CHAPTER 78

EXHAUST

Learjet

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RECORD OF TEMPORARY REVISIONS

TEMP REV NO	DESCRIPTION	ISSUE DATE	ATP REV DATE	INSERT BY	DATE REMOVED	REV INCOR	REMOVE BY

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THRUST REVERSER - DESCRIPTION AND OPERATION

1. GENERAL

A. The thrust reverser system consists of two independently operated systems: one system functions to apply reverse thrust from the right engine, and the other functions to apply reverse thrust from the left engine. Each engine reverser installation consists of a throttle quadrant installation, Aeronca thrust reverser installation, and miscellaneous interface/joining components.

B. Power (28 vdc) for normal operation is supplied through the T/R CONT circuit breaker on the copilot's circuit breaker panel. Power (28 vdc) for emergency stow operation and position indicator lights is supplied through the T/R EMER STOW and T/R POSN IND circuit breakers.

C. The thrust reverser system includes automatic stow and stow prevention features which reduce the possibility of asymmetric thrust occurring either in-flight or on the ground. The automatic stow feature activates the stow cycle in the event of a pneumatic latch failure. The stow prevention feature keeps either thrust reverser from stowing while the other is in reverse thrust mode.

2. DESCRIPTION

A. With the NORM-EMER STOW Switch on the thrust reverser control panel in the NORM position, the throttle quadrant provides all necessary controls to operate the system. The reverser levers are pivoted on the main thrust levers, and control system operation through stow, deploy, and reverse thrust operations when the main thrust levers are in the IDLE position. A throttle control interlock switch, solenoid, and pawl, incorporated in the control quadrant assembly, prevent application of reverser thrust above approximately 45% N1 rpm until both thrust reversers are fully deployed. With the NORM-EMER STOW Switch in the EMER STOW position, the ignition switches in the throttle quadrant installation and the thrust reverser emergency stow cutout box prevent completion of emergency stow circuits above approximately 70% N1 rpm.

B. The bleed air supply system provides bleed air from the engine high pressure compressor to drive the air motor in the pneumatic actuator assembly and operate the pneumatic latches.

C. The electrical wiring installation is composed of the squat switch relay panel, thrust reverser control panel, throttle quadrant switches, thrust reverser relay panel, thrust reverser relay box, and thrust reverser emergency stow cutout box.

(1) The squat switch relay panel prevents normal operation of the thrust reverser system until the squat switches are in the ground mode.

(2) The thrust reverser control panel, located on the glareshield, provides the crew with visual indication of system operation and normal or emergency mode selection.

(3) The throttle quadrant assembly contains two switches for each thrust reverser system. One switch arms the system when the main thrust levers are moved to the IDLE position and the other completes deploy circuits when the thrust reverser levers are pulled to the deploy position, or completes stow circuits when the thrust reverser levers are moved to the stow position. The throttle quadrant installation also contains ignition switches which, in addition to their normal functions, prevent completion of emergency stow circuits unless the main thrust levers are below a position corresponding to approximately 70% N1 rpm. A mechanical interlock secures the thrust reverser levers in the stowed position with the main thrust levers in any position other than idle.

(4) The thrust reverser relay panel is located on the left side of the aircraft just forward of frame 26 and is attached to stringers 13 and 14. The panel contains the necessary relays for normal operation of the thrust reverser system.

(5) The thrust reverser relay box is located immediately left of the aircraft centerline just forward of frame 27. The box contains relays which, when activated during thrust reverser deploy and stow cycles, interrupt circuits for windshield anti-ice, nacelle heat, wing heat and stabilizer heat.

(6) The thrust reverser emergency stow cutout box is attached to the inside of the LH pedestal panel. The cutout box and the ignition switch in the throttle quadrant installation prevent completion of emergency stow circuits above approximately 70% N1 rpm.

3. **OPERATION** (See figure 1.)

A. The thrust reversers are commanded to translate by proper positioning of the main and thrust reverser levers located in the throttle quadrant when the aircraft is on the ground. With the thrust reverser control system circuit breakers engaged and the Normal/Emergency Stow Switch in "NORM," 28 vdc is applied to the squat switch relay panel, the source side of the Bleed Valve Test Switch, and to the thrust reverser pneumatic latch switches (B) contacts.

Engaging the thrust reverser position indicator circuit breaker supplies 28 vdc to the (C) contacts of the pneumatic latch switches.

With weight on the gear, the closed squat switch applies 28 vdc to the main thrust levers "IDLE" arming switches in the Throttle Quadrant, and to the throttle interlock relay in the thrust reverser relay panel.

28 vdc is also routed through the Thrust Reverser Control relay switches to the "STOW" side of the airmotor. The thrust reversers remain in the stowed and locked position until the pilot initiates a deploy command.

With the main throttle levers in the "IDLE" position and the thrust reverser thrust levers in the deploy position, electrical circuits are completed through the Idle Arming Switches in the throttle quadrant to the deploy side of the reverser control relay within the Thrust Reverser Relay Panel Box.

NOTE: Electrical power to deploy the thrust reversers will not be available unless both thrust reverser levers are in the deploy position.

When both reverser control relays are energized to deploy, electrical power is routed to the pneumatic latch control valves, to the deploy coil of the directional control valve and air-on-valve in the thrust reversers. The thrust reverser translates to deploy.

NOTE:
- When the pneumatic latches are energized, electrical circuits are completed to illuminate the "UNLOCK" lights on the control panel.
- Bleed air supply to the windshield heat, wing/stabilizer heat, and nacelle heat is shut off during the deploy and stow cycles (approximately 3 seconds.)

When the thrust reversers are fully deployed (approximately 2 seconds) the deploy limit switches are actuated and complete an electrical circuit to (1) energize the L/R throttle release solenoid control relay in the thrust reverser relay panel, and (2) energize the "DEPLOY" light and extinguish the "UNLOCK" lights on the control panel.

NOTE: Both the left-hand and right-hand deploy limit switches must be actuated in order to complete the circuit to the L/R throttle release solenoid.

When the throttle release solenoid is energized, the thrust reverser lever locks are released which allows the crew to apply increasing reverser thrust.

NOTE: Excessive force applied to the thrust reverser levers, while the throttle lock is still engaged, will prevent the throttle lock from releasing and reverse thrust above 60% N1 will not be available.

As reverse thrust is applied, a pressure switch in the thrust reverser is actuated when engine bleed air pressure reaches 50 psia during engine acceleration. Actuating the pressure switch completes a circuit to illuminate the "BLEED VALVE" light on the control panel.

NOTE: The "DEPLOY" and "BLEED VALVE" lights will remain illuminated until a stow command is initiated.

The thrust reverser system incorporates an indicator system to warn the crew, by means of a flashing unlock light, if the thrust reversers should stow with the blocker doors inside the fan duct.

On Aircraft 35-439 thru 35-500, 35-506, 36-051 thru 36-053, and prior aircraft modified per AMK 81-6, "Installation of Thrust Reverser Blocker Door Position Indicator," the UNLOCKED light is an amber flashing light.

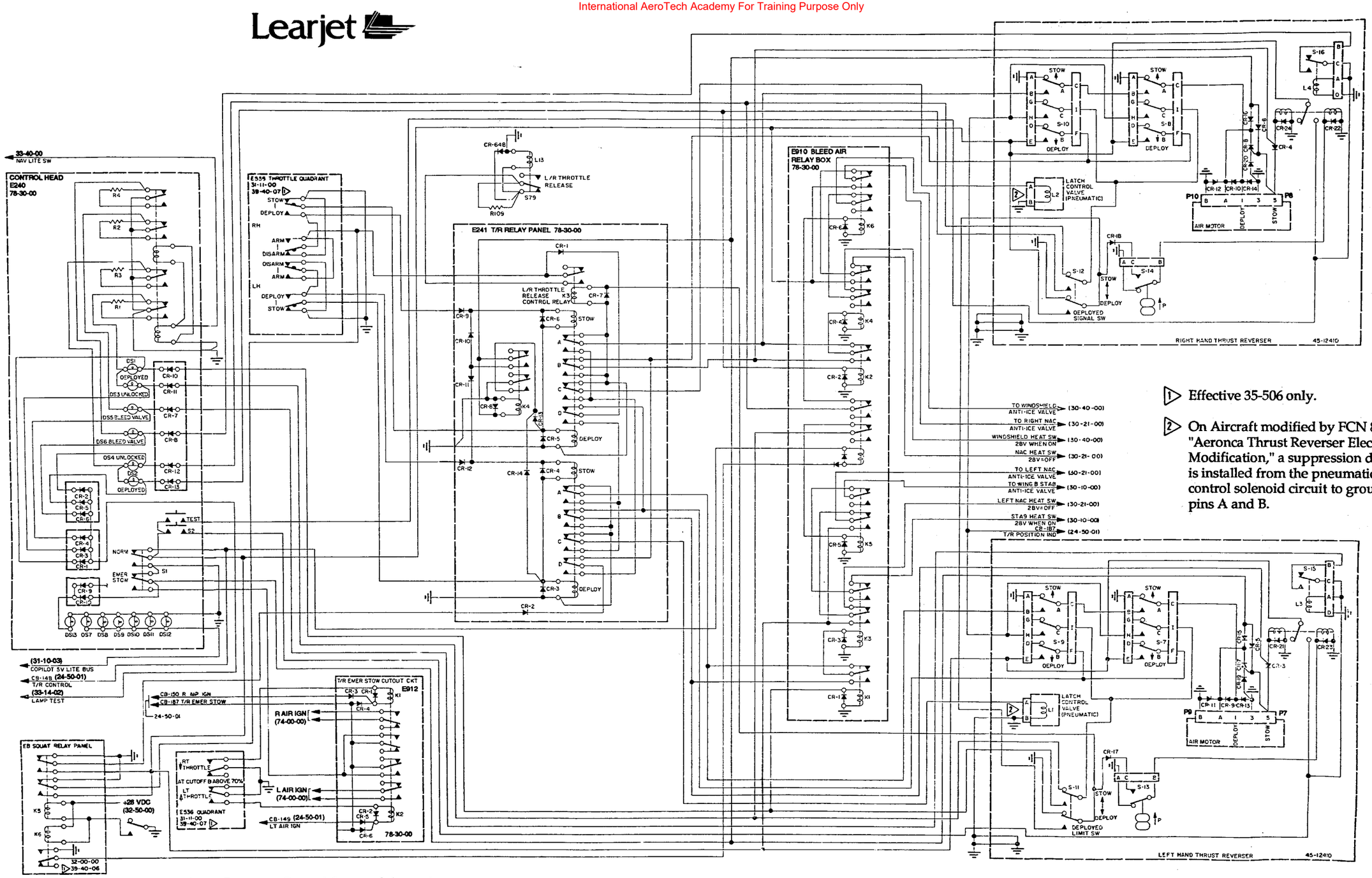
A test switch located on the thrust reverser control panel is used to test the bleed valve and the door position indicator circuits prior to takeoff or landing. When the test switch is depressed and held to TEST, the bleed valve light will illuminate and the UNLOCKED (amber) light will flash.

A diagnostic circuit is included in the door position indicator installation to sense a failure of the door position switches. A relay is wired into the circuit which will cause the UNLOCKED light to remain illuminated when the deploy light is on in the event of a switch malfunction.

The Normal/Emergency Stow switch mounted on the thrust reverser control panel must be in the "NORMAL" position for all normal operations. When EMER STOW is selected, electrical power is removed from both normal systems and power is applied from a separate circuit breaker directly to both air-on-valves and pneumatic actuators to stow the system.

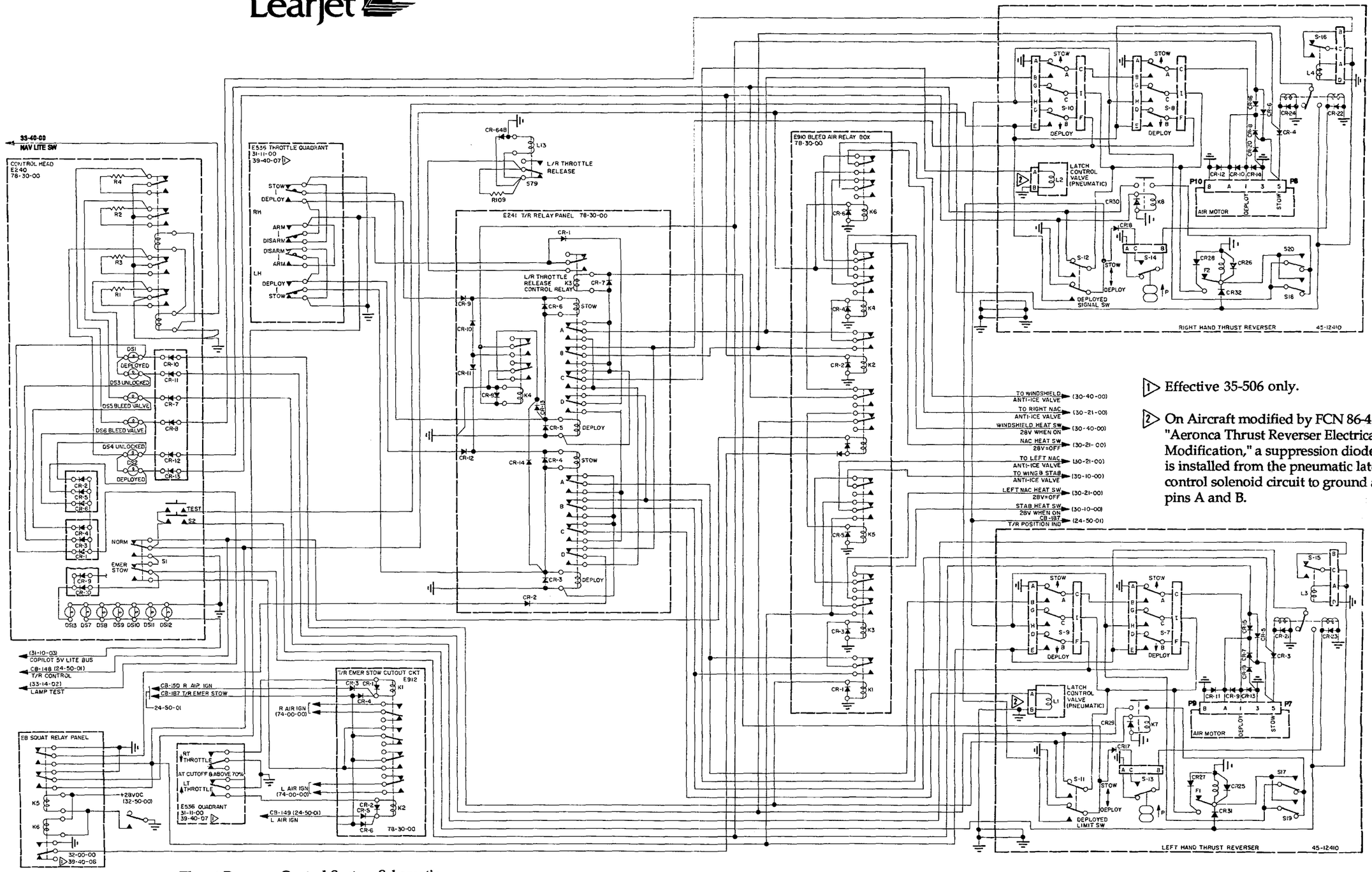
To protect the flexible drive cables, a 70% RPM cutout switch in the throttle quadrant prevents a stow signal to the system until the main thrust levers are retarded below 70% N1 RPM. A switch position light is incorporated to warn the crew that the Normal/Emergency Switch is in EMER STOW position, and that the thrust reversers will not operate while the light is on.

For more detailed operation of the thrust reverser components, refer to Aeronca Maintenance Manual, Publication No. 78-30-01.



1. Effective 35-506 only.
2. On Aircraft modified by FCN 86-4, "Aeronca Thrust Reverser Electrical Modification," a suppression diode is installed from the pneumatic latch control solenoid circuit to ground at pins A and B.

Thrust Reverser Control System Schematic
Figure 1 (Sheet 1 of 2)



Thrust Reverser Control System Schematic
Figure 1 (Sheet 2 of 2)

1 Effective 35-506 only.

2 On Aircraft modified by FCN 86-4, "Aeronca Thrust Reverser Electrical Modification," a suppression diode is installed from the pneumatic latch control solenoid circuit to ground at pins A and B.

THRUST REVERSER - TROUBLE SHOOTING

1. GENERAL

A. The following trouble shooting test procedure is provided as an aid to detect and isolate possible trouble areas in the thrust reverser system.

B. A thrust reverser test box may be fabricated as shown in figure 101 as an aid in checking the electrical circuits.

2. TROUBLE SHOOTING

A. Trouble Shooting Test Procedure

(1) Fabricate a thrust reverser test box as shown in figure 101.

(2) Remove access panels from thrust reversers as applicable to gain access to thrust reverser translating structure.

(3) Lower tailcone access door and disconnect electrical connector from thrust reverser relay box. Connect test box electrically between aircraft wiring and thrust reverser relay box.

(4) Ensure that squat switches are in ground mode, EMER STOW/NORM Switch (on control panel) is in NORM position, and thrust reverser circuit breakers are depressed. Set Battery Switches on.

(5) Set main thrust levers between IDLE and 70% rpm. Check that SQUAT SWITCH light and LH and RH AIR MOTOR-STOW lights on test box are illuminated.

NOTE: This indicates that 28 vdc power, from the thrust reverser circuit breaker through the EMER STOW/NORM (in the NORM position) and the energized relays in the squat switch relay panel, is applied to the thrust reverser system.

(6) Position main thrust levers to IDLE. Check that both LH and RH ARMED lights on test box are illuminated.

NOTE: This indicates that the armed switches in the throttle quadrant have actuated and 28 vdc is applied to the stow solenoid of the stow/deploy latching relays.

(7) Move main thrust levers forward; ARMED lights shall extinguish when main thrust levers are approximately 0.25 inch forward of idle stop. Reposition main thrust levers to IDLE; both ARMED lights shall again illuminate.

(8) With main thrust levers in IDLE, move both thrust reverser levers to deploy. Check that both LH and RH DEPLOY lights, LH and RH LATCH CONTROL VALVE lights and LH and RH AIR MOTOR-DEPLOY lights on test box are illuminated. Check that both LH and RH ARMED lights remain illuminated.

NOTE:

- Ensure both LH and RH ARMED lights remain illuminated whenever the main thrust levers are in the IDLE position.
- This indicates that the deploy switches in the throttle quadrant have actuated to deploy and (1) 28 vdc is applied to the deploy solenoid of the stow/deploy latching relays, (2) the ground circuit to the stow solenoid has opened, (3) 28 vdc is applied to the solenoid of the latch control valves within the thrust reversers, and (4) 28 vdc is applied to the deploy solenoid of both thrust reverser air motors. Since no air pressure is available, the thrust reversers will not move to the deployed position. The UNLOCK lights on the thrust reverser control panel will not illuminate.

(9) Move thrust reverser levers back to stow position and verify that both LH and RH ARMED lights are illuminated. Verify that LH and RH DEPLOY lights, LH and RH LATCH CONTROL VALVE lights and LH and RH AIR MOTOR-DEPLOY lights extinguish.

(10) Move thrust reverser levers back to deploy and manually move thrust reverser pneumatic latches to unlocked position. Verify that both LH and RH UNLOCK lights on thrust reverser control panel are illuminated.

(11) Using a 5/16 inch Allen wrench fitted to a speed handle, hand translate thrust reverser to deploy. Verify that thrust reverser control panel UNLOCK lights extinguish and that DEPLOY lights illuminate near end of deploy travel. Verify that THROTTLE LOCKOUT SOLENOID light on test box is illuminated.

NOTE: This indicates that both the LH and RH deployed signal switches are actuated to the deployed position. This opens the 28 vdc power circuit to the UNLOCK lights and completes a 28 vdc power circuit to the DEPLOY lights. A 28 vdc power circuit is completed through both deployed signal switches to the throttle release control relay.

(12) Hand translate either LH or RH thrust reverser towards stow. Verify that applicable DEPLOY light extinguishes, UNLOCK light is again illuminated, and THROTTLE SOLENOID light extinguishes.

NOTE: This indicates proper operation of the throttle release interlock and that the thrust reverser levers will not release allowing more than ground idle power until both thrust reversers are fully deployed.

(13) Hand translate applicable thrust reverser back to deployed position. Verify that thrust reverser levers can be pulled past deploy to increasing reverse thrust.

(14) Position thrust reverser levers to stow position (full down). Verify that test box lights: (1) LH & RH DEPLOY lights extinguish; (2) LH & RH ARMED lights are illuminated; (3) LH & RH AIR MOTOR-DEPLOY lights go out; (4) AIR MOTOR-STOW and AUTO-STOW lights are illuminated and (5) LH and RH LATCH CONTROL VALVE lights extinguish.

(15) Hand translate thrust reverser back to the stow position.

NOTE: When the thrust reversers start towards the stow position, the deployed signal switches switch to the stow position and the DEPLOY lights on the thrust reverser control panel will extinguish. The UNLOCK lights will also illuminate and remain illuminated until the latch switches are in the stow position.

(16) With thrust reverser levers in stow and both ARMED lights illuminated, set EMER STOW/NORM Switch to EMER STOW. Verify that ARMED lights extinguish.

NOTE: This indicates that power is removed from the normal deploy-stow circuits and that a power circuit to the emergency stow cutout circuits is completed.

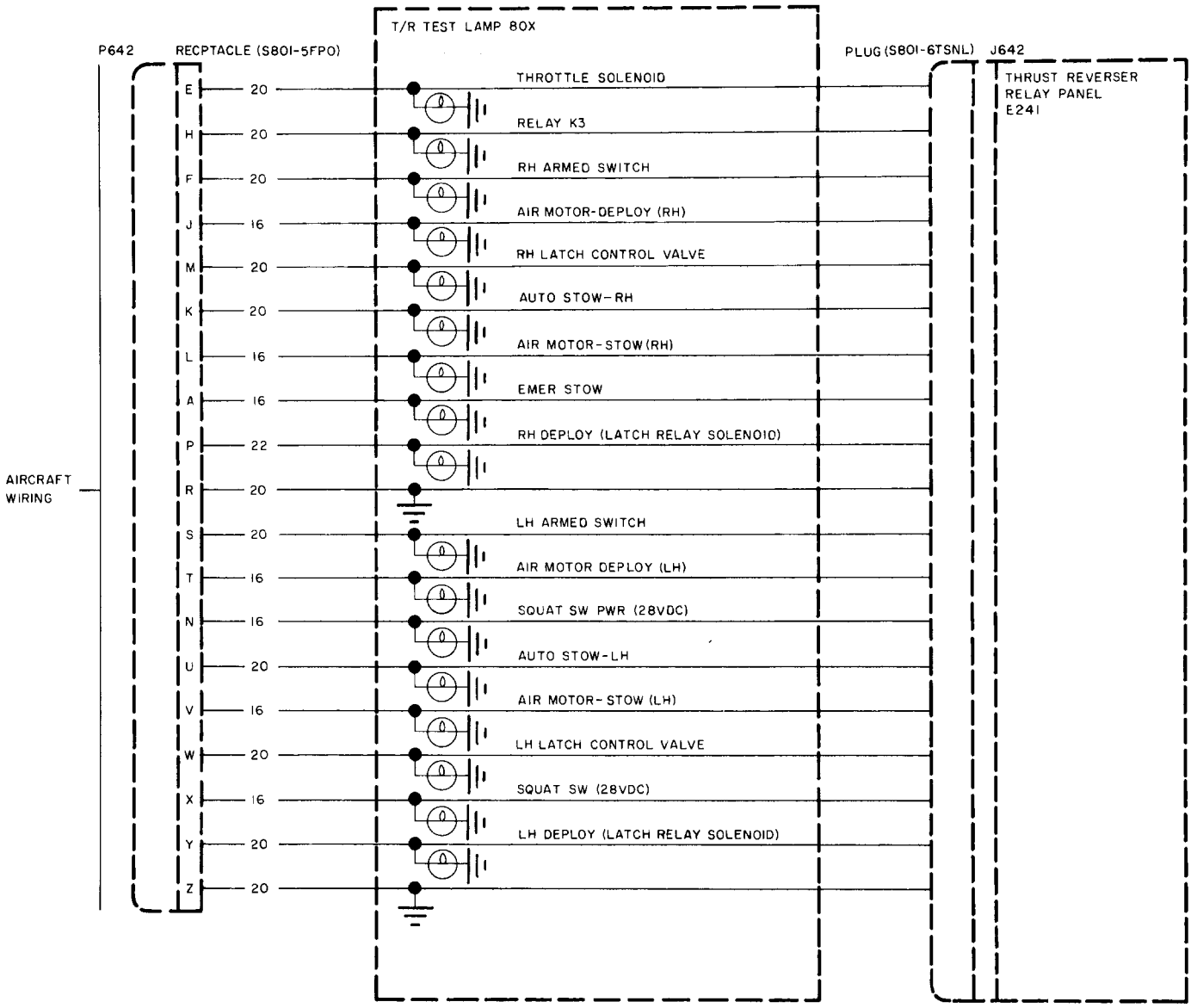
(17) Disconnect electrical connector from LH air motor solenoid valve. Connect a voltmeter between pin 5 and thrust reverser ground.

(18) Set LH main thrust levers between IDLE and 70% rpm (ignition or range). Check for 28 vdc between pin 5 and ground and that indicator light adjacent to EMER STOW/NORM Switch is illuminated.

(19) Move main thrust levers to 70% rpm, check for zero voltage between pin 5 and ground when approximately 70% rpm position is reached.

NOTE: This indicates that the emergency stow cutout circuit is operating properly and prevents the thrust reverser from being stowed while engines are above 70% N1 rpm. The ignition switches in the throttle quadrant are used to control the ground circuit for the emergency stow cutout circuits.

(20) Repeat steps 2.A.(17) thru 2.A.(19) using RH thrust reverser air motor and main thrust lever.



Thrust Reverser Test Box
Figure 101

THRUST REVERSER - MAINTENANCE PRACTICES

1. GENERAL

CAUTION: DO NOT PERFORM GROUND OPERATIONAL CHECKS OF THRUST REVERSER WITH ENGINES OPERATING AND TAILCONE ACCESS DOOR OPEN OR DAMAGE TO THE ACCESS DOOR WILL RESULT.

A. Refer to Aeronca TFE 731 Thrust Reverser System - Learjet 35/36 Installation - Maintenance Manual (Aeronca Publication No. 78-30-01) for maintenance practices.

NOTE: The aft pylon fairings must be removed to allow removal of engine nacelle aft cowl access panels on the inboard side of the engine nacelle.

B. Replacement of the thrust reverser deploy/stow switches and/or arming switches requires removal of the throttle quadrant assembly from the center pedestal.

2. REMOVAL/INSTALLATION

A. Throttle Quadrant Assembly Removal

(1) Remove pilot's and copilot's crew seats.
(2) Remove screws securing plate on forward side of quadrant.
(3) Remove Emergency Brake handle and Parking Brake handle.

NOTE: If aircraft is equipped with engine synchronizer system, loosen and remove nuts securing synchronizer switches to bracket. Let switches hang loose after quadrant cover is removed.

(4) Remove attaching parts and cover from center pedestal.
(5) Remove attaching parts and side covers from center pedestal.
(6) Remove cotter pins, nuts, washers and bolts securing throttle cable eyebolts to output link of the quadrant assembly.
(7) Remove attaching parts securing lockout solenoid links to lockout solenoid.
(8) Remove nuts, washers and bolt securing aural warning switch links to thrust lever assemblies.
(9) Remove attaching screws (both sides of pedestal) and remove throttle quadrant from center pedestal. Retain spacers (if installed) for proper spacing when quadrant assembly is installed.

B. Throttle Quadrant Assembly Installation

NOTE: When installing throttle quadrant assembly, ensure that bolt through forward pedestal clevis also passes through hole in fixed cam and idle stop assembly (see figure 201).

(1) Secure quadrant assembly to pedestal with attaching parts.
(2) Install aural warning switch links on thrust lever assemblies and secure with attaching parts.
(3) Install lockout solenoid links to lockout solenoid and secure with attaching parts.
(4) Install throttle cable eyebolts in output links and secure with attaching parts.
(5) Install side covers and secure with attaching parts.
(6) Perform trouble shooting test procedure as outlined in this chapter.
(7) Install pedestal cover and plate and secure with attaching parts.
(8) Position engine synchronization switches in bracket and secure.
(9) Install Emergency Brake and Parking Brake handles and secure.
(10) Install crew seats.

3. APPROVED REPAIRS

A. Tools and Equipment

NOTE: Equivalent substitutes may be used in lieu of the following items.

NAME	PART NUMBER	MANUFACTURER	USE
Multimeter	Model 260	Simpson	Check continuity to verify switch adjustment.

B. Throttle Quadrant Disassembly (See figure 201.)

CAUTION: WHEN QUADRANT IS DISASSEMBLED, NOTE THE NUMBER AND POSITION OF SPACERS AND SHIMS SO THAT THE THROTTLE QUADRANT CAN BE RE-ASSEMBLED CORRECTLY.

(1) Loosen and remove screw and retainer plate from left side of quadrant assembly.

NOTE: Quadrant assembly retainers should be marked on top surface as an aid in aligning retainer and spline shaft.

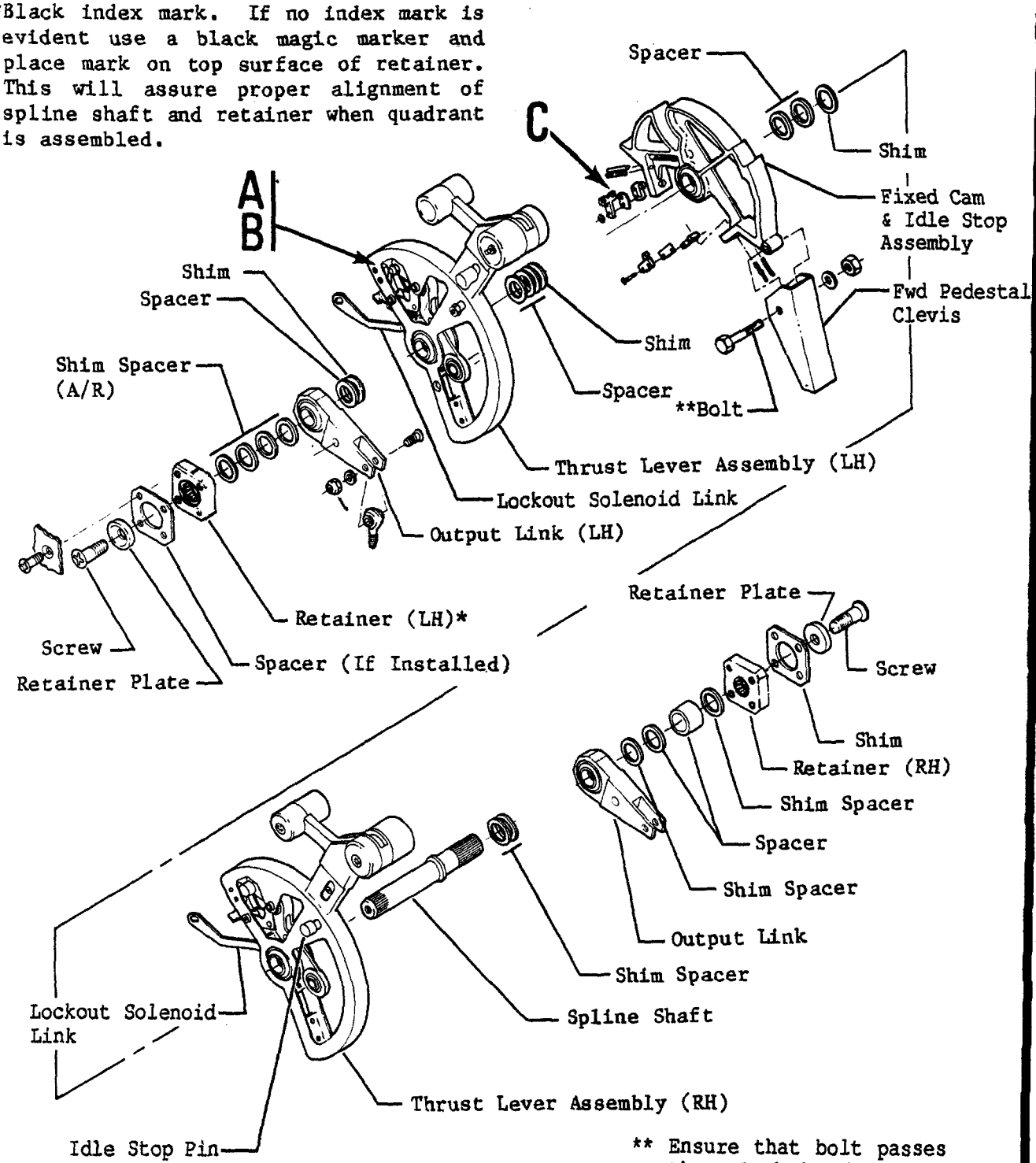
(2) Remove retainer from end of spline shaft.
(3) Remove shim spacers from spline shaft noting the number and position of shim spacers.
(4) Remove output link, shims, LH thrust lever assembly, spacers, shims, fixed cam and idle stop assembly, spacers, shims and RH thrust lever assembly from spline shaft. Note position and number of shims and spacers.

NOTE: Unless bearing replacement is required on the RH output link, do not disassemble the components on the RH side of the spline shaft.

C. Throttle Quadrant Assembly (See figure 201.)

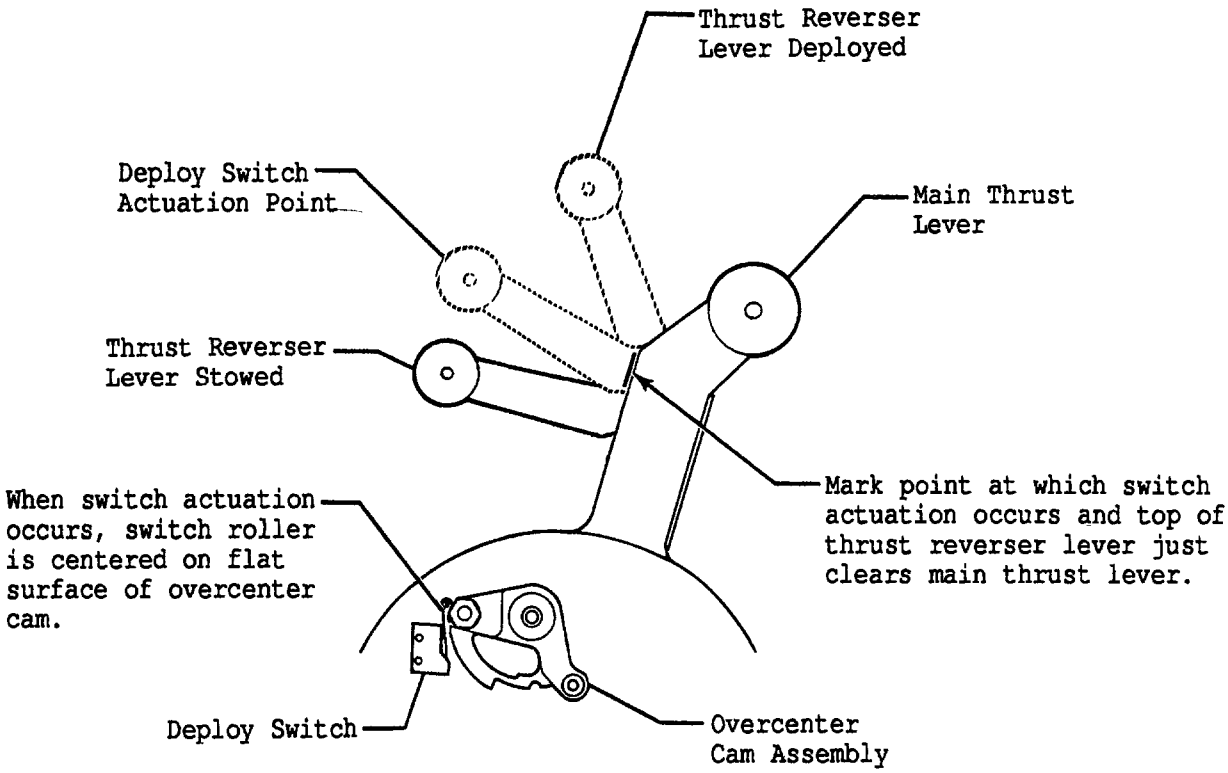
(1) Assemble RH thrust lever assembly, shim and spacers, fixed cam and idle stop assembly, shim and spacers, LH thrust lever assembly, shim and spacer, LH output link, and shim spacers on spline shaft.
(2) Position LH retainer on spline shaft with index mark (black mark on edge of retainer) in the up position.
(3) Secure LH retainer to spline shaft using retainer plate and screw. Tighten screw.
(4) When quadrant is assembled, measure overall width of quadrant assembly from outside surface of RH retainer to outside surface of LH retainer. Measurement should be 5.500 ± 0.010 inches.
(5) Check dimensions and clearances as shown on sheet 3 of figure 201.

*Black index mark. If no index mark is evident use a black magic marker and place mark on top surface of retainer. This will assure proper alignment of spline shaft and retainer when quadrant is assembled.

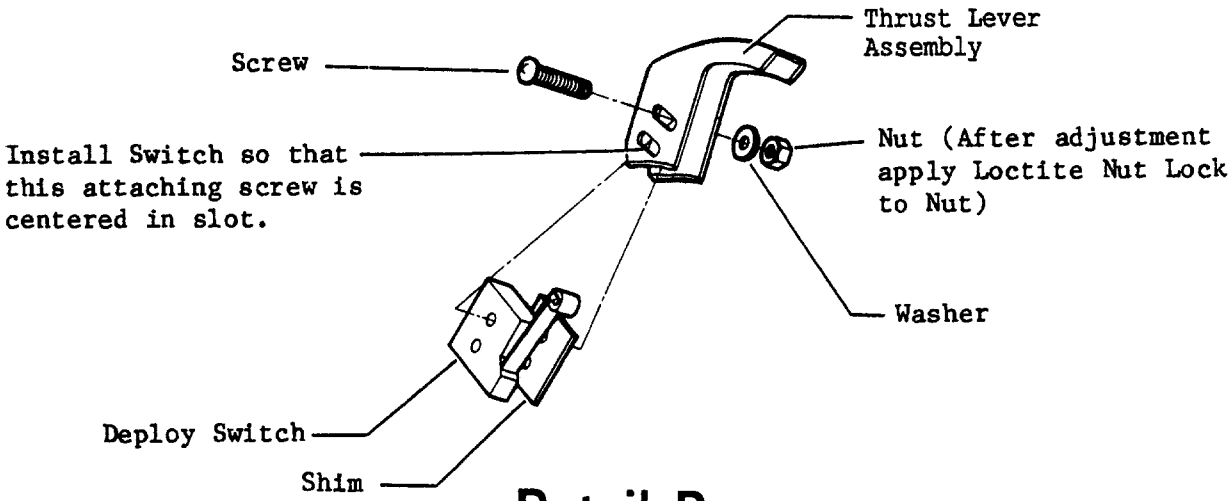


** Ensure that bolt passes through hole in Fixed Cam and Idle Stop Assembly before tightening.

Thrust Reverser Quadrant Assembly
Figure 201 (Sheet 1 of 3)

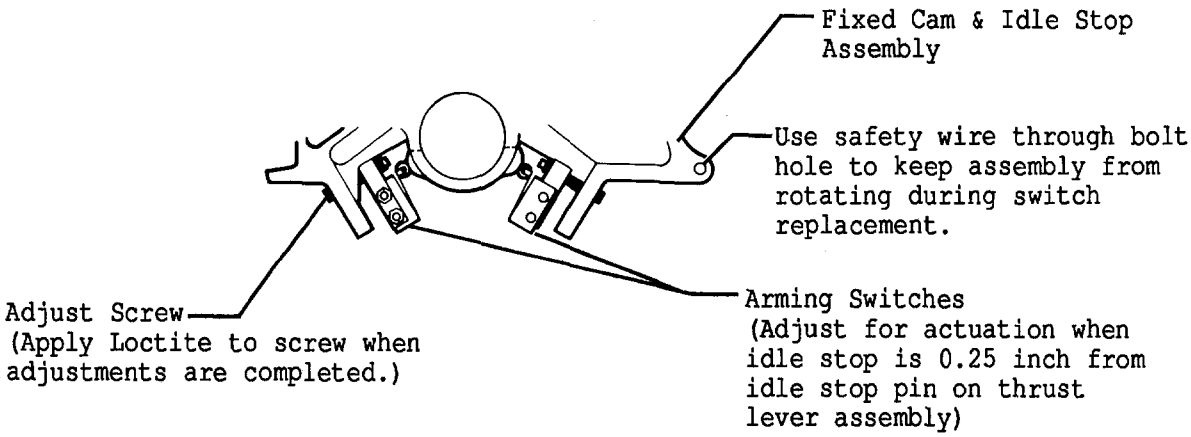


Detail A

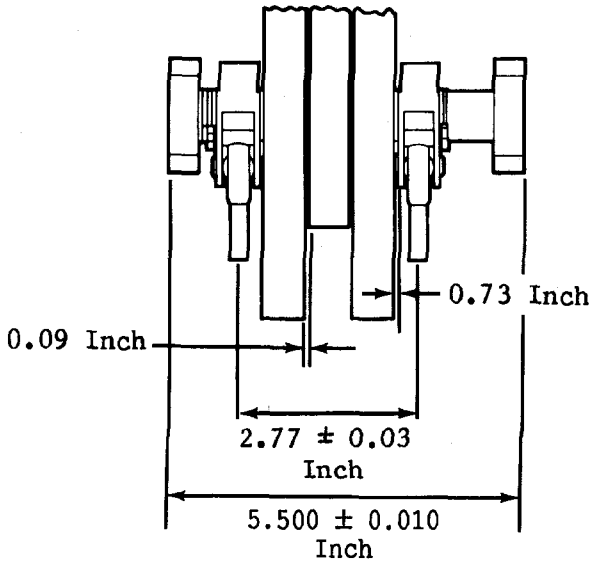


Detail B

Thrust Reverser Quadrant Assembly
Figure 201 (Sheet 2 of 3)



Detail C



Measurement of Throttle Quadrant Assembly

Thrust Reverser Quadrant Assembly
Figure 201 (Sheet 3 of 3)

D. Replace Individual Thrust Reverser Deploy Switches (See figure 201.)

NOTE: If switch actuation point cannot be determined as described below, both deploy switches must be replaced (refer to paragraph E).

(1) With main thrust levers in idle position and thrust reverser lever stowed, raise thrust reverser lever until deploy switch actuates and top of thrust reverser lever just clears main thrust lever. Mark thrust reverser lever at this point (see detail A). Switch actuation occurs when rollers are centered on flats of overcenter cam.
(2) Verify switch actuation by comparing actuation point of opposite deploy switch. Both switches should actuate when thrust reverser lever knobs are in alignment.
(3) Disconnect electrical wiring from switch. Identify wires for reinstallation.
(4) Remove hardware attaching switch to thrust lever assembly. Retain shim for reinstallation (see detail B).
(5) Position replacement switch and shim in thrust lever assembly and install attaching hardware. Center screw on lower slotted hole and tighten sufficiently to allow switch position adjustment along upper slotted hole (see detail B).
(6) Connect electrical wires to switch.
(7) Adjust switch so that actuation point is at position established in step (1).
(8) To verify switch adjustment, connect ohmmeter between pins P and J of P613 for left-hand switch or between pins L and M of P613 for right-hand switch. Ensure continuity between pins when switch rollers are centered on flats of overcenter cam and at position established in step (1).
(9) If switch adjustment is correct, tighten screws. To ensure that switch did not move when screws were tightened, repeat step (8), above. Apply loctite to nuts.

E. Replace Both Thrust Reverser Deploy Switches (See figure 201.)
(1) Disconnect electrical wiring from switches. Identify wires for reinstallation.
(2) Remove hardware attaching switches to thrust lever assembly. Retain shims for reinstallation (see detail B).
(3) Position replacement switches and shims in thrust lever assembly and install attaching hardware. Center screws on lower slotted holes and tighten sufficiently to allow switch position adjustment along upper slotted holes (see detail B).
(4) Connect electrical wires to switches.
(5) Adjust switches so that they actuate when rollers are centered on flats of overcenter cam and top of thrust reverser lever just clears main thrust lever (see detail A).
(6) To verify switch adjustment, connect ohmmeter between pins P and J of P613 for left-hand switch and between pins L and M of P613 for right-hand switch. Ensure continuity between pins when switch rollers are centered on flats of overcenter cam and at position established in step (5), above.
(7) If switch adjustment is correct, tighten screws. To ensure that switches did not move when screws were tightened, repeat step (6), above. Apply loctite to nuts.

F. Replace Thrust Reverser Arming Switches (See figure 201.)
   (1) Position main thrust levers to within 0.25 inch of idle position, measured between idle stop on fixed cam assembly and idle stop pin on throttle lever assembly. Switch actuation should occur at this point. Mark position on throttle lever assembly prior to disassembly.
   (2) *Disconnect electrical wiring from arming switch. Identify wires for reinstallation.*
   (3) Remove hardware attaching switch to fixed cam assembly.
   (4) Position replacement switch on fixed cam assembly and install attaching hardware.
   (5) Connect electrical wiring to switch.
   (6) With main thrust lever near idle position and thrust reverser lever in stowed position, idle stop pin should be 0.25 inch from idle stop on fixed cam assembly (see detail C). To verify switch actuation at this point, connect ohmmeter between pins M and N of P613 for right-hand switch and between pins N and P of P613 for left-hand switch. Ensure continuity between pins at the actuation point.
   (7) If necessary, adjust arm screws to obtain proper actuation per step (6), above.
   (8) When switch adjustment is correct, tighten screws. To ensure that switch did not move when screws were tightened, repeat step (6). Apply loctite to adjusting screw.