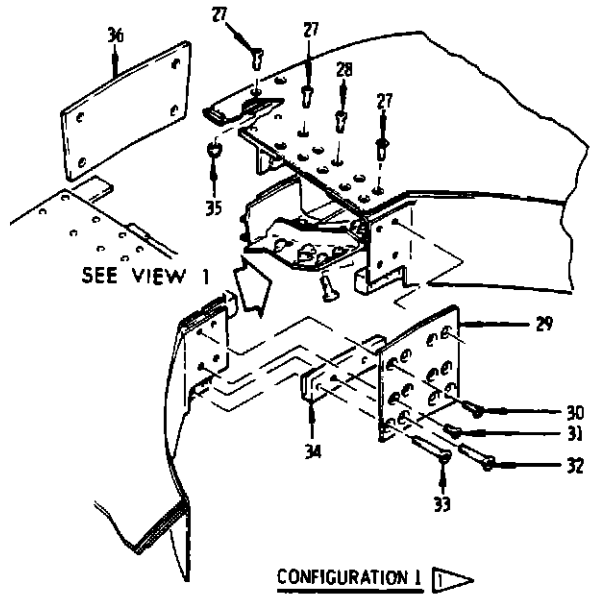
(b) Remove bolts attaching carriage assemblies at left and right horizontal centerlines. (See view 4.)

1 LOWER SEAL RING SPLICE INSTALLATION SCREW - 6 NAS517 3 4
2 LOWER COWL RING ASSEMBLY INSTALLATION SCREW - 10 NAS517 3-2
3 WASHER - 16 AN960D10
4 NUT - 18 NAS679 A3W
5 LOWER SPLICE ANGLE
6 LOWER COWL RING ASSEMBLY INSTALLATION SCREW - 2 NAS517 3-3
7 LOWER AFT SPLICE PLATE
8 COWL RING ASSEMBLY HALF
9 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 8 BAC B30EF-3-3 [1]
9 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 8 BAC B30EF 3 2 [2]
10 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 4 BAC B30EF-3-4 [3]
10 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 8 BAC B30EF-3-3 [2]
11 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 4 BAC B30EF-3-6 [1]
11 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 4 BAC-B30EF-3-5 [3]
12 LOWER COWL RING ASSEMBLY INSTALLATION SCREW - 10 NAS517-3-2
13 WASHER - 2 AN960-10L
14 NUT - 14 NAS679-A3W
15 SPLICE ANGLE INSTALLATION SCREW - 4 NAS517-3-4
16 WASHER - 8 AN960 D10
17 LOWER SPLICE INSTALLATION SCREW - 4NAS517-3-4
18 SPLICE PLATE
19 NUT - 4 NAS679 A3W
20 WASHER - 4 AN960-10L
21 LOWER SEAL RING SPLICE PLATE
22 WASHER - 2 AN960 416
23 LOWER SPLICE PLATE INSTALLATION BOLT - 2 NAS1304-6 [1]
23 LOWER SPLICE PLATE INSTALLATION BOLT - 2 NAS1304-6W [2]
24 LOWER SPLICE PLATE INSTALLATION BOLT - 4NAS1303-5 [1]
24 LOWER SPLICE PLATE INSTALLATION BOLT - 4 NAS1303 5W [2]
25 LOWER SPLICE PLATE INSTALLATION SCREW - 4 NAS517 3-4
26 LOWER SPLICE PLATE



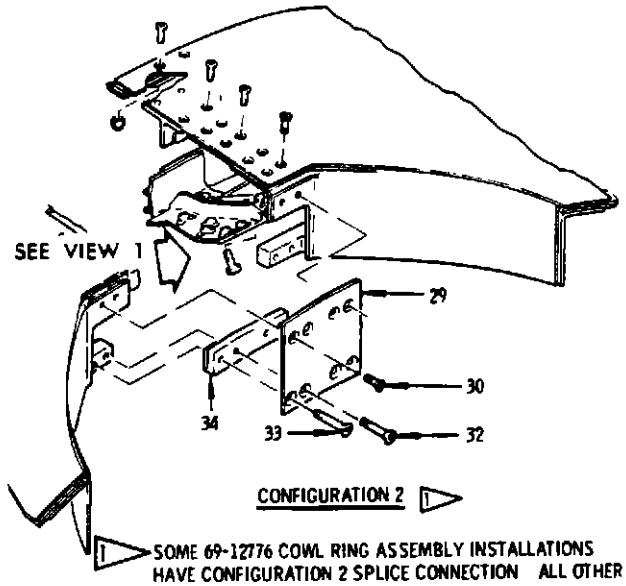
Cowl Ring Assembly Installation
Figure 201 (Sheet 1 of 4)

27 UPPER SPLICE CONNECTION SCREWS 6 NAS517-3-4
28 UPPER SPLICE CONNECTION SCREWS 6 NAS517-3 3
29 UPPER SPLICE PLATE
30 UPPER SPLICE PLATE INSTALLATION SCREWS 4 NAS517-3-6
31 UPPER SPLICE PLATE INSTALLATION SCREWS - 4 NAS517-3 2
32 UPPER SPLICE PLATE INSTALLATION SCREWS - 2 NAS517 4-13



CONFIGURATION 1 [1]

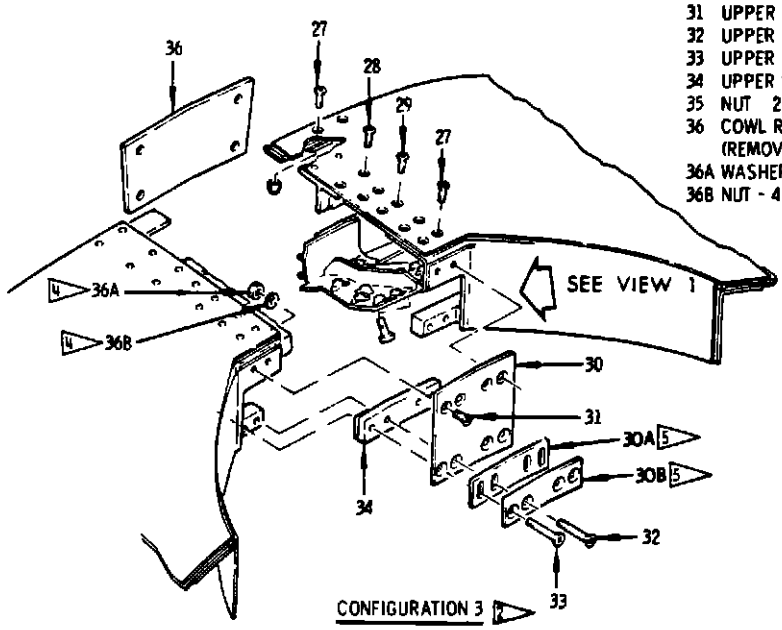
33 UPPER SPLICE PLATE INSTALLATION SCREWS - 2 NAS517 4-16
34 UPPER SPLICE ANGLE
35 NUT 2 NAS679-A3W
36 COWL RING UPPER SPLICE PLATE (REMOVE WITH CARRIAGE ASSEMBLY)



CONFIGURATION 2 [1]

[1] SOME 69-12776 COWL RING ASSEMBLY INSTALLATIONS HAVE CONFIGURATION 2 SPLICE CONNECTION ALL OTHER 69-12776 INSTALLATIONS HAVE CONFIGURATION 1 SPLICE CONNECTION

27 UPPER SPLICE CONNECTION SCREWS - 6 NAS517-3-4
28 UPPER SPLICE CONNECTION SCREWS - 2 NAS517-3-3
29 UPPER SPLICE PLATE INSTALLATION SCREWS - 4 NAS517-3-2
30 UPPER SPLICE PLATE
30A SEAL [5]
30B RETAINER [5]
31 UPPER SPLICE PLATE INSTALLATION SCREWS - 4 NAS517-3-4
32 UPPER SPLICE PLATE INSTALLATION SCREWS - 2 NAS517-4-13
33 UPPER SPLICE PLATE INSTALLATION SCREWS - 2 NAS517-4-16
34 UPPER SPLICE ANGLE
35 NUT 2 NAS679A3W
36 COWL RING UPPER SPLICE PLATE (REMOVE WITH CARRIAGE ASSEMBLY)
36A WASHER - 4 AN960PD416L [4]
36B NUT - 4 NAS679A4W [4]



CONFIGURATION 3 [2]

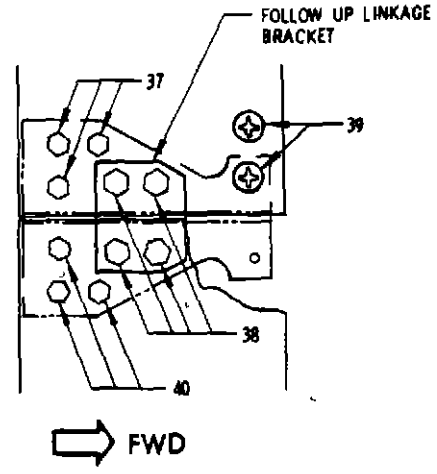
[2] APPLICABLE TO 65-57051 COWL RING ASSEMBLIES ONLY

[4] NUTPLATES USED INSTEAD OF NUTS AND WASHERS ON SOME ASSEMBLIES

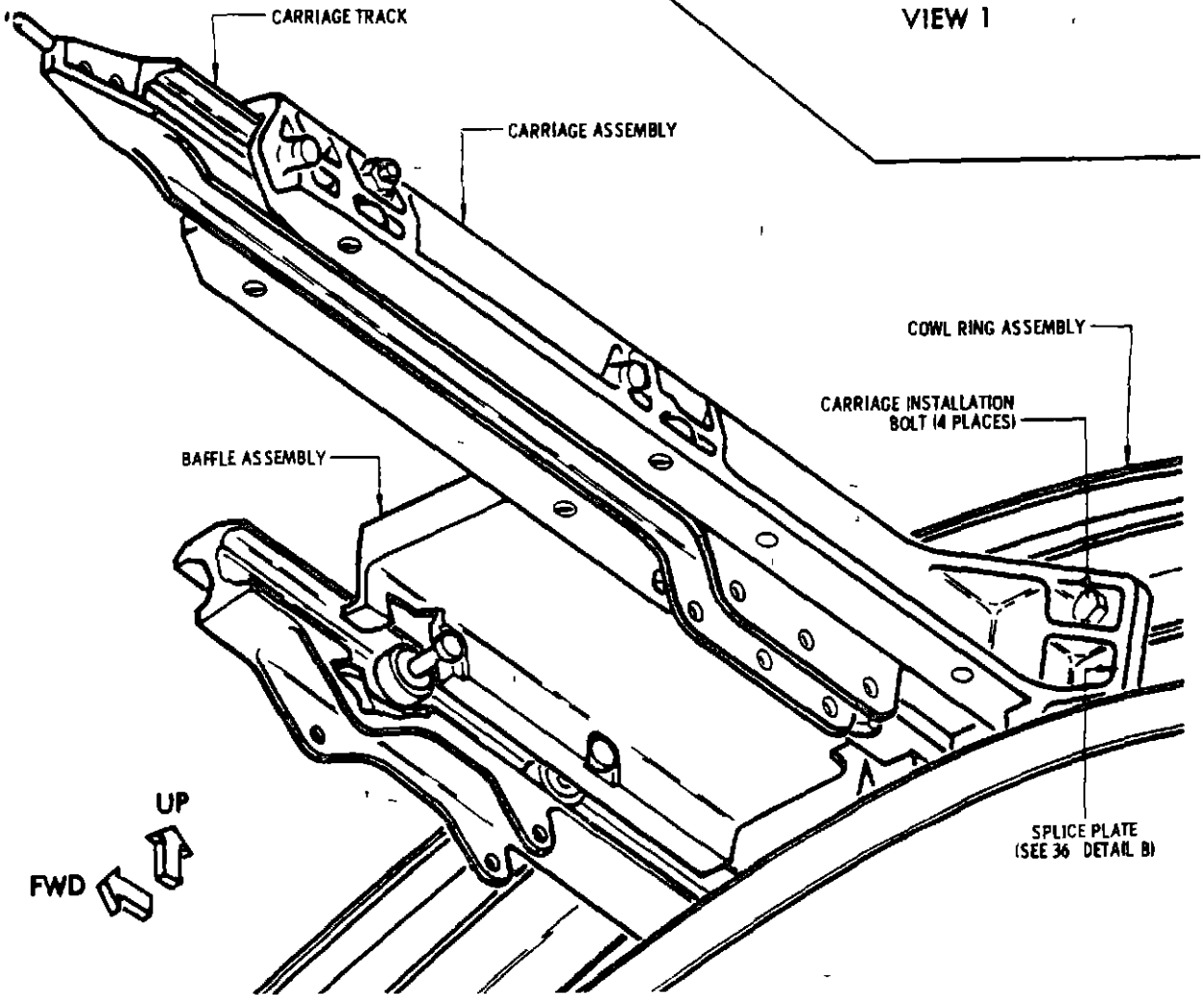
[5] APPLICABLE TO ASSEMBLIES HAVING ADJUSTABLE SEALS AT COWL SPLITTER AREA

DETAIL B

37 INNER TOP SPLICE INSTALLATION SCREWS - 3 NAS1303-3W
38 INNER TOP SPLICE INSTALLATION BOLTS (4 NAS1304-6) AND WASHERS (4 AN960-D416)
39 UPPER SPLICE CONNECTION SCREWS - 2 NAS517-3-5
40 INNER TOP SPLICE INSTALLATION BOLTS (3 NAS1303-3W) AND WASHER (3 NAS679-A3W)

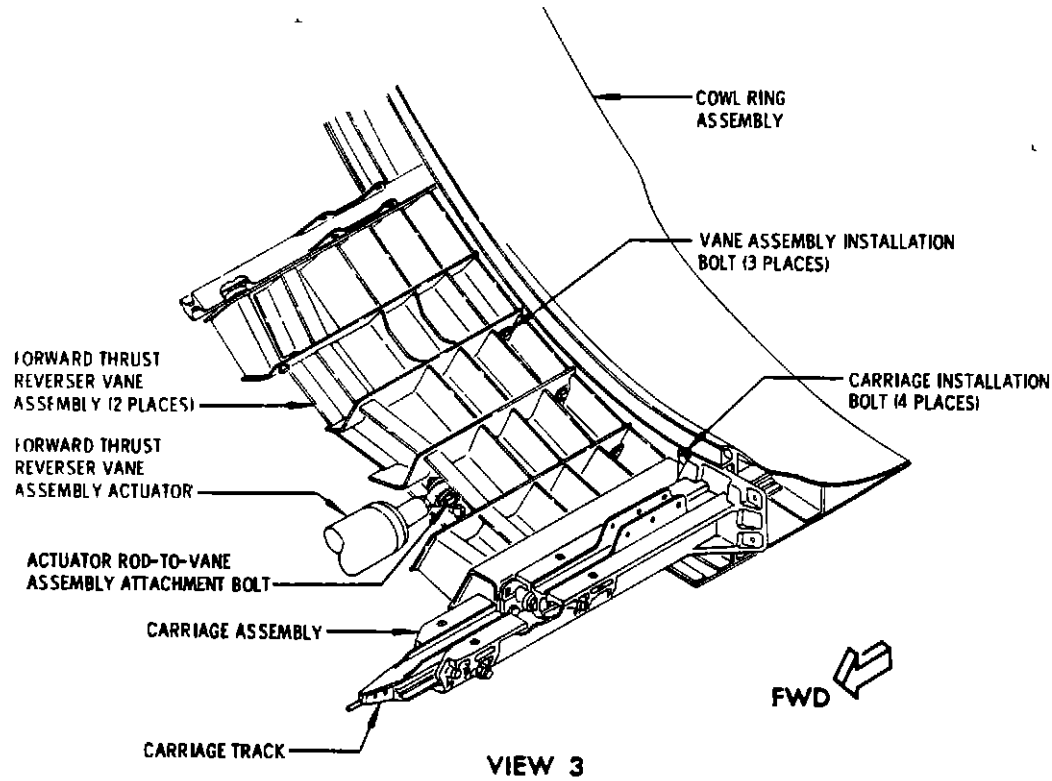


VIEW 1



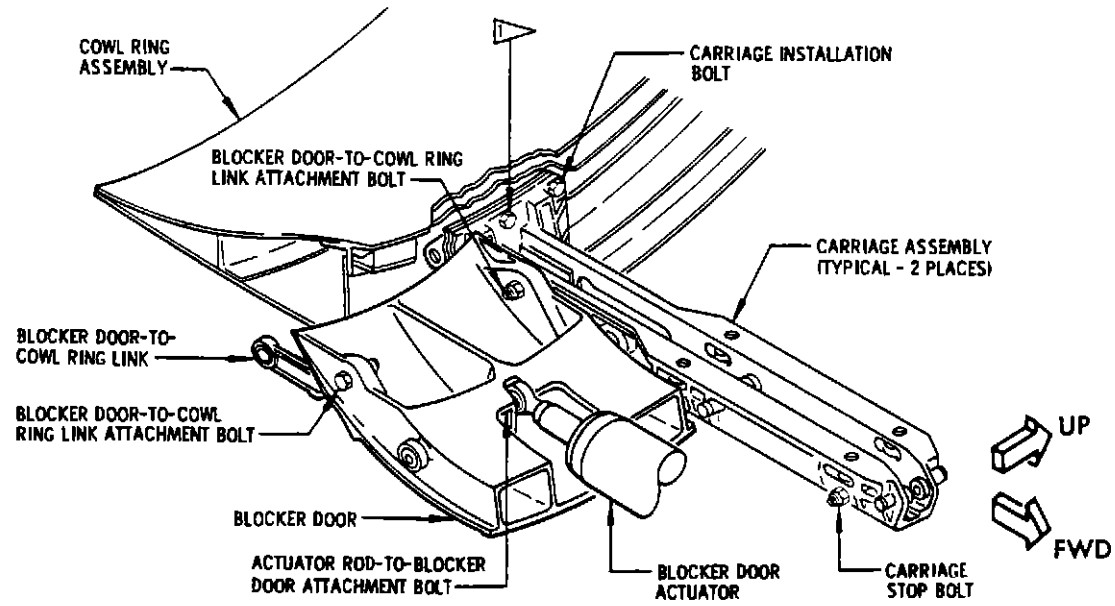
VIEW 2

Cowl Ring Assembly Installation
Figure 201 (Sheet 3 of 4)



VIEW 3

1 CENTER BOLT DELETED ON SOME AIRPLANES



VIEW 4

(3) Remove two vane assemblies, located on either side of lower carriage assembly, from cowl ring assembly.

(a) Disconnect vane actuator from each vane assembly by removing actuator rod-to-vane attachment bolt. (See view 3.)

(b) Remove bolt, nut, and washer (3 places) attaching vane assembly to cowl ring.

(4) Remove installation bolts attaching cowl ring assembly halves together at splice connection at upper vertical centerline. (See detail B and view 1.)

(a) Remove screws (37, view 1), bolts (38), screws (39), and bolts (40) from nutplates at inner top splice.

(b) On airplanes having configuration 1 or configuration 2, remove nuts (35, detail B), and screws (27) and (28). On airplanes having configuration 3, remove nuts (35), and screws (27, 28, and 29).

(c) On airplanes having configuration 1, remove screws (30, 31, 32 and 33), upper splice plate (29) and upper splice angle (34). On airplanes having configuration 2, remove screws (30, 32, and 33), upper splice plate (29) and upper splice angle (34). On airplanes having configuration 3, remove screws (31, 32, and 33), retainer (30B) and seal (30A) when applicable, upper splice plate (30), and upper splice angle (34).

(5) Remove installation bolts attaching cowl ring assembly halves together at splice connection at lower vertical centerline. (See detail A.)

(a) Remove nuts (19, detail A), screws (17), and splice plate (18).

(b) Remove bolts (23 and 24), washers (22), screws (25), and lower splice plate (26).

(c) Remove nuts (4), washers (3 and 13), screws (1, 2 and 6), and lower seal ring splice (21).

(d) Remove nuts (14), washers (20 and 16), screws (12 and 15) and lower splice angle (5).

(e) Remove bolts (9, 10 and 11), lower aft splice plate (7), and separate left and right-hand ring assemblies (8).

(6) Lift cowl ring assembly halves away from engine.

C. Install Cowl Ring Assembly

(1) Position cowl ring halves on engine and assemble at splice connections at upper and lower vertical centerlines.

NOTE: Individual cowl ring assembly halves of 65-57051 and 65-11750 cowl ring assemblies are not interchangeable with units of other serial numbers. The sleeve assemblies are fabricated in matched sets to match the fan exhaust area and are serialized as a set.

(a) While manually maintaining alignment of ring assembly halves position lower aft splice plate (7, detail A, figure 201) and secure with bolts (9, 10 and 11).

(b) Position lower splice angle (5) at the lower, outer splice. Secure with screws (12 and 15), washers (20 and 16), and nuts (14).

(c) Position lower seal ring splice (21) at the lower, inner splice. Secure with screws (1, 2 and 6), washers (3 and 13), and nuts (4).

(d) Position lower splice plate (26), and secure with screws (25), washers (22), and bolts (23 and 24).

(e) Position splice plate (18) at the lower, outer splice. Secure with screws (17) and nuts (19).

(f) On airplanes having configuration 1, position upper splice angle (34, detail B) and upper splice plate (29), and secure with screws (30, 31, 32 and 33) at the top aft splice. On airplanes having configuration 2, position upper splice angle (34, detail B) and upper splice plate (29) and secure with screws (30, 32 and 33) at the top aft splice. On airplanes having configuration 3, position upper splice angle (34, detail B), upper splice plate (30), and seal (30A) and retainer (30B) when applicable, and secure with screws (31, 32 and 33).

(g) On airplanes having configuration 1 or configuration 2 install screws (27 and 28) and nuts (35) at top outer splice. On airplanes having configuration 3 install nuts (35), and screws (27, 28 and 29).

(h) Install screws (37 and 39, view 2), bolts and washers (38), and bolts (40).

(2) Install four carriage assemblies, located at upper and lower vertical centerlines, and left and right horizontal centerlines, to cowl ring assembly.

(a) Attach carriage assemblies located on left and right horizontal centerlines and on lower vertical centerline of reverser to cowl ring assembly with bolts. (See view 4.)

(b) Position splice plate between cowl ring and carriage assembly at upper vertical centerline and install four bolts through carriage assembly and splice plate. (See view 2.)

(3) Install two vane assemblies, located on either side of the lower carriage assembly, to the cowl ring assembly.

(a) Install with bolt, nut, and washer (three places) at attachment brackets on cowl ring. (See view 3, figure 201.)

(b) Position actuator piston rod end between the flanges of the clevis attachment on the forward face of the vane assembly and attach with bolt, nut, and two washers. Install washers between rod end and flange on either side. Tighten nut until snug.

CAUTION. NUT MUST BE TIGHTENED CAREFULLY SO THAT BOLT HEAD AND NUT ARE JUST SEATED AGAINST THE FLANGES OF THE CLEVIS OVER-TIGHTENING CAN CAUSE BENDING OF THE CLEVIS FLANGES WHICH MAY RESULT IN THEIR FAILURE.

(4) Connect blocker doors to cowl ring assembly. (See view 4.)

(a) Install blocker door-to-cowl ring links with bolt, nut, washer, and cotter pin (two places) to blocker door attachment bosses, (two places each door on twelve blocker doors)

(b) Attach blocker door actuator rod to blocker door rod attachment bracket.

(5) Adjust entire installation according to instructions given in 78-5-1, Adjust Forward Thrust Reverser Installation.

FORWARD THRUST REVERSER BLOCKER DOORS - REMOVAL/INSTALLATION

1. General

A On some of the blocker door installations adjacent to the left and right-hand side carriages, a 1/2 inch diameter hole has been added to the web at the reverser short tracks to allow removal of the blocker doors without removing the short track brackets.

2. Remove Blocker Door (See figure 401.)

A. Move forward thrust reverser sleeve and blocker door into reverse thrust position.

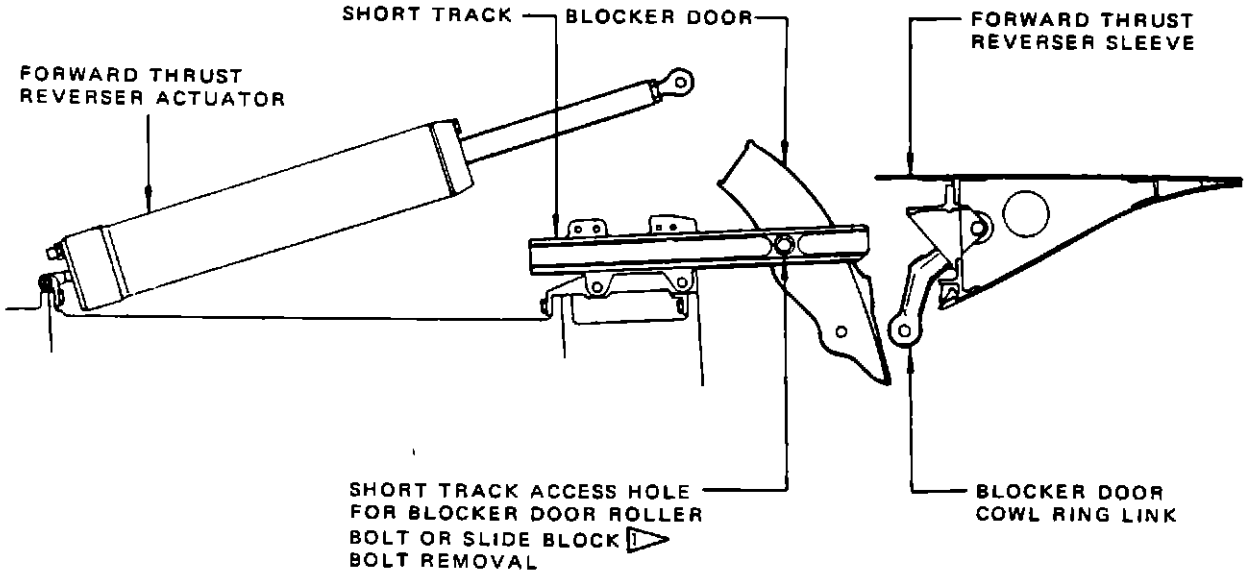
B. On installations with short track access holes, proceed as follows:

(1) Pull the door to be removed forward until the door roller or slide block lines up with the hole in the short track web.

(2) Disconnect actuator rod end and blocker door-to-cowl ring links from blocker door which is to be removed.

(3) Using an Allen Wrench through the access hole remove the roller retaining bolt or slide block retaining bolt.

(4) Remove blocker door by swinging it out of tracks.



Blocker Door Installation
Figure 401

C. On installations adjacent to side carriages but not having short track access holes, proceed as follows·

(1) Disconnect actuator rod end and blocker door-to-cowl ring links from blocker door which is to be removed.

(2) Remove short track and track mounting bracket adjacent to blocker door.

(3) Remove blocker door.

D. On all other installations proceed as follows:

(1) Disconnect blocker door-to-cowl ring links and actuator rod end at the blocker door.

(2) Slide the door out the front of the short tracks.

3. Install Blocker Door (See figure 401.)

A. Maintain thrust reverser sleeve in same position as in paragraph 2.

B. On installations with short track access holes, proceed as follows:

(1) Position blocker door with roller through slot on side carriage onto long track and align blocker door so that roller or slide block attach point is lined up with short track access hole.

(2) Using an Allen wrench through the access hole, install the roller or slide block with the retaining bolt. Use washers where required. Tighten nut to within 20 to 28 pound-inches torque.

(a) For installations using aluminum blocker doors, check that door installation permits full engagement of contact surfaces of slide blocks with tracks when door is in cruise position. Adjust, if necessary, by adding washers in equal increments, not to exceed 0.20 inch maximum total (0.10 inch maximum per side), between slide block and slide block retaining bolt bushing in door. After adjustment, tighten slide block retaining bolts to 20 to 28 pound-inches torque.

(3) Connect actuator rod end and blocker door-to-cowl ring links to blocker door.

(4) Rig blocker door installation per instructions in paragraph 1.B.(2) and 1.B.(3) of 78-5-1, Forward Thrust Reverser - Adjustment/Test.

C. On installations adjacent to side carriages but not having short track access holes, proceed as follows:

(1) Position blocker door roller in recess on short track and position track, track mounting bracket, and blocker door in place on engine with the other blocker door roller through side carriage slot and onto long track.

(2) Install short track and track mounting bracket.

(a) For installations using aluminum blocker doors, check that door installation permits full engagement of contact surfaces of slide blocks with tracks when door is in cruise position. Adjust, if necessary, by adding washers in equal increments, not to exceed 0.20 inch maximum total (0.10 inch maximum per side), between slide block and slide block retaining bolt bushing in door. After adjustment, tighten slide block retaining bolts to 20 to 28 pound-inches torque.

(3) Connect actuator rod end and blocker door-to-cowl ring links to blocker door.

(4) Rig blocker door installation per instructions in paragraph 1.B.(2) and 1.B.(3) of 78-5-1, Forward Thrust Reverser - Adjustment/Test.

D. For all other blocker doors proceed as follows:

(1) Slide blocker door into recesses on tracks from forward end of tracks.

(a) For installations using aluminum blocker doors, check that door installation permits full engagement of contact surfaces of slide blocks with tracks when door is in cruise position. Adjust, if necessary, by adding washers in equal increments, not to exceed 0.20 inch maximum total (0.10 inch maximum per side), between slide block and slide block retaining bolt bushing in door. After adjustment, tighten slide block retaining bolts to 20 to 28 pound-inches torque.

(2) Connect blocker door-to-cowl ring links and actuator rod end to blocker door.

(3) Rig blocker door installation per instructions in paragraph 1.B.(2) and 1.B.(3) of 78-5-1, Forward Thrust Reverser - Adjustment/Test.

NOTE: On installations having snubbing cam device at the six upper door locations (three on each side of the fan bifurcation), additional rollers and matching parts are required before sliding door into tracks.

FORWARD THRUST REVERSER BLOCKER DOORS - INSPECTION/CHECK

1. Forward Thrust Reverser Blocker Doors Inspection

A. General

(1) The blocker doors are magnesium or aluminum alloy castings. The examination criteria in this section applies to all blocker doors.

B. Examine Forward Thrust Reverser Blocker Doors

(1) Position cowl ring aft to reverse thrust position.

(2) Examine blocker doors for cracks, corner damage, and broken out sections:

(a) Cracks 1/2 inch or less in length are allowable. Stop drill.

(b) Cracks are not permitted in vicinity of bearing surfaces.

(c) Corner damage up to 1/2 inch in any direction is allowable. Blend to smooth contour.

(d) Repair broken out sections. Refer to Forward Thrust Reverser Blocker Doors - Approved Repairs.

(3) Position cowl ring forward to cruise position.

FORWARD THRUST REVERSER BLOCKER DOORS - APPROVED REPAIRS

1. General

   A. The blocker doors are magnesium or aluminum alloy castings. Repair welding is accomplished using filler material and sheet stock according to the Overhaul Manual procedure applicable to alloy requiring repair.

2. Repair Forward Thrust Reverser Blocker Doors

   A. Remove defective blocker door from airplane. Refer to Forward Thrust Reverser Blocker Doors - Removal/Installation.

   B. Repair cracks, corner damage, and broken out sections as follows:

      (1) Weld repair cracks exceeding 1/2 inch according to applicable Overhaul Manual procedure. If crack is located in previous weld area, remove entire weld area and weld in new section.

      (2) For corner damage up to 1/2 inch in any direction, blend to smooth contour. Build up damage over 1/2 inch with weld according to applicable Overhaul Manual procedure.

      (3) For broken out sections 3/4 inch or less in depth, trim up to 3/4 inch along edge with 1/4 inch radius at either end. For larger broken out sections, repair by welding in new section according to applicable Overhaul Manual procedure.

   C. Install repaired blocker door. Refer to Forward Thrust Reverser Blocker Doors - Removal/Installation.

FORWARD REVERSER LONG TRACK FORWARD SUPPORT BRACKET - REMOVAL/INSTALLATION

1. Remove Forward Reverser Long Track Forward Support Bracket

   A. Remove fan cowl panel. Refer to Chapter 71, Power Plant.

   B. Position cowl ring assembly to reverse thrust position (fully aft).

   C. Remove three bolts and nuts attaching long track to mounting bracket on engine flanges C and D. (See figure 401.)

   D. Move long track aft until forward end is disengaged from forward support bracket on engine flange B.

   E. Cut lockwire and remove two bolts attaching forward support bracket to engine flange and remove forward support bracket. Remove fillers and wiring support bracket as applicable.

2. Install Forward Reverser Long Track Forward Support Bracket

   A. Position forward support bracket at engine flange B and install two bolts. At the 9 o'clock position only, install wiring support bracket under bolt head. If a 69-11707-8 support bracket is being installed on an installation having gimbal type actuators, install fillers under support bracket. (See figure 401.)

   B. Torque both bolts to 120-180 pound-inches and lockwire.

   C. Move long track forward and carefully engage forward end in support bracket.

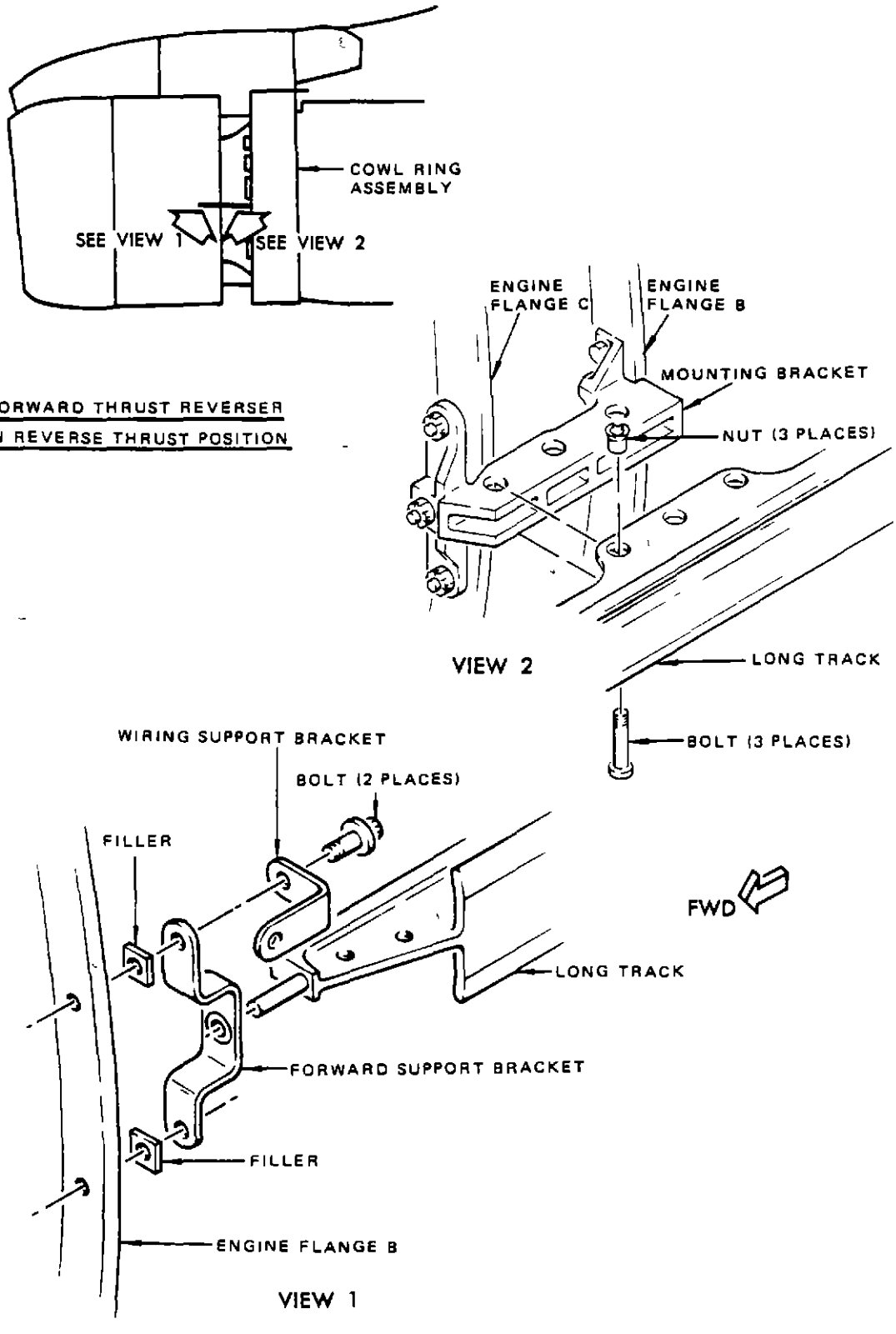
   D Adjust position of long track until mounting holes in track and mounting bracket are aligned.

   E. Attach track to mounting bracket with three bolts and nuts.

   F. Cycle cowl ring assembly and check for freedom of travel. If interference exists, refer to Forward Thrust Reverser - Adjustment/Test.

   G. Position cowl ring assembly in cruise position (fully forward).

   H. Install fan cowl panel. Refer to Chapter 71, Power Plant.



Forward Reverser Long Track Forward Support Bracket Installation
Figure 401

AFT THRUST REVERSER - MAINTENANCE PRACTICES

1. Removal/Installation Aft Thrust Reverser

A. General

(1) The aft thrust reverser, consisting of the thrust reverser assembly, tailpipe, and the aft thrust reverser sleeve may be removed from the engine as a single unit.

B. Equipment and Materials

(1) Antiseize compound, Fel-Pro C-5 or equivalent (Felt Products Mfg. Co., Chicago 7, Illinois) or Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent

(2) Air pressure source - 0 to 60 psig

(3) Thrust Reverser Cradle - F70141 or equivalent

(4) Fork Lift Truck - with 5 foot tines (for use with F70141)

C. Remove Aft Thrust Reverser

(1) Place thrust reverser in reverse thrust position.

(a) Connect air pressure source to ground service connection and regulate to 25 psig.

WARNING: GROUND AIR SUPPLY MUST NOT BE CONNECTED UNLESS THE ENGINE SIDE COWL PANELS ARE COMPLETELY CLOSED, AND FAN COWL PANELS REMOVED, TO AVOID STRUCTURAL OR ENGINE DAMAGE OR INJURY TO PERSONNEL.

(b) Move applicable reverse thrust lever in control cab aft to interlock position. Check that thrust reverser has moved aft to reverse thrust position.

WARNING: PERSONNEL MUST STAY CLEAR OF ENGINE WHEN THRUST REVERSER IS BEING ACTUATED. A PLACARD SHOULD BE PLACED ON CONTROL STAND WARNING AGAINST ACTUATION OF THRUST LEVERS WHILE PERSONNEL ARE WORKING ON THRUST REVERSER.

(c) Disconnect ground air supply.

(2) Disconnect lower actuator support link at thrust reverser connection by removing cotter pin, nut, bolt (1, view 2, figure 201A), and bushing (2 places).

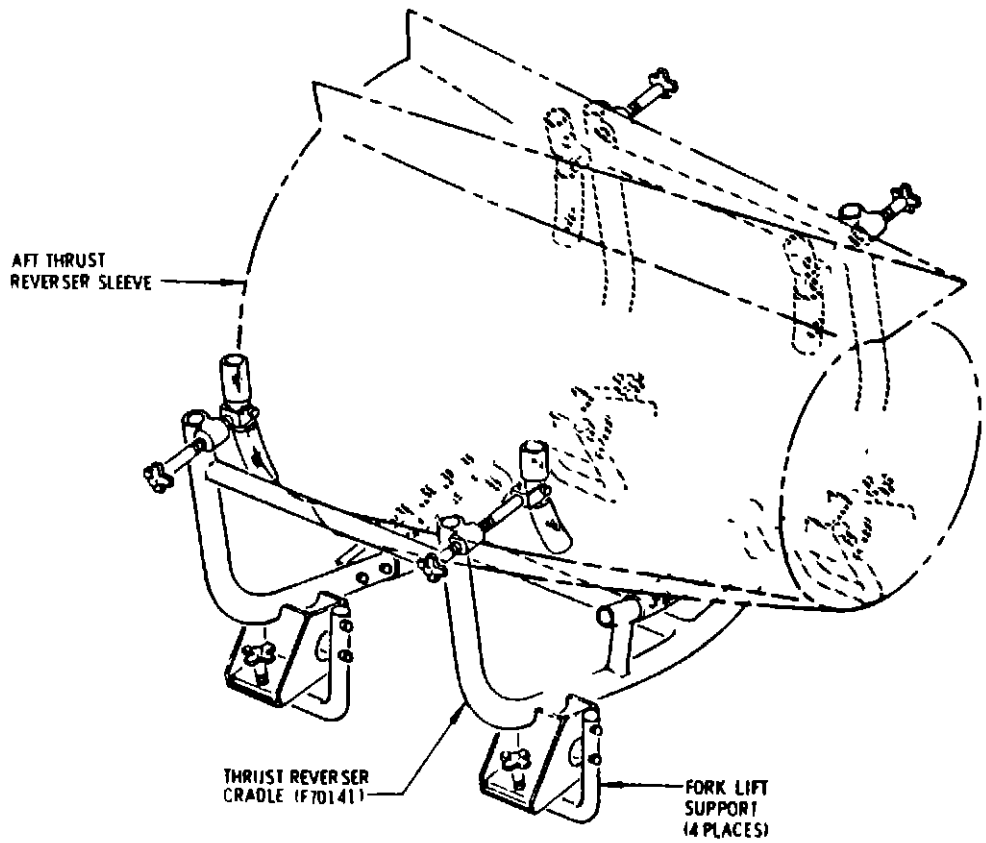
(3) Remove nut and bolt (2) connecting sleeve lower track to actuators.

(4) Disconnect lower actuator rod ends from lower actuators truck assembly by removing cotter pin, nut, bolt (3), and two bushings (2 places).

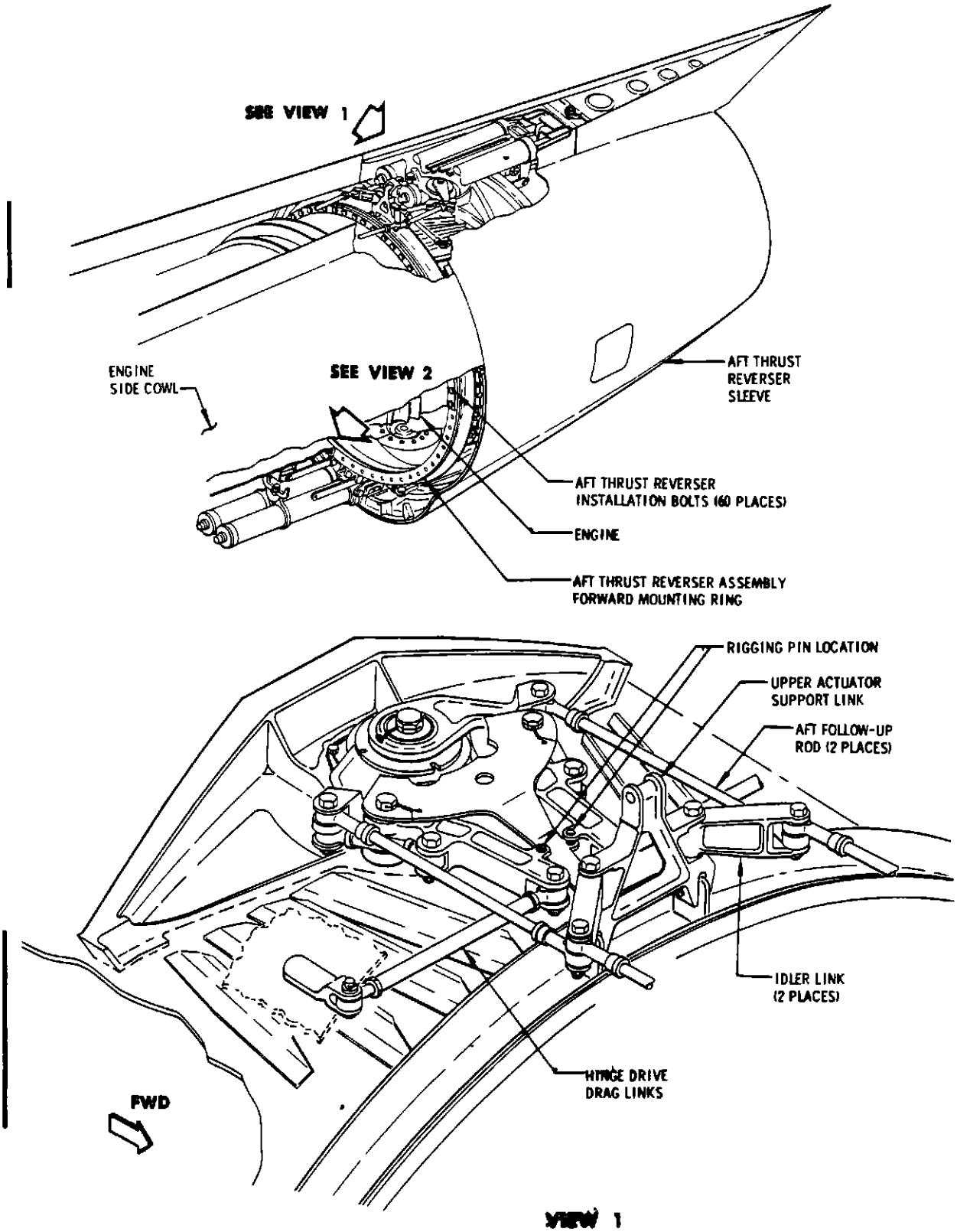
(5) Disconnect lower actuator lock from actuators assembly at actuator attach lugs (2 places) by removing bolt 2 places. This will allow hook to rotate about lock actuator rod end, and hang below lock actuator.

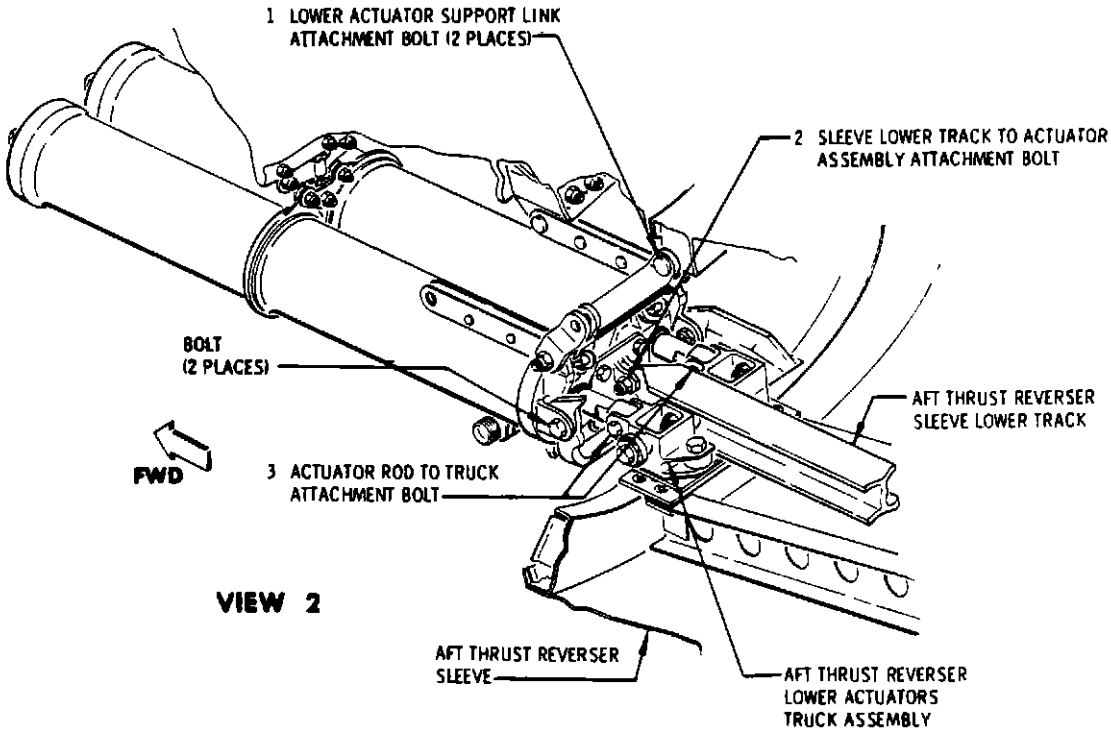
NOTE: This step necessary when using F70141 cradle to provide clearance for sleeve retaining lip across bottom of forward tubular support on cradle.

(6) Disconnect upper actuator tubing at forward end of actuators (4 places if upper actuator assembly includes a lock actuator, 2 places if upper actuator assembly does not have a lock actuator).

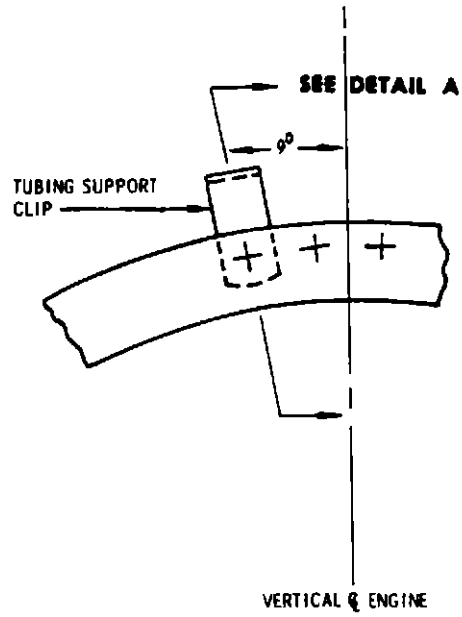


Attachment of Cradle (F70141) to Aft Thrust Reverser Sleeve
Figure 201

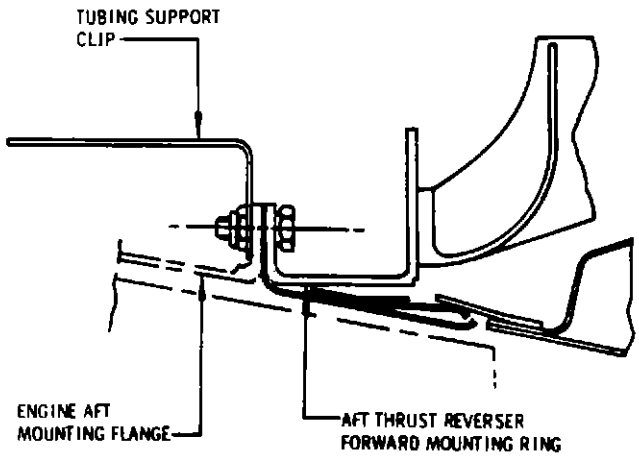

SEE VIEW 1
ENGINE SIDE COWL
SEE VIEW 2
AFT THRUST REVERSER SLEEVE
AFT THRUST REVERSER INSTALLATION BOLTS (60 PLACES)
ENGINE
AFT THRUST REVERSER ASSEMBLY FORWARD MOUNTING RING
RIGGING PIN LOCATION
UPPER ACTUATOR SUPPORT LINK
AFT FOLLOW-UP ROD (2 PLACES)
IDLER LINK (2 PLACES)
HINGE DRIVE DRAG LINKS
FWD
VIEW 1



VIEW 2



VIEW 3



DETAIL A

Aft Thrust Reverser Installation
Figure 201A (Sheet 2)

(7) Disconnect aft follow-up rod assemblies (2 places) at upper actuator support link by removing nut and bolt (2 places) holding rod assemblies to idler links. (See view 1.)

(8) Disconnect system wiring at lower left-hand side of thrust reverser assembly.

(9) Manually position sleeve to cruise position.

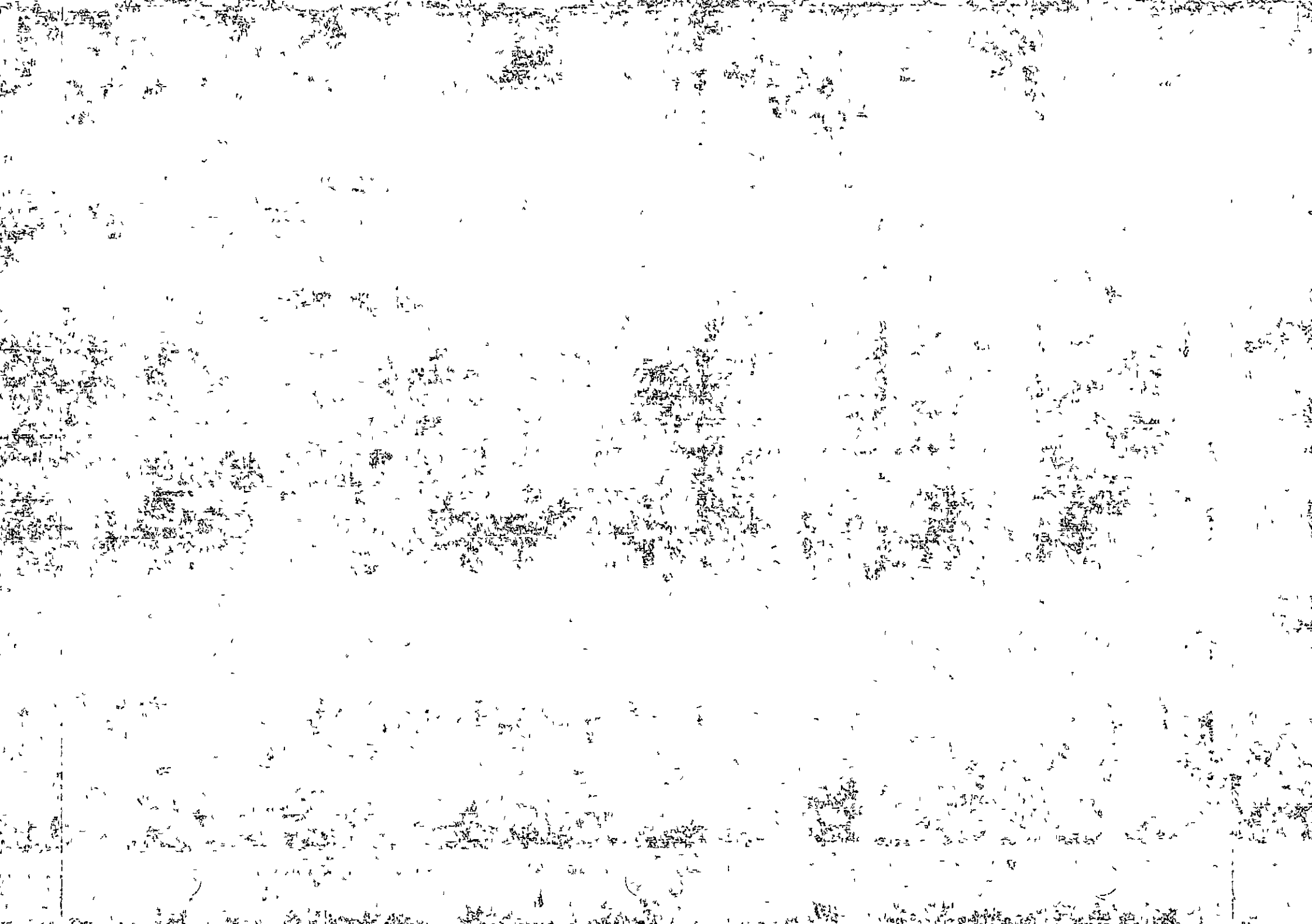
(10) Secure thrust reverser cradle, F70141, to aft thrust reverser as shown in figure 201 and position fork lift truck at supports on cradle to take load of thrust reverser, and secure lifts to supports.

CAUTION: WHEN INSTALLING OR REMOVING THRUST REVERSER FROM OUTBOARD SIDE OF ENGINE, CRADLE MUST BE SECURED TO FORK LIFT TRUCK BY CHAINS OR OTHER SUITABLE MEANS. THIS IS NECESSARY BECAUSE THE ENGINES HANG AT A 7° ANGLE TO THE VERTICAL DUE TO THE DIHEDRAL ANGLE OF THE WING.

CARE MUST BE EXERCISED WHEN POSITIONING CRADLE WITH FORK LIFT TRUCK TO PREVENT DAMAGE TO THRUST REVERSER SLEEVE, ENGINE, OR STRUT.

(11) Remove bolts (60 places) around thrust reverser forward support ring.

CAUTION: CHECK THAT THRUST REVERSER CRADLE HAS ASSUMED THRUST REVERSER LOAD BEFORE REMOVING ALL BOLTS.



D. Install Aft Thrust Reverser

(1) Coat threads and shank of all bolts and screws with anti-seize compound prior to installation.

(2) With thrust reverser cradle, F70141, secured to aft thrust reverser sleeve as shown in figure 201, position thrust reverser on rear of engine using fork lift truck.

CAUTION: WHEN INSTALLING OR REMOVING THRUST REVERSER FROM OUTBOARD SIDE OF ENGINE, CRADLE MUST BE SECURED TO FORK LIFT TRUCK BY CHAINS OR OTHER SUITABLE MEANS. THIS IS NECESSARY BECAUSE THE ENGINES HANG AT A 7° ANGLE TO THE VERTICAL DUE TO THE DIHEDRAL ANGLE OF THE WING.

CARE MUST BE EXERCISED WHEN POSITIONING CRADLE WITH FORK LIFT TRUCK TO PREVENT DAMAGE TO THRUST REVERSER SLEEVE, ENGINE, OR STRUT.

(3) Attach thrust reverser to engine at thrust reverser assembly forward mounting ring by installing bolts (60 places). Attach tubing support clip at location shown in view 3, figure 201A. Bolt threads must completely penetrate nuts.

NOTE. Obtain proper positioning of thrust reverser by lining up lower actuator support link to attaching points at bottom of thrust reverser frame. (See view 2.)

(4) Remove cradle, F70141.

(5) Reposition aft sleeve to reverse thrust position.

(6) Connect lower actuator lock by rotating it into position about lock actuator rod end and attaching with two bolts at attach lugs on actuator assembly.

(7) Install sleeve lower track by bolt (2) and nut to lower actuators at mounting flanges on aft end of actuators.

(8) Install lower actuator rod ends to lower truck assembly with 2 bushings, bolt (3), nut, and cotter pin (2 places).

(9) Attach lower actuator support link to actuator with bolt (1), bushing, nut, and cotter pin (2 places).

(10) Connect thrust reverser pneumatic lines at forward end of upper actuator. Tighten coupling nut at connection of pneumatic line to welded manifold cross fitting to 350 to 400 pound-inches torque.

CAUTION: DO NOT EXCEED 350 TO 400 POUND-INCHES TORQUE ON ANY WELDED FITTINGS ON THE MANIFOLD. DAMAGE TO FITTINGS MAY RESULT IF THIS TORQUE IS EXCEEDED.

(11) Connect aft follow-up rods (2 places) to idler link at upper actuator support link. (See view 1.)

(12) Connect wiring at lower left side of aft thrust reverser assembly.

(13) Return aft thrust reverser sleeve to cruise position.

(14) Adjust entire installation per paragraph 2.

2. Adjustment/Test Aft Thrust Reverser

A. Equipment and Materials

(1) Three 0.150 inch thick gage blocks to match surface of rub strip.

B. Adjust Aft Thrust Reverser

(1) Remove aft thrust reverser sleeve access panels L3708, R3708, L3710, R3710, and 3711. (See figure 202 and Chapter 12, Access Panels.)

(2) Disconnect lower actuators at their rod end connection to sleeve mounted carriage (6:00 o'clock position). Disconnect upper actuators at their rod end connection to sleeve structure. Gain access to upper thrust reverser actuator rod connections through aft thrust reverser sleeve access panels, L3708 and R3708.

(3) Disconnect drag links (4 places) connecting actuator hinge idler links to thrust reverser sleeve. Disconnect at sleeve end of rods.

(4) Disconnect forward follow-up rods at cable drum yoke connection. (See figure 202, view 1.)

(5) Insert a 0.15 inch spacer or gage block in the 12:00, 3:00, and 9:00 o'clock positions between the skid plates of the tailpipe and the sleeve. Move sleeve as far forward as it will go, jamming the spacers between tailpipe and sleeve at locations noted.

(6) With main side cowl panels installed, check for correct alignment between upper exterior surface of sleeve and cowl per figure 202.

(a) Add or subtract the same amount of shims at the upper or lower roller carriage trucks to attain gap specified in figure 202. (See details A and E.) Do not tighten bolts

(b) Center sleeve at 3:00 and 9.00 o'clock positions relative to engine case and thrust reverser by adjusting serrated plates at upper and lower roller carriage attach points Adjustment is limited to point where gap between sleeve and vane segment (section C-C) is equal within 0 12 inch on both sides of sleeve

(c) With sleeve centered per step (b), tighten bolts at upper and lower roller carriage trucks

(7) With spacers installed per step (5), adjust aft sleeve support carriages (view 2)

(a) Gain access to sleeve support carriages through access panel locations L3708, R3708, L3710, R3710, and 3711 located halfway back on sleeve at 12:00, 3·00, 6·00 and 9:00 o'clock positions

(b) Adjust the four carriages such that the large rollers spanning the sleeve track may be turned by hand (no load) Set adjustment nuts and safety

(c) Fore and aft motion of the sleeve shall be free without sticking or binding throughout its full travel. If binding exists, check for chips, nuts, bolts, etc , trapped in sleeve tracks.

(8) Check alignment of aft end of sleeve fairing and strut trailing edge fairing (See detail F) If sleeve fairing does not center vertically with strut fairing within 0 03 inch, determine amount of shift required by measuring misalignment at a point directly above sleeve fairing attachment to sleeve. Adjust installation as follows

(a) Remove nut (1, section B-B) and push sleeve fairing toward head of bolt to extrude bushing (2), shim (3), washers (4), and spacer (5) outside of structure

(b) Repeat procedure at other side of fairing to remove bolt (8), spacer (6) and bushing (7).

(c) Relocate washers (4) on appropriate side of anchor fitting as required to obtain shift determined above. If necessary, peel laminations from shim (3).

(d) Reinstall removed parts, making sure positive clamp-up of all parts is obtained to prevent chattering of sleeve fairing.

(e) Lockwire head of bolt (8) and nut (1) to fairing.

(9) With sleeve in full forward position per step (5), connect upper and lower actuator rod ends to sleeve structure attach points.

(a) Install upper actuator rod end eccentric bushing so that rod is in uppermost position relative to cylinder centerline (hole in bushing down)

(b) Install lower actuator rod end eccentric bushings so that rod is centered as nearly as possible in cylinder at both extremes of sleeve travel.

(10) With rigging pins installed in hinge drive idler arms as shown in view 1, figure 201A (thrust reverser assembly rigged according to overhaul manual instructions prior to assembly with sleeve and installation on engine), connect the two upper and the two lower hinge drive drag links to thrust reverser hinge drive idler links and sleeve

(11) Connect aft thrust reverser follow-up rods to yoke at follow-up cable drum Adjust the rods such that the yoke is 90 degrees to strut horizontal centerline with rig pin installed in follow-up drum

NOTE: The two aft follow-up rods between the thrust reverser hinge idler and the follow-up system idler are preset to 9.76 inches and should not be altered.

(12) Remove four rigging pins from reverser hinge idler arms and one rigging pin from follow-up cable drum Replace access panels

(13) Extend sleeve and remove gage blocks from aft supports.

(14) Check rigging of aft thrust reverser lower lock as follows.

(a) Move reverse thrust lever in control cab to interlock position with reverser in forward thrust position

CAUTION. CHECK THAT GROUND AIR SOURCE IS NOT CONNECTED.

(b) Manually push aft thrust reverser sleeve aft until roller (two places) on sleeve lower truck contacts lower lock hook Check that vertical gap between top of roller and hook is 0.00 (+0 05/-0 00) inch (two places).

(c) If this dimension is not met, adjust hook position to bring gap within allowable range by shimming between the thrust reverser actuator end fitting and mounting face of lock actuator This is the preferred method. An alternate method is given in step (d) below

NOTE The thickness of the shims added will approximate the reduction in hook gap obtained Fabricate shims locally.

(d) (Alternate method of adjusting allowable gap between hook and rollers) Adjust hook position to bring gap within allowable range by adjusting lock actuator rod end as follows (See figure 202.)

1) Remove rod end bearing retaining rivet

2) Adjust lock actuator rod end to shorten rod as required to get gap within 0 050-inch.

NOTE. There is approximately a 1/1 relationship between changes in dimension "A" and the subject gap.

3) With rod end held in this position drill through and reinstall retaining rivet

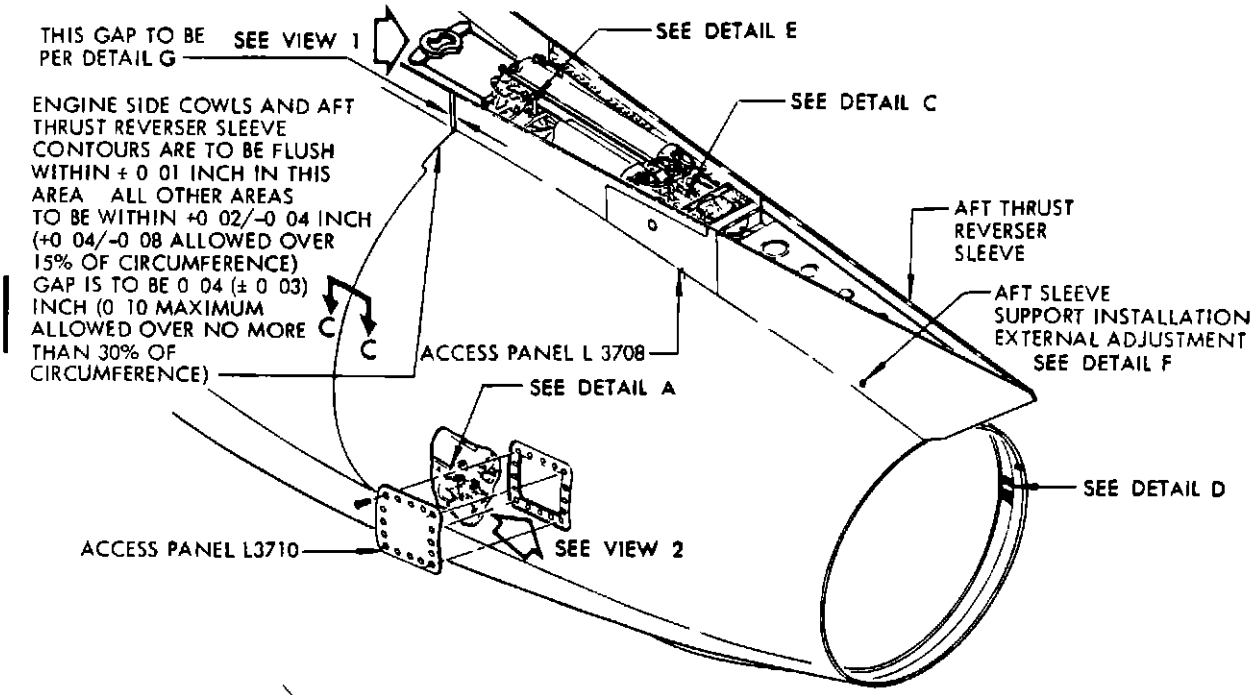
(15) Adjust gap between sleeve and strut skin as follows:

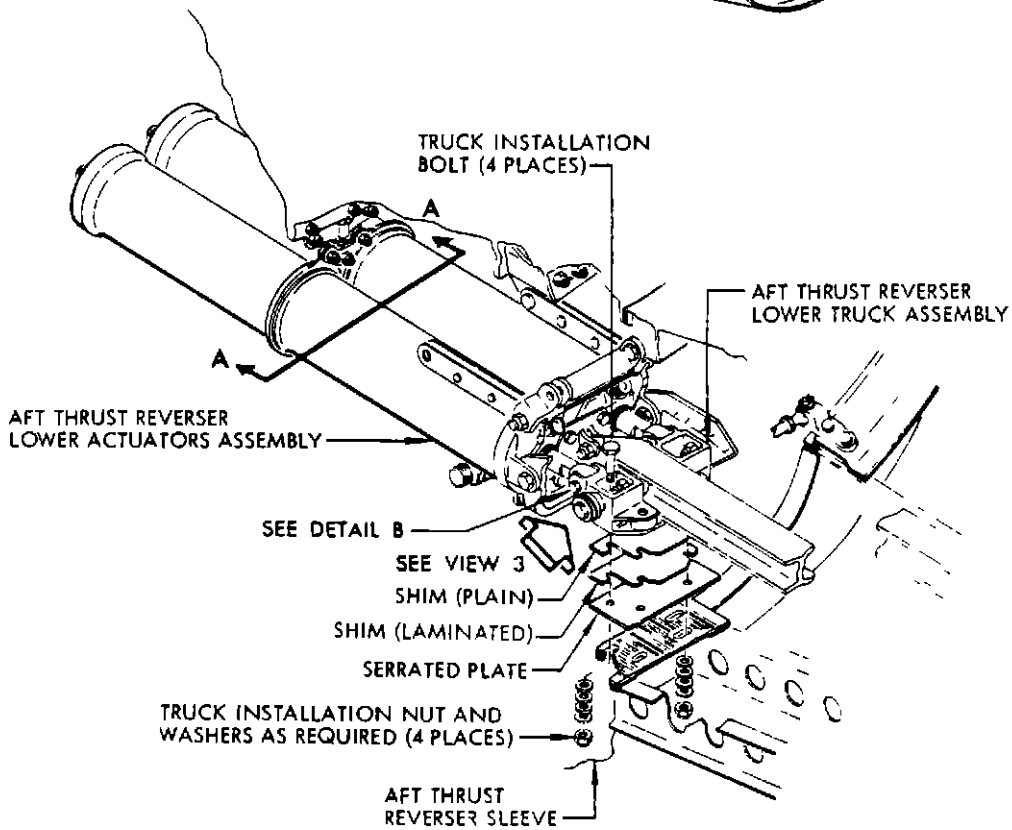
(a) With cowl panels on and thrust levers in the forward thrust position, apply 80 to 100 psig to ground connection (78-6-0, view 2, figure 6) Check that sleeve does not contact strut stop (See detail G, figure 202)

(b) Adjust skin plate (detail H, figure 202) such that the gap between skin plate and forward edge of sleeve is 0.09 (± 0 01) inch Secure skin plate by tightening screws

(c) Then remove air pressure source and with cowl panels off, adjust strut stops such that the gap between skin plate and forward edge of sleeve is 0.04 (+0 00/-0.02) inch

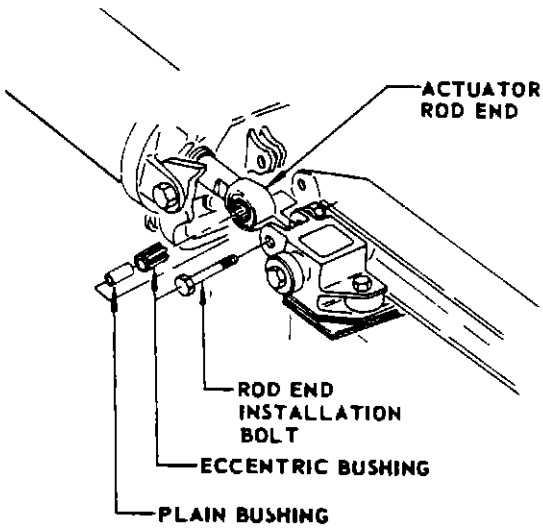
(d) With side cowl panels off and 20 psig applied to ground connection (forward thrust lever still in forward thrust position) gap shall be 0.04 (+0.00/-0.02) inch.



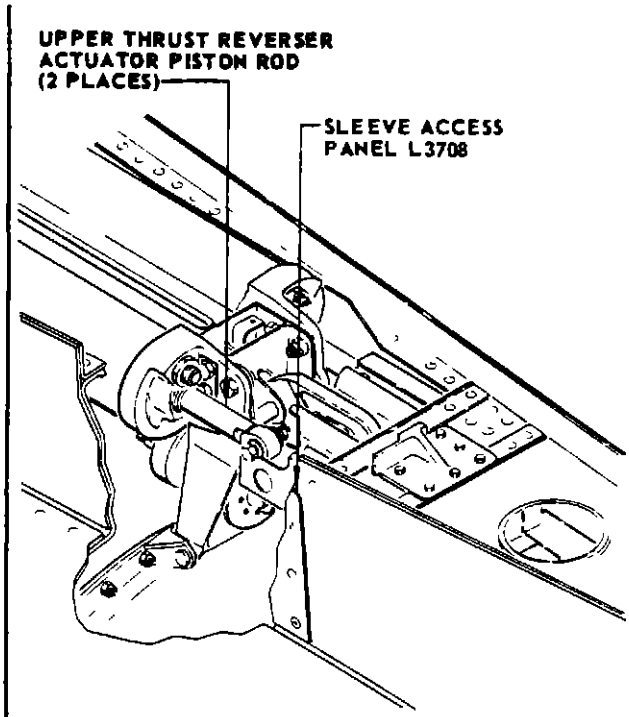


DETAIL A

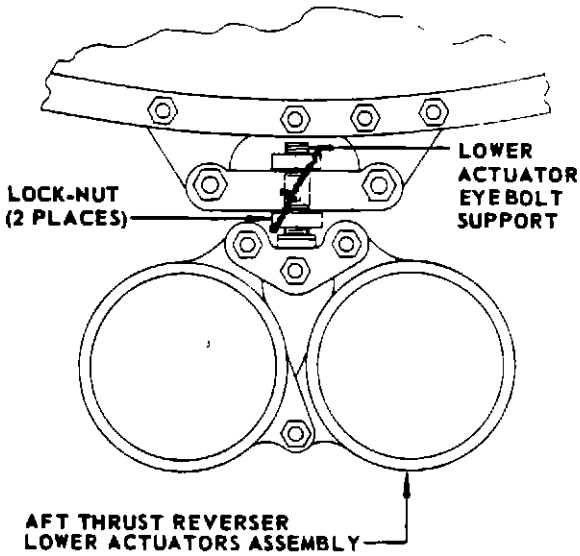
Aft Thrust Reverser Installation Rigging
Figure 202 (Sheet 1)



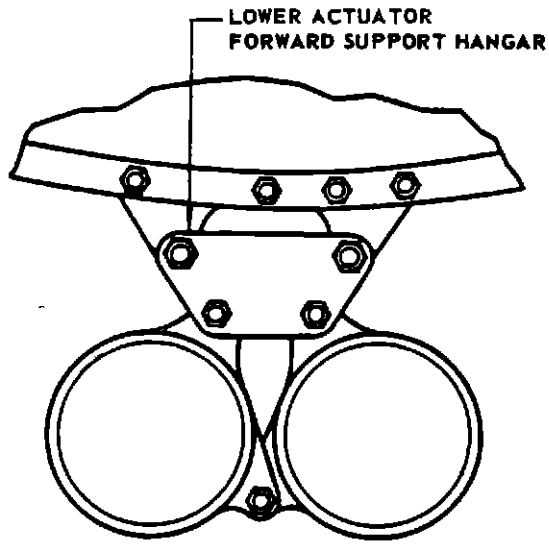
DETAIL C



DETAIL D

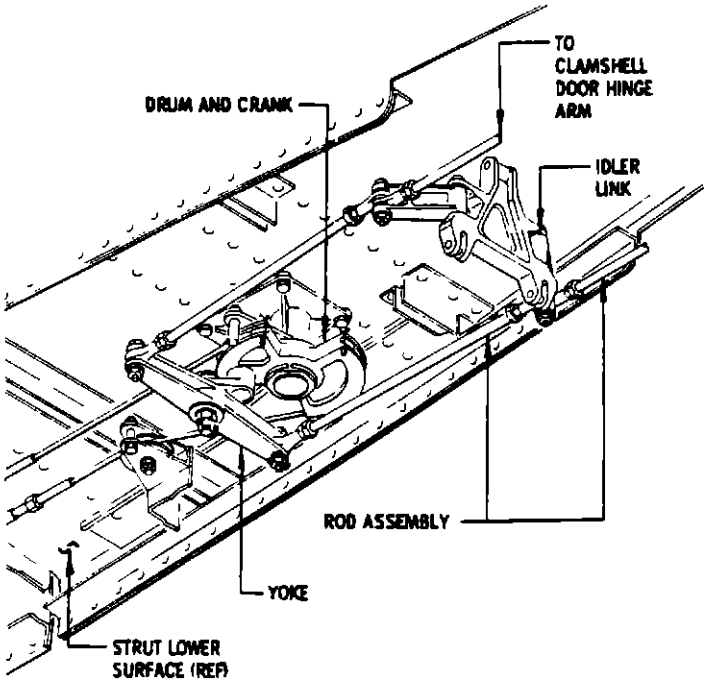


CONFIGURATION 1

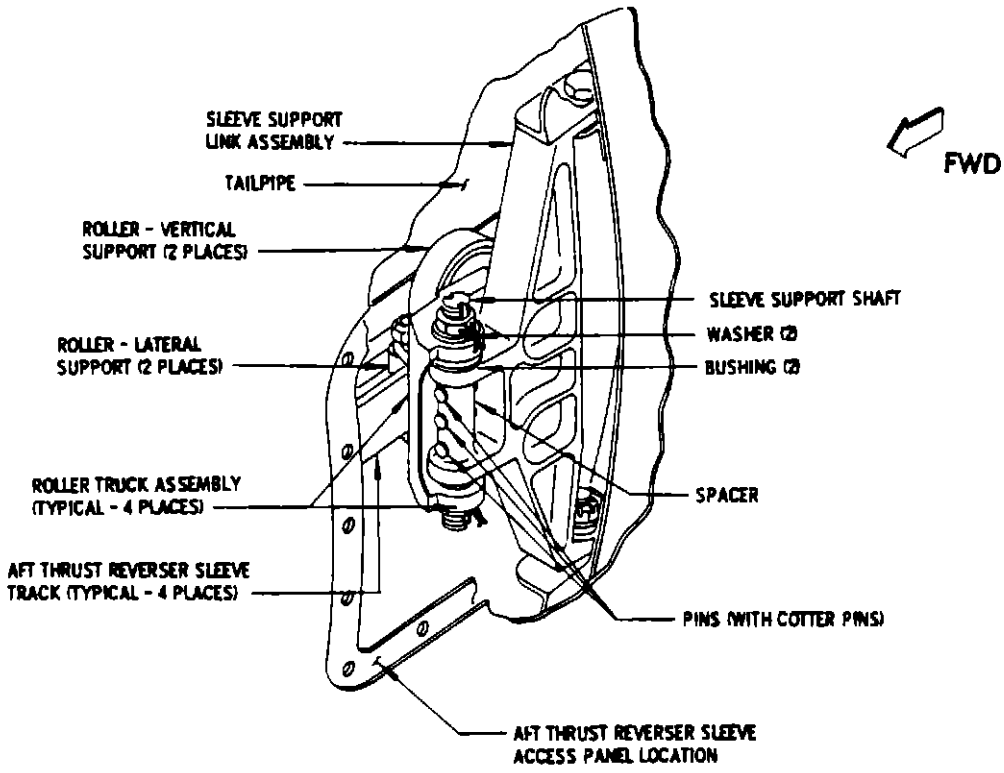


CONFIGURATION 2

A - A

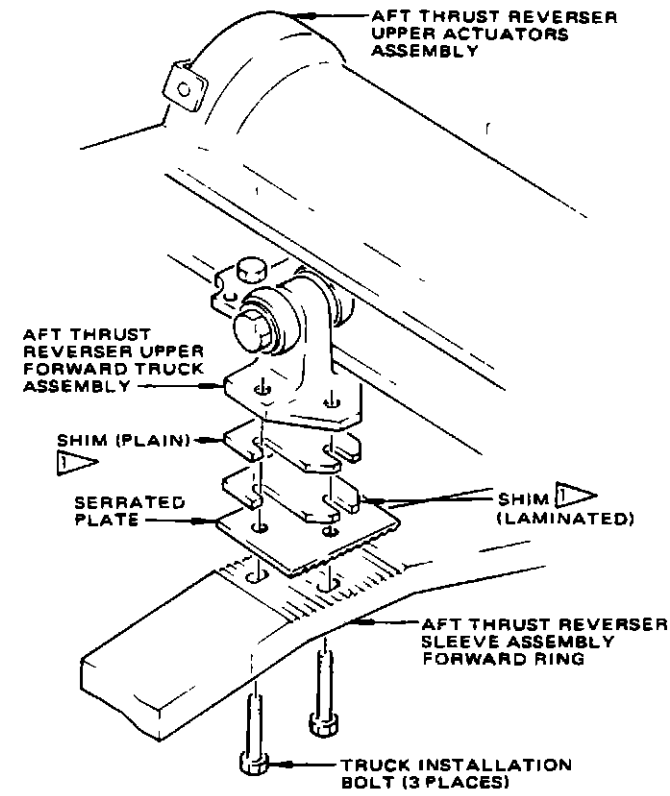


VIEW 1

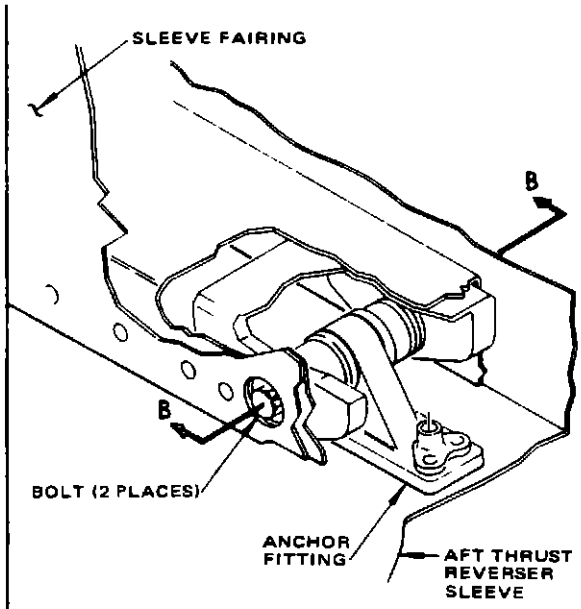


VIEW 2

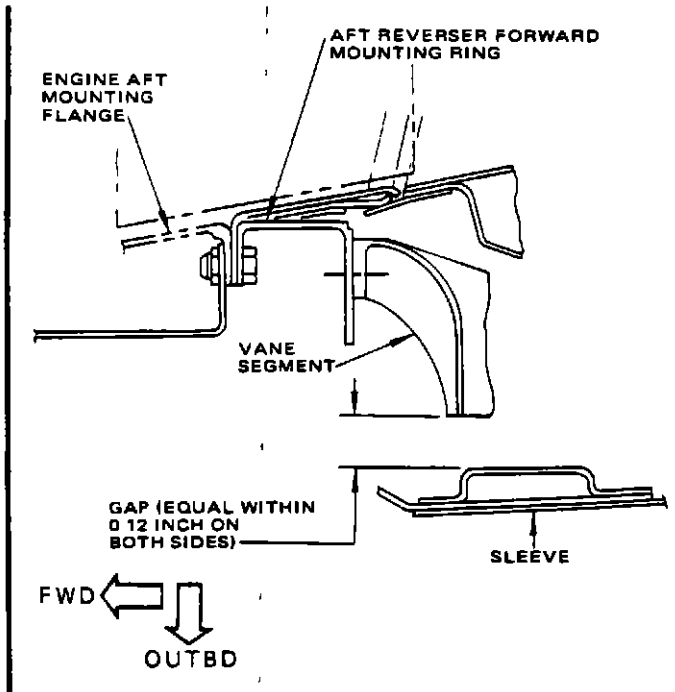
Aft Thrust Reverser Installation Rigging
Figure 202 (Sheet 3)



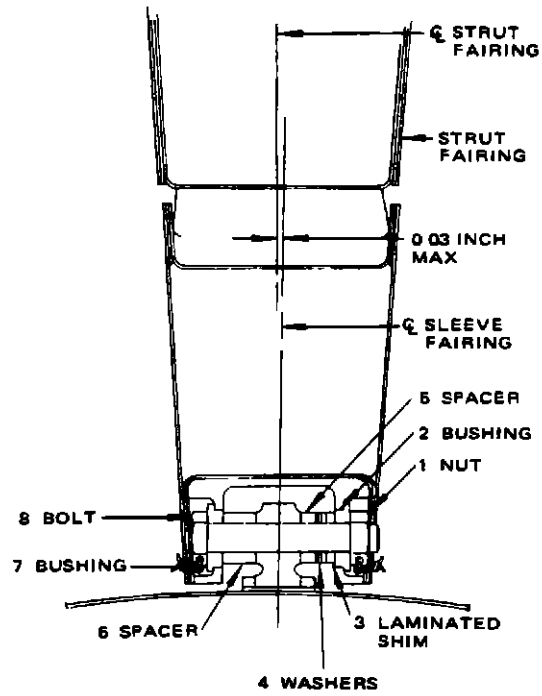
DETAIL E



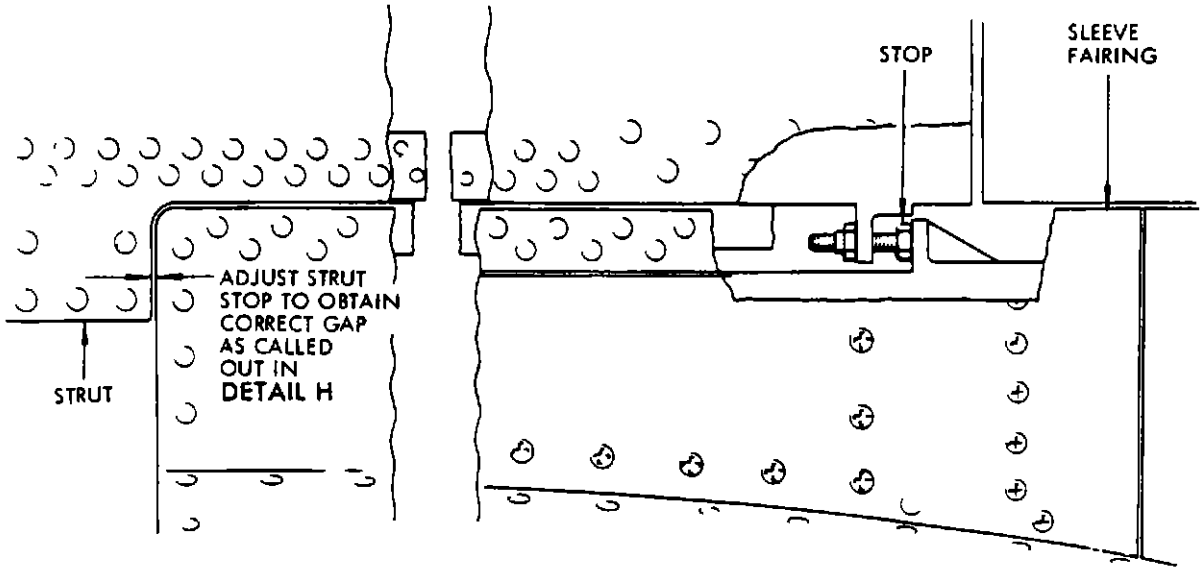
DETAIL F



SECTION C–C

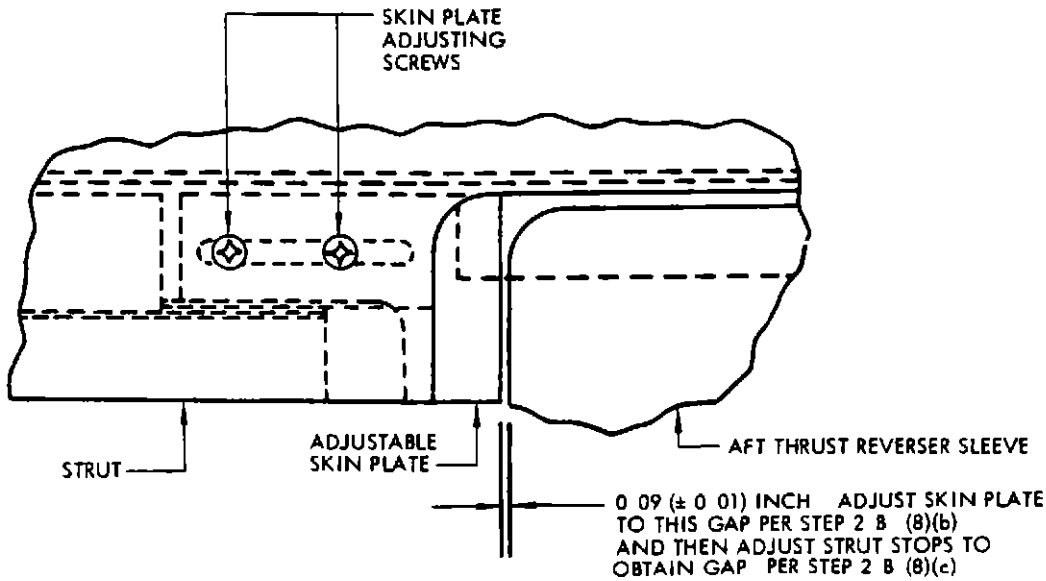


SECTION B–B



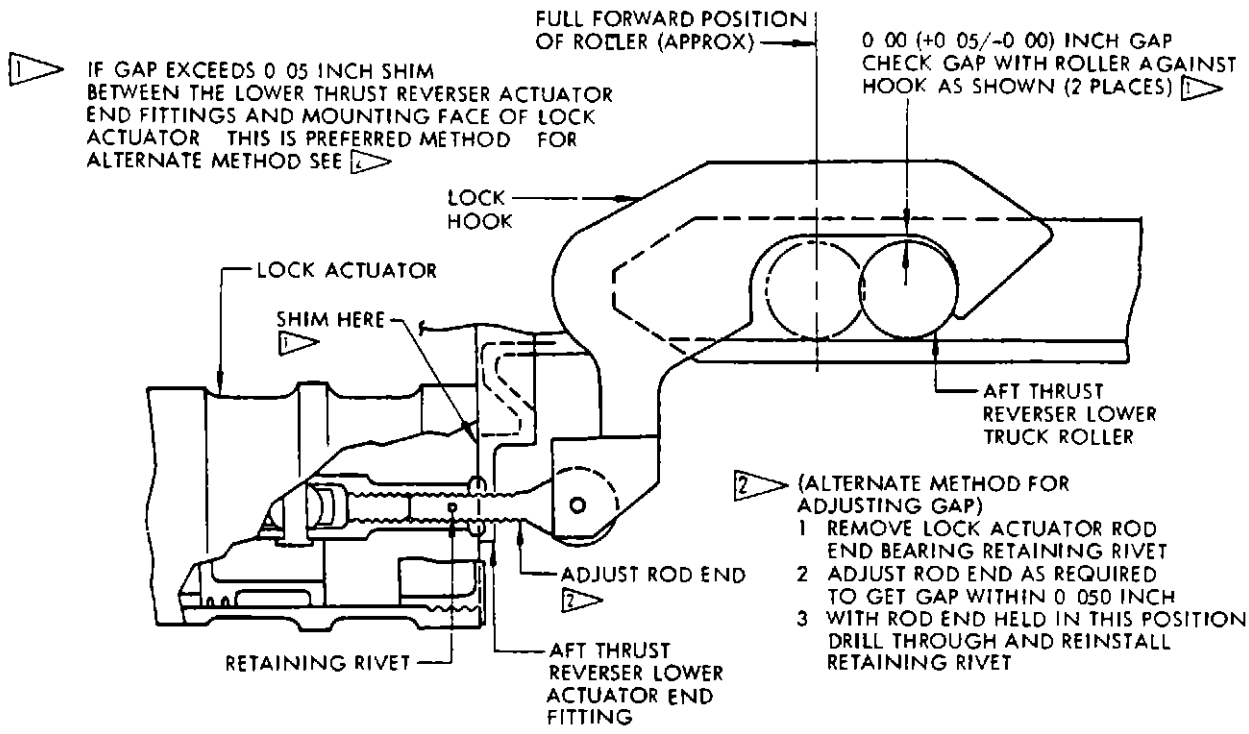
ADJUSTMENT OF AFT REVERSER STOP

DETAIL G

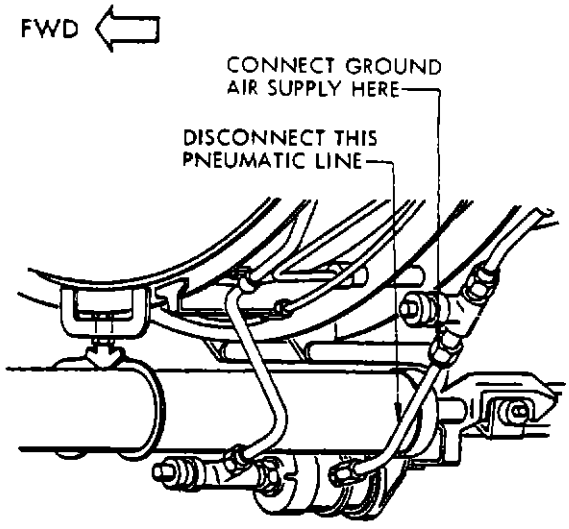


ADJUSTABLE SKIN PLATE
STRUT-SLEEVE GAP ADJUSTMENT

DETAIL H

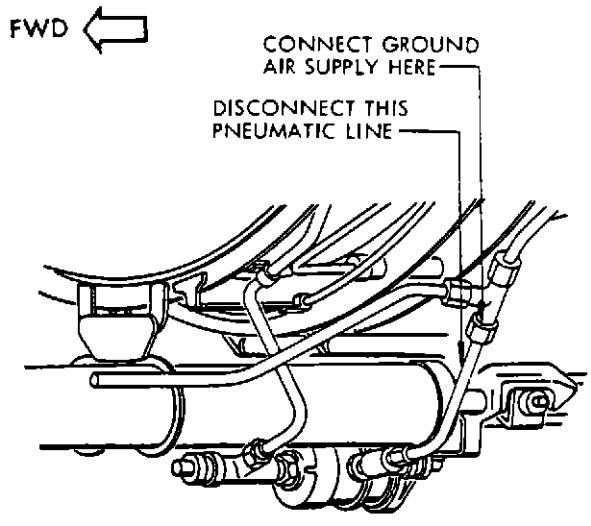


VIEW 3



CONFIGURATION 1

(REVERSERS WITH TWO SLEEVE LOCKS)



CONFIGURATION 2

(REVERSERS WITH ONE SLEEVE LOCK)

C Test Aft Thrust Reverser

(1) Place forward thrust lever in idle position and reverse thrust lever in off position for applicable engine

(2) Connect external air source to ground service connection in strut and regulate to 25 psig Gain access to ground service connection through access panel 1739 or 3716, depending on type of engine

(3) With side cowl panels on, check that side cowl panels and aft thrust reverser sleeves are flush at top and bottom within ± 0.01 inch.

(4) With side cowl panels open, check that gap on horizontal centerline between the cascade vane assemblies and forward ring of sleeve is equal on each side

(5) Check that there is no preload on aft track roller installation (four places). Gain access to aft track rollers by removing access panels L3708, R3708, L3710, R3710 and 3711 located at horizontal and vertical centerlines of aft thrust reverser sleeve.

(6) With cowl panels off, check that vertical gap between sleeve and strut skin is 0.04 (+0.00/-0 02) inch at forward end of sleeve.

(7) Bring forward thrust lever back to the idle position and then actuate the reverse thrust lever aft to either the interlock or the full reverse thrust position The aft thrust reverser sleeve shall move to reverse thrust position within 3 seconds.

(8) Move reverse thrust lever forward to the idle position. The clamshell doors shall go to full forward thrust position and be firmly seated in the seals within 5 seconds

WARNING: WHEN RETURNING THE THRUST REVERSER TO CRUISE POSITION USING GROUND AIR THE FORWARD THRUST REVERSER SLEEVE MUST BE HELD IN THE AFT POSITION UNTIL ALL THE BLOCKER DOORS HAVE ROTATED TO THE "CRUISE" OR FAIRED POSITION THIS MAY BE DONE BY USING A RESTRAINT HARNESS, BOEING PART NO. MIT65-10621, OR EQUIVALENT AS AN ALTERNATE METHOD THE SLEEVE MAY BE RESTRAINED MANUALLY BY A MECHANIC ON EACH SIDE OF THE SLEEVE PUSHING AFT ON THE SLEEVE DURING THE RETRACT CYCLE UNTIL ALL THE BLOCKER DOORS HAVE ROTATED TO THE CRUISE POSITION THE MECHANICS SHOULD EXERCISE CAUTION TO PLACE THEIR HANDS ON THE SLEEVE IN THE LOWER AREA ADJACENT TO THE FIXED VANE ASSEMBLIES TO PREVENT THEIR HANDS BEING HIT BY THE ROTATING BLOCKER DOORS

(9) Disconnect air pressure source from ground service connection.

(10) Check locking capability of lower hook lock as follows:

(a) With lower lock rigged per paragraph B.(15) above manually move sleeve as far forward as it will go, such that horizontal gap exists between hook and roller.

(b) Remove pneumatic line between lower lock actuator and tee connection to bypass lower lock actuator as shown in figure 202.

(c) Apply 60 psig at tee. Repeat test three times. Lock shall hold the thrust reverser in the forward thrust position.

(d) Reconnect pneumatic line segment and check for leakage at connections by applying 60 psig at ground service connection with reverser manually positioned in reverser thrust position and reverse thrust lever positioned to interlock.

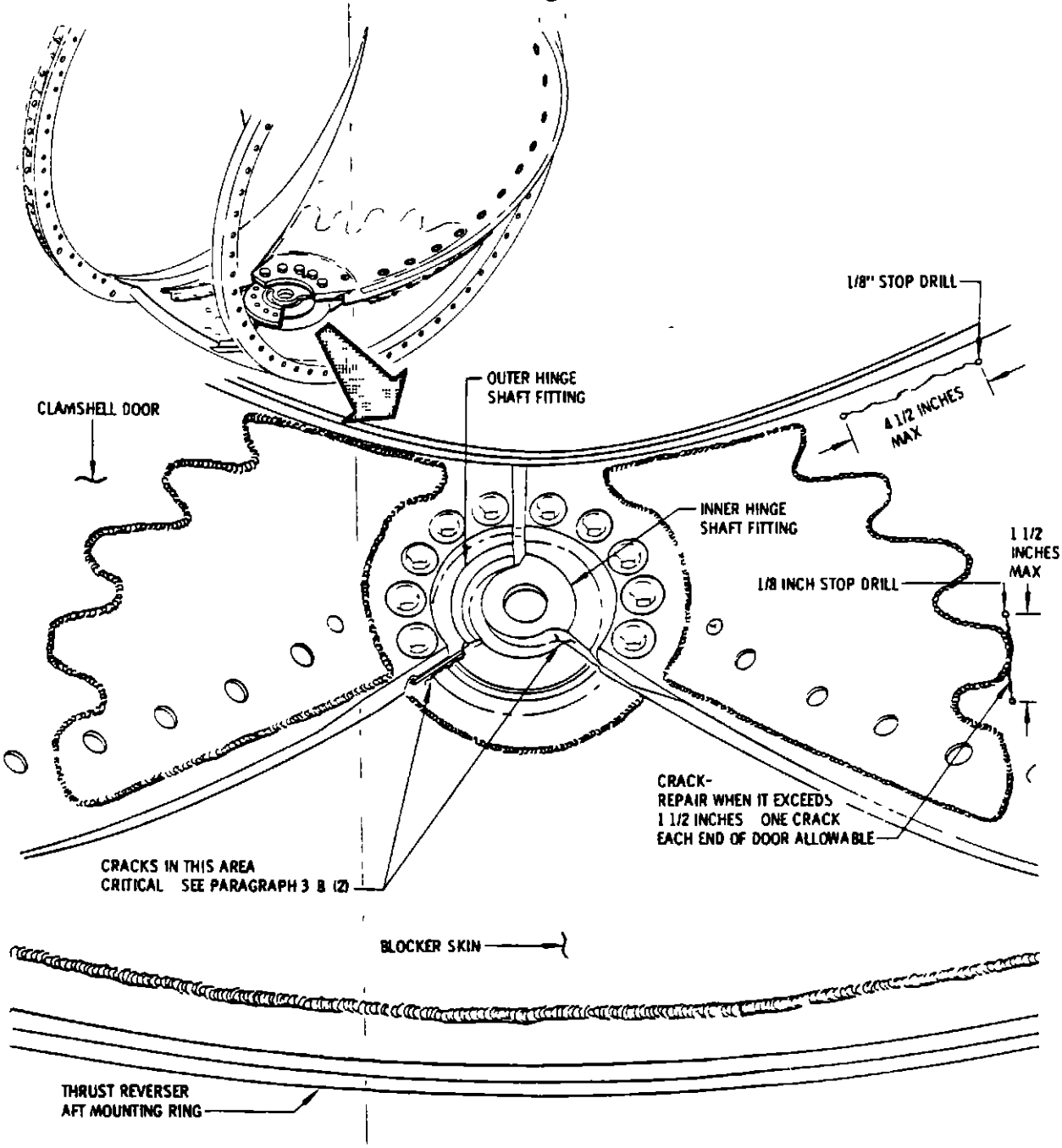
(11) Test aft thrust reverser operating light switch. Refer to 78-7-1, Warning Light Switches.

(12) Remove air pressure source, recap ground connection and replace access panels.

3. Inspection/Check Aft Thrust Reverser

A. General

(1) Inspection of the thrust reverser consists mainly of the following: checking for cracks and wear of the thrust reverser components, checking for proper seal contact, checking for missing seal leaves on the seal assemblies, checking for missing or loose rivets in the aft thrust reverser translating sleeve, and checking for freedom of movement of the translating sleeve.



Clamshell Door Hinge Area and Hinge Fitting Crack Limitations
Figure 203

B. Check Clamshell Doors

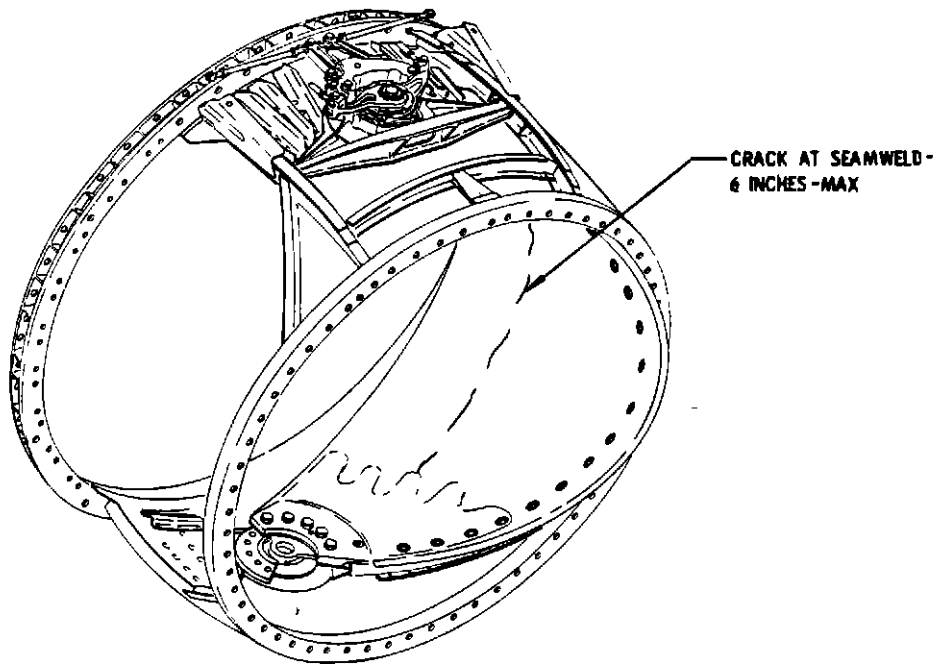
(1) Visually inspect the clamshell doors for cracking or distortion (See figure 203.)

(a) Cracks in the inner skin of the door adjacent to the finger-like doubler at the hub area and located in a fore-and-aft direction may be stop-drilled. A maximum of one crack up to 1-1/2 inches in length at each door finger double location is considered tolerable before repair.

(b) Cracks at the seam weld between the door and the leading edge seal contact angle up to 4-1/2 inches in length are considered tolerable before repair is required.

(2) Visually inspect the clamshell door hinge shaft fitting for cracks Particular attention should be given to the machined fillet area between the shaft and the flange edge at the clamshell door trailing edge plane. Replace thrust reverser if hinge support fitting crack exceeds 0.75 inch. (See figure 203.) If crack does not exceed 0 75 inch, the thrust reverser may be continued in service, but not in operation, for a maximum of 25 flight hours before replacement.

NOTE: Frequent inspection of the hinge shaft fitting is necessary to preclude the possibility of hinge shaft failure and loss of the clamshell door itself.



Typical Cracks Clamshell Door
Figure 204

(3) Examine inner skin of clamshell door for seamweld cracks. (See figure 204) Cracks at the seamweld between the door inner skin and the internal stiffening structure up to 6.00 inches long are considered tolerable before repair.

NOTE: Wrinkling of the door inner skin between the supporting stiffeners is not considered detrimental to door strength or function.

(4) With the doors in the reverse thrust position, inspect the gap between the Left Hand and Right Hand doors. A gap of 5/16 inches is considered tolerable before repair.

(5) Visually inspect the clamshell door seals for contact with their mating surfaces or for missing seal leaves. This check is to be made with the thrust reverser in the "cruise" position and 75 psig applied at the ground service connection.

(a) Connect ground air supply.

1) Place forward and reverse thrust levers at idle and placard control stand to warn against actuation of thrust levers when personnel are working on thrust reverser

2) Remove engine side cowl panels and fan cowl panels

CAUTION: GROUND AIR SUPPLY MUST NOT BE CONNECTED UNLESS THE ENGINE SIDE COWL PANELS ARE REMOVED OR COMPLETELY CLOSED AND FAN COWL PANELS REMOVED, TO AVOID STRUCTURAL OR ENGINE DAMAGE OR INJURY TO PERSONNEL.

3) Connect air source to ground air connection located in strut. Gain access to ground service connection through access panel 3716 or 1739 located in strut. See Chapter 12, "Access Doors and Panels."

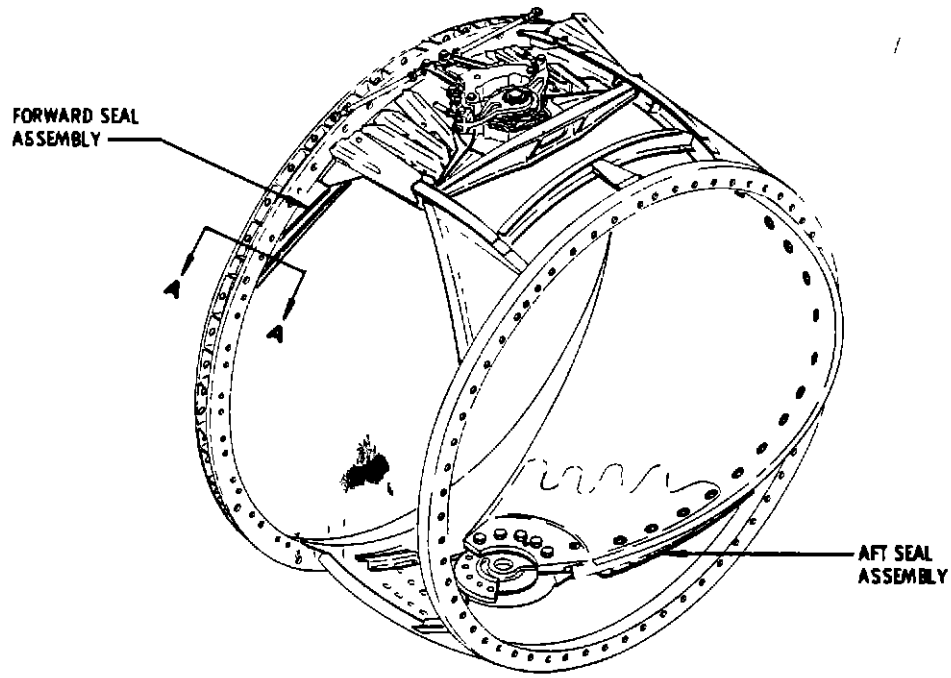
NOTE: Supply line between the ground air supply pressure regulator and the ground air connection shall have a minimum inside diameter of 9/32 of an inch.

(b) Regulate pressure source to 75 psig.

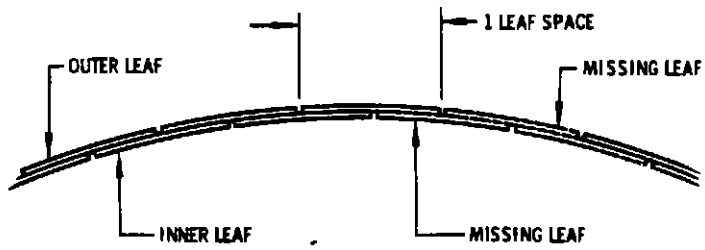
(c) Check clamshell doors for at least a 50 per cent contact between both the forward seal assembly and its contact area and the aft seal installations on the doors and their contact area on the frame.

(d) The loss of one or the other of two overlapping seal leaves on either the forward or aft seal assemblies is permissible (See figure 205)

(e) The loss of both inner and outer overlapping seal leaves totaling a maximum of six leaf spaces in the contact area of the forward seal assembly with the clamshell door or in the contact area of the aft door seals is considered tolerable



A-A

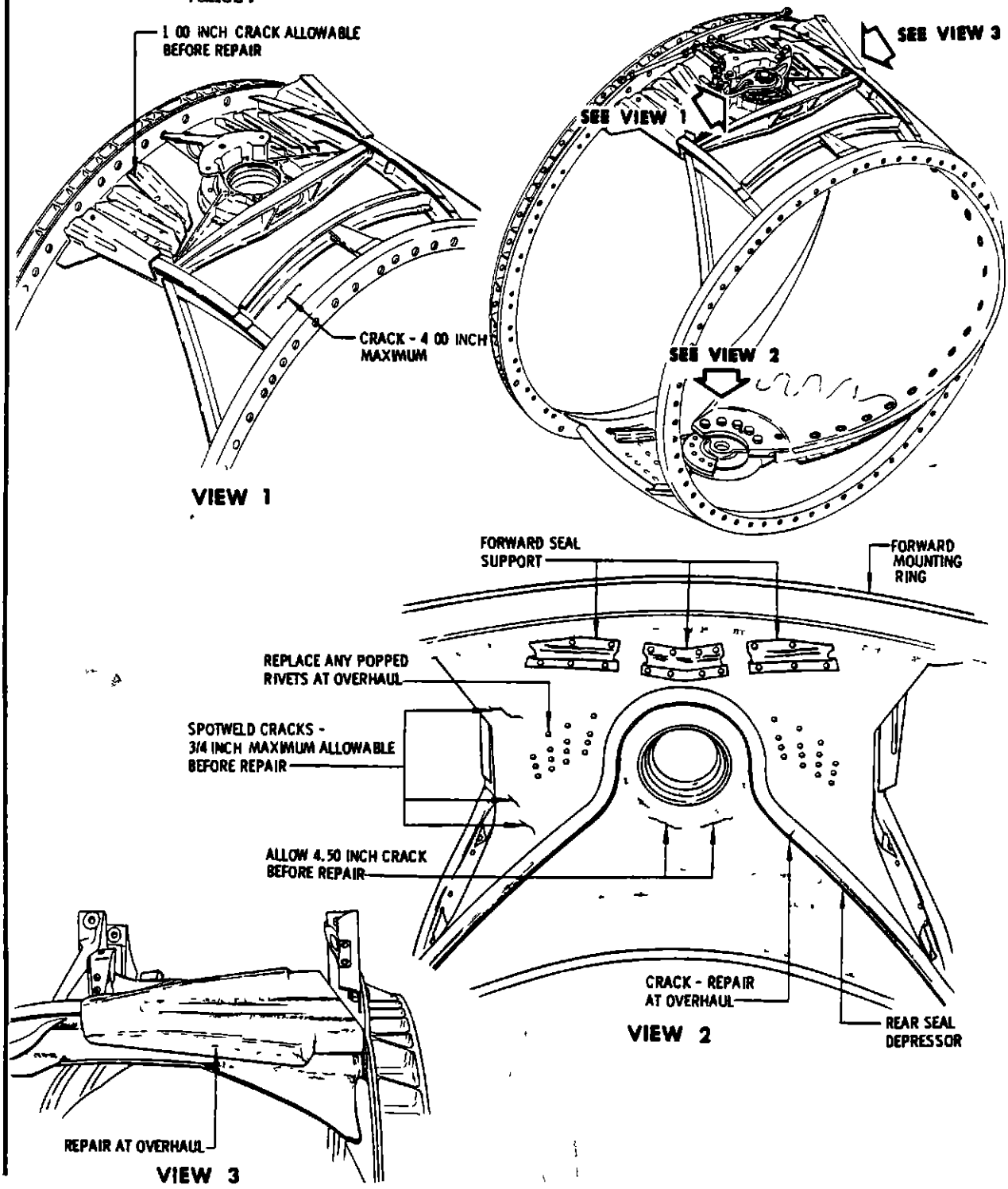


B - B

Seal Assembly Examination Data
Figure 205

(f) Cracks in the aft door seal depressor angle are not considered detrimental to effective sealing. (See figure 206, view 2.)

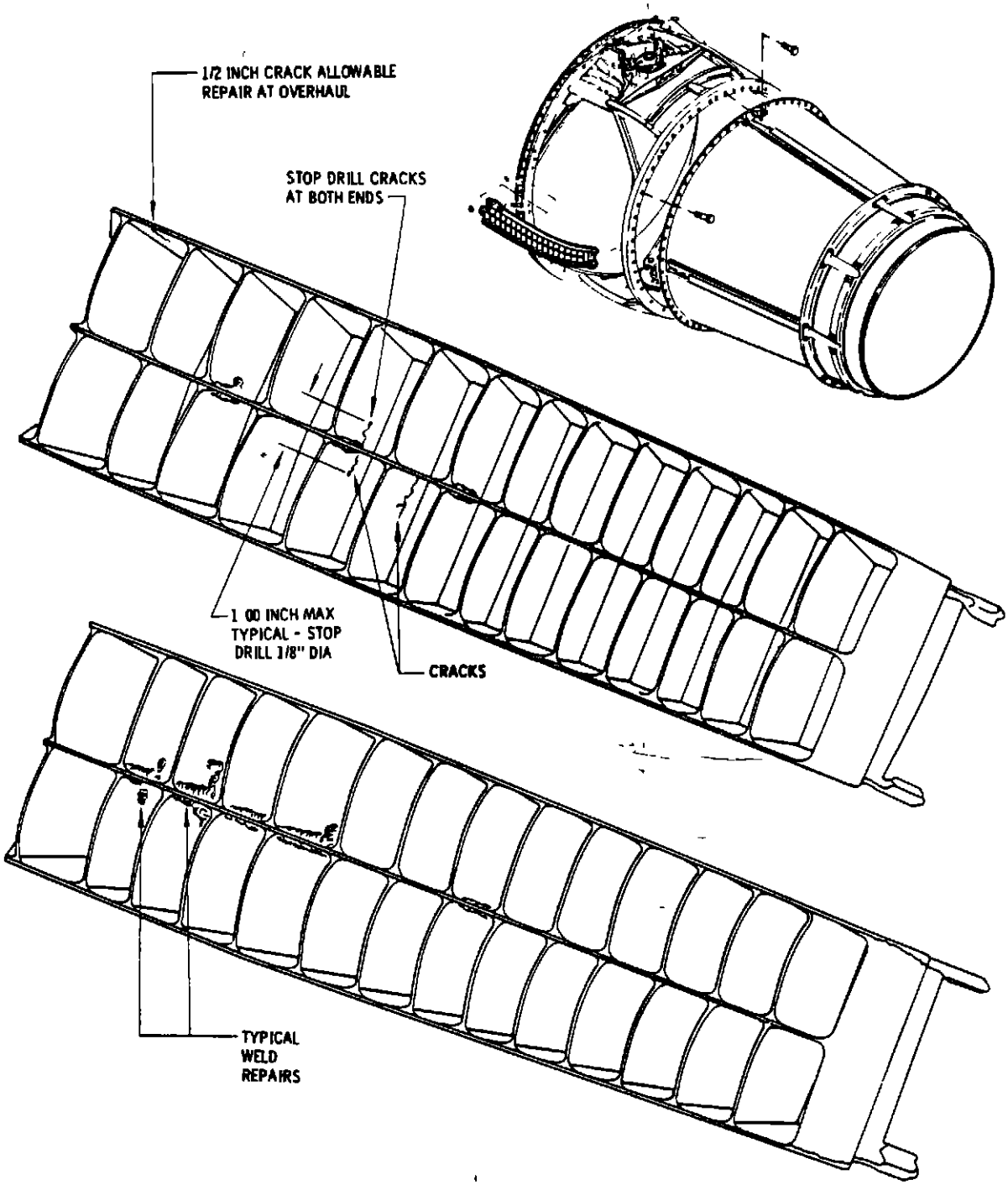
(6) Check for evidence of clamshell door interference with the cascade vanes.



Typical Crack Limits and Repair Data Ring and Deflector Assembly 2
Figure 206

C Visually check the cascade vane assemblies for cracks and missing vanes. (See figure 207.)

(1) Cracks in a vane or blocker assembly up to 1.00 inch in length are allowable before repair is required Stop drill (1/8 inch dia) and continue in service until overhaul



Typical Cascade Vane Assembly Crack Limits and Repair Data
Figure 207

(2) Cracks in the side strongbacks up to 1/2 inch in length are considered to be tolerable before repair.

NOTE: Repair is recommended when these limits are reached due to the possibility of sleeve damage upon retraction from reverse to cruise thrust.

(3) Operation of the thrust reverser with one or two missing vanes in a cascade vane assembly is permissible. This is considered allowable to a maximum of two missing vanes per vane assembly in a total of four vane assemblies. The unit may be operated to overhaul with the above limits.

D. Check actuators and linkages for freedom of movement.

(1) Check actuators by moving piston rod and note if "floating gland" of actuator is free at both ends of travel. Move rod through its travel and check for binding. Check all rod end bearings for freedom of movement.

(2) Check for galled or worn parts. Replace where found.

E. Examine tailpipe and aft sleeve carriage trucks.

(1) Check for cracks in tailpipe. Stop drill (1/8-inch dia) upon discovery. Repair per Overhaul Manual when crack exceeds four inches in length or if there are more than two cracks. No more than one crack is allowable in any of the four main skin areas bounded on either side by the tailpipe tracks.

(2) Check for freedom of roller carriage trucks to roll along tracks. (Lift up on trailing edge.)

(3) Check track for galling and grind smooth if local depth exceeds 0 03 inches

NOTE: Some brinelling may occur where rollers rest in cruise position but rework is not required if thrust reverser operation is satisfactory. See 78-6-0, "Adjustment/Test Thrust Reverser."

F Check lower surface of strut

(1) Check sleeve stop for bent or damaged stop bolt. Replace and rerig as required. (See aft thrust reverser.)

(2) Check aft thrust reverser follow-up installations.

(a) Check cables and pulleys for excessive wear.

(b) Check rigging and tension. (See 78-6-21, "Adjustment/Test Aft Thrust Reverser.)

G. Visually inspect ring and deflector assembly for cracks (See figure 206.)

(1) Cracks in the longitudinal braces and stiffeners for the hinge support fitting up to 1 0 inch in length are considered to be tolerable before repair.

(2) Cracks in upper and lower deflector skins adjacent to the weld between the hinge support casting and deflector skin may be allowed to grow to 4 50 inches and then stop drilled 1/8 inch diameter and unit allowed to continue in service until overhaul If crack progresses after stop drill, it must be repaired.

(3) Cracks in the basic hinge support casting, originating at weld and progressing towards centerline of hinge, must be repaired immediately

(4) Cracks up to 3/4 inch in length resulting from failed spotwelds between the stiffeners and the deflector skins are allowable before repair is necessary.

H. Examine aft thrust reverser translating sleeve.

(1) Check for missing or loose rivets. If the number of missing rivets exceeds two rivets in adjoining holes or 4 rivets in 15 inches in any one rivet row repair according to instructions in Chapter 54, "Structural Repair Manual."

(2) Check for skin cracks Cracks up to 4 inches are tolerable providing the crack does not go through more than two fastener holes.

(3) Check for broken or cracked frames. These must be repaired immediately. Refer to Chapter 54, "Structural Repair Manual."

I. Exhaust Plug (Tailcone) Crack Limits - See 78-5-111.

4 Approved Repairs Aft Thrust Reverser

A General

(1) Maintenance and repair of the thrust reverser consists largely of welding Welding should be by the inert-gas tungsten-arc process (Heliarc)

(2) Parts must not be pickled before welding because the acids used would become entrapped in areas where it would be impossible to adequately neutralize the solution. Before welding, parts should be degreased by any of the liquid or vapor methods employed for other aircraft parts Parts may be cleaned by Vapor-Blast or Dry-Hone process. A 25-30% nitric acid solution may be used It is also important to stop-drill and grind out cracks to remove oxide and dirt prior to welding.

B Equipment and Materials

(1) Inert tungsten arc welding equipment

(2) Bare filler wire - Hastelloy W

(3) Spreader bar

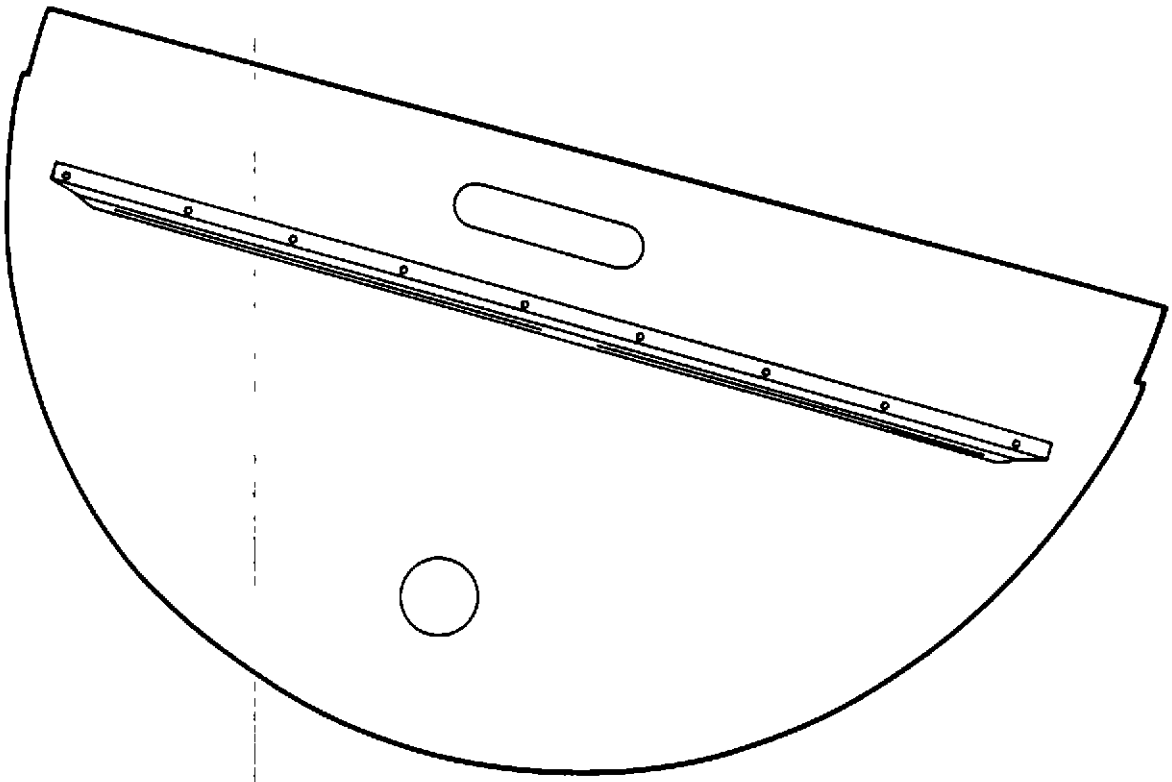
(4) Clamshell door contour template

C Repair Clamshell Door Assemblies

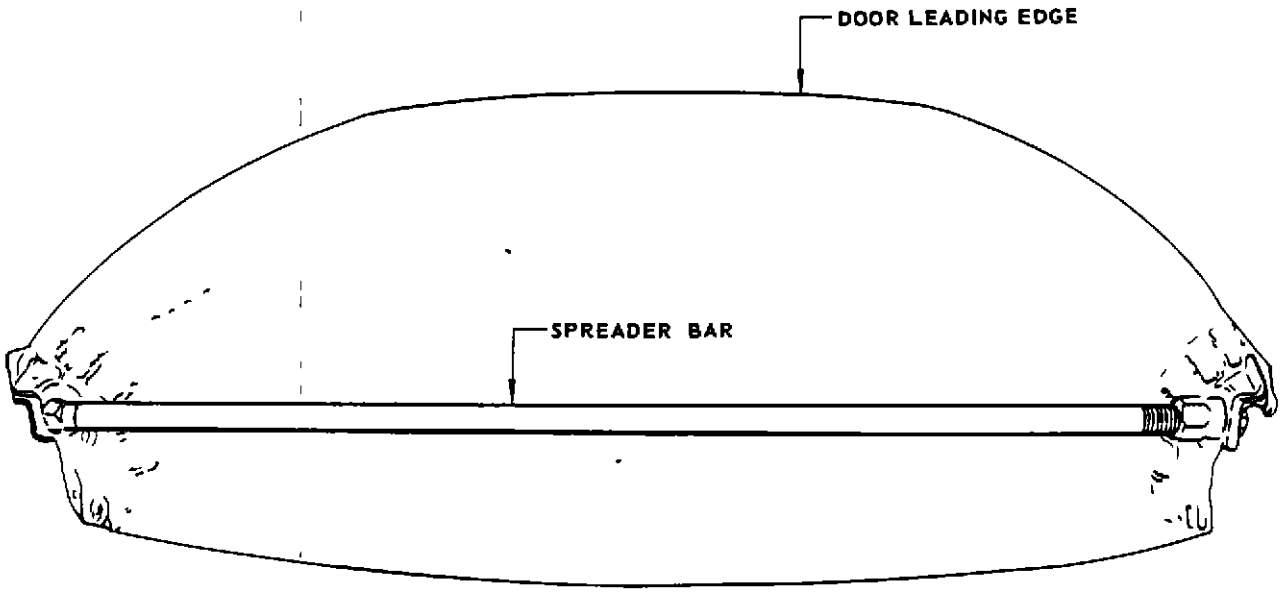
(1) If the leading edges of the clamshell doors do not properly mate with the forward seal the door is probably out of contour and should be reworked

(a) In some cases, the leading edges of the doors can be reworked on the engine Access to the doors can be gained by removing the vane segment assemblies The doors are easily disconnected from their actuating arms so that they can be moved by hand

(b) If the thrust reverser if off the engine and the doors are out of contour, remove them from the rest of the thrust reverser With the doors removed, the template shown in figure 208 may be used to establish the correct contour. In conjunction with the template, a spreader bar as shown in figure 209 is recommended. The spreader bar aids in establishing the correct spacing between door fittings and holds the door during rework. Figure 210 shows the recommended use of the template and



Clamshell Door Contour Template
Figure 208



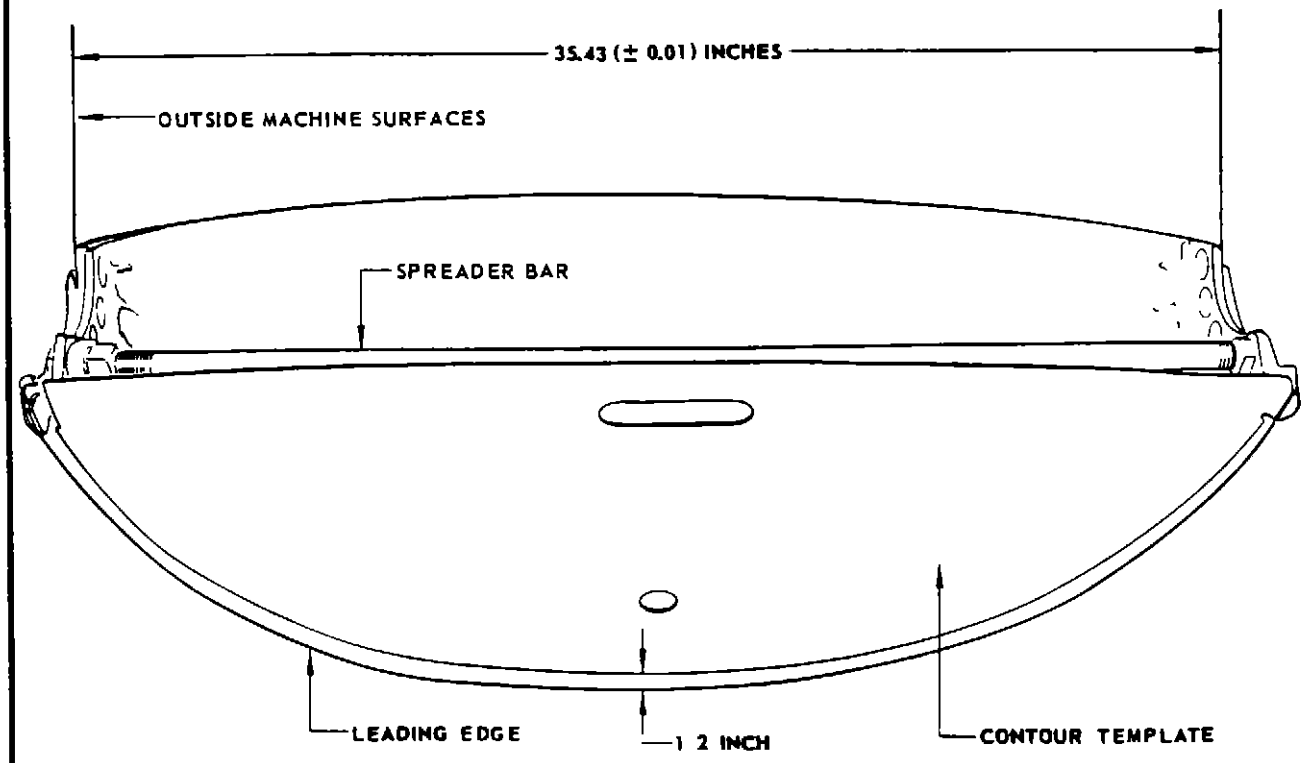
Spreader Bar Application
Figure 209

spreader bar for checking door contour. The spreader bar can be made easily from material normally found in a machine shop. The correct distance between machined faces of the hub fittings is 35.43 (± .01) inches.

(c) Keep seamweld cracks on the inner skin of the door under surveillance. The need for repair depends on the location of cracks and their rate of increase. (See figure 204.) Repair cracks near hub fitting by welding, especially if they form a continuous line of defects.

(d) When cracks exceed the limits shown for the hinge area (figure 203) they should be repaired by welding as soon as the airplane reaches a base having the necessary facilities.

(e) Replace missing seal leaves on aft door seal if seal leaves are missing from both inner and outer layer. Sealing is not appreciably affected if leaves from only one layer are missing.



Spreader Bar and Template Installed for Contour Rework
Figure 210

D. Repair Forward Seal Assembly

(1) A few isolated cracks at the radius of the seal mounting flange are not serious. If a crack is continuous for 6.00 inches or more repair at overhaul. If the seal has been separated from the mounting flange, repair as soon as possible

E. Repair Ring and Deflector Assembly (Figure 206)

(1) Repair cracks in ring and deflector assembly by inert tungsten arc welding (Heliarc). Use Hastelloy "W" or AISI 347 bare filler wire only. See figure 206 for crack limitations and repair data

F. Repair Cascade Vane Assemblies

(1) Repair cracks in vane segment assemblies by welding. Use Hastelloy "W" filler wire only. Typical repairs are shown in figure 207

G. Replace Thrust Reverser Forward Seal Assembly

(1) Replacement of the thrust reverser forward seal assembly is accomplished by removing the thrust reverser. The forward seal is then separated from the thrust reverser by removing 4 countersunk bolts holding the forward seal support ring to the thrust reverser ring and deflector assembly.

H. Replace Thrust Reverser Aft Seal Assemblies

(1) The aft seals are installed on the aft edges of the clamshell doors and replacement is accomplished by removing the doors. See "Removal/Installation Clamshell Doors."

I. Replace Thrust Reverser Hub Seals

(1) The hub seals are installed on the clamshell doors between the doors and door hinges. Replacement is accomplished by removing the doors. See "Removal/Installation Clamshell Doors."

AFT THRUST REVERSER SLEEVE - MAINTENANCE PRACTICES

1. Removal/Installation Aft Thrust Reverser Sleeve

A. General

(1) The aft thrust reverser sleeve may be removed from the engine without removing the thrust reverser assembly and tailpipe assembly

B. Equipment and Material

(1) Air pressure source - 0 to 60 psig.

(2) Anti-seize compound, Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent.

C. Remove Aft Thrust Reverser Sleeve

(1) Place thrust reverser in reverse thrust position. (See 78-5-61, "Removal/Installation Aft Thrust Reverser.")

(2) Disconnect hinge drive mechanism drag links (view 1, figure 201) from aft thrust reverser sleeve assembly.

(3) Disconnect lower actuator rods (view 2) from lower actuators truck assembly by removing cotter pin, bolt, nut, and two bushings (2 places).

(4) Disconnect sleeve lower track support link (view 3) from sleeve track by removing nut, bolt, and bushing.

(5) On airplanes having sleeve forward ring upper support fitting as shown in view 4, figure 201, remove aft thrust reverser upper actuators assembly (1, view 4, figure 201) to permit removal of sleeve.

(a) Manually position thrust reverser in forward thrust position

(b) Remove aft thrust reverser sleeve access panels L3708 and R3708 in strut fairing area of sleeve.

(c) Remove bolt (3), nut, and bushing (2 places) attaching actuator assembly to tailpipe.

(d) Disconnect actuator piston rods from sleeve connection by removing bolt (2), 2 bushings, washer, nut, and cotter pin in two places.

(e) Manually move sleeve aft to gain access to upper actuator truck attachment bolts (5).

(f) Remove 3 bolts, washers, serrated splice plate and shims attaching truck to forward ring.

(g) Remove bolt (4), nut, and two bushings attaching upper actuators assembly to upper actuator support link and remove assembly (1).

(6) On airplanes having sleeve forward ring upper support fitting as shown in view 5, figure 201, proceed as follows to permit removal of sleeve.

(a) Slide sleeve forward but do not engage sleeve locks.

(b) Disconnect sleeve support fitting bolts (5), nuts (6) and shims if used.

(c) Remove aft thrust reverser sleeve access panels L3708 and R3708 in strut fairing area of sleeve.

(d) Disconnect actuator piston rods from sleeve connection by removing bolt (2), two bushings, washer, nut and cotter pin in two places.

(7) Disconnect roller truck assemblies (detail A) from tailpipe sleeve track connections (4 places).

(a) Gain access to truck assemblies through five aft thrust reverser sleeve access panels (L3708, R3708, L3710, R3710 and 3711) located half way back on sleeve at left and right hand horizontal centerline, lower vertical centerline, and on right and left hand strut fairing portion of sleeve. See Chapter 12, "Access Doors and Panels."

(b) Remove sleeve support shaft, spacer, 3 pins with cotter pins, 2 washers, 2 bushings, and 2 nuts attaching sleeve to truck assembly at support link assembly.

(8) With two men, one on each side of the sleeve assembly, slide sleeve aft over tailpipe and away from engine.

D Install Aft Thrust Reverser Sleeve

(1) Coat threaded surfaces of all bolts or shafts with anti-seize compound prior to installation.

(1A) Position 4 roller truck assemblies (detail A, figure 201) on tailcone near forward end of tracks.

(2) With two men, one on each side of the thrust reverser sleeve, position sleeve forward over tailpipe and thrust reverser assembly.

(a) Position rollers of lower actuators truck assembly in grooves at aft end of lower sleeve track prior to moving the sleeve assembly forward.

(b) Move sleeve forward until sleeve support link assemblies (detail A) on sleeve align with roller truck assemblies on tailpipe.

(3) Attach sleeve support link assemblies to roller truck assemblies (4 places).

(a) Gain access to support links and truck assemblies through five aft thrust reverser sleeve access panels (L3708, R3708, L3710, R3710 and 3711) located half way back on sleeve at left and right hand horizontal centerline, lower vertical centerline, and left and right hand sides in upper strut fairing area of sleeve.

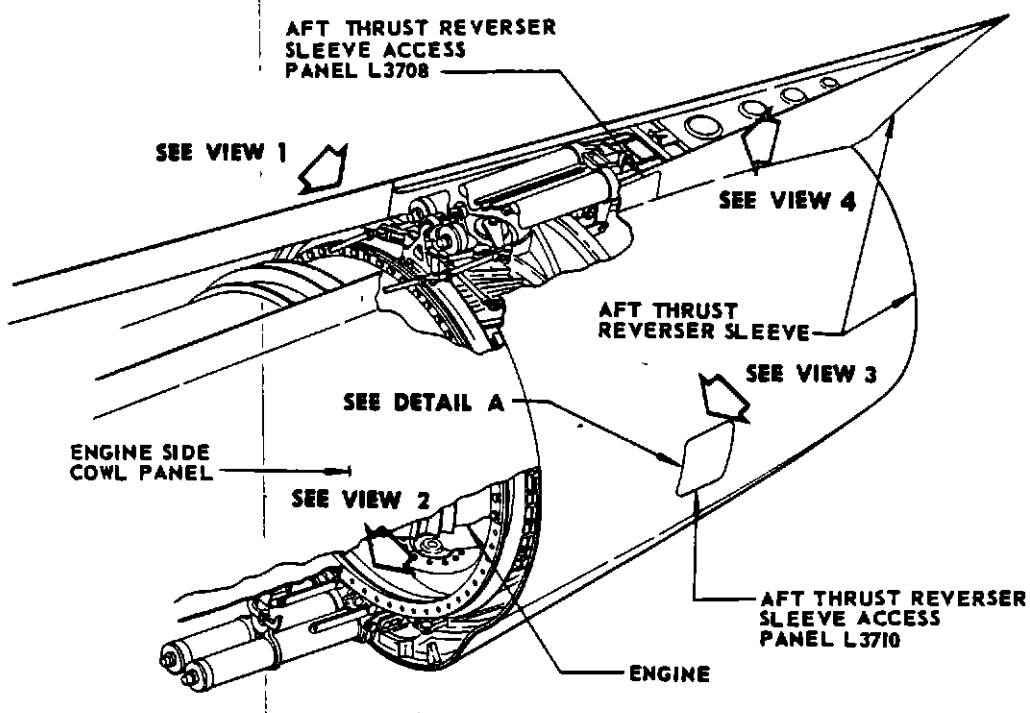
(b) Align truck with support link assembly and attach with support shaft, spacer, 3 pins with cotter pins, 2 bushings, 2 washers, and 2 nuts (4 places).

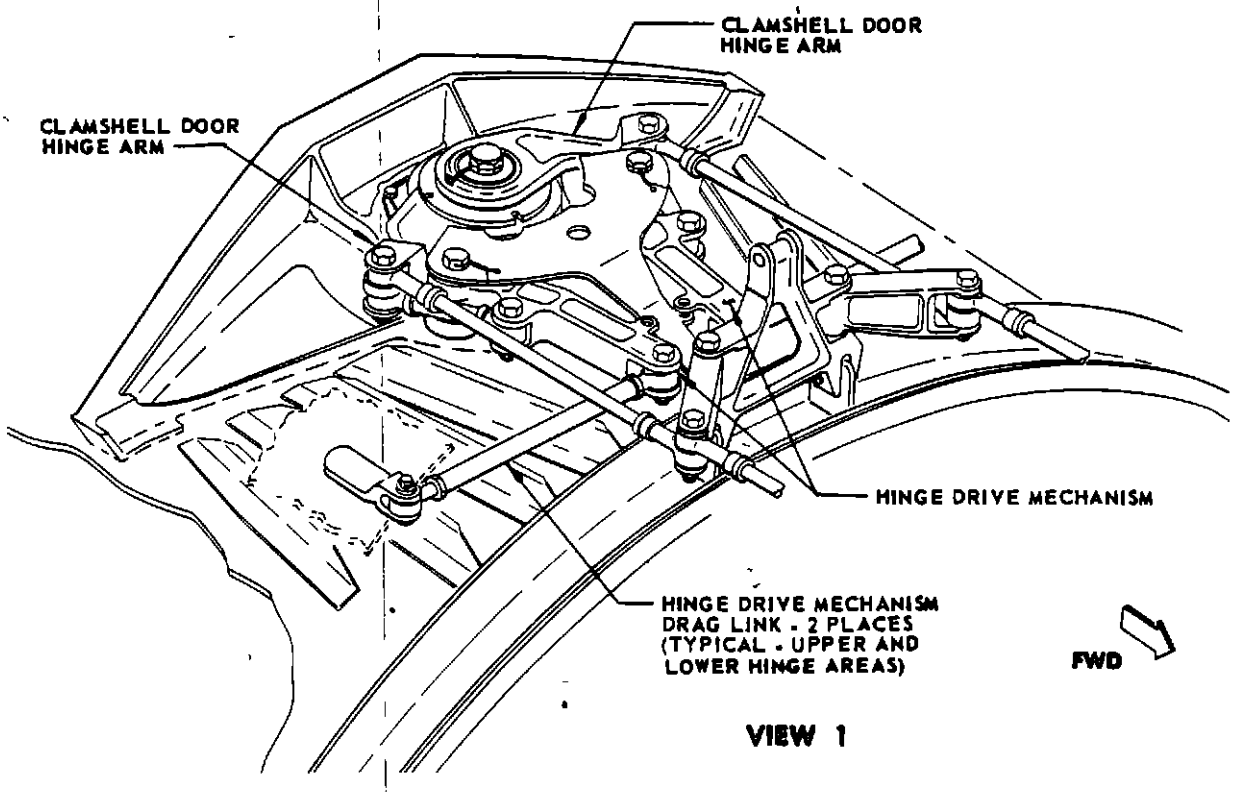
(4) On airplanes having sleeve forward ring upper support fitting as shown in view 4, figure 201, install aft thrust reverser upper actuators assembly (See view 4, figure 201)

(a) Slide sleeve forward so that sleeve forward ring is forward of tailpipe mounting flange.

(b) Position actuators from forward end of sleeve. Align upper actuator truck assembly with mounting surface on sleeve forward ring.

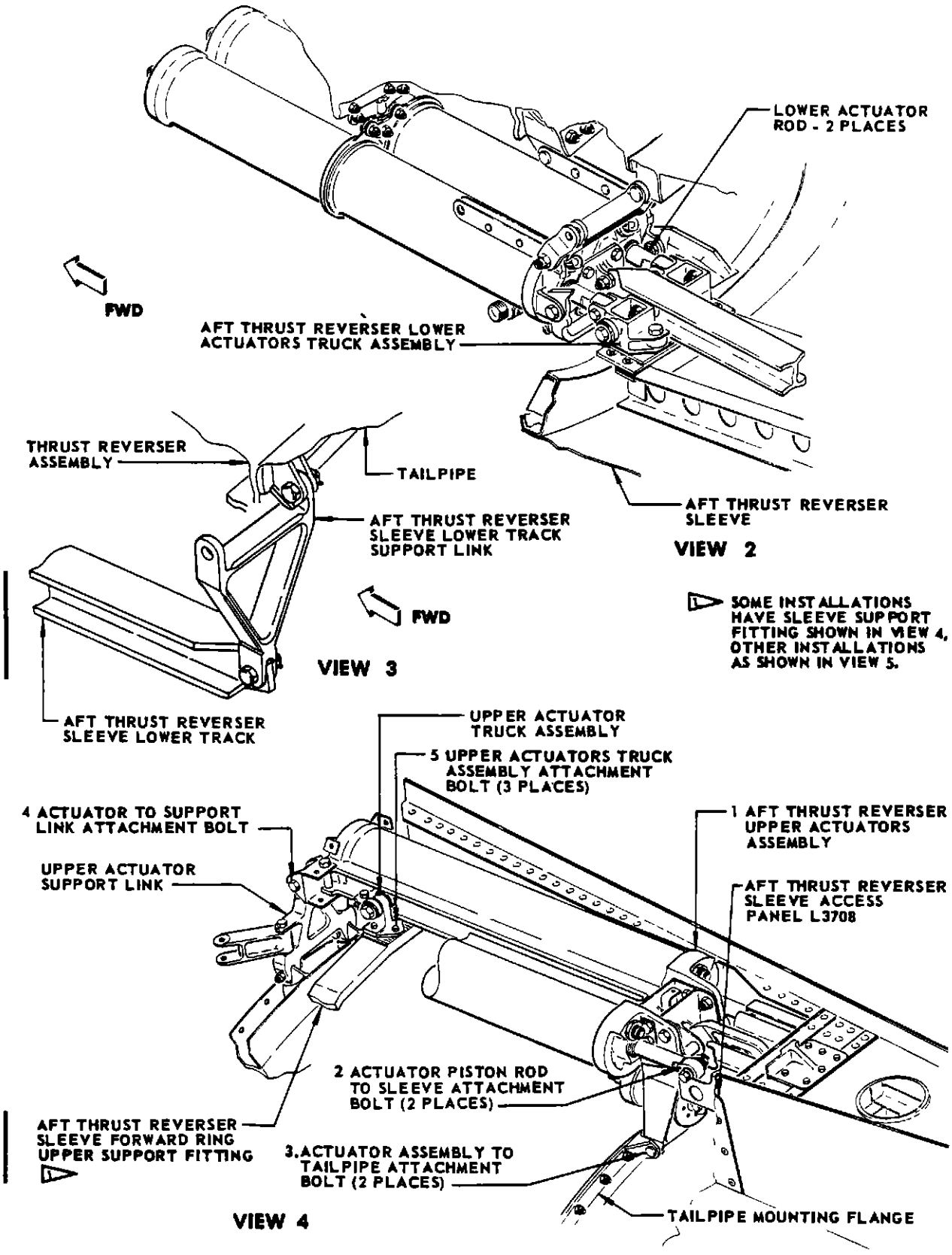
(c) Attach sleeve forward ring to upper actuator truck with 3 bolts (5) and washers, serrated splice plate, and shims. Position splice plate and shims between truck and upper surface of forward ring. Install bolts from bottom side of ring.

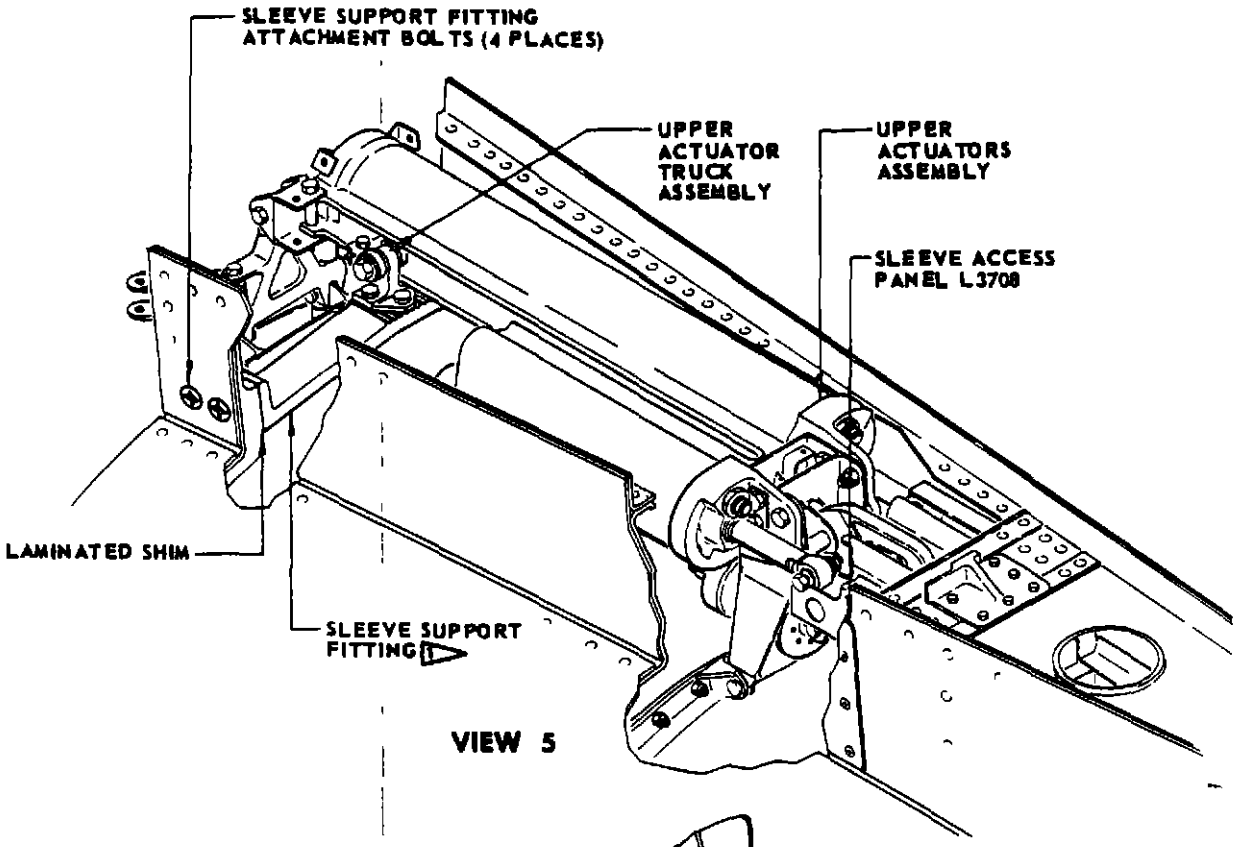


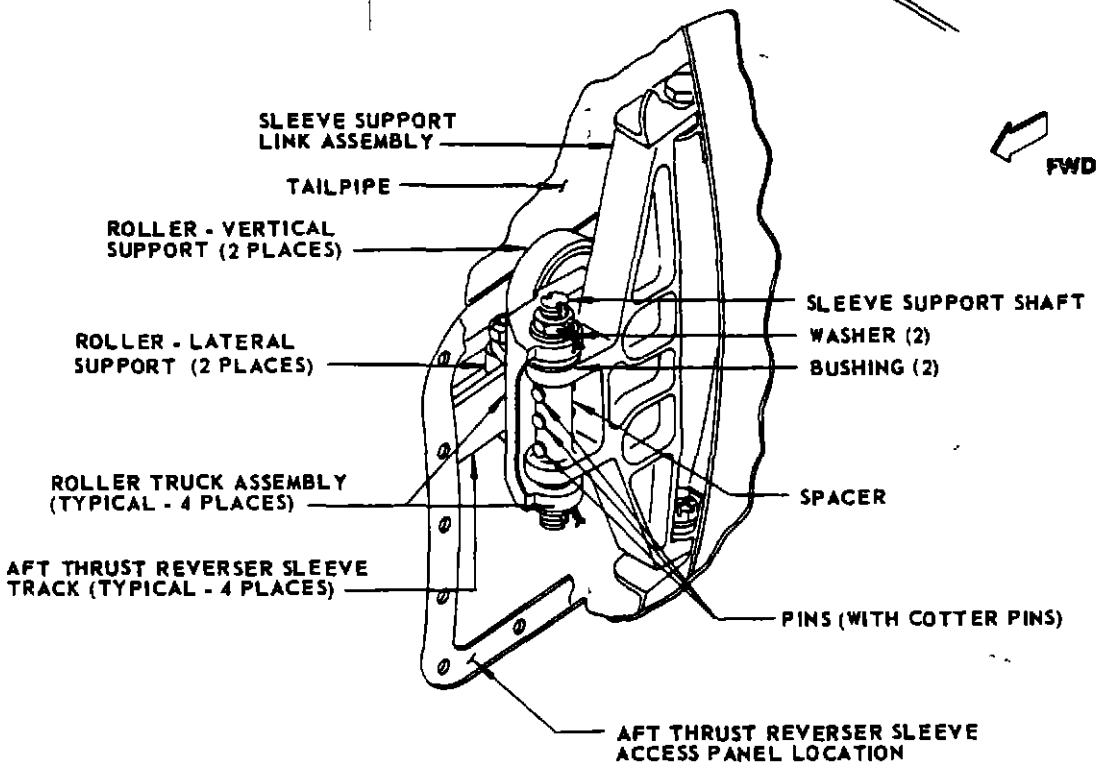


VIEW 1

Aft Thrust Reverser Sleeve Installation
Figure 201 (Sheet 1 of 3)


LOWER ACTUATOR ROD - 2 PLACES
FWD
AFT THRUST REVERSER LOWER ACTUATORS TRUCK ASSEMBLY
THRUST REVERSER ASSEMBLY
TAILPIPE
AFT THRUST REVERSER SLEEVE LOWER TRACK SUPPORT LINK
AFT THRUST REVERSER SLEEVE
VIEW 2
SOME INSTALLATIONS HAVE SLEEVE SUPPORT FITTING SHOWN IN VIEW 4, OTHER INSTALLATIONS AS SHOWN IN VIEW 5.
FWD
VIEW 3
AFT THRUST REVERSER SLEEVE LOWER TRACK
UPPER ACTUATOR TRUCK ASSEMBLY
5 UPPER ACTUATORS TRUCK ASSEMBLY ATTACHMENT BOLT (3 PLACES)
4 ACTUATOR TO SUPPORT LINK ATTACHMENT BOLT
1 AFT THRUST REVERSER UPPER ACTUATORS ASSEMBLY
UPPER ACTUATOR SUPPORT LINK
AFT THRUST REVERSER SLEEVE ACCESS PANEL L3708
2 ACTUATOR PISTON ROD TO SLEEVE ATTACHMENT BOLT (2 PLACES)
AFT THRUST REVERSER SLEEVE FORWARD RING UPPER SUPPORT FITTING
3.ACTUATOR ASSEMBLY TO TAILPIPE ATTACHMENT BOLT (2 PLACES)
TAILPIPE MOUNTING FLANGE
VIEW 4





DETAIL A

Aft Thrust Reverser Sleeve Installation
Figure 201 (Sheet 3 of 3)

(d) Attach actuators to tailpipe with bolt (3), nut, and bushing (2 places).

(e) Attach actuators to upper actuator support link with bolt (4), nut, and two bushings.

(5) On airplanes having sleeve forward ring upper support fitting as shown in view 5, figure 201, connect thrust reverser sleeve to support fitting.

(a) Manually position sleeve to forward thrust position.

(b) Align sleeve support fitting attached to upper truck assembly with attachment holes on forward end of aft thrust reverser sleeve and install sleeve fitting attachment bolt (5) and nut (6) four places. Install shims as necessary between sleeve and support fitting to maintain alignment of sleeve with strut and side cowl panels per 78-5-61, "Rig Aft Thrust Reverser." Use maximum of 2 shims per side and remove .002 inch laminations as required.

(6) Attach lower track support link assembly (view 3) to track.

(7) Install aft thrust reverser upper actuators assembly piston rods to sleeve using bolt (2, view 4) in two places.

(a) With sleeve in reverse thrust position, gain access to actuator rods and sleeve connection through access panels L3708 and R3708.

(b) Position eccentric bushing in rod end.

(c) Position plain bushing in eccentric bushing.

(d) Attach rod end with bolt (2) nut, washer, and cotter pin to sleeve connection.

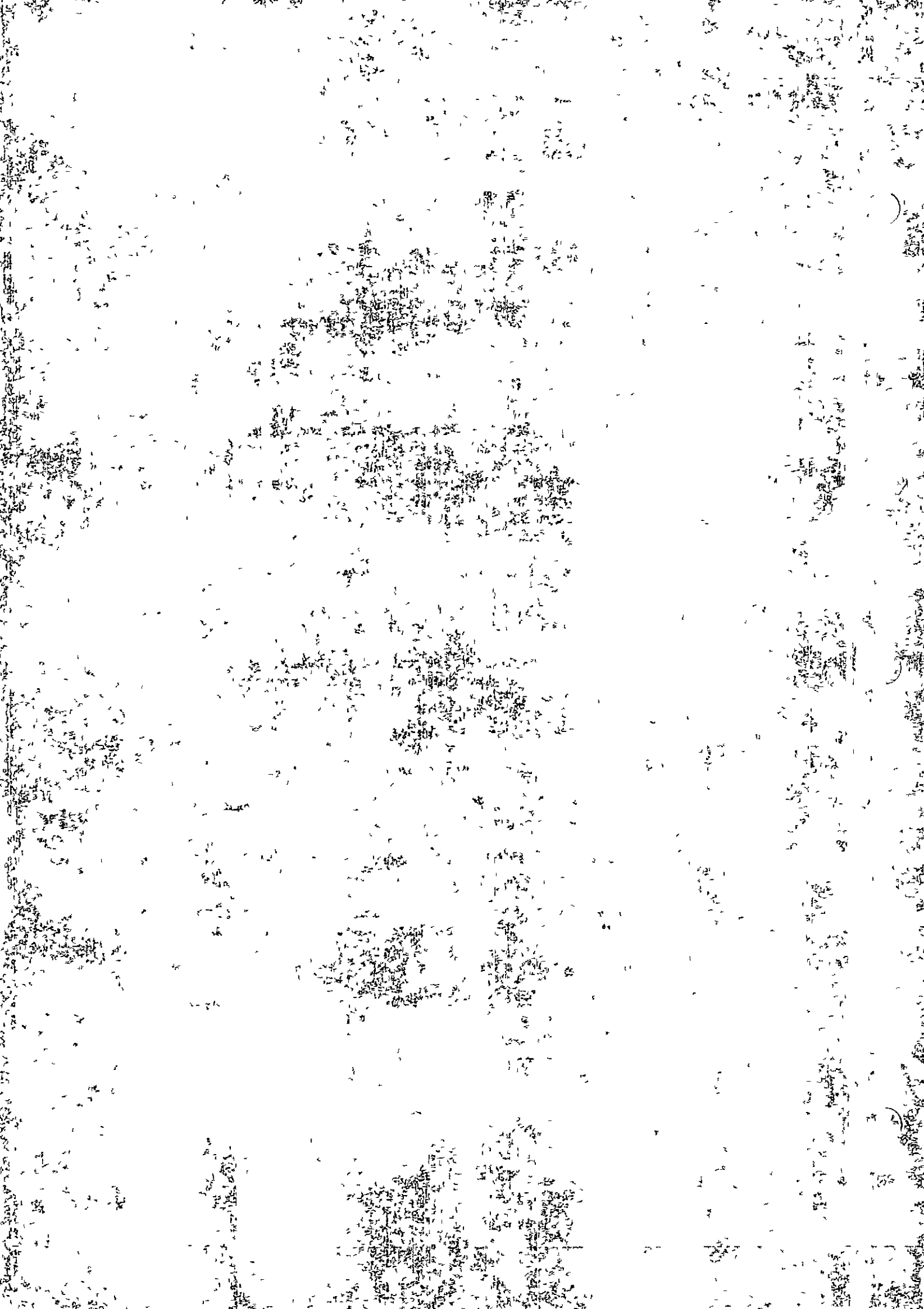
(8) Install aft thrust reverser lower actuators assembly piston rods (view 2) to sleeve.

(a) Position rod end between truck connection mounting flanges and attach with bolt, bushings, cotter pin and nut (2 places).

(9) Attach hinge drive mechanism drag links (view 1) to sleeve.

(a) Position drag link rod ends at attachment flanges on sleeve and attach with pin, washer, and cotter pin (4 places).

(10) Adjust entire installation. See 78-5-61, "Adjustment/Test Aft Thrust Reverser."



TAILPIPE - MAINTENANCE PRACTICES

1. Removal/Installation Tailpipe

A. General

(1) The tailpipe may be removed by removing the aft thrust reverser sleeve and then removing the tailpipe from the aft thrust reverser assembly.

B. Equipment and Materials

(1) Antiseize Compound, Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent

C. Remove Tailpipe

(1) Remove aft thrust reverser sleeve. (See 78-5-71, Remove Aft Thrust Reverser Sleeve.)

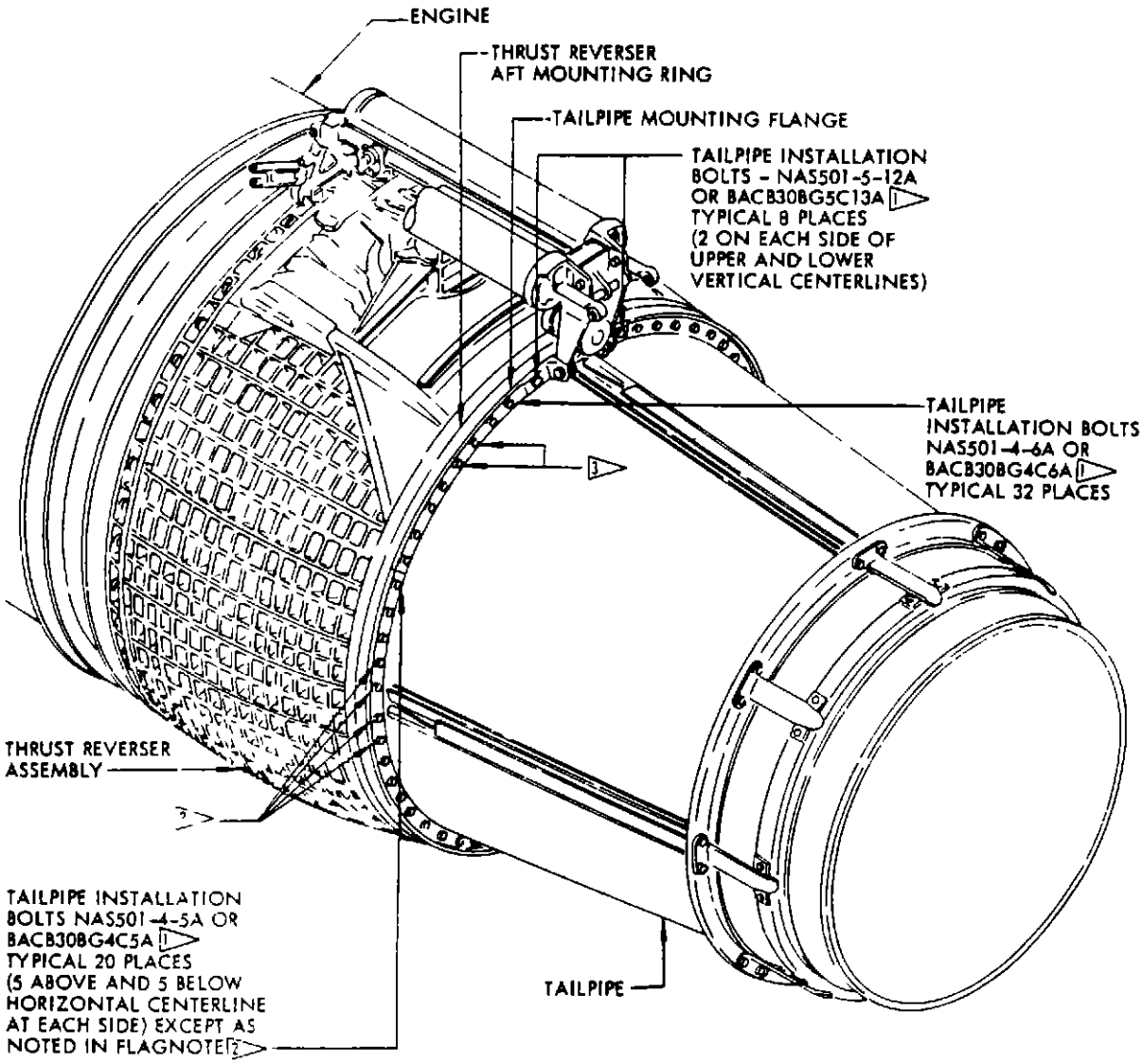
(2) Remove bolts (60 places) at tailpipe mounting ring, holding tailpipe to aft thrust reverser assembly. Remove upper bolts last.

D. Install Tailpipe

(1) Coat threaded surface and shank to head of all bolts with antiseize compound prior to installation.

(2) Position tailpipe on thrust reverser assembly aft mounting ring and install with 60 bolts per figure 201.

(3) Install aft thrust reverser sleeve. (See 78-5-71, Install Aft Thrust Reverser Sleeve.)



[1] THE BACB30BC BOLTS ARE INSTALLED ON LATER AIRPLANES AND ARE THE PREFERRED PARTS

[2] BACB30G4C10A BOLTS ARE USED TWO PLACES ABOVE AND TWO PLACES BELOW THE HORIZONTAL CENTERLINE ON BOTH SIDES OF THE TAILPIPE ON THRUST REVERSERS WHICH HAVE CASCADE VANE ASSEMBLIES AND BLOCKER SEGMENTS BOLTED TO THE THRUST REVERSER AFT MOUNTING RING AND TAILPIPE

[3] BACB30BG4C11A USED AT 5TH AND 6TH BOLT LOCATION ON EITHER SIDE OF 6 00 AND 12 00 O'CLOCK POSITIONS ON AIRPLANES USING NEW BOLTED FRAME ASSEMBLY (65-16032-34)

CASCADE VANE ASSEMBLIES - MAINTENANCE PRACTICES

1. Removal/Installation Cascade Vane Assemblies

A. General

(1) Cascade vane assemblies may be removed from the aft thrust reverser while it is installed on the airplane provided the thrust reverser is in the reverse thrust position.

B. Equipment and Materials

(1) Antiseize compound - Ease-Off, 990 (Texacone Company, Dallas 8, Texas) or equivalent

(2) Air pressure source - 0 to 60 psig

C. Remove Cascade Vane Assemblies

(1) Place thrust reverser in reverse thrust position.

(a) Connect air pressure source to ground service connection and regulate to 30 psig.

(b) Move applicable reverse thrust lever in control cab aft to interlock position. Check that thrust reverser has actuated to reverse thrust position.

(c) Disconnect ground air supply.

WARNING. WITH THRUST REVERSER IN REVERSE THRUST POSITION, GROUND AIR SOURCE MUST BE DISCONNECTED BEFORE WORKING ON THRUST REVERSER TO PRECLUDE INJURY TO PERSONNEL.

(2) Remove bolts holding vane assemblies or blocker segment to thrust reverser forward support ring. (See figure 202.)

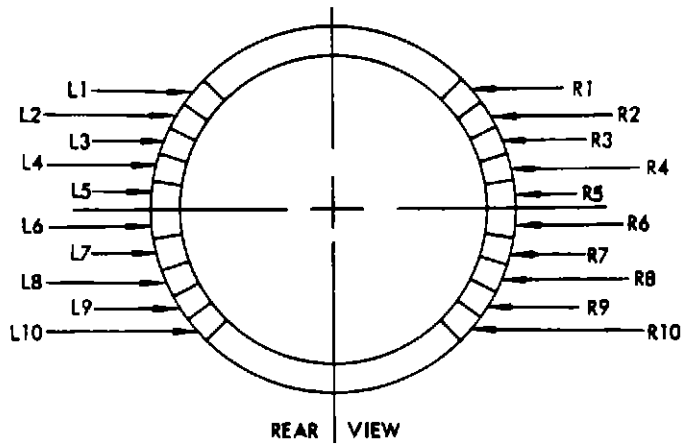
(3) At the two vane assembly locations on either side of the horizontal centerline of the reverser on both sides of the reverser (3.00 and 9 00 o'clock positions) remove two bolts (not on all installations) that secure each segment at the aft end to the thrust reverser aft mount flange and the tailpipe mount flange.

NOTE: To determine whether the vane segment is bolted at the aft end look at the forward side of the aft member of the vane segment inside the recess of the thrust reverser aft mounting flange. If two nutplates and protruding bolt shanks are visible, the segment is bolted.

(4) Remove vane assemblies by lifting out and forward from thrust reverser. Tag removed vane assemblies and shims with location numbers as shown in figure 201 to facilitate identification of vane assembly with respect to installation position.

D. Install Cascade Vane Assemblies

(1) Deleted



CASCADE VANE ASSEMBLY LOCATIONS - TYPICAL

WHEN REMOVING VANE ASSEMBLIES, TAG WITH LOCATION NUMBERS AS SHOWN ABOVE, OR USE ANY EQUIVALENT SYSTEM FOR IDENTIFYING POSITION OF VANE ASSEMBLY ON REVERSER

Cascade Vane Assembly Location Diagram
Figure 201

(2) Coat threaded surface and shank to head of all bolts with antiseize compound prior to installation.

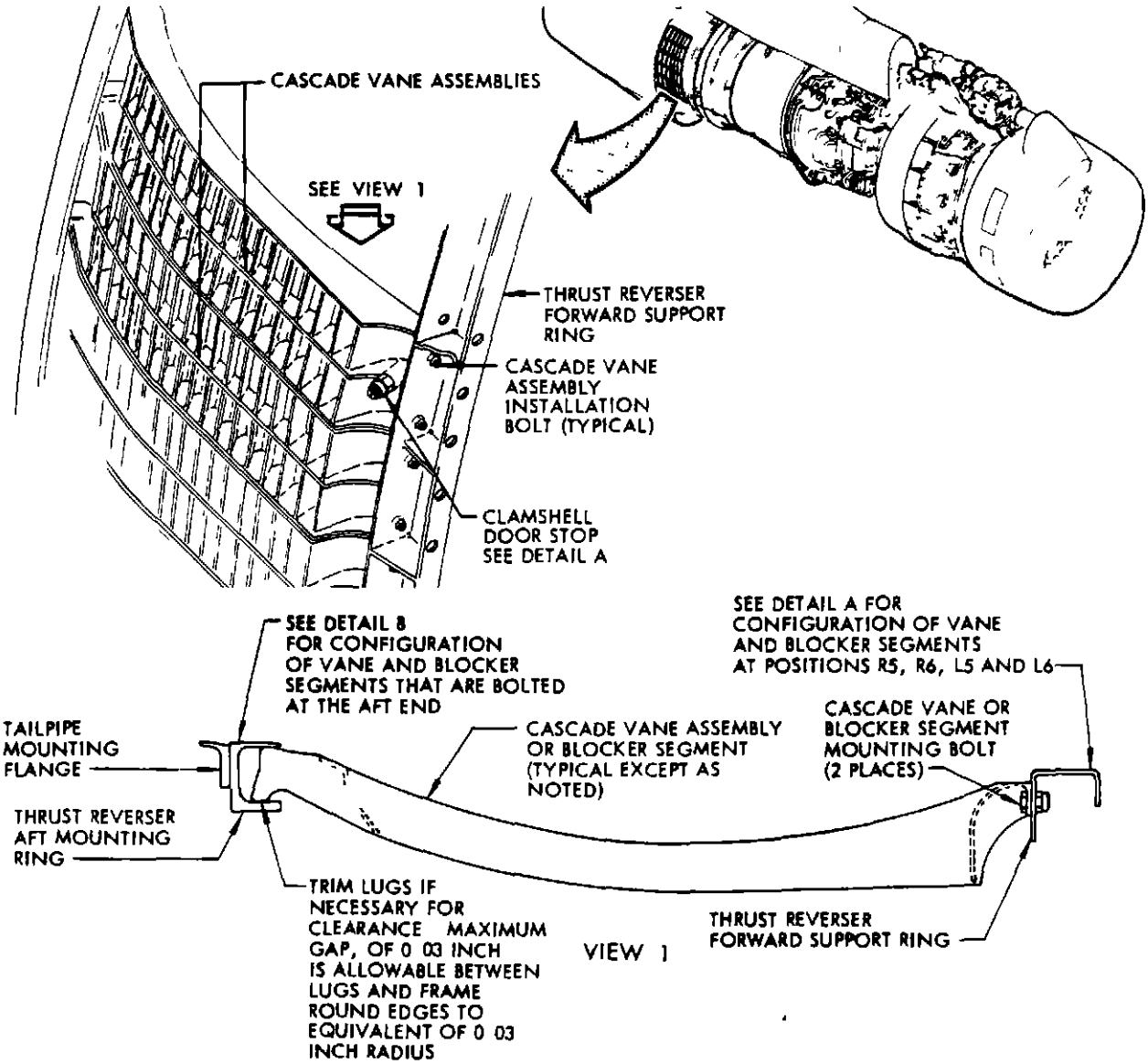
(3) Position cascade vane assembly or assemblies on thrust reverser per figure 201 and attach with bolts to thrust reverser forward support ring. (See figure 202.)

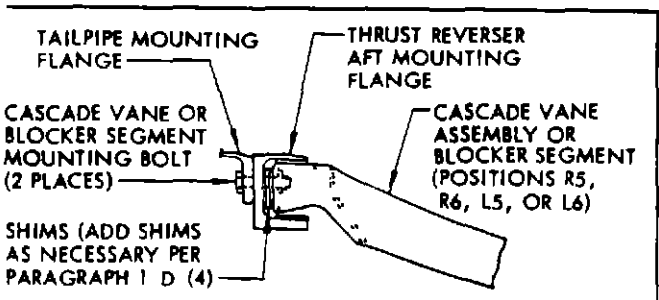
(4) If the vane or blocker segment has installation holes at both ends, proceed as follows:

(a) Position vane assembly or blocker segment at thrust reverser aft mounting flange and shim as necessary between vane or blocker segment and thrust reverser aft flange to obtain flush fit between forward end of vane segment and thrust reverser mounting flange (maximum gap allowable is 0.005 inch). (See figure 202) Secure vane or blocker segment with two bolts through tailpipe, thrust reverser flange, shims and segment.

(b) Secure vane or blocker segment to thrust reverser forward mounting flange with 2 bolts and nuts.

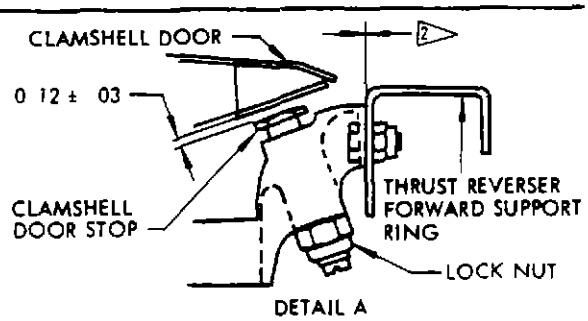
(5) Check and adjust clearance between clamshell door and clamshell door stops to 0.12 (± 0.03) inch. See figure 202 for correct positioning of stops. Vane assemblies having clamshell door stops are located in positions R4 through R7 and L4 through L7 as called out in figure 201.





DETAIL B 1

1 VANE AND BLOCKER SEGMENTS AS SHOWN IN DETAIL B ARE INSTALLED IN POSITIONS R5, R6, L5, AND L6 ON LATER INSTALLATIONS ONLY



DETAIL A

2 FLUSH FIT (MAXIMUM GAP ALLOWABLE IS 0 005 INCH) BETWEEN VANE OR BLOCKER SEGMENTS AND THE THRUST REVERSER FORWARD SUPPORT RING TO BE OBTAINED ON SEGMENTS THAT ARE BOLTED AT THE AFT END AS SHOWN IN DETAIL B OBTAIN BY SHIMMING PER PARAGRAPH 1 D (4)

Cascade Vane Assembly Installation
Figure 202

CLAMSHELL DOOR - MAINTENANCE PRACTICES

1. Removal/Installation Clamshell Door

A. Equipment and Materials

(1) Air pressure source - 0 to 200 psig capacity.

(2) Antiseize compound - Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent

(3) Clamshell door spreader bar or retracting tool - F70061 or equivalent.

B. Remove Clamshell Door

(1) Remove aft thrust reverser sleeve. See 78-5-71, "Remove Aft Thrust Reverser Sleeve."

(2) Remove tailpipe. See 78-5-81, "Remove Tailpipe."

(3) Disconnect aft thrust reverser follow-up rods at aft follow-up idler link connections. See figure 201, 78-5-61.

(4) Manually rotate clamshell doors to forward thrust position.

(5) Remove bolts holding clamshell door to hinge face.

(6) Install clamshell retracting rod assembly on clamshell door.

(a) Remove rod ends from rod assembly.

(b) Thread rod ends into two tapped holes on interfaces of clamshell door attachment fittings.

(c) Position rod assembly and secure to rod ends with flat head pins.

(7) Compress door to overall dimension of 35.06 (+0.00/-0.10) inches with rod assembly.

(8) Remove door through rear of thrust reverser.

CAUTION EXERCISE CARE WHEN REMOVING DOOR TO PREVENT DAMAGE TO HUB SEAL.

C. Install Clamshell Door

(1) Install clamshell retracting rod assembly on clamshell door.

(a) Remove rod ends from rod assembly.

(b) Thread rod ends into two tapped holes on interfaces of clamshell door attachment fittings.

(c) Position rod assembly and secure to rod ends with flat head pins.

(2) Compress clamshell door to overall dimension of 35.06 (+0.00/-0.10) inches with rod assembly.

(3) Position door in thrust reverser and start several bolts on each end of door.

(4) Remove rod assembly.

(a) Expand rod assembly and remove from rod ends.

(b) Remove rod ends from clamshell door attachment fittings.

(5) Coat thread surfaces and complete shank of bolts with thread lubricant.

(6) Install remaining bolts through door fitting and hinge face. Torque bolts 95 to 110 pound-inches.

NOTE: 0.032 inch thick washers may be used if and as required to maintain minimum clearance of 0.04 inches between clamshell door installation bolts and hinge support fitting.

(7) Install tailpipe. See 78-5-81, "Install Tailpipe."

(8) Replace aft thrust reverser sleeve. See 78-5-71, "Install Aft Thrust Reverser Sleeve."

EXHAUST PLUG - MAINTENANCE PRACTICES

1 Removal/Installation Exhaust Plug

A. General

(1) The exhaust plug may be removed by removing the cascade vane assemblies on either side of the aft thrust reverser with the aft thrust reverser sleeve and the clamshell doors in the reverse thrust position.

B. Special Materials

(1) Antiseize compound, Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent

C Remove Exhaust Plug

(1) Open engine side cowl panels.

(2) Manually move aft thrust reverser sleeve aft to reverse thrust position

(3) Remove cascade vane assemblies. See 78-5-91, "Remove Cascade Vane Assemblies."

(4) Remove bolts in exhaust plug support ring holding exhaust plug to engine plug support and remove.

D Install Exhaust Plug

(1) Install exhaust plug by installing bolts holding exhaust plug to engine plug support Coat threaded surfaces and complete shank of bolt with antiseize compound.

(2) Install cascade vane assemblies. See 78-5-91, "Install Cascade Vane Assemblies "

(3) Return aft thrust reverser to forward thrust position

(a) Connect ground air supply to ground service connection. Gain access to ground service connection through access panels 1705, 1737 or 3716 on strut. See Access Doors and Panels, 12-2-0.

(b) With applicable reverse thrust lever in control cab and "IDLE" position, regulate ground air supply to 30 psig to bring thrust reverser to forward thrust position.

(4) Close side cowl panels.

2. Inspection/Check Exhaust Plug

A. General

(1) The following exhaust plug crack and damage limits are emergency limits only to allow operation of the aircraft to a main base where the plug can be repaired or replaced. Field repairs should not be attempted for damage beyond the limits given below. A plug damaged beyond these limits should be replaced.

B. Visually inspect the exhaust plug for cracks and other damage.

(1) Circumferential cracks up to four inches in length at any location on the plug are allowable

(2) Longitudinal cracks up to two inches in length at any location on the plug are allowable.

(3) Loss of a plug tip not to exceed five inches is allowable provided ragged edges are bent inward.

(4) Cracks extending longitudinally into the tip area of the plug must be included within the five inch maximum limit per step (3) if plug tip removal is planned.

THRUST REVERSER CONTROL SYSTEM - DESCRIPTION AND OPERATION

1. General

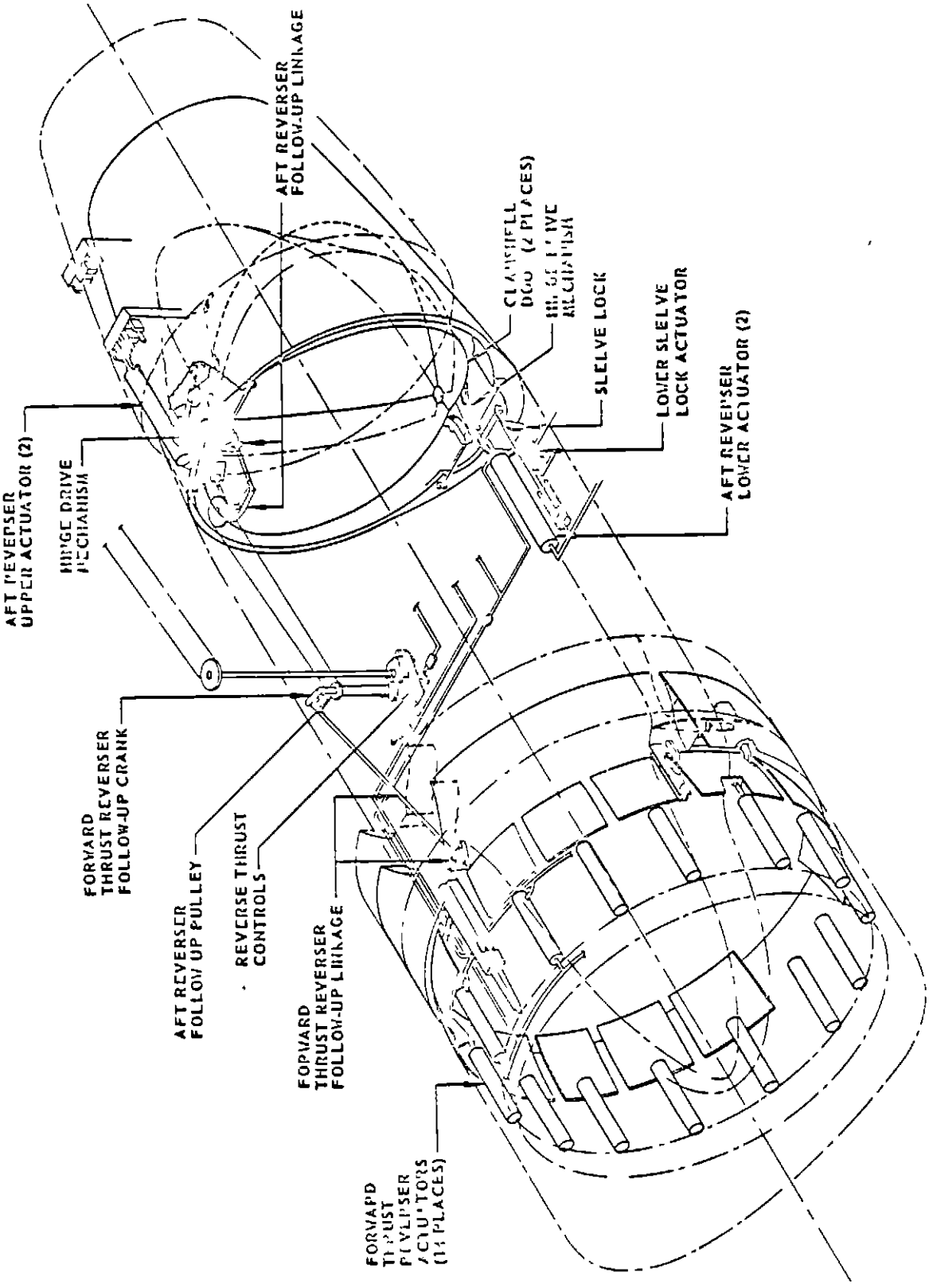
A. The thrust reverser control system directs pneumatic pressure to the actuators of the forward and aft thrust reversers which position the flow reversing components for the desired forward or reverse thrust operations. The system consists of the reverse thrust controls mounted on the thrust control shaft and on the engine controls strut bracket, forward thrust reverser follow-up linkage, aft thrust reverser follow-up linkage, hinge drive mechanisms, forward thrust reverser actuators, aft reverser actuator assemblies, and miscellaneous control system components. (See figure 1.)

B. A lock-out feature in the system prevents application of full forward or reverse thrust until the flow reversing components of the forward and aft thrust reversers have nearly reached their full travel position for forward or reverse thrust. A forward thrust reverser locking cam and an aft thrust reverser locking cam lock the thrust control shaft in a partial thrust position until follow-up linkages connecting the cams to the forward thrust reverser cowl ring and aft reverser sleeve reposition the cams to allow full forward or reverse thrust operation. An override provision on the forward thrust reverser interlock allows application of increased thrust by manual override of a spring loaded interlock position if additional thrust is required to move the forward thrust reverser back to the cruise position.

C. The reverse thrust controls direct pneumatic air to the actuators to position the reversers for the forward or reverse thrust position. The forward thrust reverser actuators control the movement of the cowl ring assembly, blocker doors, and lower vane assemblies. The aft thrust reverser actuators control the movement of the aft reverser sleeve which operates the hinge drive mechanism and causes the clamshell doors to open and close.

2. Reverse Thrust Controls

A. The reverse thrust controls consist of a thrust reverser directional control valve, a rocker arm mechanism, thrust reverser directional valve actuating cam, forward thrust reverser locking cam, aft thrust reverser locking cam, aft thrust reverser follow-up pulley, forward thrust reverser follow-up crank, and two concentric shafts on which the locking cams, follow-up crank, and follow-up pulley are mounted. The directional valve actuating cam is installed on the lower end of the thrust control shaft at the engine strut. The other reverse thrust controls are installed at the engine controls strut bracket which is installed over the lower end of the throttle and start shafts.

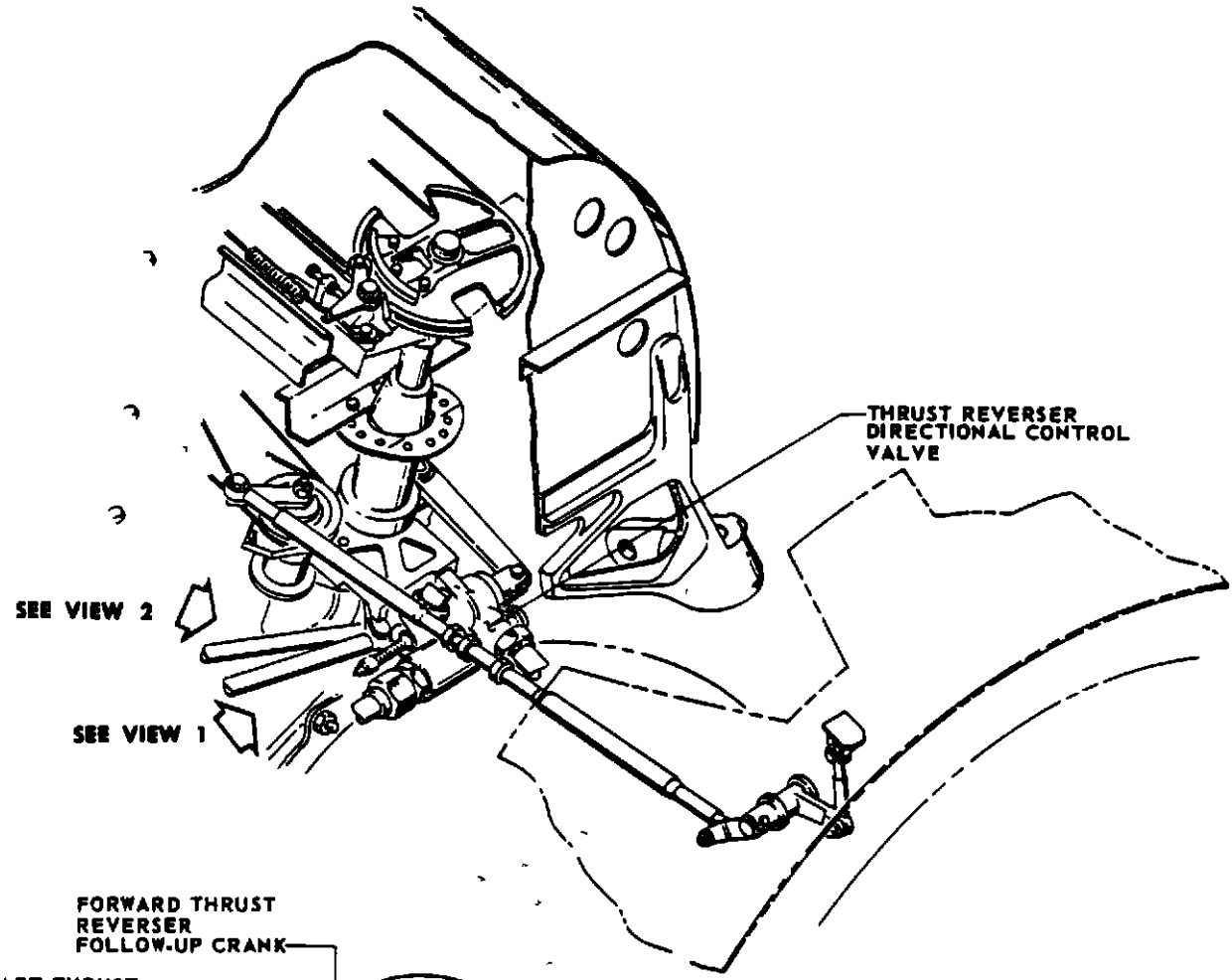


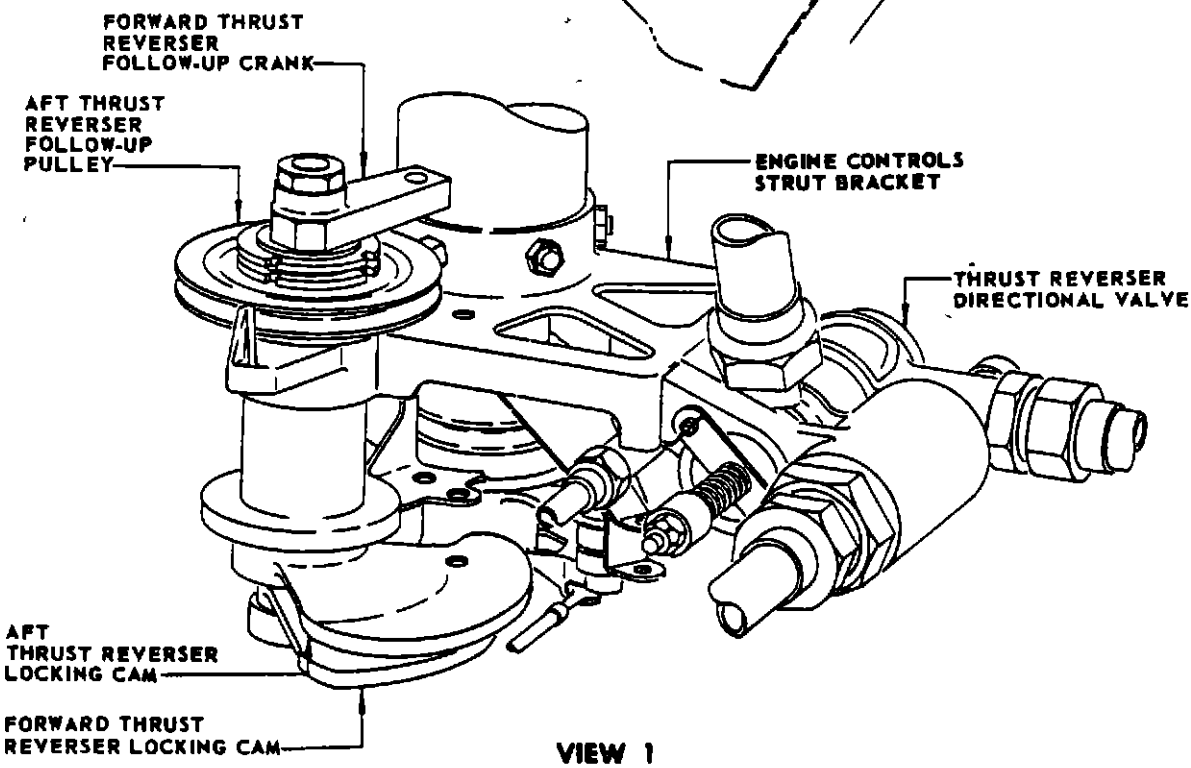
Thrust Reverser Control System Component Location
Figure 1

B. The thrust reverser directional valve actuating cam transmits thrust lever movement from the thrust control shaft to the thrust reverser directional valve through a rocker arm mechanism to position the directional valve for the selected thrust condition. Four stops, installed on the cam, bear on the thrust reverser locking cams during thrust reverser actuation to limit thrust control shaft rotation while the thrust reversers are intransit between thrust positions. Two of the stops are rollers mounted one above the other and bear on the locking cams during reverse thrust actuation. The other two stops bear on the locking cams during forward thrust actuation. The stop that interlocks with the aft thrust reverser locking cam is a fixed stop. The stop that interlocks with the forward thrust reverser locking cam is a spring loaded pivoting stop. The stop arrangement allows override of the interlock, by application of increased force on the thrust lever which compresses the spring loaded stop, thereby increasing thrust. The interlock override provision is used when additional bleed pressure is required to return the forward thrust reverser to cruise position.

C. The thrust reverser directional valve is a simple, two-position valve that receives its position input from the directional valve actuating cam to provide the pneumatic signal for thrust reverser actuation. The directional valve piston is positioned by the directional valve actuating cam through a rocker arm mechanism to route engine bleed air through either or two ports on the valve to the "reverse" or "cruise" pneumatic manifolds.

D. The forward thrust reverser follow-up crank and aft thrust reverser follow-up pulley are installed on the upper end of two concentric shafts through the engine controls strut bracket. The follow-up crank is installed on the inner shaft and the follow-up pulley on the outer shaft The forward thrust reverser locking cam is installed on the lower end of the inner shaft The aft thrust reverser locking cam is installed on the lower end of the outer shaft The follow-up crank and follow-up pulley are connected by the follow-up linkages to the respective forward or aft thrust reverser. The locking cams bear on the directional valve actuating cam to provide throttle shaft lockout during thrust reverser actuation. The follow-up pulley and the follow-up crank transmit thrust reverser movement from the follow-up linkages through the concentric shafts to reposition the locking cams and remove the interlock when thrust reverser travel is completed.



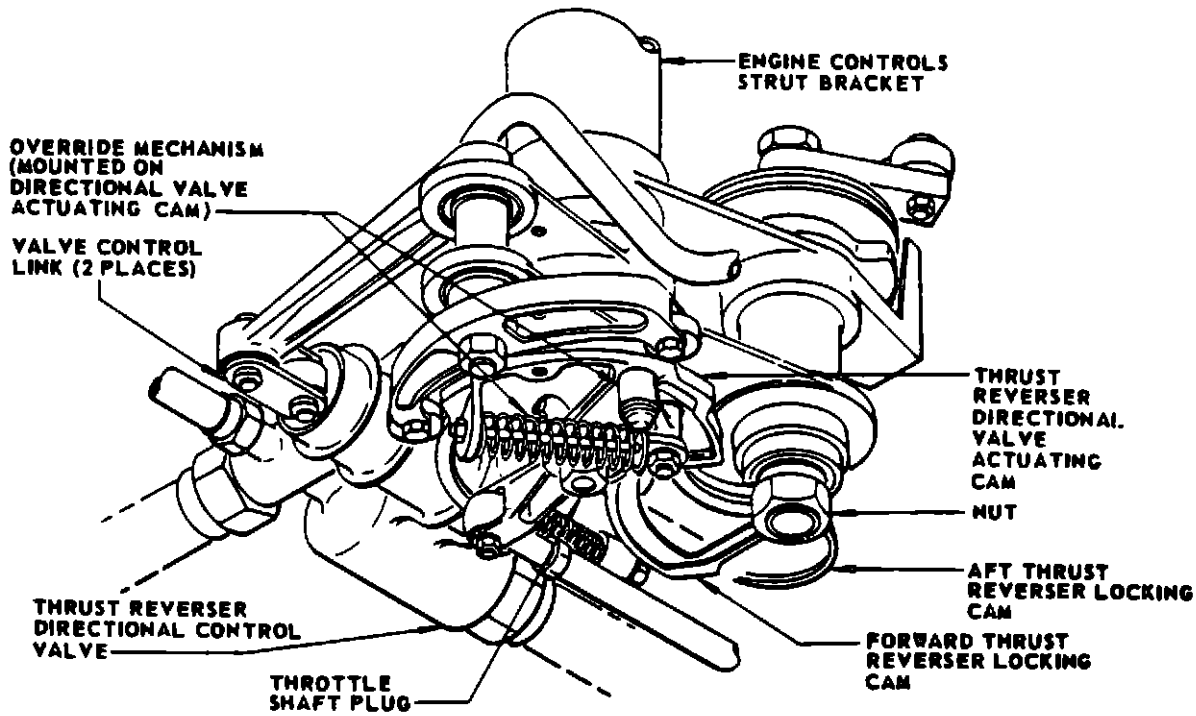


VIEW 1

Reverse Thrust Controls
Figure 2 (Sheet 1 of 2)

3. Forward Thrust Reverser Follow-Up Linkage

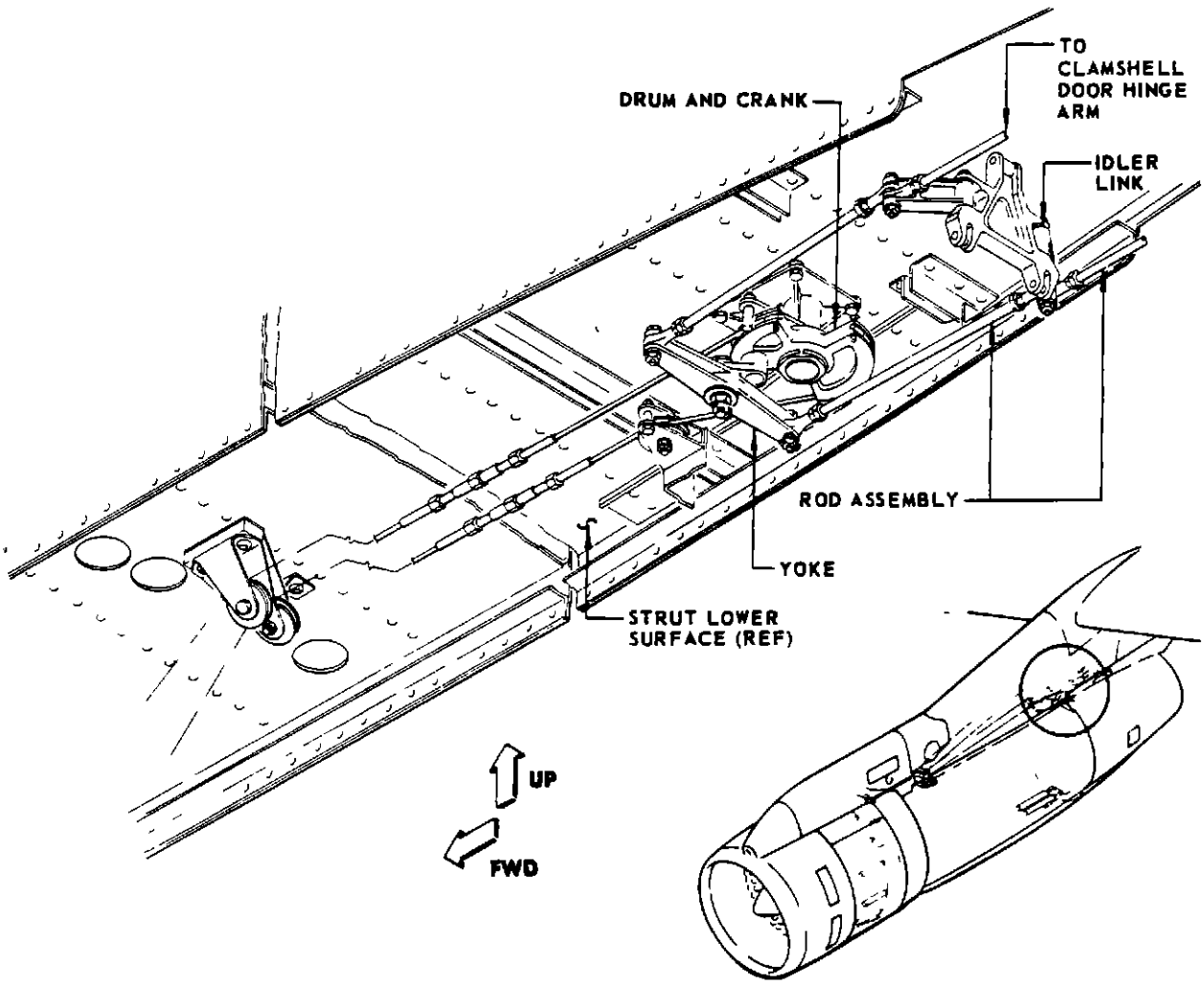
A. The forward thrust reverser follow-up linkage controls the position of the forward thrust reverser locking cam, preventing application of full forward or reverse thrust until the forward thrust reverser has assumed the correct position for the selected thrust condition. The linkage consists of a rod assembly, linkage connecting the rod assembly to the forward thrust reverser cowl ring assembly, and a follow-up crank connecting the rod assembly through a shaft to the forward thrust reverser locking cam. (See figure 2.) The follow-up linkage is controlled by movement of the cowl ring assembly. The follow-up crank is on the same shaft as the forward thrust reverser locking cam. When the forward thrust reverser is actuated, movement of the cowl ring repositions the follow-up crank, causing the locking cam to be repositioned.



VIEW 2

4. Aft Thrust Reverser Follow-Up Linkage

A. The aft thrust reverser follow-up linkage controls the position of the aft thrust reverser locking cam, preventing application of full forward or reverse thrust until the aft thrust reverser has moved to the correct position for the selected thrust condition. The linkage consists of a follow-up pulley mounted on a shaft at the engine controls strut bracket; a yoke and a drum and crank assembly mounted on the strut and connected to the follow-up pulley by a cable; and idler links and rod assemblies connecting the clamshell door hinge arm to the yoke. (See figure 3.) Movement of the hinge drive mechanism operates the follow-up linkage, causing rotation of the follow-up pulley. The aft thrust reverser locking cam is mounted on the same shaft as the follow-up pulley, and is repositioned by rotation of the shaft.



Aft Thrust Reverser Follow-up Linkage
Figure 3

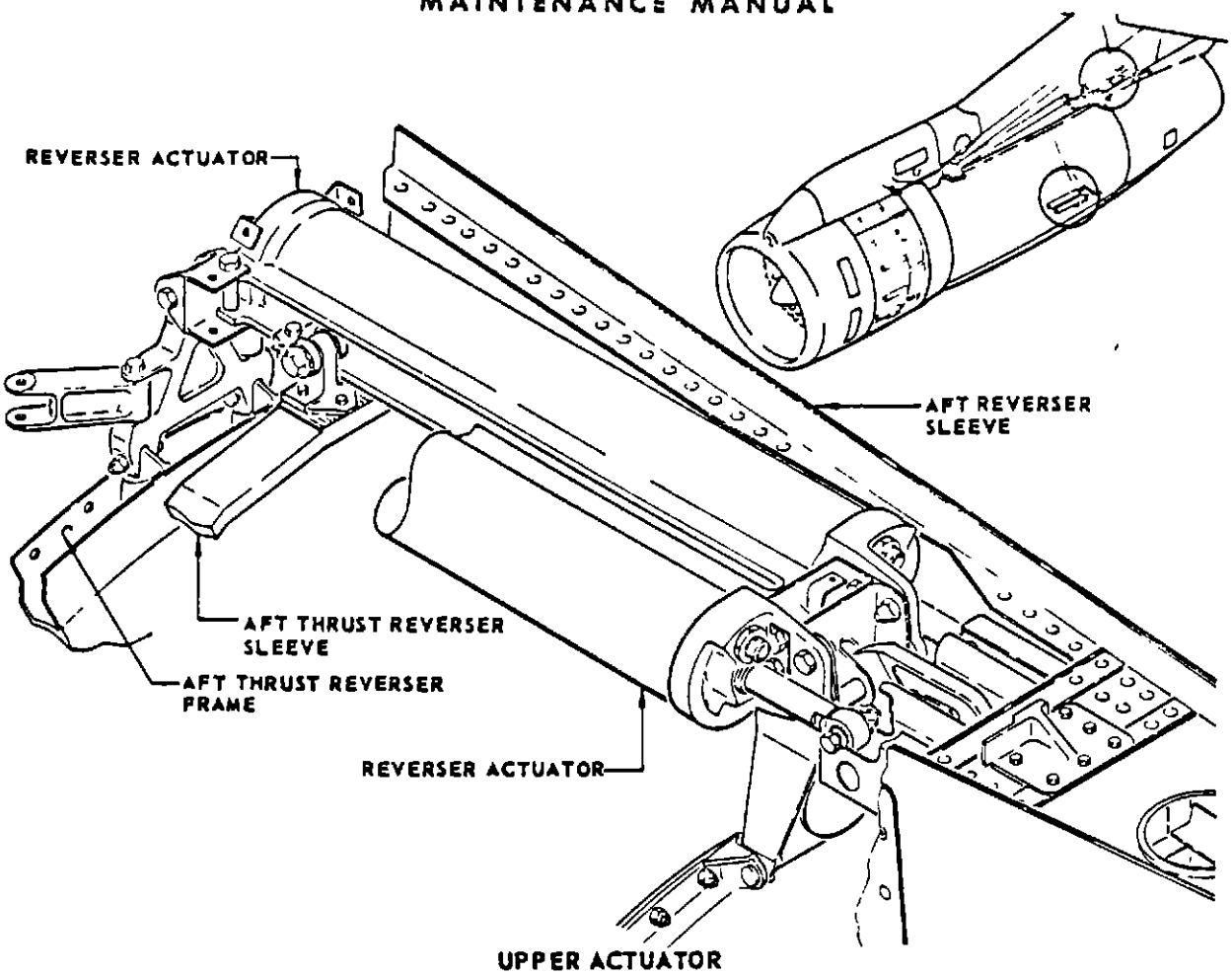
5. Forward Thrust Reverser Actuators

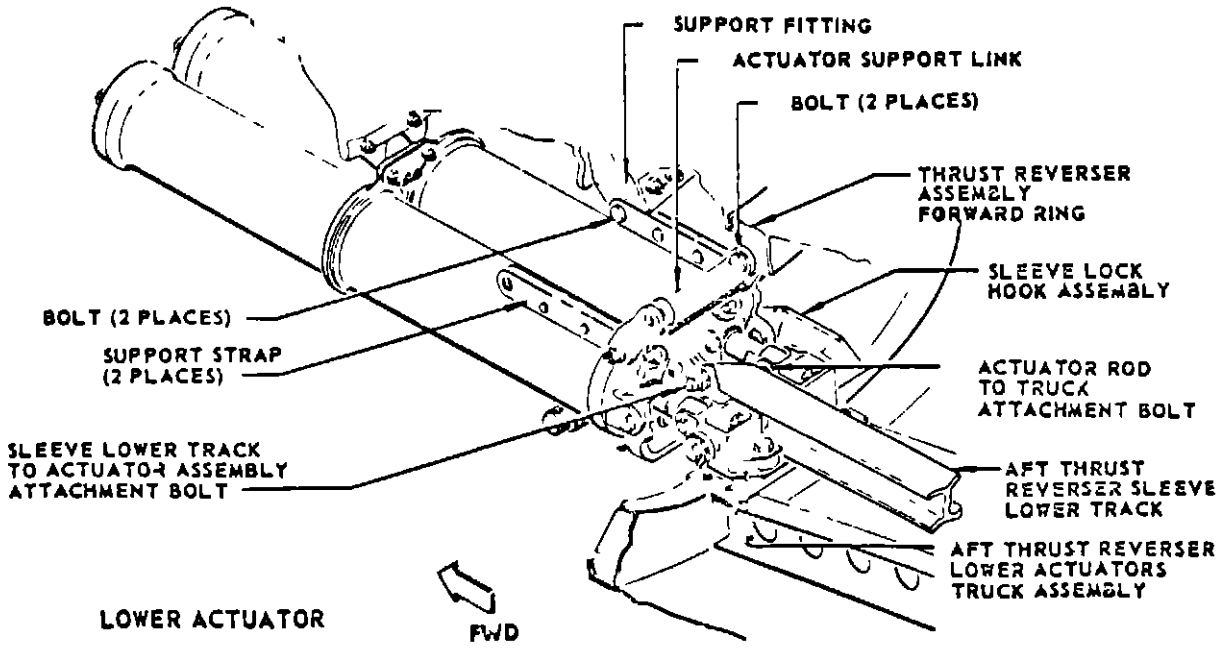
A. The forward thrust reverser actuators operate the cowl ring assembly, blocker doors, and lower vane assemblies. The actuators consist of the actuator housing and piston rod assembly. (See figure 1.) There are fourteen actuators located circumferentially around the engine. Twelve of these actuators are identical and operate the blocker doors and the baffle assemblies. The other two actuators are smaller, have a shorter stroke, and operate the vane assemblies. The blocker doors, vane assemblies, and baffle assemblies are connected to the cowl ring assembly. The actuator piston rod ends are connected to the blocker doors and lower vane assemblies. For forward thrust operation, pneumatic pressure enters the rod ports of the actuators pulling the blocker doors forward and out of the fan air duct to lay flat around the compressor case. The vane assemblies move forward also. The cowl ring assembly is repositioned forward to exhaust the fan air in an aft direction. For reverse thrust operation, air enters the head ports of the actuators to move the cowl ring aft and reposition the blocker doors, vane assemblies and baffle assemblies to discharge the fan exhaust air in a forward direction.

6. Aft Thrust Reverser Actuator Assemblies

A. Two dual-cylinder pneumatic actuator assemblies actuate the aft thrust reverser when reverse thrust operation is selected in the control cab. One of the actuator assemblies is mounted on top of the thrust reverser frame. (See figure 4.) The other actuator assembly is mounted underneath the engine just forward of the aft thrust reverser. Each of the actuator assemblies include two side-by-side joined cylinders each containing a piston with a piston rod which extends outside the cylinder. The piston rod ends are connected to the aft thrust reverser sleeve. Lower actuator assembly also includes a lock actuator and a hook-type lock. The lock mechanism is installed to prevent in flight translation of the aft thrust reverser sleeve with the engine shut down. The lock actuator, mounted below the dual cylinder assembly in an extension of the dual cylinder housing, contains a spring-loaded piston with a piston rod connected at the rod end to the lock hook. The hook is attached to pivot around an axis at the aft end of the actuators and engage the aft thrust reverser sleeve to provide a mechanical lock for the thrust reverser in the "cruise" position. The actuator is spring-loaded to hold the lock in the hooked position. During reverse operation, pneumatic pressure forces the actuator piston aft against the spring force to disengage the lock. (See figure 7.)

B. When reverse thrust is selected at the control stand, the lower lock actuator receives a pneumatic signal to actuate, disengaging the lock from the aft sleeve and uncovering a port in the actuator to route the pneumatic air to the head ports of the actuators for thrust reverser actuation.



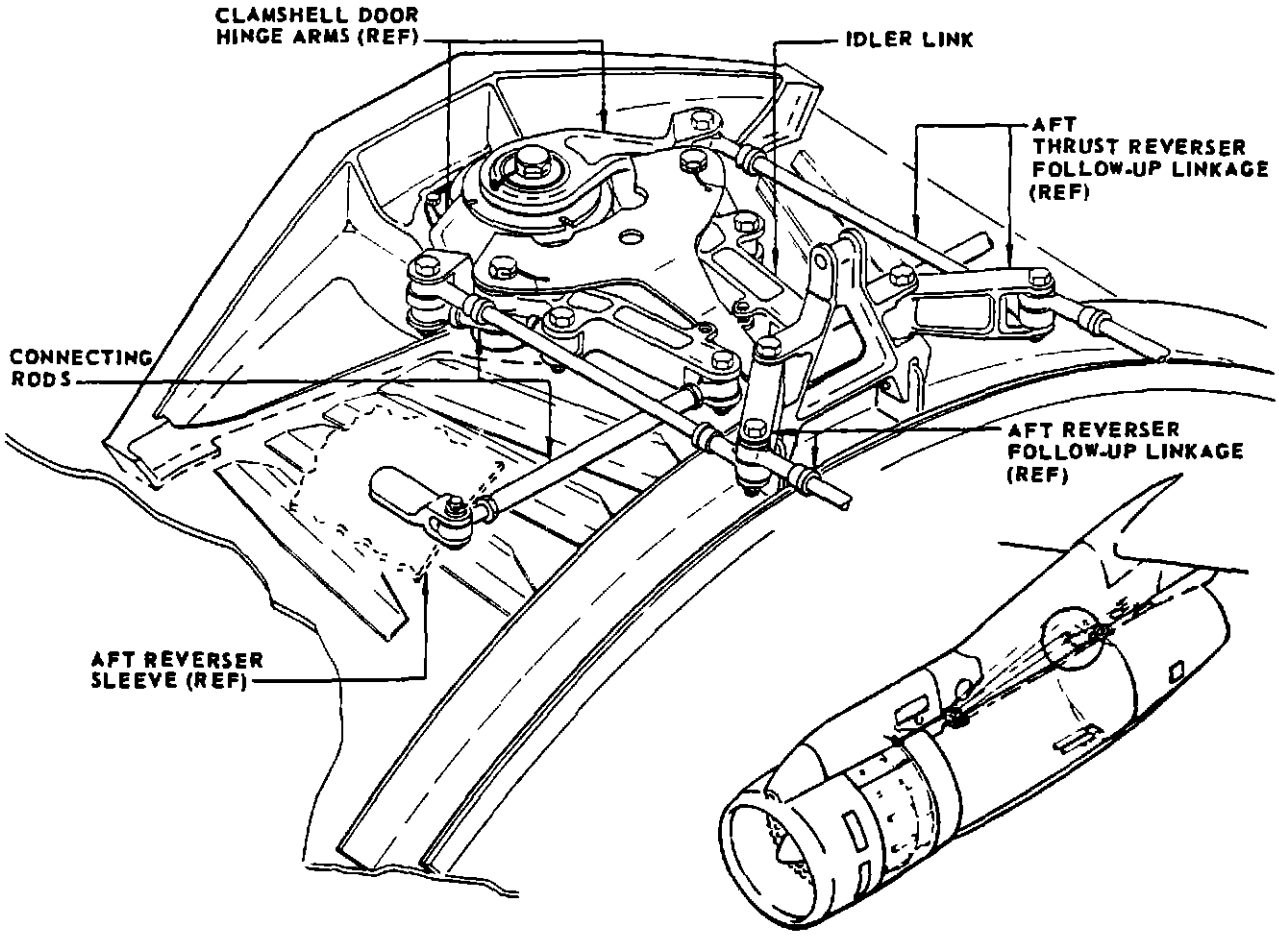


Aft Thrust Reverser Actuator Assemblies
Figure 4

When "cruise" operation is selected, pneumatic air is routed directly from the directional valve to the rod ports of the actuators causing retraction of the thrust reverser to the "cruise" position. The lock actuator is not pressurized and assumes the spring-loaded position. Movement of the aft sleeve forward causes the lock hook to engage the sleeve as the sleeve reaches the forward faired position.

7. Hinge Drive Mechanism

A. The hinge drive mechanism, when operated by movement of the aft reverser, causes the clamshell doors to open and close by driving the clamshell door hinge arms. The mechanisms for the upper and lower clamshell door hinge arms are identical and each consists of two idler links and four connecting rod assemblies. (See figure 5.) Two of the rod assemblies connect the aft reverser sleeve to the idler links. The other two short rod assemblies connect the idler links to the clamshell door hinge arms. Movement of the aft reverser sleeve forward or aft causes the two long rod assemblies to rotate the idler links which in turn drive the clamshell door hinge arms through the short rod assemblies.



Hinge Drive Mechanism
Figure 5
SB. 2098

8. Miscellaneous Control System Components

A. Aft Thrust Reverser Pressure Relief Valves

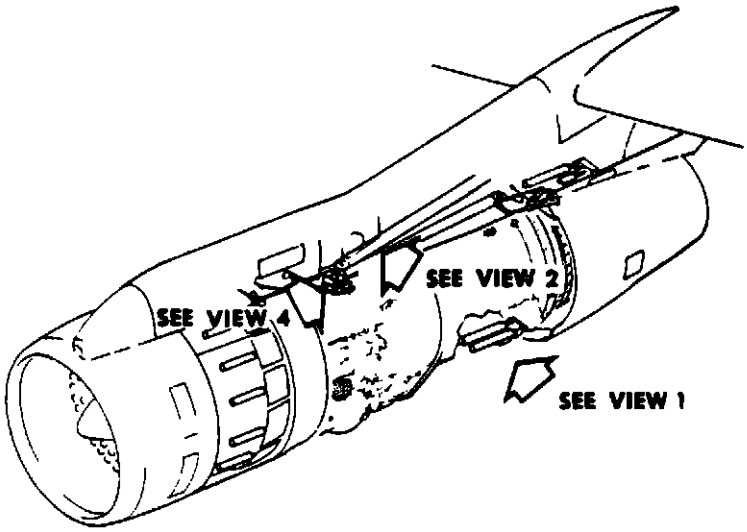
(1) There are two pressure relief valves located in the aft thrust reverser pneumatic tubing. One of the valves is located in the line between the thrust reverser directional valve and the lower lock actuator at the forward end of the lower lock actuator. (See view 1, figure 6.) The second relief valve, is in the line between the lower lock actuator and the head end ports of the upper and lower aft reverser actuators. The relief valves preclude excessive static torque on the clamshell door hings shafts. The valves are set to relieve at 60 (± 5) psig. (See figure 6.)

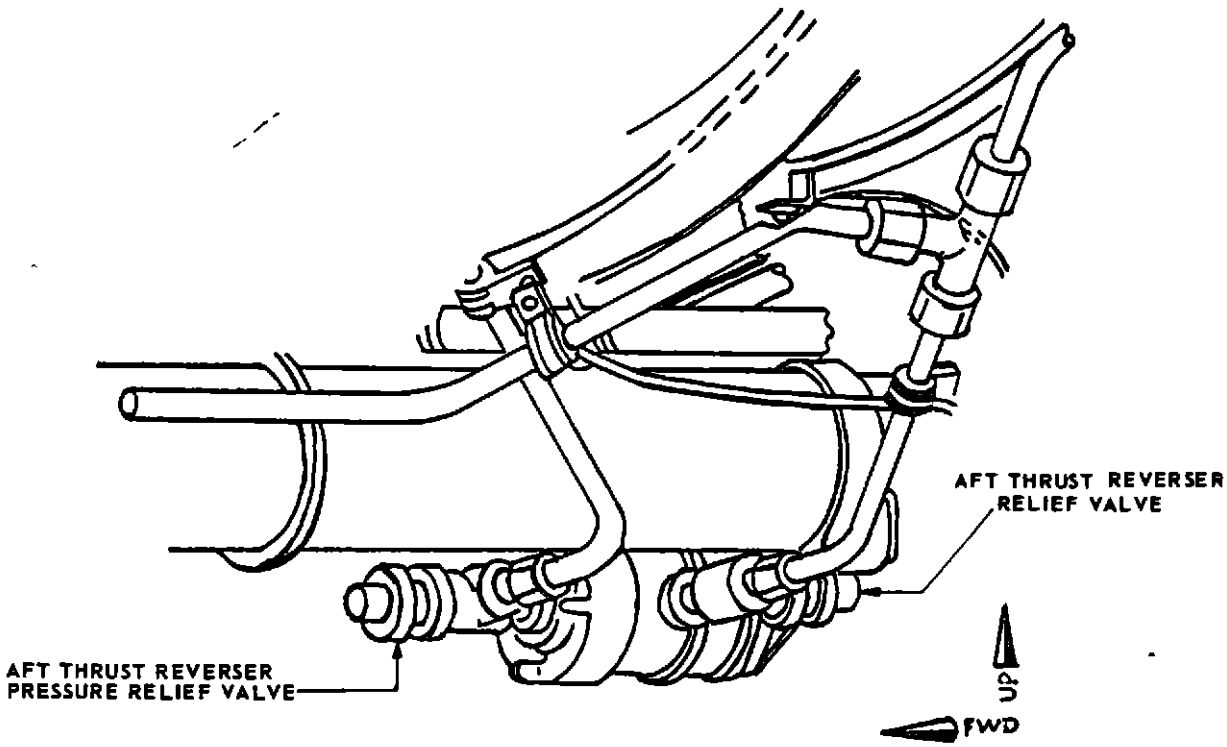
B. Pneumatic Supply Check Valves

(1) Two check valves in the thrust reverser pneumatic lines allow pneumatic air to be directed to the thrust reverser directional control valve from either the engine diffuser casing (N2 compressor delivery air) or from an external pressure source through the ground service connection. One of the check valves is located in the thrust reverser pneumatic plumbing at the high pressure bleed connection on the right side of the engine. (See figure 6.) The other check valve is in the line from the ground service connection in the nacelle strut. (See view 2, figure 6.) A tee connection joins the pneumatic lines from the two pressure sources to the thrust reverser directional valve supply line. If pneumatic pressure is being applied from either source through the check valve in that line, the other check valve prohibits air flow in the line from the other source.

C. Forward Thrust Reverser Flow Restrictor Valve.

(1) A flow restrictor is located in the pneumatic line from each forward thrust reverser actuator to the cruise manifold (14 places). The flow restrictors are installed in the union fittings where the actuator lines connect to the cruise manifold and provide snubbing action for the actuators during reverse thrust actuation. When pneumatic air enters the head ports of the actuators, trapped air is forced out the rod ports. The air is restricted at the flow restrictor orifices, providing the snubbing action. To avoid No. 1 and 2 (L.H and R.H) blokker doors hang up due to asymmetrical sequencing of the actuators, SB 2555 replaces the corresponding flow restrictors with four restrictor-check valves. These units are designed to provide snubbing action during reverse thrust actuation and to permit faster pressurization, thus more uniform sequencing, of of the upper blokker door actuators when going from reverse to cruise position.





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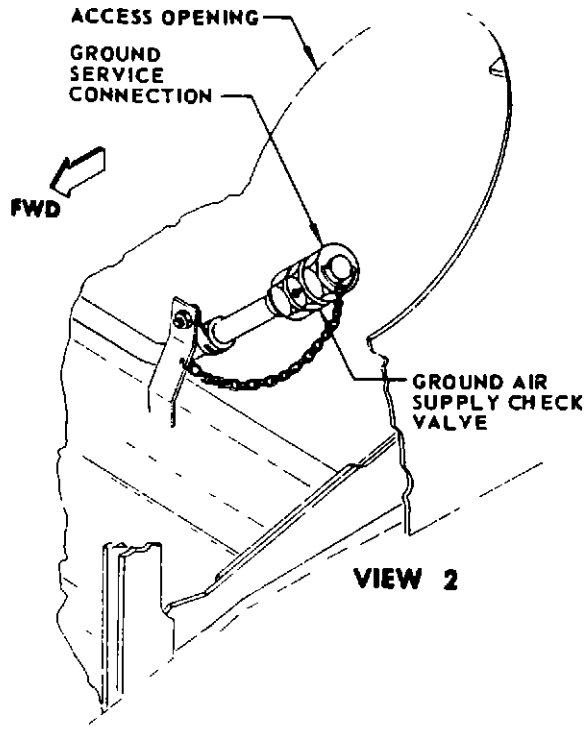
VIEW 1



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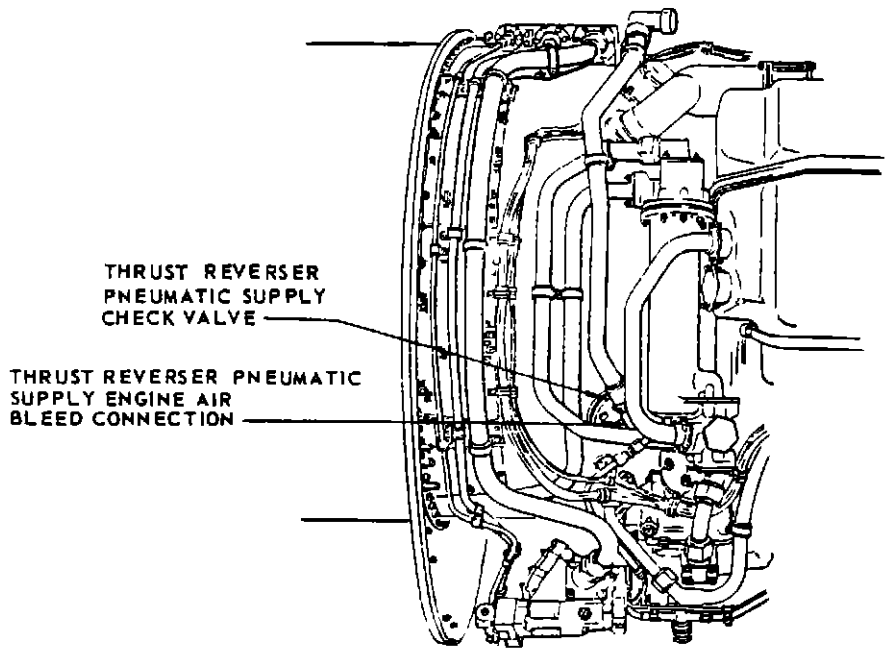
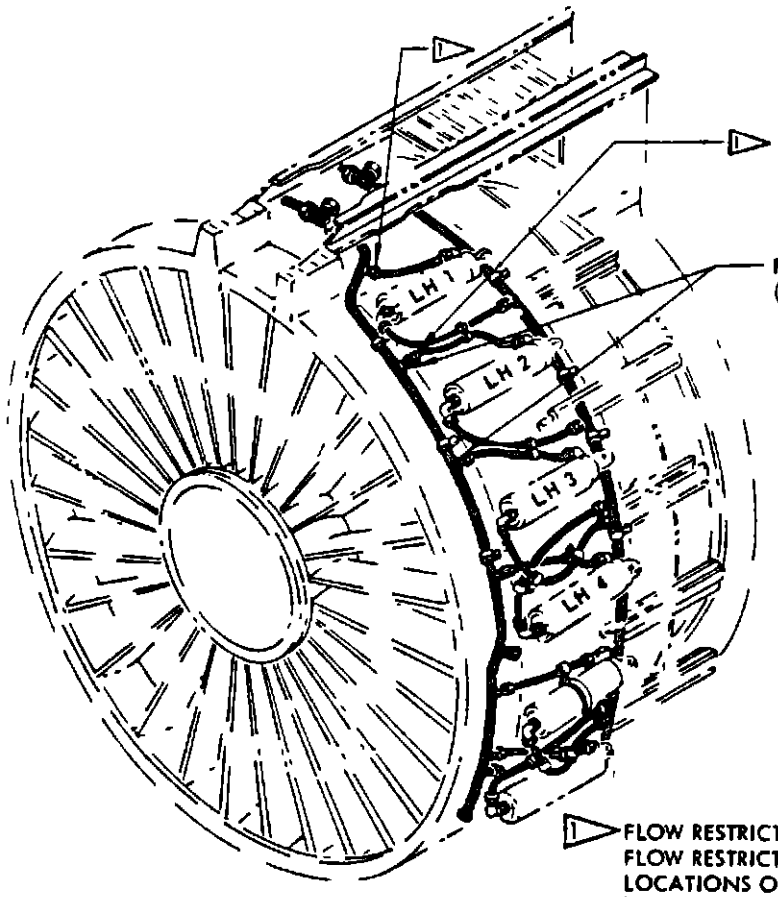


RH SIDE OF ENGINE

DETAIL A

Thrust Reverser Miscellaneous Control System Components
Figure 6 (Sheet 2 of 3)



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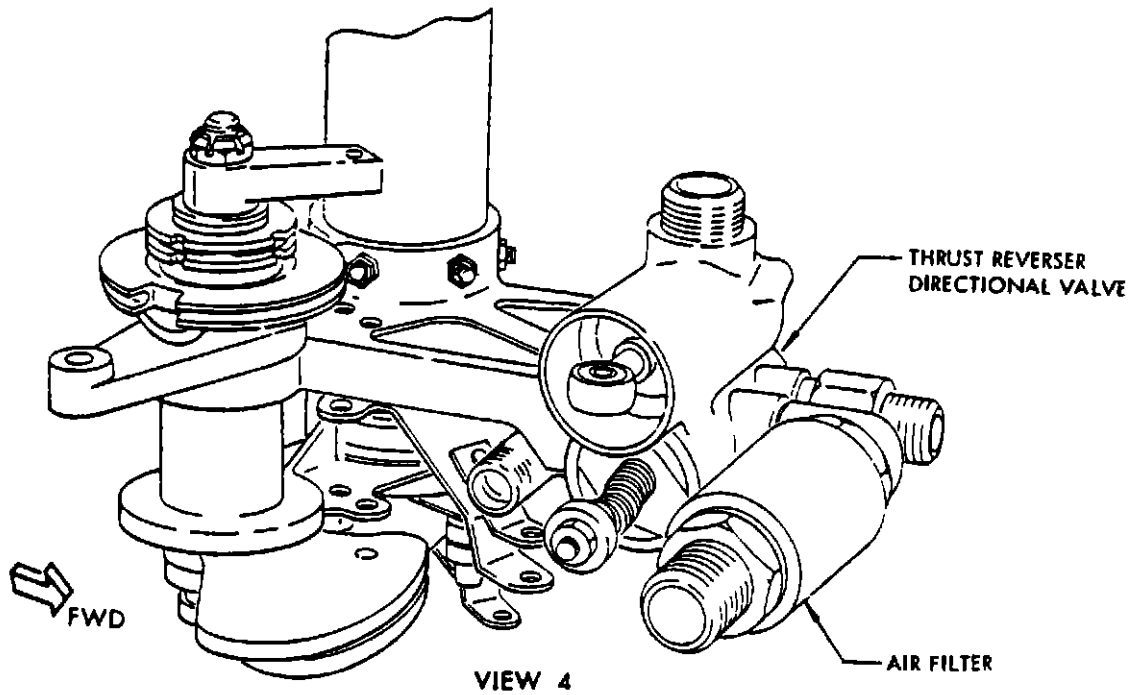

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Thrust Reverser Miscellaneous Control System Components
Figure 6 (Sheet 3)

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Thrust Reverser Control System Shematic
Figure 7 (Sheet 1)
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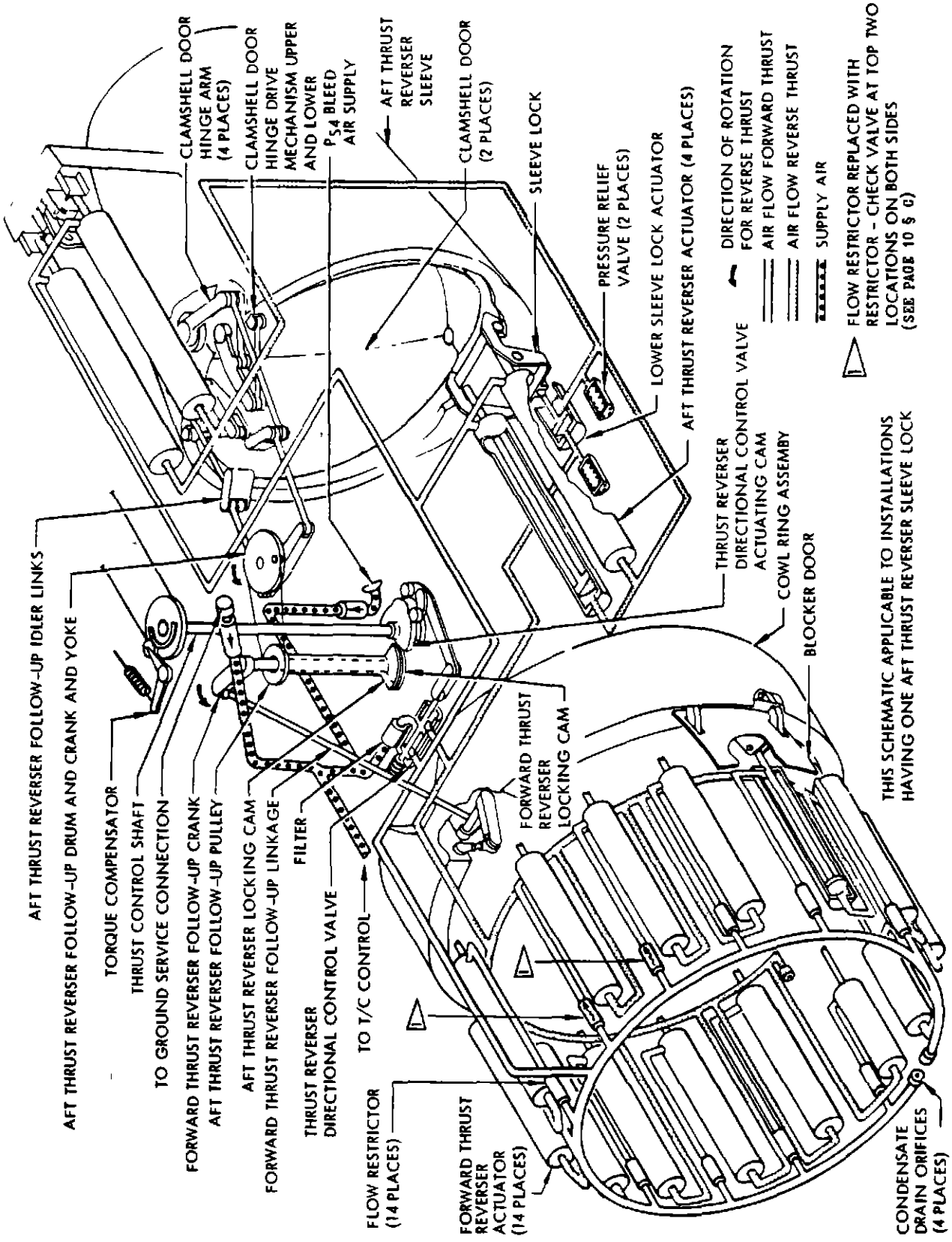


Thrust Reverser Control System Schematic
Figure 7 (Sheet 2)

D. Air Filter

(1) An air filter is provided to prevent contamination of the pneumatic system. (See view 4, figure 6.) The screen in the filter can be removed for cleaning or replacement. The air filter is in the line between the air source tee connection and the thrust reverser directional valve and is located at the directional valve.

9. Operation

A. The thrust reverser control system is actuated and controlled entirely by use of the reverse thrust lever. (See figure 7.) Pneumatic pressure is normally supplied from the engine diffuser casing. During ground tests, an external air source may be connected to the ground service connection to supply air pressure to the system.

B. During forward thrust operation, the thrust reverser directional valve maintained in the forward thrust position by the directional control valve actuating cam on the thrust control shaft, directs pneumatic air to the rod ports of the forward thrust reverser actuators and the aft thrust reverser actuators to hold the forward and aft thrust reversers in the forward thrust position. If the forward or aft thrust reverser moves to reverse thrust position during forward thrust operation, the forward or aft thrust reverser follow-up mechanism will rotate the respective locking cam which will contact the directional control valve actuating cam on the control shaft, forcing the shaft to an interlock position, thus reducing engine thrust. If either of the reversers move to the forward thrust position during reverse thrust operation, the thrust control shaft will be forced back to an interlock position thereby reducing engine thrust.

C. For reverse thrust operation, the forward thrust lever must be returned to idle before the reverse thrust lever can be moved sufficiently to initiate reverse thrust operation. This prevents accidental actuation of the reversers during forward thrust operation. Initial movement of the reverse thrust lever to an interlock position rotates the thrust reverser directional valve actuating cam to reposition the directional valve, directing high pressure air to the head ports of the forward and aft reverser actuators. The forward and aft reverser locking cams prohibit further movement of the reverse thrust lever until the clamshell doors on the aft reverser and the forward thrust reverser cowl ring assembly approach the full reverse thrust position. As the clamshell doors approach the full reverse thrust position, movement of the aft reverser follow-up linkage repositions the aft reverser locking cam. As the cowl ring assembly approaches the full reverse thrust position, movement of the forward thrust reverser follow-up linkage repositions the forward thrust reverser locking cam. Repositioning of both the cams allows the reverse thrust lever to be moved toward the maximum reverse thrust position.

D. For return to forward thrust operation, the reverse thrust lever is returned to idle, causing the thrust reverser directional valve actuating cam on the thrust control shaft to rotate, repositioning the directional valve to the forward thrust position, thus directing air to the forward and aft thrust reverser actuators for forward thrust operation. When the forward thrust reverser and aft thrust reverser have nearly reached the full forward thrust position, the forward thrust reverser follow-up linkage and the aft thrust reverser follow-up linkage reposition the respective locking cams allowing the forward thrust lever to be moved past the interlocked position to increase forward thrust. On airplanes having the interlock override mechanism, the spring loaded forward reverser follow-up stop on the directional valve actuating cam prevents application of increased forward thrust until either the forward thrust reverser locking cam is repositioned or, if the forward reverser does not move to the "cruise" position, increased manual force is applied to the forward thrust lever, forcing the directional valve actuating cam to rotate, compressing the spring loaded interlock stop. If the forward reverser should now fail to return to "cruise" position, a second (fixed) stop on the directional valve cam will contact the follow-up cam, preventing further control shaft rotation or further increase in forward thrust.

THRUST REVERSER CONTROL SYSTEM - TROUBLE SHOOTING

1. General

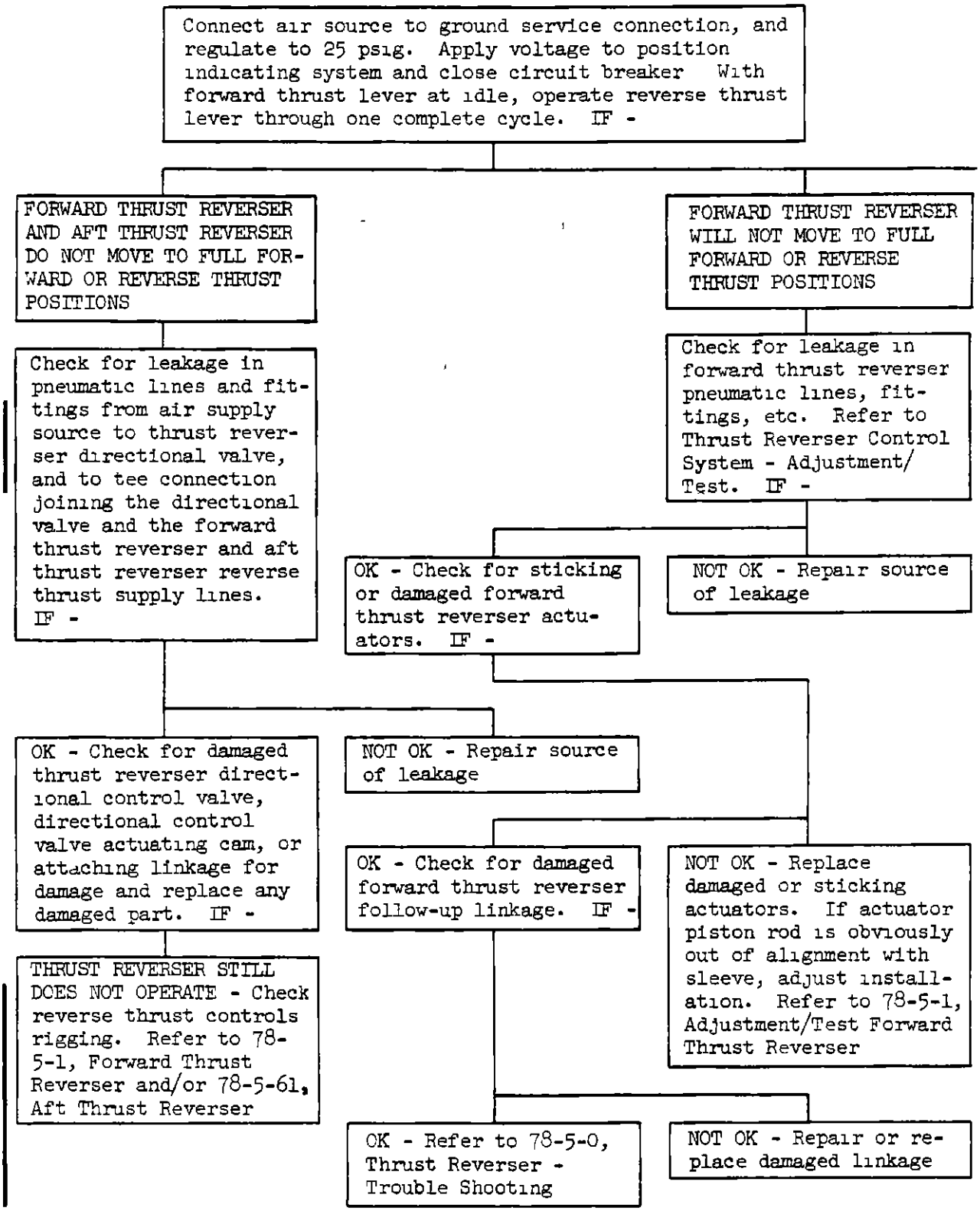
A. Trouble shooting can be performed on the thrust reverser control system without operating the engines. An external dry air source capable of supplying a pressure of 60 psig is satisfactory for trouble shooting the system. Caution must be exercised when using an external air source to avoid violent operating speeds

WARNING: PERSONNEL MUST STAY CLEAR OF THE ENGINE WHILE THE THRUST REVERSER IS BEING ACTUATED, TO PREVENT INJURY TO PERSONNEL PLACARD CONTROL STAND TO WARN AGAINST ACTUATION OF THRUST LEVERS WHILE THRUST REVERSER IS BEING WORKED ON

CAUTION: MAKE SURE ENGINE COWL PANELS ARE CLOSED AND FAN COWL PANELS ARE REMOVED BEFORE CONNECTING GROUND AIR SUPPLY TO PREVENT STRUCTURAL OR ENGINE DAMAGE OR PERSONNEL INJURY.

THE SUPPLY LINE BETWEEN THE SUPPLY PRESSURE REGULATOR AND THE GROUND AIR CONNECTION SHALL HAVE A MINIMUM INSIDE DIAMETER OF 9/32 INCH.

2. Thrust Reverser Control System Trouble Shooting Chart


Connect air source to ground service connection, and regulate to 25 psig. Apply voltage to position indicating system and close circuit breaker With forward thrust lever at idle, operate reverse thrust lever through one complete cycle. IF -
FORWARD THRUST REVERSER AND AFT THRUST REVERSER DO NOT MOVE TO FULL FORWARD OR REVERSE THRUST POSITIONS
FORWARD THRUST REVERSER WILL NOT MOVE TO FULL FORWARD OR REVERSE THRUST POSITIONS
Check for leakage in pneumatic lines and fittings from air supply source to thrust reverser directional valve, and to tee connection joining the directional valve and the forward thrust reverser and aft thrust reverser reverse thrust supply lines. IF -
Check for leakage in forward thrust reverser pneumatic lines, fittings, etc. Refer to Thrust Reverser Control System - Adjustment/ Test. IF -
OK - Check for sticking or damaged forward thrust reverser actuators. IF -
NOT OK - Repair source of leakage
OK - Check for damaged thrust reverser directional control valve, directional control valve actuating cam, or attaching linkage for damage and replace any damaged part. IF -
NOT OK - Repair source of leakage
OK - Check for damaged forward thrust reverser follow-up linkage. IF -
NOT OK - Replace damaged or sticking actuators. If actuator piston rod is obviously out of alignment with sleeve, adjust installation. Refer to 78-5-1, Adjustment/Test Forward Thrust Reverser
THRUST REVERSER STILL DOES NOT OPERATE - Check reverse thrust controls rigging. Refer to 78-5-1, Forward Thrust Reverser and/or 78-5-61, Aft Thrust Reverser
OK - Refer to 78-5-0, Thrust Reverser - Trouble Shooting
NOT OK - Repair or replace damaged linkage

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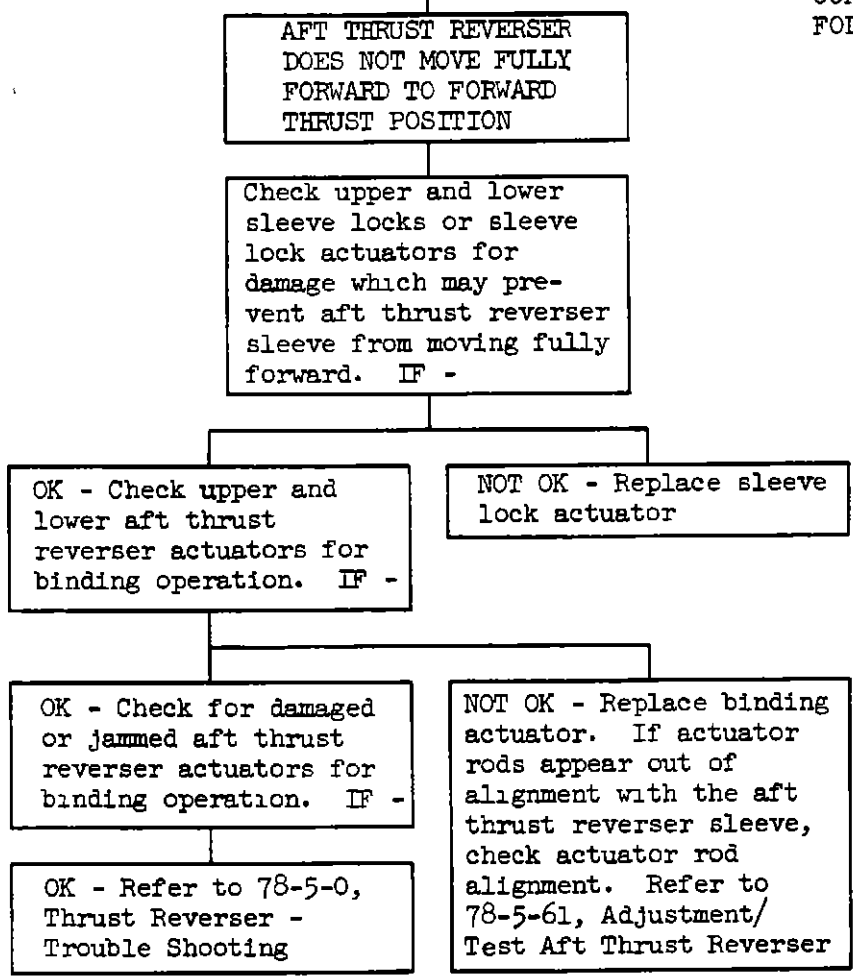

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AFT THRUST REVERSER DOES NOT MOVE TO REVERSE THRUST POSITION, OR ACTUATES ONLY PARTIALLY, OR BINDS DURING TRAVEL

Check for leakage in thrust reverser pneumatic lines, fittings, etc. Refer to Thrust Reverser Control System - Adjustment/Test. IF -

NOT OK - Repair source of leakage

OK - Check upper and lower aft thrust reverser sleeve locks for damage or sticking. IF -

NOT OK - Replace damaged sleeve lock, or adjust installation, if jammed. If sleeve locks are ok, check upper and lower sleeve lock actuators, in that order for damage or sticking piston rods. Replace defective lock actuator

OK - Check upper and lower aft thrust reverser actuators for sticking. IF -

NOT OK - Replace damaged or sticking actuators

OK - Visually check for interference with clamshell door movement

NOT OK - Repair or replace damaged part

OK - Check for damaged or jammed aft thrust reverser follow-up linkage (78-6-21) or hinge drive mechanism (78-6-51). IF -

NOT OK - Replace damaged linkage or correct installation of jammed controls. Rig affected controls

THRUST REVERSER CONTROL SYSTEM - MAINTENANCE PRACTICES

1. Adjustment/Test Thrust Reverser Control System

A. General

(1) Rigging of the thrust reverser control system consists of rigging the forward and aft thrust reverser follow-up linkage. See 78-6-11, "Adjustment/Test Forward Thrust Reverser Follow-Up Linkage," and 78-6-21, "Adjustment/Test Aft Thrust Reverser Follow-Up Linkage."

(2) The thrust reverser control system may be tested without operating the engines. An external air source capable of supplying a pressure of 60 psig is satisfactory for checking the system. Caution must be exercised when operating the system with an external air source to avoid violent operating speeds. The thrust reverser warning light system provides indication of forward thrust reverser cowl ring position and aft thrust reverser sleeve position. Refer to 78-7-0.

WARNING: PERSONNEL MUST STAY CLEAR OF ENGINE WHEN THRUST REVERSER IS BEING ACTUATED. A PLACARD SHOULD BE PLACED ON CONTROL STAND WARNING AGAINST ACTUATION OF THRUST LEVERS WHILE PERSONNEL ARE WORKING ON THRUST REVERSER.

B. Equipment and Materials

(1) Air pressure source - 0 to 60 psig adjustable, using dry air.

(2) Spring scale - 0 to 50 pounds capacity.

C. Test Thrust Reverser Control System

(1) Place forward and reverser thrust levers at "IDLE," and placard control stand to warn against actuation of thrust levers when personnel are working on thrust reverser.

(2) Connect ground air supply.

(a) Close engine side cowl panels and remove fan cowl panels.

WARNING: GROUND AIR SUPPLY MUST NOT BE CONNECTED UNLESS THE ENGINE SIDE COWL PANELS ARE COMPLETELY CLOSED AND FAN COWL PANELS REMOVED, TO AVOID STRUCTURAL OR ENGINE DAMAGE OR PERSONNEL INJURY.

(b) Disconnect and cap thrust reverser pneumatic line to engine bleed connection. Make disconnection at engine end of flexible hose in line and cap flexible hose.

NOTE: This step is necessary on engines on which the check valve at the thrust reverser 16th stage bleed connection on the engine has been reworked to remove the internal parts (flapper and hinge) to preclude possible internal failure on this valve Therefore, disconnection and capping of the line is necessary to prevent ground service air from venting to atmosphere through the open check valve into the engine.

It is not necessary to perform this step on airplanes having the improved Parker check valve, number 1111-577098M1.

(c) Connect air source to ground air connection located in strut. Gain access to ground service connection through access panel 3716 or 1739 located in strut. See Chapter 12, "Access Doors and panels."

NOTE: Supply line between the ground air supply pressure regulator and the ground air connection shall have a minimum inside diameter of 9/32 of an inch.

(3) Check for leakage in pneumatic system.

(a) Check that thrust reverser is in forward thrust position.

(b) Regulate air supply to 60 psig pressure.

(c) Check that there is no apparent leakage (leakage that can be detected by placing a hand on or near a connection) at tube or flexible hose connections.

(d) Regulate air supply to 25 psig.

(e) With forward thrust lever in "IDLE" position actuate reverse thrust lever aft to full reverse thrust position. Verify that forward and aft thrust reversers have moved to reverse thrust position.

(f) Regulate air pressure source to 60 psig.

(g) Check that there is no apparent leakage (leakage that can be detected by placing a hand on or near a connection) at tube or flexible hose connections.

(4) Regulate air pressure source to 25 psig and place the reverse thrust lever in the OFF position. Check that forward and aft thrust reversers have moved to the forward thrust position.

WARNING: WHEN RETURNING THE THRUST REVERSER TO CRUISE POSITION USING GROUND AIR THE FORWARD THRUST REVERSER SLEEVE MUST BE HELD IN THE AFT POSITION UNTIL ALL THE BLOCKER DOORS HAVE ROTATED TO THE "CRUISE" OR FAIRED POSITION. THIS MAY BE DONE BY USING A RESTRAINT HARNESS, BOEING PART NO. MIT65-10621, OR EQUIVALENT. AS AN ALTERNATE METHOD THE SLEEVE MAY BE RESTRAINED MANUALLY BY A MECHANIC ON EACH SIDE OF THE SLEEVE PUSHING AFT ON THE SLEEVE DURING THE RETRACT CYCLE UNTIL ALL THE BLOCKER DOORS HAVE ROTATED TO THE CRUISE POSITION. THE MECHANICS SHOULD EXERCISE CAUTION TO PLACE THEIR HANDS ON THE SLEEVE IN THE LOWER AREA ADJACENT TO THE FIXED VANE ASSEMBLIES TO PREVENT THEIR HANDS BEING HIT BY THE ROTATING BLOCKER DOORS.

(5) Apply dc power to bus and engage applicable thrust reverser circuit breaker on radio and TR circuit breaker panel (P5).

(6) Check that the thrust reverser warning light on the pilot's instrument panel is off.

(7) Actuate reverse thrust lever aft to either the interlock or the full reverse thrust position.

(8) Check that the forward thrust reverser and the aft thrust reverser sleeve move to reverse thrust position within three seconds. The applicable thrust reverser warning light should come on immediately after both of the reverser sleeves leave the forward sealed position. Disengage the circuit breaker. The light shall go off. Re-engage the circuit breaker.

(9) Actuate reverse thrust lever forward to the IDLE position.

CAUTION: APPLY RESTRAINT TO FORWARD REVERSER SLEEVE PRIOR TO APPLICATION OF PRESSURE. SEE STEP (4).

(10) Both sleeves shall move to the forward thrust position and the lignt shall go off within five seconds. Check that the clamshell doors are firmly seated in the seals.

(11) Remove air pressure from system.

(12) Move forward thrust lever fully aft to IDLE position.

(13) Place friction brake handle in full aft position.

(14) Actuate reverse thrust lever aft against a stop position (interlock position).

(15) Apply 50 pound load to reverse thrust lever knob centerline in aft direction. Check that follow-up lock (forward and aft reverser locking cams) resists this load.

(16) Regulate air supply to 25 psig and verify that the forward and aft thrust reverser move to reverse thrust position.

(17) Remove air pressure from system.

(18) Return reverse thrust lever to the "OFF" position.

(19) Actuate forward thrust lever forward against a stop position (interlock position).

(20) Apply a 50 pound load to the forward thrust lever in the forward direction. Check that follow-up lock (fan and aft reverser locking cams) resists this load.

(21) Perform the following operation check of the forward thrust reverser interlock override mechanism.

(a) With air pressure off, manually push the aft sleeve only to "cruise" position.

(b) Actuate forward thrust lever forward against the first stop position which is at approximately 12° from the IDLE position.

(c) Apply a 15 pound load to this lever in the forward direction. The follow-up lock shall resist the load.

(d) Apply a 25 pound load to this lever in the forward direction. The lever shall rotate a minimum of 45° from the idle position before the second stop is contacted.

(22) Regulate air pressure to 25 psig. Clamshell doors shall return to forward thrust position, and thrust reverser warning light shall go out.

CAUTION: APPLY RESTRAINT TO FORWARD REVERSER SLEEVE PRIOR TO APPLICATION OF PRESSURE. SEE STEP (4).

(23) Remove air pressure from system.

(24) Remove test equipment and recap ground service connection. Replace access panel.

(25) Reconnect thrust reverser air supply flex hose.

(26) Replace engine side cowl panels and fan cowl panels.

(27) Remove placard from control stand.

(28) Reset friction brake handle.

THRUST REVERSER DIRECTIONAL CONTROL VALVE - REMOVAL/INSTALLATION

1. Remove Thrust Reverser Directional Control Valve (See figure 401.)

   A Remove engine side cowl panels.

   B Disconnect pneumatic tubing from directional control valve fittings.

   C Disconnect valve control links at valve rod end by removing nut, bolt and cotter pin.

   D Remove two bolts attaching control valve to engine controls strut bracket.

   E. Remove valve from engine, being careful not to damage valve or tubing.

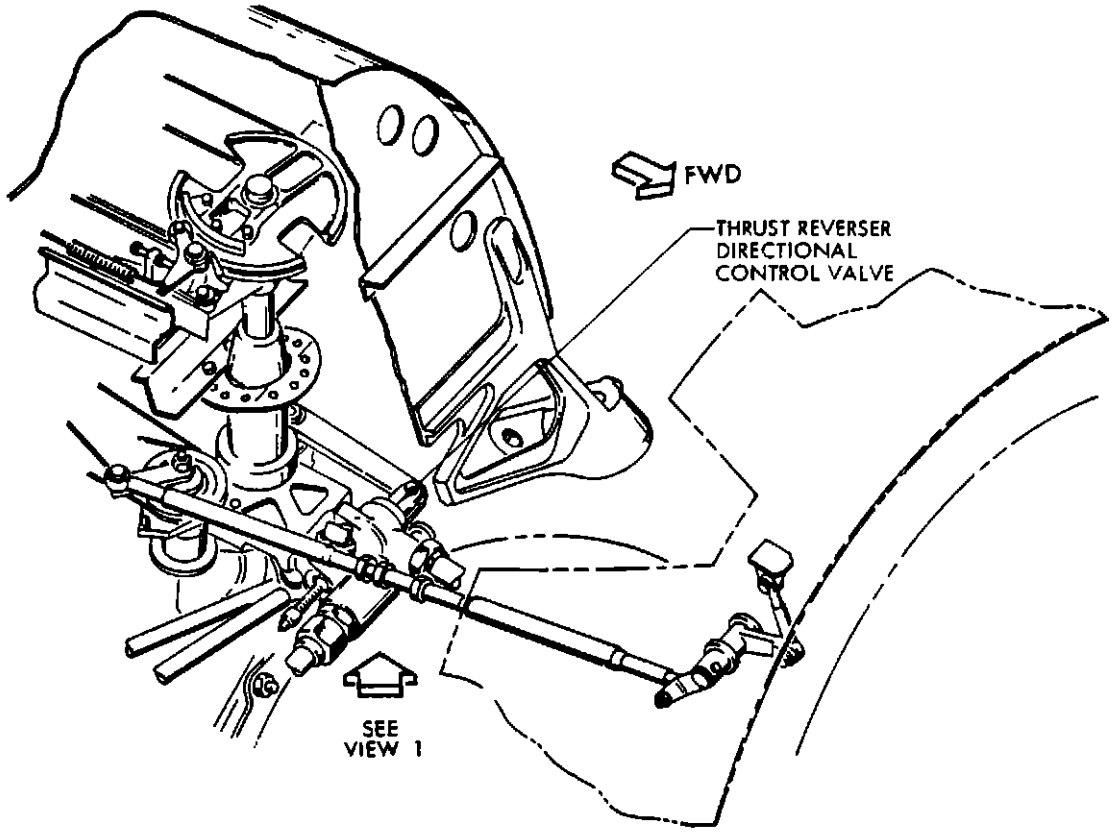
2. Install Thrust Reverser Directional Control Valve (See figure 401.)

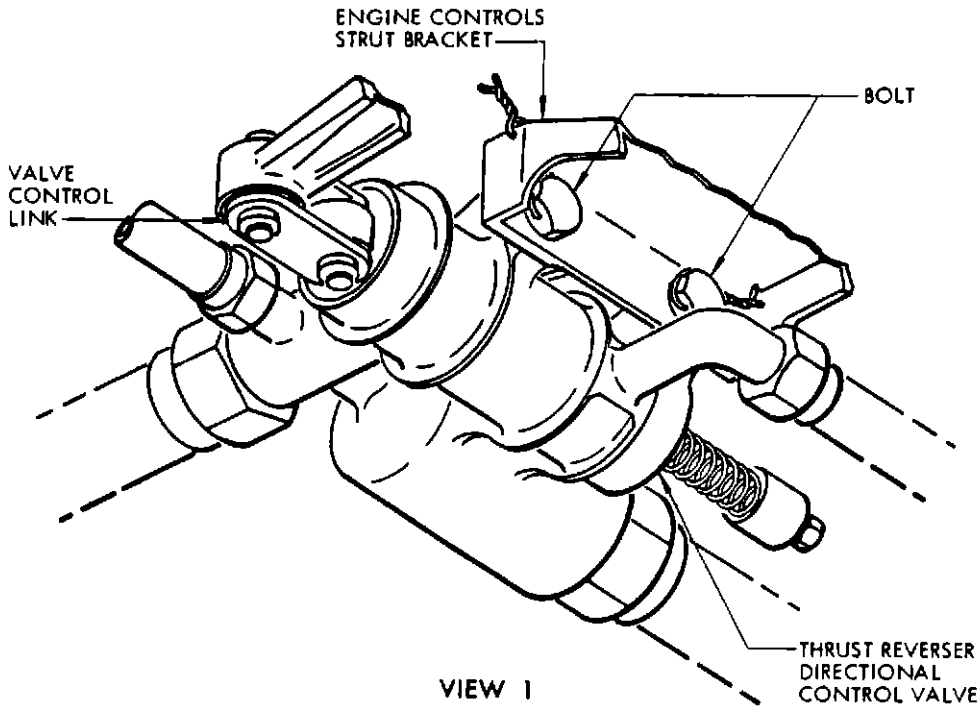
   A Place forward thrust lever in control cab to forward thrust idle position.

   B. Position directional control valve at engine controls strut bracket and attach with bolts and washers. Lockwire.

   C. With valve control links attached to valve control arm, attach valve control links to valve rod end with bolt, nut and cotter pin.

   D. Connect pneumatic tubing to directional control valve fittings.





Thrust Reverser Directional Control Valve Installation
Figure 401

THRUST REVERSER DIRECTIONAL VALVE ACTUATING CAM - REMOVAL/INSTALLATION

1. Remove Thrust Reverser Directional Valve Actuating Cam (See figure 401.)

   A Remove engine side cowl panels.

   B Disconnect thrust control rod from thrust reverser control cam.

   C Move thrust lever in control cab as necessary to position control cam in best position for removal.

   D Slide cam off shaft.

2. Install Thrust Reverser Directional Valve Actuating Cam (See figure 401.)

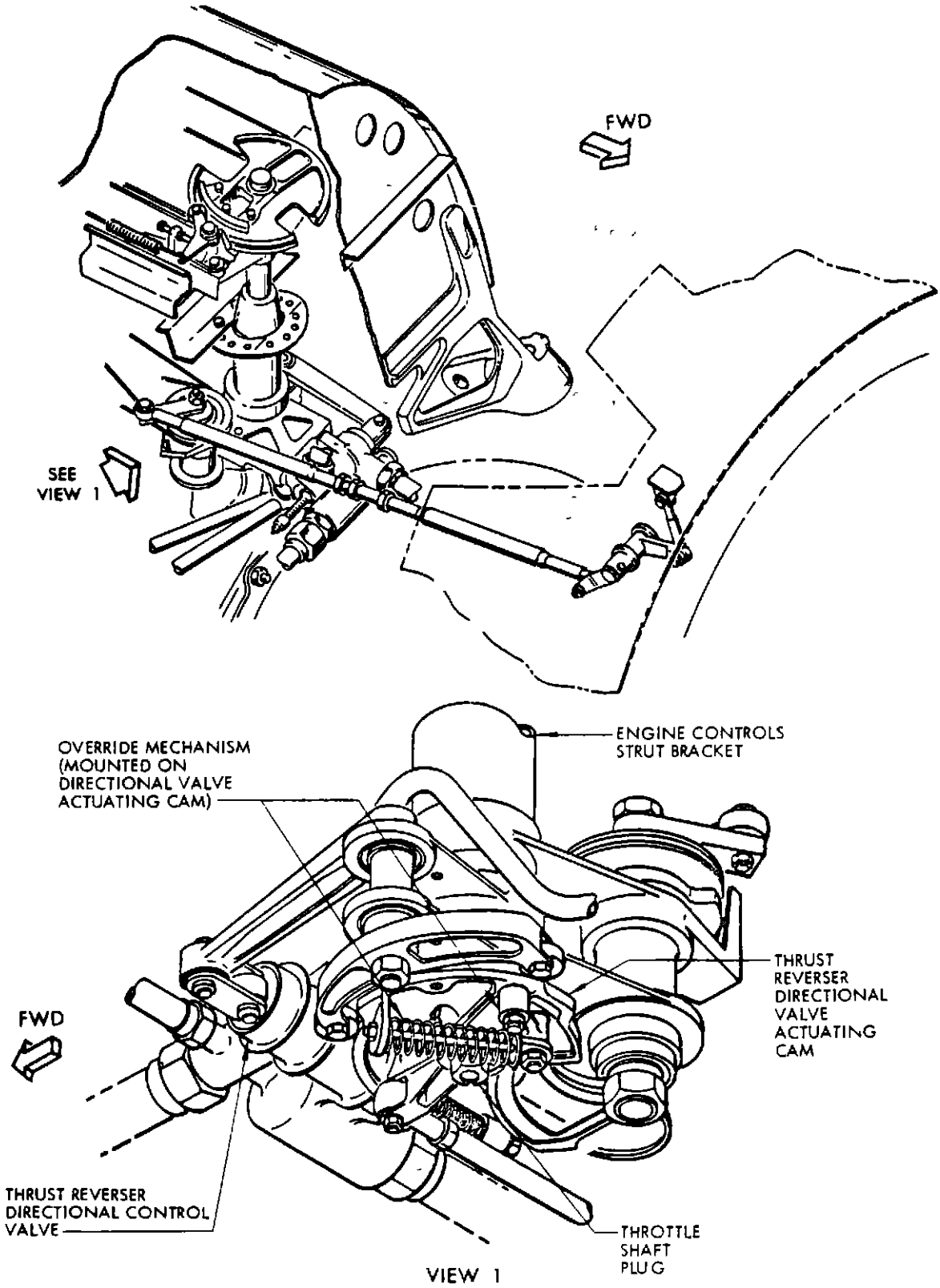
   A Line up spline indices on directional valve actuating cam and throttle control shaft and slide cam onto shaft.

   B Install throttle shaft plug on lower end of throttle shaft and tighten within 290 to 410 pound-inches. Install cotter pin. Maximum torque allowed for installation of cotter pin is 660 pound-inches. Lockwire.

   C. Connect throttle rod to thrust reverser control cam.

   D. Check adjustment of thrust system. See chapter 76, Engine Controls.

   E. Install engine side cowl panels.



Thrust Reverser Directional Valve Actuating Cam Installation 2
Figure 401

THRUST REVERSER LOCKING CAMS - REMOVAL/INSTALLATION

1. Remove Thrust Reverser Locking Cams

A Remove engine side cowl panels.

B. If removal of aft reverser locking cam is desired, remove engine. Refer to Power Plant, Chapter 71.

C If removing only the forward reverser locking cam (14, figure 401), disconnect throttle rod from control valve actuating cam.

D. Remove nut (15) from bottom of locking camshaft (9).

E. Slide cam (14) off bottom of shaft (9).

F. Loosen aft reverser follow-up cable turnbuckles and free cable from drum (5).

G. Remove nut (1) from top of camshaft (9)

H. Slide crank (2) from shaft (9).

I Remove locking ring (16) from nut (4) and remove nut from aft reverser locking camshaft (11).

J. Slip drum (5) and spacer (6) off shaft

NOTE: On later installations, the lower bearing is not swaged. On these airplanes, a threaded retainer is utilized for the lower bearing and is lockwired to the aft reverser locking cam (13). Remove lockwire and bearing retainer prior to removing shafts (9) and (11), cam (13), and spacer (12).

K. Slide two shafts down and out of bearings in bracket (7).

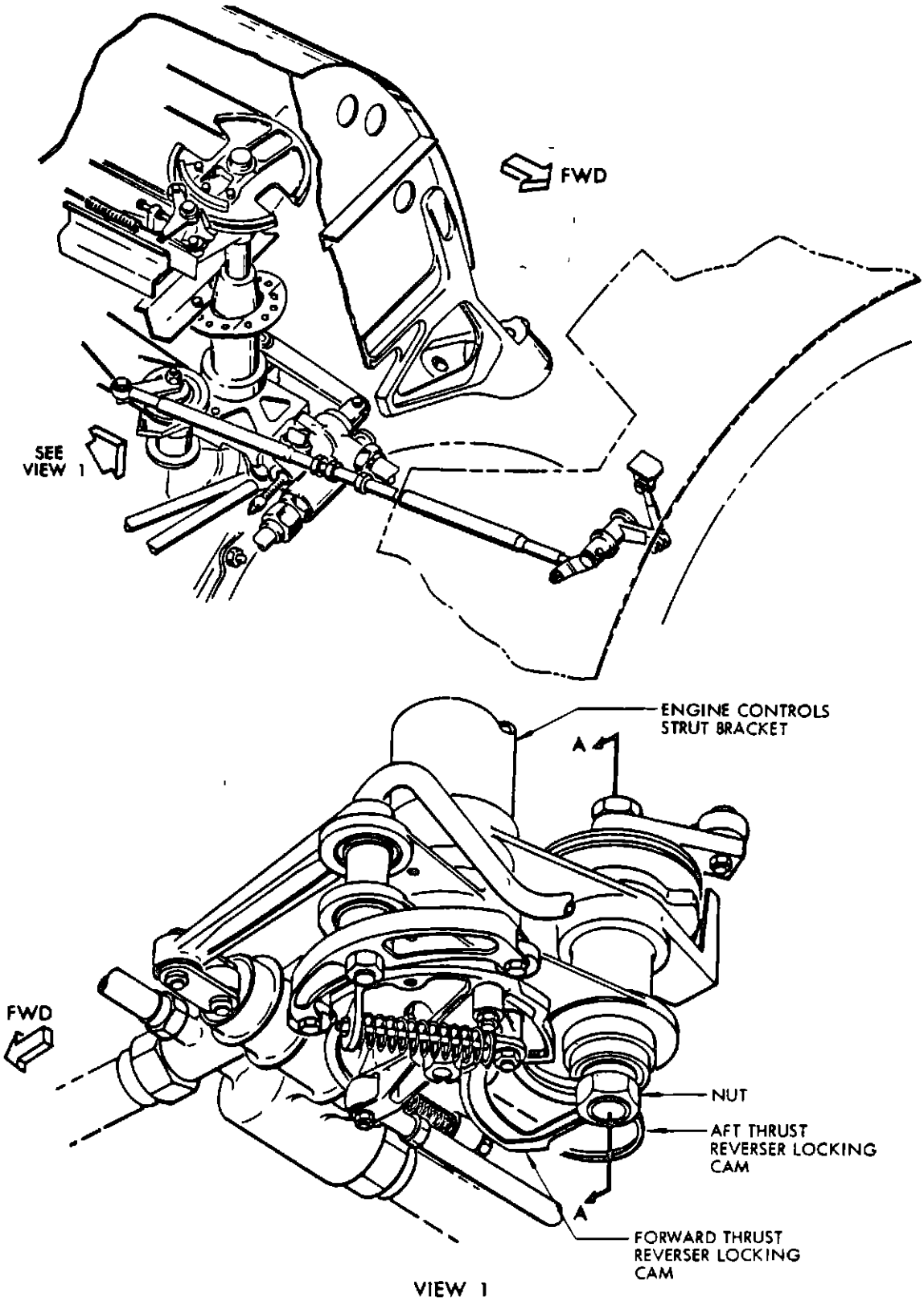
CAUTION: TAKE CARE NOT TO DAMAGE BEARINGS IN BRACKET. LOWER BEARING IS STAKED IN PLACE, BUT UPPER BEARING (8) IS RETAINED ONLY BY TIGHT FIT

L. If desired, slide reverser camshaft (9) out upper end of aft reverser camshaft (11).

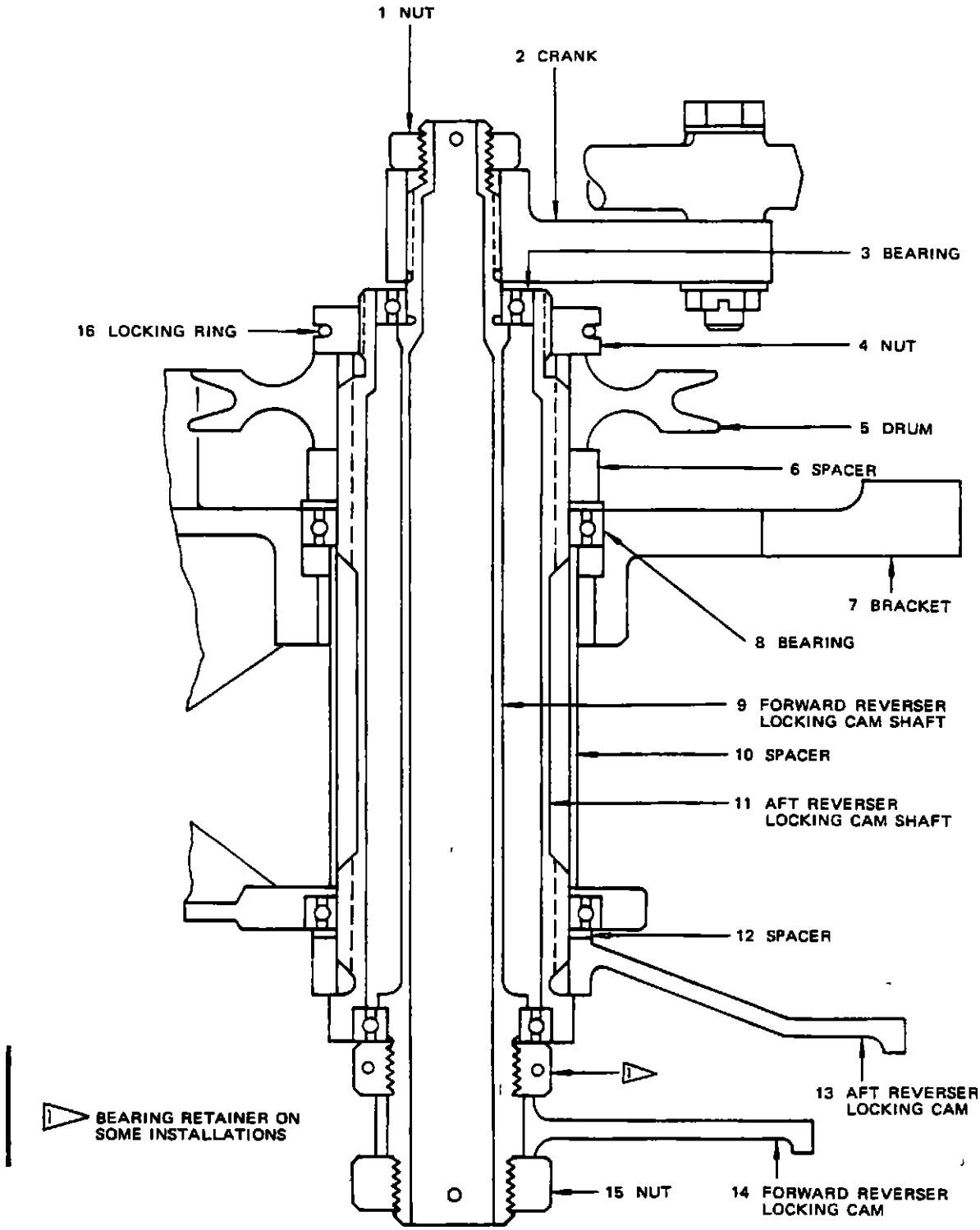
NOTE: Bearing is staked in lower end of shaft, but bearing in upper end is retained only by tight fit.

M. Slide spacer (12) and reverser cam (13) off shaft (14).

N. Check condition of bearings in bracket (7) and shaft (11).



Thrust Reverser Locking Cams Installation
Figure 401 (Sheet 1)


1 NUT
2 CRANK
3 BEARING
16 LOCKING RING
4 NUT
5 DRUM
6 SPACER
7 BRACKET
8 BEARING
9 FORWARD REVERSER LOCKING CAM SHAFT
10 SPACER
11 AFT REVERSER LOCKING CAM SHAFT
12 SPACER
13 AFT REVERSER LOCKING CAM
BEARING RETAINER ON SOME INSTALLATIONS
15 NUT
14 FORWARD REVERSER LOCKING CAM

SECTION A-A

2. Install Thrust Reverser Locking Cams

A Slide aft reverser locking cam (13, figure 401) and spacer (12) onto camshaft (11).

NOTE: One tooth of mating serrations on cam and shaft have been omitted to proved positive alignment at components.

B. Insert forward reverser locking camshaft (9) into bearing in aft reverser locking camshaft (11).

C. Carefully press camshaft upper bearing (3) into place over shaft (9).

D. Slip assembly of two shafts up through bearings in bracket (7).

E. If upper bearing (8) was removed, slip spacer (6) down over shaft (11) and carefully press bearing (8) into place in bracket (7).

F Install spacer (6) and follow-up drum (5).

G. Install nut (4) using spanner wrench. Tighten nut to 290-410 pound-inches. Install lockring (16) carefully, checking for firm circumferential contact of ring in nut groove and correct tang penetration. Maximum of 660 pound-inches is allowed for installation of lockring.

CAUTION CAREFUL INSTALLATION OF LOCKRING IS REQUIRED. DISTORTION OF LOCKRING OR IMPROPER INSTALLATION MAY CAUSE INSUFFICIENT PENETRATION OF LOCKRING TANG, RESULTING IN NUT LOOSENING.

H. If applicable, install bearing retainer on lower bearing, torque to 15-25 pound-inches and lockwire retainer to cam (13).

I. Slip locking cam (14) onto bottom of shaft and install nut. Tighten nut to 290-410 pound-inches, 660 pound-inches maximum allowed for installation of cotter pin. Install cotter pin.

CAUTION DO NOT INSTALL CAM (14) IN INVERTED POSITION. SEE FIGURE 401, FOR CORRECT POSITION OF CAM.

J. Place crank (2) on top of camshaft and install nut (1). Tighten nut to 290-410 pound-inches, 660 pound-inches maximum allowed for installation of cotter pin. Install cotter pin.

K. Install aft reverser follow-up cable to drum (5).

L. Install engine. Refer to Power Plant, Chapter 71.

M. Adjust forward and aft follow-up installation per 78-6-11 and 78-6-21.

THRUST REVERSER ROCKER ARM SHAFT CONTROLS - REMOVAL/INSTALLATION

EFFECTIVITY

TURBOFAN

1 Remove Thrust Reverser Rocker Arm Shaft Controls (Applicable to Configuration 1, figure 401.)

A Disconnect rocker arm crank from directional valve links.

B. Remove nut from lower end of rocker arm shaft and remove rocker arm from lower end of shaft.

C Remove rocker arm crank and shaft from bracket by lifting them out of bracket as a unit while holding spacer. Remove spacer.

D Check condition of bearing.

2. Install Thrust Reverser Rocker Arm Shaft Controls (Applicable to Configuration 1, figure 401.)

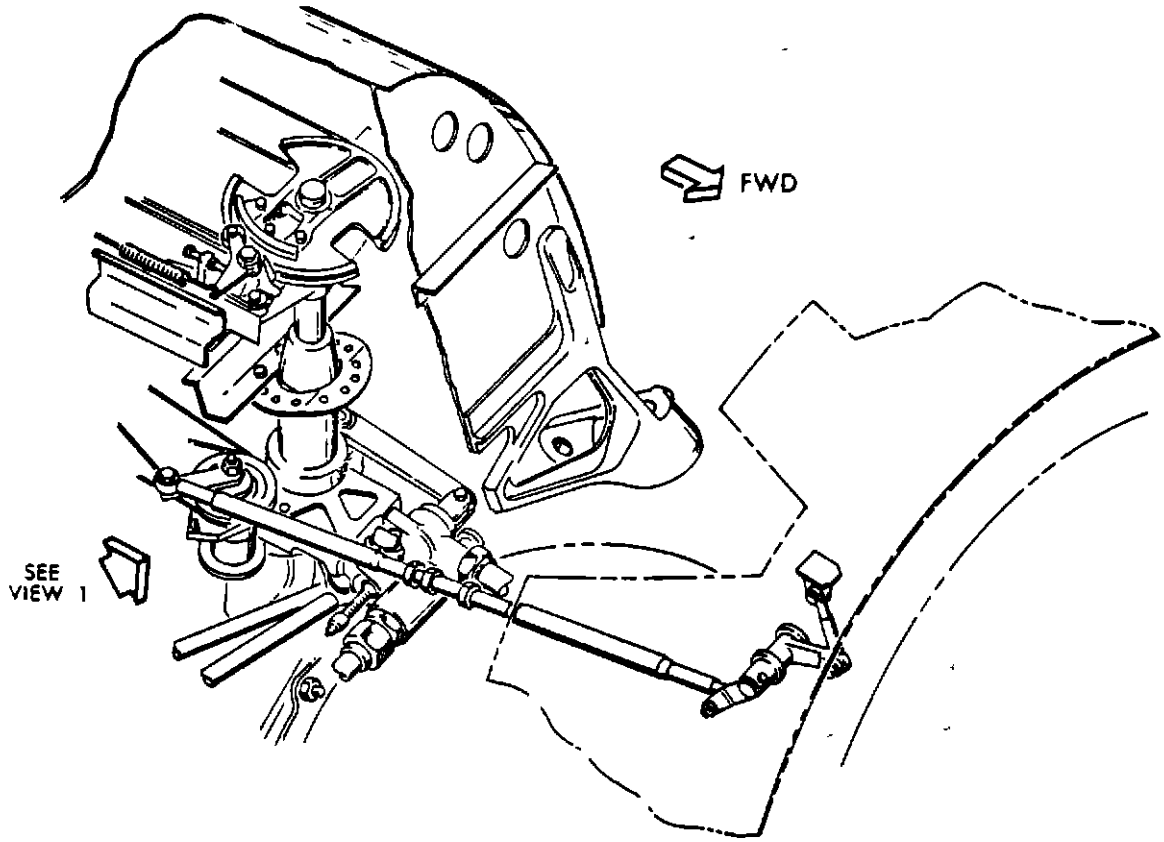
A Press bearing (if removed) into upper flange shaft mounting hole in bracket.

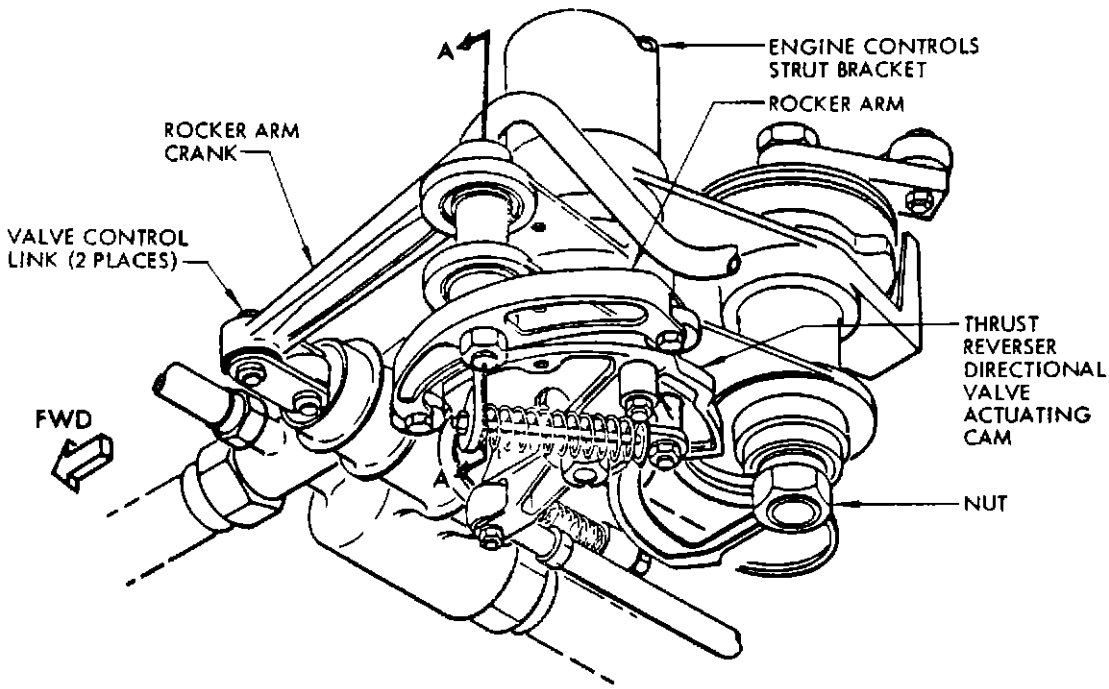
B Position rocker arm crank over end of rocker arm shaft and position crank up to top end of shaft so that splines are engaged and crank is bottomed against lip at top end of shaft.

C. Position spacer between bracket flanges and position rocker arm shaft through bracket flanges and spacer.

D. Insert rocker arm over splines on lower end of shaft and push arm up on shaft.

E. Secure rocker arm with nut. Tighten nut to 290 to 410 pound-inches. Install cotter pin. Maximum torque allowed for installation of cotter pin is 660 pound-inches.



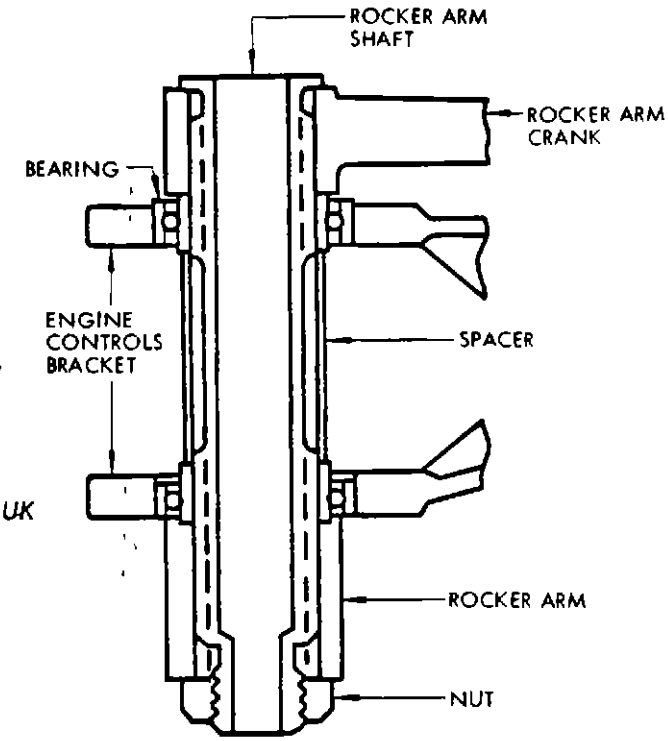


VIEW 1

Thrust Reverser Rocker Arm Shaft Controls Installation
Figure 401 (Sheet 1)

EFFECTIVITY

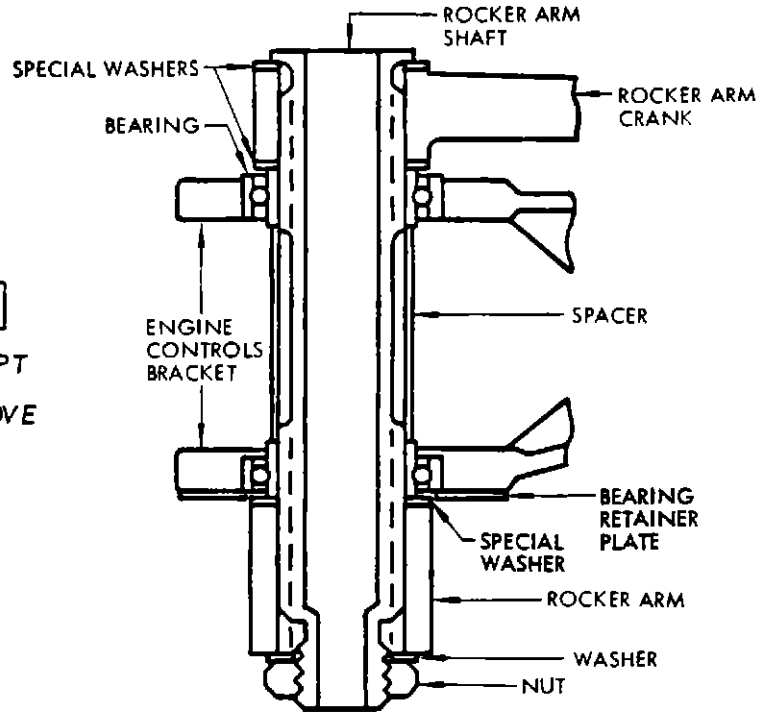
PAA	N401PA THRU N418PA N760PA THRU N799PA
TWA	N760TW, N773TW THRU N780TW, N793TW, N8705T, N8715T, N8725T, N18701 THRU N18709
AF	F-BHSV THRU F-BHSZ F-BLCA THRU F-BLCD
BOAC	G-ASZF AND G-ASZG
DLH	D-ABOT THRU D-ABOX D-ABUA THRU D-ABUH AND D-ABUK
AII	VT-DPM, VT-DSI AND VT-DVA
SAA	ZS-DYL
SABENA	OO-SJH THRU OO-SJK



CONFIGURATION 1

EFFECTIVITY

ALL AIRPLANES EXCEPT THOSE LISTED FOR CONFIGURATION 1 ABOVE



CONFIGURATION 2

SECTION A-A

Thrust Reverser Rocker Arm Shaft Controls Installation
Figure 401 (Sheet2)

3. Remove Rocker Arm Shaft Controls (Applicable to Configuration 2, figure 401.)

A Disconnect rocker arm crank from directional valve links.

B Remove nut from lower end of rocker arm shaft and remove washer, rocker arm, and special washer from lower end of shaft.

C Remove rocker arm crank, two special washers, and shaft from bracket by lifting out of bracket as a unit while holding spacer. Remove spacer.

D Check condition of bearing.

4. Install Rocker Arm Shaft Controls (Applicable to Configuration 2, figure 401.)

A Press bearing (if removed) into upper flange shaft mounting hole in bracket.

B With special washer positioned on top of rocker arm crank, position crank over end of rocker arm shaft and up to top end of shaft so that splines are engaged and crank and washer are bottomed against lip at top end of flange.

C Position spacer between bracket flanges and position rocker arm shaft through bracket upper flange, spacer, and lower flange.

D Position special washer over end of shaft and, while holding washer, insert rocker arm over splines on lower end of shaft and push arm up on shaft.

E Secure rocker arm with washer and nut. Tighten nut to 290 to 410 pound-inches. Install cotter pin. Maximum torque allowed for installation of cotter pin is 660 pound-inches.

NOTE: If after installation the bearing retainer on the bracket lower flange contacts the special washer, the retainer may be repositioned to clear by loosening the attachement screws, adjusting retainer and repositioning screws.

FORWARD THRUST REVERSER FOLLOW-UP LINKAGE - MAINTENANCE PRACTICES

1 Removal/Installation Forward Thrust Reverser Follow-Up Linkage

A. Remove Forward Thrust Reverser Follow-Up Linkage

(1) Remove engine side cowl panels

(2) Place thrust reverser in forward thrust position.

(3) Disconnect follow-up rod (2, figure 201) from forward thrust reverser follow-up crank (6).

(4) Remove follow-up crank (6) by removing nut (3) attaching crank to shaft

(5) Disconnect follow-up rod (2) from follow-up linkage arm (7) at linkage support bracket (8) on power plant diaphragm at upper vertical centerline of engine.

(6) Disconnect follow-up rod (9) from bracket (10) at inner surface of cowl ring at upper vertical centerline.

(7) Remove follow-up linkage mounted on shaft through bracket (8) by removing bracket. Remove 4 bolts on each side attaching bracket to power plant fan air exhaust diaphragm. Follow-up rod (9) is removed with bracket linkage.

B. Install Forward Thrust Reverser Follow-Up Linkage

(1) Place thrust reverser in forward thrust position.

(2) Install linkage support bracket (8, figure 201) including shaft mounted linkage and follow-up rod (9) to power plant fan air exhaust diaphragm at mounting location at upper vertical centerline of diaphragm with 8 bracket attachment bolts. Add or remove laminated shims between bracket and bolt heads as required.

(3) Connect follow-up rod (9) to bracket (10) on underside of cowl ring upper surface with nut, bolt, washer, and cotter pin. Install bolt from left side as shown in figure 201.

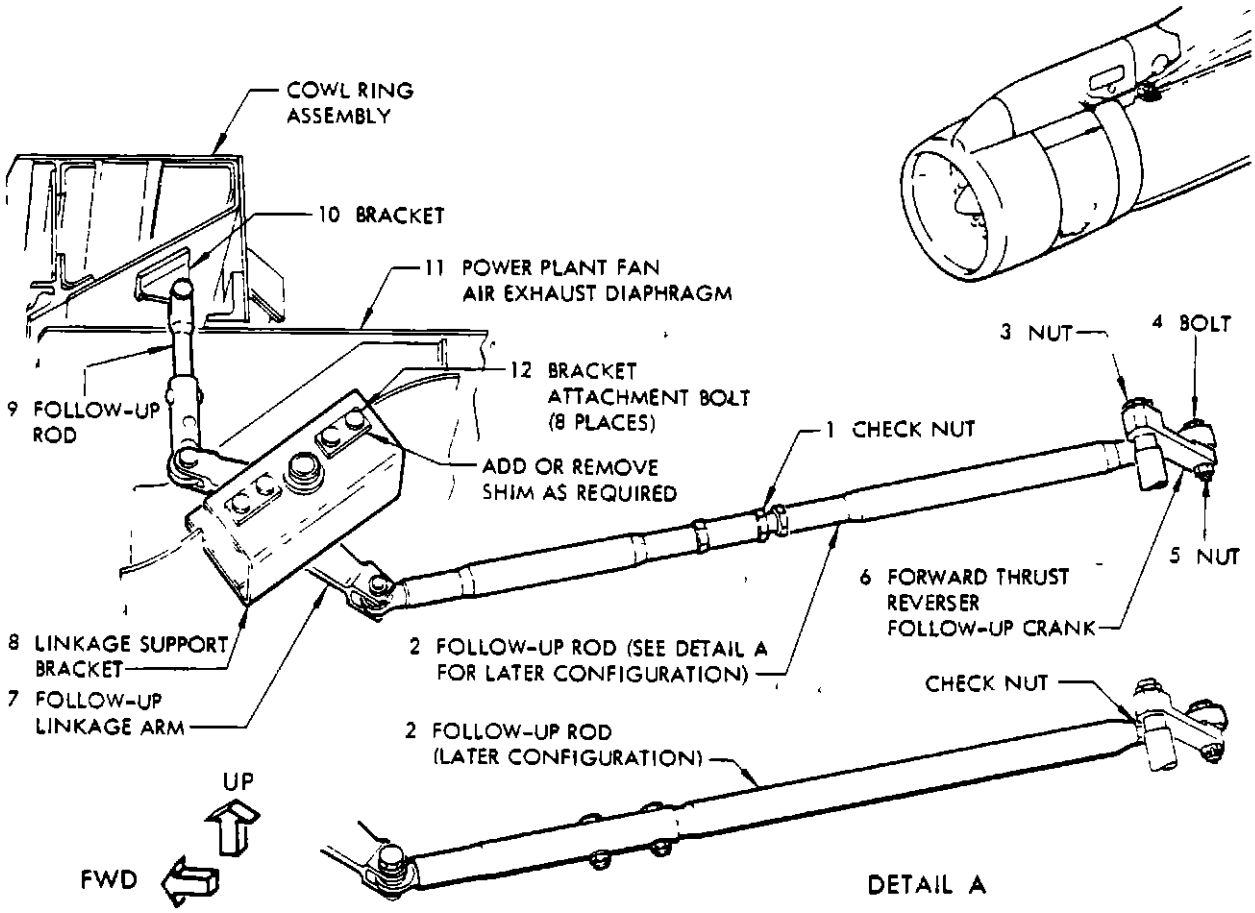
(4) Install follow-up crank (6) on shaft through engine controls strut bracket. Secure crank to shaft with nut (3).

(5) Connect follow-up rod (2) to linkage arm (7) on bracket mounted linkage with bolt, nut, washer and cotter pin. See figure 201 to determine correct end of rod to connect to linkage arm (7).

NOTE: Reinstallation of bolt connecting follow-up rod (2) to linkage arm (7) may be simplified by first installing a guide bolt from the right side. The installation bolt is then inserted from the left side, pushing out the guide bolt. This places the nut on the right side for more convenient access.

(6) Connect the other end of follow-up rod (2) to upper surface of follow-up crank (6).

(a) Insert rigging pin through rigging pin holes in forward and aft thrust reverser locking cams, and engine controls strut bracket.



Forward Thrust Reverser Follow-Up Linkage Installation
Figure 201

(b) Position end of follow-up rod (2) over installation hole in end of follow-up crank and insert bolt (4), with washer, shank down, through rod end and follow-up crank. If bolt cannot be inserted freely, adjust length of follow-up rod until bolt can be inserted freely. Loosen checknut (1) in center of rod assembly or at aft end of rod (on later installations) to make adjustments. Tighten checknut following adjustment.

(c) Install washer and nut (5).

(7) On inside surfaces of bracket, apply fillet sealing compound, Pro-Seal 567 (Coast Pro-Seal and Manufacturing Co., Los Angeles, Calif.) or equivalent, around joining edge of bracket and diaphragm structure. Do not seal drain hole in bracket.

(8) Remove rigging pin.

2. Adjustment/Test Forward Thrust Reverser Follow-Up Linkage

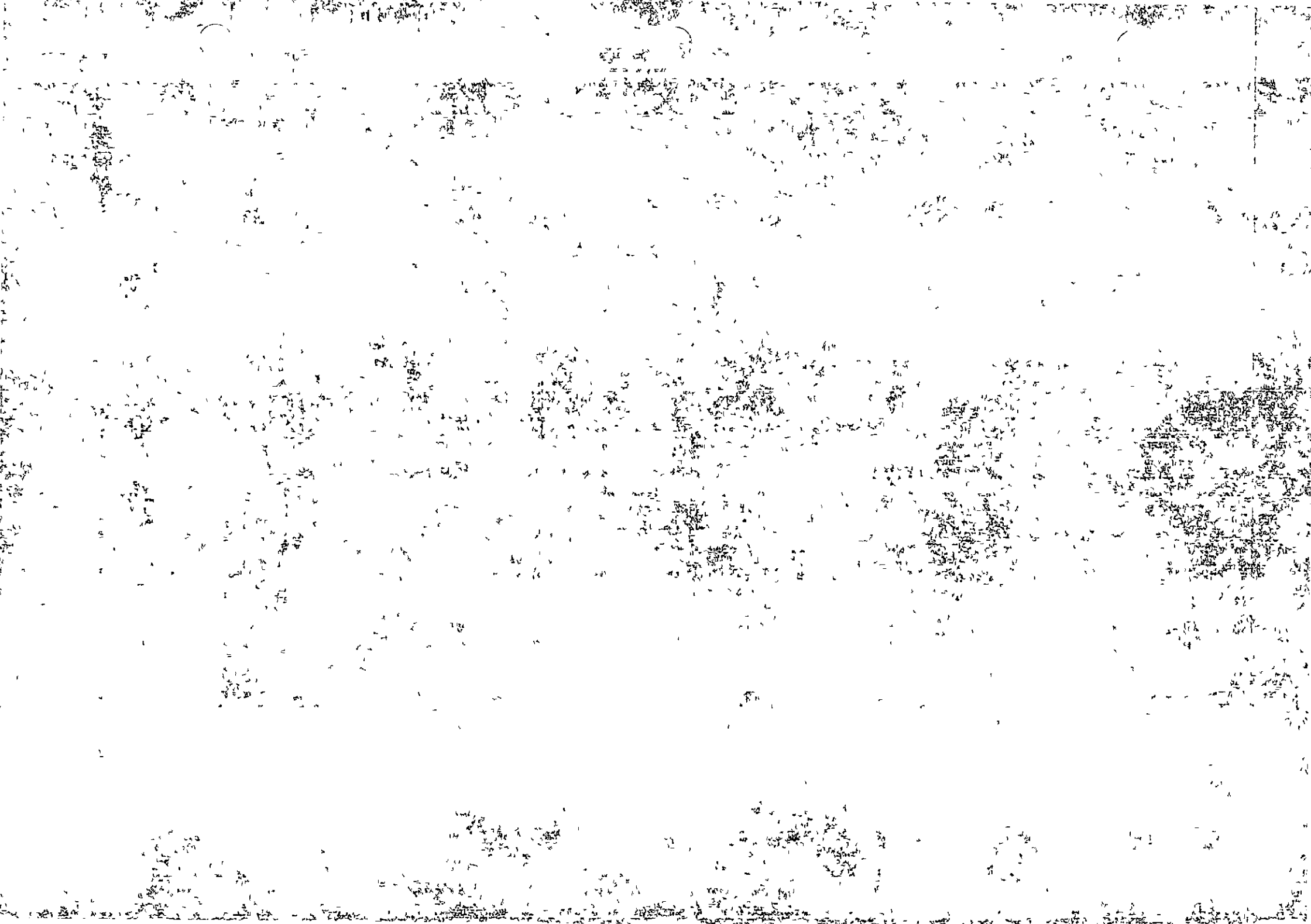
A. Rig Forward Thrust Reverser Follow-Up Linkage

(1) Place forward thrust reverser in full forward thrust position (against forward stops).

(2) Adjust length of follow-up rod assembly (2) until rigging pin can be inserted easily through rigging pin holes through engine controls strut bracket, aft thrust reverser locking cam, and forward thrust reverser locking cam.

CAUTION: CHECK THAT THE CLEVIS OR FORK END OF FOLLOW-UP ROD (9) DOES NOT CONTACT STRUCTURE WITH LINKAGE IN THE REVERSE THRUST POSITION. SUCH A CONDITION COULD IMPOSE EXCESSIVE STRAIN ON ROD (9) AND RESULT IN THE FORK AND/OR SPHERICAL BEARING BEING LOOSENED IN THE BARREL OF THE ROD END FITTING.

NOTE Aft thrust reverser follow-up linkage rigging should be checked prior to performing this rigging. (Refer to 78-6-21.)



AFT THRUST REVERSER FOLLOW-UP LINKAGE - MAINTENANCE PRACTICES

1. Removal/Installation Aft Thrust Reverser Follow-Up Linkage

A. General

(1) The aft thrust reverser follow-up pulley, the aft thrust reverser drum-and-crank and yoke assembly, and the miscellaneous linkages (control rods and idler arms) may be removed separately. When any miscellaneous linkages are removed, perform rigging according to instructions in paragraph 2.B.

(2) If replacing idler link (figure 201) the torque on the bolt attaching idler link to actuator support link should be limited to 15 to 25 pound-inches, to prevent bushing seizure.

B. Equipment and Materials

(1) Spring scale - 0 to 250 pounds

(2) Rigging pin MS20392 or 0.312 (+0.000/-0.003) diameter pin

(3) Spanner wrench - F71435-4 or equivalent (F71435-4 is part of engine control wrench kit - F71435.)

C. Remove Aft Thrust Reverser Follow-Up Linkage

(1) Remove aft thrust reverser follow-up pulley. (See figure 201.)

(a) Remove cotter pin, nut, washers and bolt attaching forward thrust reverser follow-up rod to forward thrust reverser follow-up crank (9).

(b) Remove nut (10) securing follow-up crank to shaft through engine controls strut bracket.

(c) Remove forward thrust reverser follow-up crank from shaft.

(d) Remove lockring (15) from nut (14). Remove nut (14) using spanner wrench.

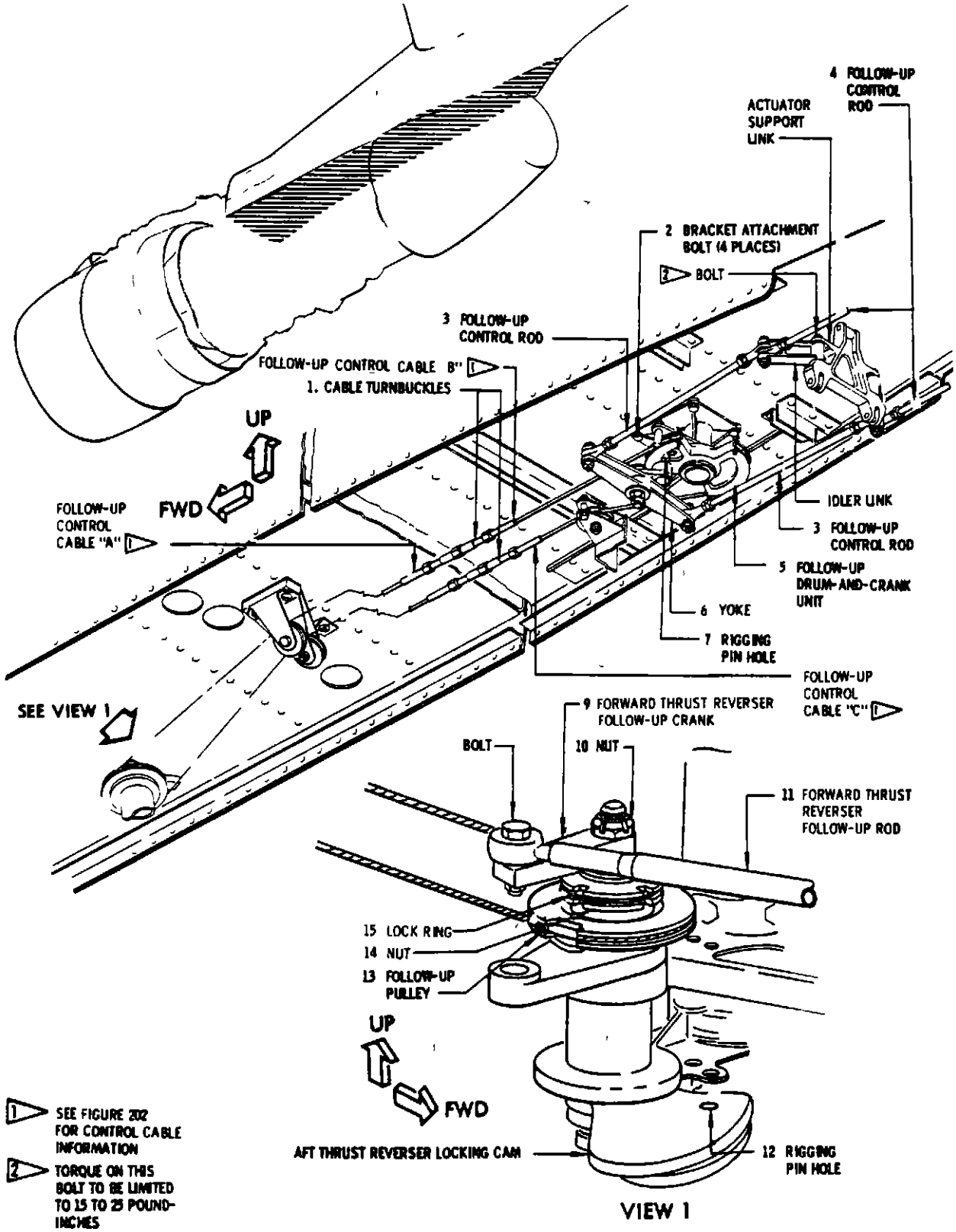
(e) Loosen cable turnbuckles (1) and remove cables from aft thrust reverser follow-up pulley (13).

(f) Remove follow-up pulley from shaft.

(2) Remove follow-up drum-and-crank and yoke.

(a) Loosen cable turnbuckles and remove cables from follow-up drum-and-crank unit (5, figure 201).

(b) Disconnect two follow-up control rods (3) at yoke (6) attachment.



1 SEE FIGURE 202 FOR CONTROL CABLE INFORMATION

2 TORQUE ON THIS BOLT TO BE LIMITED TO 15 TO 25 POUND-INCHES

Aft Thrust Reverser Follow-Up Linkage
Figure 201

(c) Remove bolts (2) and washers from bracket (4 places) and remove drum-and-crank and yoke from engine.

D. Install Aft Thrust Reverser Follow-Up Linkage

(1) Install aft thrust reverser follow-up pulley (13, figure 201).

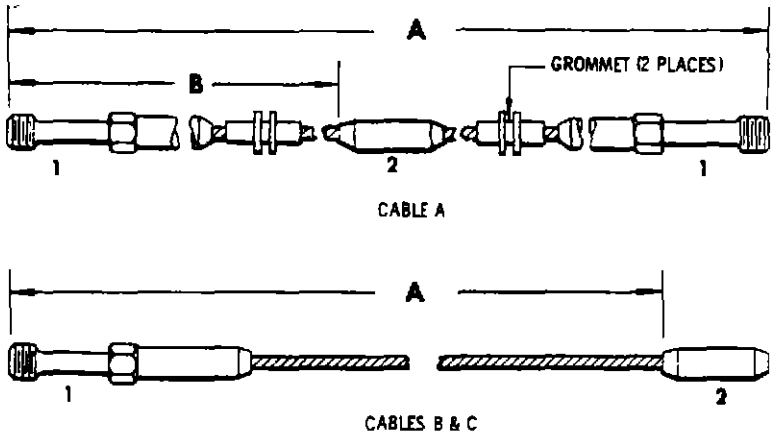
(a) Place forward thrust reverser follow-up pulley on follow-up controls shaft through engine controls strut bracket.

(b) Install nut (14, figure 201) using spanner wrench. Tighten nut within torque range of 290-410 pound-inches. Install lockring (15) carefully, checking for firm circumferential contact of the ring in the nut groove and correct tang penetration.

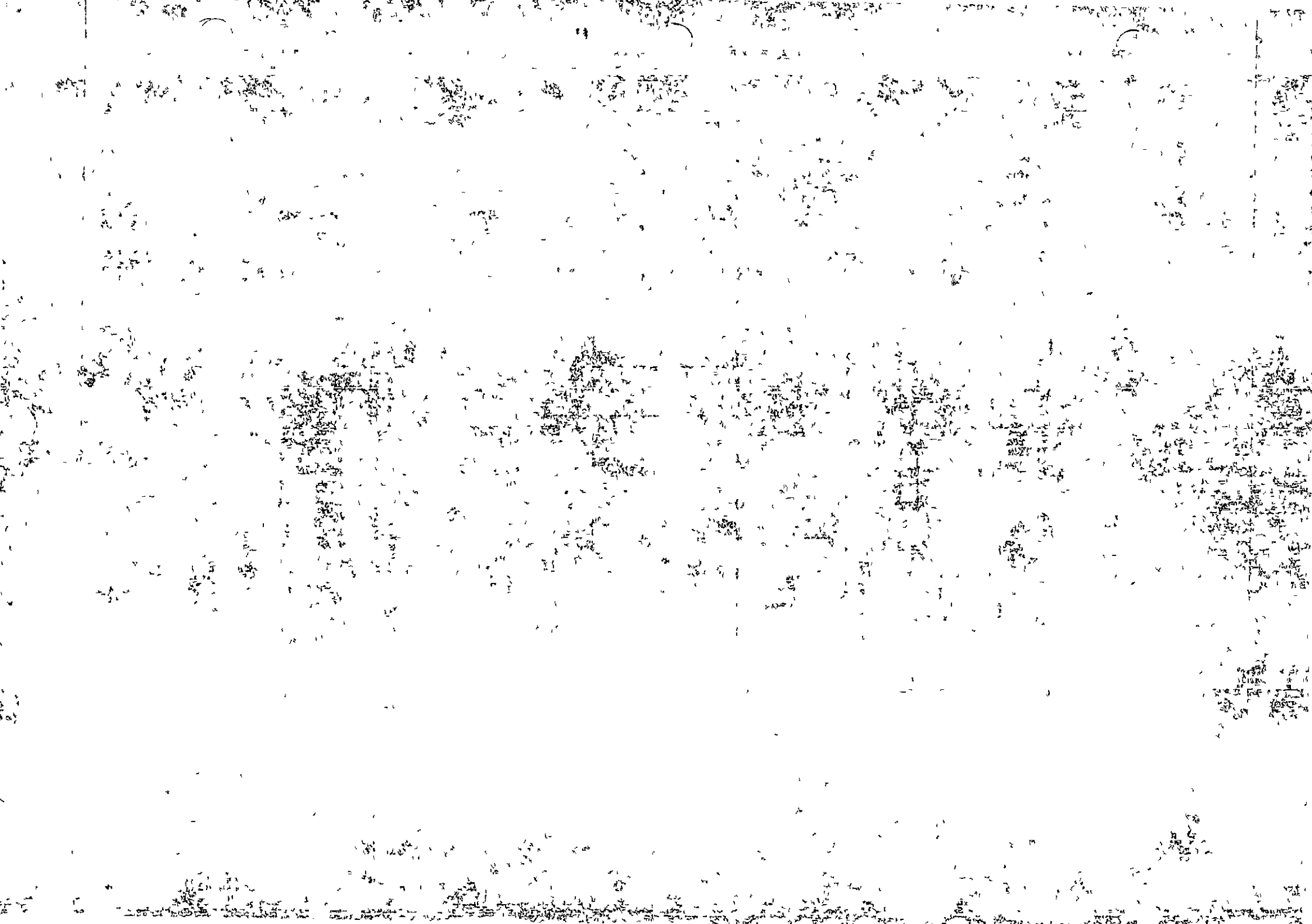
CAUTION CAREFUL INSTALLATION OF THIS LOCKRING IS REQUIRED. DISTORTION OF LOCKRING OR IMPROPER INSTALLATION MAY CAUSE INSUFFICIENT PENETRATION OF LOCKRING TANG RESULTING IN NUT LOOSENING.

CABLE REF ▷1	DRAWING NO	NO REQ	CABLE LENGTH A	CABLE LENGTH B	CABLE SIZE	FITTINGS 1	FITTINGS 2
A	63-10189	1	81 30	42 80	1/8 7 x 19	AN669S4RH	BAC-T14A-4
B	BAC-C13G-466-225C	1	22 5		1/8 7 X 19	AN669S4LH	BAC-T14A-4
C	BAC-C13G-466-267C	1	26 7		1/8 7 X 19	AN669S4LH	BAC-T14A-4

▷1 SEE FIGURE 201 FOR CABLE LOCATIONS



Aft Thrust Reverser Follow-Up Control Cables
Figure 202



(c) Install forward thrust reverser follow-up crank (9) over shaft

(d) Install nut (10) securing follow-up crank to shaft through engine controls strut bracket. Tighten nut within torque range of 290-410 pound-inches Maximum of 660 pound-inches is allowable for installation of cotter pin.

(e) Attach control cables to follow-up pulley (13).

(f) Insert rigging pin through rigging pin hole (7) in follow-up drum-and-crank unit (5) and drum support bracket.

(g) Place forward thrust lever in full forward thrust position and insert rigging pin through rigging pin hole (12) in aft thrust reverser locking cam and engine controls strut bracket.

(h) Adjust turnbuckles (1) until rigging pin is easily inserted with a cable tension of 200 to 230 pounds.

(i) Remove rigging pins.

(j) Attach forward thrust reverser follow-up rod to forward thrust reverser follow-up crank with nut, bolt and washer Rig forward thrust reverser follow-up linkage. See 78-6-11, "Rig Forward Thrust Reverser Follow-Up Linkage "

(2) Install follow-up drum-and-crank and yoke.

(a) Position bracket with follow-up drum-and-crank and yoke attached and install bracket with washers and mounting bolts (2).

(b) Connect cables to drum-and-crank unit (5).

(c) Insert rigging pin through rigging pin hole (7) in drum-and-crank unit and bracket.

(d) Place forward thrust lever in full forward thrust position and insert rigging pin (12) through aft thrust reverser locking cam and engine controls strut bracket

(e) Adjust turnbuckles (1) until rigging pin is easily inserted with a cable tension of 200 to 230 pounds.

(f) Remove rigging pin (12) from aft thrust reverser locking cam and engine controls strut bracket, but leave rigging pin (7) through follow-up drum-and-crank unit (5) and bracket in place

(g) Check that correct vertical clearance exists between sleeve and strut skin and adjust if necessary. Refer to 78-5-61, "Adjustment/Test Aft Thrust Reverser "

(h) Position thrust reverser sleeve against forward stop

(i) Adjust length of two follow-up control rods (3) such that holes in rod ends align freely with holes in yoke (6) while maintaining yoke in correct horizontal alignment.

NOTE. The length of follow-up control rods (4) is not to be adjusted during rigging. The length of these rods should be the original installed length of 9.76 inches

(j) Install bolts with nuts and cotter pins through rod ends and yoke

(k) Remove rigging pin (7)

2 Adjustment/Test Aft Thrust Reverser Follow-Up Linkage

A General

(1) The aft thrust reverser follow-up linkage is rigged with the thrust reverser in the forward thrust position and with the engine at ambient (atmospheric) temperature

B Equipment and Materials

(1) Rigging pin MS20392 or 0 312 (0 000/-0 003) diameter pin

C. Adjust Aft Thrust Reverser Follow-Up Linkage

(1) Insert rigging pin (7, figure 201) in follow-up drum-and-crank unit (5, figure 201) and follow-up drum support bracket.

(2) Place forward thrust lever in full forward thrust position and insert rigging pin (12) through aft thrust reverser locking cam and engine controls strut bracket

(3) Adjust turnbuckles (1) until rigging pin is easily inserted with a cable tension of 200 to 230 pounds.

(4) Remove rigging pins.

(5) Prepare to rig aft thrust reverser follow-up linkage from follow-up drum to aft thrust reverser hinge drive mechanism

(a) For this rigging it is necessary that the aft thrust reverser sleeve stop be adjusted to give correct clearance between sleeve and strut skin. Refer to 78-5-61, "Adjustment/Test Aft Thrust Reverser "

(6) Position thrust reverser sleeve against forward stop.

(7) Remove bolt from end of both follow-up control rods (3) at yoke (6) connection.

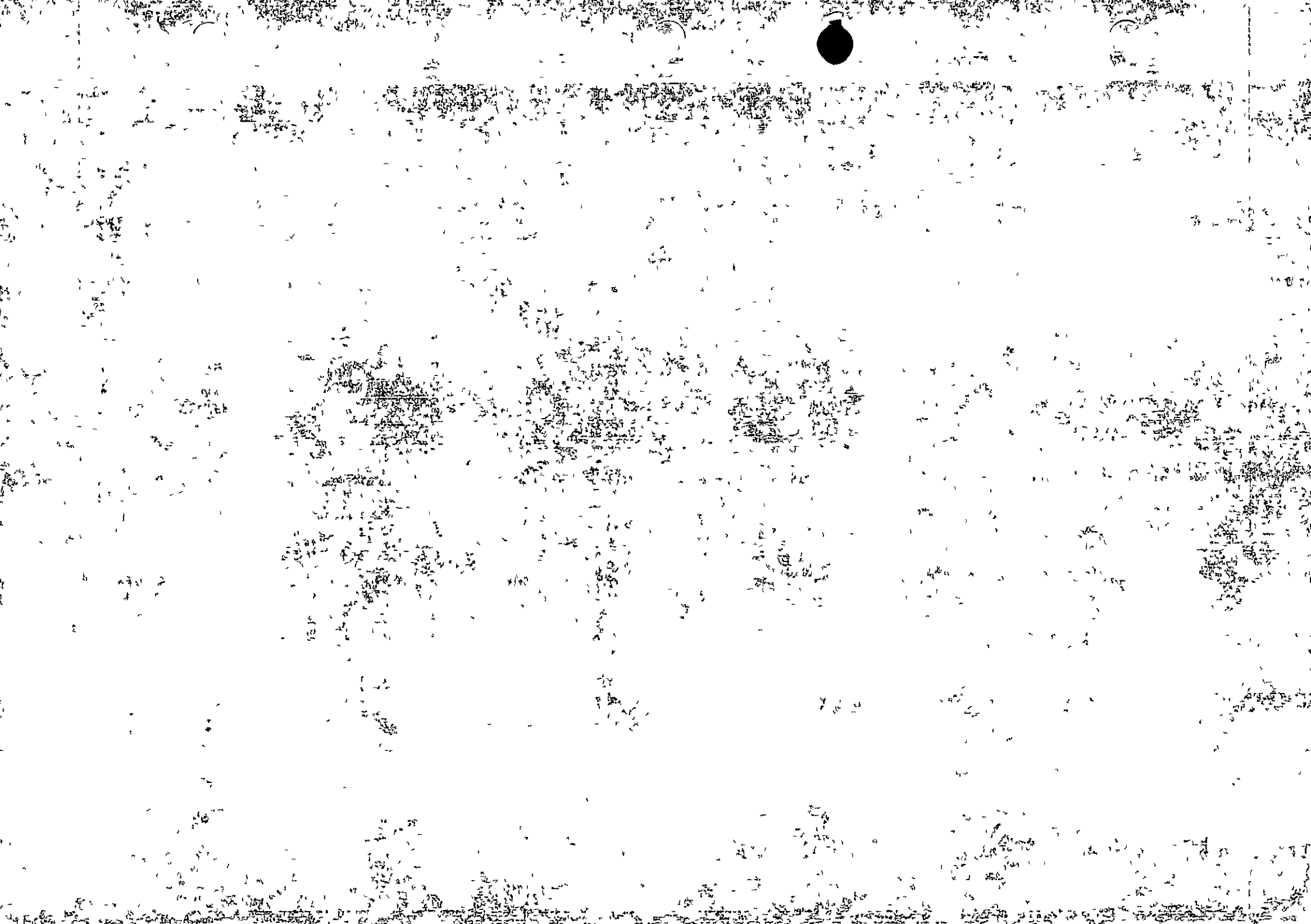
(8) With forward thrust lever maintained in the forward thrust position, install rigging pin through follow-up drum-and-crank unit (5) and follow-up drum support bracket.

(9) Adjust length of control rods (3) such that bolts removed in step (7) can be installed freely while maintaining yoke horizontally aligned.

NOTE: The length of follow-up control rods (4) is not to be adjusted during rigging. The length of these rods should be the original installed length of 9.76 inches.

(10) Install nuts and cotter pins.

(11) Remove rigging pins.



AFT THRUST REVERSER ACTUATORS - MAINTENANCE PRACTICES

1. General

A The time involved in removing the upper actuator assembly is greater than for the lower actuator assembly. If one of the upper actuator cylinders is damaged, an alternative to replacing the complete upper actuator assembly would be to deactivate the damaged actuating cylinder by disconnecting the cylinder rod end and capping the air source according to the procedure in paragraph 3 below It is not allowable to deactivate a complete actuator, top or bottom Only one cylinder of the four in both actuator assemblies may be rendered inoperative. When an actuating cylinder is deactivated, appropriate provision should be made to insure that the complete actuator is changed at the first layover where time and parts are available.

2. Removal/Installation Aft Thrust Reverser Actuators

A. Equipment and Materials

(1) Antiseize compound - Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent

B. Remove Aft Thrust Reverser Actuators (See figure 201)

(1) Remove aft thrust reverser lower actuator assembly. (See view 1, figure 201.)

(a) Disconnect pneumatic tubing.

(b) Manually actuate lower sleeve lock and slide sleeve slightly aft so that lock remains disengaged.

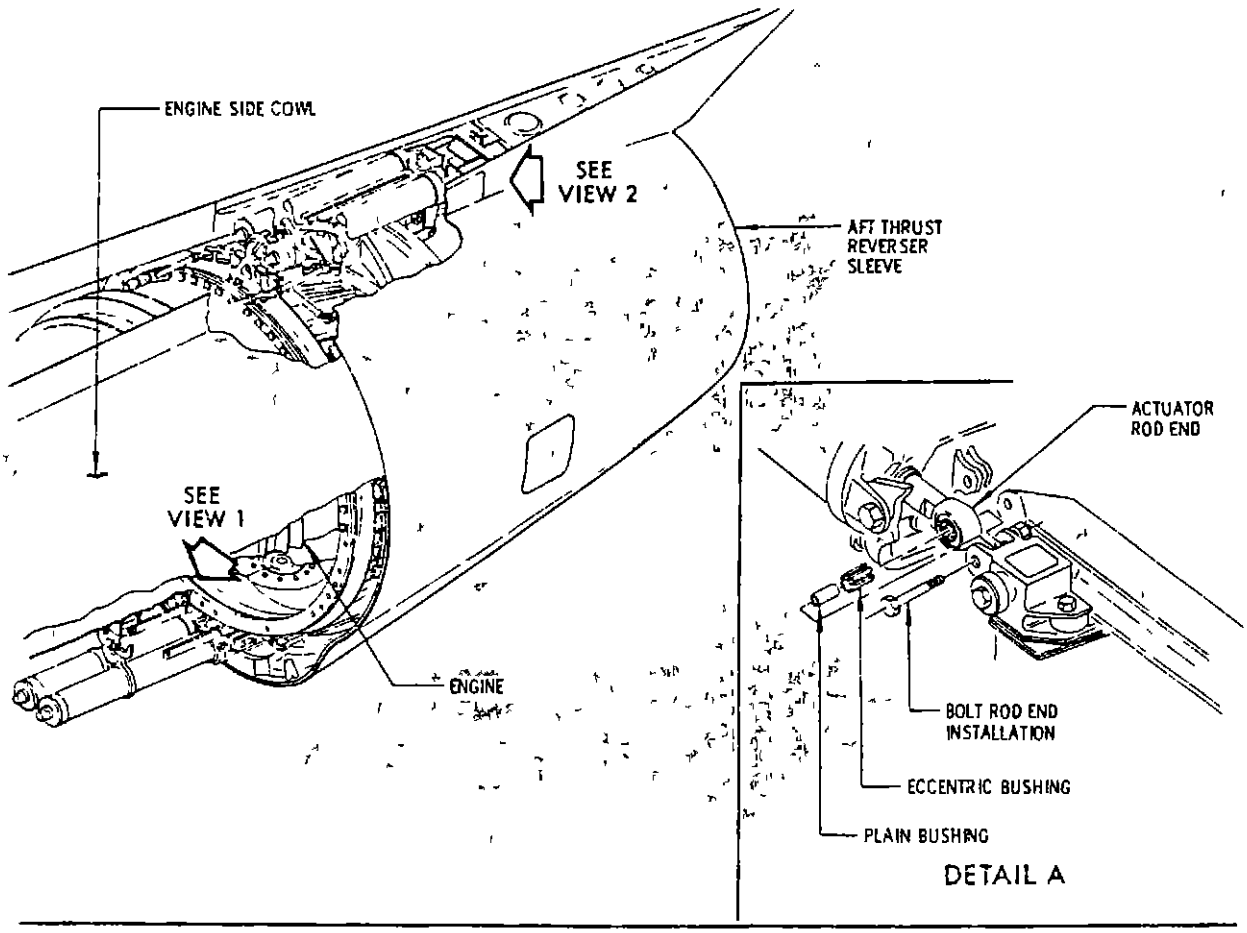
(c) Remove sleeve lower track to actuator assembly attachment bolt (2).

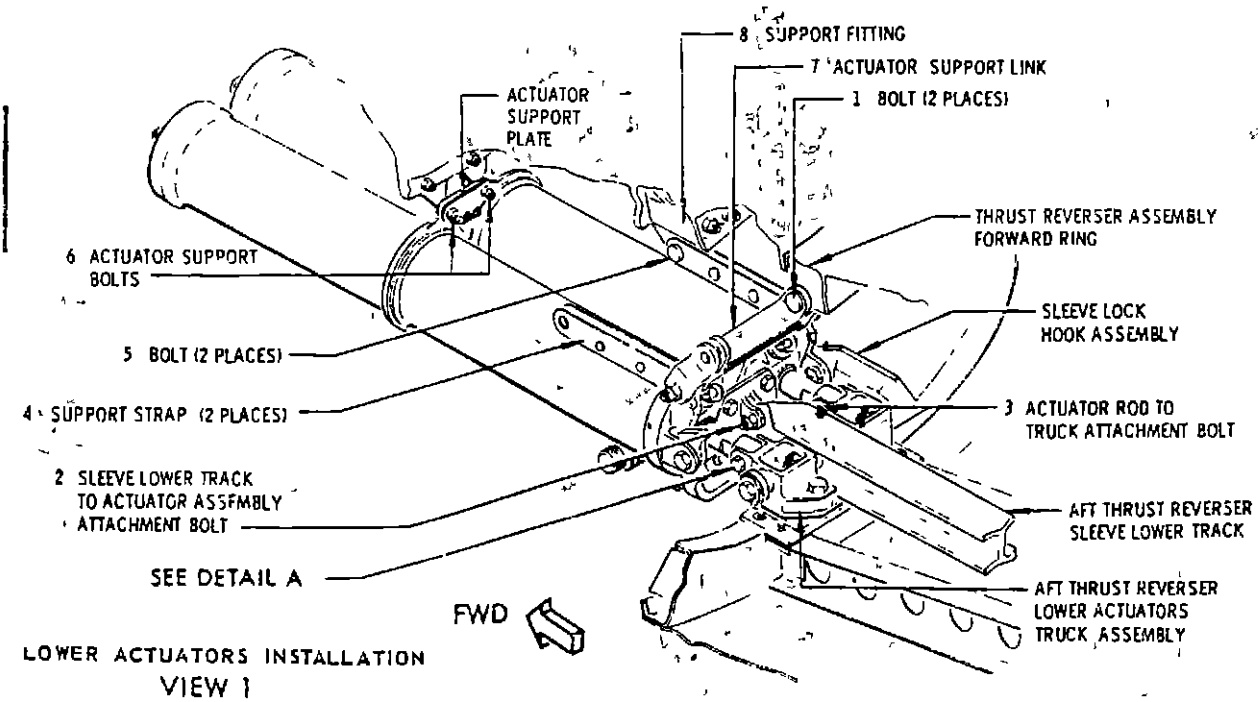
(d) Remove actuator rod to truck attachment bolts (3).

(e) Remove bolts (1, figure 201) attaching lower actuator support link (7) to thrust reverser assembly forward ring.

(f) Remove bolts (5) attaching support strap (4) to support fitting (8).

(g) Remove two bolts (6) at lower actuator support plate connection and remove actuator assembly from engine. Provide support for actuators while removing bolts.





LOWER ACTUATORS INSTALLATION
VIEW 1

Aft Thrust Reverser Actuators Installation
Figure 201 (Sheet 1 of 2)

(2) Remove aft thrust reverser upper actuator assembly. (See view 2, figure 201.)

(a) Manually position thrust reverser in forward thrust position.

(b) Remove aft thrust reverser sleeve access panels L3708 and R3708 in strut fairing area of sleeve. See Chapter 12, "Access Doors and Panels."

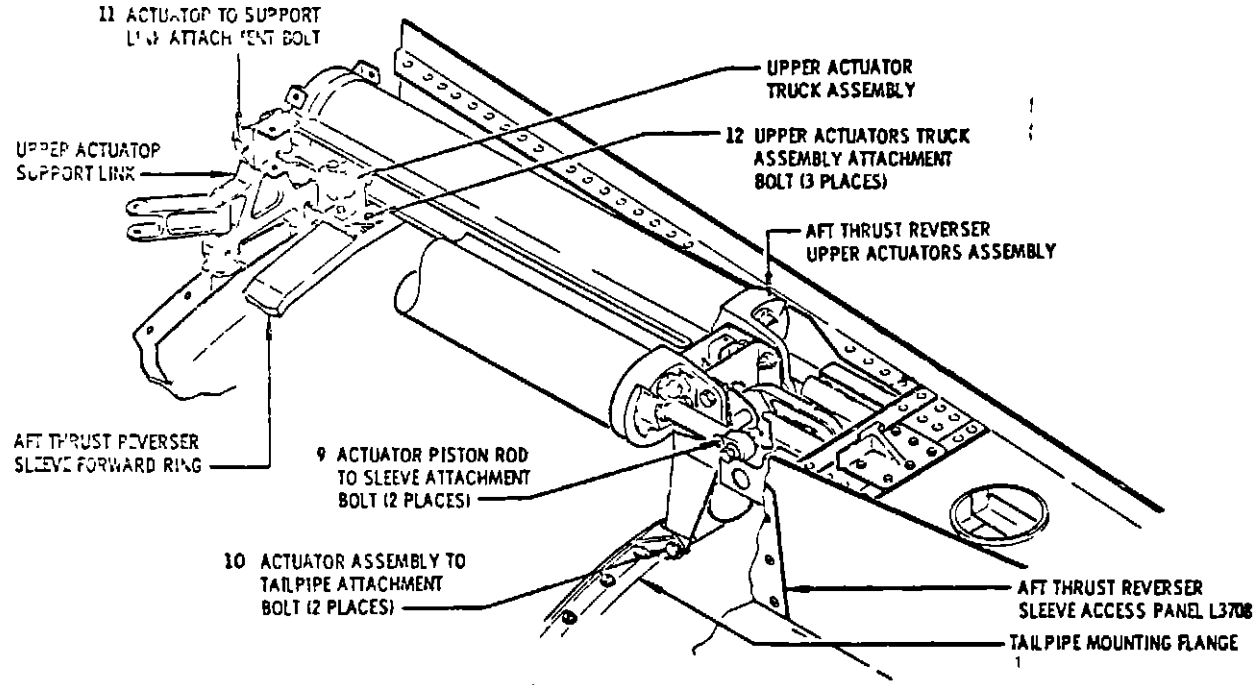
(c) Remove bolt (10, figure 201), nut and bushing (2 places), attaching actuator assembly to tailpipe.

(d) Disconnect actuator piston rods from sleeve connection by removing bolt (9), 2 bushings, washer, nut and cotter pin in two places.

(e) Disengage sleeve lower lock and manually move sleeve aft to gain acces to upper actuator truck attachment bolts (5).

(f) Remove bolts (12), washers, serrated splice plate and shims, attaching truck to forward ring.

(g) Remove bolt (11), nut, and two bushings attaching upper actuator assembly to upper actuator support link and remove upper actuator assembly.



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UPPER ACTUATORS INSTALLATION
VIEW 2

C. Install Aft Thrust Reverser Actuators

(1) Install aft thrust reverser lower actuator assembly.

(a) Coat threads and shank of all bolts with antiseize compound prior to installation.

(b) Position aft thrust reverser lower actuator assembly underneath engine and forward of aft thrust reverser sleeve, as shown in figure 201 and attach to actuator support plate with 2 bolts (6) and nuts.

(c) While still supporting actuators manually connect actuator support link (7) to thrust reverser assembly forward ring with bolt (1), nut, bushing and cotter pin (2 places)

(d) Attach support straps (4) to support fitting (8) with bushing, bolt (5), nut and cotter pin. Install bolt with shank pointing out.

(e) Connect actuator rod ends to lower actuator truck assembly with 2 bushings, bolt (3), nut and cotter pin.

(f) Connect lower sleeve track to actuators with bolt (2) and nut.

(g) Connect pneumatic tubing.

(h) Rig aft thrust reverser. See 78-5-61, "Adjustment/Test Aft Thrust reverser."

(2) Install aft thrust reverser upper actuator assembly. (See view 2, figure 201.)

(a) Coat threads and shank of all bolts with antiseize compound prior to installation.

(b) Slide sleeve forward so that sleeve forward ring is forward of tailpipe mounting flange

(c) Position actuators from forward end of sleeve. Align upper actuator truck assembly with mounting surface on sleeve forward ring.

(d) Attach sleeve forward ring to upper actuator truck with 3 bolts (12) and washers, serrated splice plate and shims. Position splice plate and shims between truck and upper surface of forward ring Install bolts from bottom side of rings.

AFT THRUST REVERSER HINGE DRIVE MECHANISM - MAINTENANCE PRACTICES

1. Removal/Installation Aft Thrust Reverser Hinge Drive Mechanism (Upper or Lower Hinge Area)

A. Equipment and Materials

(1) Antiseize compound - Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent

B Remove Hinge Drive Mechanism

(1) Disconnect hinge drive mechanism drag links (2, figure 201) from aft thrust reverser sleeve at sleeve connections.

(2) Disconnect hinge drive links (5) from clamshell door hinge arms by removing bolt (6) through clamshell door hinge arm.

(3) Unfasten lock wire and remove idler link installation bolt (7) at hinge support fitting (2 places).

(4) Remove hinge drive idler link (1) with link (5) and link (2) attached (2 places)

C. Install Hinge Drive Mechanism

(1) Coat threads and shank of all bolts with antiseize compound prior to installation.

(2) Place aft thrust reverser in forward thrust position.

(3) Position one hinge drive idler link (1, figure 201) with hinge drive drag link (2) and hinge drive link (5) attached at installation location at clamshell door hinge area and install idler link installation bolt (7) through hinge support fitting and idler link (1). Lockwire bolt.

(4) Connect hinge drive link (5) to clamshell door hinge arm with bolt (6) Insert bolt from outer surface of hinge arm through aft follow-up rod and hinge drive link (5).

(5) With aft thrust reverser sleeve against forward stops insert rigging pins through hinge drive idler links (1) and hinge support fitting, adjust length of hinge drive mechanism drag links (1) so that installation bolt (4) can be inserted freely through sleeve attachment and rod end.

(6) Install nut and cotter pin.

2. Adjustment/Test Hinge Drive Mechanism

A. Adjust Hinge Drive Mechanism (See figure 201.)

(1) Manually position aft thrust reverser sleeve against forward stops.

(2) Remove side cowl panels.

(3) Adjust length of hinge drive drag link rods by using check nut at aft thrust reverser sleeve connection end until rigging pins can be easily inserted through the rigging pin holes through the hinge drive idler links (1) and the hinge support fitting.

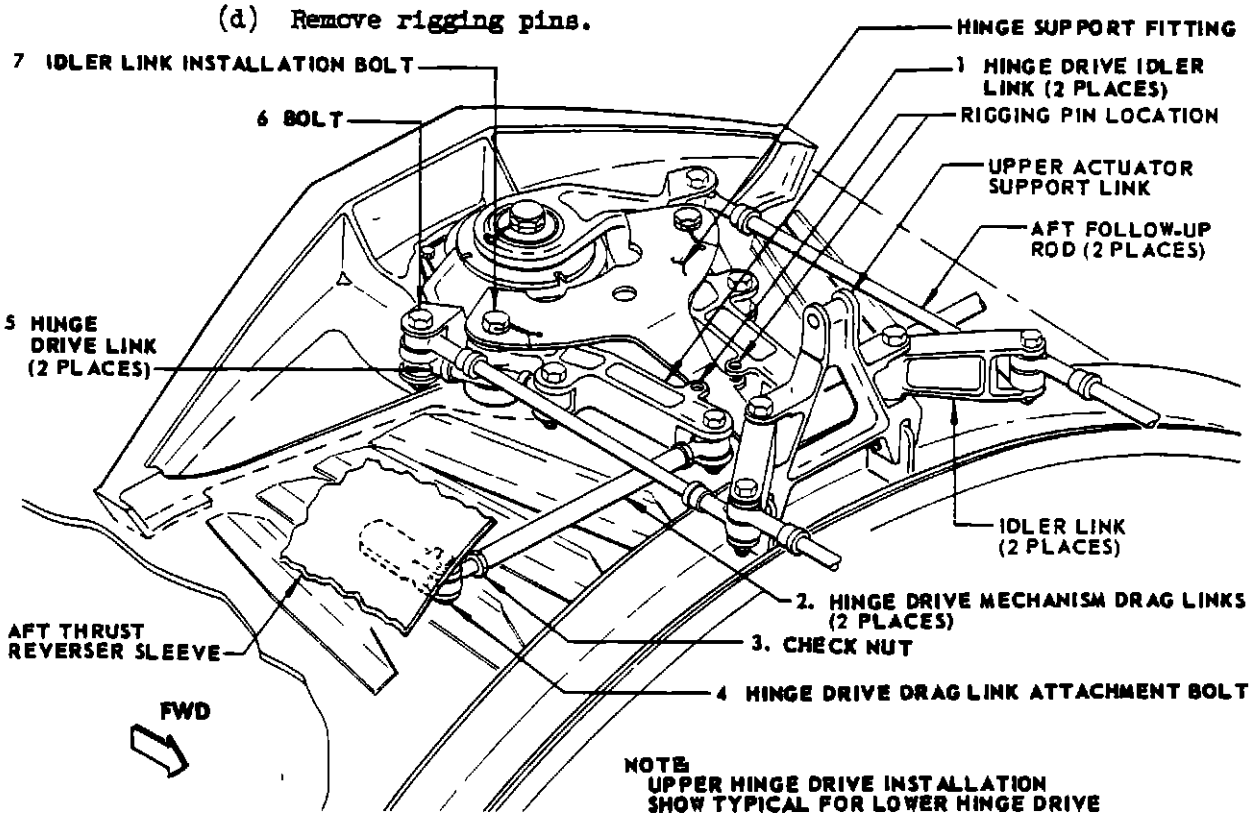
(4) Adjust length of hinge drive drag links (2) using check nuts at sleeve connection end of drag link rods.

(a) Disconnect hinge drive mechanism drag links (2) by removing bolt (4), nut and cotter pin (2 places).

(b) Align rigging pin holes in hinge drive idler links (1) and hinge support fitting and insert rigging pins.

(c) Adjust length of drag links (2) using check nut (3) at sleeve connection until attachment bolt (4) can be freely installed.

(d) Remove rigging pins.



Hinge Drive Mechanism Installation
Figure 201

(e) Attach actuators to tailpipe with bolt (10), nut and bushing (2 places).

(f) Attach actuators to upper actuator support link with bolt (11), nut and two bushings.

(g) Connect pneumatic tubing. Tighten coupling nut at connection of pneumatic line to welded manifold cross fitting to 350-400 pound-inches torque.

CAUTION: DO NOT EXCEED 350 TO 400 POUND-INCHES TORQUE ON ANY WELDED FITTING ON THE MANIFOLD. DAMAGE TO FITTINGS MAY RESULT IF THIS TORQUE IS EXCEEDED.

(h) Connect actuator rod ends to sleeve connection.

1) Gain access to actuator rods and sleeve connection through access panels L3708 and R3708.

2) Position eccentric bushing in rod end so that piston rod is in uppermost position relative to cylinder centerline. (Hole in bushing down.)

3) Position plain bushing in eccentric bushing.

4) Attach rod end with bolt (9), nut, washer and cotter pin to sleeve connection.

(i) Rig aft thrust reverser. See 78-5-61, "Adjustment/Test Aft Thrust Reverser.

3. Deactivate Aft Thrust Reverser Upper Actuator Cylinder

A. Remove aft thrust reverser sleeve access panels L3708 and R3708.

B. Remove short line at rear of the affected cylinder and cap inlet port tee. (See figure 202.)

C. Disconnect cylinder rod end, push rod to stowed position, and secure with safety wire.

D. Remove welded manifold assembly "B" nuts from the forward end of both cylinders.

NOTE: This is necessary due to the rigidity of the welded manifold and clearance between "B" nut when installing plug.

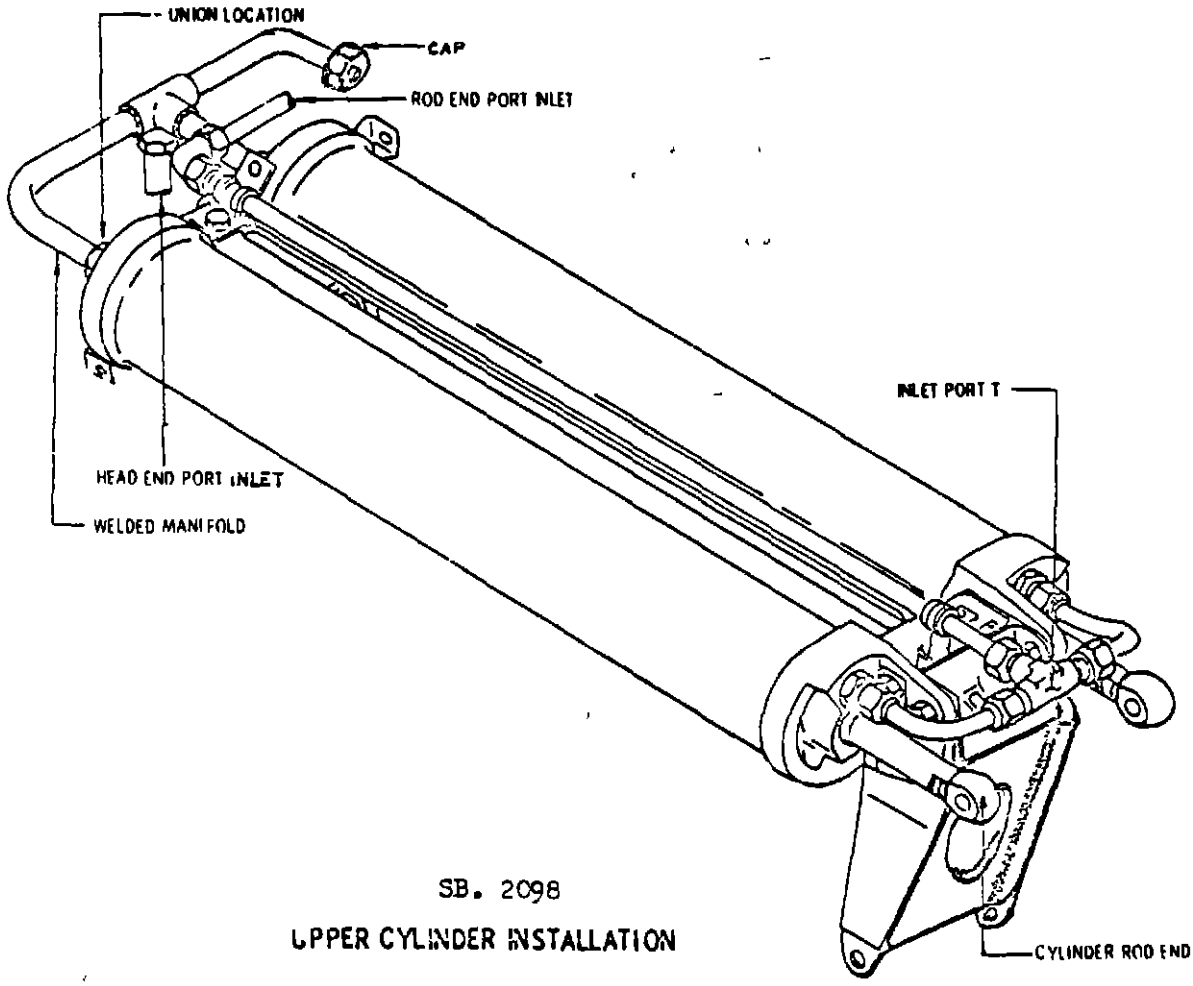
E. Remove "B" nut union from cylinder to be deactivated and plug "B" nut with suitable plug.

F. Reinstall weld manifold assembly on operative cylinder.

G. Replace access panels.

H. Run aircraft and reverse one complete cycle noting reversing action.

I. Tag all parts and store in airplane cargo compartment.



SB. 2098

UPPER CYLINDER INSTALLATION

FORWARD THRUST REVERSER ACTUATORS - REMOVAL/INSTALLATION

1 Remove Forward Thrust Reverser Actuators

A Remove fan cowl panels.

B With a man on each side of the engine, move cowl ring aft to reverse thrust position.

C Disconnect pneumatic lines (2 places) from actuator.

NOTE: If actuator is being replaced, remove lockwire and remove banjo fittings on aft end of actuators 5 and 7 left-hand and 4 and 7 right-hand. Retain fittings for installation on new actuator.

D. If removing an actuator attached to a blocker door, pull blocker door out to the reverse thrust position to gain access to the attaching bolt.

E. Remove bolt attaching actuator piston rod to blocker door or vane assembly.

F. Remove bolt holding actuator to forward support and remove actuator from engine.

2. Install Forward Thrust Reverser Actuators

A. Position actuator at forward support point on engine with fixed rod bearing end between clevis flanges of engine mounting bracket. Attach with bolt, washer, nut, and cotter pin. Install washer under bolt Tighten bolt to 20-25 pound-inches. Insert cotter pin.

NOTE. Check banjo fittings on aft end of actuators 5 and 7 left-hand and 4 and 7 right-hand If fittings were removed, loosened, or show evidence of leakage, install new crush washer, torque fitting to 200-220 pound-inches, and lockwire to the actuator bushing retainer.

B. Connect pneumatic lines to actuator (2 places). Lockwire universal fitting bolts. Check that no side loads or down loads are imposed on actuator by hose installation. If hose support clamps have been disturbed, position clamps to proper position on hose. Check corresponding actuator on another engine to verify clamp location.

C. If installing actuator to blocker door, check for clearance between door and cowl ring with actuator bottomed and cowl ring against reverse thrust stops. On installations using magnesium blocker doors, the minimum clearance is 0.02 inch. On installations using aluminum blocker doors, the minimum clearance is 0.10 inch. If specified clearance is not present at locations shown, check actuators for proper extended length measured from rod end bearing centerline to aft face of bushing retainer plate. (See figure 401.)

D. If installing actuator to vane assembly, adjust length of actuator rod so that actuator will not bottom in either extreme of actuator travel.

NOTE: With vane actuator adjusted to desired length make sure that the 0.125 inch wrenching hole in the actuator is not aligned over the keyway in the rod end bearing or excessive air leakage can result.

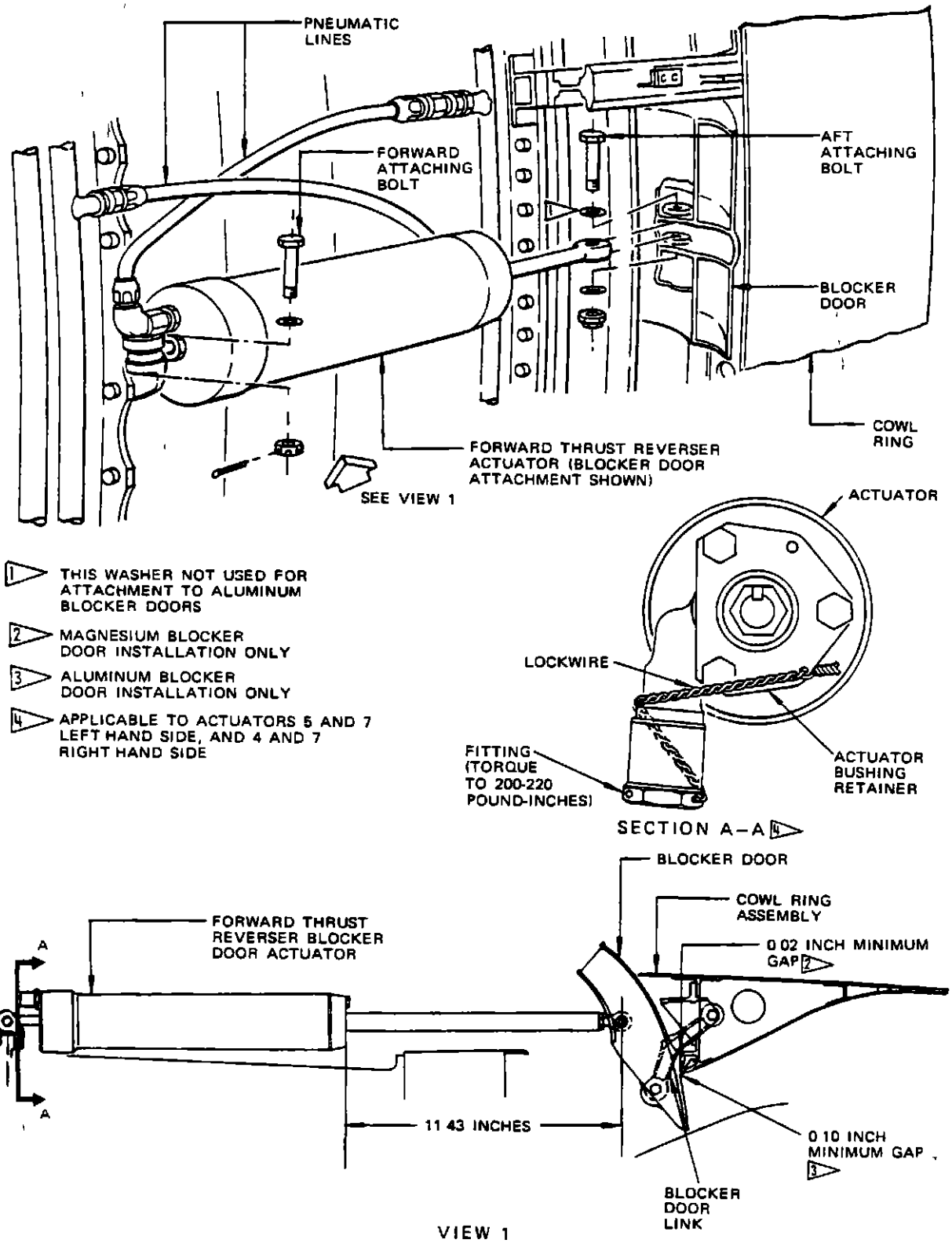
E. Lockwire jamnut on rod end bearing assembly.

F. Install bolt attaching actuator to blocker door or to vane assembly. Install one washer under nut and one under bolt head at magnesium blocker door connection. Install one washer under nut at aluminum blocker door connection. Install one washer under nut at vane assembly connection.

G. Check blocker door for free movement by raising door by hand from reverse thrust position to point where door links bottom against the link fitting stop. The door is to be moved into this position and back to reverse thrust position freely by hand.

CAUTION. WHEN CONNECTING ACTUATOR ROD TO VANE ASSEMBLY TIGHTEN NUT CAREFULLY SO THAT BOLT HEAD AND NUT ARE JUST SEATED AGAINST THE FLANGES OF THE CLEVIS. OVERTIGHTENING OF THIS NUT AND BOLT CAN CAUSE BENDING OF THE CLEVIS FLANGES WHICH CAN RESULT IN THEIR FAILURE.

H. Test thrust reverser operation per 78-6-0, Test Thrust Reverser Control System.



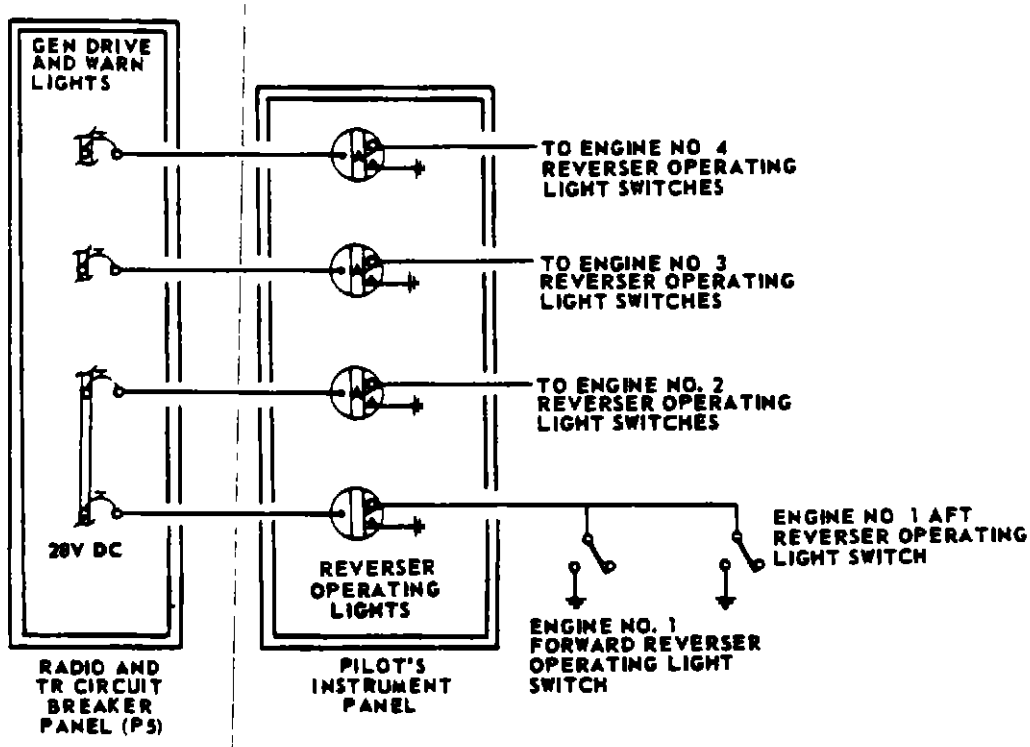
Forward Thrust Reverser Actuator Installation
Figure 401

THRUST REVERSER POSITION INDICATING SYSTEM - DESCRIPTION AND OPERATION

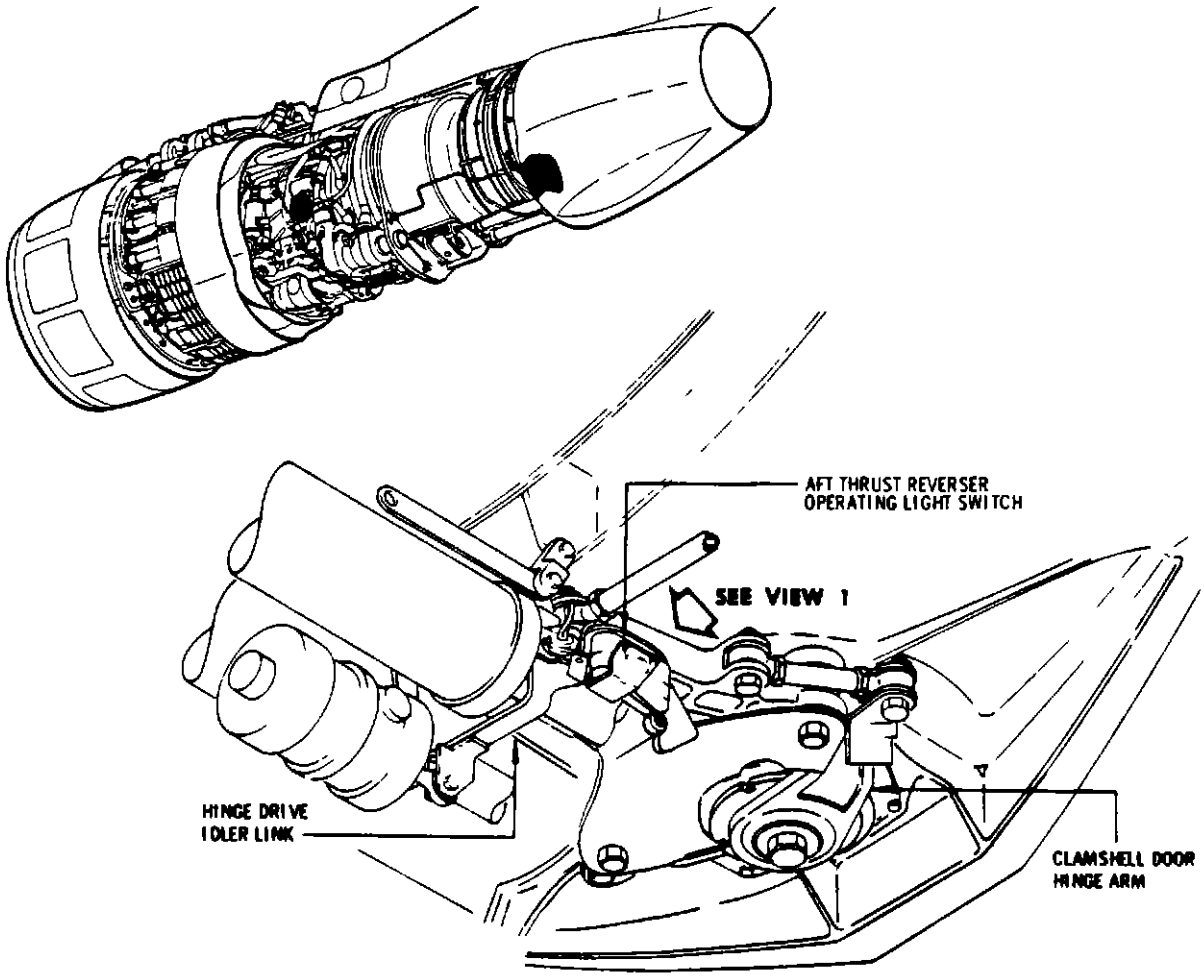
1. General

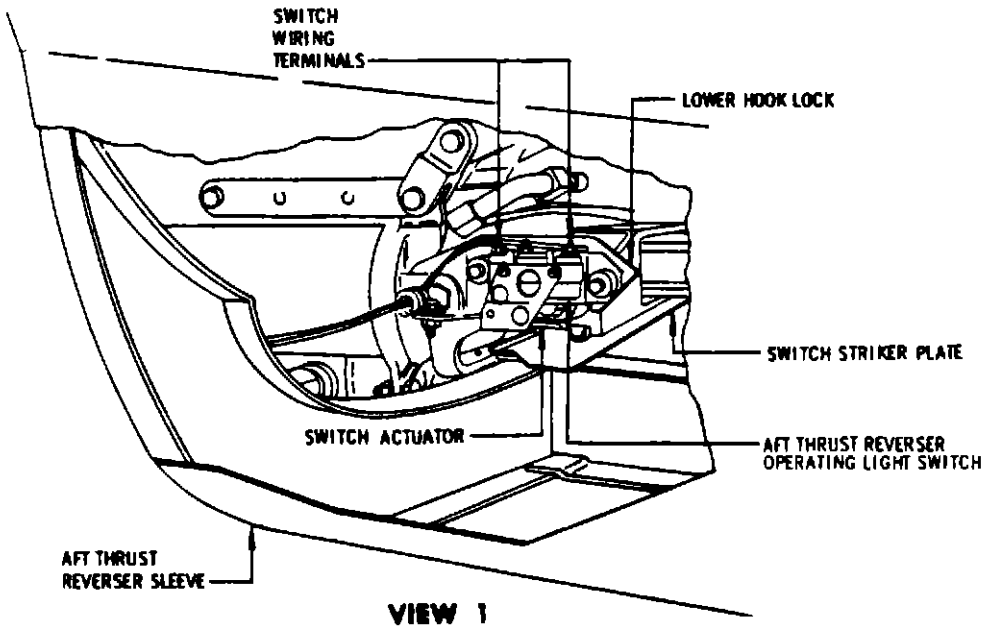
A. A position indicating system for each thrust reverser provides an amber light indication (to the pilot) of the position of the forward and aft thrust reversers relative to their forward stowed position and whether or not the aft thrust reverser is locked. Illumination of a light indicates that either the forward thrust reverser sleeve or the aft thrust reverser sleeve has left the forward stowed position or that both sleeves have left the forward stowed position. The light will illuminate whenever the aft thrust reverser sleeve mechanical lock is disengaged.

B. The position indicating system consists of two microswitches on each engine, one for the forward thrust reverser and one for the aft thrust reverser, and an amber position indicating light for each engine. (See figure 1.) The system utilizes 28 volt d-c power.



Thrust Reverser Position Indicating System Circuit
Figure 1

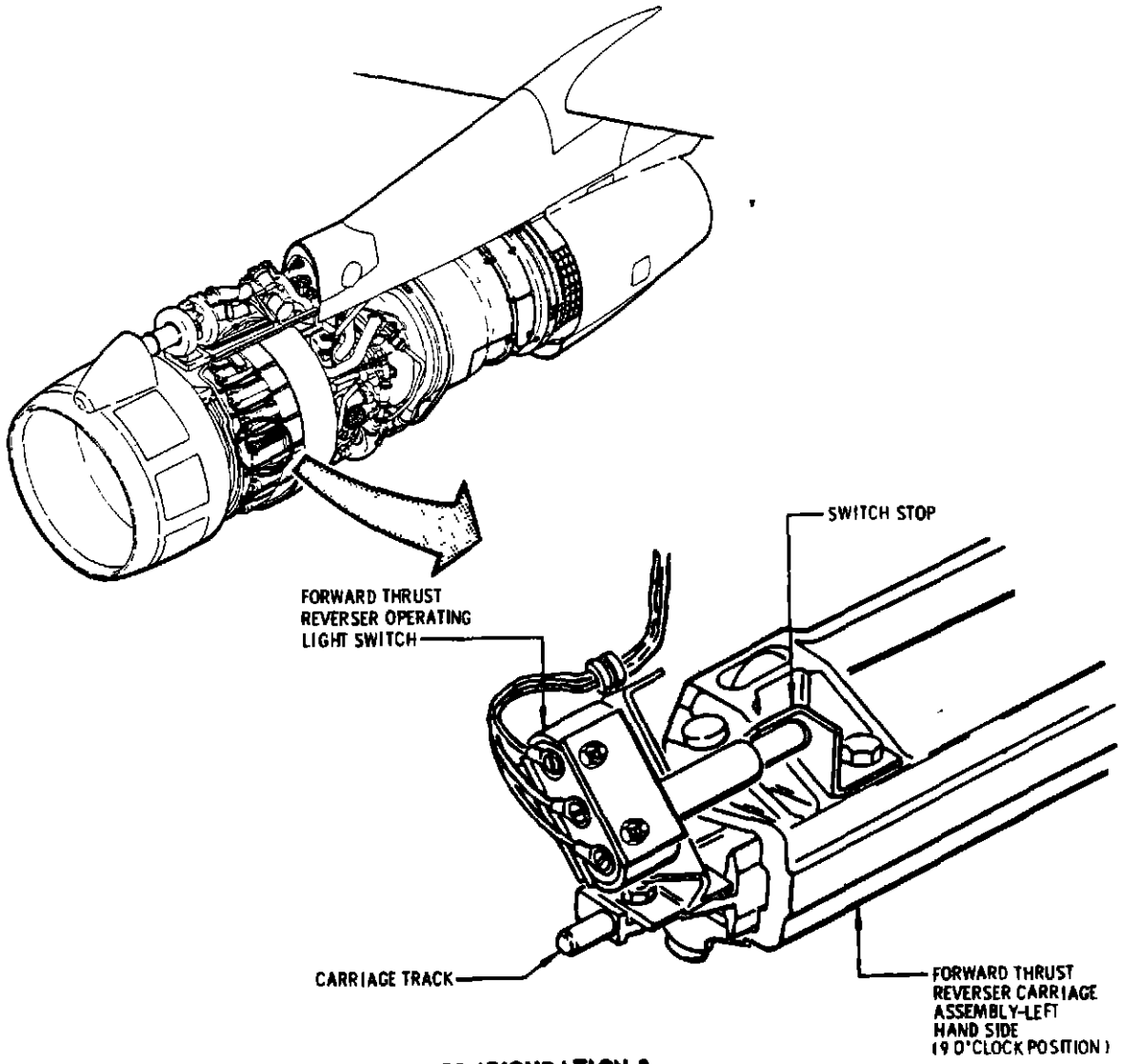




VIEW 1

Aft Thrust Reverser Operating Light Switch
Figure 2

The microswitch for the aft thrust reverser is mounted to the left hand side of the lower hook lock. The switch actuator contacts a metal plate mounted to the undersurface of the thrust reverser lower truck, maintains the switch plunger in the depressed position (position indicating light off) when the aft thrust reverser sleeve is in the forward stowed position and the hook lock is engaged Whenever either the hook lock is disengaged or the sleeve is out of the forward stowed condition or both, the position indicating light will illuminate. The forward thrust reverser micro-switch is attached to the forward thrust reverser carriage assembly at the 9:00 o'clock position as shown in figure 3. A striker plate, mounted on the carriage, holds the switch plunger in the depressed position (position indicating light off) during forward thrust operation.



CONFIGURATION 2

Forward Thrust Reverser Operating Light Switch
Figure 3

THRUST REVERSER OPERATING LIGHT SWITCHES - MAINTENANCE PRACTICES

EFFECTIVITY

TURBOFAN

1. Removal/Installation Thrust Reverser Operating Light Switches

A. General

(1) There is one operating light microswitch mounted on the forward thrust reverser and one mounted on the aft thrust reverser. Each switch is bracket-mounted by two screws. The forward thrust reverser operating light switch has screw-type wiring terminal connectors. The aft thrust reverser operating light switch has stud-type terminals and nuts. Both nut and screw-type switch terminal connectors should be tightened to 9 pound-inches torque when connecting wiring to the switch. Locknuts may be replaced by plain nuts and lockwashers if unable to meet this torque requirement.

CAUTION: DO NOT EXCEED 9 POUND-INCHES TORQUE ON SWITCH TERMINAL CONNECTOR NUTS (OR SCREWS) OR DAMAGE TO SWITCH MAY RESULT.

2. Adjustment/Test Thrust Reverser Operating Light Switches

A General

(1) The thrust reverser operating light switches may be tested by observing the lights while operating the thrust reverser with ground air. Caution must be exercised when operating the system with an external air source to avoid violent operating speeds.

WARNING: PERSONNEL MUST STAY CLEAR OF ENGINE WHEN THRUST REVERSER IS BEING ACTUATED. A PLACARD SHOULD BE PLACED ON CONTROL STAND WARNING AGAINST ACTUATION OF THRUST LEVERS WHILE PERSONNEL ARE WORKING ON THRUST REVERSER.

B. Equipment and Materials

(1) Air Pressure Source - 60 psig capacity

C. Adjust Aft Thrust Reverser Operating Light Switch

(1) Open engine side cowl panels.

(2) Manually move aft thrust reverser sleeve aft until sleeve truck roller contacts hook and check that vertical gap between top of roller and hook is 0.00 (+0.05/-0.00). This shall be defined as the fully locked position of hook.

(3) Check that switch is actuated (reverser operating light illuminates) when lock hook is moved upward 0.10 (+0.05/-0.00) inch from the fully locked position as defined above. Adjust switch to attain this requirement by bending the switch actuator arm slightly within limits shown in figure 201.

D. Test Aft Thrust Reverser Operating Light Switch

(1) Remove engine side cowl panels and fan cowl panels.

WARNING GROUND AIR SUPPLY MUST NOT BE CONNECTED UNLESS THE ENGINE SIDE COWL PANELS ARE REMOVED OR COMPLETELY CLOSED AND FAN COWL PANELS REMOVED, TO AVOID STRUCTURAL OR ENGINE DAMAGE OR INJURY TO PERSONNEL.

(2) Disconnect electrical leads from forward thrust reverser operating light switch.

NOTE This is necessary because either the forward or aft operating light switches, when actuated, cause the reverser operating light to illuminate.

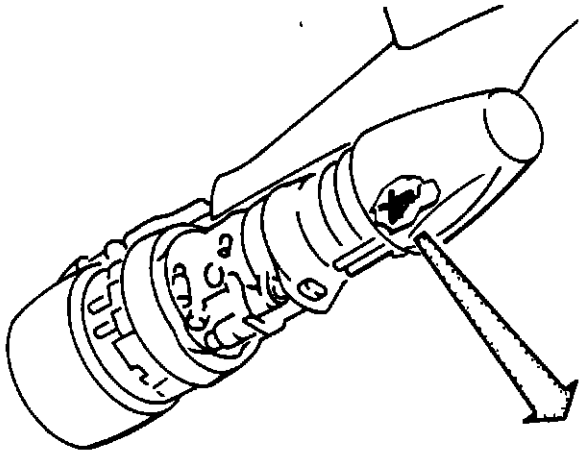
(3) Connect electrical power to reverser operating light circuit.

(4) Place forward and reverse thrust levers at idle.

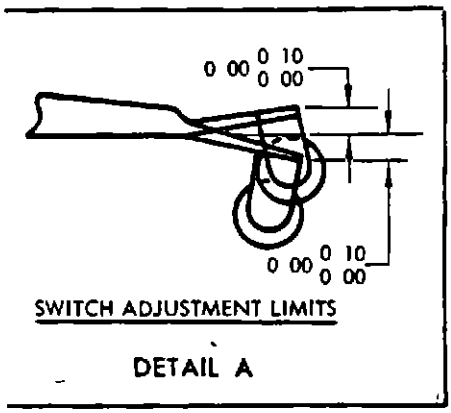
(5) Connect air pressure source to ground service connection in nacelle strut, and regulate to 25 psig to hold thrust reverser in forward thrust position. See figure 6, 78-6-0, for location of ground service connection.

(6) Check that applicable REVERSER OPERATING light on pilot's instrument panel is not illuminated.

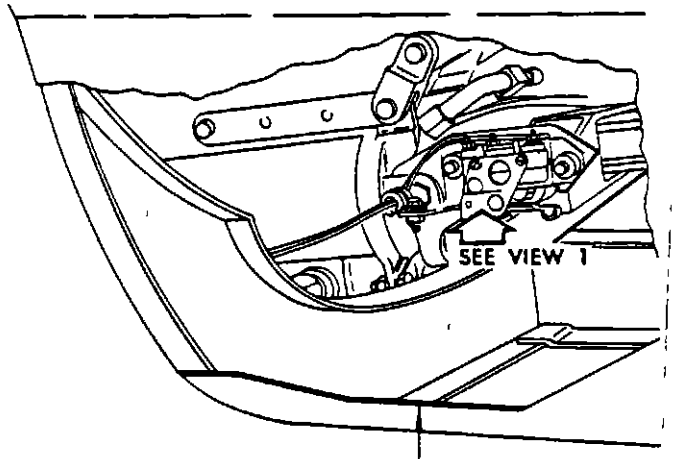
(7) Push aft end of lock hook upwards 0.10 (+0.05/-0.00) as shown in figure 201 and check that REVERSER OPERATING light illuminates.

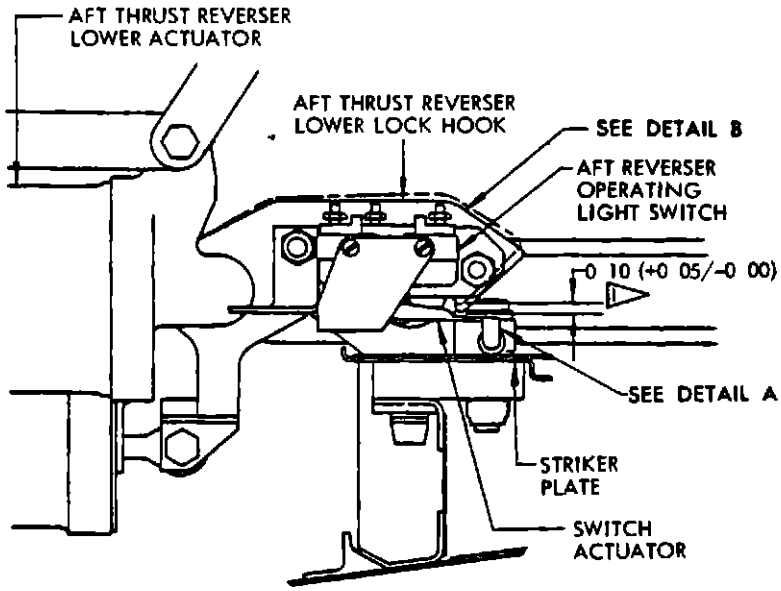


1 SWITCH MUST BE ACTIVATED WITHIN THIS DIMENSION FROM FULLY LOCKED POSITION TO ATTAIN THIS REQUIREMENT, THE SWITCH MAY BE ADJUSTED BY BENDING THE SWITCH ACTUATOR ARM SLIGHTLY WITHIN LIMITS SHOWN IN DETAIL A

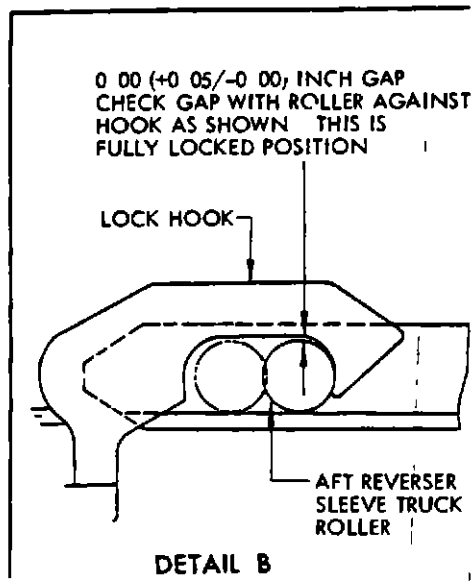


DETAIL A





VIEW 1



DETAIL B

(8) Move reverse thrust lever aft to maximum reverse thrust position and return to interlock position. Check that light remains illuminated during entire cycle.

(9) Return reverse thrust lever to IDLE position. Check that light goes out.

(10) Disconnect air source and electrical power.

(11) Reconnect wiring to forward thrust reverser operating light switch. Tighten terminal connector screws on switch to 9 pound-inches torque.

CAUTION: DO NOT EXCEED 9 POUND-INCHES TORQUE OR DAMAGE TO SWITCH MAY RESULT.

(12) Replace side cowl panels and fan cowl panels.

E. Test Forward Thrust Reverser Operating Light Switch

(1) Remove engine side cowl panels and fan cowl panels.

WARNING: GROUND AIR SUPPLY MUST NOT BE CONNECTED UNLESS THE ENGINE SIDE COWL PANELS ARE REMOVED OR COMPLETELY CLOSED AND FAN COWL PANELS REMOVED, TO AVOID STRUCTURAL OR ENGINE DAMAGE, OR INJURY TO PERSONNEL.

(2) Disconnect electrical leads from aft reverser operating light switch.

NOTE: This is necessary because either the forward or aft thrust reverser operating light switches, when actuated, cause the operating light to illuminate. (See 78-7-0, figure 1.)

(3) Connect electrical power to operating light circuit.

(4) Place forward and reverse thrust levers at idle.

(5) Connect air pressure source to ground service connection in nacelle strut and regulate to 25 psig to hold thrust reverser in forward thrust position. See figure 6, 78-6-0, for location of ground service connection.

(6) Check that applicable operating light is not illuminated.

(7) Move reverse thrust lever aft to interlock position (approximately 60° of lever movement). The applicable operating light should illuminate immediately after the cowl ring assembly has left the forward sealed position. Open the circuit breaker. The light shall go off. Close the circuit breaker.

(8) Move lever to maximum reverse thrust position and return to interlock position. Check that light remains illuminated during entire cycle.

(9) Return reverse thrust lever to forward thrust IDLE position. Check that operating light goes out.

(10) Disconnect air source and electrical power.

(11) Reconnect wiring to aft thrust reverser operating light switch. Tighten terminal connector nuts on switch to 9 pound-inches torque.

CAUTION: DO NOT EXCEED 9 POUND-INCHES TORQUE OR DAMAGE TO SWITCH MAY RESULT.

(12) Replace engine side cowl panels and fan cowl panels.