



MAINTENANCE TECHNICAL TRAINING

FOR TRAINING PURPOSES ONLY

SUBJECT: B727 ENGINES ATA 71-80 DOC ID 1216E DATE 12/89 PAGE 143

CHAPTER 8

A. THRUST REVERSER - DESCRIPTION AND OPERATION

1. General

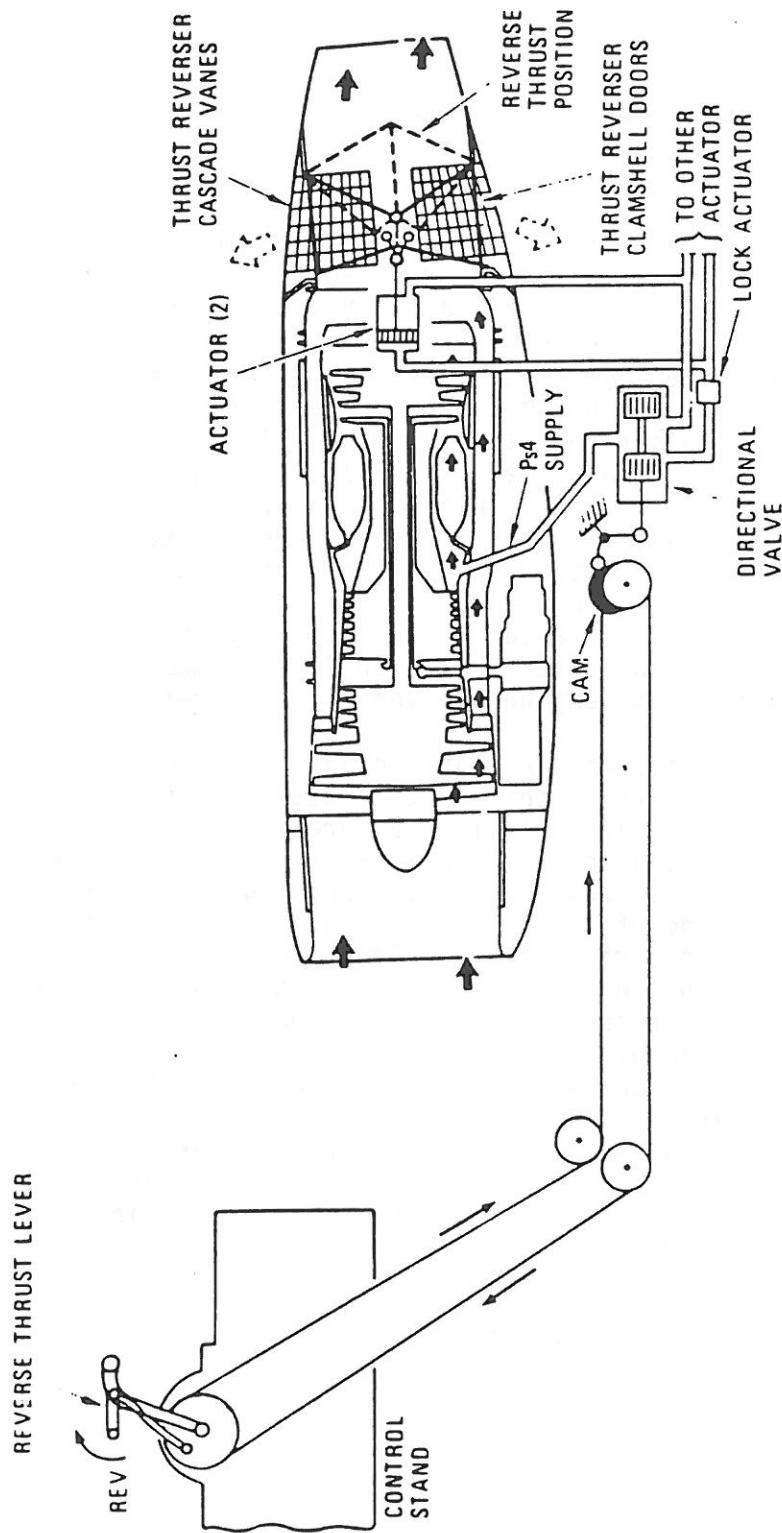
- a. A thrust reverser unit, located on the aft end of each engine, is used to reduce the length of the landing roll. The thrust reverser is of the clamshell door type, providing thrust reversal by blocking the engine exhaust gas flow path with clamshell doors and deflecting the gases through openings in the reverser frame onto two cascade vane deflectors which further deflect the gases forward and overboard. Each thrust reverser operates independently. The major components of the thrust reverser are the frame assembly, two axially mounted clamshell doors, two hinge installations for the clamshell doors, two cascade vane deflectors, two thrust reverser actuators, a thrust reverser lockout actuator. The tailpipe is attached to the thrust reverser unit and is considered as part of the thrust reverse assembly. A thrust reverser shroud assembly installed around the circumference of the thrust reverser forward mounting ring acts as a gas seal between the engine and the thrust reverser.
- b. The thrust reverser on the center engine (engine No. 2) is the same as the thrust reversers on the strut mounted engines (engines 1 and 3) except for certain installation features. The center engine thrust reverser is mounted so that the exhaust gases are deflected out the sides of the thrust reverser or aft fuselage since the thrust reverser forms the aft end of the fuselage. The strut mounted thrust reverser installations are oriented to deflect exhaust gases above and below the engine, resulting in the center engine reverser installation being rotated 90° with respect to the strut mounted reversers. Also, a double flanged adapter ring or spacer tapered from top to bottom is installed between the aft end of the engine and the forward end of the thrust reverser on engines 1 and 3 to direct the exhaust gases for the proper thrust angle. Engine No. 3 thrust reverser installation is rotated 180° from engine No. 1 installation to make the installations compatible with the thrust reverser pneumatic tubing installation on the respective engines.



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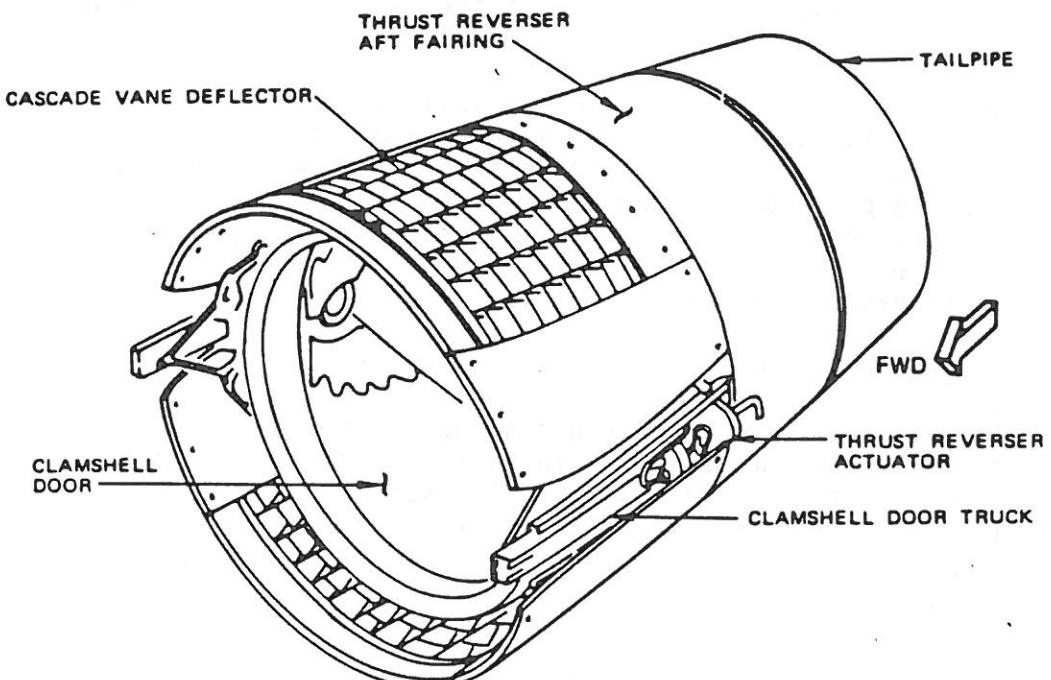
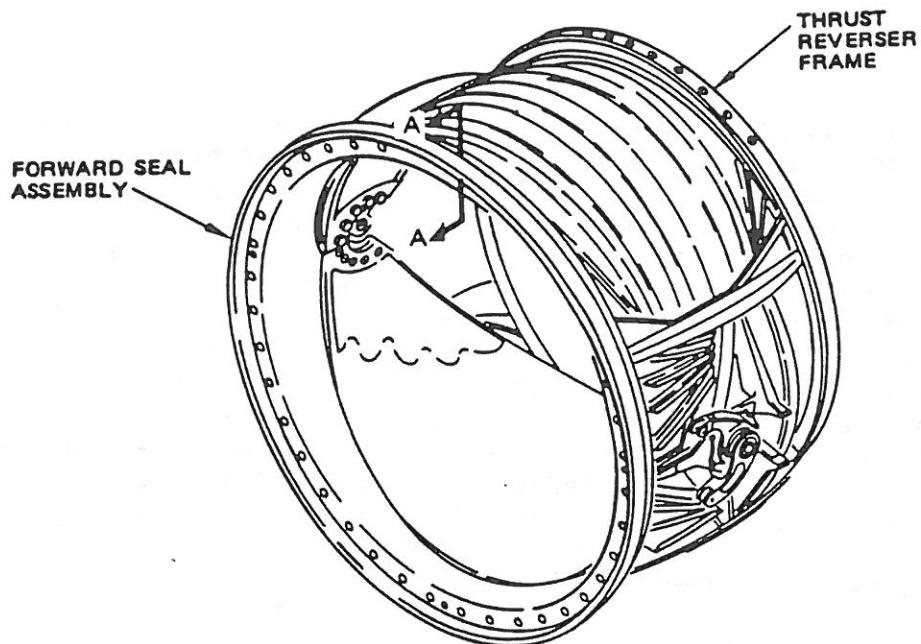
THRUST REVERSER FUNCTIONAL DIAGRAM



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THRUST REVERSER SHOWN
IN FORWARD THRUST POSITION
(OUTBOARD SIDE OF ENGINE NO. 1)



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- c. The thrust reverser is pneumatically actuated and control is provided by a reverse lever (one for each engine) on the pilot's control stand. Pressure is supplied by engine 13th stage bleed air source (Ps4). The thrust reverser pneumatic plumbing taps into a 13th stage air distribution line located on the engine (center engine) and in the strut (side engines). The pneumatic supply line routes air to a thrust reverser directional valve which is mounted to the engine control shaft bracket underneath the forward end of the engine on the center engine and in the strut on the side engines. Thrust lever input is transmitted to the engine controls shaft installation by direct cable connection. A thrust reverser control cam on the lower end of the shaft provides position input for the directional valve. Air is routed from the directional valve by the pneumatic plumbing to two thrust reverser actuators providing the input to the thrust reverser for "cruise" and reverse thrust actuation and operation. The thrust reverser lockout actuator, located upstream of the thrust reverser actuators in the reverse thrust pneumatic line, maintains the thrust reverser mechanically locked in forward thrust position until reverse thrust is selected. When reverse thrust is selected the actuator is pneumatically operated to unlock the reverser and route air to the thrust reverser actuators for reverse thrust operation. A push pull control follow up system running between the thrust reverser clamshell hinge arm and follow up cam in the thrust control mechanism limits thrust control motion while reverser is in transit or is not in command position.
- d. Reverse or "cruise" thrust operation is selected by use of the reverse thrust lever in the control cabin. Actuation of the reverse thrust levers positions the directional valve to direct Ps4 pneumatic air to the appropriate ports of the thrust reverser actuators causing the clamshell doors to be actuated to the selected thrust position. The follow up control prevent full thrust command from being applied while the thrust reverser is in transit or is not in command position.
2. Thrust Reverser Frame Assembly
- a. The thrust reverser frame is a welded structure to which the clamshell doors, clamshell door actuating linkage, thrust reverser actuators, and tailpipe are attached. Hinge support assemblies are installed through the upper and lower vertical centerlines of the frame providing attachment for the clamshell door hinge assemblies.



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3. Cascade Vane Deflectors

- a. Cascade vane deflectors are mounted on each side of the aft reverser frame assembly on the center engine. The side engines have cascade vanes top and bottom. Each vane is a welded assembly with 10 rows 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. The cascade vane deflector has turning vanes installed at different angles to achieve the desired direction of exhaust gas deflection during reverse thrust.
- b. Cascade vane deflector installation, fixed covers are added over portions of the exposed cascade vane deflectors for reduction of drag and improved airplane performance.

4. Clamshell Doors

- a. Two thrust reverser clamshell doors, located inside the thrust reverser frame assembly, are attached to coaxial hinge assemblies installed at the upper and lower surfaces of the frame assembly on the vertical centerline. The doors are fabricated from panels of stainless steel honeycomb core sandwich construction. Each door is made from a panel which is composed of two facing sheets welded to a cellular shaped foil ribbon core, and contoured to the clamshell door configuration. A leaf type seal installation on the outer surface of the doors serves as a gas seal between the doors and the front frame when the doors are in the forward thrust position. The front edge of the doors are in the forward thrust position contacts a leaf type seal assembly installed circumferentially around the inner surface of the thrust reverser forward mounting ring.

5. Clamshell Door Hinge Assemblies

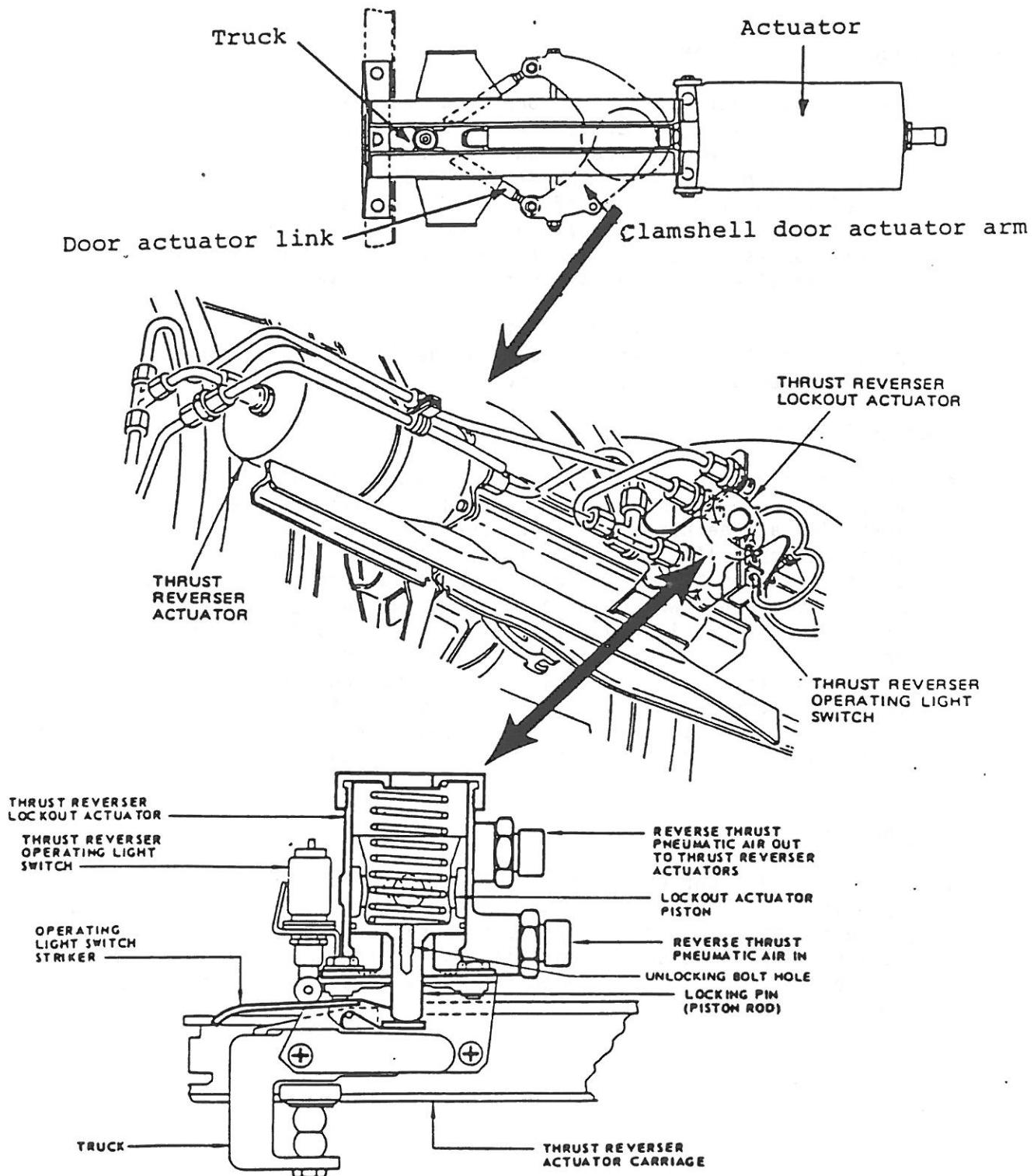
- a. Two clamshell door hinge assemblies are installed diametrically opposite each other in recesses in the thrust reverser frame. Each hinge assembly consists of two concentric shafts flanged on one end to attach to the clamshell door fittings. Hinge arms on the other end of the shaft provide attachment to the actuator piston rod mechanism. The hinge shafts and the recess cutout are separated by bearings.



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6. Thrust Reverser Actuators

- a. The thrust reverser actuators are pneumatically operated piston units, and provide the mechanical driving force to operate the clamshell doors when reverse or "cruise" thrust has been selected at the control stand. There are two actuators on each thrust reverser, one actuator assembly being located on each of the clamshell door hinges on opposite sides of the thrust reverser.
- b. Each thrust reverser actuator assembly consists of a piston actuator, a carriage track assembly attached to the actuator and the clamshell door truck, mounted on the track. The actuator cylinder contains a piston. In "cruise" position the piston head is bottomed against the rod end of the cylinder. Outside the actuator, the piston rod attaches at the rod end to the door truck.
- (c) When reverse thrust operation is selected with the reverse thrust lever at the control stand, air is routed through the thrust reverser lockout actuator to the rod ports of the actuators driving the piston aft, causing the clamshell doors to actuate to the exhausts through a restrictor which provides some degree of snubbing. The push pull control is repositioned. When the reverse thrust lever is repositioned to select "cruise" operation, air is routed to the primary head port of the actuators, pressurizing the piston head, causing the clamshell door piston to drive forward, actuating the clamshell doors to the cruise position.

7. Thrust Reverser Lockout Actuator

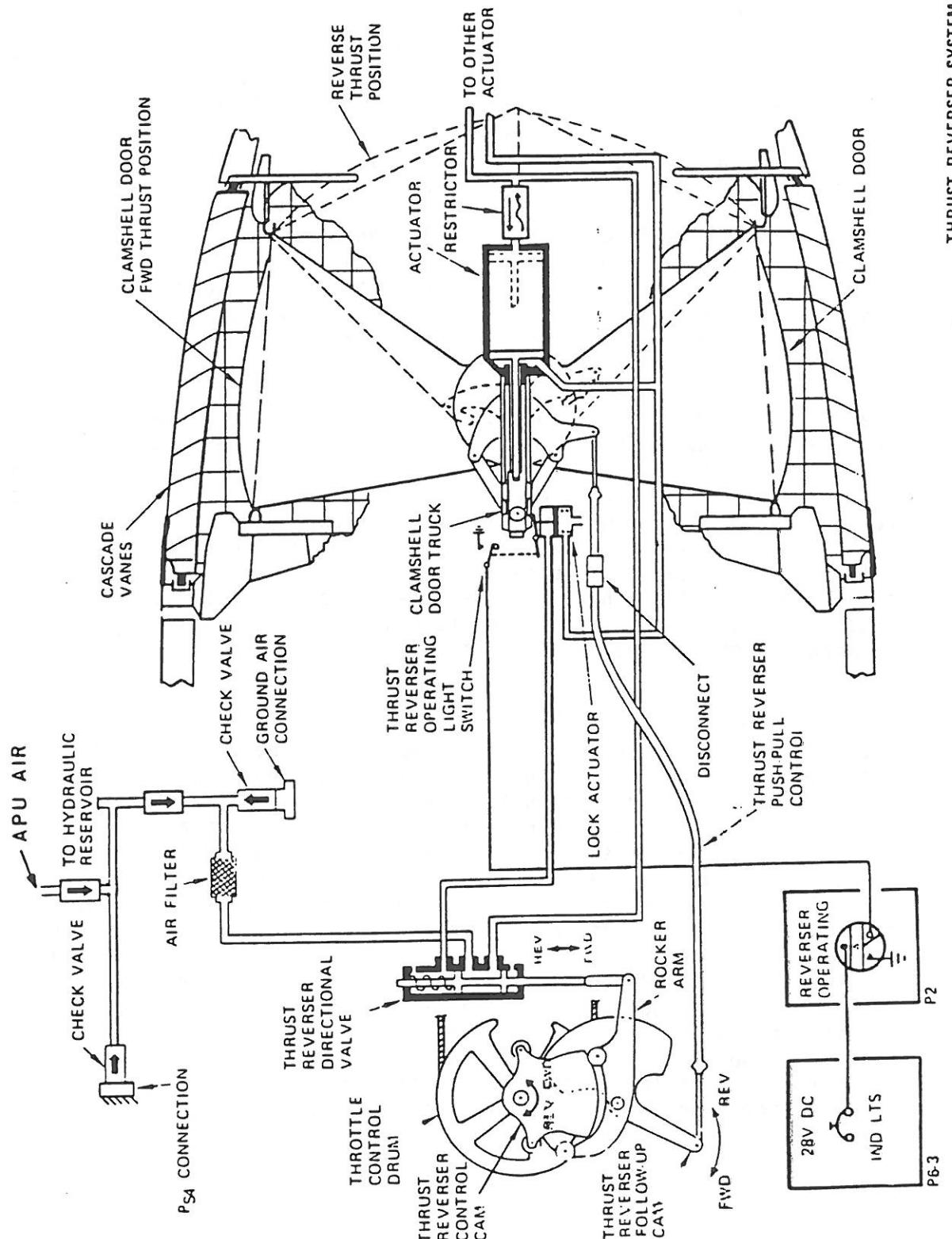
- a. The thrust reverser lockout actuator maintains the thrust reverser mechanically locked in the forward thrust position at all times except when reverse thrust operation is selected at which time it actuates to unlock the thrust reverser operation. The lockout actuator is mounted to the end of the thrust reverser actuator carriage on the side engine inboard actuator installation and the center engine upper actuator installation. Functionally, it is located in the reverse thrust pneumatic line just upstream of the thrust reverse actuators. The lockout actuator consists of a cylinder and a piston which is spring loaded in the extended position. The piston rod is a locking pin which, when extended, prevents the truck from moving aft. When reverse thrust is selected, air enters a port beneath the piston, forcing it up, retracting the locking pin and at the same time, uncovering a port in the cylinder which routes the air to the thrust reverser actuators. The piston has a tapped hole into which a long bolt may be threaded and used as a handle to manually unlock the truck.



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8. Thrust Reverser Operating Light Circuits

- a. A thrust reverser operating light circuit for each engine provides amber light indication to the crew that either the thrust reverse is not in the full forward thrust position or the thrust reverser lockout actuator is in the unlocked (piston retracted) position. The circuit for each engine consists of an amber light on the engine instrument panel and a microswitch mounted to the lockout actuator housing. The switch plunger is maintained in the depressed position during forward thrust operation by a pivoting switch striker which at one end is pushed downward by the lockout actuator piston so that the other end pushes upward against the switch plunger maintaining the plunger in the depressed position when the door truck is fully forward. When the thrust reverser is out of the forward thrust position the switch striker will move so as to close the switch causing the thrust reverser operating light to illuminate. During normal operation the thrust reverser operating light illuminates following reverse thrust selection as soon as the lockout actuator piston retracts. The light remains illuminated until the thrust reverser returns to forward thrust position.

9. Tailpipe and Thrust Reverser Aft Fairing

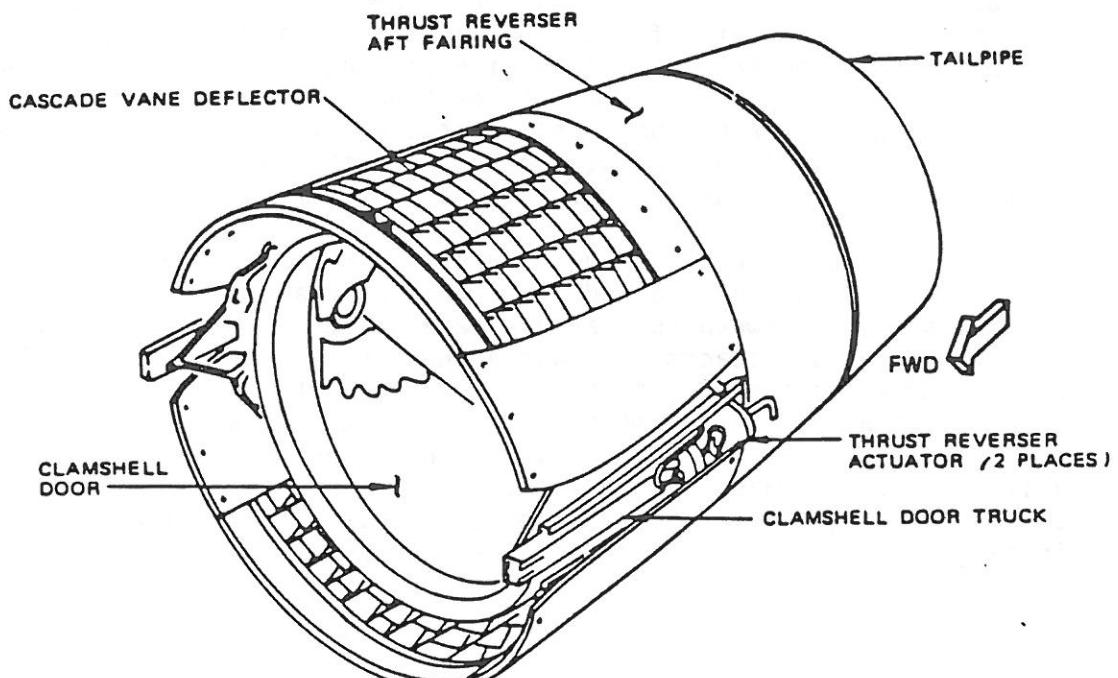
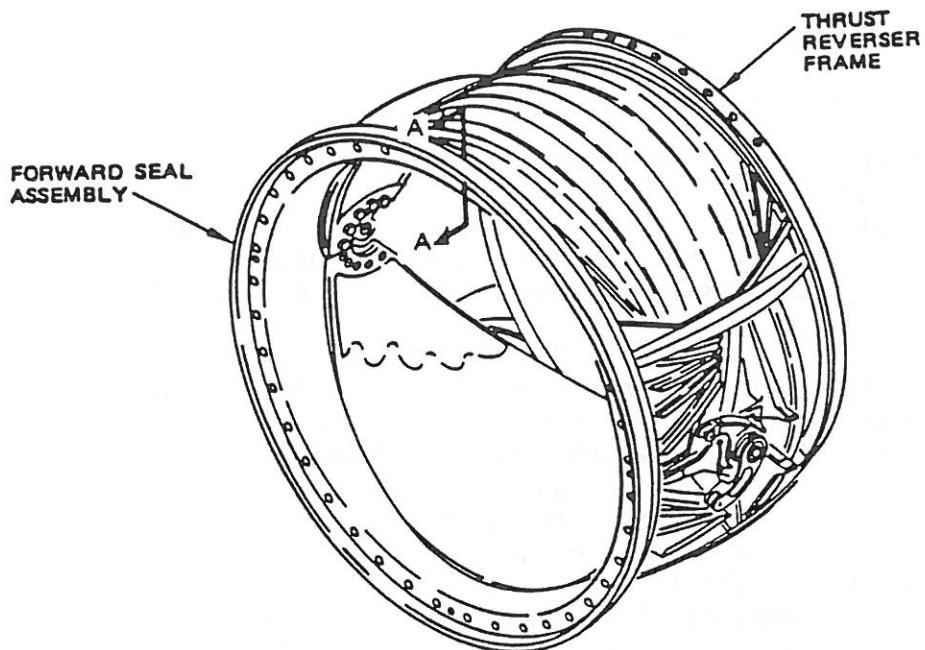
- a. Attached to the left aft mount ring of the thrust reverser frame is the engine exhaust nozzle or tailpipe. The tailpipe is a welded assembly consisting of a forward portion cylindrical in shape and an aft portion in the form of a truncated cone and welded to the forward section. The tailpipe provides the exit path for exhaust gases during cruise operation. A circumferential attachment angle around the outer surface of the tailpipe, about a quarter of the way back from the forward end provides attachment for the thrust reverser aft fairing.
- b. The thrust reverser aft fairing is a complete circumferential ring located around the forward end of the tailpipe and shaped to provide a fairing surface between the cascade vane deflector and the tailpipe. A circumferential attachment angle around the inner surface of the aft fairing provides for direct attachment of the aft fairing to the tailpipe at a mating circumferential attach angle on the tailpipe. This enables the tailpipe and aft fairing to be removed as a single unit for ease of maintenance. Access plates around the forward end of the aft fairing, when removed, provide access to the tailpipe installation bolts and the thrust reverser plumbing in the area of the tailpipe.



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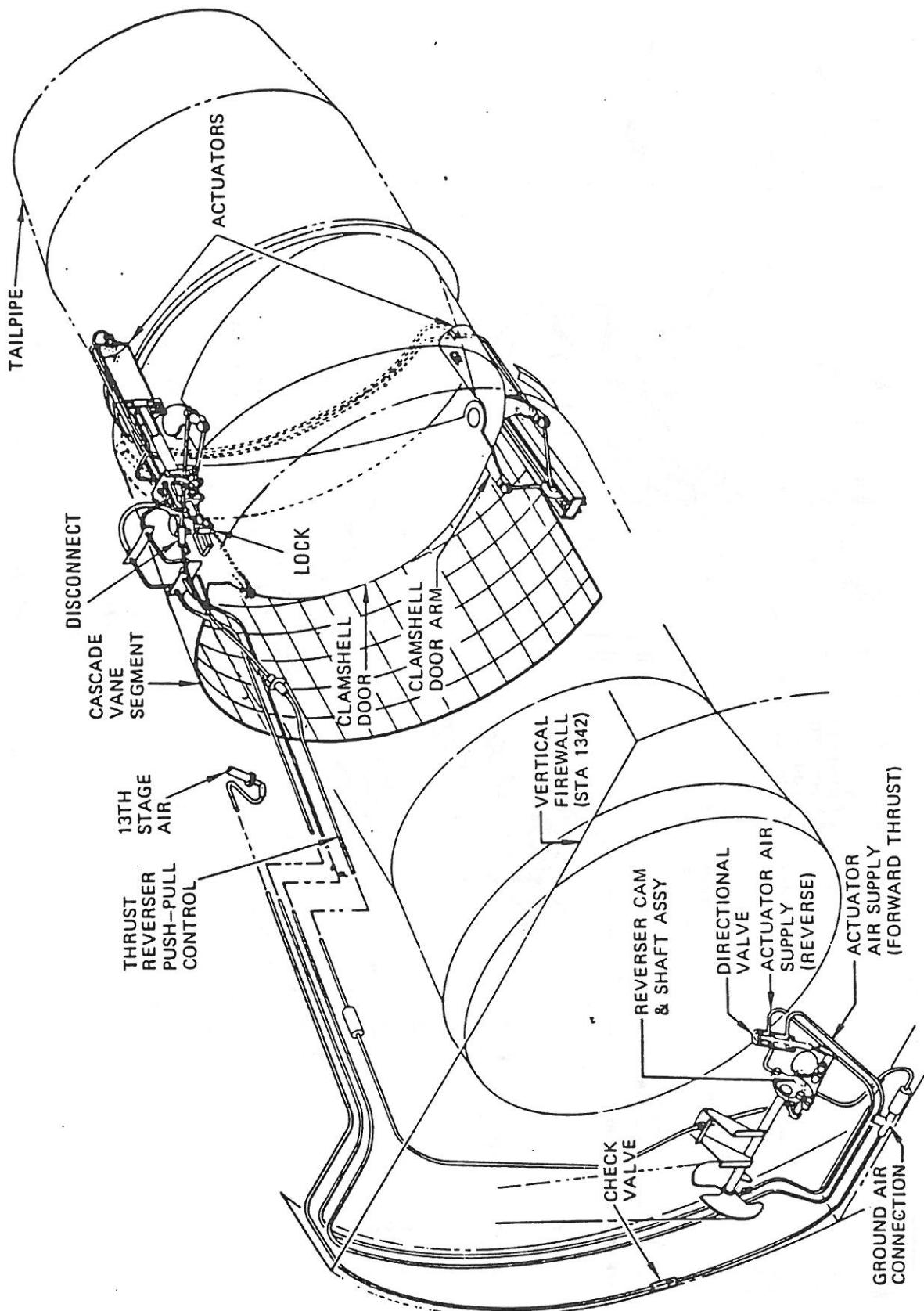
THRUST REVERSER SHOWN
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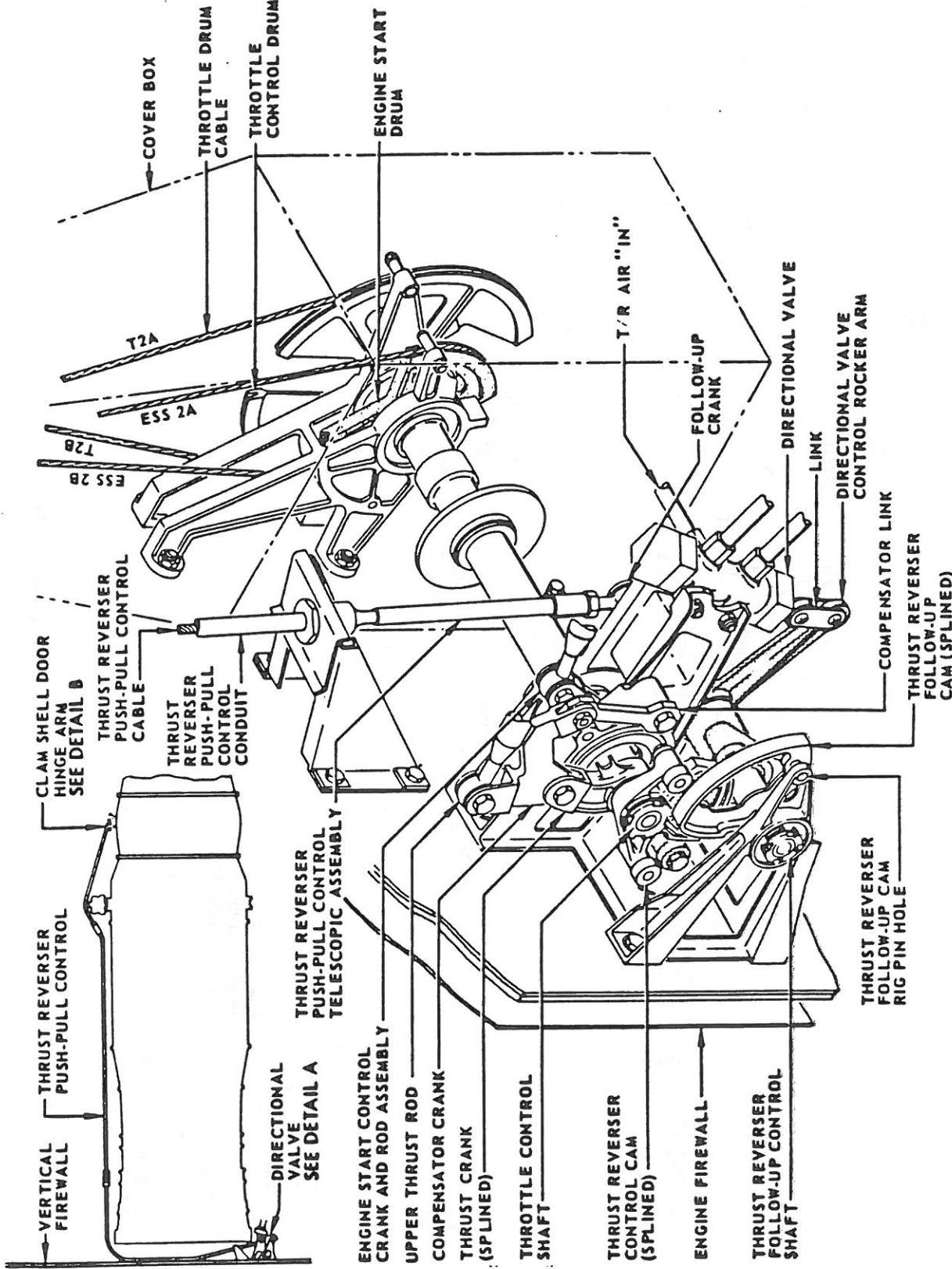
THRUST REVERSER PLUMBING - CENTER ENGINE



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THRUST REVERSER CONTROLS-CENTER ENGINE



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10. Thrust Reverser Shroud Assembly

- a. The thrust reverser shroud assembly is a four piece box type structure forming an annular ring around the forward end of the thrust reverser. The shroud assembly provides a fairing between the engine cowling and the thrust reverser and also provides a gas and vapor seal between the engine compartment and the thrust reverser compartment. The four shroud assembly sections are installed around the circumference of the reverser and are attached to the reverser forward mounting flange forming a complete circumferential ring except for a gap on either side of the reverser, which accommodates the extension of the actuator carriage tracks. Each of these gaps is bridged by a fiberglass track cover which encloses the end of the actuator carriage and is fastened to both of the shroud sections adjoining the gap, thereby providing continuity of the sealing effect of the shroud in this area.

11. Thrust Reverser Controls and Pneumatic System

a. Pneumatic Plumbing

- (1) The thrust reverser pneumatic plumbing routes pneumatic high pressure compressor air (13th stage bleed air), Ps4) to the thrust reverser actuators for thrust reverser actuation. On the center engine the pneumatic supply line taps off high pressure air from either the 13th stage bleed manifold or the hydraulic oil cooler air supply line. The pneumatic supply line for the thrust reverser on engines 1 and 3 taps into the 13th stage air supply duct in the strut and routes air to the directional valve. Two manifolds route air from the directional valve to the thrust reverser actuators. The "reverse" manifold line directs air from the directional valve and through the thrust reverser lockout actuator to the rod ports on the thrust reverser actuators for "reverser" thrust operation. The cruise manifold line directs air from the directional valve to the head port on the actuators for forward thrust actuation and operation.

b. Thrust Reverser Directional Valve

- (1) The thrust reverser directional valve is a two position pneumatic control valve providing the directional control for routing air through the "reverse" or "cruise" manifolds, as selected by the reverse thrust lever in the control cab. The directional valve is actuated by the thrust reverser control cam on the throttle control shaft. When "reverse" or "cruise" thrust is selected at the control stand, control shaft rotation repositions the directional valve, and air is routed through the valve to the appropriate manifold. The directional valve is mounted to the engine controls bracket at the engine control shaft.



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c. Thrust Reverser Control Cam

- (1) The thrust reverser control cam transmits position input to the thrust reverser directional valve from the thrust levers. The control cam is splined to the end of the throttle control shaft. When the forward or reverse thrust levers are operated, the throttle shaft rotates and the control cam positions the directional valve through a rocker arm.

d. Thrust Reverser Follow up Controls

- (1) The thrust reverser follow up controls on the center engine consists of a shaft on which are installed the thrust reverser follow up cam, directional valve rocker arm, and a follow up crank. The shaft installation is supported between two flanges on the same bracket that supports the engine controls drum-and-shaft installation at the engine vertical firewall. The follow up cam and follow up crank are splined to opposite ends of the shaft. The rocker arm is supported by bearings at the middle of the shaft and is connected to the directional valve piston. The follow up crank is connected to the thrust reverser push pull control.
- (2) The thrust reverser follow up control components on the side engines consist of a bolt serving as a shaft on which are installed the thrust reverser follow up cam and the directional valve rocker arm. The shaft installation is supported between two flanges on the same bracket that supports the engine controls drum-and-shaft installation in the engine strut. The follow up cam and rocker arm are supported by bearings on the shaft. A lever arm on the follow up cam connects the cam to the thrust reverser push-pull control.
- (3) The rocker arm transmits thrust reverser control cam rotation to the directional valve, repositioning it to the selected thrust position. The thrust reverser follow up cam and follow up crank (center engine only) transmit thrust reverser clamshell door position from the thrust reverser push-pull control to the throttle control shaft to lock shaft against command of increased thrust until the clamshell doors have reached the selected thrust position.



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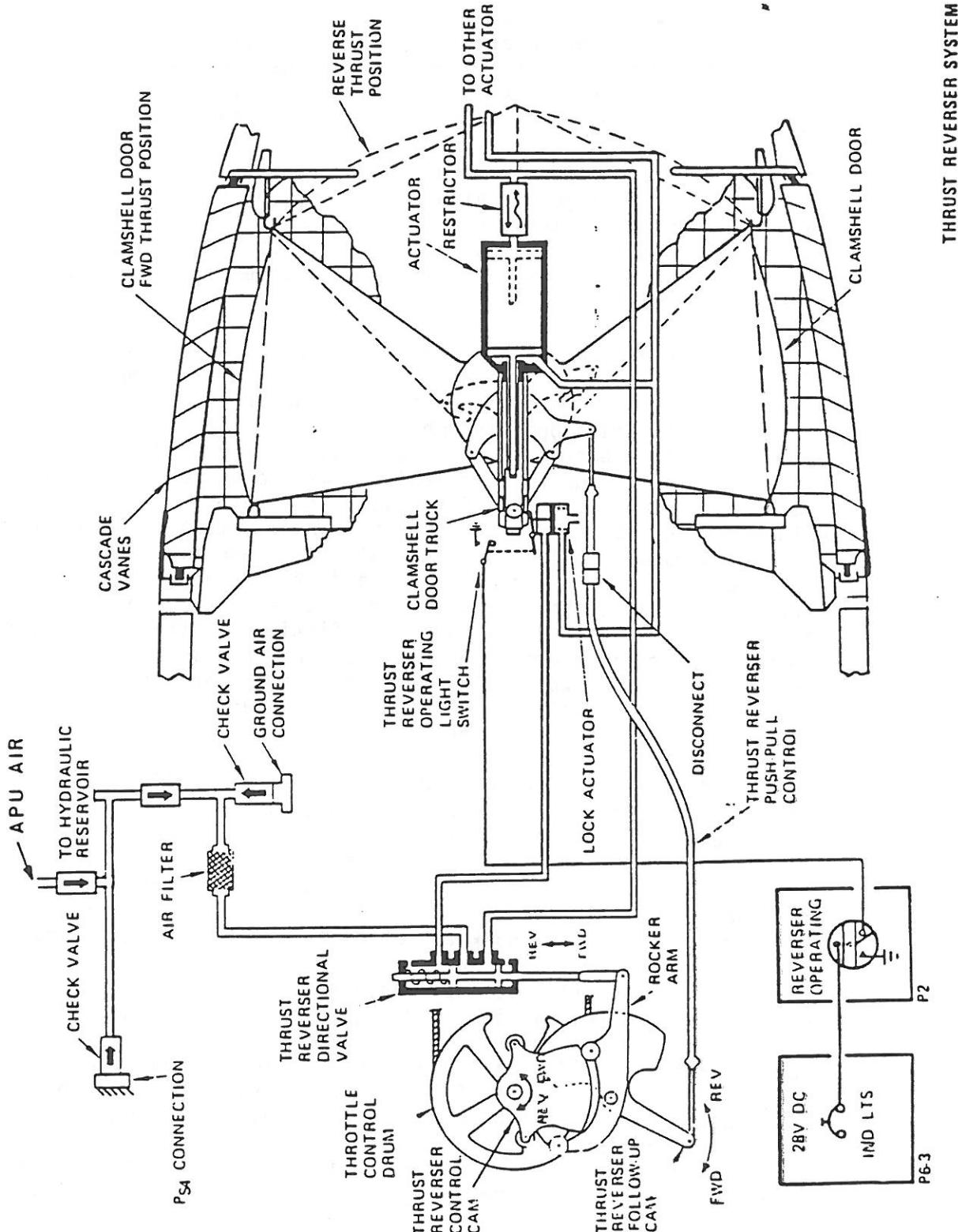
e. Thrust Reverser Push-Pull Cable

- (1) The thrust reverser push-pull cable transmits clamshell door position to the throttle control shaft to provide lockout of the shaft at a low thrust setting when the thrust reverser is in transit between thrust positions. The push-pull cable is connected at one end to the clamshell door hinge arm on the thrust reverser and at the opposite end to the thrust reverser follow up controls at the throttle control shaft. The cable consists of two cable subassemblies joined at a quick disconnect and enclosed in a conduit inside which the cable translates when actuated. The quick disconnect facilitates removal and installation of the engine and thrust reverser. A telescopic assembly is located at both ends of the cable.
- (2) On the center engine, the forward telescopic assembly of the push-rod cable terminates the cable beneath a bracket mounted to the engine vertical firewall just above the thrust reverser controls. The telescopic assembly rod end is attached to a follow up crank on the controls. The cable runs in the conduit from above the bracket, up the vertical firewall and along the underside of the horizontal firewall to the thrust reverser upper actuator. The cable terminates at the upper actuator carriage in the aft telescopic assembly. The quick disconnect in the cable and conduit is located near the aft end of the cable above the thrust reverser actuator track. The inner slider of the aft telescopic assembly and the cable end fitting is attached to the clamshell door hinge arm. The cable conduit consists of several rigid sections and two flexible sections at the aft end. The flexible conduit sections are at the aft end and are joined together at the quick disconnect.
- (3) On the side engines, the forward end of the push-pull cable terminates in the forward telescopic assembly inside the engine strut, near the forward end at the thrust reverser controls. The forward telescopic unit rod end is connected to the thrust reverser follow up cam. The cable runs aft inside the conduit from the telescopic unit bulkhead connection through the length of the strut and through a bulkhead connection in the strut firewall to the thrust reverser inboard actuator track, where the cable terminates in the aft telescopic assembly. The quick disconnect in the cable and conduit is located just aft of the conduit aft bulkhead fitting in the strut firewall on the reverse reverser side. The inner slider of the aft telescopic assembly and the cable end fitting are part of the aft cable subassembly. The cable end fitting is attached to the clamshell door hinge arm. The conduit consists of two flexible conduit sections. The forward conduit section is located inside the strut. The forward end of the conduit is connected to the forward telescopic unit at the strut bulkhead connection. The aft end of the conduit terminates in the strut firewall connection at the aft end of the strut.

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THRUST REVERSER SYSTEM



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12. Operation

- a. The thrust reverser control system is actuated and controlled entirely by use of the reverse thrust lever. Pneumatic pressure for actuation is supplied from the engine diffuser casing.
- b. Reverse thrust operation is initiated by operation of the reverse thrust levers in the control cab. The operation of each thrust reverser is independent. The forward thrust lever must be returned to idle before the reverse thrust lever can be operated sufficiently to initiate reverse thrust actuation. This prevents accidental actuation of the reverser during forward thrust operation. Initial movement of the reverse thrust lever aft to an interlock positions provides sufficient thrust control shaft rotation for the thrust reverser control cam to reposition the directional valve, causing high pressure bleed air to be routed through the reverse thrust manifold to the rod ports of the thrust reverser actuators. Before reaching the actuator rod ports, the air passes through a lockout actuator in the reverse thrust line just upstream of the actuators. At entering the lockout actuators retracts the lockout actuator piston, unlocking the truck to free the thrust reverser for reverse thrust actuation. Simultaneously, ports in the piston housing are uncovered, allowing air to be routed through the lockout actuator to the rod ports of the thrust reverse actuators. Retraction of the lockout actuator piston also releases the thrust reverser operating light switch plunger illuminating the thrust reverser operating light in the control cab.

The thrust reverser follow up cam prohibits movement of the reverse thrust lever beyond interlock until the reverse reverser clamshell doors approach the full reverse thrust position. Pressure at the actuator rod ports drives the piston aft actuating the clamshell doors. Clamshell door hinge arm rotation pulls the push-pull cable aft causing the telescopic section at the hinge arm to extend and the telescopic section at the engine controls thrust shaft to retract, rotating the follow up cam. When push-pull cable travel is completed (clamshell door near end of travel) the follow up cam has rotated sufficiently to allow throttle control shaft movement for application of maximum reverse thrust.



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- (c) To return the thrust reverser to "cruise" position, the reverse thrust lever is moved forward. As the reverse thrust lever nears the off position, the thrust reverser control cam, rotating with the throttle shaft, repositions the directional valve. Bleed air entering the directional valve is then routed through the "cruise" manifold. The thrust reverser follow up cam prohibits further movement of the reverse thrust lever until the clamshell doors have almost reached the "cruise" position. Air is routed to the primary head port of both thrust reverser actuators. Air entering this port pressurizes the piston head driving the piston forward causing the clamshell doors to actuate to the cruise position. The push-pull cable, which is slaved to the clamshell hinge arm, retracts at the clamshell end telescopic section and extends at the control shaft end, rotating the follow up cam to free the control shaft maximum cruise thrust application after the clamshell doors have nearly retracted to the cruise position. When the thrust reverser reaches the forward thrust position, the thrust reverse operating light switch plunger is depressed by the switch striker on the truck causing the operating light to go out.
- (d) The interlock provision limits power setting if the thrust reverser is not in the correct position for the selected thrust condition. If the thrust reverser inadvertently moves to reverse thrust position during forward thrust operation, the push-pull control drives the follow up cam at the control shaft, forcing the throttle control shaft to a reduced thrust setting. If the thrust reverser inadvertently actuates to "cruise" while in reverse thrust, the same sequence of actions occurs to reduce the thrust setting, except that all control movements are in the opposite direction.



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THRUST REVERSER - DESCRIPTION AND OPERATION

1. General

- A. The thrust reverser system provides a means of reversing the direction of engine exhaust gas flow after landing to provide additional dynamic braking. No. 1 and No. 3 engine each has an identical independent thrust reverser system.
- B. The thrust reverser system is mechanically selected and hydraulically operated to the fully stowed or fully deployed position.
- C. Each control system responds to movement of the reverse thrust lever at the control pedestal by activating a hydraulic control valve, located forward of Station 1243.
- D. The indicating system presents visible evidence in the flight compartment of thrust reverser status and low hydraulic accumulator pressure.

2. Thrust Reverser - Engines No. 1 and No. 3

A. Description

Each thrust reverser consists of two reverser doors, two door latch assemblies, two door actuators and the door actuating linkages.

(1) Door Actuator - The door actuator drives the actuating linkage guide carriages for upper and lower reverser doors. A dashpot installed in the forward end of each actuator absorbs energy as the reverser deploys, to prevent damage. The reverser consists of a guide carriage on each side connected through overcenter links to the driver links. A set of idler links complete the four bar linkage.

(a) Two door actuators are installed on each engine thrust reverser. The piston-type actuator is attached to the door actuating linkage through a moveable carriage. Selecting reverse thrust on the reverse thrust levers applies aircraft main hydraulic pressure to the deploy port of the actuator causing the piston to retract, unlocking the overcenter linkage. The reverser doors are deployed. Selecting forward on the reverse thrust lever applies hydraulic pressure to the stow port of the piston to stow the reverser doors. The piston actuator incorporates a dashpot consisting of two springs, a variable orifice and a filter to protect the orifice. The dashpot prevents the reverser doors from forcibly bottoming out in the deployed position.

(2) Thrust Reverser Door Latch Assembly - The door latch assembly is a hydraulically powered safety device that retains the reverser doors in the stowed position should the reverser actuating linkage be moved out of overcenter position. Each latch assembly consists of a door latch and tension spring, striker arm and tension spring, hydraulic actuator and latch switch.



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- (a) One latch assembly is installed at the forward edge of each door. The piston-type actuator is attached to the thrust reverser door latch. Selecting reverse thrust applies hydraulic pressure to the deploy port of the actuator causing the piston to retract and unlatch the doors. Selecting forward (stowed) on the reverse thrust lever operates the control valve and hydraulic pressure is applied to the stow port of the actuator causing the piston to extend and latch the reverser doors when they are stowed.
- (3) Thrust Reverser Doors – The doors are target-type. The doors become the upper and lower aft fairing for the demountable power plant when stowed. The doors are hydraulically operated and mechanically controlled.
- (4) Thrust Reverser Door Actuating Linkage – The door actuating linkage consists of a sliding carriage driven by the door actuator, connected to an overcenter linkage, driver links and a feedback control rod (left side only).

3. Thrust Reverser Control System – Engines No. 1 and No. 3

A. Description

Thrust reverser control system levers are mounted on the control pedestal in the flight compartment. The lever, one for each engine, is hinged to each thrust control lever. The levers are connected to the same clutches and cable systems used by the thrust control levers, but cannot be operated unless the thrust control levers are in the idle position (Ref. 76-00-00). Each thrust reverse lever has a total travel of 138 degrees (2.41 rad.) with the thrust control lever at idle. The thrust reverser control system consists of reverse thrust levers, thrust cable system, control valve and push-pull cable, hydraulic accumulator, interlock mechanism and push-pull cables, control cam and flow limiter valve.

- (1) Thrust Reverser Hydraulic Accumulator – The hydraulic accumulator, located in the aft stairwell, provides hydraulic pressure to the actuating cylinders while the doors are stowed and the reverser system is isolated from the aircraft hydraulic system in flight. The accumulator provides sufficient pressure to extend and partially stow the reverser doors. The accumulator is equipped with a pressure gage, air filler valve and a low-pressure warning switch.
- (2) Thrust Reverser Interlock Feedback Mechanism and Push-Pull Cable – The interlock mechanism and push-pull cable located on the left side of the thrust reverser consists of an interlock crank (operated by the guided carriage rod), an interlock control crank and a push-pull feedback cable connected to the interlock control crank. The interlock mechanism prevents reverse thrust being applied until the thrust reverser doors are fully deployed.
- (3) Thrust Reverser Control Cam – The control cam transmits the thrust levers position input to the hydraulic control valve. The control cam is splined to the end of the engine thrust control shaft in the engine support strut. When the reverse thrust levers are operated, the thrust control shaft rotates to move the cam, rocker arm and the push-pull control cable attached to the hydraulic control valve control arm.



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- (4) Thrust Reverser Control Valve – The control valve consists of a mechanically actuated, slide-type, four-way control valve and a solenoid operated, hydraulically piloted slide-type, isolation valve enclosed in the same housing. The four-way control valve is actuated through a control crank and a cable system by a reverse thrust lever, on each thrust control lever. The reverse thrust lever cannot be moved until the thrust control lever is placed in the idle position (Ref. 76-00-00). The isolation valve portion of the control valve is spring-loaded to the open position and solenoid actuated to the closed position. Electrical power to the isolation solenoid is controlled by the thrust reverser lower latch switch, in series with a ground sensing relay, and nose gear squat switch. The ground sensing relay and squat switch are normally closed when the nose gear strut is extended. The ground sensing relay and nose gear squat switch will open and deenergize the isolation solenoid when the nose gear strut is compressed. This allows the thrust reverser accumulator to be charged when the airplane is on the ground, independent of thrust reverser position. When performing ground maintenance near the reverser doors, the valve should be lockpinned in the dump position to render the doors inoperative.
- (a) A check valve is incorporated in the system pressure port of the thrust reverser control valve. The check valve will prevent loss of accumulator pressure if system failure occurs upstream of the control valve, with the control valve open. A check valve is installed in the return line of the control valve and functions to prevent hydraulic surges from acting on the thrust reverser hydraulic system.
- (5) Thrust Reverser Flow Regulator Limiter Valve – A flow regulator limiter valve is installed in the stow pressure line on the firewall, forward of each thrust reverser door actuator. In the event of inadvertent thrust reverser deployment in flight, the valve prevents pressure surge by limiting the pressure flow to the thrust reverser door actuator at 1500 psi (10342 kPa).

B. Operation

- (1) When the thrust control levers are in the idle position and full airplane hydraulic pressure is available to the system, lifting the reverse thrust lever to the detent position operates the control valve. Hydraulic pressure is directed to the deploy side of the door latch and thrust reverser door actuators. The door latch actuator operates first, withdrawing the door latches. An amber REVERSER OPERATING light comes on in the P2 engine instrument panel indicating that the doors are unlatched. Initial movement of the door actuator removes the overcenter lock; further movement of the actuator fully deploys the thrust reverser doors. Once the doors are fully deployed, the interlock is removed from the reverse thrust lever and reverse thrust can be applied. The deployment sequence is completed in approximately 2 seconds.



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- (2) Placing the thrust reverser lever in the full forward (stowed) position actuates the thrust reverser control valve and engages the interlock. The four-way portion of the control valve moves to the stow position, connecting the deploy port to return. The accumulator and pressure ports are connected to the stow port. The door actuator moves the doors to the stowed position in approximately 2 seconds. As the door latch engages, the amber REVERSER OPERATING light goes off. Accumulator pressure retains the doors in the stowed position. The amber indicator light REVERSER OPERATING will go out when the door latch actuators have completed their travel to lock the doors.
- (3) While the airplane is in flight, the isolation portion of the control valve isolates airplane system pressure from the thrust reverser door actuator after the latch has closed, isolating the thrust reverser hydraulic system from the airplane hydraulic system. However, normal thrust reverser deployment in flight is possible. Isolating the thrust reverser hydraulic system from the airplane hydraulic system is accomplished through isolation of the thrust reverser control valve by means of main and nose undercarriage microswitches (Ref. Fig. 1).
- (4) Ground maintenance may be performed only after the system has been placed in a safe condition. This may be accomplished with the doors stowed or deployed, as desired, by manually placing the control valve lever in the dump position and installing the lockpin. When the doors are stowed or deployed, the shutoff portion of the control valve blocks system pressure.

4. Thrust Reverser Indicating System

A. Description

- (1) The thrust reverser indicating system for No. 1 and No. 3 engine thrust reversers consists of a thrust reverser low pressure warning switch (mounted on the thrust reverser hydraulic accumulator bracket) and a reverser position switch located on each reverser door latch assembly.
 - (a) Thrust Reverser Accumulator Low Pressure Warning Switch – A thrust reverser accumulator low pressure warning switch is installed on each side of the rear fuselage, and forward of Station 1243 adjacent to the thrust reverser hydraulic accumulator. The switch actuates an amber legend "No. 1 REV ACCUM LOW PRESS or No. 3 THRUST REV ACCUM LOW PRESS on the (P4) third crewman's panel. A two second delay relay in the indicator light circuitry prevents illumination of the legend when a momentary drop in hydraulic pressure occurs on door actuator deployment.



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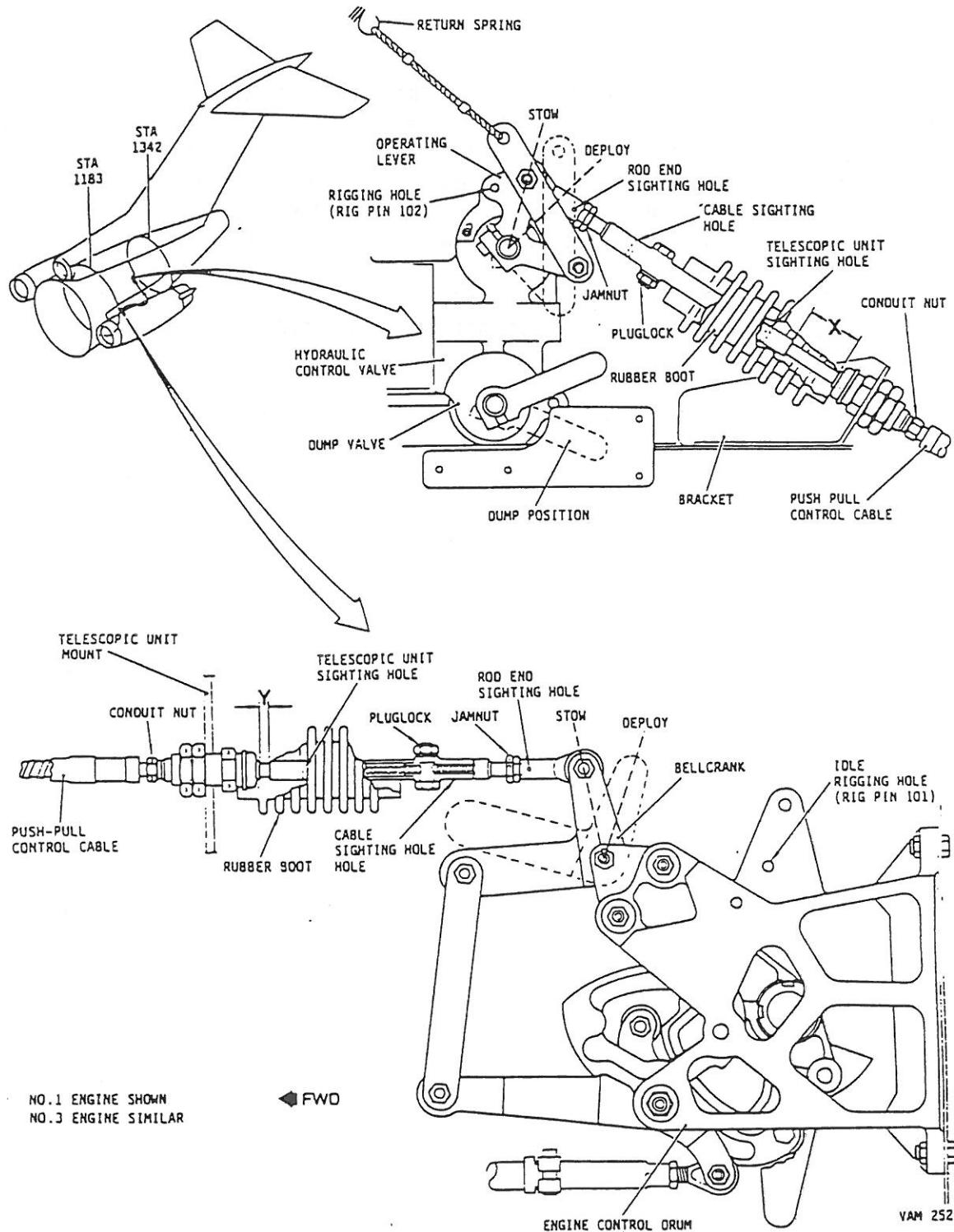
- (b) The thrust reverser operating light circuits for No. 1 and No. 3 engines provides amber light indication to the crew that the thrust reverser is in the unlocked position. The circuit for each engine consists of an amber light on the (P2) engine instrument panel operated by microswitch mounted on each door latch actuator housing. The switch plunger is maintained in the depressed position during forward thrust operation by a pivoting switch plunger striker which at one end is pushed forward by the latch actuator. When reverse thrust is selected the "REVERSER OPERATING" light illuminates as soon as the door mechanism becomes unlocked. The light remains illuminated until the thrust reverser doors are returned to the fully stowed/locked position.



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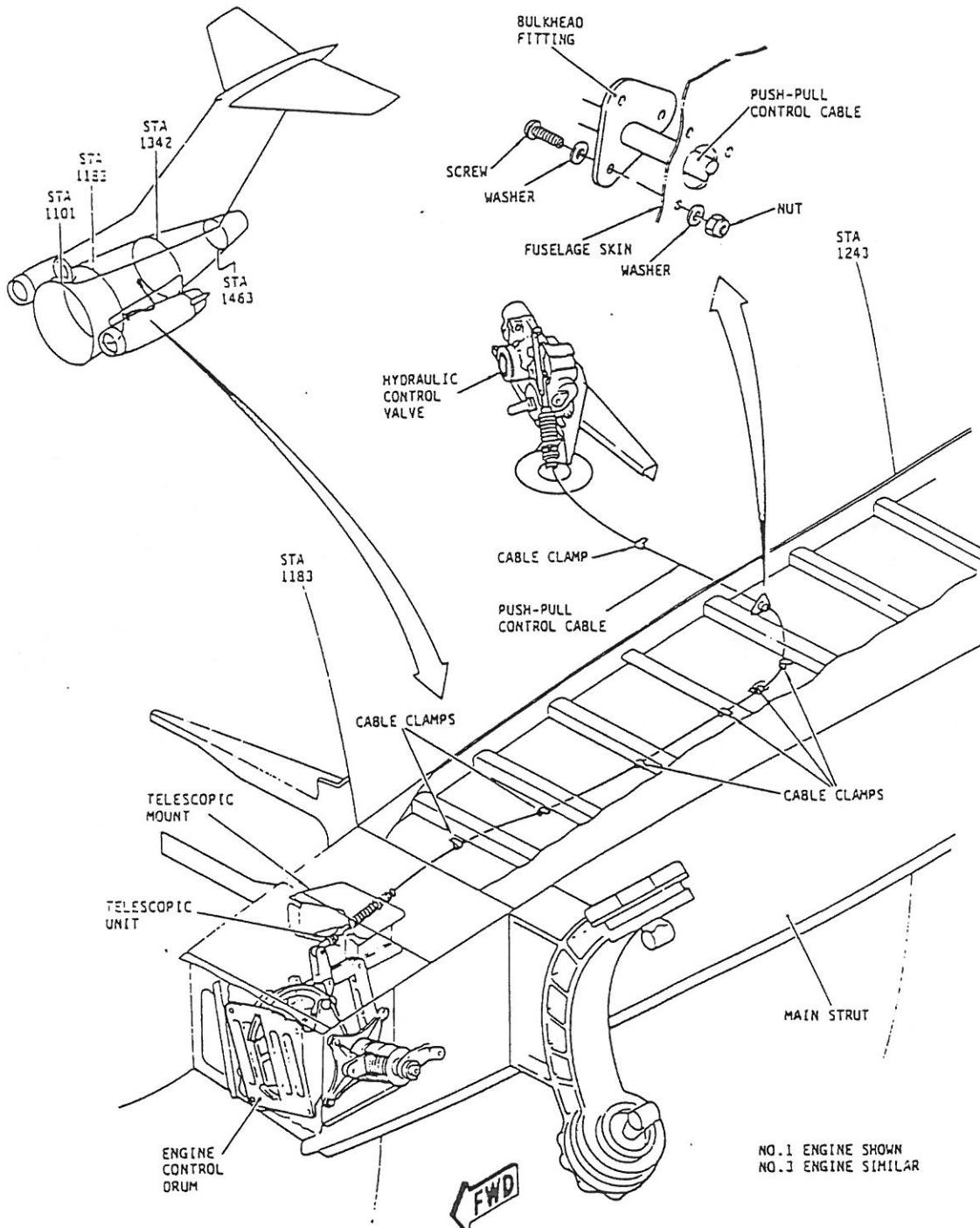




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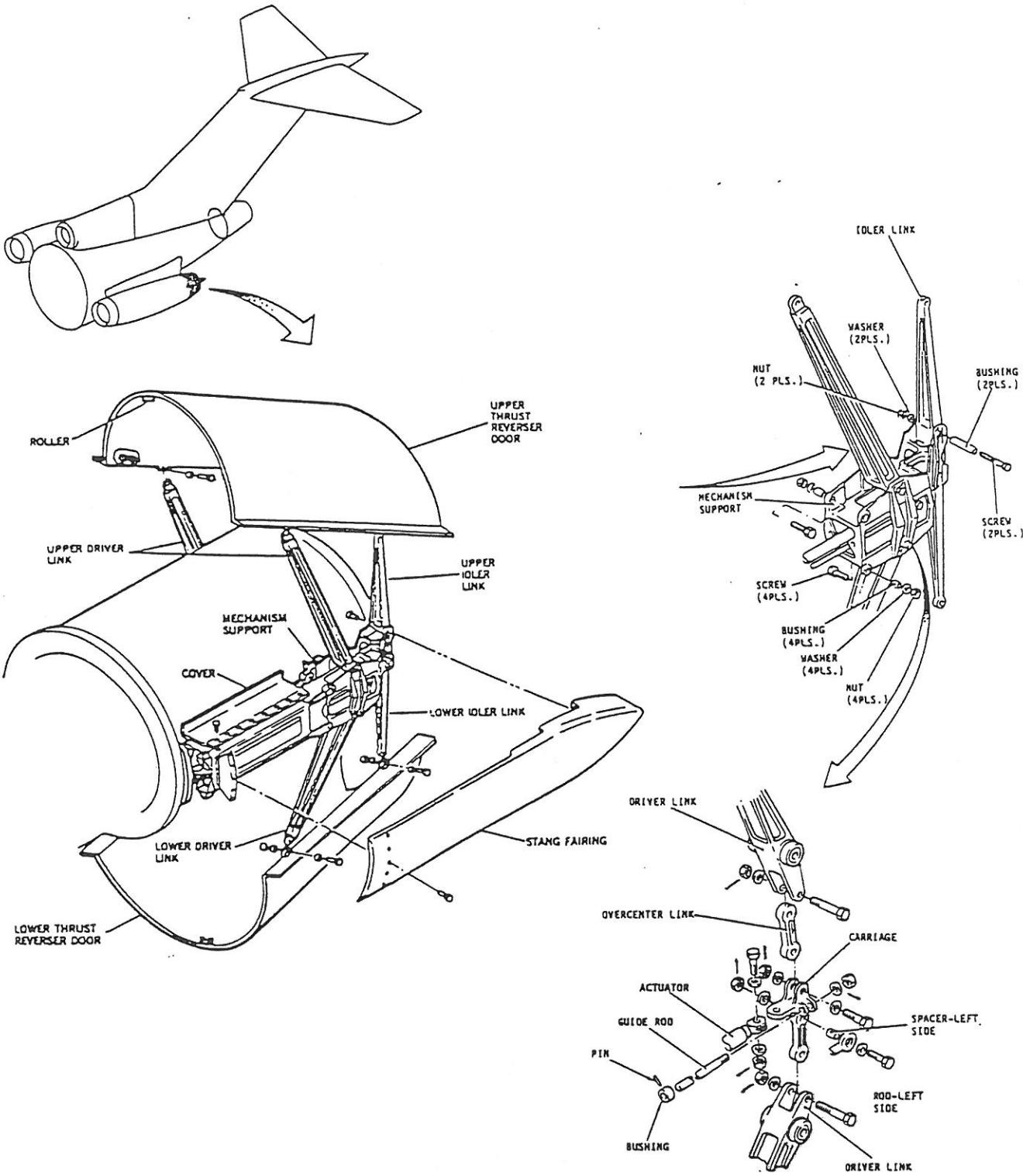
Thrust Reverser Push-Pull Control Cable



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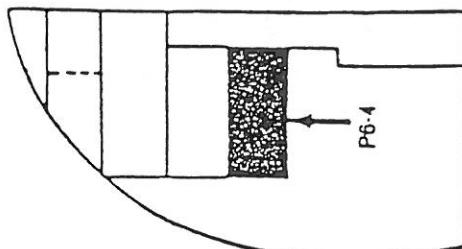
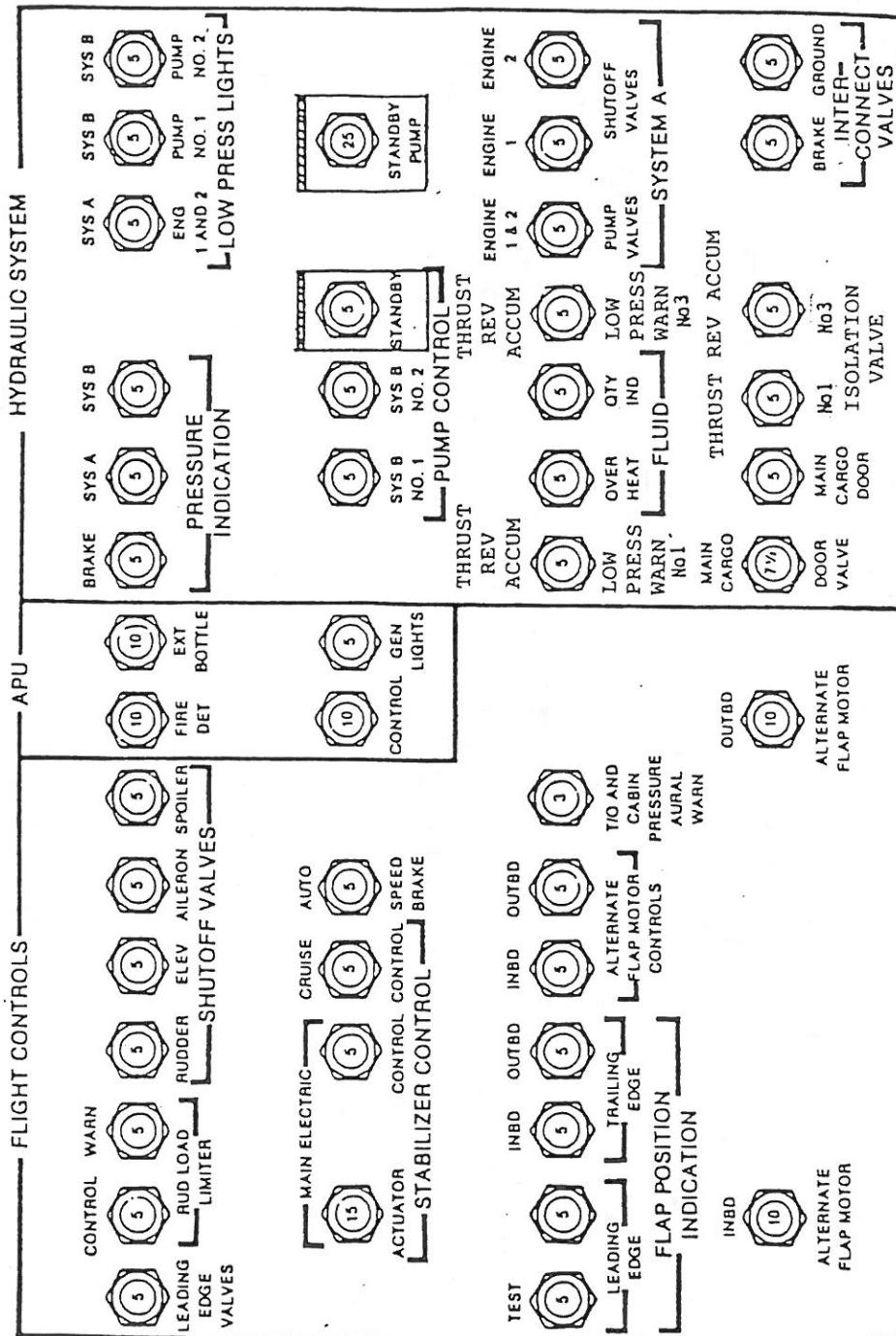
Thrust Reverser Door Actuating Linkage



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PANEL LOCATION
BULKHEAD STA 302

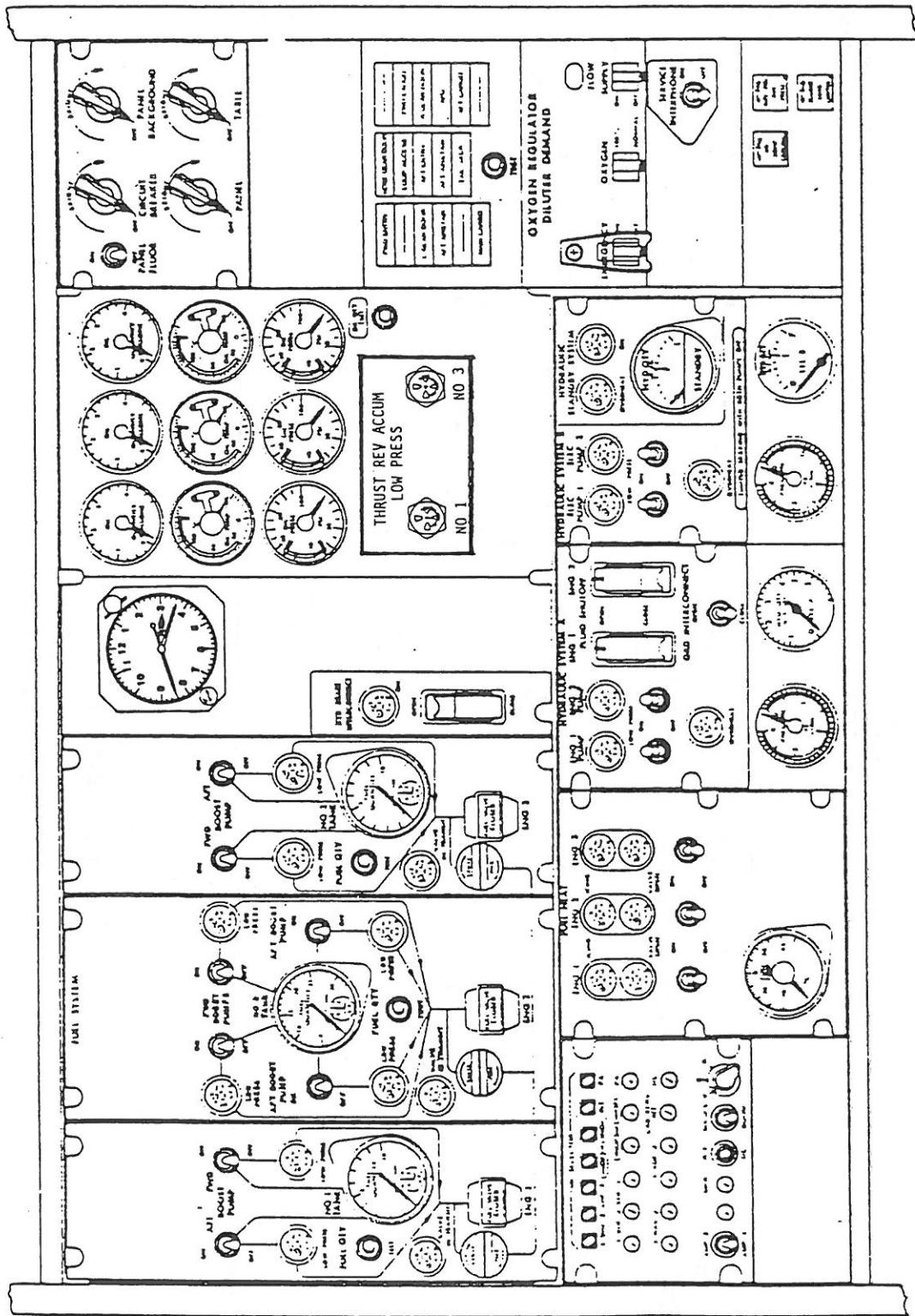
**TERUST REVERSER LOW PRESSURE
WARNING CIRCUIT BREAKERS
(P6-4 PANEL)**



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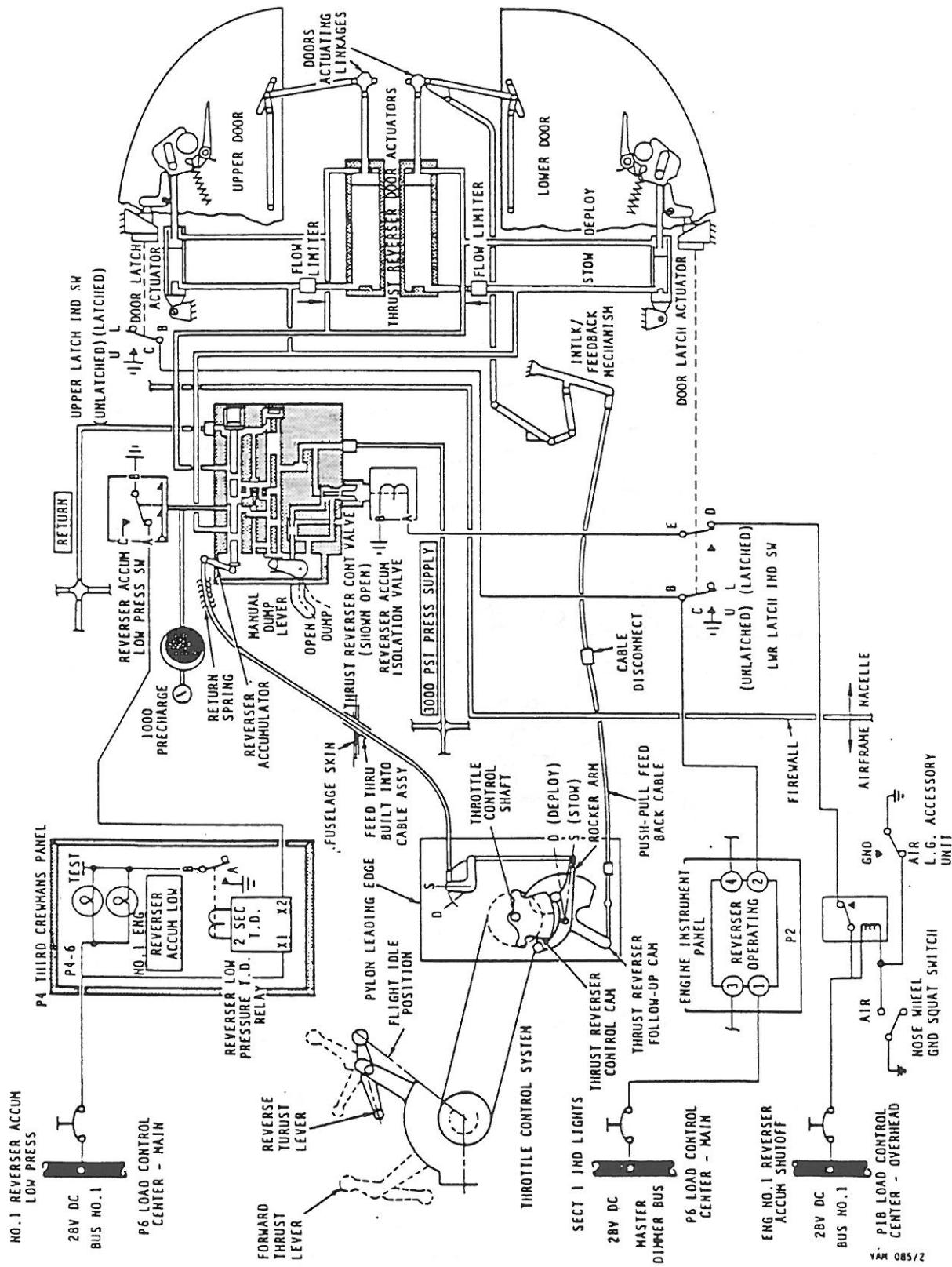
FLIGHT ENGINEER'S LOWER



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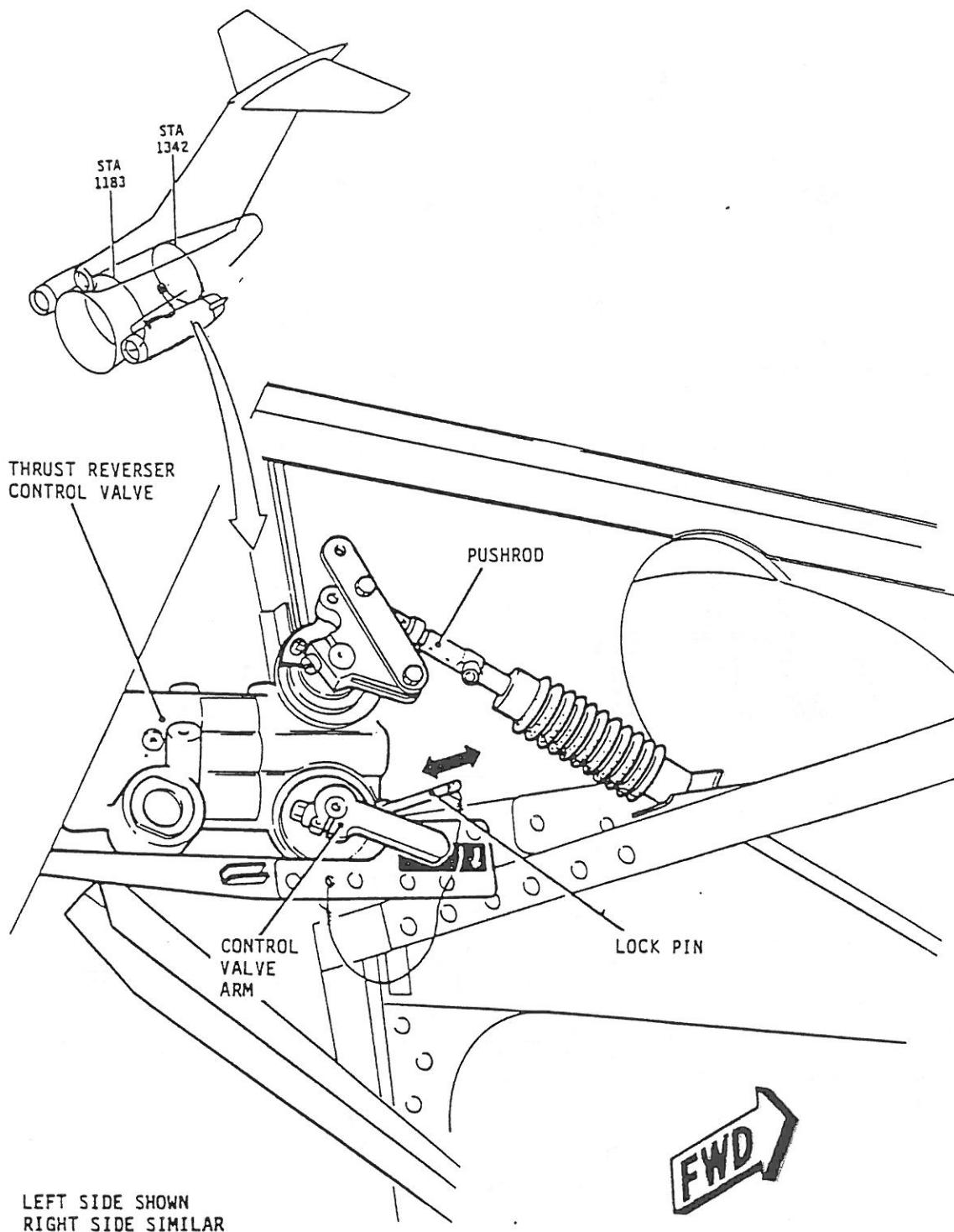
Thrust Reverser Control Schematic Figure 1



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THRUST REVERSER CONTROL VALVE
(LOCKED IN DUMP POSITION)



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MAINTENANCE (M)

Deactivate the affected thrust reverser system as follows:

1. One System Inoperative

- A. Verify upper and lower thrust reverser doors are faired at the leading edge.
- B. Check that thrust reverser doors are fully stowed by checking that the overcenter link is overcenter (must be aft of driver links.)

NOTE: Position of overcenter links can be verified by looking through the opening in the reverser stang panel.

- C. Gain access to the applicable thrust reverser control valve and place valve in DUMP position and install lockpin.
- D. Check accumulator indicators and associated lines for hydraulic leaks.

NOTE: Access to the T/R valve, accumulator indicators and associated piping is through access panel 3756 for engine No. 1 and 3856 for engine No. 3. The panels are located in the aft passenger stairwell.

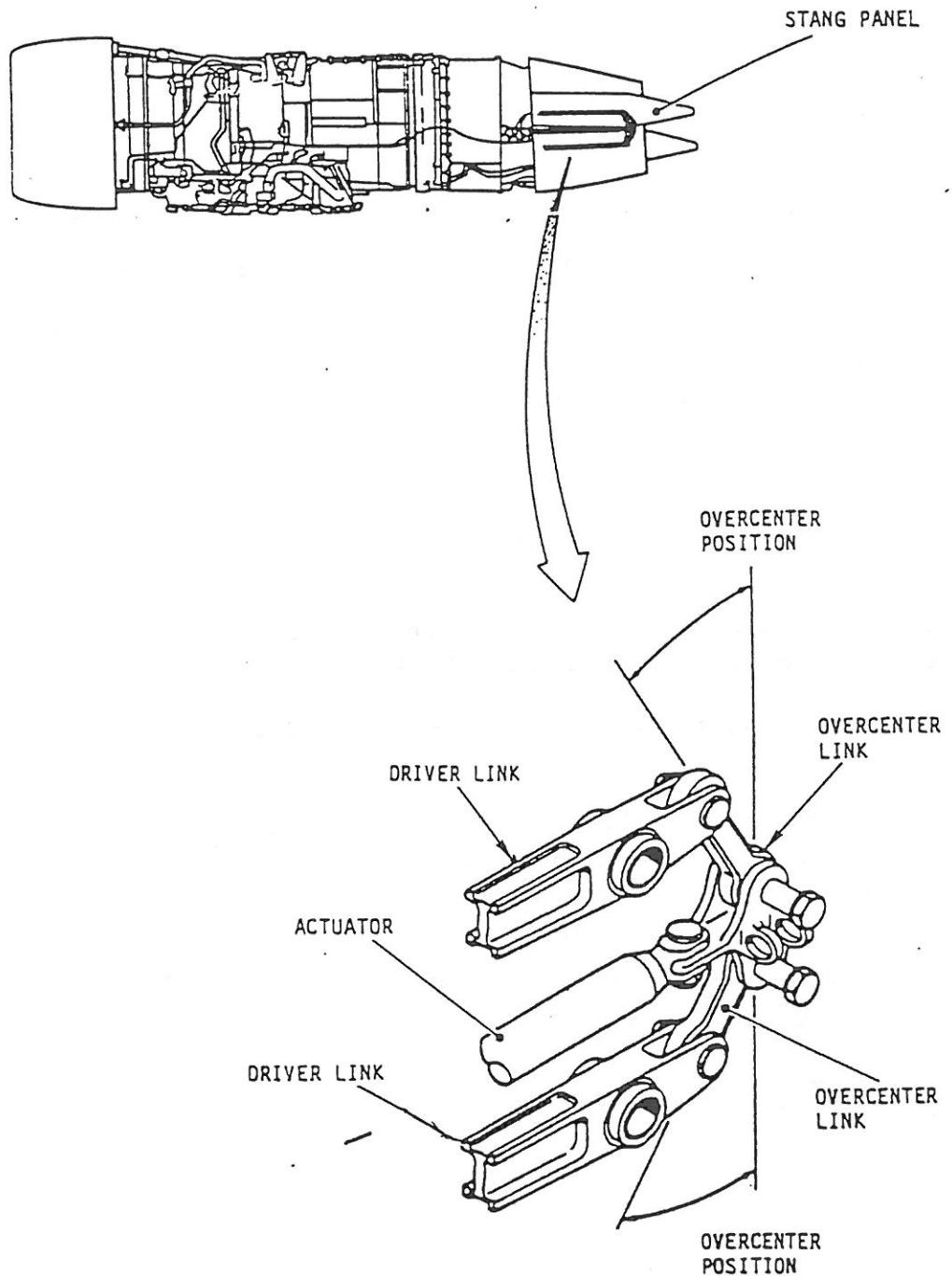
- E. Open and collar applicable THRUST REVERSER ACCUMULATOR LOW PRESS WARN light circuit breaker.
- F. Lockwire or tape the thrust reverser levers (piggy-back) in the stowed position.



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OVERCENTER LINK POSITION
(REVERSER STOWED)



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MAINTENANCE (M)

Inspect as follows:

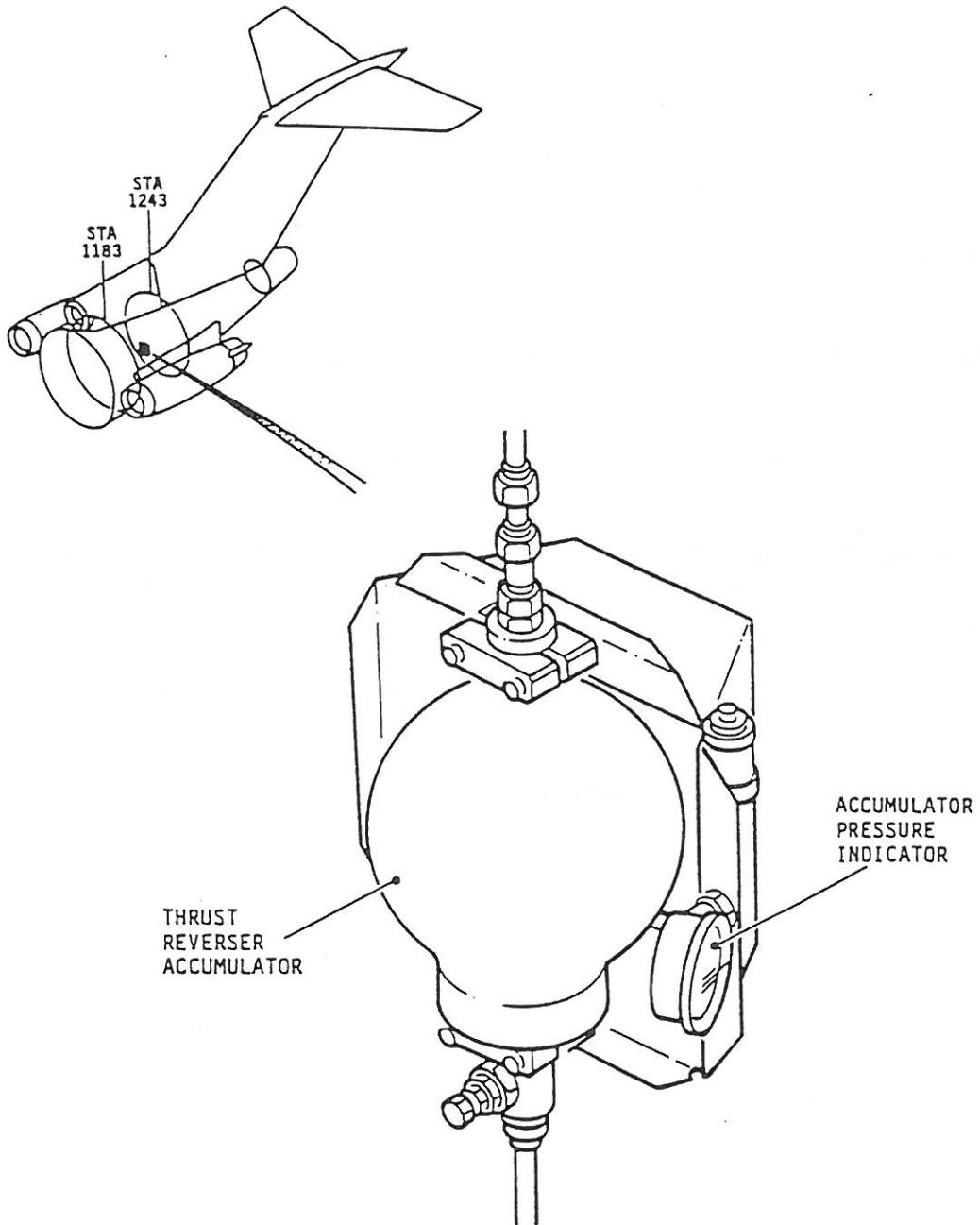
1. System A Reservoir, Accumulator, Accumulator Piping, And Indicator
 - A. Open applicable access panel ((3756) for No. 1 and (3856) for No. 3), left side of aft passenger stairwell.
 - B. Check affected accumulator and associated lines for hydraulic leakage.
 - C. Check contents gage of System A reservoir reads a minimum of 4 gallons.
 - D. Check affected Accumulator pressure indicator for reading of approximately 3000 PSI (hydraulic system pressurized) or 950-1050 PSI (hydraulic system unpressurized).
 - E. Check gage on third crewman's panel in the flight compartment to confirm reservoir quantity.
 - F. Close access panels in aft passenger stairwell.



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THRUST REVERSER ACCUMULATOR
PRESSURE INDICATOR



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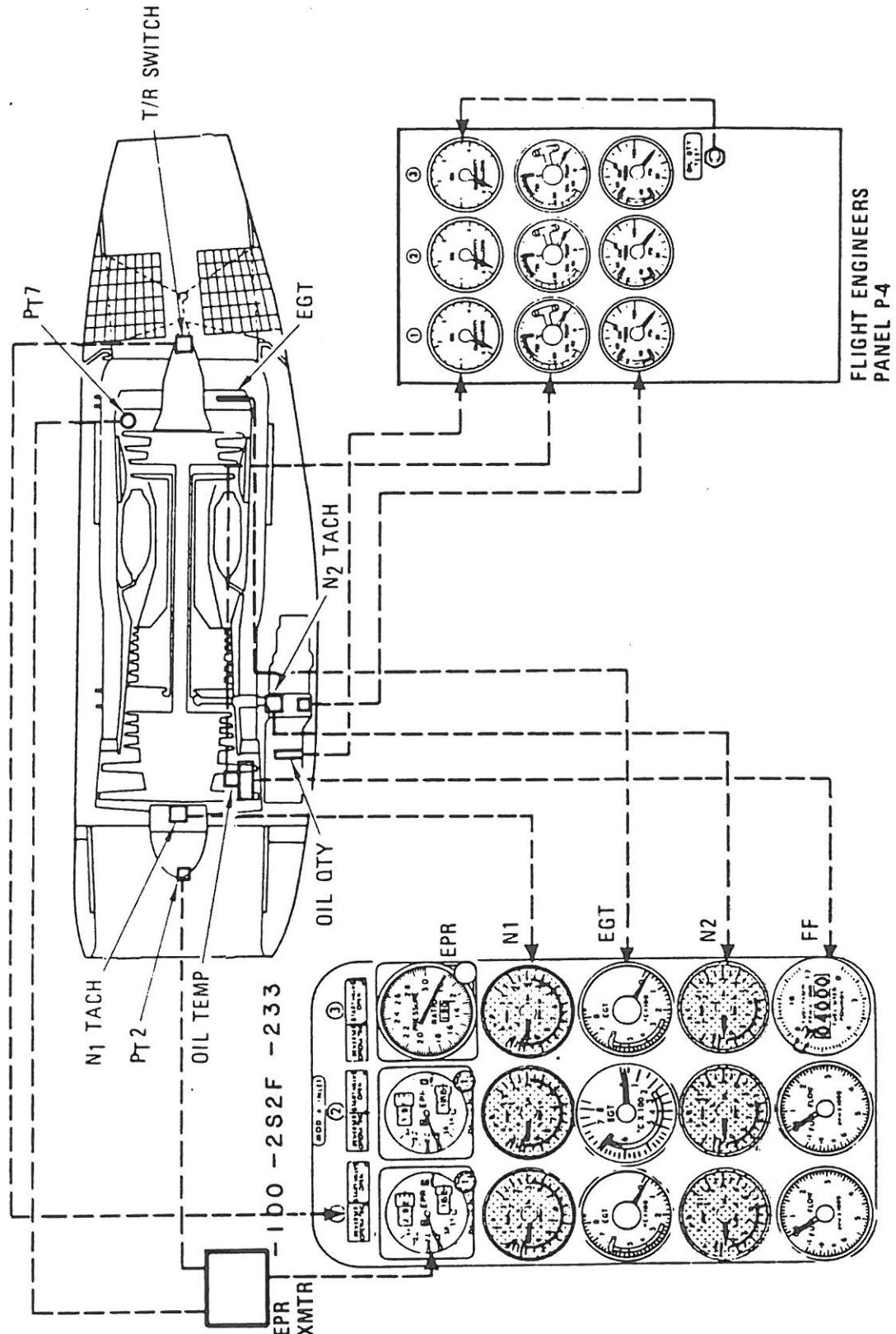
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ENGINE INDICATION FUNCTIONAL DIAGRAM

FLIGHT ENGINEERS
PANEL P4