Section IV

AIR INDUCTION SYSTEMS

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VARIABLE RAMP SYSTEM

DESCRIPTION

4-1. GENERAL.

The variable ramp system is provided to control the position of shock waves at the inlet duct lip during supersonic flight. Control of the shock waves at supersonic flight speeds is necessary in order to provide the engine with a stable, constant flow of air regardless of airplane speed, and to prevent air spillage at the intake duct lip with resultant aerodynamic drag. The variable ramp assembly in each duct is composed of three hinged, interlocked sections. These sections are automatically positioned to reduce the size of the duct passage and to control the shock wave pattern, providing subsonic airflow to the engine for optimum engine operation. The variable ramp system is controlled by a two position switch located on the cockpit left-hand switch panel. Switch positions are provided for automatic and emergency operation. The forward edge of the forward ramp section is hinged to the inlet duct, the angle of which may be varied with respect to the airplane centerline. The center ramp section is hinged to the aft side of the forward ramp section and provides a slightly diverging passage through the inlet duct throat. The third section (diverging flow ramp) incorporates a slip joint connection to the aft side of the center section and provides a smooth contour to fair the ramp to the duct wall regardless of the ramp position. The aft side of the aft ramp section is hinged to the inlet duct. The ramp sections are sealed to the top and bottom of the intake ducts by inflatable seals. These seals are inflated automatically at all times during engine operation, by the airplane low-pressure pneumatic system. A pitot-static probe is installed in the throat of each inlet duct to sense air velocity and pressure through the duct. A normal air flow rate through the ducts is maintained by automatic hydraulic-mechanical positioning of the ramps, resulting in peak engine performance at full power. The ramp total pressure (P_t) and static pressure (P_s) shuttle valves and the afterburner time delay circuit are incorporated in the system to minimize the effects of ramp inlet duct instability which arise from air flow transients and flight attitudes. Openings are provided in each ramp assembly to bleed low energy boundary layer air out of the intake ducts. This air is routed to the lower side of the fuselage where it is vented overboard. Each variable ramp is extended and retracted by four screw jacks that are driven by flexible shafts from a single hydraulic motor. Hydraulic power for motor operation is derived from the airplane secondary hydraulic system. In the event of hydraulic pressure failure, an emergency source of high-pressure air, stored in a 100 cubic inch flask, can be selected to drive the ramps to the fully retracted position (ducts open). For a data flow diagram of the air induction system, see figure 4-1.

4-2. VARIABLE RAMP CONTROL SYSTEM.

The variable ramp control system consists of an inlet amplifier control unit, hydraulic and pneumatic valves, hydraulic servo motor, and a control switch located in the cockpit. The electrical control system is powered from the 28-volt dc nonessential bus and the 115-volt ac nonessential bus. In the normal or automatic mode of operation, the ramp control circuit is activated by a signal from the air data converter at a specified mach number. The control system is protected by the following fuses:

FUSE	LOCATION
"INLET CONT" 5 amp. (115-volt ac)	Nose wheel well fuse panel.
"INLET CONT" 5 amp. (28-volt dc)	Nose wheel well fuse panel.
"VAR INLET OVERRIDE" 5 amp. (28-volt dc)	Cockpit LH fuse panel.

For schematic illustrations of the variable ramp system, see figures 4-2 through 4-3. The control system operates in two modes: normal and emergency. Either mode can be selected by the pilot. In the normal mode, the system is automatically placed in operation when the airspeed reaches the supersonic range of operation. From this speed on, sensing equipment determines the correct positioning of the ramps for optimum engine operation. System operation is then completely automatic. When the airplane speed decreases to lower supersonic speeds, the system automatically returns the ramps to the retracted position, and actuates the variable ramp retract limit switch, which closes the system hydraulic shutoff valve. If the limit switch fails to operate, the ramp control system will be shut off after a delay of 7 to 13 seconds. The normal mode is also equipped with a time delay device that prevents ramp retraction for a period of 1.8 to 2.5 seconds when the engine afterburner exhaust nozzle is either opening or closing. In the emergency mode, all electrical power is removed from the normal control system. The hydraulic dump valve actuates, opening the hydraulic return line from the ramp servo motor and routing the system hydraulic oil to an overboard drain. At the same time a pneumatic selector valve is actuated which routes high-pressure air to the shuttle valve, through the looped retract line to the hydraulic motor. The looped configuration of the retract line serves as a reservoir for hydraulic fluid that is forced through the hydraulic motor by the high-pressure air. This head of fluid provides optimum initial torque and lubrication for motor operation. The motor then drives the ramps to the fully retracted position. *Applicable to F-106A airplanes 57-2453 and F-106B airplanes 57-2517; and all other airplanes after incorporation of TCTO 1F-106-681,* ramp emergency retract time is increased from 2.0 seconds to 5.5 seconds by a restrictor installed in the pneumatic inlet port of the shuttle valve. This extended travel time prevents abrupt cessation of movement when the ramps contact the mechanical stops, thus eliminating possible shearing of the gear teeth or the gear box shaft. As air from the pneumatic system fills the supply line to the hydraulic motor, a pressure switch opens the circuit to a hydraulic shutoff valve. This prevents hydraulic drive power from being restored to the ramp system as long as air pressure is present. For a schematic illustration of the ramp emergency operation, see figure 4-3. When the normal mode of operation is restored, the high-pressure air is then vented by closing of the pneumatic valve; and the hydraulic dump valve then returns to normal operating condition. When the pneumatic pressure in the hydraulic motor supply line drops to 50 psi, the line pressure switch closes, restoring electrical power to the hydraulic shutoff valve. See figures 4-4 and 4-5 for illustrations of the variable ramps and for locations of the ramp system components.

4-3. VARIABLE RAMP SEAL SYSTEM.

The variable ramp seal system is provided to prevent entry of ram air into the area between the fuselage and the inboard side of the variable ramp sections. Each ramp section is equipped with an inflatable rubber boot installed in the outer edge of each ramp section. The boots are automatically inflated during engine operation by compressed air from the airplane low-pressure pneumatic system. Inflation of the boots at the upper and lower surfaces of each ramp section presses silicone rubber seal strips against the inner surface of the inlet ducts to seal the areas. In the areas of the ramp section hinges, the boots inflate and fill the hinged area. The seal pressurization system is protected by a relief valve and a safety valve. The relief valve is set to actuate at 16 ($\pm$1.5) psi pressure. The safety valve is set to actuate at 30 ($\pm$1.5) psi pressure. For a schematic illustration of the ramp seal system, see figure 4-6.

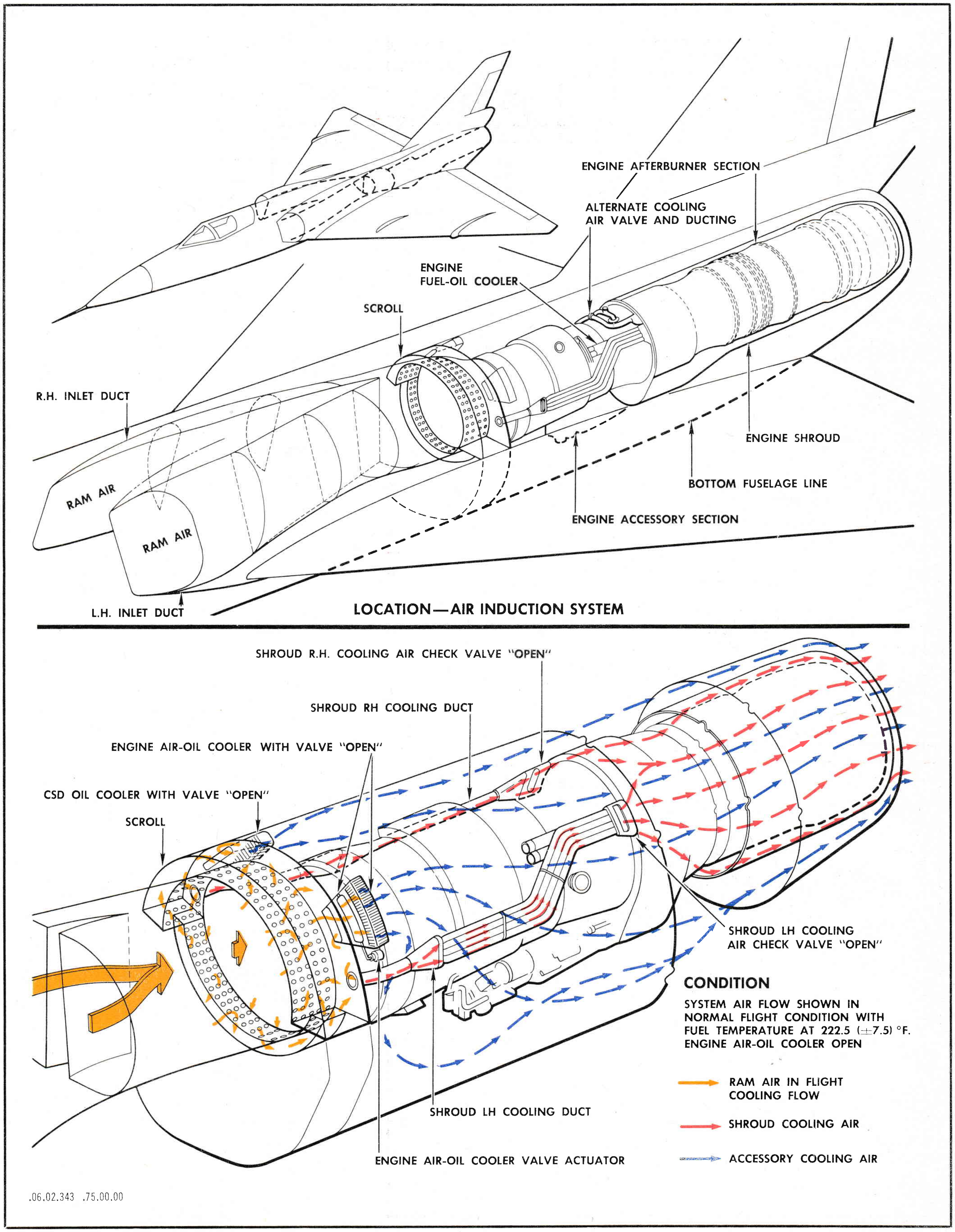
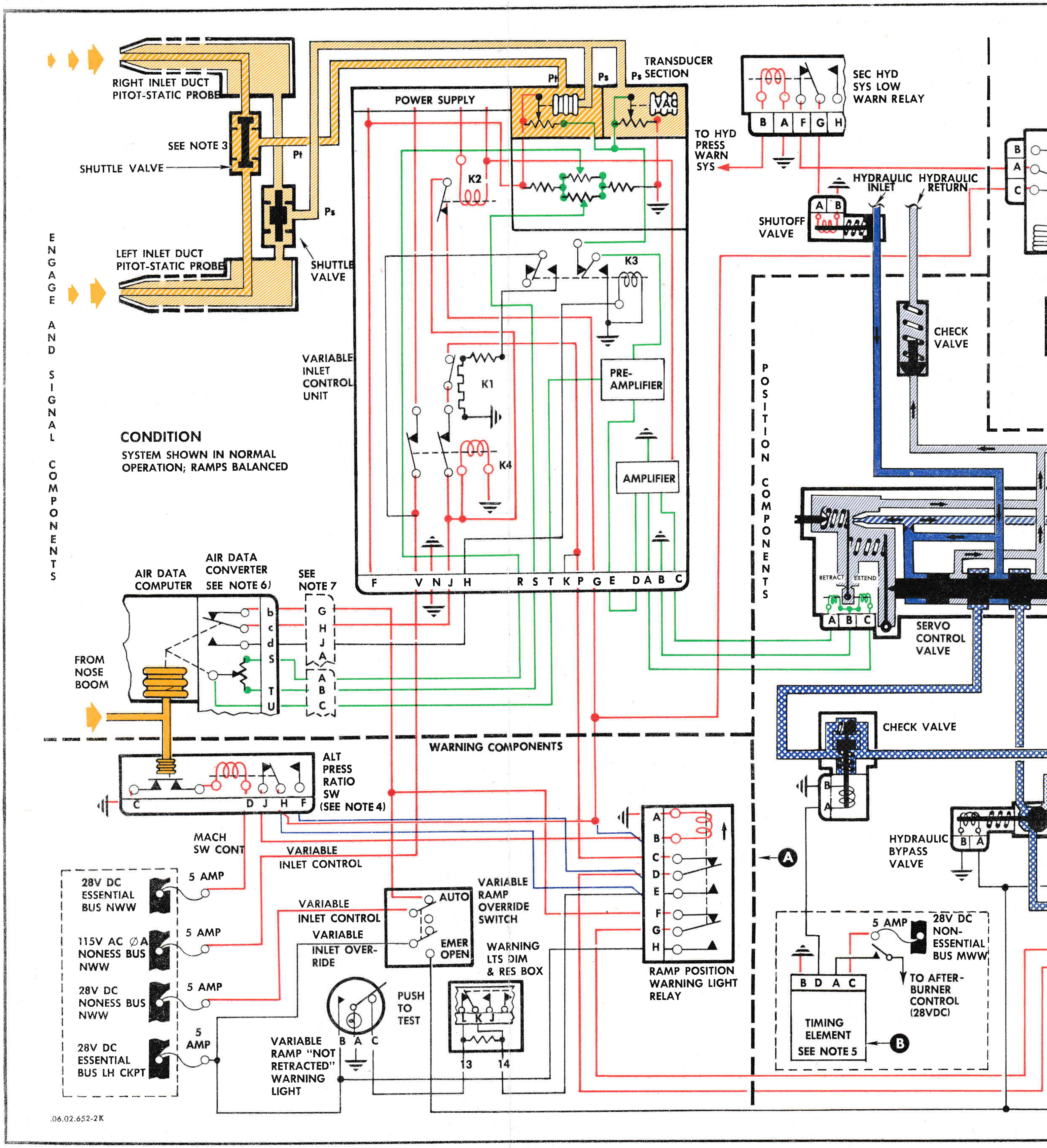
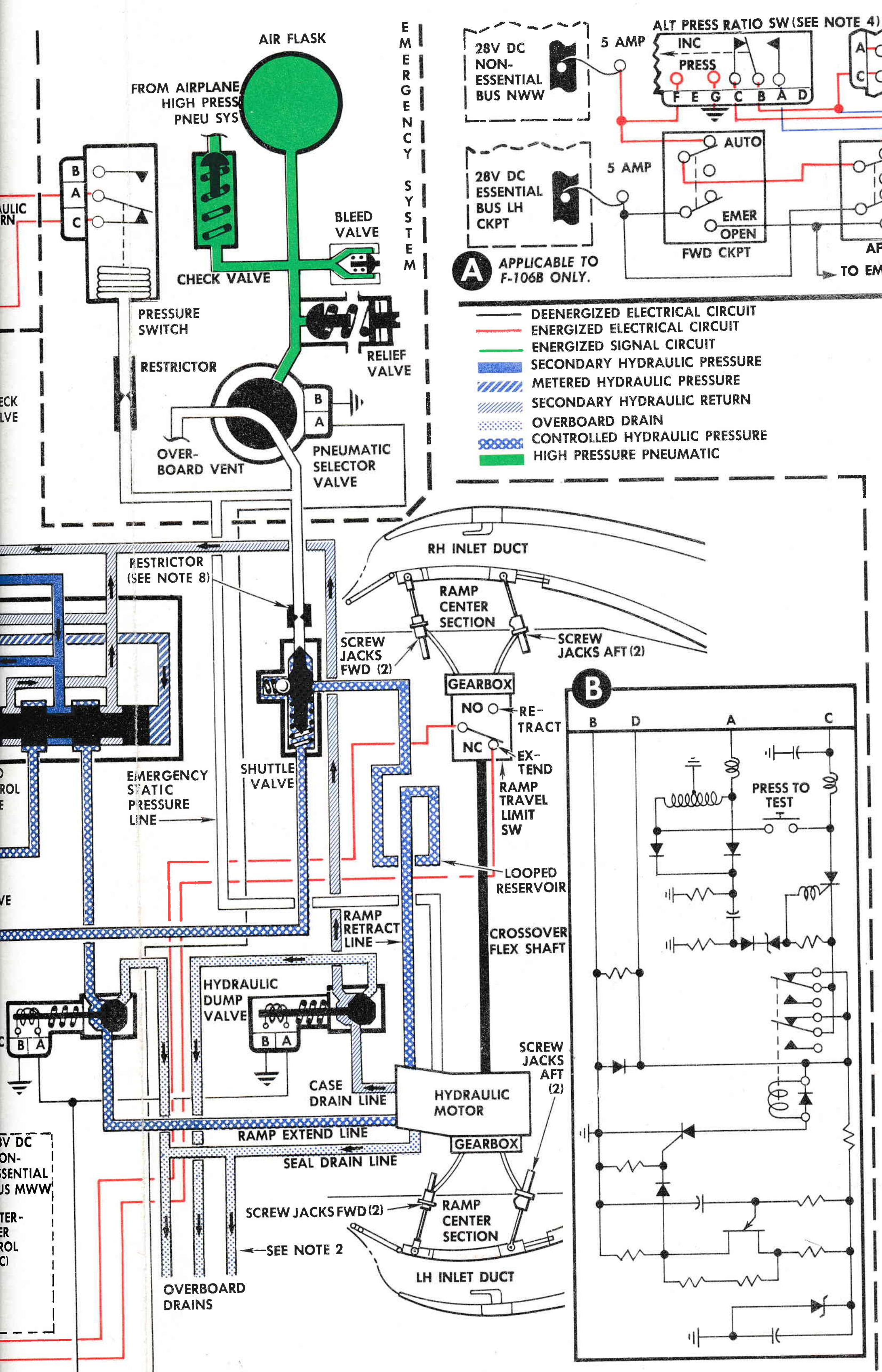
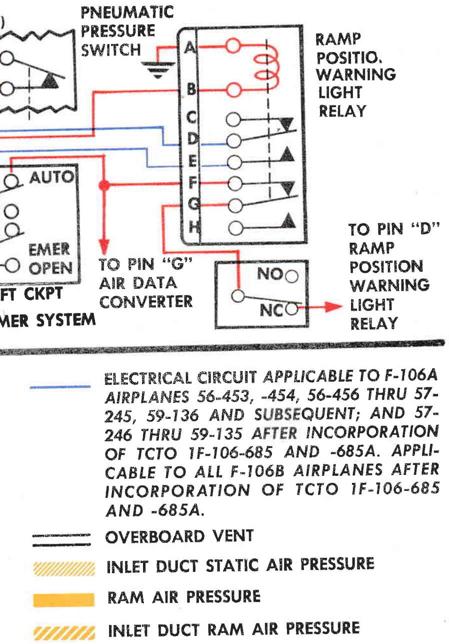


Figure 4-1. Air Induction System Flow Diagram



ENGAGE AND SIGNAL COMPONENTS
RIGHT INLET DUCT PITOT-STATIC PROBE
SEE NOTE 3
SHUTTLE VALVE
Pt
Ps
LEFT INLET DUCT PITOT-STATIC PROBE
SHUTTLE VALVE
POWER SUPPLY
TRANSDUCER SECTION
VAC
K2
K3
K1
K4
PRE-AMPLIFIER
AMPLIFIER
VARIABLE INLET CONTROL UNIT
F V N J H R S T K P G E D A B C
SEC HYD SYS LOW WARN RELAY
B A F G H
TO HYD PRESS WARN SYS
HYDRAULIC INLET
HYDRAULIC RETURN
SHUTOFF VALVE
CHECK VALVE
POSITION COMPONENTS
RETRACT
EXTEND
SERVO CONTROL VALVE
CONDITION
SYSTEM SHOWN IN NORMAL OPERATION; RAMPS BALANCED
AIR DATA COMPUTER
AIR DATA CONVERTER SEE NOTE 6)
SEE NOTE 7
FROM NOSE BOOM
b c d S T U
G H J A
A B C
WARNING COMPONENTS
ALT PRESS RATIO SW (SEE NOTE 4)
C D J H F
MACH SW CONT
VARIABLE INLET CONTROL
28V DC ESSENTIAL BUS NWW
5 AMP
115V AC ∅A NONESS BUS NWW
28V DC NONESS BUS NWW
28V DC ESSENTIAL BUS LH CKPT
VARIABLE INLET CONTROL
VARIABLE INLET OVER-RIDE
AUTO
EMER OPEN
VARIABLE RAMP OVERRIDE SWITCH
PUSH TO TEST
VARIABLE RAMP "NOT RETRACTED" WARNING LIGHT
B A C
WARNING LTS DIM & RES BOX
L K J
13 14
RAMP POSITION WARNING LIGHT RELAY
A B C D E F G H
CHECK VALVE
HYDRAULIC BYPASS VALVE
5 AMP
28V DC NON-ESSENTIAL BUS MWW
TO AFTER-BURNER CONTROL (28VDC)
B D A C
TIMING ELEMENT SEE NOTE 5
.06.02.652-2K





NOTES

1. RAMP CIRCUIT SHOWN AFTER INCORPORATION OF THE RAMP PRESSURE RATIO CONTROL CIRCUIT. THE PRESSURE RATIO CONTROL CIRCUIT IS APPLICABLE TO ALL F-106A AIRPLANES AND F-106B AIRPLANES 57-2508 THRU 57-2515, 57-2532 AND SUBSEQUENT.
2. THIRD DRAIN LINE IS APPLICABLE TO F-106B AIRPLANES 57-2508 THRU 57-2515, 57-2532 AND SUBSEQUENT. ON THESE AIRPLANES THE DRAIN LINES ARE NOT CONNECTED BY A MANIFOLD.
3. REVERSE ACTING P_1 SHUTTLE VALVE IS APPLICABLE TO F-106A AIRPLANES 56-453, 56-454, 56-456 THRU 57-245, 59-060 AND SUBSEQUENT; AND 57-246, 57-2454 THRU 58-761, 58-763 THRU 59-059 AFTER INCORPORATION OF TCTO 1F-106-593. APPLICABLE TO F-106B AIRPLANES 57-2508 THRU 57-2515, 59-149 AND SUBSEQUENT; AND 57-2516 THRU 57-2527, 57-2529 THRU 58-904 AFTER INCORPORATION OF TCTO 1F-106-593.
4. ALTITUDE PRESSURE RATIO SWITCH IS APPLICABLE TO ALL F-106A AIRPLANES. APPLICABLE TO F-106B AIRPLANES 57-2508 THRU -2515, -2517, -2523, 57-2535 AND SUBSEQUENT; AND 57-2516, -2518 THRU -2522, -2524 THRU 57-2534 AFTER INCORPORATION OF TCTO 1F-106B-523.
5. TIME DELAY CIRCUIT AND THE HYDRAULIC CHECK VALVE ARE APPLICABLE TO F-106A AIRPLANES 56-453, -454, 56-456 THRU 57-245, 57-2454, 59-060 AND SUBSEQUENT; AND 57-246, -2453, 57-2455 THRU 59-059 AFTER INCORPORATION OF TCTO 1F-106-628. APPLICABLE TO F-106B AIRPLANES 57-2508 THRU -2515, 57-2517, 59-149 AND SUBSEQUENT; AND 57-2516, 57-2518 THRU 58-904 AFTER INCORPORATION OF TCTO 1F-106-628.
6. AIR DATA CONVERTER CONNECTION APPLICABLE TO F-106A AIRPLANES 56-453, 56-454, 56-456 THRU 57-245, 57-2465, 58-759 AND SUBSEQUENT; AND F-106B AIRPLANES 57-2508 THRU 57-2515, 57-2523, 57-2532 AND SUBSEQUENT.
7. AIR DATA CONVERTER CONNECTION SHOWN IN PHANTOM APPLICABLE TO F-106A AIRPLANES 57-246 THRU 57-2464, 57-2466 THRU 57-2506 AND F-106B AIRPLANES 57-2516 THRU 57-2522, 57-2524 THRU 57-2531.
8. RESTRICTOR IS APPLICABLE TO F-106A AIRPLANES 57-2453, AND F-106B AIRPLANES 57-2517; AND ALL OTHER AIRPLANES AFTER INCORPORATION OF TCTO 1F-106-681.

Figure 4-2. Variable Ramp System With Inlet Control Unit 8-06474-1, -3, -5, or -7

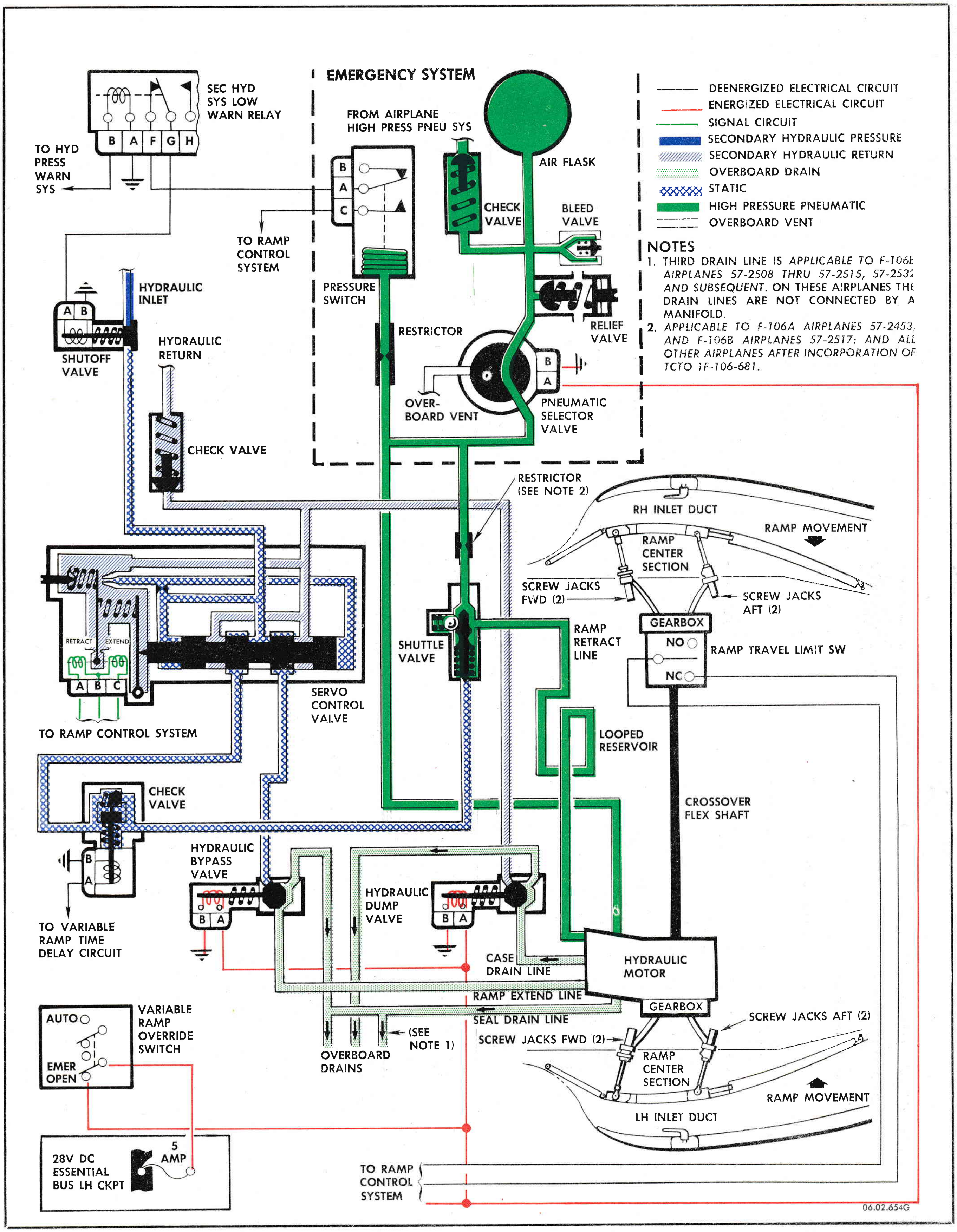


Figure 4-3. Variable Ramp Emergency Operation, Typical

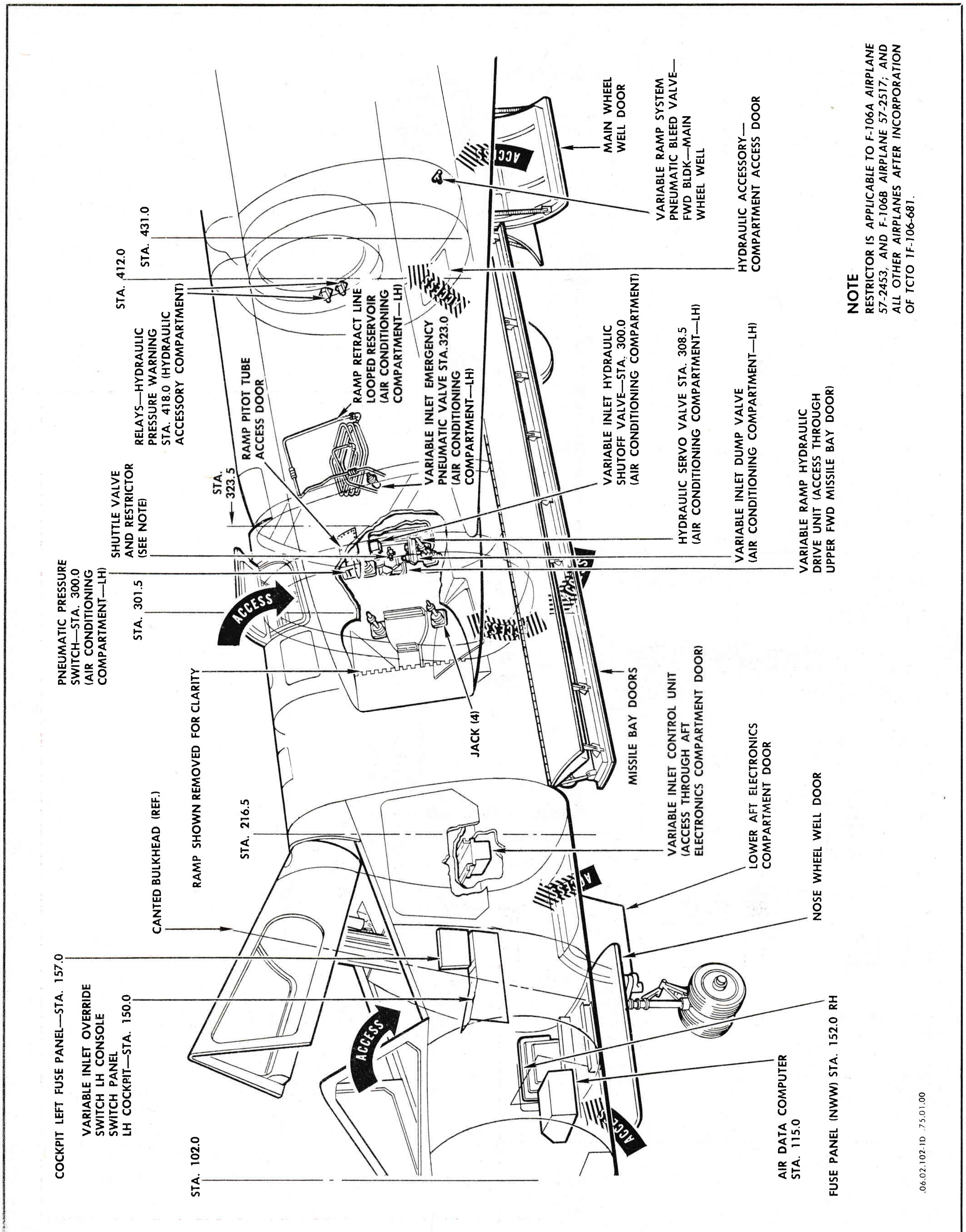


Figure 4-4. Variable Ramp System, Component Location

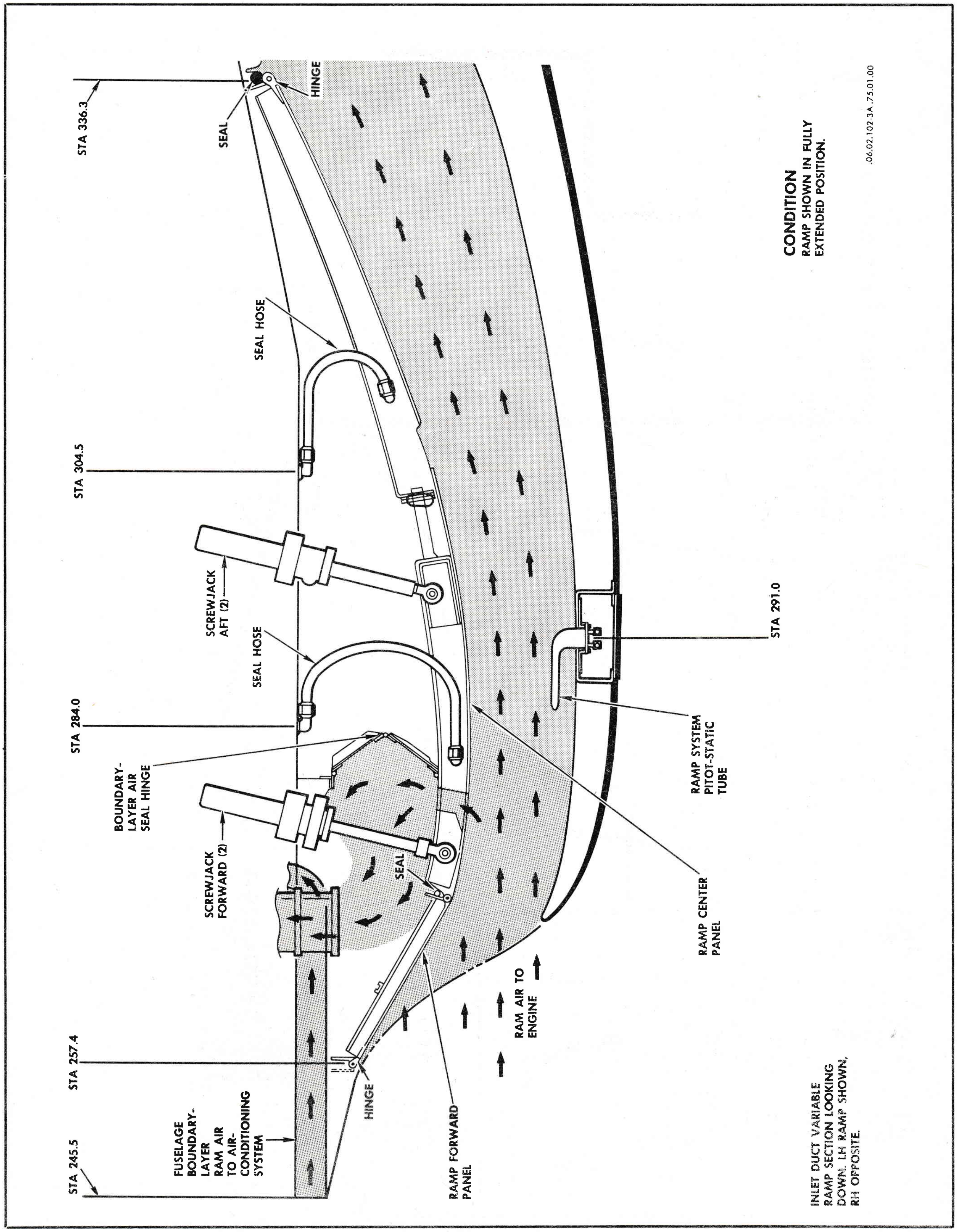


Figure 4-5. Variable Ramp

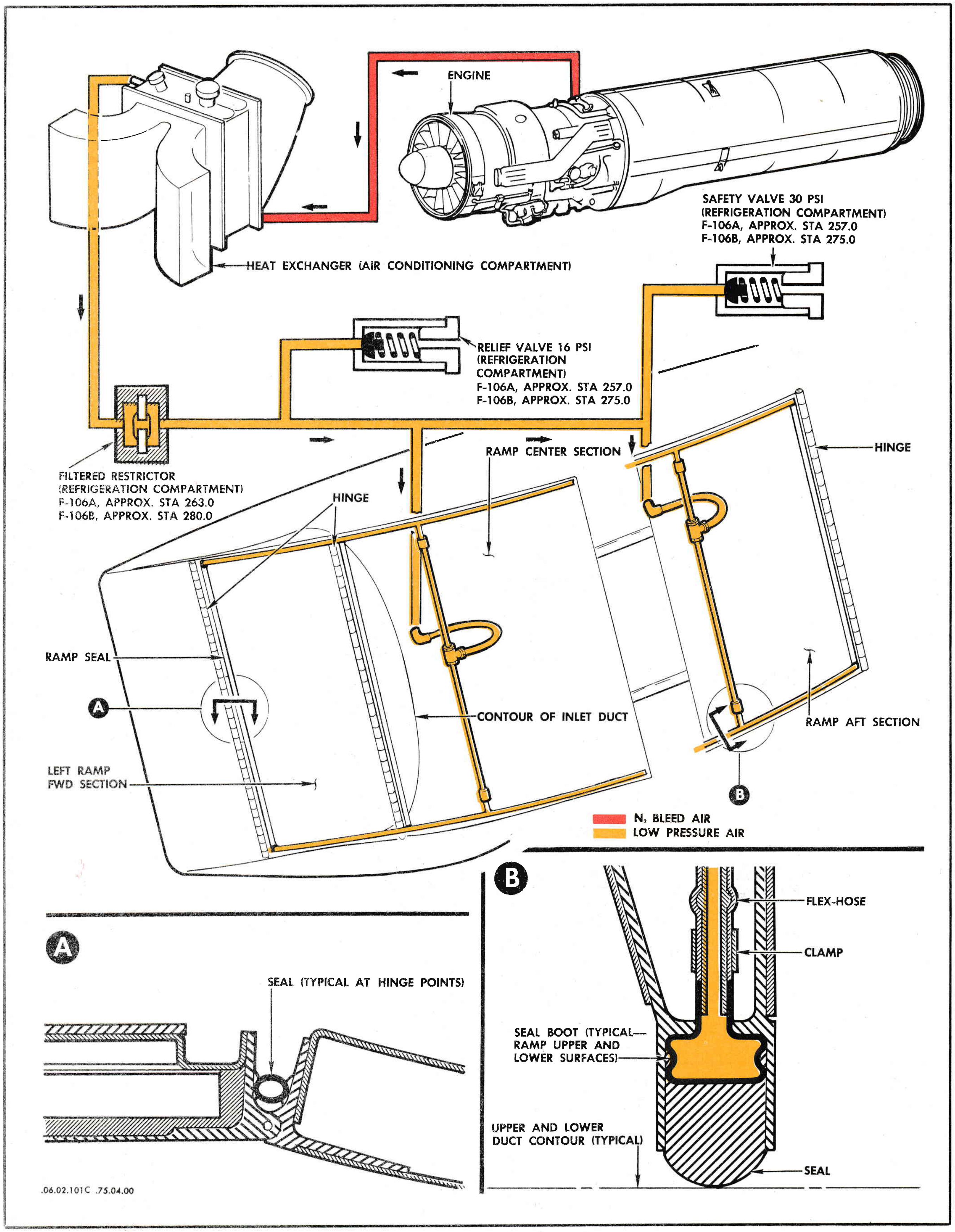


Figure 4-6. Variable Ramp Seal System, Schematic

4-4. VARIABLE RAMP EMERGENCY PNEUMATIC SYSTEM.

Air for emergency operation of the variable ramps is obtained from an isolated flask in the airplane high-pressure pneumatic system. The flask is isolated from the aircraft pneumatic system by a check valve, to provide sufficient air to drive the ramps from the fully extended to the fully retracted positions. A pressure relief valve is installed in the system adjacent to the flask to relieve pneumatic pressure in excess of 3200 psi. The flask is installed in the right side of the air conditioning compartment at sta. 316.0. A screw type air bleed valve is installed in the forward side of the left main wheel well to bleed air pressure from the flask and system. Filling of the ramps pneumatic system is accomplished by normal filling of the airplane high-pressure pneumatic system. Refer to T.O. 1F-106A-2-3 for the pneumatic system filling procedure.

NOTE

It will be necessary to purge the ramp hydraulic system of air after each emergency operation. Refer to paragraph 4-71 for this procedure.

4-5. VARIABLE RAMP CONTROL UNIT.

The variable ramp control unit, installed on the left side of the aft lower electronics compartment, is the major control component of the variable ramp system. The control unit consists of a pressure ratio sensor, a ramp retract relay, a servo amplifier, and a time delay circuit. The control unit, which is of the variable set point type, is shown in figure 4-2. The desired signal voltage to the pre-amplifier is varied as a function of airplane mach by the air data converter.

NOTE

Pressure ratio in the variable ramp system application is not to be construed as the pressure ratio indicating engine operational thrust.

The error signal from the pre-amplifier is amplified and is then routed to the hydraulic servo valve that controls the hydraulic motor operation.

4-6. VARIABLE RAMP SERVO CONTROL VALVE.

The variable ramp servo control valve is an electrically controlled, hydraulically operated valve installed in the left side of the air conditioning compartment at sta. 308.0. The electrical control consists of two solenoids that position a flapper-type pilot valve across the face of the valve hydraulic orifice. The solenoids receive signals that reflect duct over-pressure or under-pressure from the ramp system control unit. These pressure ratio error signals acting on the solenoids result in pilot valve positioning which determines the direction the hydraulic motor will position the ramps. With full displacement of the pilot valve, the hydraulic motor can drive the ramps through their full travel in approximately 6 seconds. During system operation, as the servo motor drives the ramps toward the desired position, the duct air pressure ratio also changes toward the desired condition. The system control unit senses the change and the correction signal to the servo control valve decreases. When the correct ramp position has been reached, the correction signal from the control unit cancels out and the ramp movement stops.

4-7. AIR DATA CONVERTER.

The air data converter, installed on the left side of the nose wheel well compartment, supplies the factor of airplane mach to the variable ramp control system. When the variable ramp selector switch is in the automatic mode, the mach data is used to turn the ramp system on or off electrically, and provide for variation of the ramp set point. For additional information on the function of the air data converter, refer to T. O. 1F-106A-2-14 and -2-15.

4-8. VARIABLE RAMP HYDRAULIC MOTOR.

The variable ramps are powered by a reversible hydraulic motor installed adjacent to the left ramp assembly, between the two aft jacks. The motor assembly consists of a piston type hydraulic motor, a reduction gear assembly, and a torque sensitive brake. The hydraulic motor is connected to the ramp jack assemblies through a system of flexible shafts and adapters. When ramp movement is desired, hydraulic pressure is directed to the motor, causing the torque sensitive brake to release. This action permits the motor to move the ramps to the desired setting. Upon completion of the desired ramp movement, hydraulic pressure to the motor is terminated, causing the torque sensitive brake to engage. Ramp movement, due to imposed flight air loads, is prevented by the engagement of the brake.

4-9. VARIABLE RAMP CONTROL SWITCH.

The "VAR INLET" ramp control switch is a two position switch located in the cockpit above the left-hand console on the left-hand switch panel. The switch is placarded for "AUTO" and "EMER OPEN" positions. The switch provides the pilot with a means of opening the ramps in case of any automatic system malfunction.

4-10. VARIABLE RAMP RETRACT LIMIT SWITCH.

The variable ramp retract limit switch is a cam actuated micro switch assembly installed adjacent to the right-hand ramp flex drive gear box. As the ramps near the full retract position, the cam lobe contacts the micro switch causing the switch to deactuate. This action removes electrical power from the ramp system solenoid hydraulic shutoff valve, causing the valve to close. This prevents further retraction of the ramps. An adjustment feature is incorporated in the cam assembly that permits adjustment without removing the cam from the switch assembly. Access to the cam and switch assembly is through an access plate on the switch assembly housing.

4-11. ALTITUDE PRESSURE RATIO SWITCH.

Applicable to all F-106A airplanes and F-106B airplanes 57-2508 thru 57-2515, 57-2523 and 57-2532 and subsequent. An altitude pressure ratio switch is incorporated in the variable ramp control system to provide an alternate indication that the airplane mach has decreased below the ramp system cutoff point. This equipment is provided so that air data computer failure in the ramp system operational range will not deactivate the ramp warning light circuit. The switch assembly is a bellows actuated unit that is energized by pitot pressure from the instrument pitot-static system. Electrical power for the circuit is derived from the 28-volt dc essential bus through a 5-amp fuse located on the nose wheel well fuse panel. The switch assembly also incorporates functions for the F-106A airplane CG fuel transfer system. Refer to T. O. 1F-106A-2-5 for switch replacement information.

4-12. VARIABLE RAMP TIME DELAY.

Applicable to F-106A airplanes 56-453, -454, 56-456 thru 57-245, 57-2454, 59-060 and subsequent; and 57-246, -2453, 57-2455 thru 59-059 after incorporation of TCTO 1F-106-628. Applicable to F-106B airplanes 57-2508 thru -2515, 57-2517, 59-149 and subsequent; and 57-2516, 57-2518 thru 58-904 after incorporation of TCTO 1F-106-628. The variable ramp time delay is a relay circuit located in the lower aft electronics compartment. The delay unit is equipped with a test switch. Whenever the afterburner switch in the throttle quadrant is actuated (A/B "OFF" or A/B "ON") the delay circuit is energized which acts through a solenoid actuated hydraulic check valve to prevent ramp retraction for 1.8 to 2.5 seconds. The ramps will respond normally to the auto mode extend signals during the time delay period.

CAUTION

Do not depress the variable ramp time delay test switch while the engine is operating. Depressing the test switch during engine operation will energize the afterburner control circuit.

4-13. HYDRAULIC SOLENOID SHUTOFF VALVE.

The hydraulic solenoid shutoff valve is a two position valve installed in the variable ramp hydraulic system up stream of the ramp servo control valve. The valve is energized to the open position, and closes when the ramps are in the fully retracted position or when ramp emergency operation occurs. Closing of the valve prevents further entry of hydraulic power to the ramp drive system. The valve is energized through the secondary hydraulic system low-pressure warning relay. Deactuation of the relay prevents hydraulic operation of the ramps when the secondary hydraulic system pressure is below 900 psi. At this time, emergency actuation must be selected for ramp retraction. The valve is installed on the left side of the air conditioning compartment at sta. 300.0.

4-14. HYDRAULIC DUMP VALVE.

The hydraulic dump valve, installed on the left side of the air conditioning and refrigeration compartment, is incorporated in the ramp system to route hydraulic fluid, in the ramp system plumbing, overboard at the time of ramp emergency operation. The valve is normally closed and actuates upon selection of the ramp control system to the emergency open position. This action permits fast evacuation of hydraulic fluid and enables the ramps to retract in a minimum amount of time.

4-15. HYDRAULIC CHECK VALVE (RAMP RETRACT LINE).

Applicable to F-106A airplanes 56-453, -454, 56-456 thru 57-245, 57-2454, 59-060 and subsequent; and 57-246, -2453, 57-2455 thru 59-059 after incorporation of TCTO 1F-106-628. Applicable to F-106B airplanes 57-2508 thru -2515, 57-2517, 59-149 and subsequent; and 57-2516, 57-2518 thru 58-904 after incorporation of TCTO 1F-106-628. This hydraulic check valve is solenoid actuated by the variable ramp time delay circuit. During the 1.8 to 2.5 second delay period that the circuit is energized, the check valve prevents hydraulic retract pressure from being applied to the drive motor. This prevents retraction of the ramps when going in or coming out of afterburner. Refer to paragraph 4-12 for a description of the variable ramp time delay system.

4-16. SHUTTLE VALVE (HYDRAULIC-AIR).

The ramp system shuttle valve is a spring loaded two position valve installed in the ramp retract line between the servo control valve and the hydraulic motor. During the system automatic operation, the shuttle valve is spring positioned to permit flow of hydraulic oil from the hydraulic motor back to the servo control valve. Upon selection of the emergency open position, high-pressure air moves the shuttle valve to the second position. This action within the shuttle valve blocks off the hydraulic oil flow from the servo valve and routes the high-pressure air to the ramp motor retract port. The motor then operates until the ramps are in the fully retracted position. The valve remains in the second position until the system selector is returned to the automatic position. The shuttle then returns to the first position.

4-17. SHUTTLE VALVE (RAMP STATIC PRESSURE SENSE).

The ramp system static pressure sense line shuttle valve is a two position valve installed at the juncture of the static lines from the left and right engine air inlet duct pitot-static probes. During airplane operation, flight conditions can occur that will produce an unbalanced static pressure condition between the two engine air inlet ducts. This condition will automatically cause the shuttle valve to close off the low-pressure side, and will route the high-pressure to the ramp inlet control unit. The valve will always sense and position to the duct having the highest static pressure.

4-18. SHUTTLE VALVE (RAMP TOTAL PRESSURE SENSE).

Applicable to F-106A airplanes 56-453, -454, 56-456 thru 57-245, 59-060 and subsequent; and 57-246, 57-2454 thru 58-761, 58-763 thru 59-059 after incorporation of TCTO 1F-106-593. Applicable to F-106B airplanes 58-2508 thru 57-2515, 59-149 and subsequent; and 57-2516 thru 57-2527, 57-2529 thru 58-904 after incorporation of TCTO 1F-106-593. The function of the reverse-acting ramp total pressure (P_t) shuttle valve is to permit the lower of the two duct total pressures to be sensed by the variable ramp control unit. When decreasing pressure is applied to one duct sensing probe, the shuttle valve seals off the other duct sensing probe, allowing flow from the low pressure duct to the control unit.

4-19. PNEUMATIC PRESSURE SWITCH

The pneumatic pressure switch is installed on the left side of the air conditioning compartment. This switch is incorporated in the variable ramp system to prevent introduction of hydraulic pressure into the ramp system during emergency operation, regardless of the position of the variable ramp control switch, until the pneumatic pressure drops to approximately 50 psi. At this pressure the switch closes allowing restoration of electrical power to the hydraulic shutoff valve.

4-20. PNEUMATIC SOLENOID VALVE.

The pneumatic solenoid valve is a three way, two position valve installed on the left side of the air conditioning compartment. The valve is incorporated in the ramp system to control high-pressure air flow for ramp emergency operation. At the time of emergency operation, the valve actuates, permitting high-pressure air to enter the system to drive the ramps to the fully retracted position. Upon selection of the ramps to the automatic system, the valve repositions, shuts off the air pressure source, and vents air pressure from the ramp system plumbing.

4-21. EMERGENCY AIR STORAGE FLASK.

The emergency air storage flask is a fiberglass sphere located just forward and to the right of the main air flask between sta. 316.0 and 323.5. The flask is a part of the high-pressure pneumatic system, and is isolated for use by the variable ramp system by a check valve. Sufficient air is contained in the flask, when fully charged to 3000 psi pressure, for one operation of the ramps from the fully extended to the retracted position. Filling of the flask is accomplished during normal filling of the high-pressure pneumatic system. For servicing of the high-pressure pneumatic system, refer to T.O. 1F-106A-2-3.

4-22. EMERGENCY PNEUMATIC SYSTEM CHECK VALVE.

The emergency pneumatic system check valve is a poppet type valve installed between the airplane high-pressure pneumatic system and the variable ramp emergency pneumatic system. The valve is located on the left side of the hydraulic accessory compartment, just forward of sta. 431.0. As the main pneumatic system air pressure drops from use, the check valve closes and prevents the ramp supply system air from flowing back into the main system. This isolates sufficient air for one operation of the ramps from the fully extended position to the fully retracted position.

4-23. RAMP SYSTEM PNEUMATIC BLEED VALVE.

The variable ramp emergency pneumatic system is equipped with a screw type bleed valve installed on the forward left side of the main wheel well. The valve is installed adjacent to the main high-pressure pneumatic system bleed valve. Refer to T.O. 1F-106A-2-3 for the ramp pneumatic system bleeding procedure.

4-24. VARIABLE RAMP NOT RETRACTED WARNING SYSTEM.

An amber variable inlet warning light, placarded "VARIABLE RAMP NOT RETRACTED," is located on the pilot's main instrument panel on *F-106A airplanes,* and on the forward and aft main instrument panels *on F-106B airplanes.* The light illuminates to indicate that the variable ramps have not retracted. Retraction normally occurs when the airplane decelerates to below mach 1.20. During emergency operation, the light will remain illuminated until the ramps have fully retracted. The warning light receives 28-volt dc power from the essential bus through a 5-ampere circuit fuse in cockpit left-hand fuse panel. Power is directed to the warning light when the variable ramp control unit deenergizes a ramp position warning light relay. With the ramp position relay deenergized, electrical power is free to pass through the variable ramp retract limit switch to the warning light if the switch is still in the extended position. The position warning light relay is installed on the right side of the nose wheel well compartment. The variable ramp not retracted warning light is a push-to-test type light. The variable ramp not retracted warning system is an integrated part of the variable ramp control circuit. Refer to T. O. 1F-106A-2-9 for additional information on this system.

4-25. SAFETY PRECAUTIONS, MAINTENANCE OF PNEUMATICALLY OPERATED SYSTEMS.

Observe the following precautions to prevent injuries due to air blast, and to prevent inadvertent operation of the system in work, or other pneumatically operated systems not in work:

a. Prior to disconnection of pneumatic lines or removal of components on any system powered by high-pressure air, ascertain that the pressure in the entire system is relieved. To relieve pneumatic system pressure, refer to T.O. 1F-106A-2-3.

b. Before reapplying the high-pressure air, check that all components or systems powered by high-pressure air are properly connected. Check that control valves and switches for all pneumatically operated systems are properly positioned to prevent inadvertent operation and injury to personnel.

OPERATIONAL CHECKOUT

4-26. OPERATIONAL CHECKOUT AND TEST, VARIABLE RAMP SYSTEM.

4-27. Equipment Requirements.

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
Refer to T.O. 1F-106A-2-10	Generator Set (Gas).	8-96026-801 AF/M32A-13 (6115-583-9365)	8-96026 AF/M32M-2 (6115-617-1417)	To energize electrical systems on aircraft equipped with special quick disconnect receptacle.
	Generator Set (Elec).	8-96025-803 AF/ECU-10/M (6125-583-3225)	8-96025-805 A/M24M-2 (6125-628-3566)	
			8-96025 AF/M24M-1 (6125-620-6468)	
	Generator Set.		MC-1 (6125-500-1190)	To energize electrical systems (except AWCIS) on aircraft equipped with standard AN receptacle and on others by using adapter cable 8-96052.
			MD-3 (6115-653-5595)	
	Adapter Cable.	8-96052 (6115-557-8548)		To connect MC-1 and MD-3 units to aircraft equipped with special quick disconnect receptacle.
Refer to T.O. 1F-106A-2-3.	Portable Hydraulic Test Stand (Gas).	SE 1061-801 (4920-670-9415)	SE 1061 (4920-517-1028)	To supply pressure to hydraulic systems for ground test.
			SE 0567-801 (4920-204-2462)	
	Portable Hydraulic Test Stand (Elec).	SE 0976-801 (4920-675-4258)	SE 0976 (4920-204-3115)	

4-27. Equipment Requirements (Cont).

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
Refer to T.O. 1F-106A-2-3 (cont).	Hydraulic hose support.	8-96193 (4920-621-3011)		To support hydraulic test stand return hose.
	Adapter (2 each).	8-96080 (4620-566-8882)		Used with SE0567 or SE0567-801 to connect test stand hoses to quick disconnect fittings.
	Adapter Kit.	SE 1093		Used with SE1061; MJ-2 or MK-3 to connect test stand hoses to quick disconnect fittings.
4-7 4-8	Tester, Variable Ramp Control.	8-96051-803 (1730-710-7310)	8-96051-801 (4920-623-2177)	To check operation of the variable ramp system.
Refer to T.O. 1F-106A-2-9.	Pitot-Static System Field Tester.	MB-1 (6635-334-7433)	Equivalent	To supply air pressures for testing ramp retract warning light.
	Multimeter.	USAF TS-505B/U (6625-620-6366)		To measure variable ramp system electrical values.
	Steel Scale.	6 inches in length		To measure ramp travel.

4-28. Preparation.

a. Connect external electrical power source to the airplane electrical power receptacle. Refer to T.O. 1F-106A-2-10 for this procedure.

b. Connect external hydraulic test stand to the airplane hydraulic system. Refer to T.O. 1F-106A-2-3 for this procedure.

c. Apply external electrical power to airplane.

d. Connect ramp control tester pneumatic lines to ramp pitot tubes in inlet duct as shown on figure 4-7 or 4-8.

NOTE

The variable ramp system can be functionally checked using only the pneumatic portion of the variable ramp tester. Use the electrical connections for detailed tests and troubleshooting.

e. Attach pneumatic lines to tester P_s (static) and P_t (pitot) fittings; pressure and vacuum supply valves, and P_s and P_t valves on tester are to be closed.

f. Start hydraulic test stand and set secondary pressure system at 1500 psi.

g. Check that following fuses are installed:

1. "VAR INLET OVERRIDE" Cockpit left fuse panel.
2. "INLET CONTROL" 28-volt dc Nose wheel well fuse panel.
3. "INLET CONTROL" 115-volt ac Nose wheel well fuse panel.
4. "HYDRAULIC PRESS WARN" Cockpit right fuse panel.
5. "AIR DATA COMPUTER" Nose wheel well fuse panel.
6. "MACH SW CONT" Nose wheel well fuse panel.

h. Check that the ramp cockpit control switch is in the "AUTO" position.

i. Connect the MB-1 pitot-static system tester to the airplane nose boom pitot-static probe. Refer to T.O. 1F-106A-2-9 for this procedure.

4-29. Procedure, Automatic Operation Check.

CAUTION

To prevent serious damage to the air data computer and variable ramp control unit during the Automatic Operation Check Procedure, static pressure (P_s) must not be allowed to exceed pitot pressure (P_t).

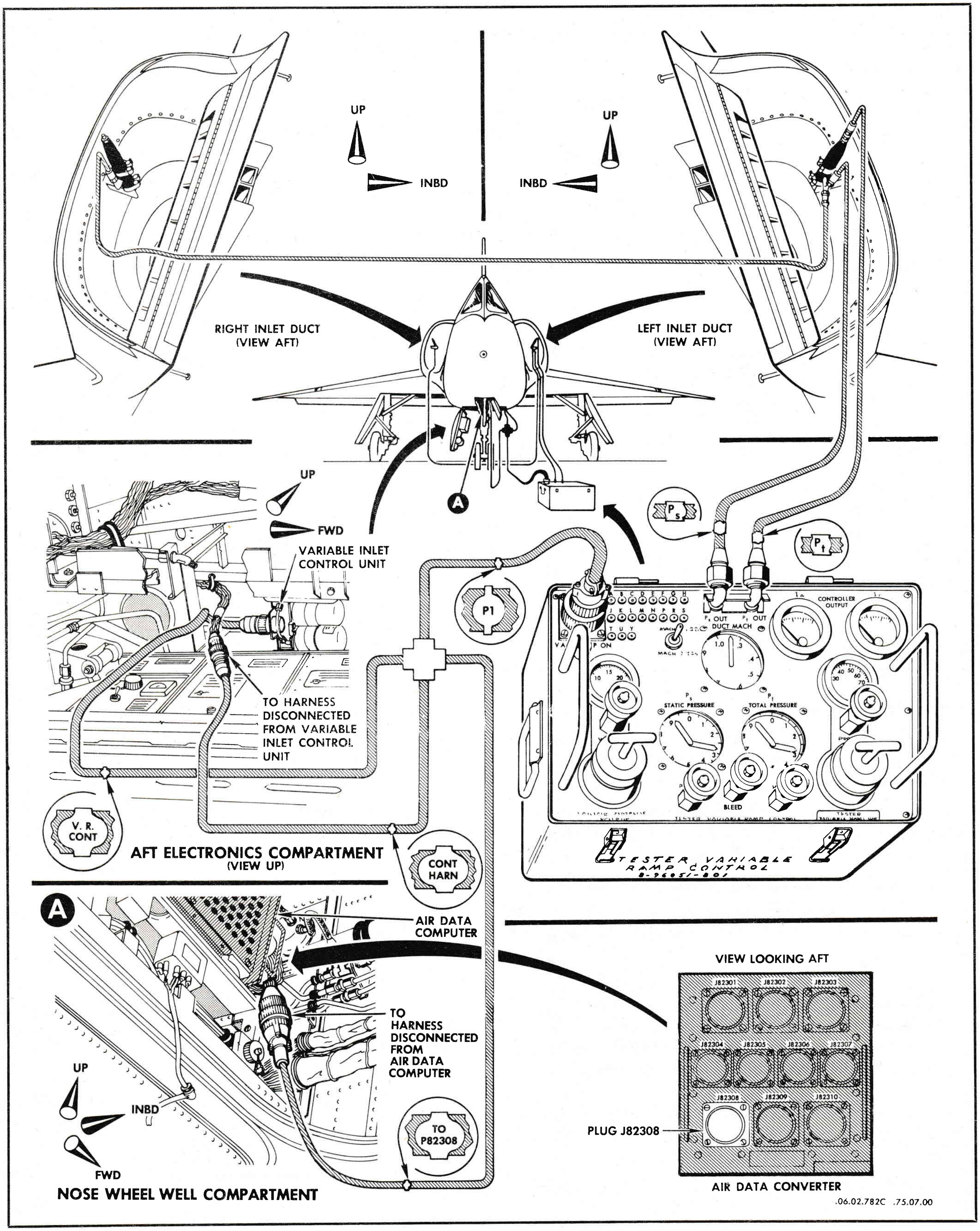


Figure 4-7. Connecting Variable Ramp Tester, 8-96051-801
Applicable to F-106A airplanes 57-246 thru 57-2464, 57-2466 thru 57-2506, and F-106B airplanes 57-2515 thru 57-2522, 57-2524 thru 57-2531

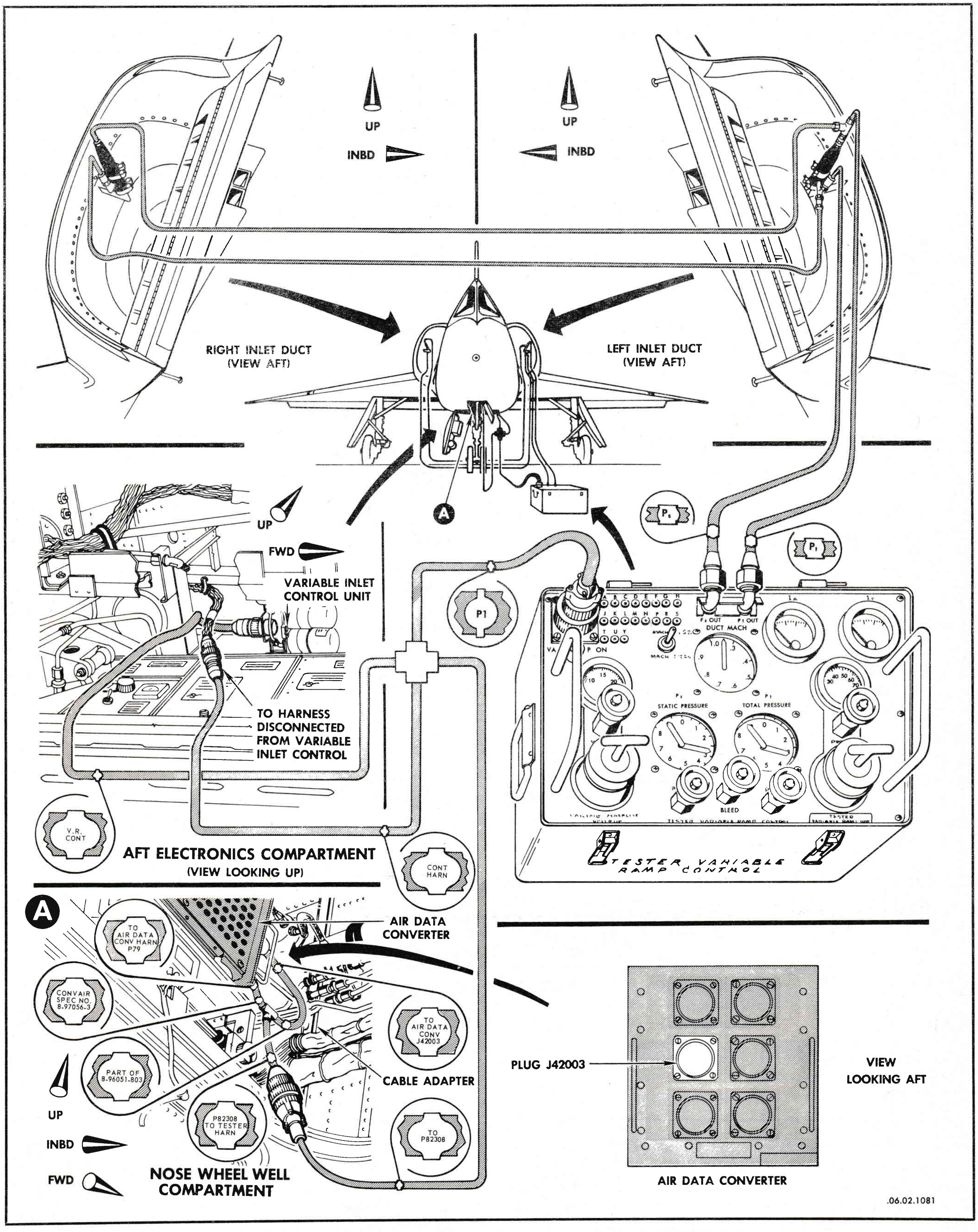


Figure 4-8. Connecting Variable Ramp Tester, 8-96051-803

Applicable to F-106A airplanes 56-453 thru 57-245, 57-2465, 58-759 and subsequent; and F-106B airplanes 57-2507 thru 57-2514, 57-2523, 57-2532 and subsequent

a. Pump up pressure on MB-1 tester to establish cockpit mach indicator reading of 1.8. Ramps shall move to the fully extended position.

b. *Prior to incorporation of ARDC instrument system,* position the cockpit radar switch to "STAND BY."

c. Pump ramp tester pressure supply to 40 inches Hg. Increase secondary hydraulic system pressure to 3000 psi.

CAUTION

During the operational checkout period, while the secondary hydraulic system is set at 3000 psi pressure, care must be taken to avoid application of rapid changes in air pressure or vacuum to the ramp system. This care is necessary to prevent fast ramp movement to the limits of travel and resultant damage to ramp mechanisms. This fast ramp movement can occur only during ground operation, since air loads in flight dampen ramp action.

d. Open pressure supply valve. Slowly open P_t valve, to increase system P_t, until ramps start to retract.

NOTE

Proper checkout requires that ramp movement be detected as soon as possible. Place finger firmly at the juncture of the ramp center section and the inlet duct wall just aft of the center forward hinge.

Hold P_t constant at this point. Ramp retract movement to the fully retracted position indicates proper P_t operation. Note tester duct mach indicator reading. Reading shall be as shown in column B of the following table; these values indicate correct control unit set point function. Note readings.

RAMP INLET CONTROL UNIT PART NUMBER	RAMP TESTER MACH READING	
	A	B
8-06474-1	0.74 to 0.78	0.79 to 0.83
8-06474-3	0.63 to 0.67	0.74 to 0.78
8-06474-5		
8-06474-7		

e. Close tester pressure supply valve, and slowly open tester bleed valve enough to decrease P_t pressure until ramps start to extend. Hold P_t reading at this point. Ramps shall move to the fully extended position.

f. Note tester duct mach reading. Reading shall be within 0.01 of reading taken in step "d."

g. Close P_t valve on tester and wait 3 minutes. Tester duct mach reading shall not vary more than 0.03 from the mach indicator reading noted in step "d."

h. Open tester P_t and bleed valves; permit P_t indication to return to ambient.

i. Pump tester vacuum supply to 20 inches Hg.

j. Close tester P_t and bleed valves; open tester vacuum supply valve. Slowly open P_s valve to decrease P_s until ramps start to retract. Hold P_s indication at this point. Observe the following:

1. Ramps shall move to full retract position.
2. Tester duct mach indicator reading shall be as shown in Column B of table in step "d"; note readings.

k. Close tester P_s valve and wait 3 minutes. Tester duct mach indicator reading shall not vary more than 0.02 from reading taken in step "j-2."

l. Reduce pressure on MB-1 pitot-static system tester until a cockpit mach indicator reading of 1.3 is obtained. Hold nose boom pressure at this point to maintain reading.

m. Close ramp tester vacuum supply valve, and slowly open tester bleed and P_s valves until ramps start to extend. Hold P_s pressure at this value. Ramps shall move to the fully extended position. Tester duct mach indicator reading shall be as shown in column A of test table in step "d." Note position of ramp center section forward hinge (light pencil mark).

n. Open P_s and bleed valves to return pressure to ambient. Close ramp tester P_s and bleed valves; open pressure supply valve. Slowly open P_t valve until ramps start to retract. Hold pressure at this point.

NOTE

F-106A airplanes 56-453, -454, 56-456 thru 57-245, 59-060 and subsequent; and 57-246, -2453, 57-2455 thru 59-059 after incorporation of TCTO 1F-106-628. Applicable to F-106B airplanes 57-2508 thru -2515, 57-2517, 59-149 and subsequent; and 57-2516, 57-2518 thru 58-904 after incorporation of TCTO 1F-106-628. These airplanes are equipped with a variable ramp time delay circuit.

1. If the airplane is equipped with a time delay circuit, depress and hold the time delay test switch (located in the lower aft electronics compartment) when the ramps start to retract. Ramp retract motion shall be delayed for 1.8 to 2.5 seconds. After delay period, ramps will continue to retract; release the test switch. Ramp retract motion shall be delayed for 1.8 to 2.5 seconds, then move to the fully retracted position. If the airplane is not equipped with a delay circuit, ramps shall move to the fully retracted position without interruption.
2. Tester duct mach indicator reading shall be as shown in column A of test table in step "d."

o. Note position of ramp center section forward hinge using 6 inch scale. Distance between position noted in step "m" and ramp center section forward hinge shall be 5.35 (±0.05) inches.

p. Close ramp tester pressure supply valve. Slowly open P_t and bleed valves until ramps start to extend. Hold pressure at this point.

1. Ramps shall go to the fully extended position.
2. *On airplanes equipped with variable ramp time delay circuitry,* depress the time delay test switch when ramps start to extend. Ramps shall continue to extend.

q. Decrease secondary hydraulic system pressure to 1500 psi.

r. *On airplanes equipped with ramp "not retracted" warning light,* remove "INLET CONTROL" 28-volt dc fuse from nose wheel well fuse panel. Warning light in cockpit shall illuminate. Re-install fuse; light shall extinguish.

s. *On airplanes equipped with ramp altitude pressure ratio* switch, check ramp warning light function as follows:

1. With ramps fully extended, light shall extinguish.
2. Remove "MACH SW CONT" fuse from nose wheel well fuse panel; light shall illuminate.
3. Install fuse; light shall extinguish.

t. Slowly return air data converter to ambient condition by returning MB-1 tester pressure to ambient. Ramps shall move to fully retracted position.

u. Note position of ramp center section forward hinge using 6 inch scale. Ramps shall have retracted 0.08 to 0.12 inches less than position noted in step "o" if ramp retract limit switch is properly rigged.

4-30. Procedure, Variable Ramp Emergency Operation Check.

NOTE

During the variable ramp emergency operation check, the ramp system may be turned on and off as required using MB-1 pressure applied to the nose boom instead of using the ramp tester mach switch. The variable ramp tester must be electrically connected to the air data converter to utilize the tester mach switch.

a. Position ramp tester mach switch to the 1.25 position; ramp shall move to the fully extended position.

b. Bleed ramp pneumatic system to 1500 psi pressure as follows:

1. Check that the airplane high-pressure pneumatic system gage in the left main wheel well indicates pressure in excess of 1500 psi. This is important in determining ramp pneumatic pressure.
2. Open starter air selector valve in left main wheel well (figure 1-6).
3. Remove ramp system pneumatic system bleed valve plug screw. Bleed valve is located on forward side of the left main wheel well (see figure 1-6).
4. Loosen bleed valve slowly while observing airplane pneumatic system pressure gage. When gage pressure reaches 1500 psi, close valve and install plug screw.
5. Close starter air selector valve and lockwire valve in closed position. Ramp pneumatic system is now charged to 1500 psi pressure.

c. *On F-106B airplanes,* momentarily position aft cockpit ramp control switch to the emergency position. Have observer signal the instant ramps start to move. Immediately position switch back to the "AUTO" position to preserve air supply. This operation checks the aft cockpit emergency selection.

d. Position ramp cockpit control switch (F-106B, forward cockpit) to emergency position. Ramps shall move to the retracted position in 8 seconds maximum.

WARNING

Stand clear of variable ramp vent port on lower side of fuselage during emergency ramp operation. Hydraulic oil and air will be expelled from this port at high velocity during this procedure.

e. Position ramp cockpit control switch to the "AUTO" position. Ramps shall move to the fully extended position.

f. Purge air from the variable ramp hydraulic system as indicated in the following paragraph.

4-31. Procedure, Bleeding Ramp Hydraulic System.

a. Bleed ramp hydraulic system using bleeding procedure in T.O. 1F-106A-2-3, cycle only the variable ramps, as follows:

NOTE

During the ramp hydraulic system bleeding procedure, the ramp system may be turned on and off as required using MB-1 pressure applied to the nose boom instead of using the ramp tester mach switch. The variable ramp tester must be electrically connected to the air data converter to utilize the tester mach switch.

1. Position ramp tester mach switch to the 1.20 position. Ramps shall retract in 8 seconds maximum.

2. Position ramp tester mach switch to the 1.25 position. Ramps shall extend in 8 seconds maximum.
3. Repeat steps 1 and 2 ten times.

NOTE

After several operations of the ramp using the tester mach switch, the ramps may not fully retract. This is due to overheating of the ramp time delay shutoff feature. Allow several minutes for time delay to cool; operation should then be normal.

b. At first engine run, perform complete bleeding procedure given in T.O. 1F-106A-2-3.

4-32. Final Cleanup.

a. With ramp tester mach switch in the 1.20 position, check ramps for full retract position as noted in paragraph 4-29, step "o."

b. Reduce pressure on MB-1 pitot-static tester to ambient; remove tester.

c. Remove external hydraulic and electrical power from the airplane.

d. Disconnect ramp tester from airplane. Reconnect harnesses to air data converter and ramp inlet control unit.

e. Recharge airplane high-pressure pneumatic system to normal full charge. Refer to T.O. 1F-106A-2-3 for this procedure.

4-33. OPERATIONAL CHECKOUT AND LEAK TEST, VARIABLE RAMP SEAL SYSTEM.

4-34. Equipment Requirements.

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
	Compressed dry air source at 35 psi.			To actuate the seal system.
	Air Pressure Gage, 0 to 30 psi.	(6685-526-6881)		To check operation of system relief valve.

4-35. Preparation.

a. Gain access to seal system pressurization line through the air conditioning compartment access door.

b. Disconnect ramp seal pressurization line at the system inlet filtered restrictor. Restrictor is located approximately at sta. 263.0 under false floor at manifold assembly *on F-106A airplanes,* and approximately at sta. 280.0 *on F-106B airplanes.*

c. Connect external air source and air pressure gage to seal system inlet at orifice.

4-36. Procedure, Variable Ramp Seal System Checkout and Leak Test.

a. Pressurize system to 30 psi as read on line pressure gage; shut off air source.

b. Pressure will drop rapidly to 16 (±1.5) psi on gage indicating relief valve is operating properly.

c. System pressure must not decrease more than 2 psi in 1 minute following stabilization.

d. If system pressure drops more than 2 psi per minute, check all connections for leaks. Replace any component found to be leaking.

e. Reduce air pressure to zero; remove test equipment. Reconnect system air line.

4-37. PURGING AND LEAK CHECKING, VARIABLE RAMP PITOT-STATIC SYSTEM.

4-38. Equipment Requirements.

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
4-7 4-8	Tester, Variable Ramp Control.	8-96051-803 (1730-710-7310)	8-96051-801 (4920-623-2177)	To provide regulated pressures to pitot-static pressure lines.
	Compressed dry air source of 35 psi pressure.			To purge ramp system pitot-static lines.
	Bubble Fluid.	Military Specification MIL-L-25567		To check pitot-static system for leaks.

4-39. Preparation.

a. Gain access to the variable ramp control unit through the lower aft electronics compartment access door.

b. Disconnect P_s and P_t lines from the ramp control unit.

c. Using ramp tester, apply a maximum pressure of 32 psi to the pitot-static sensing probe in the engine right air inlet duct. Air shall flow from the P_s line at the ramp control unit connection. Repeat this procedure for the sensing probe in the left inlet duct.

1. Connect pressure source of 32 psi maximum to the P_t line at the ramp control unit end and allow air to flow through the line. Air shall flow from the sensing probes in each inlet duct.

d. Reconnect lines to ramp control unit.

e. Seal pitot, static, and drain ports on pitot tube in left intake duct using plastic or vinyl tape.

f. Seal drain ports in pitot tube in right intake duct.

g. Connect ramp tester pressure line to pitot port on pitot tube in right intake duct.

CAUTION

Observe the following limitations when applying pressure to the variable ramp pitot-static system.

Static pressure (P_s) shall never exceed pitot pressure (P_t).

Pitot pressure shall never exceed static pressure by more than 40.72 inches Hg.

Static pressure shall never exceed 67.2 inches Hg.

If these limitations are not observed, the ramp control unit may be damaged.

4-40. Procedure.

a. Using ramp tester, slowly pump up pressure until gage on tester indicates 21.5 inches Hg above ambient. Close off pressure and allow system to remain pressurized 3 minutes.

b. Pressure drop shall not exceed 1.6 inches Hg during the 3 minute period.

c. Release pressure to pitot port.

d. Connect ramp tester vacuum source to static port of pitot tube in right intake duct.

e. Slowly draw vacuum on system until tester gage reads 13.8 inches Hg below ambient.

f. Close off vacuum source and hold vacuum for 2 minutes.

g. Vacuum gage reading shall not increase more than 0.5 inches Hg during the 2 minute period.

h. Repeat steps "a" through "g" applying the test values to the left inlet duct pitot-static probe.

i. Release vacuum pressure and remove test equipment. Remove seal tape from pitot and static ports of pitot tube in intake ducts.

4-41. SHUTTLE VALVE CHECK, VARIABLE RAMP PITOT-STATIC SYSTEM.

4-42. Equipment Requirements.

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
4-7 4-8	Tester, Variable Ramp Control	8-96051-803 (1730-710-7310)	8-96051-801 (4920-623-2177)	To provide regulated vacuum.
	Test Unit, Feel System.	SE 0985 (4920-565-0192)		To provide pneumatic pressure.

4-43. Preparation.

a. Connect source of dry filtered air (approximately 30 psig) to SE 0985 test unit. Refer to T. O. 1F-106A-2-7 for operating and hook-up instructions.

b. Connect manometer No. 2 of SE 0985 to total pressure (P_t) line of duct pitot-static probe fitting (part of 8-96051-801 or -803 variable ramp tester) using adapters as required. Connect hose from "tee" fitting (P_t) to No. 5 fitting on the hose connection panel of the SE 0985 Test Unit.

c. Connect manometer No. 3 of SE 0985 to static pressure (P_s) line of duct pitot-static probe fitting using adapter as required. Connect hose from "tee" fitting (P_s) to No. 3 fitting on the hose connection panel of SE 0985 Test Unit.

d. Disconnect P_s and P_t lines from variable inlet control unit.

e. Install duct pitot-static probe fitting of the variable ramp tester on left duct pitot-static probe. Leave right duct pitot-static probe open to atmosphere.

NOTE

Only one fitting of the variable ramp tester is required for shuttle valve checks. The unused fitting must be plugged, or the lines capped, to prevent leakage.

4-44. Procedure.

a. Apply pressure to P_t line using manometer No. 2 control valve until P_t shuttle valve shuttles and holds pressure. Shuttling will be indicated by a rapid rise in pressure as indicated on manometer No. 2.

b. Check flow from right duct pitot-static probe P_t port and from P_t line disconnected from ramp control unit. Flow shall be neglible and represents leakage.

c. Apply pressure to P_s line using manometer No. 3 control valve.

d. If valve has shuttled, flow shall be noted at P_s line disconnected from ramp control unit, but not at the right duct pitot-static probe ports.

e. Reduce P_t and P_s pressures to ambient and remove fitting from left duct pitot-static probe.

f. Install fitting on right duct pitot-static probe and repeat steps "a" through "e", substituting left for right, and right for left.

g. Remove test equipment and reconnect P_t and P_s lines to controller.

4-45. VARIABLE RAMP PNEUMATIC SYSTEM LEAK CHECK.

For the variable ramp pneumatic system leak check procedure, refer to T. O. 1F-106A-2-3.

4-46. OVERBOARD DRAIN HYDRAULIC OIL LEAK CHECK — RAMPS OPERATING.

a. Leakage from the variable ramp overboard drains (under leading edge of left wing) shall not exceed the following when the ramps are operating in the normal (automatic) mode:

Forward Drain — 5 drops per minute

Aft Drain — 6 drops per minute

b. If excessive leakage is noted from the forward drain, check leakage rate from drive and dump valve. Replace the defective component and repeat emergency operation check.

c. If excessive leakage is noted from the aft drain, crack drain lines on bypass valve and shuttle valve and check individual component leakage rate. Bypass valve allowable leakage is 5 drops per minute. Shuttle valve allowable leakage is 1 drop per minute. Replace the defective component and repeat emergency operation check.

4-47. OVERBOARD DRAIN HYDRAULIC OIL LEAK CHECK — RAMPS STATIC.

a. Leakage from the variable ramp overboard drains (under leading edge of left wing) shall not exceed the following when the ramps are operating in the normal (automatic) mode, system energized, and ramps not moving:

Forward Drain — 1 drop per minute

Aft Drain — 3 drops per minute

b. If excessive leakage is noted from the forward drain, crack the seal drains at hydraulic drive unit from dump valve. Drive unit seal drain leakage shall not exceed 15 drops per hour, dump valve leakage shall not exceed 45 drops per hour. Replace the defective component and repeat emergency operation check.

c. If excessive leakage is noted from the aft drain, crack the drain lines on shuttle valve and bypass valve and check individual component leakage rates. Bypass valve allowable leakage is 3 drops per minute, shuttle valve allowable leakage is 15 drops per hour. Replace defective component and repeat emergency operation check.

SYSTEM ANALYSIS

4-48. TROUBLESHOOTING, VARIABLE RAMP SYSTEM.

Trouble shooting the variable ramp system will require hookup of the ramp operational checkout equipment to the airplane. Refer to paragraph 4-26 for this procedure. Complete ramp tester hookup (pneumatic and electrical) is shown in figures 4-7 and 4-8. In addition to the equipment specified, it will be necessary to obtain a vacuum tube multimeter, USAF TS-505 B/U, (FSN 6625-620-6366).

4-49. Variable Ramp System Test Values.

The following listed values are provided as an aid in isolating malfunctions within the ramp control system. These values are variable ramp tester (8-96051-801 and -803) jack readings representing normal component function, and are applicable to airplanes equipped with ramp controller part No. 8-06474-1, -3, or -5.

TEST JACK	VALUE	FUNCTION
N	No voltage	Ac and dc ground.
A	*	Servo valve ramp extend coil.
B	No voltage	Servo valve ground return.
C	*	Servo valve ramp retract coil.
D	Less than 26-volt ac	Controller bridge circuit error signal to amplifier stage.
E		Controller bridge circuit error signal from bridge circuit.
G	28-volt dc	Energizes ramp position warning relay and hydraulic shutoff valves.
H	28-volt dc (ADC below mach 1.20)	Energizes controller K-3 relay. K-3 relay provides automatic retract signal and starts 7 to 13 seconds time delay. K-1 relay shuts off system after the 7 to 13 seconds delay.
J	28-volt dc (ADC below mach 1.25)	Center pole of ADC mach switch (after ramp system actuation).
P	28-volt dc	Power input interlock.
R	**	High end of ADC mach pot (mach pot pin "A").
S		Low end of ADC mach pot (mach pot pin "B").
T		ADC mach pot wiper.
V	115-volt ac	System power input.
F, K, L, M, U		These test jacks are not used.

**Normal current through each coil of the servo control valve, with the ramps motionless (no ramp movement signals), will range from 0 ma dc to 7 ma dc. A current differential of 8.0 ma or greater between the coils represents maximum movement signal.*

***ADC mach potentiometer resistance is 10K ohms. The ac signal across the potentiometer should not exceed 5.0 volts. To prevent loading the ramp controller ac bridge when making this measurement, the vacuum tube voltmeter being used must have an impedance ratio of at least 5K ohms per volt.*

4-50. Procedure.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
RAMPS DO NOT EXTEND WITH AMBIENT PRESSURE AT PITOT-STATIC PORTS (Refer to paragraph 4-29, step "a").		
Ramp hydraulic shutoff valve closed.	Position tester mach switch alternately betwen 1.20 and 1.25 positions. Listen for valve actuation.	a. If valve action is heard, valve is not at fault. Go to servo control valve malfunctioning under this heading. b. If no valve action is heard, go to next isolation procedure.
	Check for 28-volt dc at valve pin A.	a. If voltage exists, but valve inoperative, replace valve. b. If no voltage exists, go to next probable cause.

4-50. Procedure (Cont).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
RAMPS DO NOT EXTEND WITH AMBIENT PRESSURE AT PITOT-STATIC PORTS (Refer to paragraph 4-29, step "a") (Cont).		
Secondary hydraulic system low warning relay malfunctioning.	Check relay for continuity from pins F to G.	a. If continuity exists, relay is not at fault. Go to next probable cause. b. If no continuity exists, go to next isolation procedure.
	Check for 28-volt dc at relay pin B.	a. If voltage exists, but no continuity from F to G, replace relay. b. If no voltage exists, refer to hydraulic low-pressure warning system trouble shooting in T.O. 1F-106A-2-9.
Ramp emergency pneumatic pressure switch malfunctioning.	Check for 28-volt dc at switch pin A.	a. If voltage exists, switch is not at fault. b. If voltage does not exist, go to next isolation procedure.
	Check for 28-volt dc at switch pin C.	a. If voltage exists at C but not at A, change switch. b. If voltage does not exist, go to next probable cause.
Inlet control unit malfunctioning.	Check for 28-volt dc at control unit pin G.	a. If voltage exists, controller is not at fault. b. If no voltage exists, go to next isolation procedure.
	Check for 28-volt dc at controller pin J.	a. If voltage exists at J but not at G, replace control unit. b. If no voltage exists, go to next probable cause.
Switch in ADC malfunctioning.	Refer to T.O. 1F-106A-2-15 for ADC system checkout and trouble shooting.	
Servo control valve malfunctioning.	Check for continuity between valve pins A and B, and between pins B and C.	a. If continuity exists, go to next isolation procedure. b. If continuity does not exist, replace valve.
	Check for current flow differential between valve pins A and B vs B and C. Refer to paragraph 4-49 for specified value limits.	a. If current differential exists as specified, valve is not at fault. Go to next probable cause. b. If current differential does not exist, go to next isolation procedure.
	Pump static pressure (P_s) to 26.0 inches Hg and hold. Vary pitot pressure (P_t) from 30 inches Hg to 40 inches Hg. Check ramp tester pins A and C for voltage variance as P_t pressure is varied.	a. If voltage variance does not occur, replace inlet control unit. b. If voltage variance does occur, go to next probable cause.

4-50. Procedure (Cont).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
RAMPS DO NOT EXTEND WITH AMBIENT PRESSURE AT PITOT-STATIC PORTS (Refer to paragraph 4-29, step "a") (Cont).		
Hydraulic motor malfunctioning.	Disconnect drive shafts from motor; check motor for freedom of rotation.	a. If motor binding is found, replace motor. b. If motor rotation is free, go to next probable cause.
Excessive ramp friction.	Check components of system for correct installation and freedom of actuation.	Adjust as required. Install replacement items as required.
RAMPS DO NOT RETRACT WITH PRESSURE APPLIED TO PITOT PORT (Refer to paragraph 4-29, step "d").		
Refer to probable causes in previous trouble item.		
RAMPS DO NOT MEET SPECIFIED TRAVEL REQUIREMENTS (Refer to paragraph 4-29, step "o").		
Interference from structure or other systems components.	Check for interference at screw-jacks.	Make correction as required.
	Foreign material between ramp panels and fuselage structure.	
Ramps improperly rigged.	Conduct rigging procedure.	
TESTER DUCT MACH READING DOES NOT HOLD SPECIFIED VALUE IN STATIC CONDITION (Refer to paragraph 4-29, step "e").		
Pressure leakage in P_t line.	Conduct line leak test.	a. Repair lines as required. b. If no line leaks are found, go to next probable cause.
Internal leakage in ramp control unit.	Remove control unit.	Install replacement item.
RAMP NOT RETRACTED WARNING LIGHT DOES NOT ILLUMINATE WHEN INLET CONTROL FUSE IS REMOVED (Refer to paragraph 4-29, step "t").		
Ramp travel limit switch malfunctioning.	Check for continuity thru switch,	a. If continuity exists, go to next probable cause. b. If no continuity exists, replace switch.
Position warning light relay malfunctioning.	Check for continuity from pins E thru H of relay.	a. If continuity exists, go to next isolation procedure. b. If no continuity exists, replace relay.
	Check condition of "INLET CONTROL" 28-volt dc fuse.	Install replacement fuse as required.
RAMPS DO NOT RETRACT WHEN SYSTEM IS SELECTED TO EMERGENCY.		
Ramp pneumatic solenoid valve not opening. Ramp hydraulic bypass valve not positioned to emergency position.	Check for continuity from pin A thru B of valve. Check for 28-volt dc at valve pin A.	a. If no continuity exists, replace valve. b. If no voltage exists, replace variable inlet override fuse.

4-50. Procedure (Cont).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
RAMP EMERGENCY TOTAL TRAVEL TIME EXCEEDS 8 SECONDS MAXIMUM TIME LIMIT (Refer to paragraph 4-30, step "d").		
Excessive ramp friction.	Check components of system for correct installation and freedom of operation.	Adjust as required. Install replacement items as required.
DUCT BUZZ REPORTED DURING FLIGHT.		
Ramp scheduling (and/or engine trim) is incorrect.	If engine trim correct, perform operational checkout of system.	Replace the unit as required.
Switching afterburner "ON" or "OFF" at high mach speeds.	Afterburner nozzle positioning causes rapid increase or decrease of engine air demands thus making ramp schedule momentarily incorrect.	
Extreme yawing or rapid deceleration at high mach speeds.	Engine air demands momentarily not compatible with ramp scheduling.	
RAMPS MALFUNCTIONING IN FLIGHT.		
Sheared flex drive shaft to one ramp.	Check that both right and left ramp are in retracted position.	Replace defective part in ramp that is not retracted.
Ramp pitot and static lines crossed (F-106B).	Check pitot and static flex lines in missile bay for proper connection.	Connect lines properly and perform system operational checkout.
Servo valve differential torque current too low.	Check that differential torque current (pins A to B, and pins B to C) is at least 8.0 ma during ramp movement.	If current is below specified limit, replace inlet control unit.
PILOT REPORTS SLOW RECOVERY FROM STALL-BUZZ.		
Defective shuttle valve.	Perform shuttle valves check. Refer to paragraph 4-41.	Replace defective valve.
RAMPS DO NOT RETRACT WHEN COCKPIT MACH INDICATION IS BELOW 1.25.		
Leak in static side of the pitot-static system.	Check all static lines and connections.	Tighten and/or replace as required.
RAMPS EXTEND WHEN HYDRAULIC PRESSURE IS APPLIED TO AIRPLANE.		
AWCIS "Short System Ground Check" performed without removing HYDRAULIC PRESS WARN fuse.		Check that "HYDRAULIC PRESS WARN" fuse is installed when external hydraulic pressure is applied to airplane. Connect MB-1 tester to nose boom and apply pitot-static pressure until ramps retract.

REPLACEMENT

4-51. REPLACEMENT, ELECTRICAL COMPONENTS GENERAL.

When removing components equipped with pigtail electrical leads, always cut leads at an existing splice. This is necessary to preserve the component lead identity and to provide sufficient length for reinstallation.

4-52. REPLACEMENT, VARIABLE RAMP SECTIONS.

4-53. Equipment Requirements.

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
4-9	Ramp Spring Depressing Tool.	8-96049 (5120-587-5894)		To depress spring on inlet ramp center section.
	Ramp Rigging Tool.	8-96184-801 8-96184-803 (5120-675-9229)		To position ramp center section at fully extended position (for use in thin lip inlet ducts).
		8-78501-300, -301, -400, -401, (Tools called for in TCTO 1F-106J-509)		To position ramp center section at fully extended position (for use in thick lip inlet ducts).
	Ramp Stop Rigging Tool.	8-96198 (1730-632-8434)		To establish position for stop adjustment.
4-7 4-8	Tester, Variable Ramp Control.	8-96051-803 (1730-710-7310)	8-96051-801 (4920-623-2177)	To actuate the ramp control system.
4-9	Ramp Dummy Door (2).	8-96183 (1730-625-5344)		To aid positioning of ramp center section.
	Ramp Section Hinge Pin Puller.	8-96043 (5120-525-7017)		To remove ramp forward and aft hinge pins.
	Forward Ramp Hold-open Tool.	8-96187 (1730-613-6610)		To hold forward ramp open during ramp maintenance.
	Ramp Actuator Rod Holding Tool.	8-96212 (1730-632-8432)		Prevent rod rotation during rigging.

4-53. Equipment Requirements (Cont).

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
Refer to T.O. 1F-106A-2-3	Portable Hydraulic Test Stand (Gas).	SE 1061-801 (4920-670-9415)	SE 1061 (4920-517-1028)	To supply pressure to hydraulic systems for ground test.
			SE 0567-801 (4920-204-2462)	
	Portable Hydraulic Test Stand (Elec).	SE0976-801 (4920-675-4258)	SE 0976 (4920-204-3115)	
	Hydraulic hose support.	8-96193 (4920-621-3011)		To support hydraulic test stand return hose.
	Adapter (2 each).	8-96080 (4920-566-8882)		Used with SE 0567 or SE 0567-801 to connect test stand hoses to quick disconnect fittings.
	Adapter (2 each).	SE 1093		Used with SE 1061, MJ-2 or MK-3 to connect test stand hoses to quick disconnect fittings.
Refer to T.O. 1F-106A-2-10	Generator Set (Gas).	8-96026-801 AF/M32A-13 (6115-583-9365)	8-96026 AF/M32M-2 (6115-617-1417)	To energize electrical systems on aircraft equipped with special quick disconnect receptacle.
	Generator Set (Elec).	8-96025-803 AF/ECU-10/M (6125-583-3225)	8-96025-805 A/M24M-2 (6125-628-3566)	
			8-96025 AF/M24M-1 (6125-620-6466)	
	Generator Set.		MC-1 (6125-500-1190) MD-3 (6115-635-5595)	To energize electrical systems (except AWCIS) on aircraft equipped with standard AN receptacle and on others by using adapter cable 8-96052.
	Adapter Cable.	8-96052 (6115-557-8548)		To connect MC-1 and MD-3 units to aircraft equipped with special quick disconnect receptacle.

4-54. Procedure.

For replacement and rigging of the variable ramp sections, see figure 4-9.

NOTE

After replacing and/or rigging any portion of the variable ramp system, perform an operational check of the system; refer to paragraph 4-29 for procedure.

4-55. REPLACEMENT, VARIABLE RAMP CONTROL SYSTEM COMPONENTS.

4-56. Procedure.

For replacement procedures for the variable ramp screw jacks, hydraulic drive unit, servo control valve, or the inlet pitot-static tubes, see figure 4-10.

4-57. REPLACEMENT, VARIABLE RAMP AIR STORAGE FLASK.

a. Bleed air from high-pressure pneumatic system. Refer to T.O. 1F-106A-2-3 for this procedure.

b. *On F-106A airplanes,* gain access to the air storage flask through the access door along centerline of missile bay roof at approximately sta. 253.0. *On F-106B airplanes,* remove the refrigeration unit. Refer to T.O. 1F-106A-2-6 for this procedure.

c. Disconnect pneumatic line from ramp pneumatic flask, located at right side of fuselage at sta. 323.5.

d. Disconnect flask strap; remove flask. Installation procedure for the ramp pneumatic system flask is essentially the reverse of the removal procedure. Torque flask attachment strap 5 to 10 inch-pounds maximum.

e. Perform variable ramp pneumatic system leak check. Refer to T. O. 1F-106A-2-3 for this procedure.

f. Recharge the variable ramp high-pressure pneumatic system when test has been completed. Refer to T. O. 1F-106A-2-3 for the charging instructions.

4-58. REPLACEMENT, VARIABLE RAMP STATIC PRESSURE SENSE SHUTTLE VALVE.

a. Gain access to the upper forward surface of the forward missile bay. Refer to T.O. 1F-106A-2-12.

b. Remove forward center and forward right access doors in upper surface of missile bay to gain access to refrigeration compartment forward right side. Shuttle valve is located just aft of refrigeration compartment forward bulkhead on the right side.

c. Remove lines (3) attached to valve.

d. Remove valve attachment bolts (2); remove valve. Installation of the variable ramp pressure sense shuttle valve is essentially the reverse of the removal procedure. Replace access doors and close missile bay. Refer to T.O. 1F-106A-2-12 for missile bay door closing procedure.

e. Perform pitot-static leak check. Refer to paragraph 4-37.

f. Conduct pitot-static system shuttle valve operational check; refer to paragraph 4-41 for procedure.

4-59. REPLACEMENT, VARIABLE RAMP TOTAL PRESSURE (P_t) SHUTTLE VALVE

a. Gain access to the upper forward surface of the forward missile bay. Refer to T.O. 1F-106A-2-12.

b. Remove forward center and forward right access doors in upper surface of missile bay to gain access to refrigeration compartment forward right side. The reverse-acting P_t shuttle valve is located just aft of refrigeration compartment forward bulkhead on the right side.

c. Remove lines (3) attached to the valve.

d. Remove valve attachment bolts (2); remove valve.

e. Installation of the variable ramp pitot-static system total pressure (P_t) shuttle valve is essentially the reverse of the removal procedure. Replace access doors and close missile bay. Refer to T. O. 1F-106A-2-12 for missile bay door closing procedure.

f. Perform pitot-static leak check. Refer to paragraph 4-37.

g. Conduct pitot-static system shuttle valve operational check; refer to paragraph 4-41 for procedure.

4-60. REPLACEMENT, VARIABLE RAMP SYSTEM HYDRAULIC CHECK VALVE.

a. Relieve hydraulic system pressure by operating elevons. Refer to T. O. 1F-106A-2-3 for this procedure. Relieve the secondary hydraulic reservoir pneumatic pressure by pressing relief valve on top of the manual filler cap of the reservoir.

b. Gain access to the hydraulic check valve through the refrigeration compartment access door. Valve is located on LH side of refrigeration compartment.

c. Remove bolts (2) attaching valve to structure; remove valve.

d. Installation of the variable ramp system hydraulic check valve is essentially the reverse of the removal procedure.

e. Bleed ramp hydraulic system. Refer to T.O. 1F-106A-2-3 for this procedure.

f. Conduct an operational checkout of the variable ramp system.

4-61. REPLACEMENT, AIR DATA CONVERTER.

For the air data converter replacement procedures, refer to T.O. 1F-106A-2-15.

4-62. REPLACEMENT, ALTITUDE PRESSURE RATIO SWITCH.

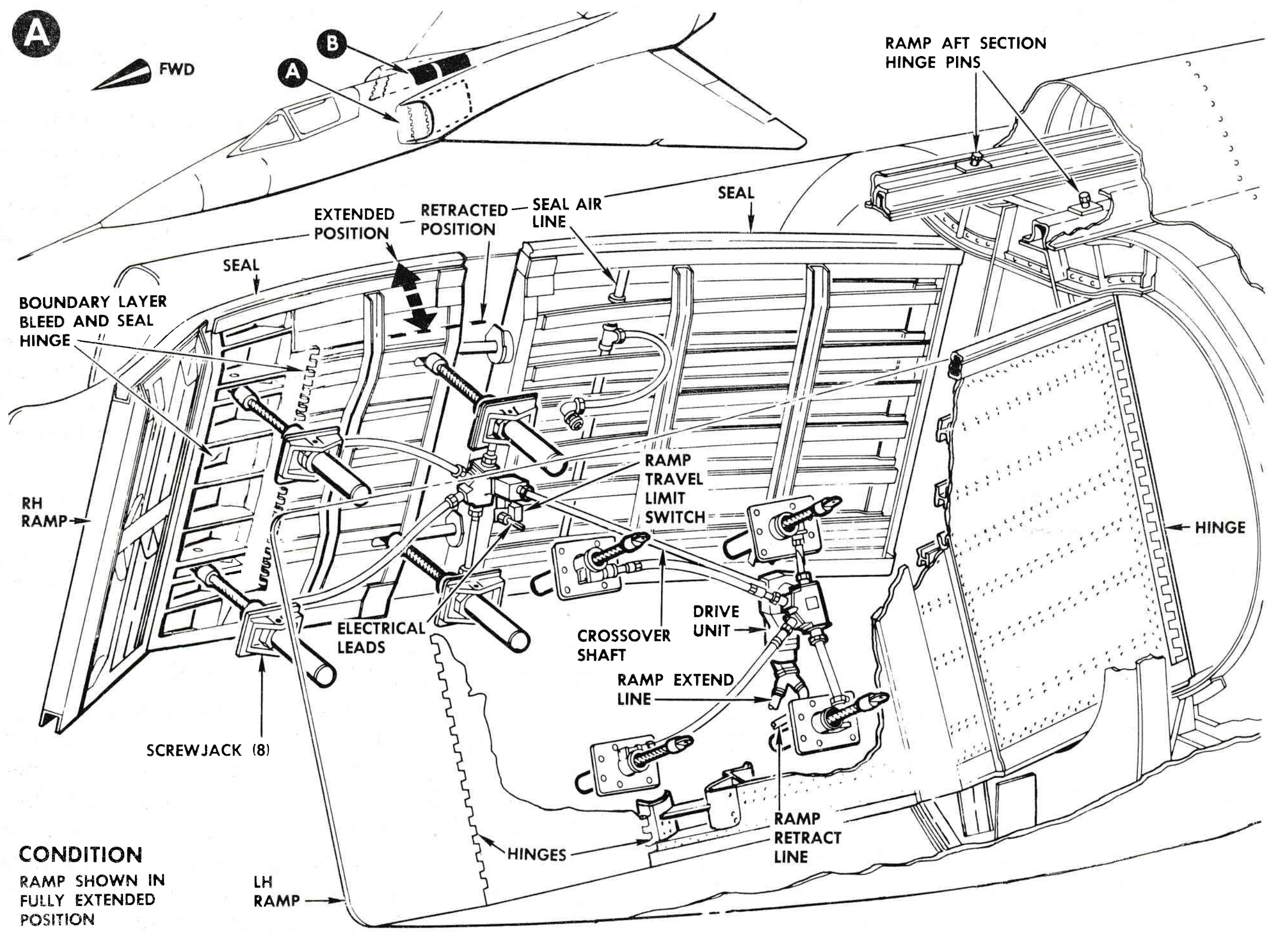
For the altitude pressure ratio switch replacement procedures, refer to T. O. 1F-106A-2-5.

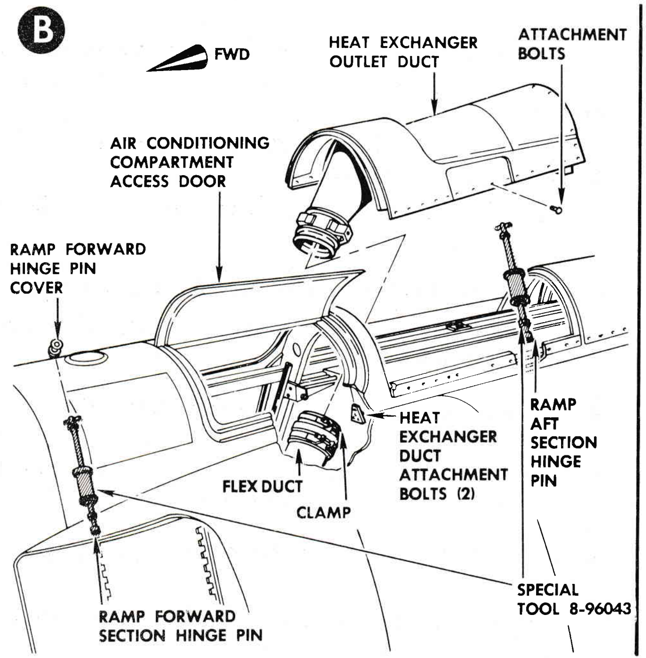
4-63. REPLACEMENT, PNEUMATIC SELECTOR VALVE.

a. Relieve high pneumatic system pressure. Refer to T. O. 1F-106A-2-3 for this procedure.

b. Gain access to the selector valve through the refrigeration compartment access door. Valve is located on the left side of the refrigeration compartment.

c. Remove electrical leads from valve.





NOTE

IT WILL BE NECESSARY TO HAVE A MAN IN THE AFT PORTION OF THE INLET DUCT TO AID IN THE REMOVAL PROCEDURE.

REMOVAL

a. Actuate ramp hydraulically to the full extended position. Refer to ramp operational checkout for this procedure.
b. Gain access to the ramp aft section hinge pin by removing the heat exchanger outlet duct portion of the fuselage dorsal fairing. Remove duct as follows:
    1. Open air conditioning compartment access door.
    2. Loosen clamp and disconnect heat exchanger flex duct attached to the exhaust fairing.
    3. Remove attachment bolts (2) between duct and support structure.
    4. Remove attachment bolts between the exhaust fairing and the fuselage; remove the exhaust fairing. Cover heat exchanger duct.
c. Remove heat exchanger and refrigeration unit from air conditioning compartment.
d. Remove cover from ramp forward hinge pin.
e. Remove forward and aft ramp section hinge pins using special tool 8-96043. Install forward ramp hold-open tool 8-96178.

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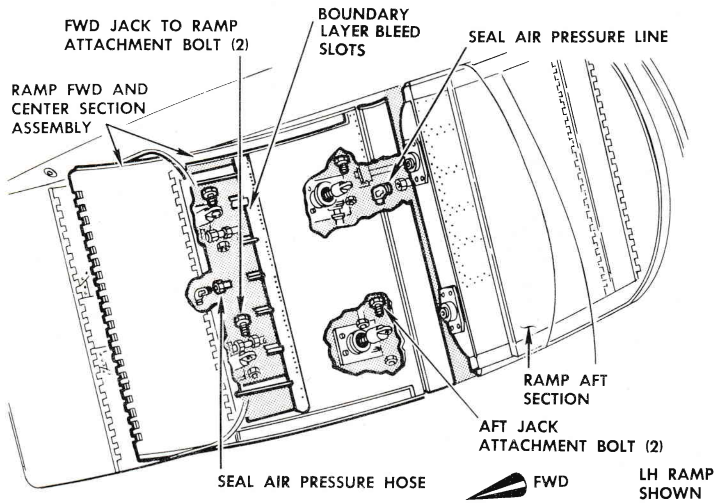
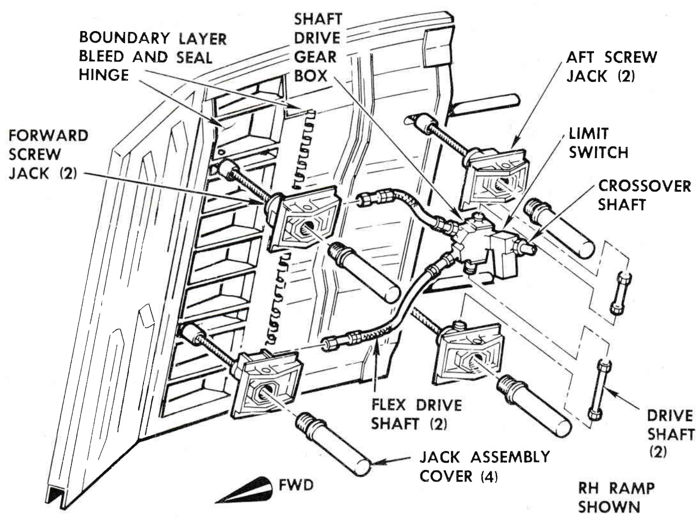
Figure 4-9. Replacement and Rigging, Variable Ramp (Sheet 1 of 4)



f. Open ramp aft section from the rear sufficiently to disconnect seal air line at fuselage wall.
g. Remove ramp aft section by moving section aft to disengage from center section.
h. Disconnect boundary layer bleed ducts (2) from the forward ramp section or boundary layer seal hinge from the ramp center section.
i. Remove forward jack to ramp attachment bolts (2).
j. Disconnect ramp center section seal air pressure hose at inlet duct wall.
k. Remove ramp center section aft jack attachment bolts (2).
l. Remove ramp forward and center section assembly.

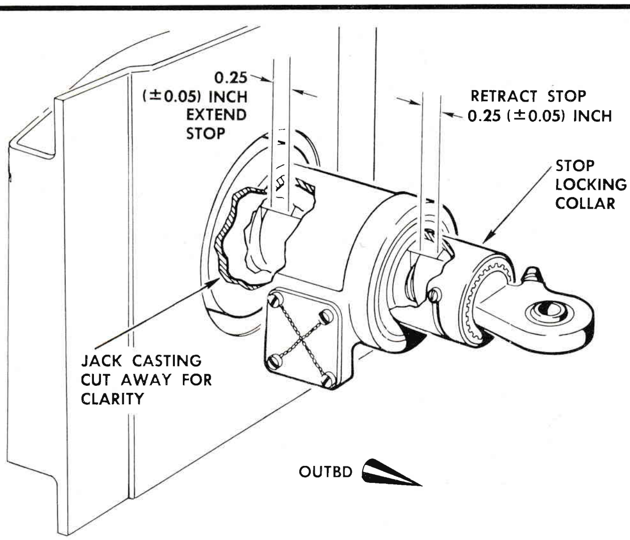


INSTALLATION AND RIGGING

a. Gain access to ramp upper jacks through the air conditioning compartment access door. Gain access to the ramp lower jacks through access plates in the upper surface of the forward armament bay. Refer to T.O. 1F-106A-2-12 for gaining access to the armament bay area.
b. Unscrew covers from inboard end of jack assemblies.
c. Disconnect flex shafts attached to forward jacks.
d. Disconnect shafts attached to aft jacks by removing shaft gear box from structure to provide sufficient room for shaft disengagement.Remove crossover flex shaft.

NOTE

ON F-106A AIRPLANES 56-453, 56-454, 56-456 THRU 57-245, 57-2465 AND SUBSEQUENT, AND F-106B AIRPLANES 57-2508 THRU 57-2515, 57-2523 AND SUBSEQUENT; IT WILL NOT BE NECESSARY TO REMOVE GEARBOXES FROM STRUCTURE TO AID SHAFT REMOVAL.



e. Check each forward jack extend and retract stop for 0.25 (±0.05) inch engagement in the stop position. This may be accomplished by wiping the stop contact surfaces clean, then placing a light film of grease or Prussian Blue on the outboard half of each extend and retract stop. Rotate each jack by hand to make extend and retract stop contact. Measure amount of contact on inboard half of each stop. Engagement to be 0.25 (±0.05) inch.

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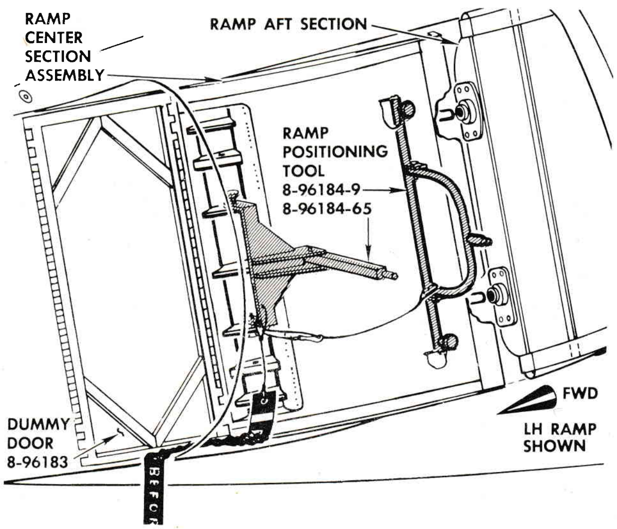
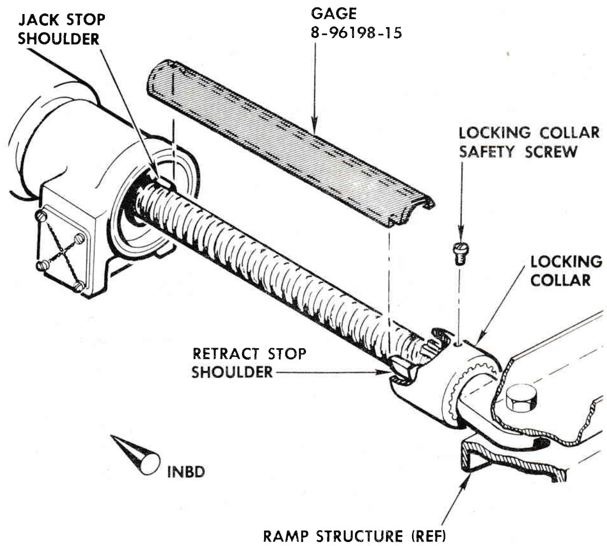
Figure 4-9. Replacement and Rigging, Variable Ramp (Sheet 2 of 4)



f. Place ramp aft section in inlet aft section but do not connect to duct or ramp center section at this time.

g. Establish ramp center section full extend point as follows:
   1. Remove ramp forward-to-center section hinge pin; remove forward section.
   2. Attach ramp forward section dummy door 8-96183 to center section using hinge pin removed in previous step.
   3. Position ramp dummy door and center section assembly in the inlet duct in the full extend position using special tool 8-96184-9-65.
   4. Position dummy door forward hinge to duct hinge; install hinge pin.
   5. Attach one forward jack to center section panel and extend ramp until spring-loaded points of rigging tools contact duct outer wall. This is the fully extended position.
   6. Extend three other jacks out to panel and attach.

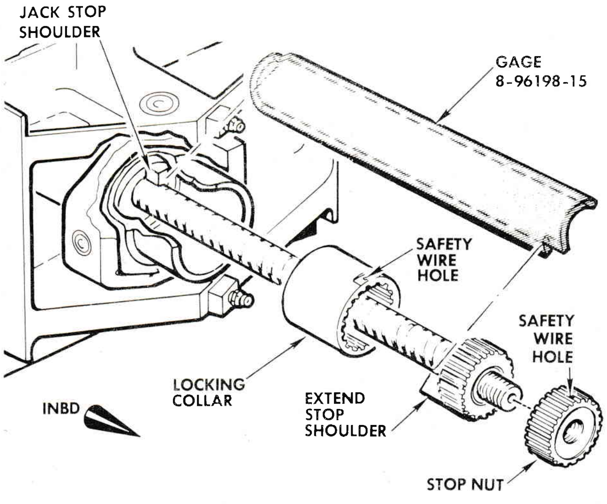


h. *Deleted.*

i. Install ramp flex and universal drive shafts, and shaft gearboxes. Installation is the reverse of removal. Do not install crossover flex shaft.

j. Adjust the forward jacks retract stops as follows:
   1. Use gage 8-96198-15 as shown. Gage positions under locking collar.
   2. After adjusting stop to gage, make engagement of locking collar between stop and stop nut. Install safety screw and torque to 5 inch-pounds maximum. Safety-wire and remove gage.

k. Retract left ramp hydraulically and right ramp by hand until stops are contacted.



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l. Adjust ramp extend stops on inboard end of forward jacks as follows:
   1. Use gage 8-96198-15 as shown in application diagram. Gage positions under locking collar.
   2. Hold extend stop at this point. Install stop nut on shaft and turn until contact is made with stop; align splines. If stop does not fit in notch of gage, start stop nut rotation on another thread of screw.
   3. Engage stop and stop nut by sliding locking collar over stop and stop nut. Align safety-wire holes and install safety wire; remove gage.

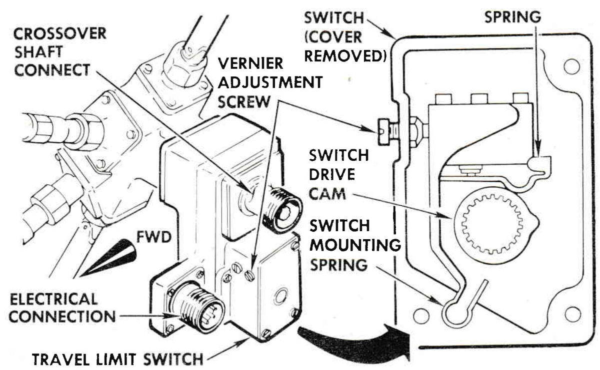
NOTE

RECESSED FACE OF STOP NUT MUST NOT EXTEND BEYOND END OF JACK SCREW.

m. Extend left ramp enough to permit insertion of a 0.090 inch temporary shim on the retract stop face of both left forward screw jacks. Retract left ramp until stops engage - (right ramp retract stops engaged).

Figure 4-9. Replacement and Rigging, Variable Ramp (Sheet 3 of 4)

n. On airplanes equipped with ramp retract travel limit switch, adjust ramp retract travel limit switch to actuate as follows:
1. Extend right ramp by hand 0.10 inch from the retract position; adjust switch to actuate at this point. Coarse adjustment is accomplished by removing cover plate from switch assembly. Depress and rotate switch drive cam in direction necessary to cause cam to actuate switch; re-engage cam. Fine or vernier adjustment is accomplished by turning adjustment screw on side of switch assembly. Install switch cover plate.
2. Retract right ramp by hand to the full retract position.

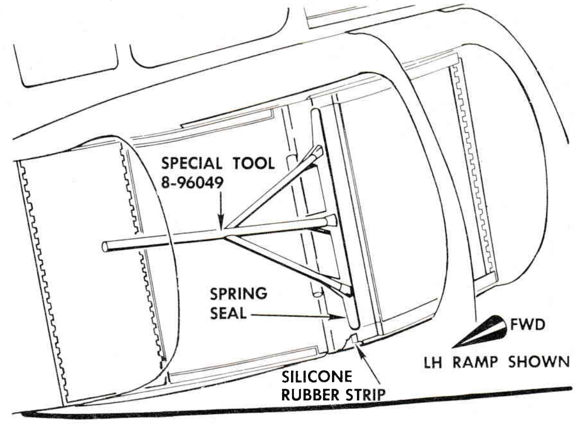


o. Install crossover flex shaft between left and right ramp gearboxes. Remove rigging tools.
p. With a man in the aft portion of inlet duct, extend the ramps hydraulically to the full extended position. Remove temporary shims installed in step "m." Re-check extend position. Install covers over inboard end of jacks and lockwire cover screws.
q. Remove jack to ramp attachment bolts; remove ramp center section and dummy door assembly from inlet duct. Install jack rod holding tool 8-96212 (2) in rod ends to prevent rod rotation.

CAUTION

EXERCISE EXTREME CARE NOT TO ROTATE JACK ROD ENDS AT THIS TIME. ROTATED ROD ENDS WILL REQUIRE RE-RIGGING OF SYSTEM.

r. Prepare and install ramps as follows:
1. Remove dummy door from ramp center section.
2. Position ramp forward section to center section; install hinge pin.
3. Place ramp forward and center section assembly in inlet duct.
4. Remove jack rod end holding tool 8-96212(2).
5. Install jack to ramp attachment bolts.
6. Connect ramp center section seal hinge to ramp if applicable.
7. Connect ramp forward and center section seal air line to fuselage fitting.
8. Connect ramp forward section bleed air flex ducts to ramp if applicable.



s. Make engagement of ramp aft section to center section. If ramp seal spring is installed on aft edge of center section, use special tool 8-96049 to depress spring when making ramp section engagement.
t. Install aft ramp section seal air hose and hinge pin, forward ramp hinge pin and access cover, and dorsal fairing section. Installation of these components is essentially the reverse of removal.
u. Install jack access doors in armament bay area.
v. Perform operational checkout of the ramp system.
w. Actuate ramp to fully retracted position; remove actuation equipment.
x. Reinstall refrigeration unit and heat exchanger.

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Figure 4-9. Replacement and Rigging, Variable Ramp (Sheet 4 of 4)

d. Remove lines (3) attached to valve.

e. Remove bolts (2) and screw attaching valve to structure; remove valve.

f. Installation of the pneumatic selector valve is essentially the reverse of removal.

g. Charge and leak test variable ramp high-pressure pneumatic system. Refer to T. O. 1F-106A-2-3 for this procedure.

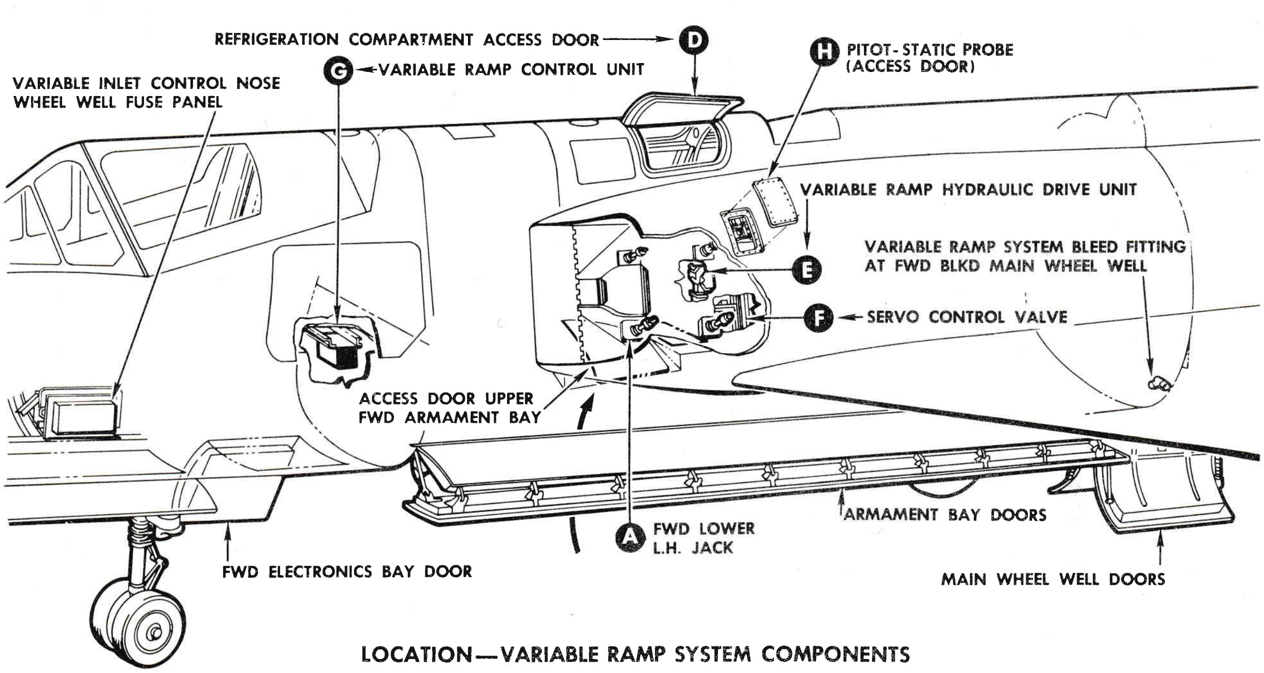
h. Conduct operational checkout of variable ramp system.

4-64. REPLACEMENT, VARIABLE RAMP SYSTEM HYDRAULIC SHUTOFF VALVE.

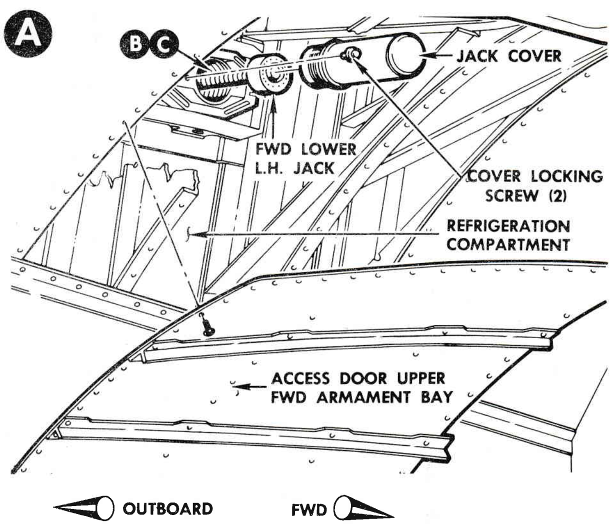
a. Remove the "VAR INLET OVERRIDE" fuse from the cockpit left fuse panel to prevent accidental high pressure pneumatic operation.

b. Relieve hydraulic system pressure by operating elevons. Refer to T. O. 1F-106A-2-3 for this procedure.

c. *On F-106A airplanes,* gain access to the hydraulic shutoff valve through the access door along centerline of missile bay roof. *On F-106B airplanes,* gain access through the refrigeration compartment access door. The valve is located on left side of refrigeration compartment.



LOCATION—VARIABLE RAMP SYSTEM COMPONENTS



NOTE

DETAILS A B C ROTATED 180° FOR CLARITY

NOTE

THE VARIABLE RAMP ATTACHED TO THE JACK BEING REMOVED, MUST BE REMOVED TO FACILITATE JACK REMOVAL.

PREPARATION

a. Operate ramps to the fully extended position. Refer to ramp system hydraulic purging procedure in this handbook section for this procedure.
b. Open armament bay doors as required to facilitate component removal. Refer to T.O. 1F-106A-2-12 for opening procedure.
c. Relieve hydraulic system pressure by operating elevons. Refer to T.O. 1F-106A-2-7 for procedure.
d. Relieve high pressure pneumatic system pressure at variable ramp system bleed fitting and at main pneumatic system bleed fitting. Fittings are located on the forward bulkhead of the main wheel well. Refer to T.O. 1F-106A-2-3 for this procedure.
e. Remove the following system fuses and placard fuse receptacles to prevent inadvertent operation of system:
   1. "INLET CONT"—nose wheel well fuse panel, 115-volt nonessential bus.
   2. "INLET CONT"—nose wheel well fuse panel, 28-volt nonessential bus.
   3. "VAR INLET OVERRIDE"—cockpit lefthand fuse panel, 28-volt nonessential bus.
f. Remove air conditioning system heat exchanger and refrigeration unit. Refer to T.O. 106A-2-6 for this procedure.

VARIABLE RAMP JACK, REMOVAL

a. Gain access to ramp upper jacks through the refrigeration compartment access door. Gain access to ramp lower jacks through access plates in the upper surface of the forward armament bay.

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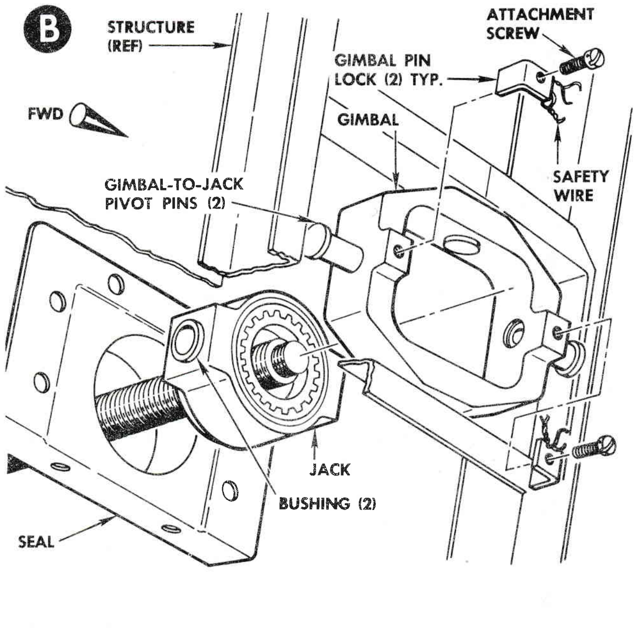
NOTE

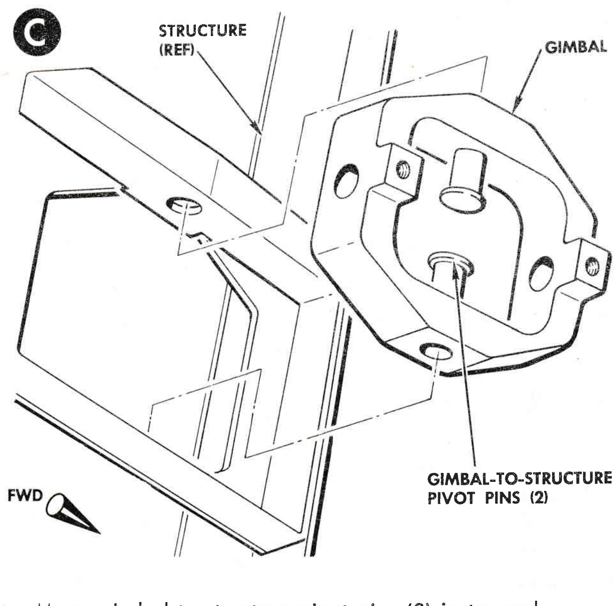
FORWARD, LOWER, LEFT-HAND JACK REMOVAL SHOWN. REMOVAL OF OTHER JACKS SIMILAR.

b. Perform all steps of preparation procedure; remove access plate in upper surface of left-hand armament bay.
c. Remove cover from inboard end of jack.

Figure 4-10. Replacement, Variable Ramp System Components (Sheet 1 of 3)



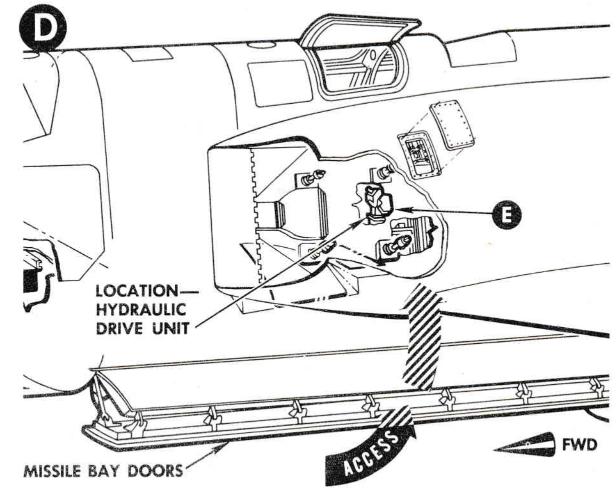
d. Remove screwjack seal.
e. Cut safety wire and remove gimbal pin locks (2).
f. Move gimbal-to-jack pivot pins away from jack; remove jack from gimbal.



g. Move gimbal-to-structure pivot pins (2) in toward center of gimbal; remove gimbal.

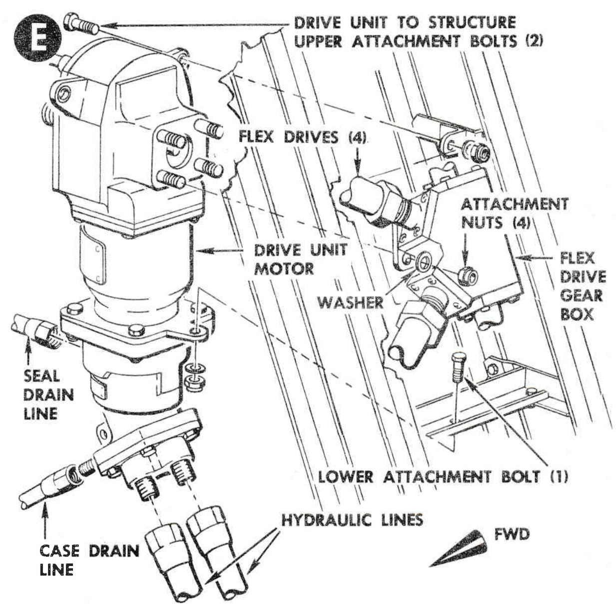
INSTALLATION

a. Installation is essentially the reverse of removal. Safety-wire all nuts, bolts, and gimbal lock pins.
b. Use sealant EC1293 (FSN 8030-576-8360) between screwjack seal and fuselage.
c. Perform ramp rigging procedure.
d. Perform all steps of the final cleanup procedure (sheet 3).



VARIABLE RAMP HYDRAULIC DRIVE UNIT, REMOVAL

a. Perform steps "a" through "e" of preparation procedure (Sheet 1).
b. Gain access to drive unit through the access door along centerline of missile bay roof at approximately sta. 253.



c. Remove lines attached to drive unit. Provide receptacle for drainage.
d. Remove attachment nuts holding flex drive gear box to drive unit.
e. Remove attachment bolts holding drive unit to structure; remove drive unit.

INSTALLATION

a. Installation is essentially the reverse of removal. Safety-wire all nuts and bolts in groups of 2 or 3.
b. Perform ramp rigging procedure.
c. Perform all steps of the final cleanup procedure (sheet 3).

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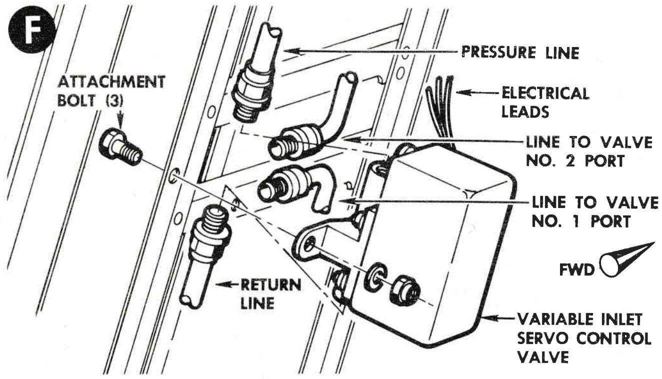
Figure 4-10. Replacement, Variable Ramp System Components (Sheet 2 of 3)

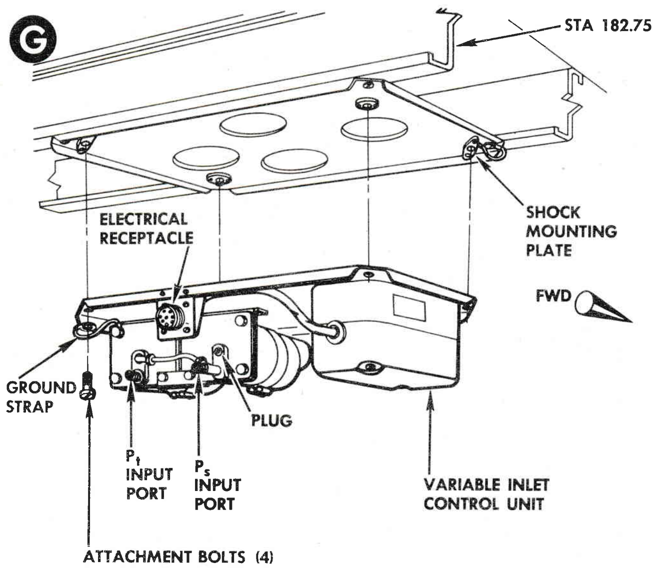


VARIABLE INLET SERVO CONTROL VALVE, REMOVAL.

a. Perform step "b," of preparation procedure.
b. Gain access to the valve through the access door along the top centerline of missile bay.
c. Remove electrical leads from valve.
d. Remove lines attached to valve. Provide receptacle for drainage.
e. Remove bolts attaching valve to structure; remove valve.

INSTALLATION

a. Installation is essentially the reverse of removal.
b. Perform all steps of the final cleanup procedure. See detail "G".



VARIABLE INLET CONTROL UNIT, REMOVAL.

a. Gain access to the control unit through the aft lower electronics compartment.
b. Remove electrical leads from control unit.
c. Remove lines attached to control unit.
d. Remove attachment bolts holding control unit to structure; remove control unit.

INSTALLATION

a. Installation is essentially the reverse of removal.

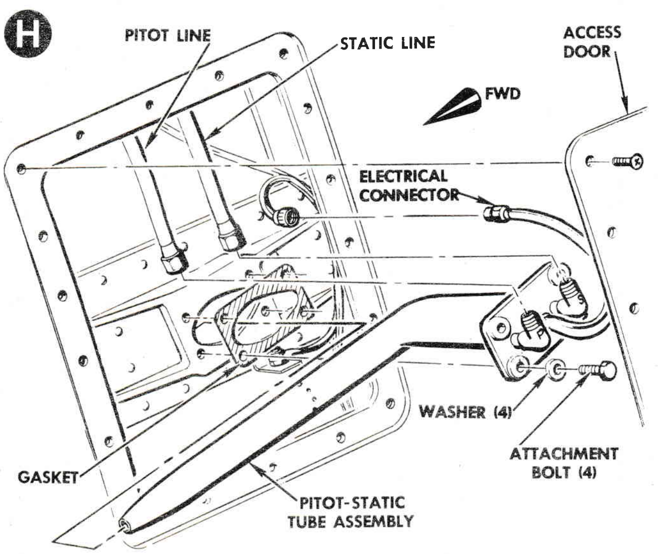
NOTE

IF RAMP PITOT OR STATIC TUBE IS REPLACED, THE NEW TUBE MUST NOT BE INCREASED IN LENGTH. THE LENGTH OF THE TUBE DETERMINES PROPER SYSTEM FUCTION.

b. Conduct ramp pitot static system leak check.
c. Perform all steps of the final cleanup procedure.

FINAL CLEANUP

a. Replace fuses removed in step "d" of preparation procedure (sheet 1).
b. Conduct operational checkout of variable ramp system.



VARIABLE INLET PITOT-STATIC TUBE, REMOVAL.

a. Check that pitot-static heat switch in cockpit is in the "OFF" position.
b. Remove access door from outboard side of engine air inlet duct.
c. Disconnect electrical connector from pitot tube assembly.
d. Disconnect pitot and static lines from pitot tube assembly.
e. Remove attachment bolts (4); remove pitot tube.

INSTALLATION:

a. Installation is essentially the reverse of removal.
b. Use new gasket on installation. Fill the void between pitot-static probe head and duct skin with sealant, EC1293 (FSN 8030-576-8360).
c. Safety-wire probe attachment bolts in pairs.
d. Conduct ramp pitot-static system leak check upon completion of replacement.

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Figure 4-10. Replacement, Variable Ramp System Components (Sheet 3 of 3)

d. Remove electrical leads from valve.

e. Remove lines (2) attached to valve. Provide receptacle for drainage.

f. Remove bolts (2) attaching valve to structure; remove valve.

g. Installation of the variable ramp system hydraulic shutoff valve is essentially the reverse of the removal procedure.

h. Bleed ramp hydraulic system. Refer to T.O. 1F-106A-2-3 for this procedure.

i. Conduct an operational checkout of the variable ramp system.

4-65. REPLACEMENT, VARIABLE RAMP SYSTEM HYDRAULIC SHUTTLE VALVE.

a. Remove the "VAR INLET OVERRIDE" fuse from the cockpit left fuse panel to prevent accidental high pressure pneumatic operation.

b. Relieve hydraulic system pressure by operating elevons.

c. *On F-106A airplanes,* gain access to the hydraulic shuttle valve through the access door along centerline of missile bay roof. *On F-106B airplanes,* gain access through the refrigeration compartment access door. The valve is located on left side of refrigeration compartment at approximately sta. 290.0.

d. Remove lines (3) attached to valve. Provide receptacle for drainage. *Applicable to F-106A airplanes 57-2453, and F-106B airplanes 57-2517; and all other airplanes after incorporation of TCTO 1F-106-681,* remove restrictor from pneumatic inlet port of valve.

e. Remove bolts (2) attaching valve to structure; remove valve.

f. Installation of the variable ramp system hydraulic shuttle valve is essentially the reverse of the removal procedure.

NOTE

On applicable airplanes, when installing restrictor ascertain that restricted flow is toward shuttle valve.

g. Bleed ramp hydraulic system. Refer to T.O. 1F-106A-2-3 for this procedure.

h. Conduct an operational checkout of the variable ramp system.

4-66. REPLACEMENT, VARIABLE RAMP SYSTEM HYDRAULIC BYPASS VALVE.

a. Remove the "VAR INLET OVERRIDE" fuse from the cockpit left fuse panel to prevent accidental high pressure pneumatic operation.

b. Relieve hydraulic system pressure by operating elevons.

c. *On F-106A airplanes,* gain access to the hydraulic bypass valve through the access door along centerline of missile bay roof. *On F-106B airplanes,* gain access through the refrigeration compartment access door. The valve is located on left side of refrigeration compartment at approximately sta. 290.0.

d. Remove electrical leads from valve.

e. Remove lines (3) attached to valve. Provide receptacle for drainage.

f. Remove bolts (3) attaching valve to structure; remove valve.

g. Installation of the variable ramp system hydraulic bypass valve is essentially the reverse of the removal procedure.

h. Bleed ramp hydraulic system. Refer to T.O. 1F-106A-2-3 for this procedure.

i. Conduct an operational checkout of the variable ramp system.

4-67. REPLACEMENT, VARIABLE RAMP SYSTEM HYDRAULIC DUMP VALVE.

a. Remove the "VAR INLET OVERRIDE" fuse from the cockpit left fuse panel to prevent accidental high pressure pneumatic operation.

b. Relieve hydraulic system pressure by operating elevons.

c. *On F-106A airplanes,* gain access to the hydraulic dump valve through the access door along the centerline of missile bay roof. *On F-106B airplanes,* gain access through the refrigeration compartment. The valve is located on left side of refrigeration compartment at approximately sta. 290.0.

d. Remove electrical leads from valve.

e. Remove lines (3) attached to valve. Provide receptacle for drainage.

f. Remove bolts (3) attaching valve to structure; remove valve.

g. Installation of the variable ramp system hydraulic dump valve is essentially the reverse of the removal procedure.

h. Bleed ramp hydraulic system. Refer to T.O. 1F-106A-2-3 for this procedure.

i. Conduct an operational checkout of the variable ramp system.

ADJUSTMENT

4-68. VARIABLE RAMP SYSTEM RIGGING.

4-69. Equipment Requirements.

For the variable ramp system rigging equipment requirements, refer to paragraph 4-52.

4-70. Procedure.

For the variable ramp system rigging procedure see figure 4-9.

SERVICING

4-71. BLEEDING, VARIABLE RAMP HYDRAULIC SYSTEM.

After each emergency actuation of the variable ramp system, or after replacement of any ramp hydraulic system component, it is necessary that the hydraulic system be bled of air. Refer to paragraph 4-31 for this procedure.

4-72. DRAINING, RAMP PITOT-STATIC SYSTEM DRAIN TRAPS.

Applicable to F-106A airplanes, the drain traps (2) are located on the forward bulkhead of the armament bays. *Applicable to F-106B airplanes,* the drain traps (2) are located on the aft bulkhead of the lower aft electronics compartment in the missile bay.

a. Open armament bays. Refer to T.O. 1F-106A-2-12 for this procedure.

b. Remove caps from pitot and static lines, drain traps. Allow moisture to drain from lines.

c. Dry inside of drain trap caps and reinstall.

4-73. BLEEDING AIR PRESSURE, VARIABLE RAMP EMERGENCY PNEUMATIC SYSTEM.

a. Gain access to pneumatic bleed valve through the left main wheel well. Plug is installed on forward bulkhead, above the main high-pressure pneumatic system bleed valve.

NOTE

Refer to T.O. 1F-106A-2-3 for bleeding procedures for the entire high-pressure pneumatic system.

b. Remove screw from bleed valve and loosen valve 1½ turns. Allow all pressure to escape.

WARNING

Plug will be expelled with explosive force if loosened excessively before pressure has bled off.

4-74. CHARGING, VARIABLE RAMP EMERGENCY HIGH PRESSURE PNEUMATIC SYSTEM.

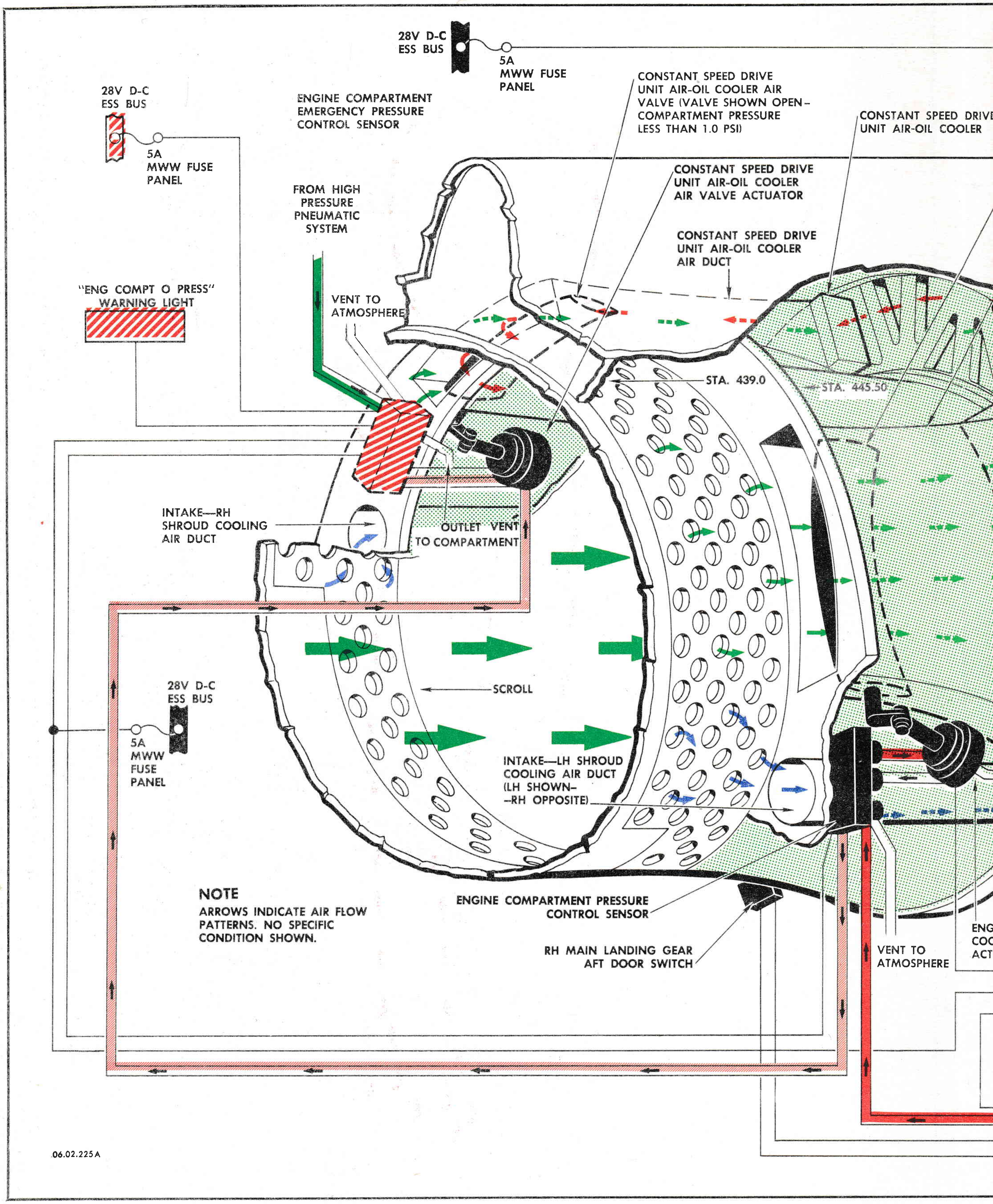
Charging of the variable ramp emergency high-pressure pneumatic system is accomplished as a part of the charging procedure for the airplane's main high-pressure pneumatic system. Refer to T.O. 1F-106A-2-3 for this procedure.

COOLING AIRFLOW SYSTEM

DESCRIPTION

4-75. GENERAL.

The engine compartment cooling air flow is divided into two flow systems that are provided to cool two separated engine area compartments. The first compartment consists of the engine accessory area that receives cooling air through the constant-speed drive unit air-oil cooler and the engine air-oil cooler. The second compartment consists of the combustion chamber and turbine area. This



28V D-C
ESS BUS
5A
MWW FUSE
PANEL
28V D-C
ESS BUS
5A
MWW FUSE
PANEL
ENGINE COMPARTMENT
EMERGENCY PRESSURE
CONTROL SENSOR
CONSTANT SPEED DRIVE
UNIT AIR-OIL COOLER AIR
VALVE (VALVE SHOWN OPEN–
COMPARTMENT PRESSURE
LESS THAN 1.0 PSI)
CONSTANT SPEED DRIVE
UNIT AIR-OIL COOLER
CONSTANT SPEED DRIVE
UNIT AIR-OIL COOLER
AIR VALVE ACTUATOR
FROM HIGH
PRESSURE
PNEUMATIC
SYSTEM
CONSTANT SPEED DRIVE
UNIT AIR-OIL COOLER
AIR DUCT
"ENG COMPT O PRESS"
WARNING LIGHT
VENT TO
ATMOSPHERE
STA. 439.0
STA. 445.50
INTAKE—RH
SHROUD COOLING
AIR DUCT
OUTLET VENT
TO COMPARTMENT
SCROLL
28V D-C
ESS BUS
5A
MWW
FUSE
PANEL
INTAKE—LH SHROUD
COOLING AIR DUCT
(LH SHOWN–
–RH OPPOSITE)
NOTE
ARROWS INDICATE AIR FLOW
PATTERNS. NO SPECIFIC
CONDITION SHOWN.
ENGINE COMPARTMENT PRESSURE
CONTROL SENSOR
RH MAIN LANDING GEAR
AFT DOOR SWITCH
VENT TO
ATMOSPHERE
06.02.225A

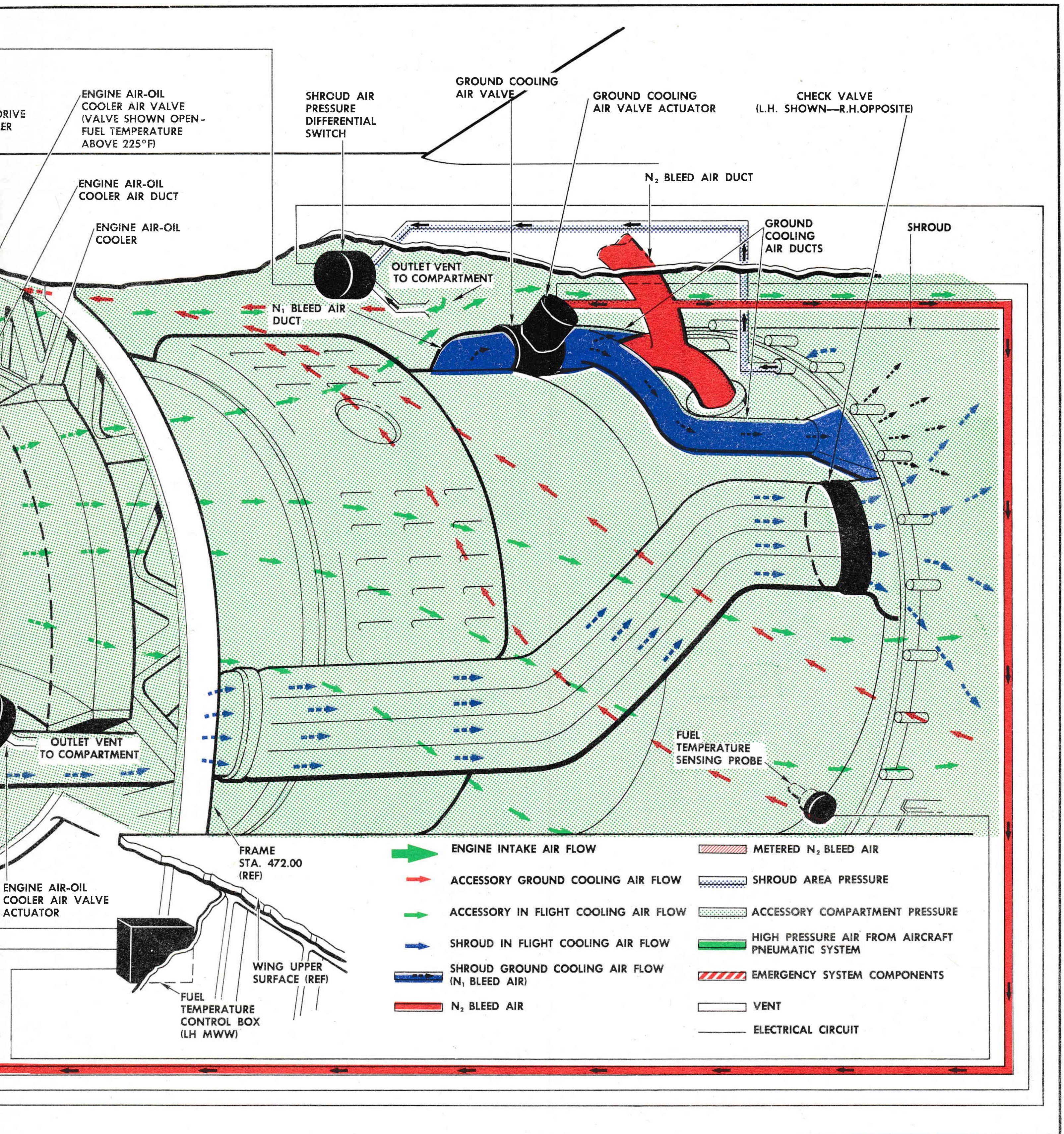


Figure 4-11. Engine and Accessory Cooling System Schematic

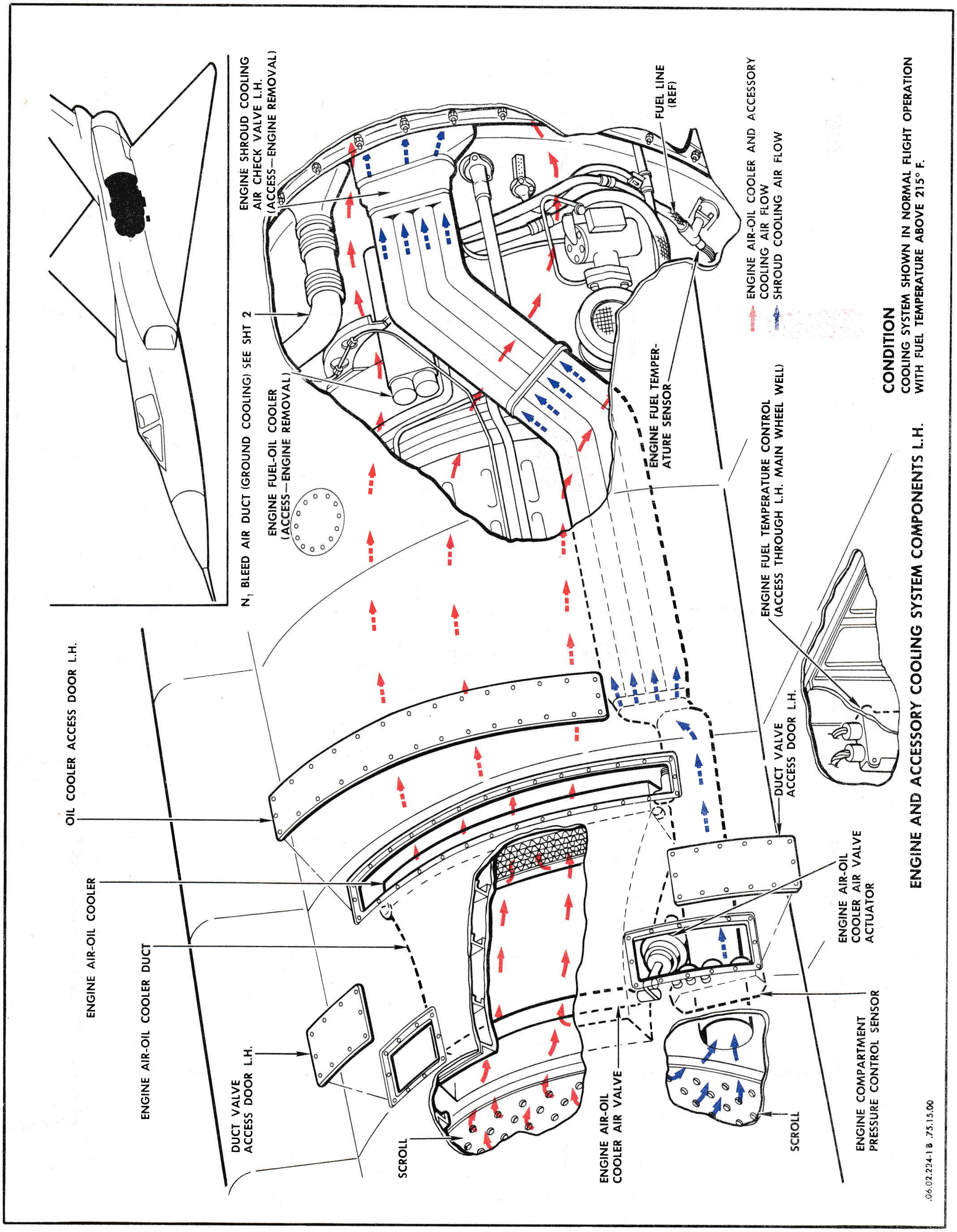


Figure 4-12. Engine and Accessory Cooling System (Sheet 1 of 2)

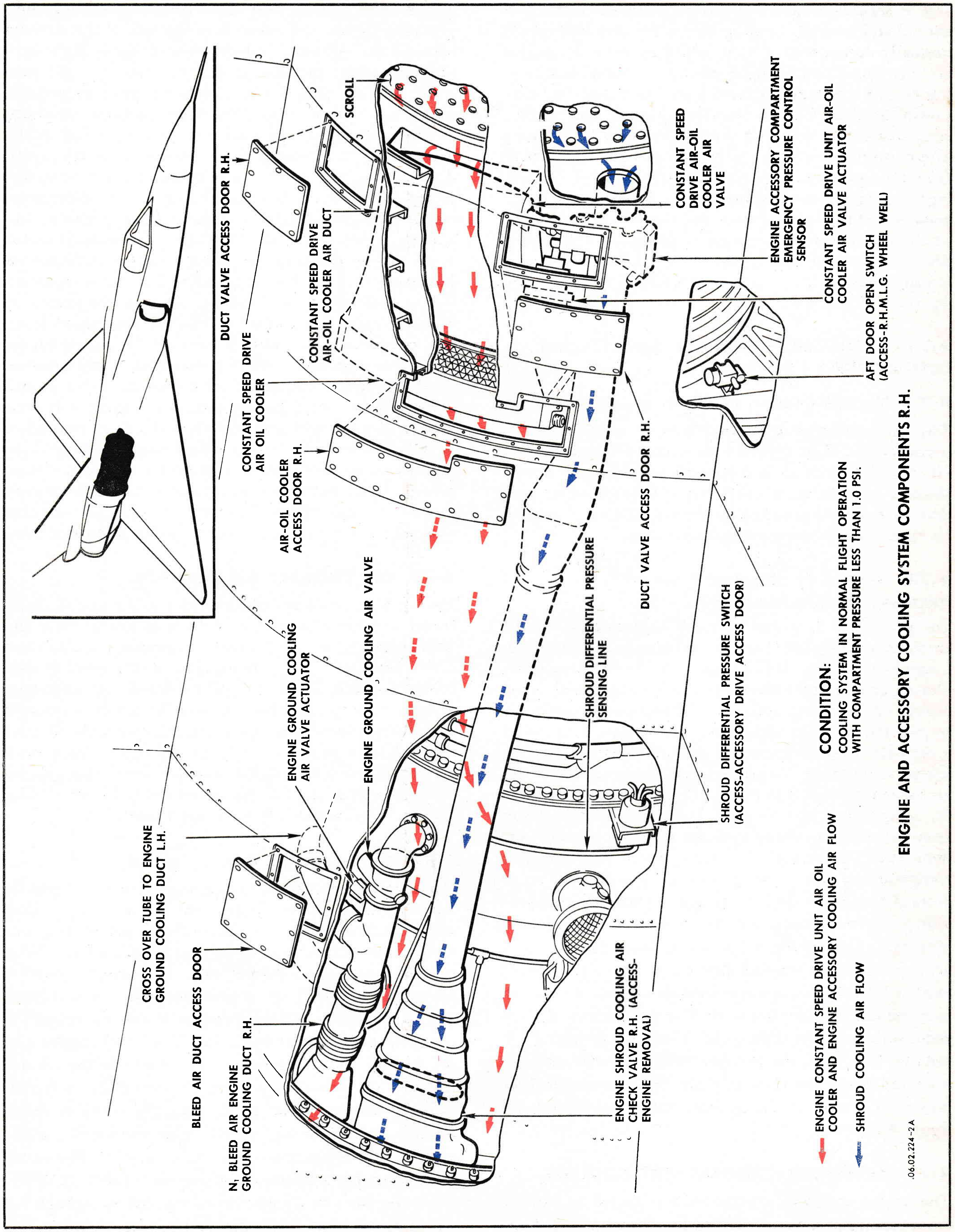


Figure 4-12. Engine and Accessory Cooling System (Sheet 2 of 2)

area is separated from the accessory area by a titanium shroud and firewall. Cooling air for the shrouded area is normally ducted from a scroll which encircles the engine air inlet duct. During engine ground run operations, cooling air for this area is ducted from the engine N_1 compressor section. The combustion chamber and turbine compartment cooling air is vented overboard between the afterburner nozzle and the engine shroud. Cooling air from the accessory compartment passes between the fuselage and the turbine area shroud and is vented overboard between the fuselage tail cone and the shroud. Operation of the cooling air flow system is automatic with operation of the engine and airplane. For schematic and component location illustrations of the cooling system, see figures 4-11 and 4-12.

4-76. COMBUSTION CHAMBER AND TURBINE COMPARTMENT COOLING.

4-77. Normal Cooling in Flight.

The combustion chamber and turbine compartment is normally cooled in flight by air ducted from the engine air inlet duct. The air is routed aft to the engine shroud through two ducts. A check valve is installed in each duct, immediately ahead of the shroud, to prevent cooling air reverse flow during ground operation.

4-78. Ground Cooling and Pressure Augmentation During Flight.

For ground cooling and pressure augmentation of the shrouded combustion chamber and turbine compartment, a supply of cooling air is ducted from the N_1 compressor. During certain flight maneuvers, such a climb with afterburner on, pumping action of the engine exhaust tends to pull the air from within the shroud area. This causes a negative pressure that could collapse the shroud if permitted to build up. To prevent this condition, a solenoid air valve is provided to control air flow from the engine N_1 compressor bleed air port. This valve receives power from two switches wired in series; the main landing gear door open switch and a pressure switch in the engine compartment. The door open switch prevents the valve from closing when the landing gear is extended, thus providing N_1 compressor air for cooling during ground operation. During flight operation, the pressure switch actuates when the pressure differential within the shroud reaches 2.5 psi. This operates the solenoid valve which in turn permits N_1 compressor air to enter the shroud. This reduces the pressure differential. When the differential is reduced to 1.3 psi, the pressure switch actuates the solenoid and causes the valve to close. For a schematic illustration of system in the ground cooling condition, see figure 4-13.

4-79. ACCESSORY COMPARTMENT COOLING.

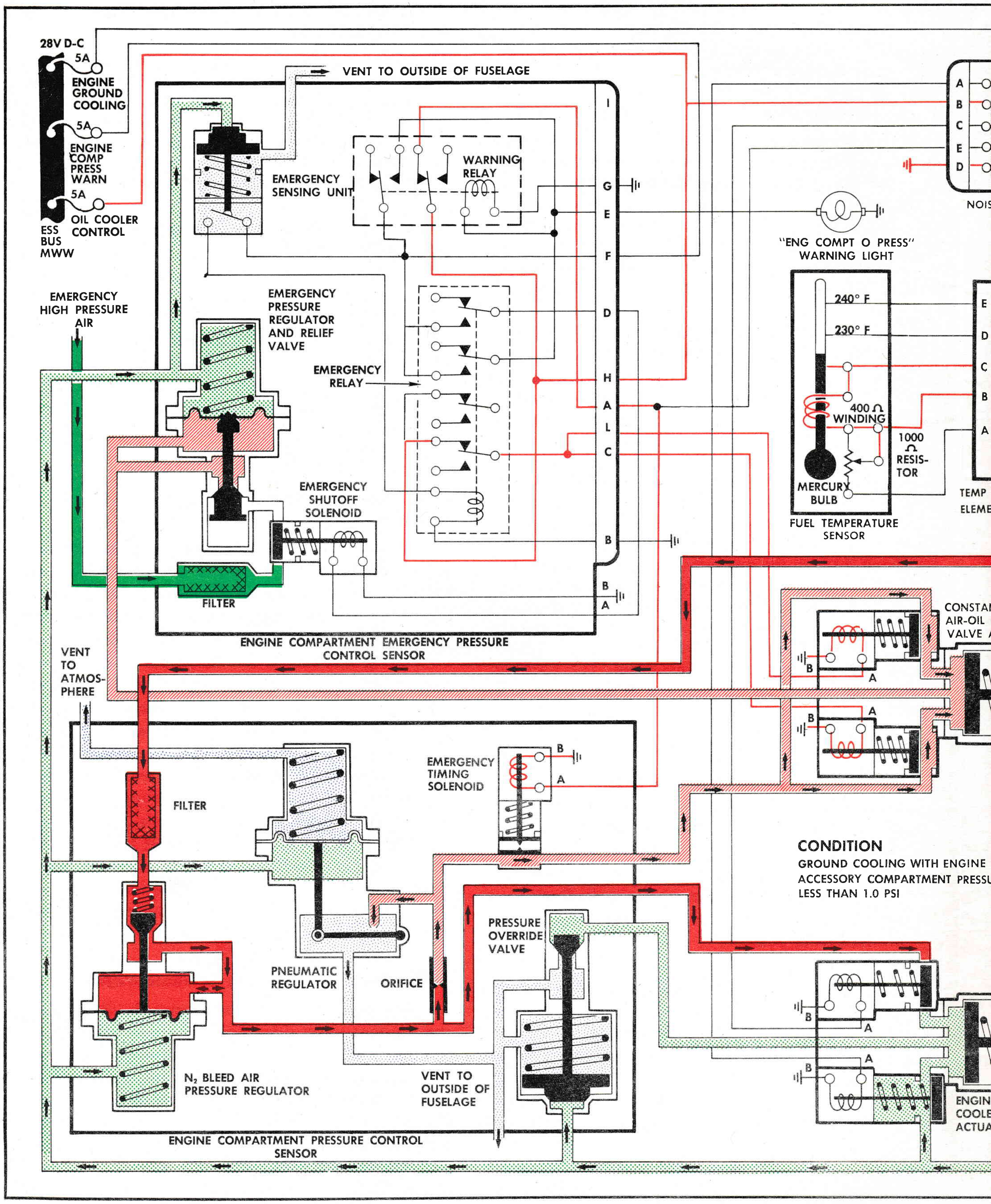
The engine accessory compartment is cooled by exit air from the engine air-oil cooler and the constant-speed air-oil cooler. The air flows through the engine accessory compartment, passes over the burner and turbine compartment shroud and exhausts at the rear of the airplane between the tail cone and the shroud. Some flight conditions increase pressure at the tail cone area and tend to increase the accessory compartment pressure. In order to protect the fuselage from high pressures resulting from this condition, pressure control is provided by the modulating air valves in the engine and constant-speed drive oil cooling systems. The constant-speed drive air-oil cooler air valve is open as long as the differential between engine accessory compartment pressure and ambient is below 1.0 psi. The valve is modulated closed as the engine accessory compartment pressure differential increases to 1.5 psi. The engine air-oil cooler is regulated by the fuel temperature sensing phase of the system. It remains under this control as long as the engine accessory compartment pressure is less than 2.0 psi. At 2.0 psi the fuel temperature control is overriden by the pressure control and the engine air-oil cooler air valve is also closed. At this point the compartment ventilation is completely shut off, with the exception of a fixed amount of air allowed to leak past the closed constant-speed drive unit oil cooler air valve. At 1.50 psi the fuel temperature control again becomes operative and the engine air-oil cooler air valve opens. The source of power for valve operation is engine bleed air controlled by solenoid valves.

4-80. OIL COOLING AIR CONTROL.

During flight, cooling air is provided to the engine air-oil cooler and the constant-speed drive oil cooler from the engine air inlet duct by means of a common annular bleed scroll. Separate ducts route the air from the scroll to each cooler. Constant-speed drive oil cooling for ground operation is accomplished by reversing the air flow through the constant-speed drive oil cooler, using engine air inlet duct negative pressure as the motive force. There is no air flow through the engine air-oil cooler during ground operation, since the fuel-oil cooler is capable of cooling the engine oil sufficiently for ground operation.

4-81. Engine Air-Oil Cooler Control.

Engine air-oil cooler air flow is regulated by a butterfly type throttling valve located in the air supply duct upstream from the cooler. The valve is electrically controlled, pneumatically actuated, and modulated according to the engine fuel temperature. A pressure override feature is actuated by engine accessory compartment internal pressure. Fuel temperature is used to dictate the need for air-oil cooler operation. The air-oil cooler and the fuel-oil cooler are mounted in series in the oil out line, the oil passing first through the air-oil cooler. In order to minimize internal air drag, the air-oil cooler is initially closed, and the fuel-oil cooler provides the necessary cooling requirements for the engine oil. The maximum allowable temperature of the fuel is 110°C (230°F). The valve remains closed preventing airflow through the air-oil cooler when fuel temperature is less than 101.7°C (215°F), and modulates to maintain fuel temperature at



28V D-C
5A
ENGINE GROUND COOLING
5A
ENGINE COMP PRESS WARN
5A
OIL COOLER CONTROL
ESS BUS MWW
VENT TO OUTSIDE OF FUSELAGE
EMERGENCY SENSING UNIT
WARNING RELAY
EMERGENCY HIGH PRESSURE AIR
EMERGENCY PRESSURE REGULATOR AND RELIEF VALVE
EMERGENCY RELAY
EMERGENCY SHUTOFF SOLENOID
FILTER
ENGINE COMPARTMENT EMERGENCY PRESSURE CONTROL SENSOR
"ENG COMPT O PRESS" WARNING LIGHT
NOIS
240° F
230° F
400 Ω WINDING
1000 Ω RESIS-TOR
MERCURY BULB
FUEL TEMPERATURE SENSOR
TEMP ELEME
CONSTAN AIR-OIL VALVE A
VENT TO ATMOS-PHERE
FILTER
EMERGENCY TIMING SOLENOID
CONDITION
GROUND COOLING WITH ENGINE ACCESSORY COMPARTMENT PRESSU LESS THAN 1.0 PSI
PNEUMATIC REGULATOR
ORIFICE
PRESSURE OVERRIDE VALVE
N₂ BLEED AIR PRESSURE REGULATOR
VENT TO OUTSIDE OF FUSELAGE
ENGINE COMPARTMENT PRESSURE CONTROL SENSOR
ENGIN COOLE ACTUA

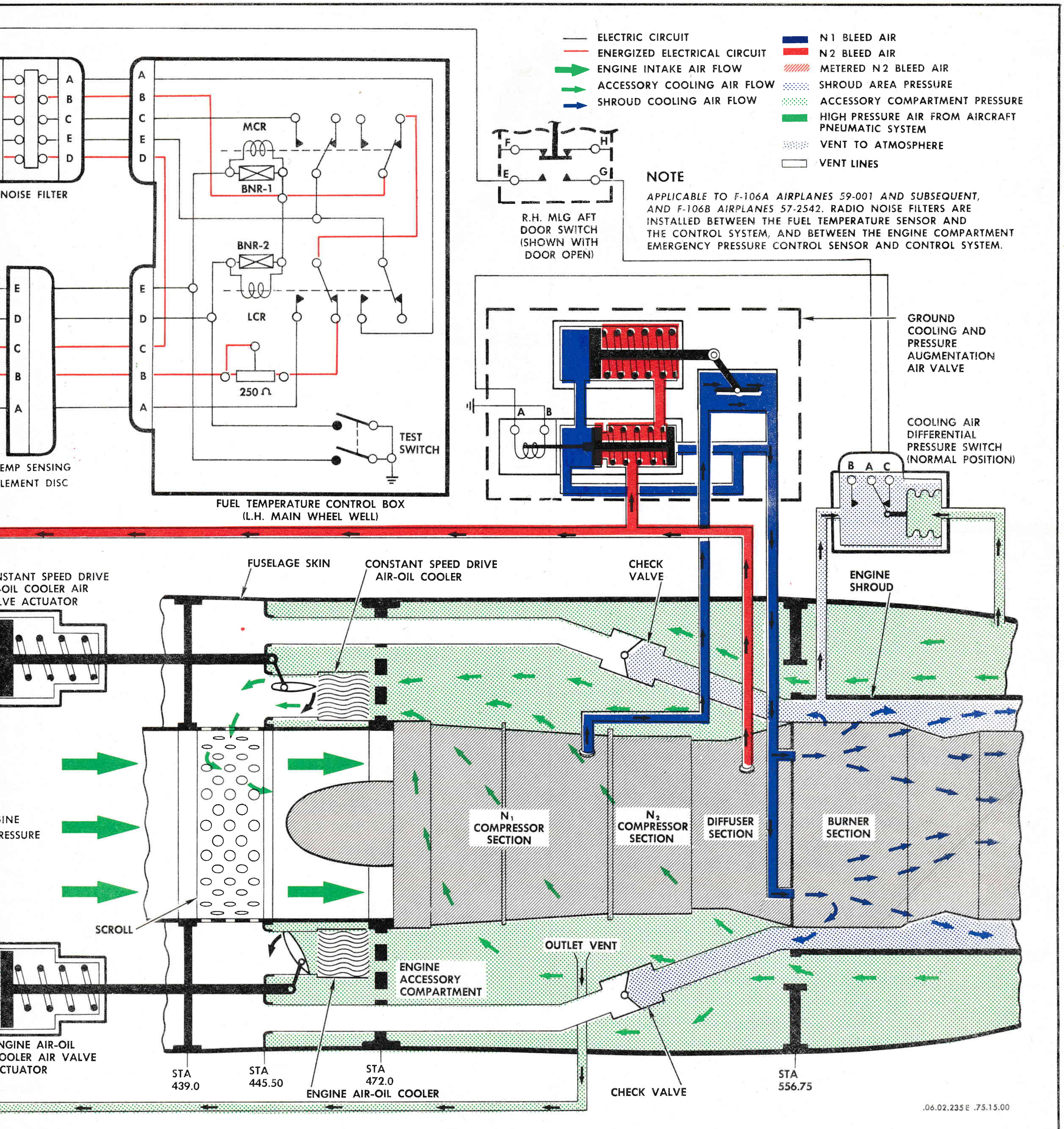


Figure 4-13. Engine and Accessory Cooling System, Ground Cooling Operation

105.8° ±4.2°C (222.5° ±7.5°F). The temperature control becomes inoperative when the engine compartment pressure rises to 2.0 psi and does not regain control until the pressure is reduced to 1.5 psi.

4-82. Constant-Speed Drive Oil Cooler Control.

The constant-speed drive oil cooler air flow is regulated by a butterfly type throttling valve located in the cooling air supply duct upstream from the cooler. This valve is controlled and actuated pneumatically, and is modulated according to the pressure requirements in the engine accessory compartment. In the closed position, sufficient air is permitted to pass through the valve for minimum oil and accessory compartment cooling requirements.

4-83. Emergency Operation, Accessory Compartment Cooling Air Control.

In the event of failure of the high-pressure bleed air system, or other failure causing the engine accessory compartment pressure to rise to 3.0 psi, the accessory compartment emergency air control system is automatically activated. The emergency system uses high-pressure air and electrical power, and when energized closes both the engine air-oil cooler air valve and the constant-speed drive oil cooler air valve. The constant-speed oil cooler air valve is closed by high-pressure pneumatic system air routed through the compartment emergency pressure sensor. The engine air-oil cooler air valve is closed by the actuator spring action. The electrical signal actuates solenoids to close the air inlet control valve and open the air outlet valve. Simultaneously, a warning light is energized on the pilot's emergency warning panel. The warning light will remain on for the duration of the flight, since the system can only be reset on the ground.

NOTE

To reset the emergency control system and to extinguish the warning light, momentarily remove electrical power from the airplane, or remove and reinstall the "COMP PRESS WARN" fuse from the main wheel well fuse panel. This procedure deenergizes a feedback circuit that holds the sensor electrical relays in the emergency position.

When the warning light goes on, the pilot must reduce the speed of the airplane to mach 1 or less within 2½ minutes of the initial warning. This is necessary in order to conserve the high-pressure pneumatic supply. When the engine accessory compartment pressure is reduced to 0.75 psi, the engine air-oil cooler control valve remains closed. At the same time, the constant-speed oil cooler air control valve is returned to control of the normal system. Emergency control will be resumed if the compartment pressure again builds up to 3.0 psi. A time delay is designed into the emergency pressure control system to limit the reopening cycle to a minimum of 30 seconds.

4-84. ENGINE COMPARTMENT PRESSURE CONTROL SENSOR.

The engine accessory compartment pressure control sensor component is composed of five units. These units are: a controlling orifice for bleed air pressure regulator, the constant-speed drive unit oil cooler air valve actuating air, the constant-speed drive unit oil cooler air valve pressure modulator, the emergency timing solenoid valve, and the engine oil temperature control pressure override.

4-85. Engine Accessory Compartment Bleed Air Pressure Regulator.

The engine accessory compartment bleed air pressure regulator is provided to regulate N_2 compressor bleed air to 60 psi pressure. Air flow from the regulator is routed through two ports. One port is connected to the inlet side of the engine air-oil cooler valve actuator. The second port routes air through a controlling orifice and an emergency timing solenoid to the constant-speed oil cooler valve actuator. A line tees off of the constant-speed line to the pressure modulator.

4-86. Constant-Speed Oil Cooler Air Valve Pressure Modulator.

The constant-speed oil cooler air valve pressure modulator is provided to vary the air pressure to the constant-speed oil cooler air control actuator according to engine accessory compartment pressure. This modulates the valve to maintain proper compartment pressure by bleeding off varying amounts of the air ported to the cooler air control actuator from the engine bleed air pressure regulator. The pressure modulator operates on pressure differential existing between ambient and engine accessory compartment pressure. The bleed nozzle of the pressure modulator remains open, bleeding off most of the air pressure until the engine accessory compartment pressure is 1.0 psi. higher than ambient. From this point the bleed is gradually reduced until at 1.5 psi the bleed is cut off. This results in gradually increasing pressure in the line to the actuator. This pressure acts upon the cooler air control actuator to modulate the valve toward the closed position.

4-87. Emergency Timing Solenoid Valve.

The emergency timing solenoid valve, in the air line to the constant-speed drive unit oil cooler valve actuator, provides a means of limiting the amount of emergency pneumatic system air used for emergency valve operation. This is accomplished by timing solenoid action in delaying the reopening cycle of the cooler valve actuator to a minimum of 30 seconds for each cycle when operating on the emergency system. When the emergency system is actuated, the cooler valve actuator solenoid valves are deenergized and closed. Simultaneously the emergency air pressure operates the cooler valve actuator to the closed position. Closing the oil cooler air valve relieves the pressure condition and the emergency system is deenergized, thus shutting off emergency air and opening the actuator solenoid valves. However, the holding coil of the warning relay continues to hold the emergency timing valve deenergized (closed). The air in the actuator, instead of escaping rapidly, bleeds off slowly through a small drilled passage in the timing valve plunger. This limits the emergency operation of the cooler valve actuator to a minimum of 30 seconds for each cycle. The timing valve will remain deenergized for the remainder of the flight.

4-88. Engine Oil Temperature Control Pressure Override.

The engine oil temperature control pressure override provides a means whereby excessive engine accessory compartment pressure overrides temperature control and closes the engine oil cooler air valve. To accomplish this, the pressure override responds to the pressure differential between the engine accessory compartment pressure and ambient. The pressure override valve is normally closed as long as the pressure differential remains below 2.0 psi. When the differential reaches 2.1 psi the valve opens, air exhausts from the actuator, and causes the cooler air valve to close. When the pressure differential is reduced to 1.65 psi the valve closes, allowing the actuator to again respond to temperature control.

4-89. ENGINE FUEL TEMPERATURE CONTROL AND SENSOR.

The fuel temperature control receives signals from the fuel temperature sensor which is located in the main fuel line near the inlet port of the fuel pressurizing and dump valve. The signals are relayed as "open" or "close" signals to the engine air-oil cooler air valve actuator. The control unit has an external push to test button that may be used to simulate a signal for "more cooling" during ground operational check. The fuel temperature sensor is a thermostatic device provided to sense the temperature of fuel that has passed through the fuel-oil cooler. The sensor contains a mercury thermometer tube with a grounded mercury column and contact points in the tube at 110°C (230°F) and 111.5°C (240°F). The sensor also contains a heater element with electrical connections to provide high range and low range rates of heating. When the fuel is cold, neither of the relays in the temperature control box will be energized. The air control valve will remain in its normal position with the inlet solenoid valve closed and the outlet solenoid valve open. At this time power is being supplied through the temperature control unit to the high heat range of the heating element in the temperature sensor. While most of this heat from the heating element is dissipated into the fuel, the temperature of the mercury column is increased several degrees above that of the fuel in the temperature bulb well. As this increase in temperature causes the mercury column to reach the 110°C (230°F) electrode, the "less cooling" relay in the control unit is energized. The "less cooling" relay switches the temperature sensor heating element to the low heat range and signals the actuator outlet solenoid of the engine air-oil cooler air valve to close. With less heat supplied to the mercury column, due to the heating element being on low range, the column will cool and break contact. This deenergizes the "less cooling" relay. With the relay deenergized, the actuator outlet solenoid is open. The heating element is again switched to the high range, and starts a new cycle. If the temperature of the fuel becomes excessive, the mercury will pass the 110°C (230°F) contact and will contact the 111.5°C (240°F) electrode. This energizes the "more cooling" relay in the control unit, which switches power to the inlet solenoid of the cooler actuator to open the air valve. At this time, power to the temperature sensor heating element is off. The energized solenoid permits air to flow into the actuator, moving the air-oil cooler air valve toward the open position to increase the cooling capacity. The sensor mercury column will cool and drop below the 111.5°C (240°F) electrode in a few seconds, switching the heater on the inlet solenoid off. When the fuel temperature is low, the actuator and valve remain in the closed position.

4-90. ENGINE ACCESSORY COMPARTMENT EMERGENCY PRESSURE CONTROL SENSOR.

The engine accessory compartment emergency sensor unit is designed to initiate closing of the engine oil cooler air valve and the constant-speed oil cooler air valve. The closing signal will occur when the pressure differential between the engine accessory compartment and ambient reach 3.0 psi. At this time the sensor will also energize a warning light on the pilot's panel. The sensor consists of an emergency sensing unit, emergency relay, emergency shutoff solenoid, emergency pressure regulator and relief valve, and a warning relay as described in the following paragraphs, 4-91 through 4-95.

4-91. Emergency Sensing Unit.

In operation, engine accessory compartment pressure is ported to the upper surface of the emergency sensing unit piston. Ambient pressure is applied to the lower surface of the piston. When the accessory compartment pressure exceeds ambient pressure by 3.0 psi, the piston moves and actuates an internal switch. This switch energizes the emergency relay. The emergency sensing unit resets when pressure differential drops to 0.75 psi; the emergency relay then returns to the normal position.

4-92. Emergency Relay.

The emergency relay controls five circuits, and performs the following functions:

a. Energizes the emergency shutoff solenoid. This admits high-pressure pneumatic air to the emergency pressure regulator for actuating the constant-speed oil cooler valve.

b. Operates and sets the warning relay.

c. Deenergizes the inlet and outlet solenoids of the engine air-oil cooler air valve actuator causing the valve to close.

d. Deenergizes the two solenoids at the constant-speed oil cooler air valve actuator, permitting the solenoids to close.

4-93. Emergency Shutoff Solenoid.

The emergency shutoff solenoid is provided to control flow of emergency high-pressure air. Operation of the solenoid admits high-pressure air to the emergency pressure regulator for constant-speed oil cooler valve operation.

4-94. Emergency Pressure Regulator.

The emergency pressure regulator is provided to reduce pressure of the emergency high pressure air to 75 psi. Engine accessory compartment pressure in the upper chamber of the regulator works in conjunction with a spring loaded piston to reduce the pressure. A relief valve, which is incorporated in the diaphragm of the regulator, protects the regulator and actuator from high pressures resulting from leakage of the regulator valve. The relief valve is designed to relieve pressures in excess of approximately 80 psi.

4-95. Emergency Warning Relay.

The emergency warning relay, when actuated, illuminates the warning light in the cockpit. At the same time the relay breaks the circuit to the emergency timing solenoid in the engine accessory compartment pressure control sensor. When initially energized, the warning relay receives power from emergency relay and remains energized after the emergency sensing unit has broken the circuit to the emergency relay. This is accomplished in the warning relay when holding coil power is transferred from the emergency relay to an emergency power contact in the warning relay. The warning relay will remain energized, retaining the warning light and the emergency timing valve in the emergency condition, until aircraft electrical power is shut off.

4-96. ENGINE AIR-OIL COOLER AIR CONTROL VALVE.

The engine air-oil cooler air control valve is installed in the cooler air inlet duct on self-aligning bearings. The valve, equipped with silicone rubber leading and trailing edge seal strips, is contoured to fit the duct wall when in the closed position. The valve is streamlined in cross section and completely closes off the duct when in the closed position. The valve is actuated by a pneumatically powered actuator through an arm splined to the valve shaft. In normal flight cooling operation, the valve remains closed. The valve will open with the need of additional oil cooling.

4-97. ENGINE AIR-OIL COOLER AIR CONTROL VALVE ACTUATOR.

The engine air-oil cooler air valve actuator is an electrically controlled, pneumatically actuated unit that operates the engine air-oil cooler air valve. The actuator is equipped with three ports; a solenoid controlled air inlet port, a solenoid controlled air outlet port that vents to the engine accessory compartment, and a second air outlet port that is pneumatically controlled by pressure override in the engine compartment pressure sensor. When electrical power to the actuator is off, the inlet solenoid valve is closed and the outlet solenoid valve is open. At this time the actuator is in the retracted position and the air-oil cooler air valve is closed. The actuator is equipped with a diaphragm that extends the piston rod when the actuator is pressurized. A spring retracts the actuator as air pressure is relieved. The inlet and outlet solenoids are controlled by fuel temperature signals from the temperature control box. The inlet solenoid is normally closed and the outlet solenoid is normally open. As temperature signals call for more cooling air, the inlet solenoid opens and the outlet solenoid closes, permitting N_2 bleed air pressure to position the actuator. A temperature signal calling for less cooling air will deenergize the outlet solenoid and permit spring pressure to retract the piston and close the valve. If the engine accessory compartment pressure becomes excessive, the pressure override will open the second outlet port regardless of temperature signals and permit actuator pressure to bleed off closing the valve.

4-98. CONSTANT-SPEED SYSTEM OIL COOLER AIR CONTROL VALVE.

The constant-speed oil cooler air control valve is a self-aligning-bearing supported valve installed in the cooler air inlet duct. The valve is shaped to the duct contour when in the closed position. In the closed position the valve permits a given quantity of air to continue flowing through the cooler. The valve is streamlined in contour and is actuated through an arm splined to the valve pivot shaft.

4-99. CONSTANT-SPEED SYSTEM OIL COOLER AIR CONTROL VALVE ACTUATOR.

The constant-speed oil cooler air control valve actuator is an electrically controlled pneumatically actuated unit that operates the constant-speed oil cooler air valve. The actuator is equipped with three ports: two solenoid controlled air inlet ports and an emergency air control system inlet port. In normal operation, the actuator is extended by pneumatic pressure, and retracted to the cooler valve open position by spring pressure. When energized, the air inlet solenoids permit engine N_2 compressor bleed air to position the cooler valve to the desired valve opening. Normal operation of the valve is controlled by a pressure modulator valve located in the engine compartment pressure control unit. Emergency operation (closing) of the cooler valve and actuator occurs when the engine compartment pressure rises to 3 psi. High-pressure pneumatic air is used for this operation.

4-100. GROUND COOLING AND PRESSURE AUGMENTATION AIR VALVE.

The ground cooling and pressure augmentation air valve is provided to control flow of N_1 compressor bleed air to the area within the engine shroud. N_1 compressor air is used within the shroud area for cooling during engine ground run operation and to relieve negative pressure buildup during flight operation. The valve assembly consists of a butterfly type valve, a spring loaded piston and cylinder and a solenoid operated pilot valve. The pilot valve is provided to route N_2 compressor bleed air to either side of the spring loaded piston assembly for control of the N_1 bleed air butterfly valve. The butterfly valve is open during engine ground operation to provide N_1 bleed air for engine cooling. During normal flight operation, the solenoid pilot valve is energized, causing N_2 bleed air to reposition the spring loaded piston assembly. This causes the butterfly valve to close. During flight operation, a shroud differential pressure switch senses inner shroud negative pressure buildup, which provides a signal to deenergize the solenoid pilot valve, N_2 bleed air is then routed to the spring loaded side of the piston assembly, causing the N_1 bleed air butterfly valve to open, relieving the shroud negative pressure.

4-101. SHROUD DIFFERENTIAL PRESSURE SWITCH.

The shroud differential pressure switch is provided to actuate the ground cooling and pressure augmentation air valve during flight operation. The switch is actuated by pressure differential between the engine accessory compartment and the area within the engine shroud. When actuated, the switch operates the solenoid actuated pilot valve causing the N_1 bleed air butterfly valve to open. Opening of the bleed air valve relieves pressure differential that tends to collapse the engine shroud. The switch is normally closed and opens when the accessory compartment pressure exceeds inner shroud pressure by 2.5 psi. The switch closes when differential pressure decreases to 1.3 psi. The switch incorporates two ports that are identified by the letters "P" and "V." Port "P" is connected to the inner shroud area. Port "V" is vented to the engine accessory compartment.

4-102. SHROUD RAM AIR COOLING CHECK VALVES.

Each of the shroud ram air inlet ducts are equipped with a spring loaded air flow check valve. These valves, installed on the forward side of the engine firewall, open during flight operation due to the flow of ram air to the inner shroud area. During engine ground run operation, a low pressure area exists within the engine air inlet duct which tends to draw hot exhaust gases in through the shrouded area thereby creating an over temperature condition. The check valves prevent this reverse flow condition and at this time N_1 compressor bleed air is ducted to the inner shroud area for the cooling.

OPERATIONAL CHECKOUT

4-103. OPERATIONAL CHECKOUT, COOLING AIR FLOW SYSTEM.

4-104. Equipment Requirements.

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
	Compressed dry air source of 100 psi.			To actuate oil cooler air valve actuators.
Refer to T.O. 1F-106A-2-10	Generator Set (Gas).	8-96026-801 AF/M32A-13 (6115-583-9365)	8-96026 AF/M32M-2 (6115-617-1417)	To energize electrical systems on aircraft equipped with special quick disconnect receptacle.
	Generator Set (Elec).	8-96025-803 AF/ECU-10/M (6125-583-3225)	8-96025-805 A/M24M-2 (6125-628-3566)	
			8-96025 AF/M24M-1 (6125-620-6468)	

4-104. Equipment Requirements (Cont).

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
Refer to T.O. 1F-106A-2-10 (cont).	Generator Set.		MC-1 (6125-500-1190)	To energize electrical systems (except AWCIS) on aircraft equipped with standard AN receptacle and on others by using adapter cable 8-96052.
			MD-3 (6115-635-5595)	
	Adapter Cable.	8-96052 (6115-557-8548)		To connect MC-1 and MD-3 units to aircraft equipped with special quick disconnect receptacle.
Refer to T.O. 1F-106A-2-9	Pitot Static System Field Tester.	MB-1 (6635-334-7433)	Equivalent	To supply vacuum pressure.

4-105. Preparation.

a. Connect external dc electrical power source to airplane.

b. Connect external source of 100 psi air pressure to the engine accessory compartment pressure control sensor by removing the engine air hose and attaching the air supply to the tube fitting. The engine air hose is attached to a fitting in the upper right-hand corner of the left-hand forward engine mount access door.

c. Connect the field tested vacuum source to the ambient pressure port in the left side of the fuselage over the wing at sta. 500.0. Use sealer or vacuum cup to hold hose to port.

d. Install the following fuses:

1. "ENG GND COOL" Main wheel well fuse panel.
2. "OIL COOL CONT" Main wheel well fuse panel.
3. "COMPT PRESS WARN" Main wheel well fuse panel.

4-106. Procedure.

a. With external air pressure and electrical power applied to the airplane, check position of the engine air-oil cooler and the constant-speed oil cooler air valve actuators. Both shall be retracted (constant-speed oil cooler open, engine air-oil cooler closed).

NOTE

Valve position may be checked by looking through the ports located in the air control valve access door at fuselage sta. 450.0 on both sides of the fuselage above the wing. Check that the movement of the valve actuator is smooth. If the movement is erratic, check the linkage for misalignment or binding.

b. Press the "PUSH TO TEST" button on the engine fuel temperature control box mounted on the aft side of the left wheel well near sta. 472.0. This simulates excessive fuel temperature. The engine air-oil cooler actuator will extend, opening the air-oil cooler and valve; release test button.

c. Apply vacuum pressure to fuselage ambient pressure port. When pressure is reduced to approximately −2.04 inches Hg, the constant-speed drive oil cooler air valve will begin to close and will be fully closed before a pressure of −3.05 inches Hg is reached.

d. Hold the "PUSH TO TEST" button in on the engine fuel temperature control box. This will cause the engine air-oil cooler valve to open. Increase vacuum pressure on the left-hand ambient port. At a pressure of −4.25 (±0.41) inches Hg the engine air-oil cooler valve will close.

e. Reduce vacuum pressure to −3.35 (±0.30) inches Hg holding in "PUSH TO TEST" button. Actuator will extend, opening the engine air-oil cooler valve.

f. Reduce vacuum pressure to −2.04 inches Hg. The constant-speed oil cooler air valve actuator shall retract, opening the air valve; remove vacuum source from port on LH side of fuselage.

g. Connect vacuum source to port on right side of fuselage above wing at sta. 500.0. Check that the airplane high-pressure pneumatic system is fully charged.

h. With fuel temperature control box test button depressed, increase vacuum to the ambient pressure port to −6.11 (+0 −0.82) inches Hg. Constant speed and fuel-oil cooler valves shall close. Engine compartment pressure warning lights in the cockpit shall illuminate and remain illuminated.

i. With test button still depressed, reduce vacuum pressure to −1.73 (±0.31) inches Hg. The engine air-oil cooler air valve shall remain closed, and the constant-speed cooler air valve shall reach full open in a minimum of 30 seconds. On both groups of airplanes, the master warning and compartment pressure warning lights shall remain illuminated. Reduce vacuum to zero.

j. Remove "COMPT PRESS WARN" fuse from main wheel well fuse panel; warning lights shall extinguish.

k. Install fuse; warning lights shall remain extinguished.

l. Shut off electrical power and remove test equipment.

m. Recharge high-pressure pneumatic system.

n. Gain access to the ground cooling and pressure augmentation air valve through the engine bleed air duct access door located on the upper right side of the fuselage.

o. Gain access to the shroud pressure differential switch through the engine accessory compartment right access door.

p. Remove vent plug from port "V" of shroud pressure differential switch; connect static system tester pressure source to port "V."

q. Prepare airplane and engine for engine ground run. Start engine and run at idle. Refer to paragraph 1-25 for these procedures.

r. Station observer with a mirror and flashlight on right wing at the ground cooling valve access door. With observer watching the cooling valve slotted position indicator, located on the upper inboard side of the valve, position the right landing gear door closed switch to the door closed position (switch actuated); valve shall close. Increase pressure on static test unit until test unit gage reads +7.1 inches Hg maximum. Cooling air valve shall open as pressure reaches +5.08 (±0.40) inches Hg.

s. Actuate right landing gear door switch to the open position (switch deactuated); cooling valve shall remain open. Actuate switch to the closed position.

t. Reduce pressure until gage reads +2.24 (±0.40) inches Hg; valve shall close.

CAUTION

Perform this check procedure as quickly as possible to prevent an over temperature condition. Cooling air flow into the inner shroud area is stopped when the cooling valve is closed.

u. Actuate landing gear door switch to the open (deactuated) position; cooling valve shall open.

v. Reduce pressure to 0; cooling valve shall remain open. Shutdown engine. Remove test equipment; reinstall vent plug in port "V" of shroud pressure differential switch. Close access doors.

SYSTEM ANALYSIS

4-107. SYSTEM ANALYSIS, COOLING AIR FLOW SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
ENGINE AIR-OIL COOLER VALVE DOES NOT CLOSE ON "PUSH-TO-TEST" WITH NORMAL AIR SUPPLIED TO ENGINE COMPARTMENT PRESSURE SENSOR.		
Actuator inlet or outlet solenoid inoperative.	Remove solenoids for bench test.	Replace if found defective.
Engine compartment pressure sensor air pressure regulator inoperative.	Remove sensor for bench test.	Install replacement item.
DURING OPERATIONAL CHECKOUT, CONSTANT-SPEED OIL COOLER ACTUATOR DOES NOT OPERATE. (Refer to paragraph 4-106, step "c.")		
Solenoid valves inoperative.	Open valve access door in RH side of fuselage; observe solenoid operation. Remove defective solenoid.	Install replacement item.

4-107. SYSTEM ANALYSIS, COOLING AIR FLOW SYSTEM (CONT).

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
DURING OPERATIONAL CHECKOUT, CONSTANT-SPEED OIL COOLER ACTUATOR DOES NOT OPERATE (Refer to paragraph 4-106, step "c") (CONT).		
Engine compartment pressure sensor air pressure regulator inoperative.	Remove sensor for bench test.	
ENGINE COMPARTMENT PRESSURE WARNING LIGHT ILLUMINATES DURING FLIGHT		
Failure of normal system.	Perform operational checkout.	Replace defective unit.
Incorrect installation of CSD or engine air-oil cooler air valves.	Inspect from scroll access door.	Install valves correctly. Refer to paragraph 4-109.
Leakage into engine compartment.	Visually inspect for leaks at following locations: 1. Engine inlet seal. 2. Engine firewall seal. 3. Ram air duct leakage.	Repair or replace.
Leaking sense lines.	Pressure check with 10 percent castile soap solution at all fittings.	Repair or replace.

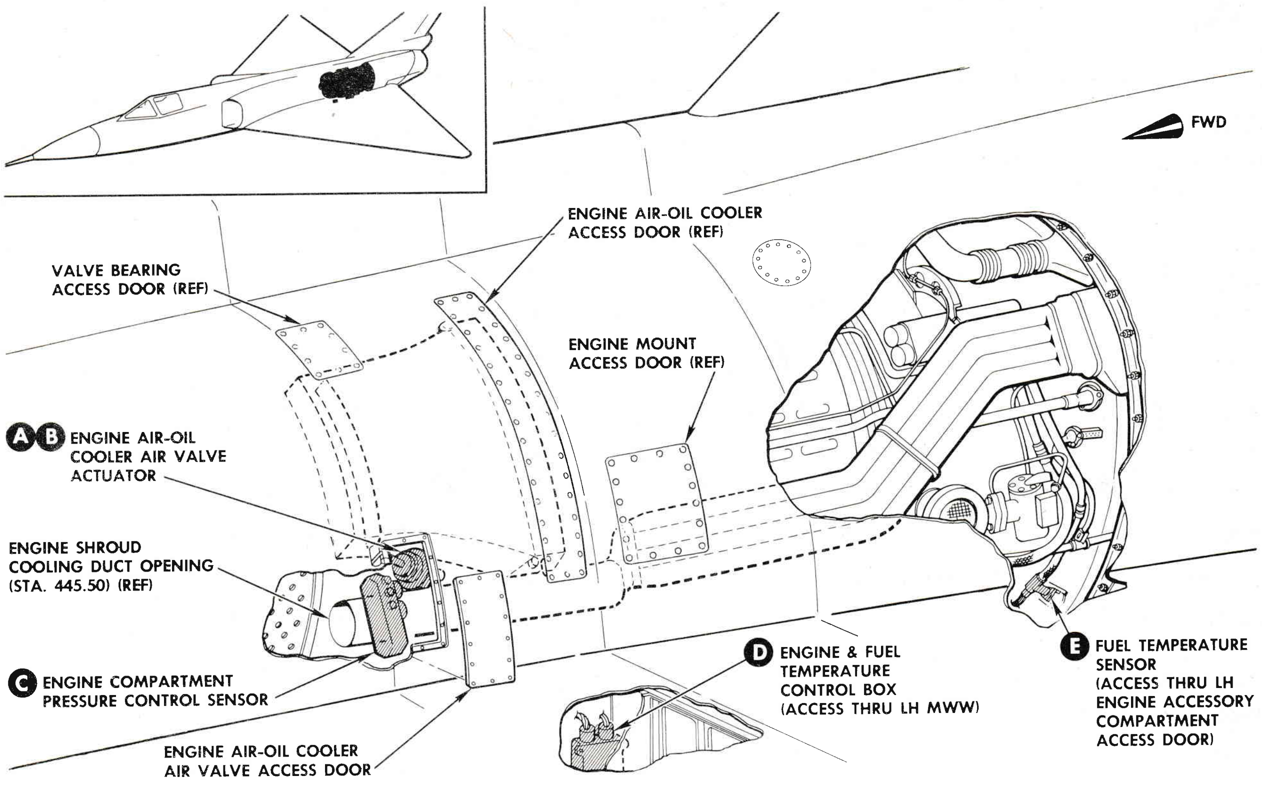
REPLACEMENT

4-108. REPLACEMENT, ELECTRICAL COMPONENTS GENERAL.

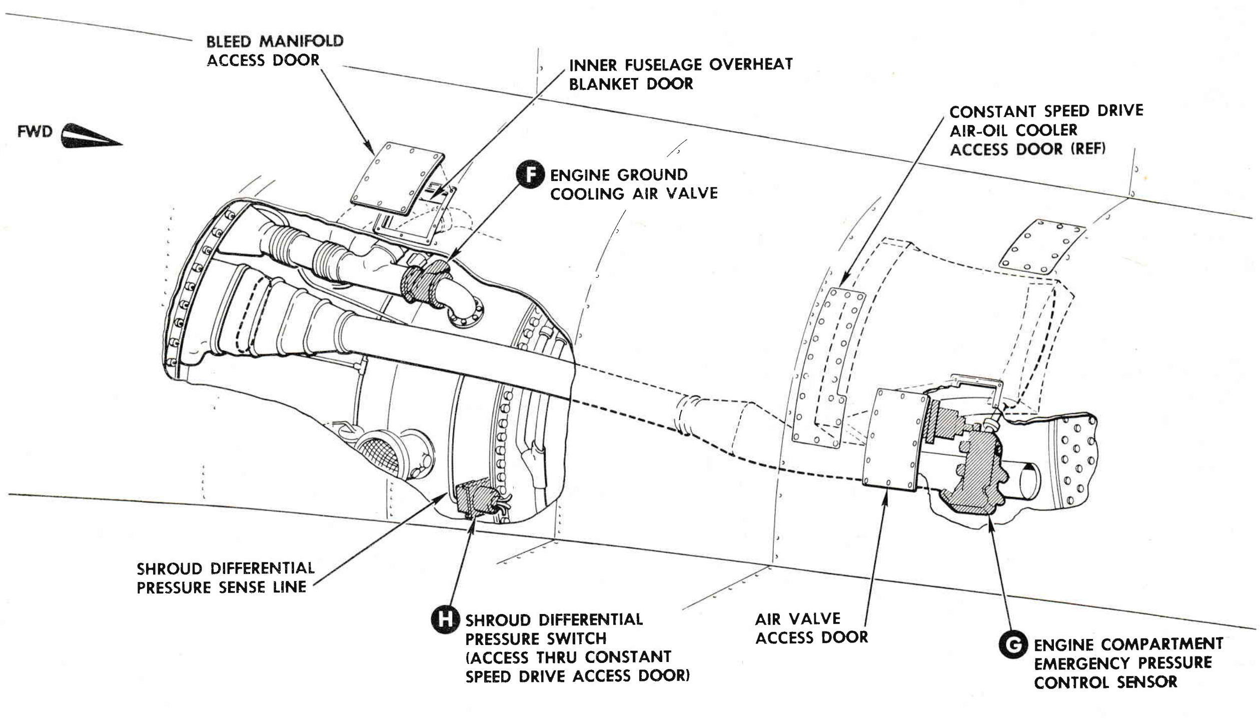
When removing components equipped with pigtail electrical leads, always cut leads at an existing splice. This is necessary to preserve the component lead identity and provide sufficient length for reinstallation.

4-109. REPLACEMENT, COOLING AIR FLOW SYSTEM COMPONENTS.

For removal and installation procedure for the cooling air flow system components, see figure 4-14.



LOCATION—COOLING SYSTEM COMPONENTS—LEFT SIDE



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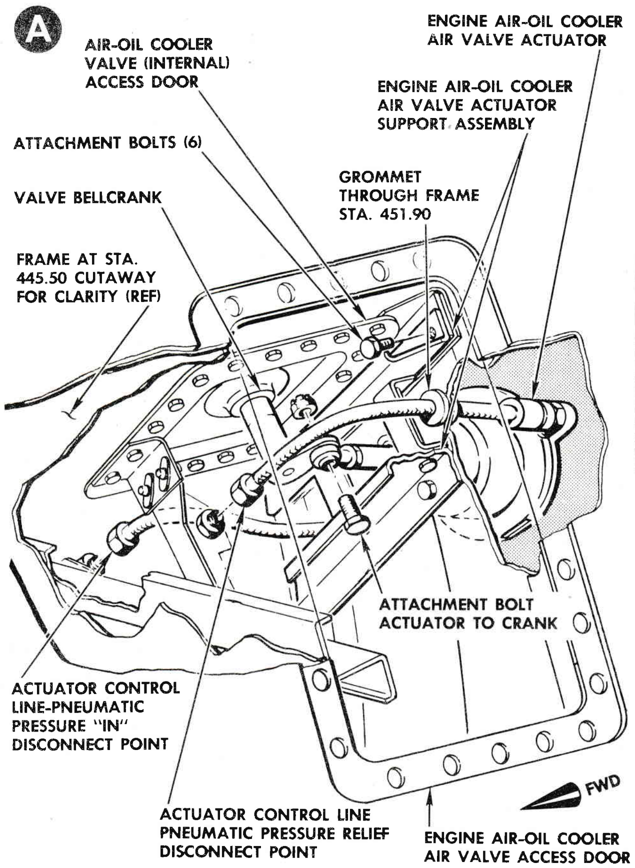
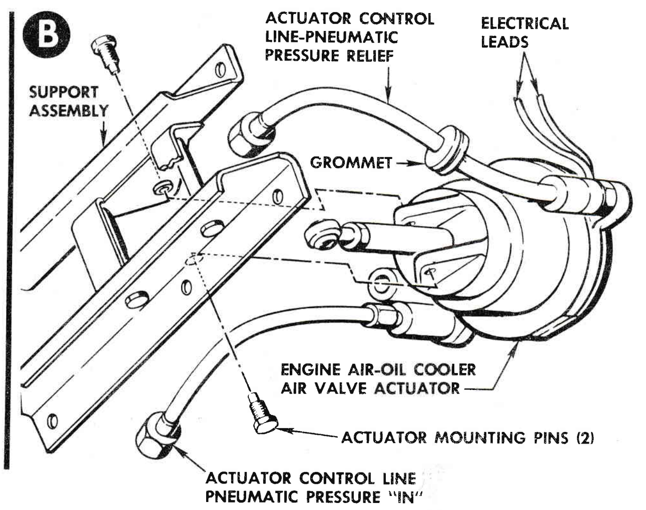
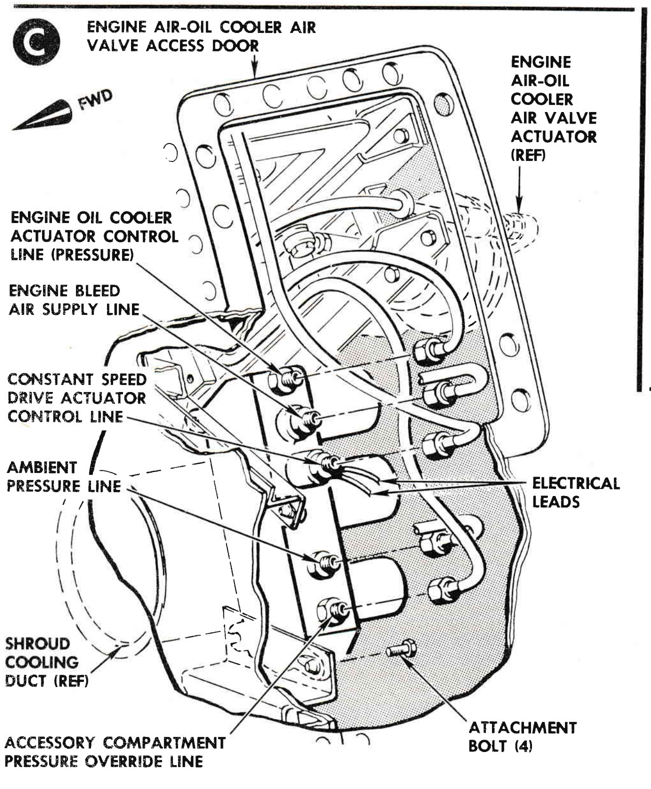
LOCATION—COOLING SYSTEM COMPONENTS—RIGHT SIDE

Figure 4-14. Replacement, Cooling System Components (Sheet 1 of 4)







REMOVAL, ENGINE AIR-OIL COOLER AND CONSTANT SPEED OIL COOLER AIR VALVE ACTUATORS.

NOTE

REMOVAL OF THE ENGINE AIR-OIL COOLER AIR VALVE ACTUATOR SHOWN. REMOVAL OF THE CONSTANT SPEED OIL COOLER AIR VALVE ACTUATOR IS SIMILAR. CONSTANT SPEED COOLER VALVE ACTUATOR IS LOCATED OPPOSITE ENGINE COOLER VALVE ON RIGHT HAND SIDE OF FUSELAGE.

a. Open access door on upper left hand side of fuselage. See detail A for location.
b. Remove pressure control sensor. See detail G for this procedure.
c. Remove attachment bolt between actuator rod and bellcrank.
d. Remove bolts (6) holding valve support assembly to fuselage structure.
e. Move valve assembly forward enough to disconnect electrical leads and pneumatic lines; remove valve assembly.
f. Remove support assembly from valve.

INSTALLATION

a. Installation is essentially the reverse of removal.
b. Perform cooling system operational checkout.

REMOVAL, ENGINE COMPARTMENT PRESSURE CONTROL SENSOR.

a. Open access door on upper left hand side of fuselage.
b. Disconnect pneumatic lines (5) and sensor electrical leads.
c. Remove attachment bolts (4) holding sensor to structure; remove sensor.

INSTALLATION

a. Installation is essentially the reverse of removal.
b. Perform cooling system operational checkout.

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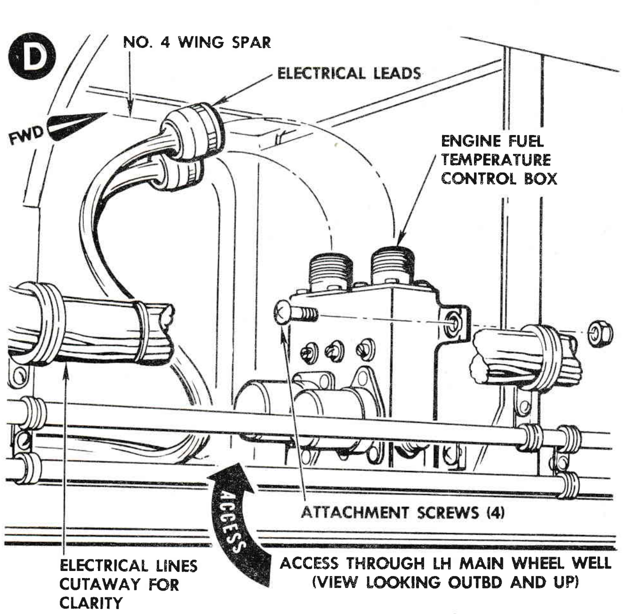
Figure 4-14. Replacement, Cooling System Components (Sheet 2 of 4)

D



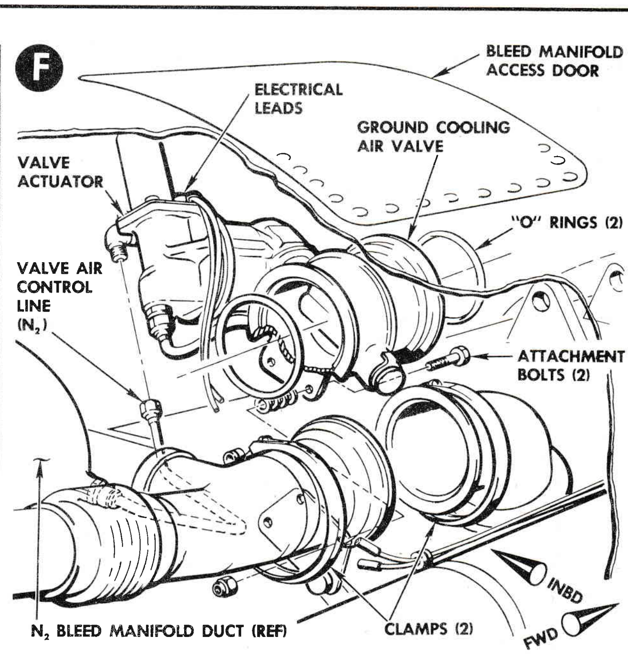
REMOVAL, ENGINE FUEL TEMPERATURE CONTROL BOX

a. Gain access to the control box through the left-hand main wheel well. Box mounted just forward of No. 4 wing spar.
b. Disconnect electrical leads from control box.
c. Remove attachment screws (4) holding box to structure; remove box.

INSTALLATION

a. Installation of the control box is essentially the reverse of removal.
b. Perform cooling system operational checkout.

F



REMOVAL, ENGINE GROUND COOLING AIR VALVE

a. Open bleed air duct access door in upper right-hand side of fuselage.
b. Disconnect electrical leads from valve.
c. Disconnect valve air control line.
d. Remove clamps (2) holding valve to duct.
e. Remove attachment bolts (2); remove valve.

INSTALLATION

a. Installation is essentially the reverse of removal.
b. Safety-wire valve air control line fittings.
c. Perform cooling system operational checkout.

E

REMOVAL, FUEL TEMPERATURE SENSOR

a. Open engine accessory compartment left access door.
b. Disconnect fuel temperature sensing probe leads from engine electrical harness.
c. Remove sensing probe from sensing port.

INSTALLATION

a. Installation is essentially the reverse of removal. Safety-wire sensor probe.
b. Connect probe leads to engine electrical harness. Refer to T.O. 1F-106A-2-10 for permanent splicing information.
c. Perform cooling system operational checkout.

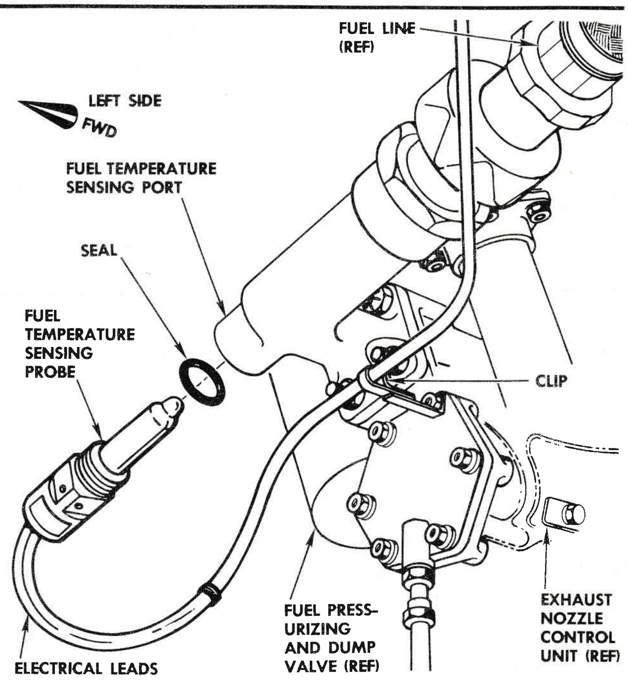


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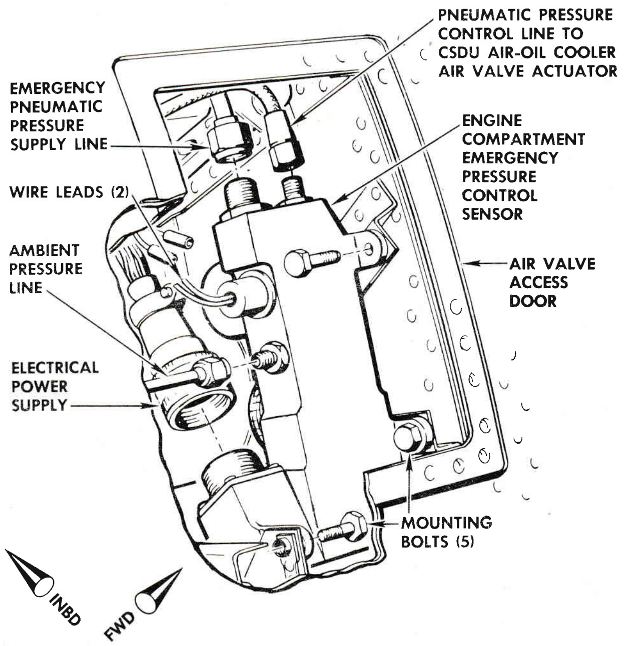
Figure 4-14. Replacement, Cooling System Components (Sheet 3 of 4)

G



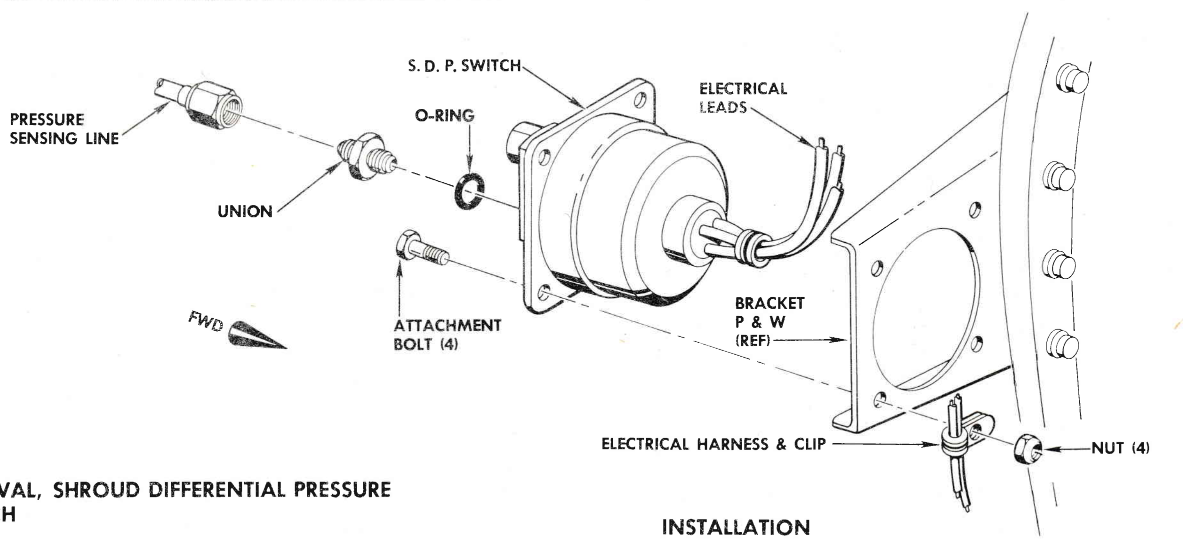
REMOVAL, ENGINE COMPARTMENT EMERGENCY PRESSURE CONTROL SENSOR.

a. Open access door on upper right-hand side of fuselage.
b. Disconnect electrical leads and pneumatic lines (3) from sensor.
c. Remove attachment bolts (5); remove sensor. Cover line openings.

INSTALLATION

a. Installation is essentially the reverse of removal.
b. Perform cooling system operational checkout.

H



REMOVAL, SHROUD DIFFERENTIAL PRESSURE SWITCH

a. Open constant speed drive access door.
b. Disconnect shroud differential pressure switch leads from engine electrical harness.
c. Disconect pressure sensing line from switch.
d. Remove attachment bolts (4) securing switch to bracket; remove switch.

INSTALLATION

a. Installation is essentially the reverse of removal.
b. Connect switch leads to engine electrical harness. Refer to T. O. 1F-106A-2-10 for permanent splicing information.
c. Perform cooling system operational checkout.

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Figure 4-14. Replacement, Cooling System Components (Sheet 4 of 4)

4-110. REPLACEMENT, ENGINE SHROUD.

4-111. Equipment Requirements.

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
4-15 4-16	Shroud Handling Adapter Stand.	USAF MMU-3/E (1730-529-8452) with Adapter Kit 8-96167 (1730-632-0058) installed. For use with engine stand ETU-8/E with Adapter Kits 8-96398-1 (1730-676-6848) 8-96398-3 (1730-676-6849) or 8-96165 (1730-632-0059) installed	8-96046 (4920-565-0191) (for use with engine stand SE 1012-803) (1740-568-1339)	To aid removal of shroud; to support shroud when removed from engine.
	Engine Hoisting Adapter.		8-96068 (1730-540-5034) (for use with SE 1012-803 engine stand)	To support aft end of engine during shroud removal.
4-15 4-16	Shroud Roller Bracket Set.	8-96047-803 (4920-632-8591)		To support and roll shroud from engine.
	Shroud Positioning Wedge.	8-96174 (4920-611-9695)		To support and position aft end of shroud. To be used with shroud part No. 8-22654 basic, -3, or -5.
		8-96200 (1560-679-4482)		To support and position aft end of shroud. To be used with shroud part No. 8-22654-801, -803, -805, or -811.
	Shroud Ejector Insert Alignment Tool.	8-96491 (4920-691-4274)		For use with shroud part No. 8-22654-809.

4-112. Procedure.

For engine shroud replacement procedures, see figures 4-15 and 4-16.

NOTE

Refer to T.O. 1F-106A-3 for shroud damage limits and repair information.

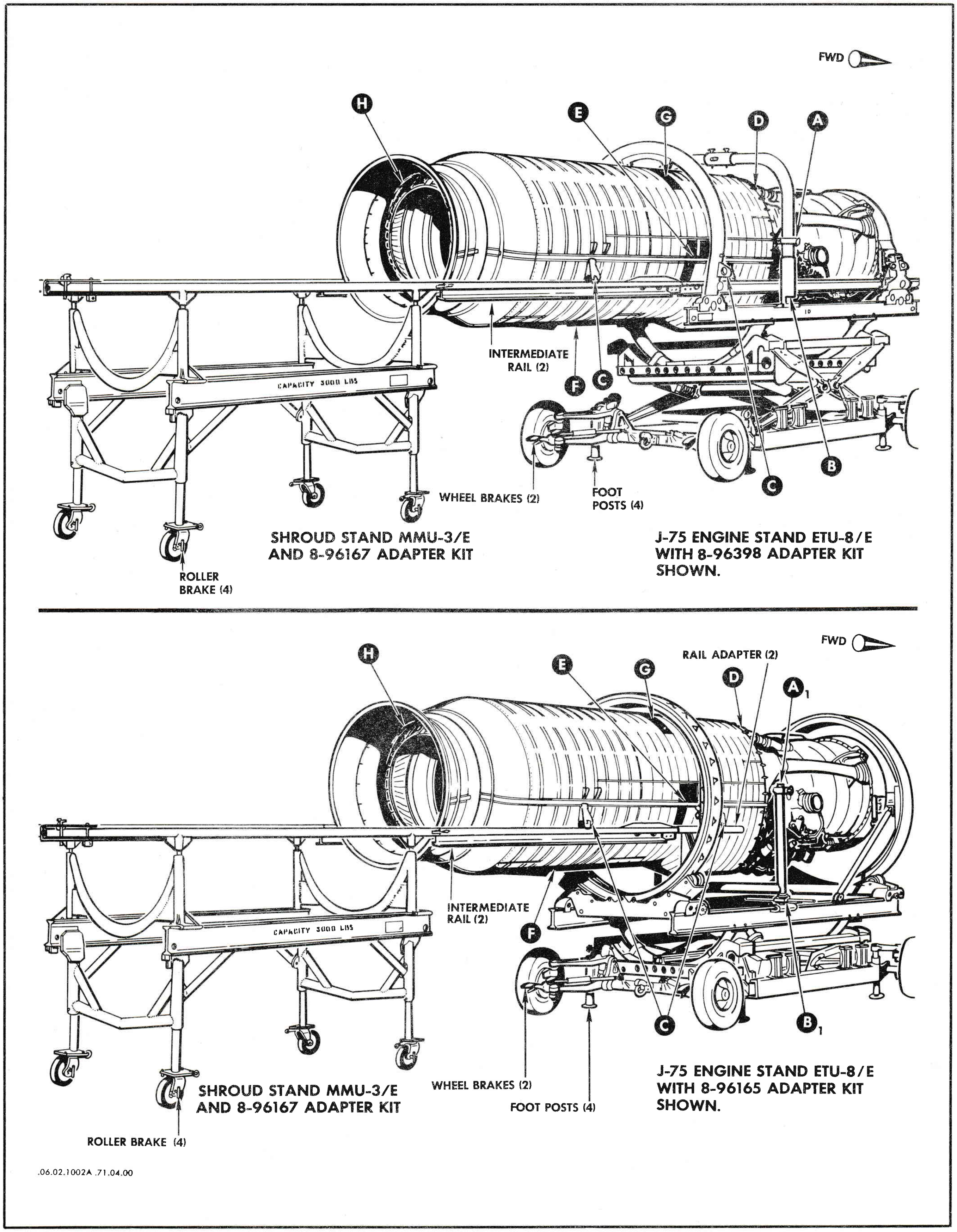
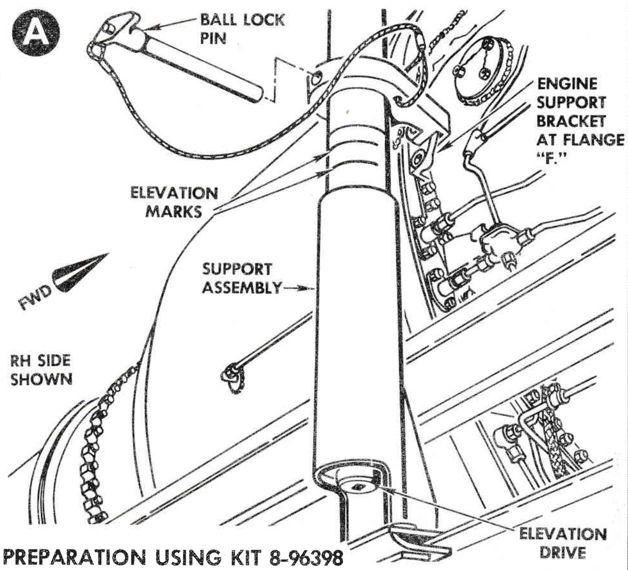


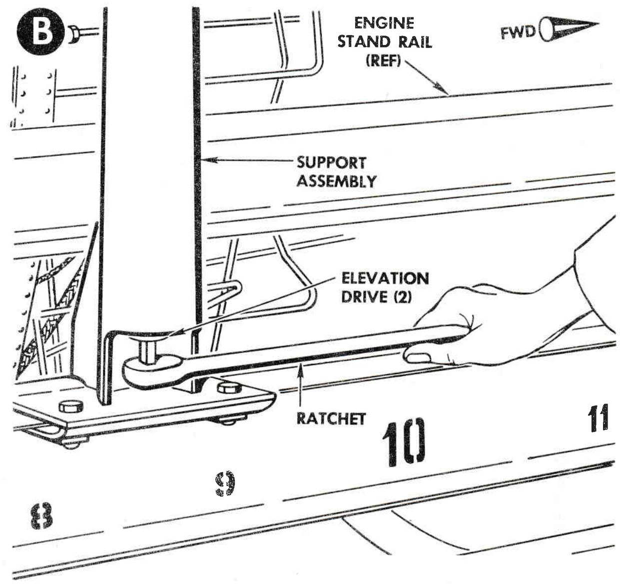
Figure 4-15. Replacement, Engine Shroud Using Stand USAF ETU-8/E (Sheet 1 of 4)



PREPARATION USING KIT 8-96398

a. Check that engine stand wheel brakes are engaged and that engine-to-stand attachments are made at engine forward left and right mount assemblies. Check that rail clamps are installed at engine aft roller brackets. Disconnect engine removal draw-bar assembly from engine stand.

b. Install engine intermediate support assembly at engine support brackets on forward side of engine firewall. Check that support legs are perpendicular to engine stand rails.

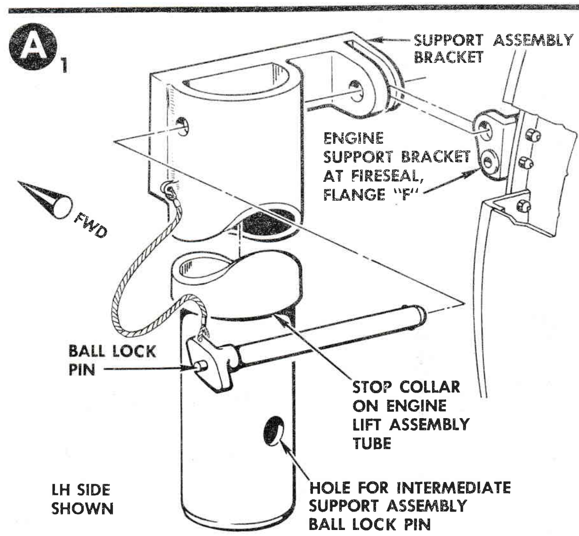


c. Install a half-inch drive ratchet in the elevation drive (left and right).

d. Tighten elevation drives evenly until weight is removed from engine aft roller brackets; remove engine aft roller brackets. See detail E.

e. Adjust shroud stand rails to same height as engine stand rails.

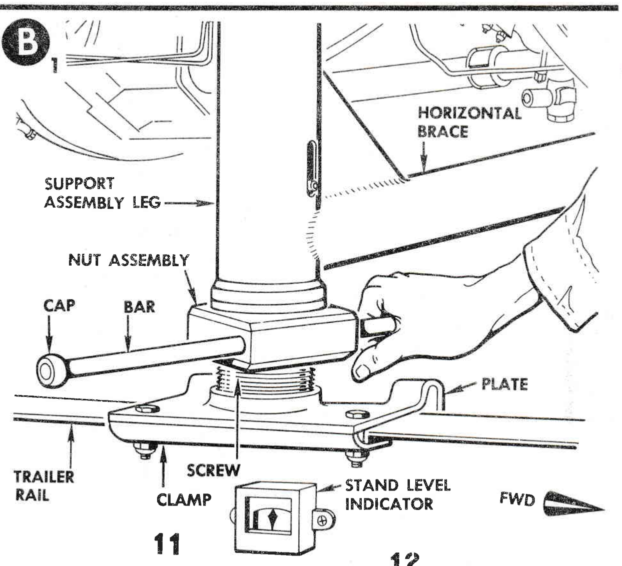
f. Install intermediate rails between engine and shroud stands. Check that rails are in alignment.



PREPARATION USING KIT 8-96165

a. Check that engine stand wheel brakes are engaged and that engine to stand attachments are made at engine forward left and right mount assemblies. Check that rail clamps are installed at engine aft roller brackets. Disconnect engine removal drawbar assembly from engine stand.

b. Install engine intermediate support assembly at engine support brackets on forward side of engine firewall. Check that support legs are perpendicular to engine stand rails.



c. Tighten adjustments (2) on support legs evenly to remove weight from engine aft roller brackets; remove aft roller brackets. See detail E.

d. Remove engine support rails and brackets from engine stand.

e. Adjust shroud support stand rails and engine stand rails to same height.

f. Connect shroud support stand to engine stand using rail adapters and intermediate rails. Check that shroud rails are in alignment.

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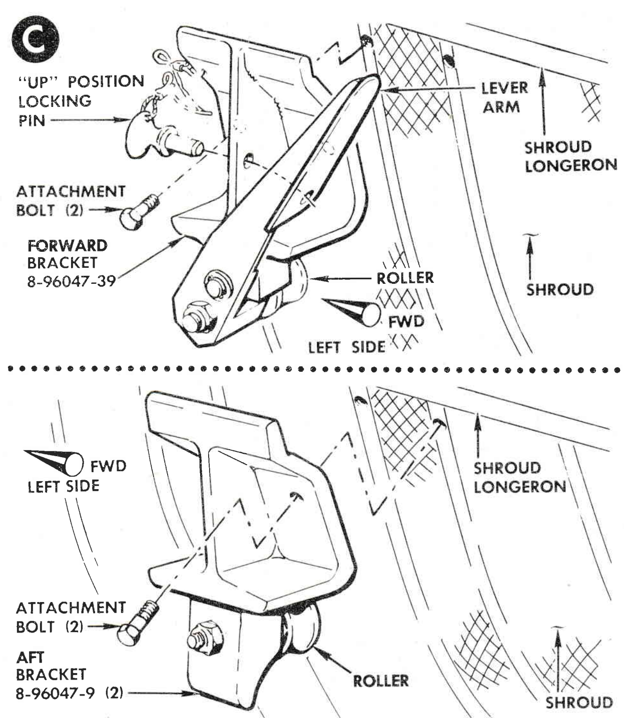
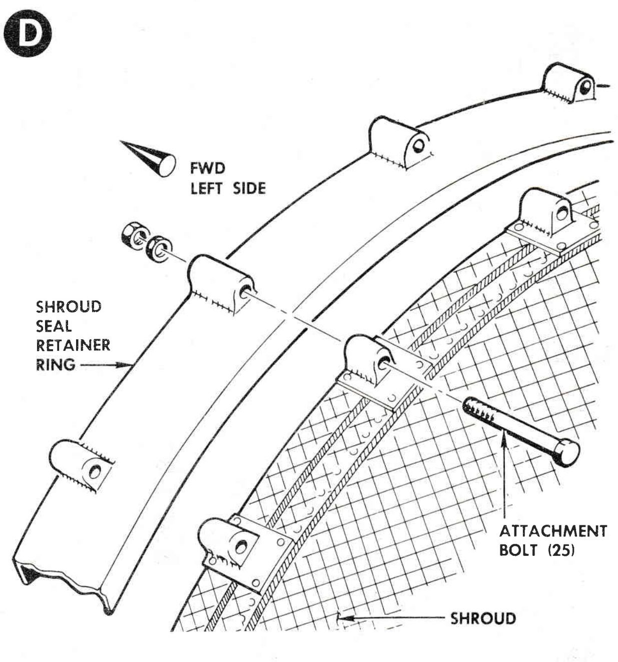
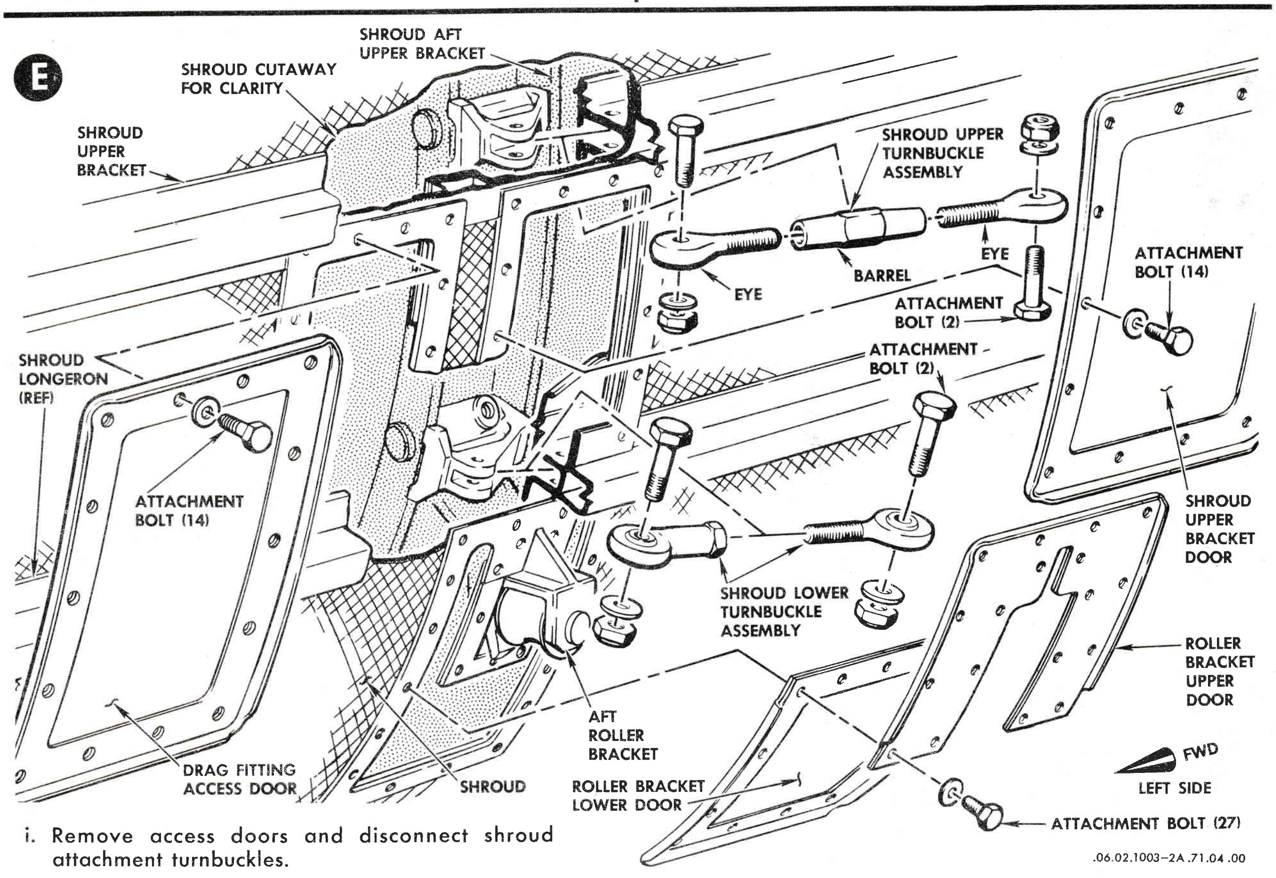
Figure 4-15. Replacement, Engine Shroud Using Stand USAF ETU-8/E (Sheet 2 of 4)



g. Install 8-96047 roller brackets on shroud assembly. Forward brackets have levers.

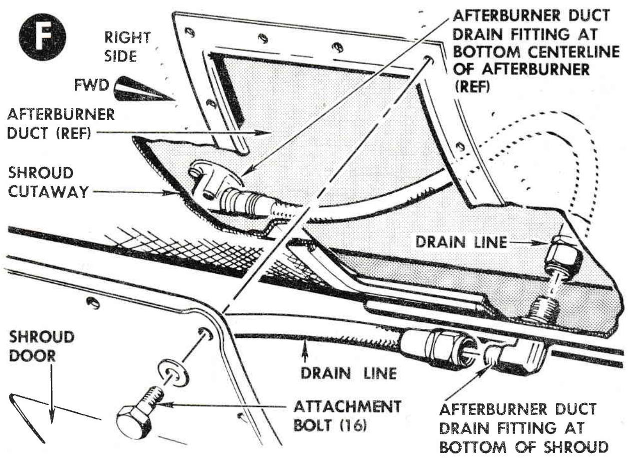


h. Remove bolts (25) securing shroud seal retainer to forward end of shroud.

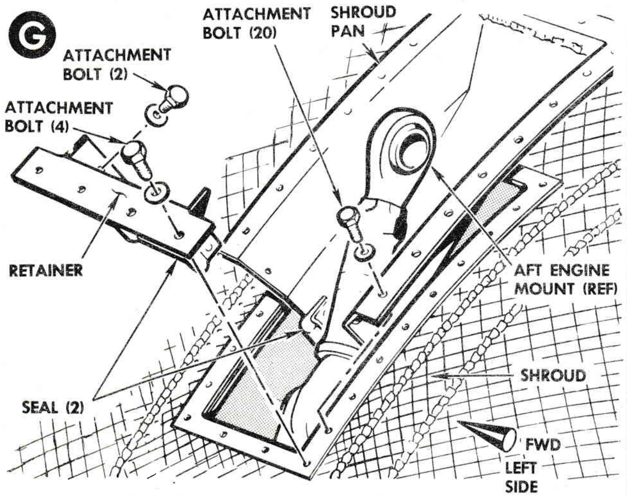


i. Remove access doors and disconnect shroud attachment turnbuckles.

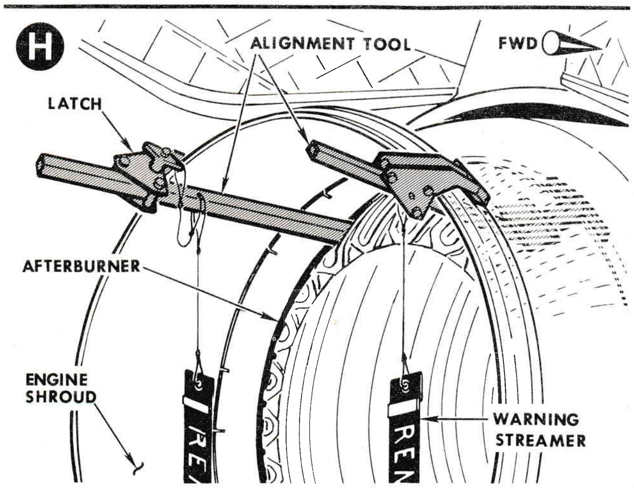
Figure 4-15. Replacement, Engine Shroud Using Stand USAF ETU-8/E (Sheet 3 of 4)



j. Remove access door and disconnect afterburner duct drain line at fitting on bottom of shroud.



k. Remove shroud pans at aft engine mounts.



l. Remove shroud ejector alignment tool, or shroud positioning wedges installed during engine removal from fuselage.

m. With shroud roller brackets in up position, carefully roll shroud from engine onto shroud stand. Secure shroud with strap. Remove seal retainer from engine.

CAUTION

IF SHROUD MOVES WITH DIFFICULTY, CHECK THAT SHROUD INNER BLANKET HAS CLEARANCE ABOUT THE CIRCUMFERENCE OF THE ENGINE. THE BLANKET IS EASILY DAMAGED.

INSTALLATION

a. Installation of the engine shroud is essentially the reverse of the removal procedure.
b. Place shroud seal retainer on forward end of shroud; attachment bolts (25) finger tight. With shroud roller brackets in up position, carefully roll shroud onto engine until edge of shroud is approximately 7 inches from engine firewall.
c. Place shroud forward roller brackets in down position. Roll shroud forward until engagement is made with engine firewall. Trim engine firewal N_1 bleed air adapter ducts on aft side of firewall as required to accomplish positive engagement of shroud ducts and firewall ducts.

WARNING

EXERCISE CARE TO AVOID INJURY TO HANDS AND FINGERS WHEN GUIDING SHROUD SEAL RING OVER ENGINE FIREWALL.

d. Install shroud positioning wedges, or ejector alignment tool.
e. Tighten seal-to-shroud attachment bolts evenly for uniform sealing. Safety-wire shroud turnbuckles and afterburner duct drain line.
f. Close all voids between shroud inner and outer surfaces at access doors and at shroud attachment to engine firewall using sealer No. HT-1 (8030-285-4436).
g. Lower engine until rollers contact rails; secure engine to stand. Remove intermediate rails and shroud stand.

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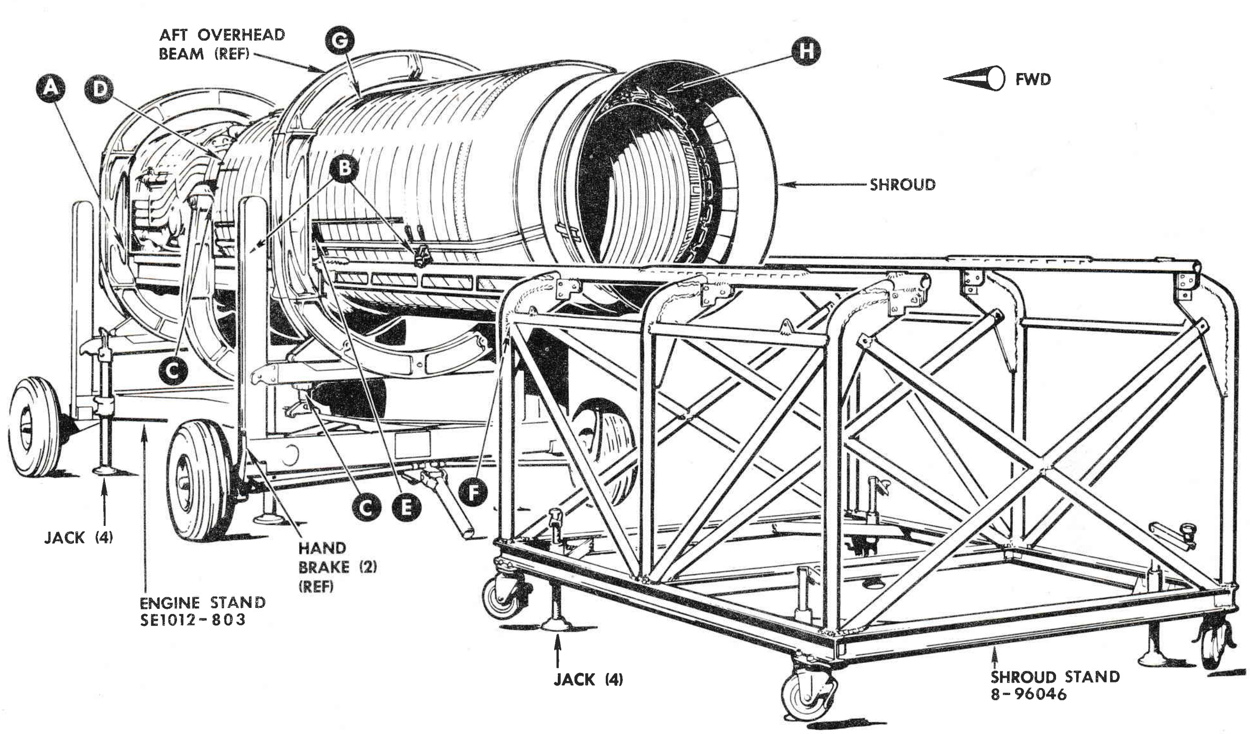
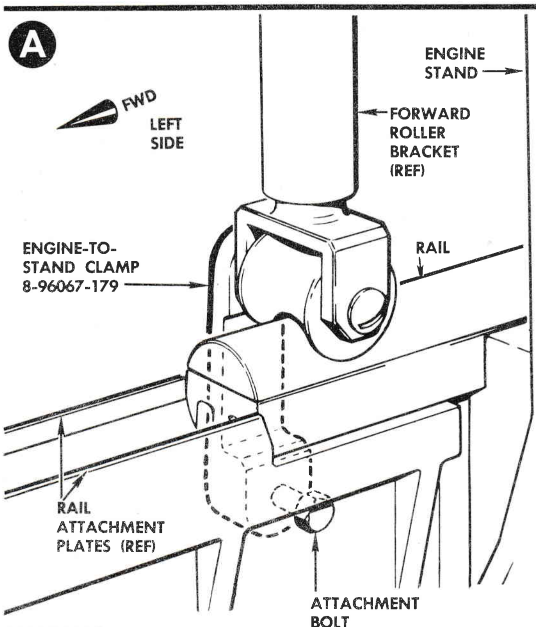
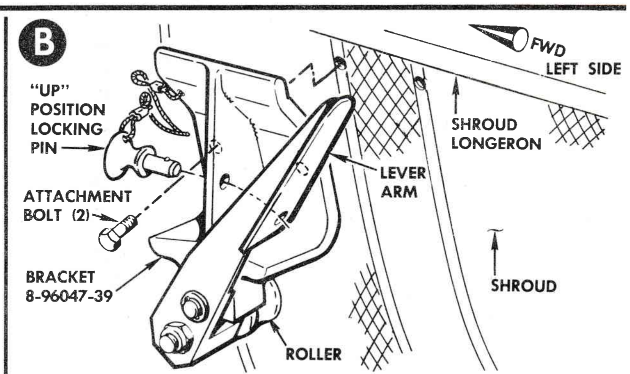
Figure 4-15. Replacement, Engine Shroud Using Stand USAF ETU-8/E (Sheet 4 of 4)

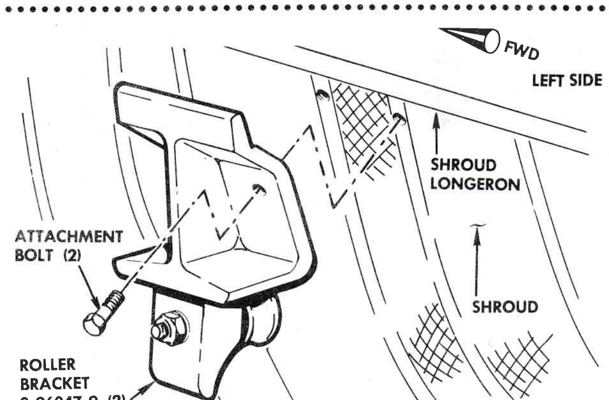




REMOVAL

a. Level engine stand with stand jacks; apply wheel brakes.
b. Position shroud adapter stand aft of engine; install engine stand to shroud stand rails. Align shroud stand and rails with engine stand.
c. Check that engine-to-stand clamp is installed at each forward roller bracket.
d. Remove engine stand aft overhead beam.





e. Install shroud roller brackets as follows:

8-96047-9 (2)	Aft left and right.
8-96047-39	Forward left.
8-96047-40	Forward right.

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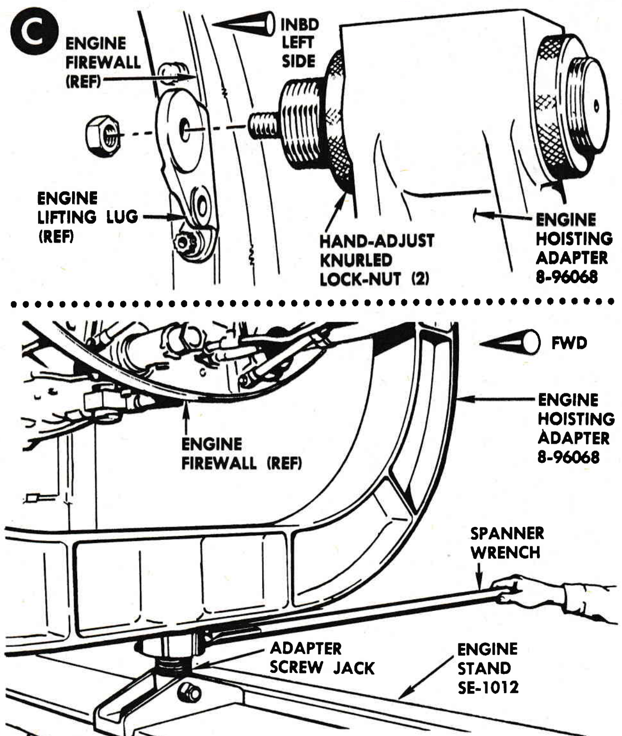
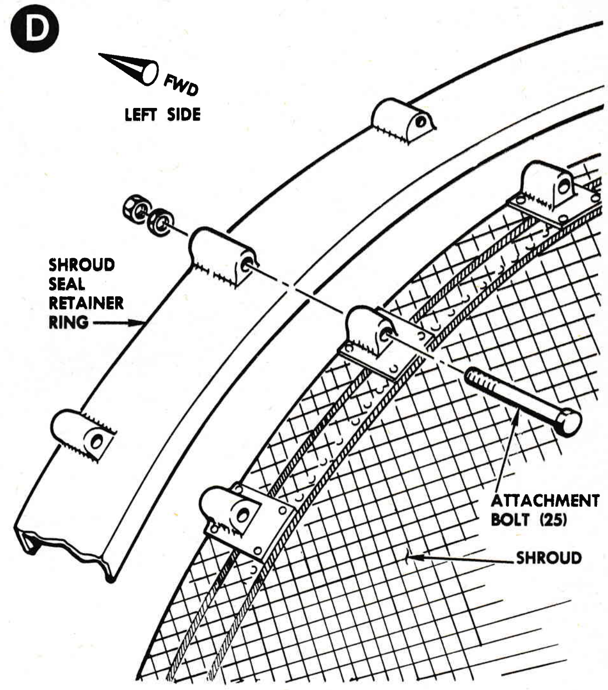
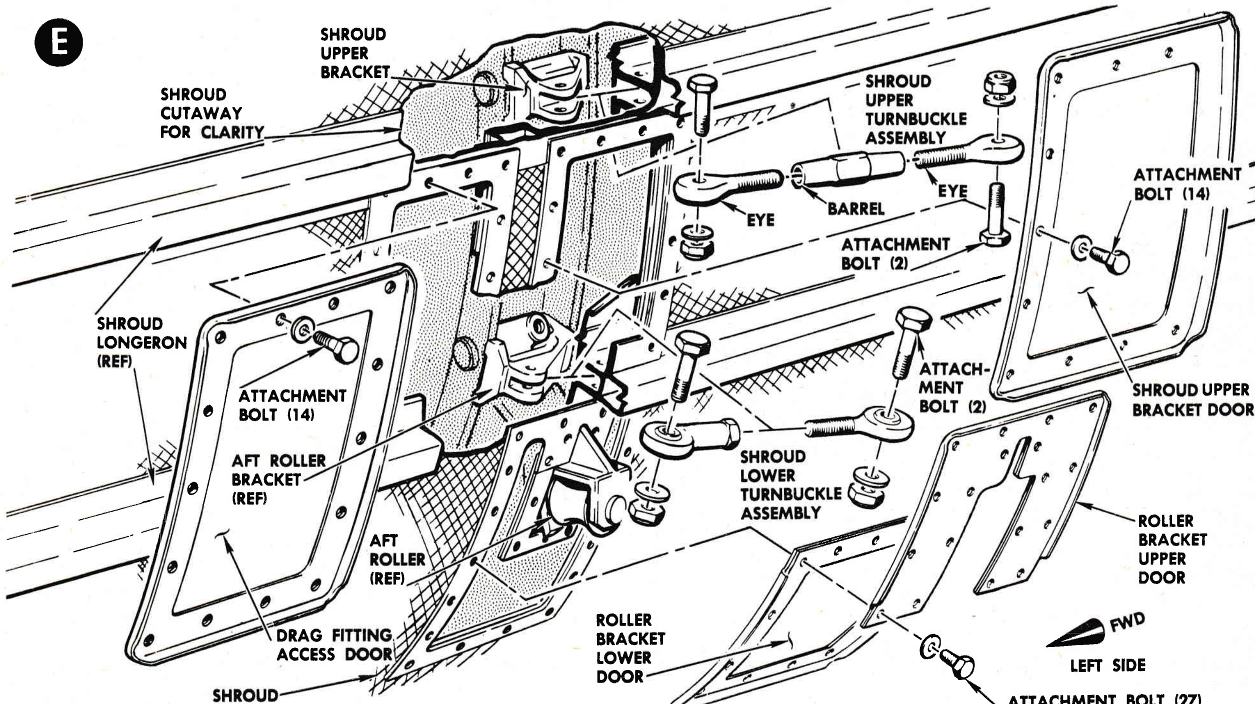
Figure 4-16. Replacement, Engine Shroud Using Stand SE 1012-803 (Sheet 1 of 3)



f. Install engine hoisting adapter 8-96068. Raise engine with adapter screw jack until engine aft roller brackets clear engine stand rails; remove engine aft roller brackets.



g. Remove bolts (25) securing shroud seal retainer to forward end of shroud.



h. Remove access doors and disconnect shroud attachment turnbuckles.

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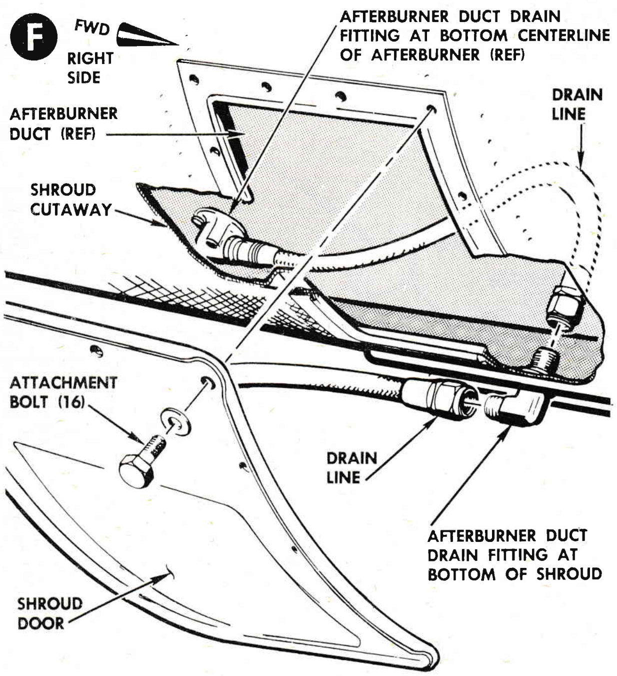
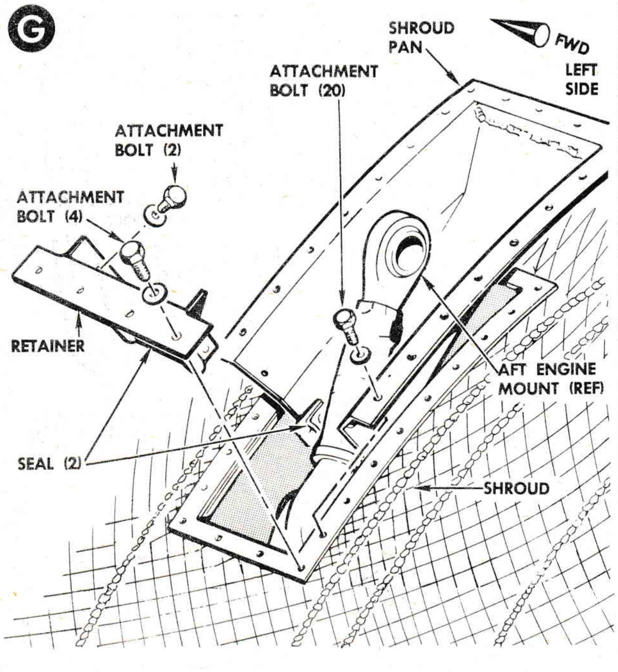
Figure 4-16. Replacement, Engine Shroud Using Stand SE 1012-803 (Sheet 2 of 3)



i. Remove access door and disconnect afterburner duct drain line at fitting on bottom of shroud.



j. Remove shroud pans at aft engine mounts.

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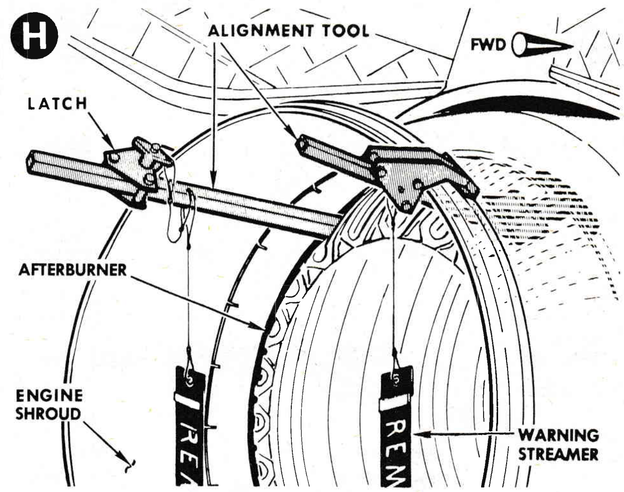

k. Remove shroud ejector alignment tool, or shroud positioning wedges installed during engine removal from fuselage.

l. With shroud roller brackets in up position, carefully roll shroud from engine onto shroud stand. Remove seal retainer from engine.

CAUTION

IF SHROUD MOVES WITH DIFFICULTY CHECK THAT SHROUD INNER BLANKET HAS CLEARANCE ABOUT THE CIRCUMFERENCE OF THE ENGINE. THE BLANKET IS EASILY DAMAGED.

INSTALLATION

a. Installation of the engine shroud is essentially the reverse of the removal procedure.

b. Place shroud seal retainer on forward end of shroud; attachment bolts (25) finger tight with shroud roller brackets in up position, carefully roll shroud onto engine until edge of shroud is approximately 7 inches from engine firewall.

c. Place shroud forward roller brackets in down position. Roll shroud forward until engagement is made with engine firewall. Trim engine firewall N_1 bleed air adapter ducts on aft side of firewall as required to accomplish positive engagement of shroud ducts and firewall ducts.

WARNING

EXERCISE CARE TO AVOID INJURY TO HANDS AND FINGERS WHEN GUIDING SHROUD SEAL RING OVER ENGINE FIREWALL.

d. Install shroud positioning wedges, or ejector alignment tool.

e. Tighten seal-to-shroud attachment bolts evenly for uniform sealing. Safety-wire shroud turnbuckles and afterburner duct drain line.

f. Close all voids between shroud inner and outer surfaces at access doors and at shroud attachment to engine firewall using sealer No. HT-1 (8030-285-4436).

Figure 4-16. Replacement, Engine Shroud Using Stand SE 1012-803 (Sheet 3 of 3)

ADJUSTMENT

4-113. ADJUSTMENT, OIL COOLER VALVES AND ACTUATORS.

4-114. Equipment Requirements.

FIGURE	NAME	TYPE	ALTERNATE	USE AND APPLICATION
Refer to T.O. 1F-106A-2-10	Generator Set (Gas).	8-96026-801 AF/M32A-13 (6115-583-9365)	8-96026 AF/M32M-2 (6115-617-1417)	To energize electrical systems on aircraft equipped with special quick disconnect receptacle.
	Generator Set (Elec).	8-96025-803 AF/ECU-10/M (6125-583-3225)	8-96025-805 A/M24M-2 (6125-628-3566)	
			8-96025 AF/M24M-1 (6125-620-6468)	
	Generator Set.		MC-1 (6125-500-1190)	To energize electrical systems (except AWCIS) on aircraft equipped with standard AN receptacle and on others by using adapter cable 8-96052.
			MD-3 (6115-635-5595)	
	Adapter Cable.	8-96052 (6115-557-8548)		To connect MC-1 and MD-3 units to aircraft equipped with special quick disconnect receptacle.
	Compressed dry air source of 70 psi.			To actuate oil cooler air valve actuators.

4-115. Preparation for Adjustment of Engine Air-Oil Cooler Air Valve and Actuator.

a. Remove engine air-oil cooler to permit checking adjustment of engine air-oil cooler air valve and actuator. See figure 6-2 for this procedure.

b. Connect external dc power source to the airplane receptacle.

c. Connect external 70 psi air pressure source to the engine accessory compartment pressure control sensor; remove engine bleed air hose and connect external source to tube fitting. The engine air hose is attached to a fitting near the upper right corner of the left forward engine mount access door.

d. Install the following fuses:

1. "OIL COOL CONT" — Main wheel well panel
2. "COMPT PRESS WARN" — Main wheel well fuse panel

4-116. Procedure, Adjustment of Engine Air-Oil Cooler Air Valve and Actuator.

a. Perform steps of preparation procedure.

b. Check alignment of actuator rod bearing with face of the valve shaft arm. Arm may be shifted on shaft to bring the parts into alignment by loosening clamp on hub of arm. End play may be taken up by tightening spring washer on the upper end of valve shaft.

c. Adjust length of actuator rod to hold valve closed.

d. Shorten rod one additional turn at bearing attachment.

e. Extend actuator by depressing test switch on fuel temperature control box to check operation of the valve. With the air valve closed, the silicone and rubber leading and trailing edges shall follow the contour of the duct walls. The convex leading edge of the valve shall close outward. It is important that the valve and actuator swing freely with no binding at any point.

f. Reinstall oil cooler. See figure 6-2 for this procedure.

4-117. Preparation for Adjustment of Constant-Speed Oil Cooler Air Valve and Actuator.

a. *Applicable to F-106A airplanes 57-246 thru 57-2455 and F-106B airplanes 57-2516 thru 57-2531.* Remove constant-speed drive oil cooler to permit checking adjustment of drive unit oil cooler air valve and actuator. See figure 9-6 for this procedure.

b. Connect external dc electrical power source to the airplane receptacle.

c. Gain access to constant-speed drive (CSD) air-oil cooler valve.

4-118. Procedure, Adjustment of Constant-Speed Oil Cooler Air Valve and Actuator.

a. Perform steps of preparation procedure.

b. *Applicable to F-106A airplanes 56-453, -454, -456 through 57-245, 57-2456 and subsequent; F-106B airplanes 57-2508 through -2515, 57-2532, and subsequent.* Adjustment procedure with valve flapper stop incorporated.

c. Disconnect the actuator rod-end from the valve arm.

d. Check that valve and actuator pivot freely and that all end play is taken up by spring washer on upper end of valve shaft.

e. Manually rotate the valve arm counterclockwise until the flapper valve contacts the stops.

f. Using a 6 inch steel scale, graduated in tenths-of-an-inch, measure the distance between 3.40 inches, minimum, and 3.60 inches, maximum, from apex of the lower mounting flange of CSD actuator valve to the aft edge of bolt hole in the valve arm. Loosen clamp at flapper valve shaft and adjust the valve arm on the splined shaft, as required, to obtain the specified dimensions.

NOTE

Valve must be maintained against stops while measurements are taken.

g. Tighten the clamp at the flapper valve shaft and recheck measurements. Readjust valve arm, if required.

h. Disconnect the actuator emergency air line at the emergency pressure regulator and relief valve.

i. Extend the actuator by applying 70 psi to the emergency air line.

j. While maintaining the flapper valve against the stops, adjust the actuator rod-end to match the hole in valve arm.

k. Shorten the actuator push rod by ½ turn of the rod-end, and attach the rod-end to valve arm.

l. Remove test equipment; reconnect air line. Reinstall oil cooler, if removed (see figure 9-6 for this procedure).

m. Conduct priming procedure for constant-speed drive system, if oil cooler was removed (refer to Section IX for this procedure).

n. Operate the engine at full military power and ascertain that the constant-speed drive air-oil cooler valve remains open (indicated by actuator remaining retracted).

o. *Applicable to F-106A airplanes 57-246 through -2455 and F-106B airplanes 57-2507, 57-2516 through -2531.* Adjustment procedure without valve flapper stop incorporated.

p. Accomplish the foregoing procedure, with the following exceptions:

1. Step "e." – Flapper valve must be in full closed position.
2. Step "f." – Adjust valve arm on splined shaft to obtain a dimension between 3.65 inches, minimum, and 3.85 inches, maximum.
3. Step "j." – With the flapper in full closed position, adjust the actuator rod-end to match the hole in the valve arm.
4. Step "k." – Shorten the actuator push rod by 2½ turns and attach the rod-end to the valve arm.

NOTE

Flapper valve should have 0.370 inch clearance between flapper valve and duct walls when in closed position after rigging.