

CHAPTER

28



MAINTENANCE MANUAL

TEMPORARY REVISION NR. DFW 28-08

INSERT COVER PAGE OF THIS TR IN FRONT OF CHAPTER 28

REASON FOR CHANGE: SFAR88 and AD note 2008-04-11

INSTRUCTION: Insert following pages of this TR in front of the original page:

CHAPTER	PAGE OF THIS TR	ORIGINAL PAGE
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28-7-0	7, 8	15
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CHAPTER 28

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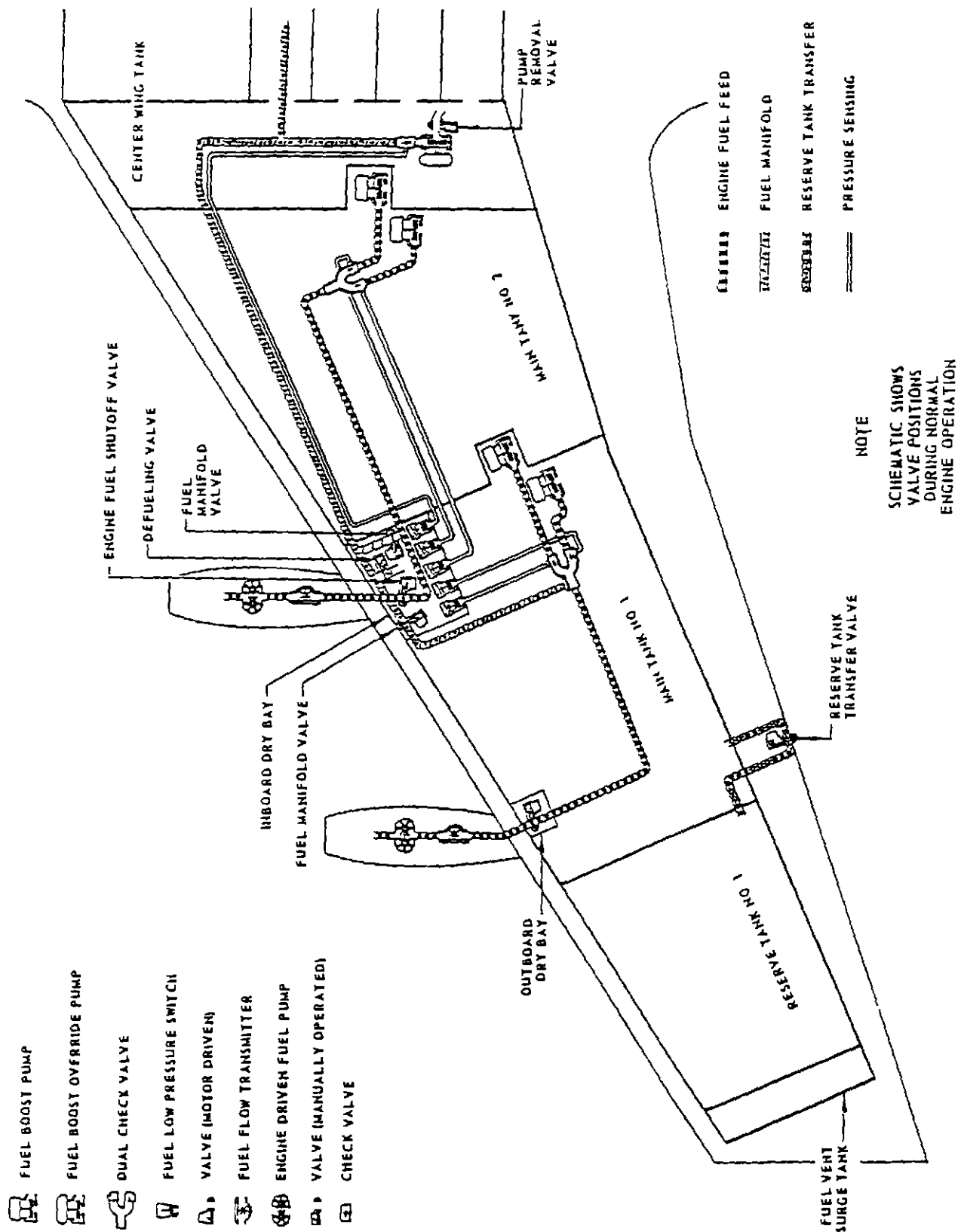
ENGINE FUEL FEED SYSTEM - DESCRIPTION AND OPERATION

1 General

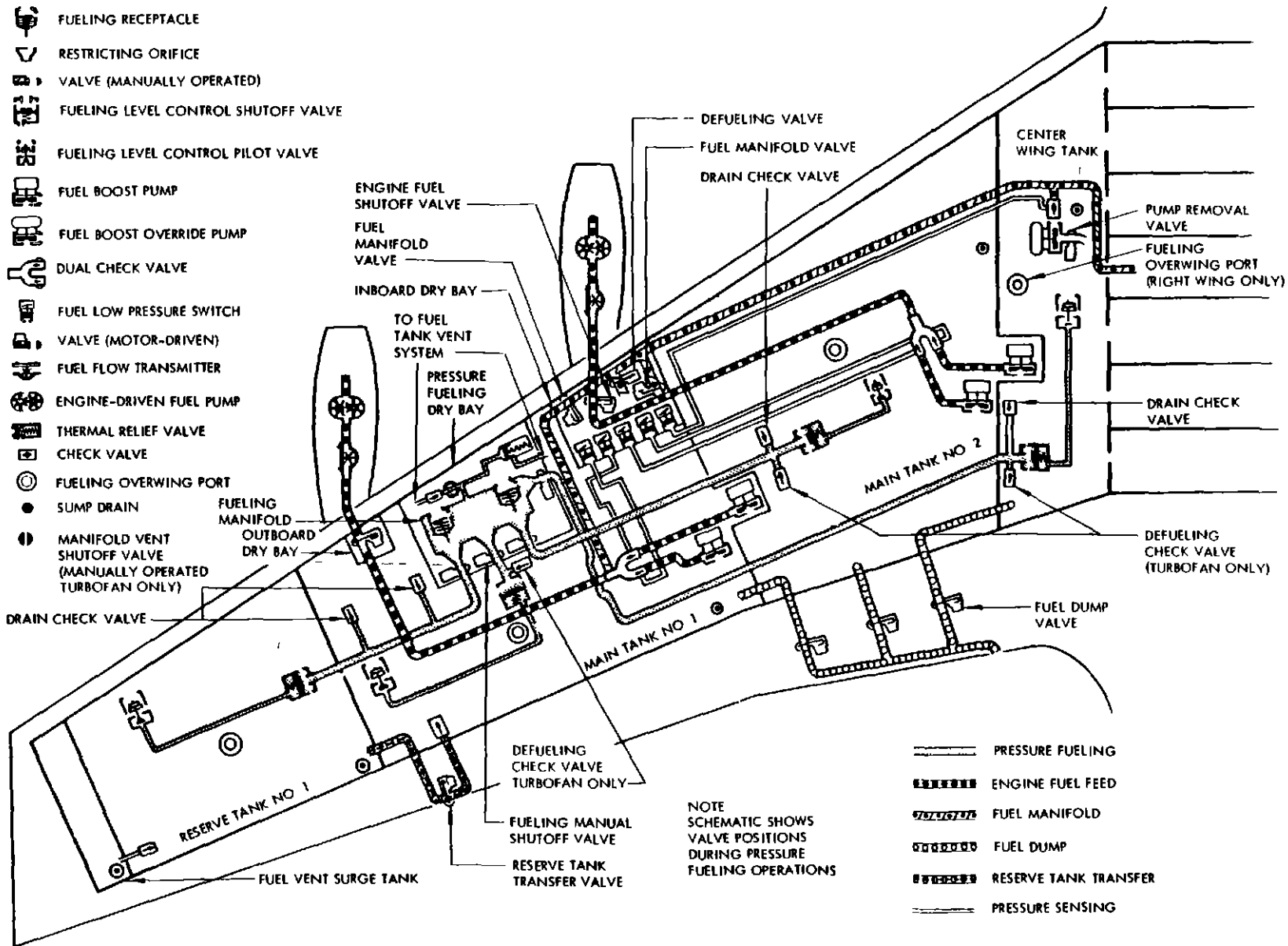
- A The engine fuel feed system is a system of fuel lines, pumps and valves which distributes fuel to the engines (See figure 1) It consists of four main tank to engine fuel feed sub-systems which are interconnected by a fuel manifold, such, that fuel may be delivered from any main tank or center wing tank to any or all engines The reserve tanks are not connected to the fuel manifold Fuel from the reserve tanks is gravity fed to main tanks n° 1 and n° 4
- B Each fuel tank except the reserve tanks, is equipped with two a-c powered fuel boost pumps The pumps are controlled by separate switches and independant circuits, so that engine operation will not be affected by the failure of a single electrical power source The center wing tank boost pumps, known as the fuel boost override pump, will override the main tank boost pumps to supply fuel to the engines
- C Electric motor driven shutoff valves control fuel flow to the engines The valves are classified into three groups the valves that shut off fuel to the engines, the valves that control manifold distribution, and the valves that transfer fuel from the reserve tanks to main tanks n° 1 and 4 The names of these valves are respectively the engine fuel shutoff valves, the fuel manifold valves, and the reserve tank transfer valves
- D The engine fuel feed system delivers fuel from the tanks through the fuel feed lines to the engines (See figure 1) The controls are centralized on the flight engineer's lower panel (detail A, figure 2), and are laid out in the form of a flow diagram Electrical power is used to position the valves and to drive the pumps

2 Engine Fuel Shutoff Valves

- A Four engine fuel shutoff valves provide a means of shutting off the supply of fuel to the engines Each valve is an electric motor driven slide shutoff valve consisting of a valve housing, sliding gate, electric motor and a manual override handle (See figure 3) One valve is located in the inboard and outboard dry bays of each wing (See views 4 and 6, figure 2) The manual override handle provides a visual means of checking the valve position and a manual means of opening or closing the valve when the motor is not energized The valve housing incorporates a thermal relief provision to limit the pressure buildup in the fuel manifold The valves are individually controlled by engine fuel shutoff valve switches on the flight engineer's lower panel and by engine fire switches on the overhead panel and for A/C LX-N1997 and LX-N20000, by the start lever on the pedestal



Engine Fuel Feed System Flow Diagram
 Figure 1



NOTE
SCHEMATIC SHOWS
VALVE POSITIONS
DURING PRESSURE
FUELING OPERATIONS

	PRESSURE FUELING
	ENGINE FUEL FEED
	FUEL MANIFOLD
	FUEL DUMP
	RESERVE TANK TRANSFER
	PRESSURE SENSING



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6. Fuel Dump System

- A. The fuel dump system consisting of fuel lines, valves, dump chutes and chute operating mechanism provides the means by which fuel can be dumped in flight. Refer to 28-22-0, Fuel Dump System. Each wing contains an extendable dump chute which must be fully extended before fuel can be dumped. Each chute is fed fuel by dump lines from the main and center wing tanks on its respective side of the airplane. The reserve tank fuel is transferred to and dumped with the main outboard tank fuel. The controls are located on the flight engineer's auxiliary panel. When all dump valves are open, the system will dump all the fuel except a predetermined amount necessary for emergency operation.

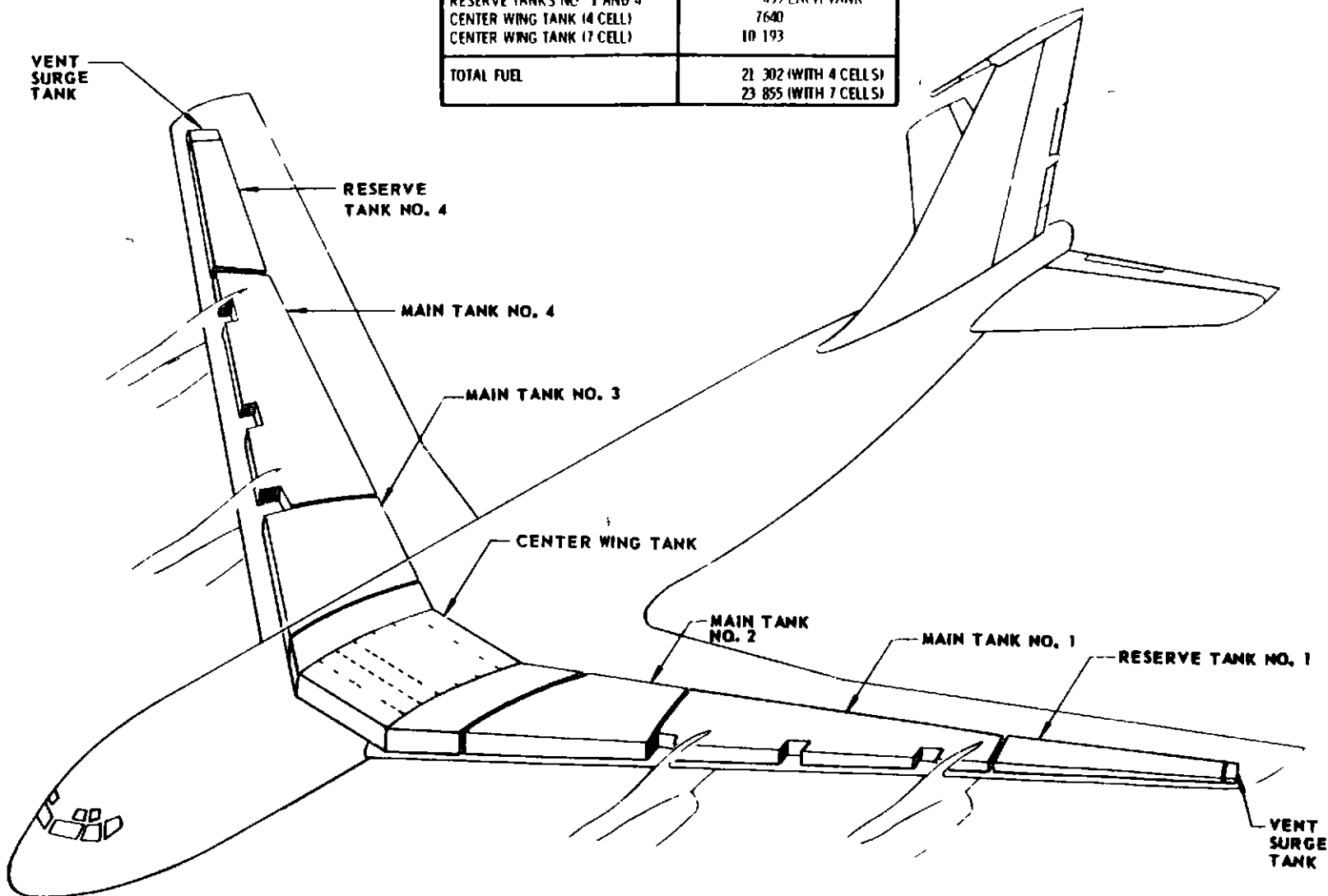
7. Indicating Systems

- A. The fuel quantity indicating system provides a measure of the weight of fuel aboard the airplane. The system incorporates internally mounted electric capacitance type tank units in all fuel tanks, with elements which compensate for fuel density variations. The fuel quantity indicators on the flight engineer's lower panel are calibrated to read in kilograms of fuel remaining in each tank. One total fuel quantity indicator provides a continuous summation of the fuel quantities in all tanks. Refer to 28-41-0 Fuel Quantity Indicating System. The fuel flow indicating system provides a visual indication at the pilots' station of the fuel consumption rate in kilograms per hour for each engine. Refer to 28-9-0, Fuel Flow Indicating System. The fuel temperature indicating system provides a means for checking the temperature of fuel in the tanks and in the fuel lines at each engine. The system consists of an indicator and five position selector switch on the flight engineer's lower panel, and five fuel temperature bulbs (one in main tank No. 1 and one at each engine on the outlet side of the fuel filter). Refer to 28-20-0, Fuel Temperature Indicating System.

8. Engine Fuel Deicing System

- A. Each engine has a manually controlled engine fuel deicing system which conditions the fuel before it reaches the fuel control unit. The principal components of each deicing system are a fuel filter, an air control valve and an air-fuel heat exchanger. The four fuel heater switches and fuel icing indicator lights are located on the flight engineer's lower panel. Power to the system is 28 volts dc.
- B. The fuel filter is fitted with a pressure warning switch which detects filter icing and then illuminates the icing indicator light. The air control valve controls the flow of high pressure discharge air to the heat exchanger through which all of the engine fuel flow passes. A fuel temperature bulb is located on the outlet side of the fuel filter to monitor the fuel-out temperature. Refer to 28-19-0, Engine Fuel Deicing System and 28-20-0, Fuel Temperature Indicating System.

TANKS	USABLE FUEL GALLONS
MAIN TANKS NO. 1 AND 4	2323 EACH TANK
MAIN TANKS NO. 2 AND 3	2069 EACH TANK
RESERVE TANKS NO. 1 AND 4	439 EACH TANK
CENTER WING TANK (4 CELL)	7640
CENTER WING TANK (7 CELL)	10 193
TOTAL FUEL	21 302 (WITH 4 CELLS) 23 855 (WITH 7 CELLS)



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Fuel Tank Arrangement
 Figure 2

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9 Miscellaneous Components

- A. Miscellaneous fuel system components include fuel filler cap assemblies, baffle check valves, defueling valve, fuel sump drain cocks, and drip sticks. Refer to 28-1-0, "Miscellaneous Components." All fuel tanks have an exterior filler cap for individual tank servicing, or the tanks can be individually or simultaneously filled at the pressure fueling stations. The main tanks have baffle check valves installed in the bottom of the inboard ribs to allow fuel to flow inboard towards the boost pumps during normal flight attitude and to not allow fuel to flow away from the pump area during turbulence or airplane maneuvers.
- B. Pressure defueling of the main tanks or center wing tank is accomplished through a defueling valve located in the inboard dry bay. The fuel boost pumps in the main tanks or the override pumps in the center wing tank deliver fuel to the defueling valve through their respective fuel manifold valves. Alternatively, fuel may be drawn from the tanks through the defueling valve by means of the fuel truck defueling pump. In addition, on turbofan airplanes, defueling check valves in the pressure fueling lines provide for rapid partial defueling through the fueling receptacles. The reserve tanks are defueled through a reserve tank transfer valve to the adjacent main tanks. Residual fuel in each tank may be drained through fuel sump drain cocks located in the bottom of each tank.
- C. In addition to the fuel quantity indicating system, the fuel quantity in each tank can be determined by calibrated drip sticks located in the wing lower surface. The drip stick is slowly lowered until fuel begins dripping from a drip hole near the base of the stick. At this moment the reading opposite the calibration plane is taken. The fuel quantity in the tank is obtained by comparing the drip stick reading with a special chart.

10. Fuel Lines

- A. All fuel lines are principally contained within the tank boundaries. They are fabricated mainly from standard aluminum alloy aircraft tubing and connected to the various fuel system components with standard NAS or MS union and couplings. Access to all tank equipment and fuel lines is provided externally by access panels in the lower wing surface and internally by openings in the tank ribs which are large enough to allow personnel to move through the ribs for inspection and maintenance. Refer to 28-2-0, "Integral Fuel Tanks."

11. Controls

- A. Fuel system controls, indicators and indicating lights, except those for the fuel dump and fuel flow systems, are located on the lower instrument panel at the flight engineer's station. The fuel dump system controls are on the auxiliary panel adjacent to the lower panel. Fuel flow indicators are located on the engine instrument panel at the pilots' station.



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12. Fuel Tank Leak Detection

- A Leakage from the tanks will be caused by a break in the seal plane, due to improper sealant application, improper mixing or storage of sealant, use of incompatible repair sealants, loose fasteners, damaged topcoating or improper installation of tank fittings. To be effective, fuel leak detection instructions must be followed explicitly. For leak detection, see 28-2-0, Integral Fuel Tanks.

13. Fuel Tank Sealing

- A. The purpose of integral fuel tank sealing is to provide an absolutely fuel tight barrier for the fuel in the tanks. To achieve this, various types of seals are used at different locations in the tanks to control the flow of fuel which otherwise would tend to leak from the tanks. Repairs to damaged fuel tank sealant must be made with approved materials, using approved methods and tools. The sealant materials used have synthetic rubber base and when properly cured are resistant to heat and extreme cold as well as fuel. For approved repairs, see 28-2-0, Integral Fuel Tanks.



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When operating the APU unattended for an extended period of time, follow Airplane Maintenance Manual 49-00-2 and 49-00-3 page 201 instructions regarding necessary fuel quantity based on APU fuel burn rate.

When defueling or transferring fuel with minimum backpressure to the pumps, it is possible for a pump low pressure light to illuminate before all fuel is transferred. In one pump fuel tank configurations, monitor the tank quantity and put the pump to OFF if the tank quantity does not change. In two pump fuel tank configurations, put the pump to OFF and continue, and if the remaining pump's low pressure light illuminates, then monitor tank quantity and put that pump to OFF if tank quantity does not change. If each pump's low pressure light illuminates simultaneously, put the aft pump to OFF and continue while monitoring tank quantity and put the forward pump to OFF if tank quantity does not change.

NOTE. Forward pumps can usually supply more fuel on the ground compared to aft pumps.

Only one pump per fuel tank can be operated when a low pressure light is illuminated for that tank and that pump should be put to OFF when the tank quantity does not change.

- (10) Start fuel truck defueling pump.
- (11) Reserve tanks defuel by gravity flow only, there being no boost or override pumps in these tanks. To defuel reserve tanks, defuel adjacent main tanks to below 5450 kilograms of fuel, position reserve tank transfer valve switch to open valve and continue defueling. When reserve tank(s) is empty, position reserve tank transfer valve switch to close valve.
- (12) When applicable fuel low pressure warning lights illuminate, position their respective pump switches to OFF.

CAUTION DO NOT ALLOW BOOST PUMPS TO OPERATE IN EMPTY TANKS.

- (13) Stop fuel truck defueling pump.
- (14) Manually close defueling valves.
- (15) Position fuel manifold valves switches to close valves.
- (16) Remove defueling hoses and ground wires, in that order. Replace valve caps, and replace inboard dry bay access panels.
- (17) Drain sump fuel from defueled tanks at fuel sump drain cocks.

WARNING DRAIN SUMP FUEL INTO PROPERLY MARKED CONTAINERS. GROUND FUNNEL AND CONTAINERS TO AIRPLANE.

- (18) Drain boost pumps at drain plug on bottom of pumps.
- (19) Determine whether there is any further need for electrical power on airplane, if not, remove external power



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F. Defueling through Defueling Valve With Fuel Tank Boost or Override Pumps Operating.

- (1) Follow the same steps given in paragraph 1.E. with the exception that fuel truck defueling pump is not used.

G. Defueling Through Defueling Valve With Fuel Truck Defueling Pump Operating.

NOTE: This method is extremely slow and should only be used as a last resort.

- (1) Follow the same steps given in paragraph 1.E. with the exception that electrical power is not used, and valve positioning must be done manually. Also instead of positioning the boost or override pump switches to ON, the truck defueling pump switch must be positioned to ON.



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- K In order to verify correct operation of the fueling level control valves, place the fueling precheck switch to CLOSE or TEST position. After completing check, place switch to NORM position.

NOTE. The fueling precheck switch (when installed) is located on the fueling instrument panel (when installed) just forward of the fueling station.

- L. Close applicable shutoff valves when respective fueling preset indicator light (when installed) illuminates. If preset system is not being used close shutoff valves when fueling of tank is completed.
- M. Close all fueling shutoff valves after completing fueling operation.
- N. After closing all fueling shutoff valves, reverse fueling pump to evacuate manifold and then stop fueling pump.
- O. Disconnect fueling hose nozzles.
- P. Disconnect nozzle bonding cable (if installed).
- Q. Replace fueling receptacle caps, and wipe up at the fueling station.
- R. Disconnect fueling track grounding cable.
- S. Close pressure fueling access door.
1. Position fueling preset switches (when installed) to NORM.
- U. Position fueling switch at external power receptacle to OFF, and disconnect external power.

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5. Fuel Tank Sump Drainage

A. General

- (1) Periodic draining of fuel tank sumps is essential for removal of free water from fuel tanks. Do not drain sumps while tanks are being fueled as the water will be suspended in the fuel. Allow maximum practical settling period prior to draining as the settling period for water in fuel is one hour per foot of fuel depth. If it is not possible to allow a settling period after fueling, the sumps should be drained before fueling to prevent excessive accumulation of water from repeated fueling.
- (2) Fuel temperatures should be above 32°F before sump draining is attempted to assure removal of all accumulated water and ice from the sump. If it is not possible to allow the fuel temperature to rise above 32°F prior to draining the sumps, the use of an approved fuel anti-icing additive may facilitate drainage. Phillips PFA 55 MB additive, or equivalent, may be used in a concentration not to exceed 0.1 per cent by volume.

B. Equipment and Materials

- (1) Clear plastic or glass container of one gallon capacity.
- (2) Wrench Assembly - Fuel Drain Valve, F65834-500 or equivalent.

C. Drain Fuel Tank Sumps

- (1) Insert screwdriver or wrench assembly in slot in fuel sump drain valve. (See figure 203.)
- (2) Push up and rotate drain valve in either direction to hold in open position.
- (3) Use clear plastic or glass container to catch drainage so that line of separation between water and fuel can be noted.
- (4) Drain each sump long enough to ensure that all free water is removed.
- (5) Insert screwdriver or wrench assembly and close drain valve.



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FUEL SYSTEM - MAINTENANCE PRACTICES

1 Defueling

A. General

- (1) Defueling can be done from both sides (wings) of the airplane, simultaneously if desired. On turbofan airplanes, rapid partial defueling can be accomplished through the pressure fueling receptacles by suction from fuel truck defueling pump.
- (2) Complete defueling can be accomplished through the defueling valves in one of the two ways - under pressure from the boost or override pumps in the tank to be defueled, or by suction from fuel truck defueling pump. The most rapid means for defueling is, however, when the two methods are combined. Suction defueling alone through the defueling valves is extremely slow and should only be used as a last resort.

WARNING OBSERVE AIRLINE AND AIRPORT STANDARD FUELING/DEFUELING PRECAUTIONS.

B. Equipment and Materials

- (1) Fuel Truck
- (2) External Power Cart
- (3) Fuel Sump Drain Cock Wrench Assembly - F65831-500, or equivalent.

C. Defueling Precautions

- (1) Ensure that defueling the required tank or tanks will not cause tipping of the airplane. When necessary, defuel other tanks first to prevent tip back.
- (2) Do not drain full reserve tank into adjacent main tank unless main tank fuel level is below 5450 kilograms.
- (3) Do not remove a tank exterior filler port cap before making sure fuel level is below level of cap. In some airplane attitudes with full fuel tanks, removal of filler cap will result in fuel flowing out through filler port onto wing.
- (4) Observe standard defueling precautions.

D. Rapid Partial Defueling Through Pressure Fueling Receptacles

- (1) Turn all unnecessary electrical equipment off.
- (2) Ground airplane and fuel truck(s). Refer to Chapter 13, Static Grounding.
- (3) Open pressure fueling station access doors, and remove receptacle caps.



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- (4) Install defueling hose nozzle grounding jacks and connect nozzles to fueling receptacles in that order.
 - (5) Manually close fueling manifold vent shutoff valve.
 - (6) Open fueling shutoff valve of one of the tanks to be defueled. Do not open reserve tank shutoff valves. Reserve tanks defuel by gravity flow into adjacent main tank only, there being no defueling check valves in the reserve tanks.
 - (7) To defuel reserve tanks, defuel adjacent main tanks to below 5450 kilograms of fuel, position reserve tank transfer valve switch to open valve and continue defueling adjacent tank until reserve tank is empty. Then position reserve tank transfer valve switch to close valve.
 - (8) Start fuel truck defueling pump.
 - (9) Continue defueling until flow ceases.
 - (10) Close fueling shutoff valve and open shutoff valve of next tank to be defueled and again continue defueling until flow ceases, then close shutoff valve.
 - (11) Stop fuel truck defueling pump.
 - (12) Manually open fueling manifold vent shutoff valve.
 - (13) Disconnect defueling hose nozzles and grounding jacks, in that order.
 - (14) Replace receptacle caps and close fueling station access doors.
- E. Defueling Through Defueling Valve With Fuel Tank Boost or Override Pumps and Fueling Truck Defueling Pump Operating
- (1) Turn all unnecessary electrical equipment off.
 - (2) Ground airplane and fuel truck(s). Refer to Chapter 13, Static Grounding.
 - (3) Connect external electrical power to airplane.
 - (4) Check that engine fuel shutoff valve switches are in CLOSE position.
 - (5) Position fuel manifold valve switches to open valves for tanks to be defueled.
 - (6) Remove inboard dry bay access panels to gain access to defueling valves.
 - (7) Connect defueling hose ground wires to nearest bonding jumper, and then connect defueling hose to defueling connection.
 - (8) Manually position defueling valves to OPEN.
 - (9) Position applicable tank boost or override pump switch to ON.
 - (9a) Monitor any fuel pump low pressure indication light during pump operation and immediately put the fuel pump switch to OFF when a low pressure light(s) comes on and stays on.



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FUEL SYSTEM - MAINTENANCE PRACTICES

1. Defueling

A. General

- (1) Defueling can be done from both sides (wings) of the airplane, simultaneously if desired. On turbofan airplanes, rapid partial defueling can be accomplished through the pressure fueling receptacles by suction from fuel truck defueling pump.
- (2) Complete defueling can be accomplished through the defueling valves in one of the two ways - under pressure from the boost or override pumps in the tank to be defueled, or by suction from fuel truck defueling pump. The most rapid means for defueling is, however, when the two methods are combined. Suction defueling alone through the defueling valves is extremely slow and should only be used as a last resort.

WARNING: OBSERVE AIRLINE AND AIRPORT STANDARD FUELING/DEFUELING PRECAUTIONS.

B. Equipment and Materials

- (1) Fuel Truck
- (2) External Power Cart
- (3) Fuel Sump Drain Cock Wrench Assembly - F65834-500, or equivalent

C. Defueling Precautions

- (1) Ensure that defueling the required tank or tanks will not cause tipping of the airplane. When necessary, defuel other tanks first to prevent tip back.
- (2) Do not drain full reserve tank into adjacent main tank unless main tank fuel level is below 5450 kilograms.
- (3) Do not remove a tank exterior filler port cap before making sure fuel level is below level of cap. In some airplane attitudes with full fuel tanks, removal of filler cap will result in fuel flowing out through filler port onto wing.
- (4) Observe standard defueling precautions.

D. Rapid Partial Defueling Through Pressure Fueling Receptacles

- (1) Turn all unnecessary electrical equipment off.
- (2) Ground airplane and fuel truck(s). Refer to Chapter 13, Static Grounding.



- (3) Open pressure fueling station access doors, and remove receptacle caps.
 - (4) Install defueling hose nozzle grounding jacks and connect nozzles to fueling receptacles in that order.
 - (5) Manually close fueling manifold vent shutoff valve.
 - (6) Open fueling shutoff valve of one of the tanks to be defueled. Do not open reserve tank shutoff valves. Reserve tanks defuel by gravity flow into adjacent main tank only, there being no defueling check valves in the reserve tanks.
 - (7) To defuel reserve tanks, defuel adjacent main tanks to below 5450 kilograms of fuel, position reserve tank transfer valve switch to open valve and continue defueling adjacent tank until reserve tank is empty. Then position reserve tank transfer valve switch to close valve.
 - (8) Start fuel truck defueling pump.
 - (9) Continue defueling until flow ceases.
 - (10) Close fueling shutoff valve and open shutoff valve of next tank to be defueled and again continue defueling until flow ceases, then close shutoff valve.
 - (11) Stop fuel truck defueling pump.
 - (12) Manually open fueling manifold vent shutoff valve.
 - (13) Disconnect defueling hose nozzles and grounding jacks, in that order.
 - (14) Replace receptacle caps and close fueling station access doors.
- E Defueling Through Defueling Valve With Fuel Tank Boost or Override Pumps and Fueling Truck Defueling Pump Operating.
- (1) Turn all unnecessary electrical equipment off.
 - (2) Ground airplane and fuel truck(s). Refer to Chapter 13, Static Grounding.
 - (3) Connect external electrical power to airplane.



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- (4) Check that engine fuel shutoff valve switches are in CLOSE position.
- (5) Position fuel manifold valve switches to open valves for tanks to be defueled.
- (6) Remove inboard dry bay access panels to gain access to defueling valves.
- (7) Connect defueling hose ground wires to nearest bonding jumper, and then connect defueling hose to defueling connection.
- (8) Manually position defueling valves to OPEN.
- (9) Position applicable tank boost or override pump switch to ON.
- (10) Start fuel truck defueling pump.
- (11) Reserve tanks defuel by gravity flow only, there being no boost or override pumps in these tanks. To defuel reserve tanks, defuel adjacent main tanks to below 5450 kilograms of fuel, position reserve tank transfer valve switch to open valve and continue defueling. When reserve tank(s) is empty, position reserve tank transfer valve switch to close valve.
- (12) When applicable fuel low pressure warning lights illuminate, position their respective pump switches to OFF.

CAUTION: DO NOT ALLOW BOOST PUMPS TO OPERATE IN EMPTY TANKS.

- (13) Stop fuel truck defueling pump.
- (14) Manually close defueling valves.
- (15) Position fuel manifold valves switches to close valves.
- (16) Remove defueling hoses and ground wires, in that order. Replace valve caps, and replace inboard dry bay access panels.
- (17) Drain sump fuel from defueled tanks at fuel sump drain cocks.

WARNING: DRAIN SUMP FUEL INTO PROPERLY MARKED CONTAINERS. GROUND FUNNEL AND CONTAINERS TO AIRPLANE.

- (18) Drain boost pumps at drain plug on bottom of pumps.
- (19) Determine whether there is any further need for electrical power on airplane, if not, remove external power.

F. Defueling through Defueling Valve With Fuel Tank Boost or Override Pumps Operating.



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- (1) Follow the same steps given in paragraph 1.E. with the exception that fuel truck defueling pump is not used.

G. Defueling Through Defueling Valve With Fuel Truck Defueling Pump Operating.

NOTE: This method is extremely slow and should only be used as a last resort.

- (1) Follow the same steps given in paragraph 1.E. with the exception that electrical power is not used, and valve positioning must be done manually. Also instead of positioning the boost or override pump switches to "ON," the truck defueling pump switch must be positioned to "ON."

2. Purging (Air Ventilating)

A. General

- (1) The following paragraphs cover the purging of fuel tanks and precautions which must be observed before entering fuel tank for maintenance. Fuel vapors in the tank and in the vicinity of the airplane present explosive and toxic dangers. The fuel tanks must be in "Fire-Safe Condition" (see definitions below) when initial tank entry is made, and respirators must be worn by personnel entering the tank. The fuel tank must be in "Health-Safe Condition" before entry or maintenance is performed without respirators. These conditions are obtained by air ventilating the fuel tank.

WARNING: DO NOT COMPROMISE THE SAFETY PRECAUTIONS GIVEN FOR PURGING AND FUEL TANK ENTRY.

(2) Definitions:

- (a) "Wetted Fuel Cell" is a fuel cell that has previously contained fuel.
- (b) "Fire-Safe Condition" for normal atmosphere operations will be at a vapor concentration of 25% or less of the lower explosive limit as determined by the use of a combustible gas indicator.
- (c) "Health-Safe Condition" for normal atmosphere operations will be a vapor concentration of 6.25% or less of the lower explosive limit for JP-4 and 8.33% or less of the lower explosive limit for kerosene. These values correspond to 500 parts of vapor per million parts of air by volume. However, the value given for kerosene can not be measured with the portable instruments available.



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(3) Properties of Aviation Fuels.

- (a) It can be seen from Table I that the vapor pressure range for JP-4 fuel is considerably lower than that for aviation gasoline. This makes it possible for explosive or combustible concentrations of JP-4 fuel vapor to be present in vented fuel cells and other vented storage containers over a wide range of temperatures. The flammability temperature range for aviation gasoline is much lower than that of JP-4, while for kerosene it is much higher. This means that at normal temperatures (32 to 90°F, or 0 to 32°C), vapors of kerosene are too lean to burn; aviation gasoline is too rich to burn; but JP-4 is ideal for burning, making it a more hazardous fuel to handle.

TYPE OF FUEL			
CHARACTERISTIC	(1) JP-4	(2) KEROSENE	(3) AVIATION GASOLINE
Flash Point, Tag Closed Cup (1 Atm.)	-10°F to +30°F -23°C to -1°C	+110°F to +140°F +43°C to +60°C	-60°F to -55°F -51°C to -48°C
Flammability Limits, % by Volume	LEL 0.8 UEL 5.6	LEL 0.6 UEL 4.9	LEL 1.4 UEL 7.6
Flammability Limits (1 Atm.)	-20°F to +100°F -29°C to +37°C	+110°F to +220°F +43°C to +104°C	-50°F to +20°F -46°C to -7°C
Reid Vapor Pressure at 100°F or 38°C	2.0 to 3.0 psia 103.4 to 155.1 mm Hg	0.1 psia 5.2 mm Hg	5.5 to 7.0 psia 284.3 to 361.9 mm Hg
Vapor Density or Specific Gravity of Pure Vapor at 70°F or 21°C (Air = 1)	4.0	4.5	3.0 to 4.0
Specific Gravity of Air-Vapor Mixture at Satura- tion at 80°F or 27°C (Air = 1)	1.26 to 1.40	1.00	1.68 to 2.00

NOTE: Due to variable compositions of fuels, values given above are approximate.

TABLE I



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- (4) The use of a combustible gas indicator is limited to JP-4 fuel and to a mixture of JP-4 and kerosene. The flash point characteristics of kerosene alone are such that presently there are no portable instruments available to measure kerosene vapor concentration. However, kerosene does not present problems if the fuel tank temperature is not above 110°F or 43°C. In geographical areas where the above temperature limits are exceeded, it is recommended that the entry into a tank that had contained kerosene is postponed until the temperature limits can be met.

B. Equipment and Materials

- (1) Lamb Air Mover (Venturi 3 inch diameter), Mine Safety Appliances Company, Pittsburgh, Pennsylvania, or equivalent.
- (2) Explosion Proof Electric Air Heater/Blower, Coats Model GA75-2, CAM Industries Inc., Kent, Washington, or equivalent.
- (3) Explosion Proof Portable Air Compressor for use with Lamb air mover.
- (4) Explosion Proof Extension Light and Explosion Proof Flashlight.
- (5) Containers - Non static material with rounded corners, for use to hold tools or mopped up fuel inside the tank.
- (6) Combustible Gas Indicators

NOTE. The instruments listed below are provided with a 10 to 1 scale in addition to the normal scale for determining the percent of the lower explosive limit, therefore, instruments of this type will give more accurate indications of vapor concentrations in the health-safe range. Refer to operating instructions on inside of instrument cover.

When indicator sampling line replacement is required, new sampling lines should be obtained from manufacturers of combustible gas indicators. Sampling lines of ordinary rubber absorb large quantities of fuel vapor, resulting in lower indicator readings, and therefore should not be used.

- (a) Davis Vapotester, Model M-6, Davis Instrument Company, Inc., Newark, New Jersey.
- (b) M.S.A., Model 40, Mine Safety Appliances Company Pittsburgh, Pennsylvania.



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(7) Clothing

- (a) Cotton Shorts
- (b) Cotton Tee Shirt
- (c) Cotton Cap (without visor)
- (d) Cotton Coveralls (No pockets)
- (e) Cotton Socks
- (f) Rubber Gloves

(8) Respiratory Equipment

- (a) Fuel Servicing Cart (See figure 201.) - F52367-500, or equivalent.
- (b) Full Face, Supplied Air Type Respirators, U.S. Bureau of Mines Approved.
- (c) Air Supply Hoses

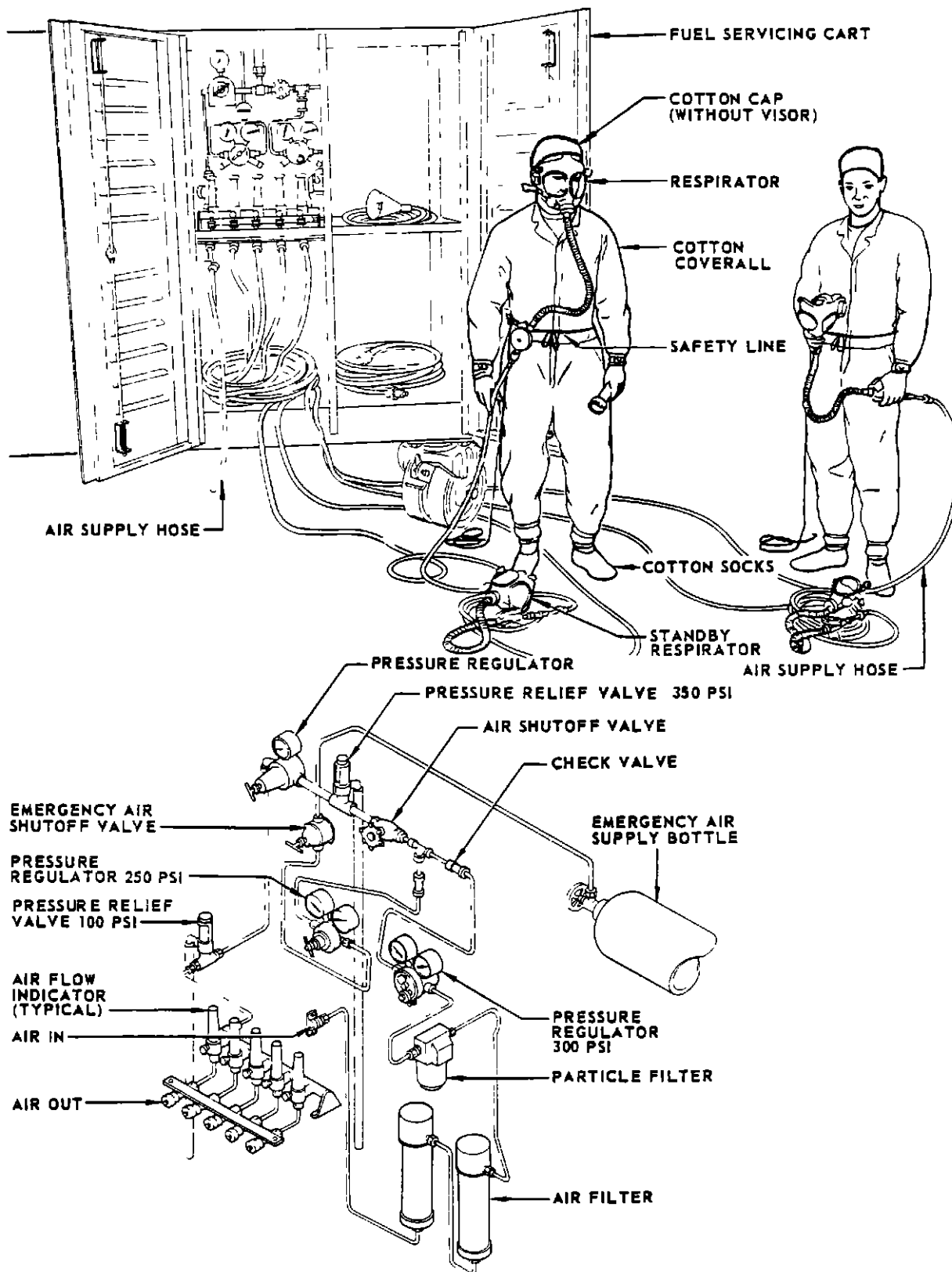
C. Purging and Fuel Tank Entry Precautions

- (1) Perform fuel tank maintenance in areas which allow free movement of air and of fire fighting and other emergency equipment.
- (2) Check that airplane is adequately grounded to an approved and identified ground.
- (3) Remove electrical power from airplane before fuel tank access panels are removed and do not restore power until fuel tank is closed and safe.
- (4) Rope off airplane and post clearly visible signs printed on both sides "DANGER - OPEN FUEL TANKS."

WARNING: IF MAIN TANK NO. 1 OR NO. 4 IS TO BE PURGED, PLACE A SIGN ON THE ADJACENT RESERVE TANK TRANSFER VALVE WHICH READS "DANGER - MEN WORKING IN FUEL TANK, DO NOT OPEN VALVE."

- (5) Disconnect battery and attach a sign which reads "OPEN FUEL TANKS - DO NOT CONNECT."

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Respiratory Equipment
Figure 201

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- (6) Attach to external power receptacle a sign which reads "OPEN FUEL TANKS - DO NOT PUT POWER ON."

WARNING· ALLOW NO ELECTRICAL POWER ON AIRPLANE WHEN A FUEL TANK IS OPEN.

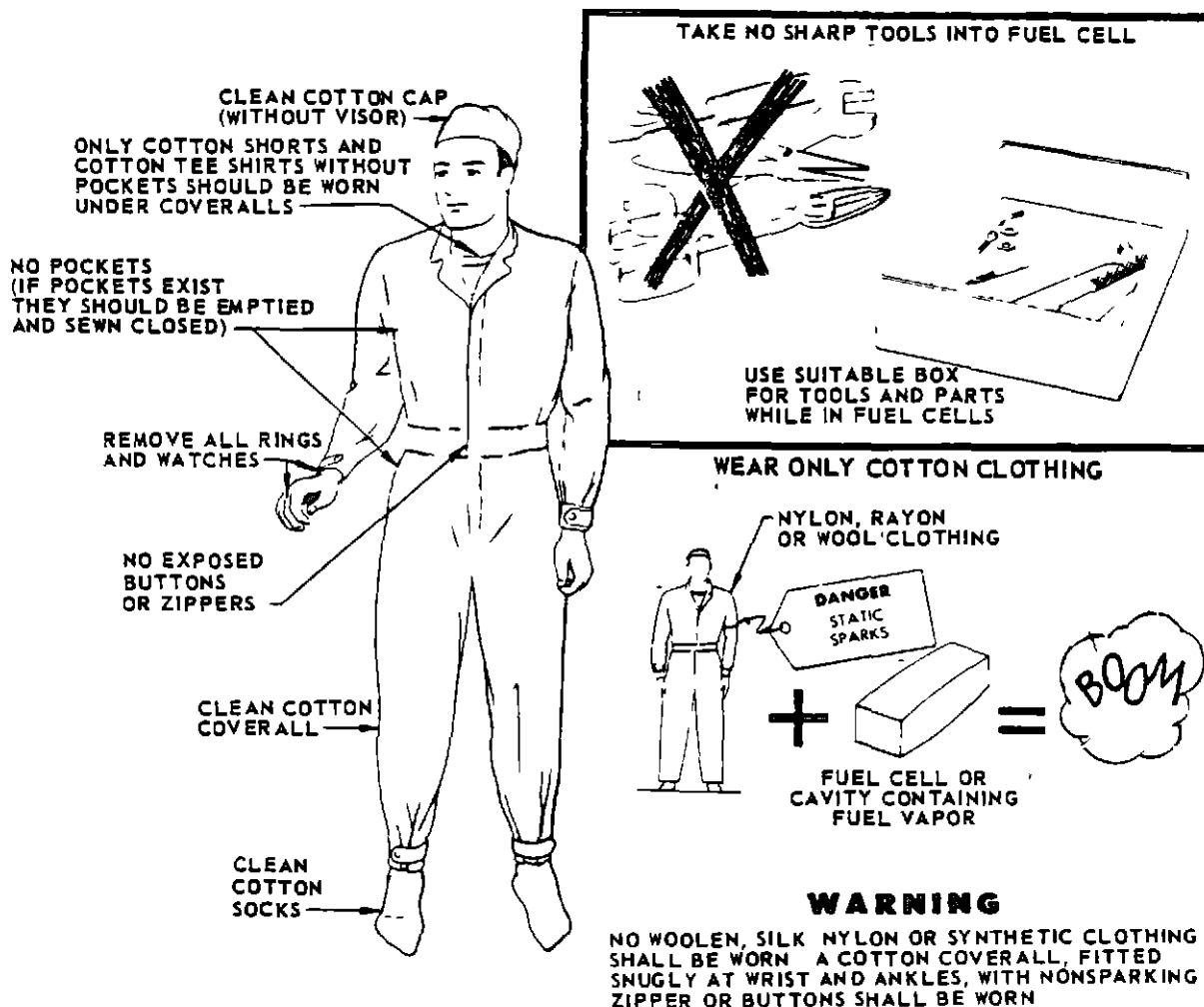
- (7) Use only explosion proof flashlights inside fuel tanks. Use of 110 volt "explosion proof" lights in or near open fuel tank is permitted only when approved by qualified personnel, and only when tank atmosphere is 25% or less of lower explosive limit.
- (8) Provide external lights by explosion proof floodlights and drop cords.
- (9) Do not plug electrical equipment into energized outlets within 100 feet of open fuel tank or puddle of fuel unless such equipment is fitted with "explosion proof" plugs.
- (10) Do not use electrical testing equipment which can produce sparks inside a fuel tank.
- (11) Ensure that personnel working in vicinity of open fuel tanks refrain from: sliding metal objects, such as tool boxes, ladders, etc.; carrying matches or pocket warmers; wearing shoes with metal clips or exposed nails; and wearing hearing aid devices or other battery operated equipment.
- (12) Ensure that, during purging operation, there is no radio or radar equipment operating closer to fuel tanks than specified below:

<u>EQUIPMENT OUTPUT</u>	<u>MINIMUM DISTANCE FROM FUEL TANKS</u>
Radio equipment transmitting at frequency of less than 100 megacycles.	100 feet
Radio equipment transmitting at frequency greater than 100 megacycles.	200 feet
Radar equipment with peak power output of 55 kilowatts.	300 feet
Radar equipment with peak power output between 56 and 75 kilowatts.	375 feet

WARNING FAILURE TO COMPLY CAN RESULT IN IGNITING FUEL VAPORS.

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- (13) Ground all work stands to the same ground used for airplane.
 - (14) Use only air driven power tools inside the fuel tank.
 - (15) Provide suitable container with rounded corners for taking tools inside the fuel tank. (See figure 202.)
- CAUTION:** UNDER NO CIRCUMSTANCES ARE METAL BOXES, OR ANY OTHER KIND OF CONTAINER WITH SHARP OR ROUGH EDGES, TO BE TAKEN INTO FUEL TANK.
- (16) Unless absolutely necessary, do not take sharp edge tools into fuel tank. If, however, such tools are required, keep them in a container when not in use.
 - (17) Wear cotton coveralls with non-sparking zippers or buttons inside the fuel tank. Do not wear wool, silk, nylon or any other synthetic clothing. (See figure 202.)



Fuel Tank Entry Precautions
Figure 202



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D. Purging (Ventilating) of Fuel Tank

- (1) Defuel applicable tank(s) per paragraph 1.
- (2) Remove inboard fuel tank access panel and one or more fuel tank access panels, as required, to ensure good ventilation. Refer to 28-2-1, Fuel Tank Access Panels - Maintenance Practices.
- (3) Install rubber protectors around access opening(s) through which a person will enter tank.
- (4) Remove applicable tank overwing filler port cap.
- (5) Ground Lamb air mover to the same ground used for airplane, then place air mover over filler port. (See figure 203.) Using tape, seal air mover to wing surface. Support air mover, as required, with suitable shot bags.

NOTE: Air mover should be placed over filler port with exhaust horn mounted vertically above wing to permit maximum dissipation of fuel vapors being exhausted from tank.

Lamb air mover (venturi) should be used for purging, rather than air blown, because of superior fuel vapor dissipation ability.

- (6) Position portable air compressor at least 100 feet from an open fuel tank, unless air compressor is explosion proof.
- (7) Connect air compressor to an energized extension cord.
- (8) Connect air hose from air compressor to Lamb air mover.
- (9) Place combustible gas indicator on a stand adjacent to access opening.
- (10) Start air supply to Lamb air mover to commence air ventilating.

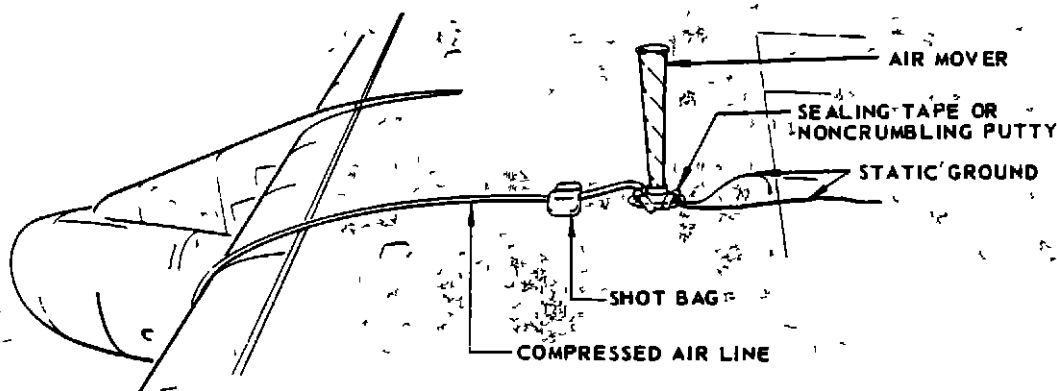
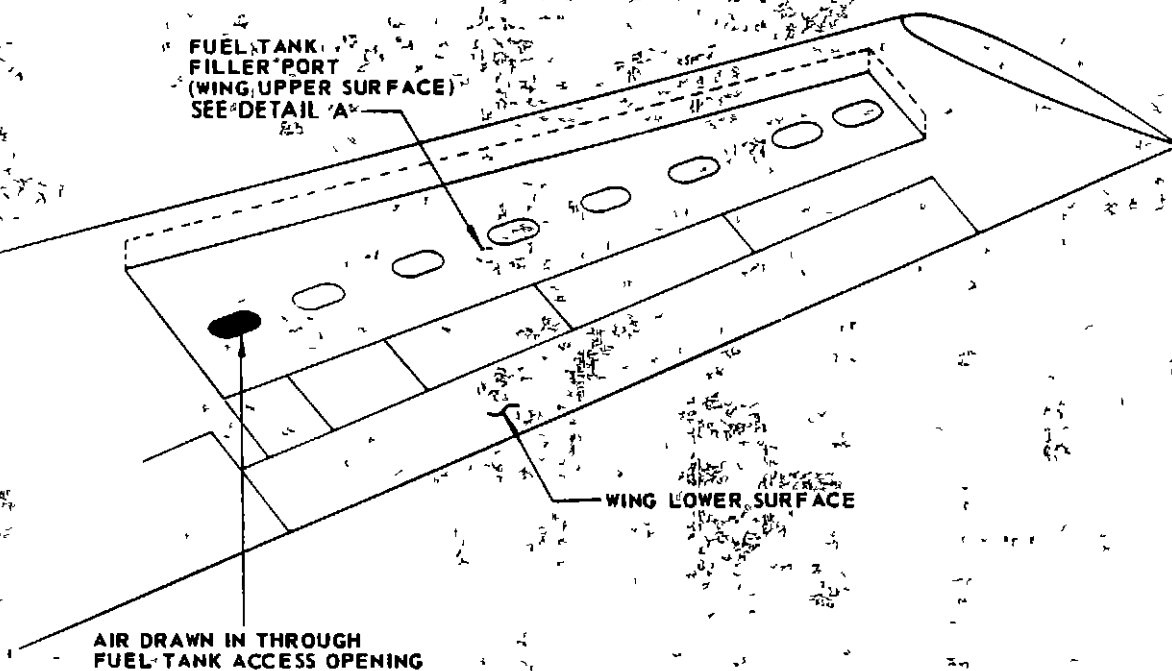
WARNING: ENSURE THAT TANK PRESSURES DO NOT EXCEED SAFE VALUES GIVEN IN 28-2-0, INTEGRAL FUEL TANKS.

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DETAIL A

Preparation for Purging
Figure 203



MAINTENANCE MANUAL

- (11) After tank has been ventilated for approximately 30 minutes, insert combustible gas indicator sampling line well into tank through tank access opening and obtain indicator reading, checking areas in which fuel vapor would be the slowest to dissipate. (See figure 204.) Refer to combustible gas indicator manufacturer's detail operating instructions and calibration.

NOTE. It is recommended that combustible gas indicator reading is taken regardless of the type of fuel that was contained in tank. If the tank had contained kerosene only, then indicator should read zero. This shows that the tank atmosphere is in fire-safe as well as health-safe condition. The use of the respirators and combustible indicator may be omitted from the following steps, providing temperature limitations of paragraph A.(4) are met.

CAUTION. TO AVOID POSSIBILITY OF IGNITING FUEL VAPORS, DO NOT TAKE COMBUSTIBLE GAS INDICATOR INSIDE THE FUEL TANK.

IF INDICATOR NEEDLE RISES FROM ZERO TO TOP OF SCALE (WITH 0 TO 100% RANGE SETTING) AND STAYS THERE, IT INDICATES A CONCENTRATION OF COMBUSTIBLES NEAR OR ABOVE LOWER EXPLOSIVE LIMIT. VAPOR MIXTURES GIVEN SUCH READINGS CAN BE VIOLENTLY EXPLOSIVE. INSTRUMENT SWITCH SHOULD BE IMMEDIATELY TURNED OFF TO PREVENT EXPLOSIONS OCCURRING IN COMBUSTION CHAMBER OF INDICATOR.

- (12) When combustible gas indicator reads 25% or less of lower explosive limit, warm or cooling air may be introduced into tank through access opening from explosion proof heater or blower.

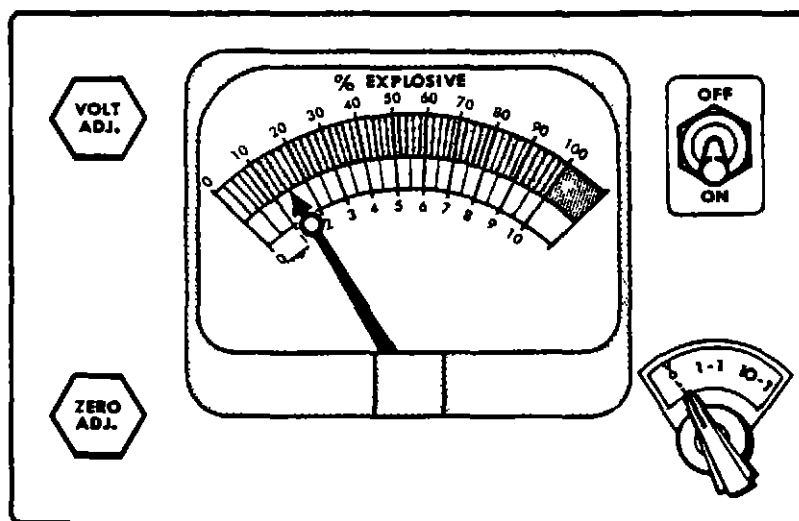
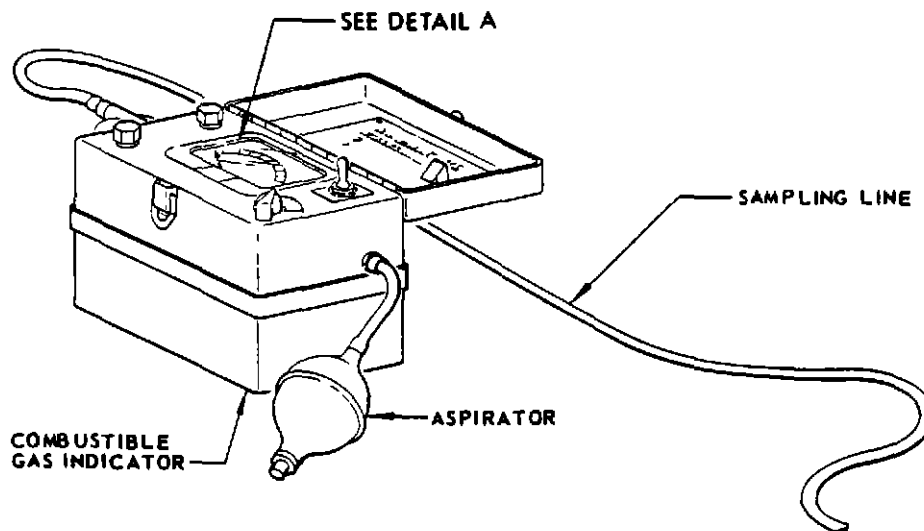
WARNING. DO NOT USE HEATER OR BLOWER UNTIL FUEL VAPOR CONCENTRATION IS REDUCED TO 25% OR LESS OF LOWER EXPLOSIVE LIMIT AS SHOWN BY COMBUSTIBLE GAS INDICATOR.

NOTE: Use of warm air or cooling air is strictly for the comfort of personnel working inside the fuel tank; it is not a function of purging operation.

- (13) Start heater or blower before inserting hose in tank.
- (14) Insert heater or blower hose in fuel tank through tank access opening.

WARNING. DO NOT STOP OR START HEATER OR BLOWER WHILE AIR HOSE IS IN TANK.

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TYPICAL COMBUSTIBLE GAS INDICATOR INSTRUMENT PANEL
DETAIL A



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- (15) Enter fuel tank per paragraph 2.E. to perform maintenance
- (16) Continue fuel tank air ventilation while maintenance is performed in fuel tank, frequently taking combustible gas indicator readings.
- (17) If fuel vapors from any source are introduced into tank that has been air ventilated to fire safe condition, all personnel shall leave the tank immediately until the tank atmosphere is again checked to be fire safe.
- (18) After fuel tank maintenance has been completed, verify that no tools or any other articles are left in fuel tank, then leave tank.
- (19) If heater or blower was used, remove air hose from fuel tank; then stop heater or blower.
- (20) Stop air compressor.
- (21) Disconnect air hose from Lamb air mover, remove air mover, and disconnect ground wire.
- (22) Install overwing filler port cap.
- (23) Install fuel tank access panel(s). Refer to 28-2-1, "Fuel Tank Access Panels - Maintenance Practices."
- (24) Remove, clean and replace all respiratory equipment in fuel servicing cart.
- (25) Remove fuel service cart from vicinity of airplane.
- (26) Remove all precautionary signs.

E. Fuel Tank Entry Procedure

- (1) Position fuel servicing cart near the open fuel tank.
- (2) Connect respirators to air supply as follows (See figure 201.):
 - (a) One respirator for person who will be entering the tank.
 - (b) One respirator for observer (person who will be stationed outside the tank with his head in tank access opening).
 - (c) Two standby respirators.



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- (3) Check air supply to respirators.
- (4) Check emergency air bottles for content and operation.
- (5) Strip down and put on cotton coveralls and cotton socks. Be sure rubber bands are around wrists and ankles holding clothing snug. (See figure 202.)

CAUTION: DO NOT PUT ON COTTON SOCKS UNTIL READY TO ENTER TANK.
SOCKS MUST BE CLEAN WHEN ENTERING TANK.

- (6) Remove rings, bracelets, wrist watches or any other jewelry from person.
- (7) Attach safety line to person entering tank. Agree on safety signals with observer.
- (8) Check standby respirator operation.
- (9) Put on respirator (both, the person entering the tank and observer) and check for operation.
- (10) Station one person at fuel servicing cart to observe breathing indicators of those wearing respirators to ensure that persons using respirators are breathing properly.
- (11) Verify that tank atmosphere is at 25% or less of lower explosive limit.
- (12) Discharge static electricity by touching identified ground used for airplane, then enter tank.

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- (13) Observer shall discharge static electricity in the same manner as the person entering the tank and assume position outside the fuel tank with his head inside the tank access opening. He should observe any signal of distress shown by the person working inside the tank.

WARNING THE MAXIMUM ALLOWABLE CONCENTRATION (MAC) VALUE FOR PROLONGED EXPOSURE TO JET FUEL VAPORS IS 500 PARTS PER MILLION PARTS OF AIR BY VOLUME. PERSONS BREATHING HIGH CONCENTRATIONS OF FUEL VAPOR MAY EXPERIENCE SEVERE HEADACHES OR GENERAL FEELING OF SLEEPINESS OR FAINTING. IF BREATHING HAS SLOWED OR STOPPED, APPLY ARTIFICIAL RESPIRATION AT ONCE. HAVE SOMEONE ELSE GET MEDICAL AID IN ANY EVENT, DO NOT DELAY OR STOP THE ARTIFICIAL RESPIRATION. PERSONS SUFFERING FROM SLIGHT HEADACHES, IRRITATION OF THE EYES OR OTHER SYMPTOMS OF OVEREXPOSURE SHOULD MOVE TO FRESH AIR IMMEDIATELY. JET FUELS CONTAIN SMALL AMOUNTS OF CHEMICAL ANTIOXIDANTS, METAL DEACTIVATORS, AND CORROSION INHIBITORS. THESE CHEMICALS ARE ALL IRRITANTS, PARTICULARLY TO THE EYES. IF SPLASHED INTO THE EYES, FLUSH WITH WATER FOR AT LEAST 15 MINUTES. LIFT UPPER AND LOWER EYELIDS FREQUENTLY TO INSURE COMPLETE WASH. OBTAIN MEDICAL ASSISTANCE. JET FUELS MAY ALSO CAUSE SKIN IRRITATION.

- (14) Soak sump fuel using sponges and cotton rags placed over the bottom of the tank. Record the number of items taken into the tank and again after they are removed making certain that nothing loose remains in the tank.

WARNING: USE ONLY SPONGES AND COTTON RAGS FOR ABSORBING SUMP FUEL. USE OF SUBSTITUTE MATERIALS MAY CAUSE STATIC DISCHARGE.

MOPPING UP SUMP FUEL SHALL BE DONE UNDER CONDITIONS OF AIR VENTILATING. DO NOT REMOVE RESPIRATOR WHILE IN TANK. DEATH, UNCONSCIOUSNESS, OR ILLNESS MAY RESULT FROM EXCESSIVE VAPORS. DO NOT PERFORM ANY MAINTENANCE UNTIL RESIDUAL FUEL IN THE IMMEDIATE AREA IS MOPPED UP.

- (15) Remove rags as soon as they are saturated with fuel or wring out into a suitable container that has been brought into tank for that purpose.



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- (16) After mopping up the tank, check that all cotton rags and sponges brought into the tank have been removed.
- (17) Continue ventilation until atmosphere in tank is determined to be health safe before removing respirator.

WARNING: VENTILATION MUST ALSO CONTINUE WHILE A PERSON IS IN TANK WITHOUT RESPIRATOR.

NOTE: For limited maintenance, tank atmosphere does not have to be health safe if respirator is not removed. The atmosphere, however, must be fire safe.

3. Fuel Tank Preservation

- A. Whenever integral fuel tanks or bladder cells are to remain emptied of fuel for more than 30 days, they should be protected with a coat of SAE 10 motor oil. Oil coating can be applied by filling the tank with oil and then draining.

4. Fuel Tank Treatment

- (1) Fuel tanks to approximately 10% capacity (Ref 12-1-41).
- (2) Add biocide to fuel in a concentration not to exceed 270 parts per million by weight. Preferred method of adding the biocide is by metered injection into flowing stream of fuel

WARNING: BIOBOR JF IS TOXIC. AVOID BREATHING OF VAPOR OR CONTACT WITH SKIN.

CAUTION: CONCENTRATED BIOCIDES SHOULD NOT BE ADDED TO FUEL TANKS, BECAUSE HIGH LOCALIZED CONCENTRATIONS CAN FORM SALT DEPOSITS. IF METERED INJECTION EQUIPMENT IS NOT AVAILABLE, REFER TO CORROSION PREVENTION MANUAL, PART I, SECTION 20-62-00, FOR OTHER APPROVED METHODS OF ADDING BIOCIDES TO FUEL TANKS

NOTE: IF JP-4 or JP-5 fuel formulated per MIL-T-5624H is used to treat the tanks, additional additives are not required. JP-4 and JP-5 fuels, per MIL-T-5624H, already contain 0.10 to 0.15% by volume of PFA55MB.

- (3) Allow fuel to remain in tanks as long as practicable.



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OVERWING FILL PORT - INSPECTION/CHECK

1. General

- A. There are seven overwing fill ports, one for each fuel tank. This procedure contains instructions to do a bonding resistance check for each overwing fill port.

2. Overwing Fill Port - Bonding Resistance Check

A. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH
- (2) Maintenance mats, commercially available

B. Consumable Materials

- (1) Sealant - BMS 5-26 Type II Class B
- (2) Alodine 600 - Type II Class D

C. Procedure

- (1) Defuel all the fuel tanks (AMM 28-0/201).
- (2) Do the "Purging (Air Ventilating)" procedure (AMM 28-0/201).
- (3) Get access to the outside of the overwing fill ports (Figure 1).

CAUTION PUT MAINTENANCE MATS ON THE WING SURFACES WHERE MAINTENANCE PERSONS WORK. DAMAGE TO THE WING SURFACES CAN OCCUR.

NOTE Do the bonding resistance inspection for one fuel tank and then repeat the inspection for the other fuel tanks.

- (4) Measure the electrical bonding resistance from the filler cap adapter to the wing upper skin for each overwing fill port (SWPM 20-20-00).
 - (a) If the resistance is less than 5 milliohm, do these steps:
 - 1) Remove the fuel tank access panel nearest to the applicable overwing fill port.
 - 2) Purge and go into the fuel tank (AMM 28-0/201).
 - 3) Get access to the overwing fill port in the fuel tank.
 - a) Clean the surfaces around the joint between the skin doubler and the retainer nut in the tank with solvent (SOPM 20-30-03)
 - b) If it is not applied, apply a fillet seal, BMS 5-26 Type II Class B, around the joint between the skin doubler and upper wing skin (SOPM 20-50-19).
 - c) If it is not applied, apply a fillet seal, BMS 5-26 Type II Class B, around the joint between the retainer nut and skin doubler (SOPM 20-50-19).



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- 4) Go out of the fuel tank and install the applicable fuel tank access panel (AMM 28-2-1/201)
- 5) Get access to the overwing fill port from outside of the fuel tank.
 - a) Clean the surfaces around the filler cap adapter and upper wing skin with solvent (SOPM 20-30-03).
 - b) If it is not applied, apply an aero smoother seal, BMS 5-26 Type II Class B, around the joint between the filler cap adapter and upper wing skin (SOPM 20-50-11).

(b) If the resistance is 5 milliohm or more, do these steps:

- 1) Remove the fuel tank access panel nearest to the applicable overwing fill port.
- 2) Purge and go into the fuel tank (AMM 28-0/201).
- 3) Have one person get access to the overwing fill port in the fuel tank and one person get access to the overwing fuel port from outside the fuel tank.
- 4) Disassemble the overwing filler cap, filler cap adapter and retainer nut.

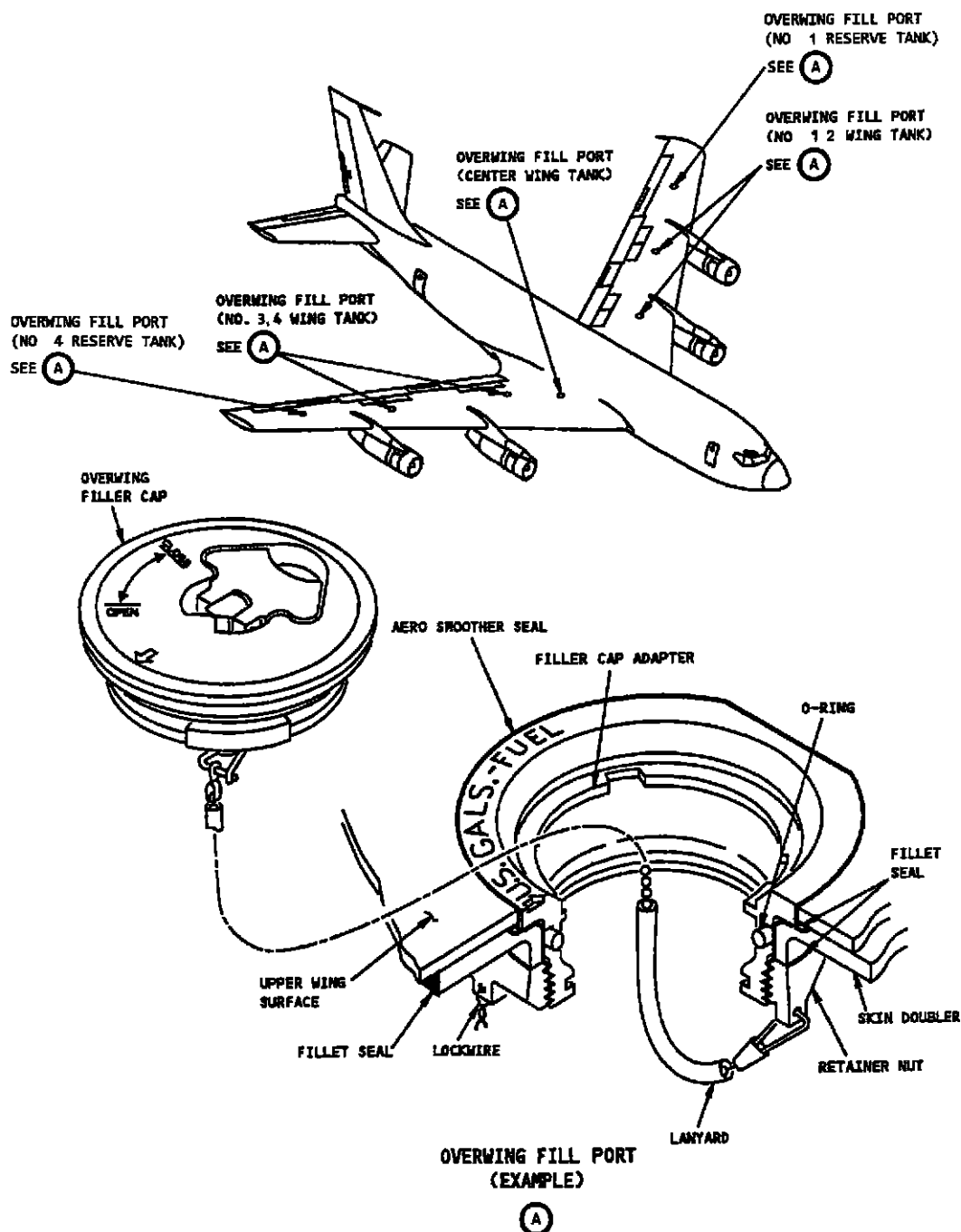
NOTE: Do not remove the lanyard from the overwing filler cap.

- 5) Clean the surfaces of all the parts and the surface between the skin doubler with the retainer nut and filler cap adapter per cleaning procedure 3 (SWPM 20-30-00).
 - a) Clean the surface of the filler cap adapter where it touches the wing to remove contamination or anodization that can prevent a good electrical bond.
 - b) Clean the upper wing skin to remove any contamination or anodization that can prevent a good electrical bond.
- 6) Install the filler cap adapter and electrically bond (SOPM 20-11-03).
 - a) Install a new O-ring in the groove on the filler cap adapter and skin doubler.
 - b) Install the retainer nut with a spanner wrench and tighten to a torque of 30-40 foot-pounds (41-54 Nm).
 - c) Install lockwire between the lug on the retainer nut and the tab attached to the airplane structure.
- 7) Apply a chemical film coating, Alodine 600 Type II Class D, to all cleaned surfaces that are exposed after the overwing fill port is installed (SOPM 20-43-03).
- 8) Measure the resistance from the filler cap adapter to the upper wing skin.
 - a) Make sure the resistance is less than 0.5 milliohm.
- 9) Measure the resistance from the retainer nut to the filler cap adapter in the fuel tank.
 - a) Make sure the resistance is less than 10.0 milliohm.



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- 10) Measure the resistance from the retainer nut to the skin doubler in the fuel tank.
 - a) Make sure the resistance is less than 10.0 milliohm.
 - 11) From inside the fuel tank, apply these fillet seals with BMS 5-26 Type II Class B sealant (SOPM 20-50-19).
 - a) Around the joint between the skin doubler and the upper wing skin.
 - b) Around the joint between the filler cap adapter and skin doubler.
 - c) Around the joint between the retainer nut and filler cap adapter and the retainer nut and skin doubler.
 - d) To the lockwire between the lug on the retainer nut and the tab attached to the airplane structure.
 - 12) Go out of the fuel tank and install the applicable fuel tank access panel (AMM 28-2-1/201).
 - 13) From outside of the fuel tank, apply an aero smoother seal, BMS 5-26 Type II Class B, around the joint between the filler cap adapter and the upper wing skin (SOPM 20-50-11).
 - 14) Remove all unwanted material from where the fay surfaces were applied.
-
- (5) Refuel all the fuel tanks (AMM 12-1-41/201).
 - (6) Make sure there are no fuel leaks (AMM 28-2-0/101).
 - (7) Put the airplane back to a serviceable condition.



Overwing Fill Port
Figure 1

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MISCELLANEOUS FUEL SYSTEM COMPONENTS -
DESCRIPTION AND OPERATION

1. General

- A. The fuel system incorporates a number of miscellaneous components which are integrated into the fuel system. These components are the fuel control panel, fuel sump drain cocks, defueling valves, fuel filler cap assemblies, drip sticks and baffle check valves.

2 Fuel Control Panel

- A. The fuel control panel provides the location for the majority of indicating instruments and controls of the fuel system. The controls and indicators for the left and right wing respectively, are arranged on the left and right side of the flight engineer's lower panels. (See figure 1.)
- B. The fuel control panel contains the indicators and controls for the following systems.

Engine Fuel Feed System	28-7-0
Fuel Quantity Indicating System	28-41-0
Fuel Temperature Indicating System	28-20-0
Pressure Fueling Preset System ▢	28-11-0
Engine Fuel Deicing System	28-19-0

▢ TURBOJET AIRPLANES ONLY

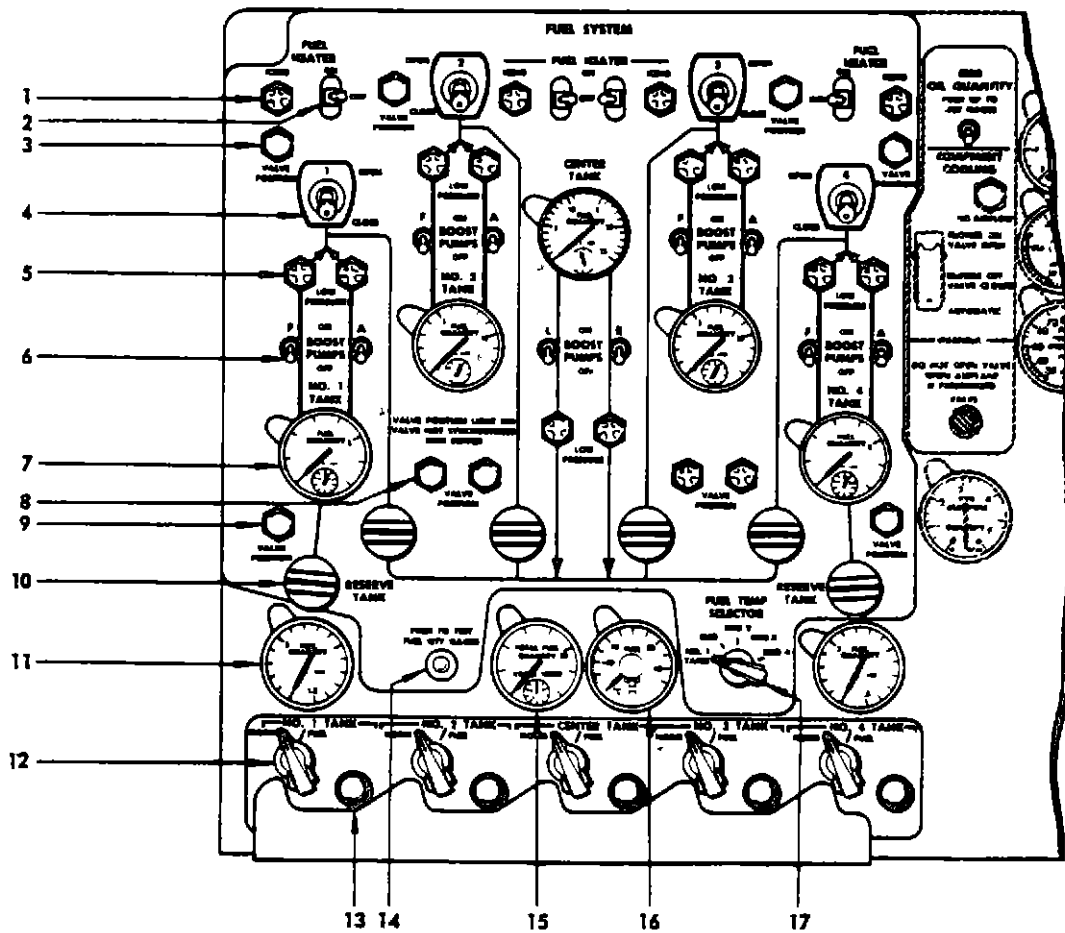
3. Fuel Sump Drain Cocks

- A. Fuel sump drain cocks, installed at low points in each fuel tank, provide for draining the accumulation of moisture in each fuel tank and for draining the fuel trapped in the fuel sump when the tank is defueled. The drain cock is a flush mounted poppet type valve, spring loaded to the closed position. A screen covers the wet side of the drain cock and a screwdriver slot to open the drain cock is in the base. When the drain cock is pushed up with the screwdriver, it allows fuel to drain out of the tank. The sump drain cock is removed by using the F65834 wrench assembly. Sealing the drain cock to structure is accomplished with an O-ring. (See figure 2.)

4. Defueling Valve

- A. The defueling valve allows the engine fuel feed manifold to be used for defueling. The valve is a sliding gate type shutoff valve installed in the inboard dry bay. (See figure 3.) The valve is operated manually by a handle which is normally in the closed position. The access door will not close unless the defueling valve is in closed position.

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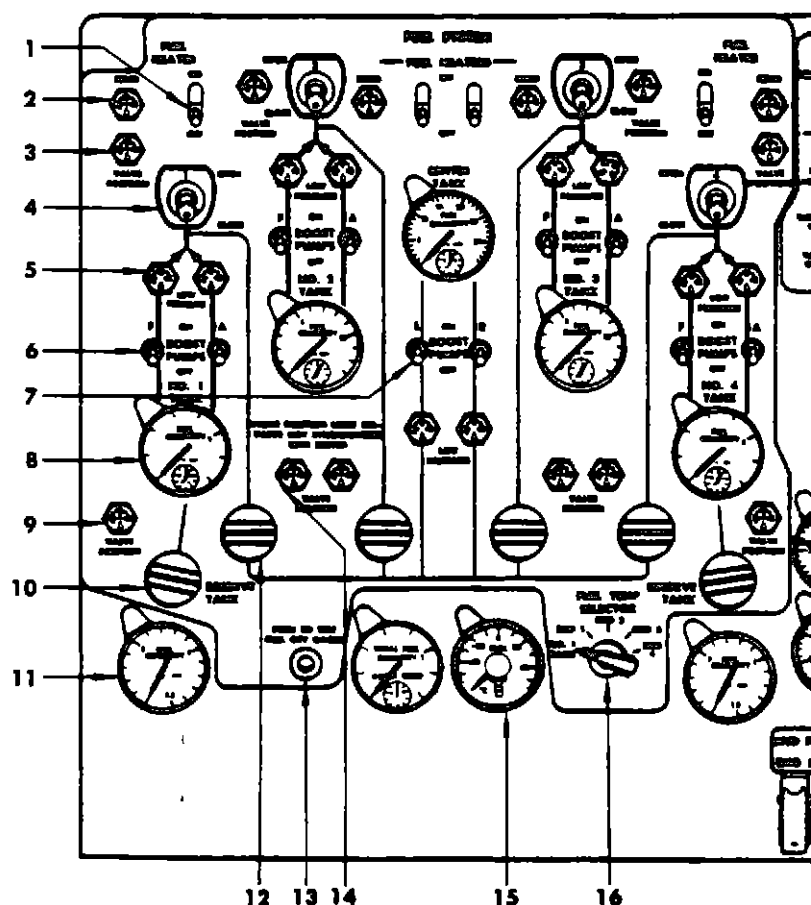
FLIGHT ENGINEER'S LOWER PANEL

- 1 FUEL ICING INDICATOR LIGHT
- 2 FUEL HEATER SWITCH
- 3 ENGINE FUEL SHUTOFF VALVE POSITION LIGHT
- 4 FUEL SHUTOFF VALVE SWITCH
- 5 FUEL LOW PRESSURE WARNING LIGHT
- 6 FUEL BOOST PUMP SWITCH
- 7 FUEL QUANTITY INDICATOR
- 8 FUEL MANIFOLD POSITION LIGHT
- 9 RESERVE TANK TRANSFER VALVE POSITION LIGHT
- 10 FUEL MANIFOLD VALVE SWITCH
- 11 RESERVE TANK FUEL QUANTITY INDICATOR
- 12 FUELING PRESET SWITCH
- 13 FUELING PRESET POTENTIOMETER
- 14 FUEL QUANTITY INDICATORS PUSH-TO-TEST SWITCH
- 15 TOTAL FUEL QUANTITY INDICATOR
- 16 FUEL TEMPERATURE INDICATOR
- 17 FUEL TEMPERATURE SELECTOR SWITCH

EFFECTIVITY

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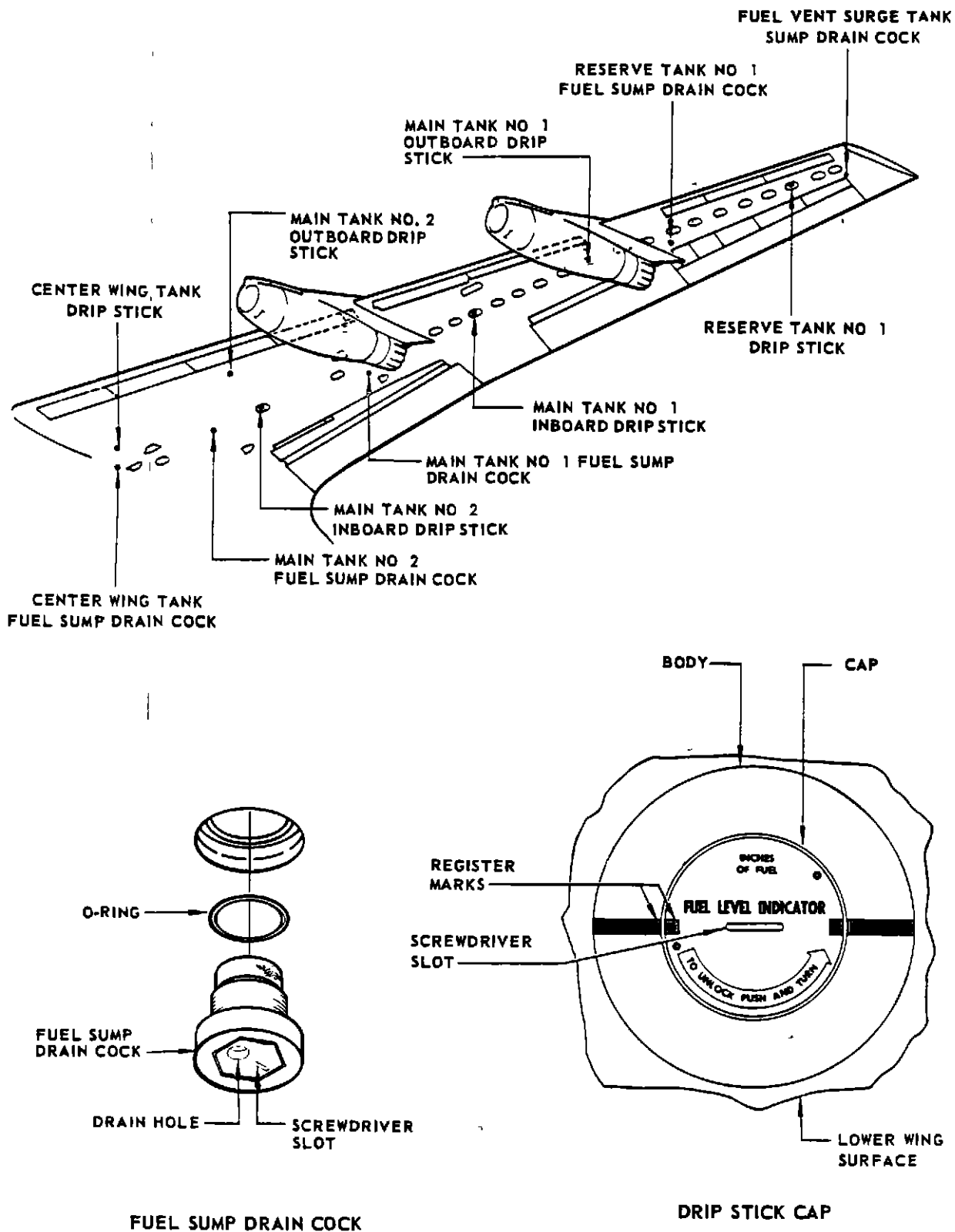


FLIGHT ENGINEER'S LOWER PANEL

1. FUEL HEATER SWITCH
2. FUEL ICING INDICATOR LIGHT
3. ENGINE FUEL SHUTOFF VALVE POSITION LIGHT
4. ENGINE FUEL SHUTOFF VALVE SWITCH
5. FUEL LOW PRESSURE WARNING LIGHT
6. FUEL BOOST PUMP SWITCH
7. FUEL BOOST OVERRIDE PUMP SWITCH
8. FUEL QUANTITY INDICATOR
9. RESERVE TANK TRANSFER VALVE POSITION LIGHT
10. RESERVE TANK TRANSFER VALVE SWITCH
11. RESERVE TANK FUEL QUANTITY INDICATOR
12. FUEL MANIFOLD VALVE SWITCH
13. FUEL QUANTITY INDICATORS PUSH-TO-TEST SWITCH
14. FUEL MANIFOLD VALVE POSITION LIGHT
15. FUEL TEMPERATURE INDICATOR
16. FUEL TEMPERATURE SELECTOR SWITCH

EFFECTIVITY

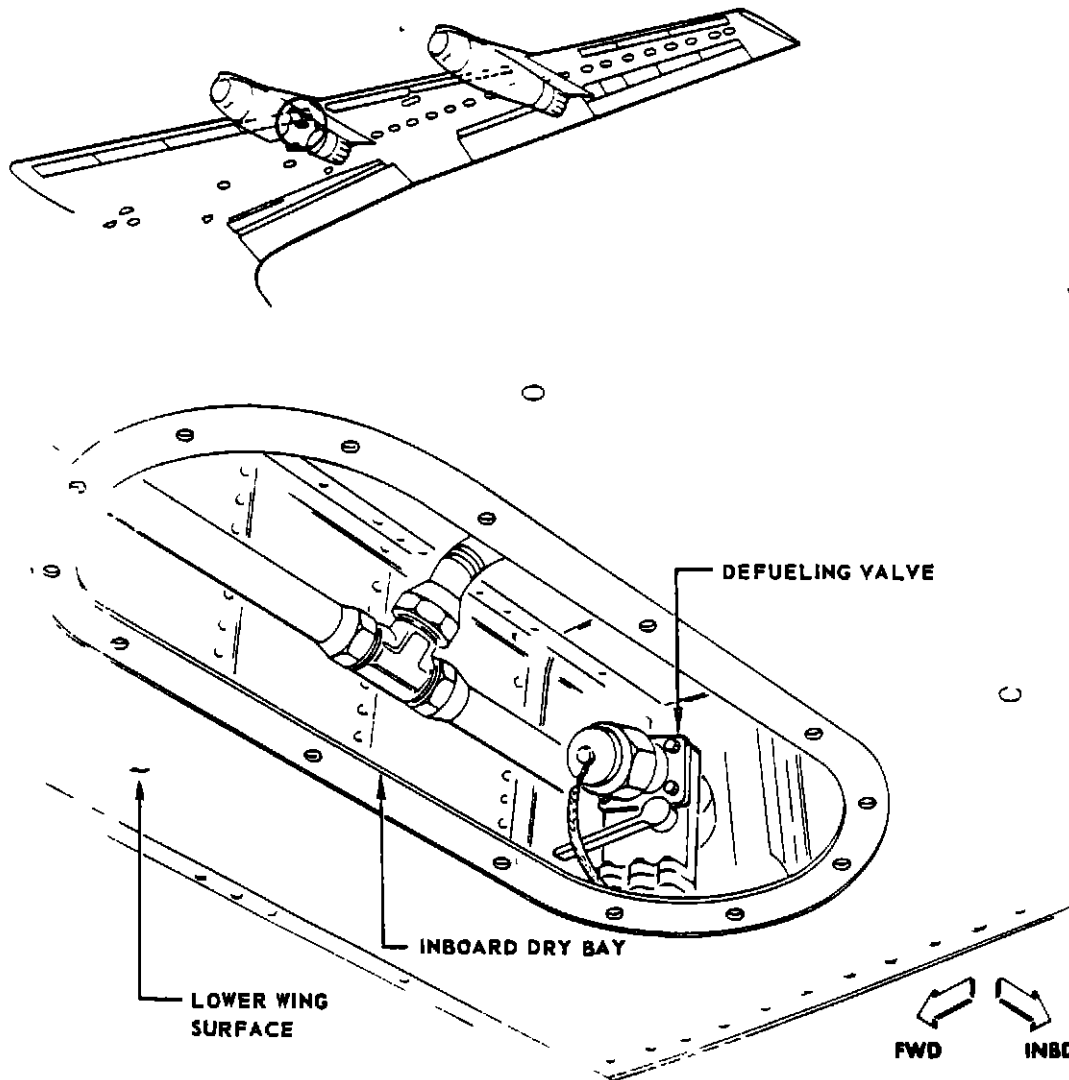
TURBOFAN



5 Filler Cap Assembly

- A The filler caps are utilized during over-wing tank-truck fueling operations. Each cap assembly consists of a flush fitting cap with a locking device and adapter on each exterior filler port. (See figure 4.)
- B The filler cap assemblies are located on top of the wing. (See figure 4.) The filler cap is attached to the adapter on the exterior filler port by rotating the cap clockwise to a stop so that it is sealed by the locking device. The cap assembly is removed by disconnecting the retaining clip on the structure and unscrewing the filler adapter.

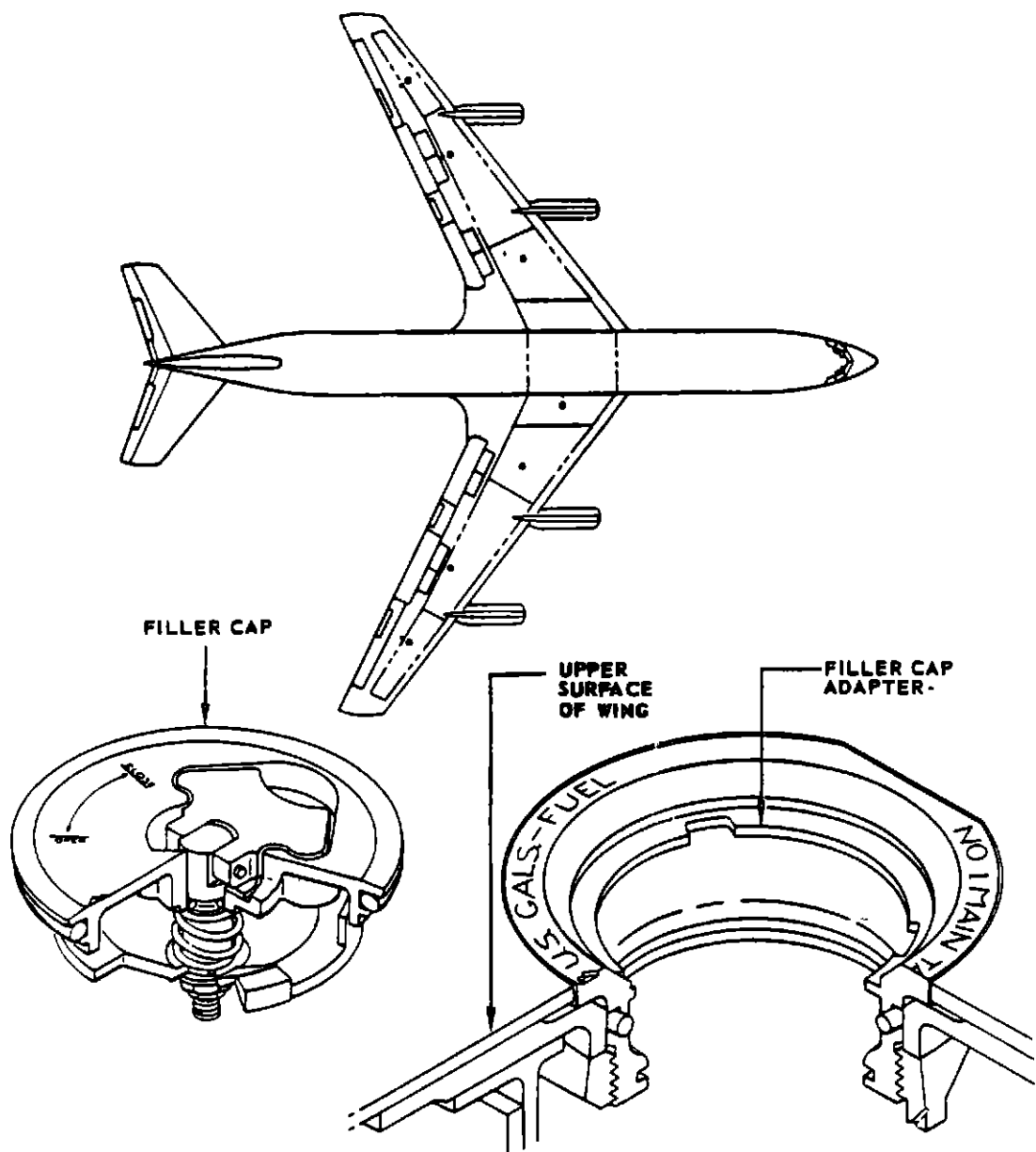
CAUTION: DO NOT OPEN FILLER CAPS BEFORE CHECKING FUEL LEVEL IN TANKS.
IN CERTAIN AIRPLANE ATTITUDES, FUEL MAY BE OVER THE LEVEL OF A FILLER PORT.

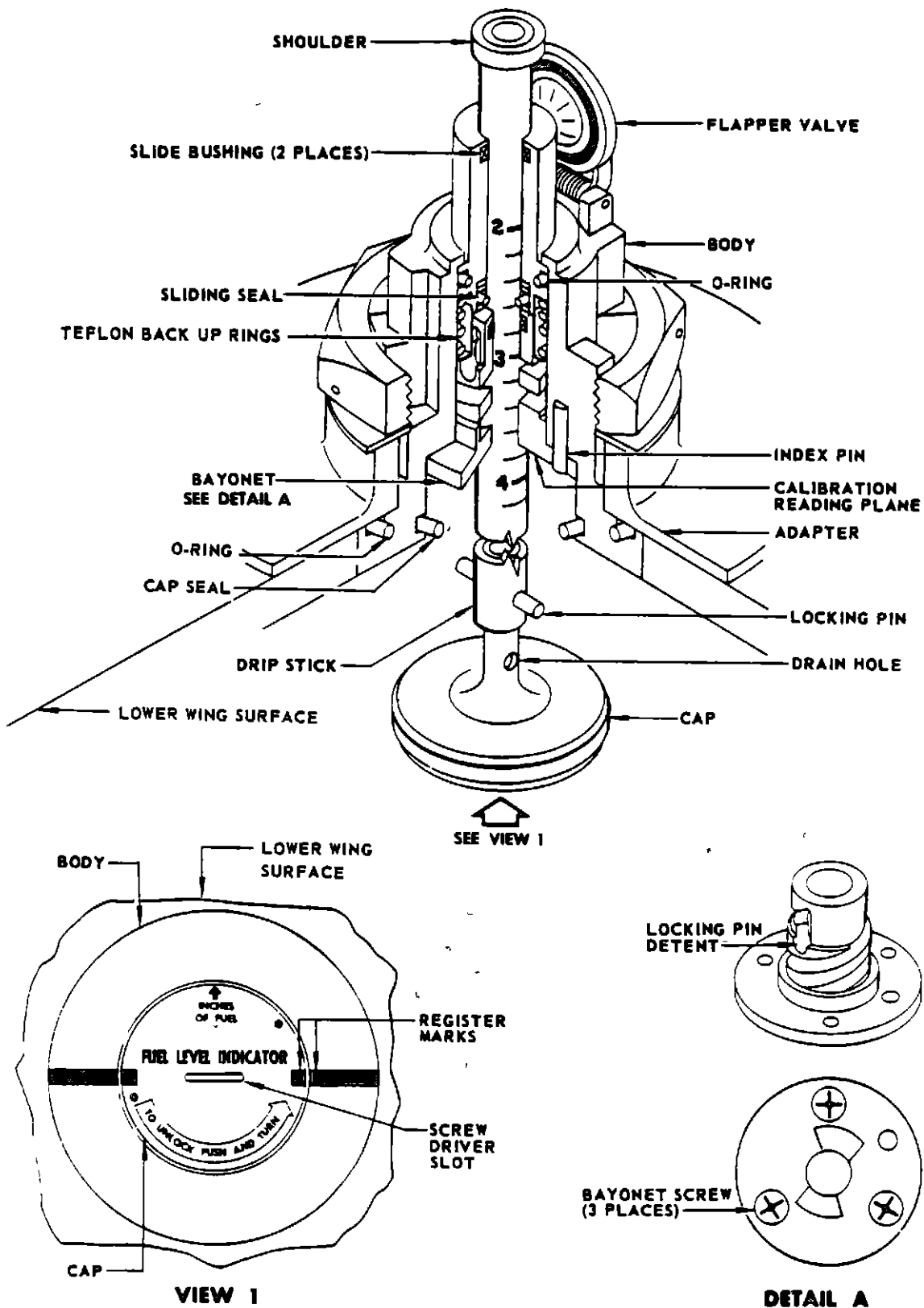


Defueling Valve Location
Figure 3

6. Drip Sticks

- A. The primary function of the drip stick is to measure the fuel level in the fuel tanks. The procedure assists the ground crew in its fueling operations by allowing a comparison on the fuel volume determined by the drip stick, with the fuel weight indicated by the fuel quantity indicators in the control cabin. The accuracy of measurement depends on level attitude of the airplane and changes in weight load.





Drip Stick
Figure 5

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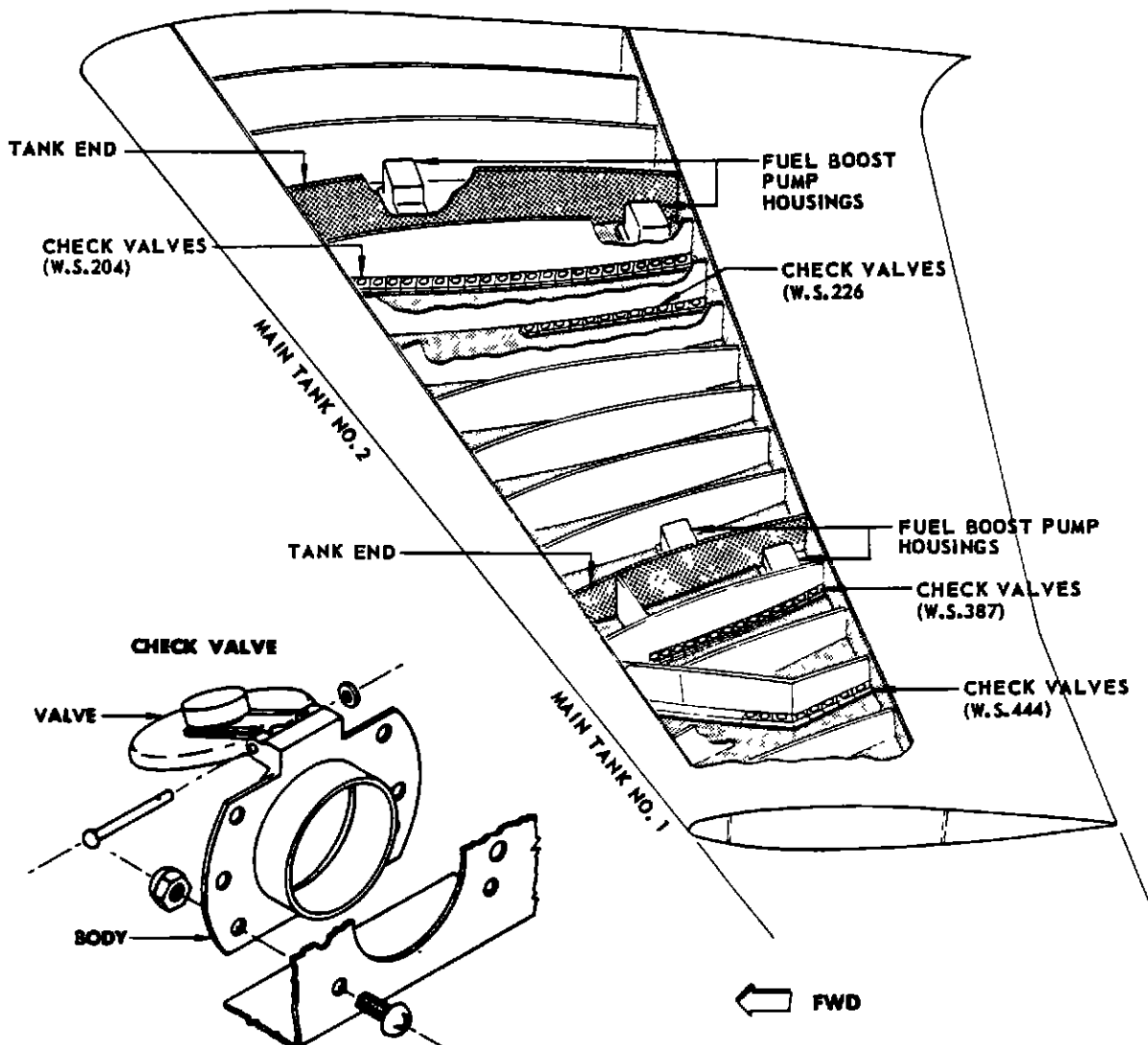
- B. The drip stick consists of a fiberglass tube, calibrated in inches, with a sealing cap at one end which locks into an adapter in the lower wing surface. (See figure 5.) Drip sticks are of different lengths. This length is determined by the location at which they are used.
- C. The entire fuel system has twelve drip sticks. One drip stick is installed in each reserve fuel tank. The main tanks and center wing tank have two drip sticks for better fuel level coverage.
- D. When the sealing cap is unlocked and the drip stick withdrawn slowly from the tank, fuel enters the top of the stick and runs down to a small drip hole near the base. At the moment the fuel appears, the reading opposite the calibration plane should be noted. This reading is the depth, in inches, of fuel in the tank. (See figure 5.) The drip stick reading shown in figure 5 indicates approximately 3.7 inches and not 4.3 inches of fuel depth. To find the gallons of fuel in a tank the drip stick reading is compared with a conversion chart which compensates for any deviation of the airplane from the level attitude, the deviation from level being determined by use of an attitude gage. (Refer to Chapter 8, Leveling.) When a reading has been completed, the drip stick cap is inserted into the adapter and locked by rotating clockwise to a stop. The drip sticks may only be used when fuel quantity is between the approximate limits noted in the chart below.

CAUTION: READ DRIP STICK CALIBRATION FROM TOP OF STICK DOWN.

Drip Stick Location	Maximum Gallons	Minimum Gallons
Main Tanks No. 1 and 4 Outboard Drip Stick	2307	1654
Main Tanks No. 1 and 4 Inboard Drip Stick	1954	627
Main Tanks No. 2 and 3 Outboard Drip Stick	4065	2020
Main Tanks No. 2 and 3 Inboard Drip Stick	2598	308
Reserve Tank No. 1 and 4	439	264
Center Wing Tank (TURBOJET)	7640	108
Center Wing Tank (TURBOFAN)	10,193	192

7. Baffle Check Valves

- A. The baffle check valves are installed in the bottom of the ribs between lower wing stiffeners of the main fuel tanks to keep fuel from flowing away from the fuel boost pumps. (See figure 6.) Each baffle check valve is a swing type valve hinged at the top which opens only inboard. The valve is free acting and the valve flapper aligns itself automatically with the valve seat when it drops from the full-open position.
- B. Access to the baffle check valves is gained through fuel tank access panels and rib access openings after the fuel tank is defueled. See 28-2-0, "Integral Fuel Tanks". A baffle check valve can be replaced by removing the hinge pin on the valve. To function properly a baffle check valve must have no binding at the hinge points.

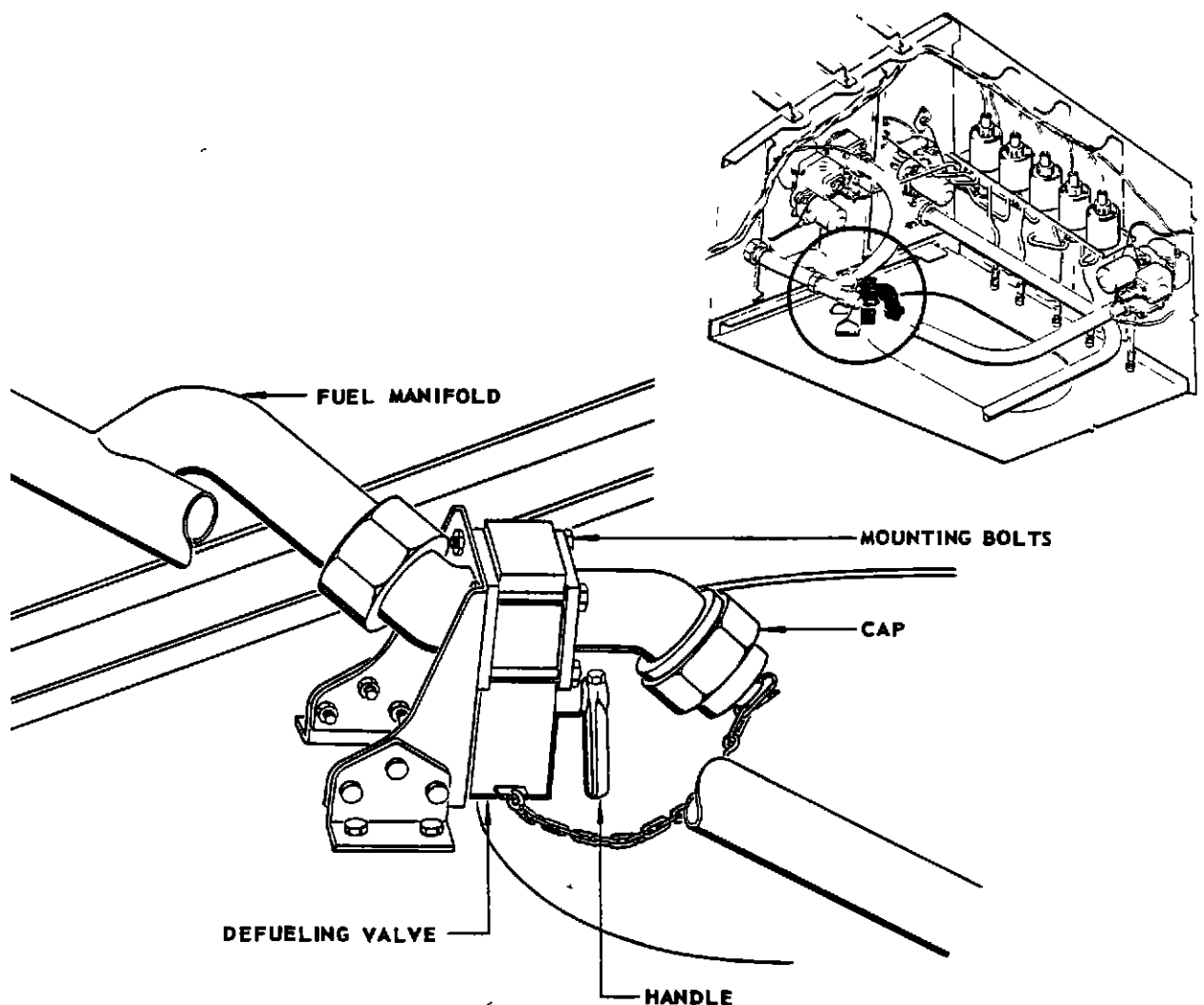


DEFUELING VALVE - MAINTENANCE PRACTICES

1. Removal/Installation Defueling Valve

A. Remove Defueling Valve (See figure 201)

- (1) Close all fuel manifold valves.
- (2) Remove both fuel boost override pump access panels.
- (3) Manually close override pump removal valves.
- (4) Remove cap from defueling valve, open defueling valve and drain fuel into suitable container.



- (5) Disconnect external power from airplane and pull boost pump and override pump circuit breakers
 - (6) Disconnect bonding jumper at valve.
 - (7) Remove bolts and lift valve free.
- B. Install Defueling Valve (See figure 201)
- (1) Clean machined surfaces with naphta, wipe dry with lint free cloth and install O-rings.
 - (2) Lift defueling valve into position and install mounting bolts
 - (3) Connect bonding jumper at valve.
 - (4) Close boost and override pump circuit breakers.
 - (5) Open override pump removal valves and close all access panels.

END

D RIP STICK - MAINTENANCE PRACTICES

1. General

A Drip stick removal does not require tank defueling.

2. Removal/Installation Drip Stick

A Remove Drip Stick

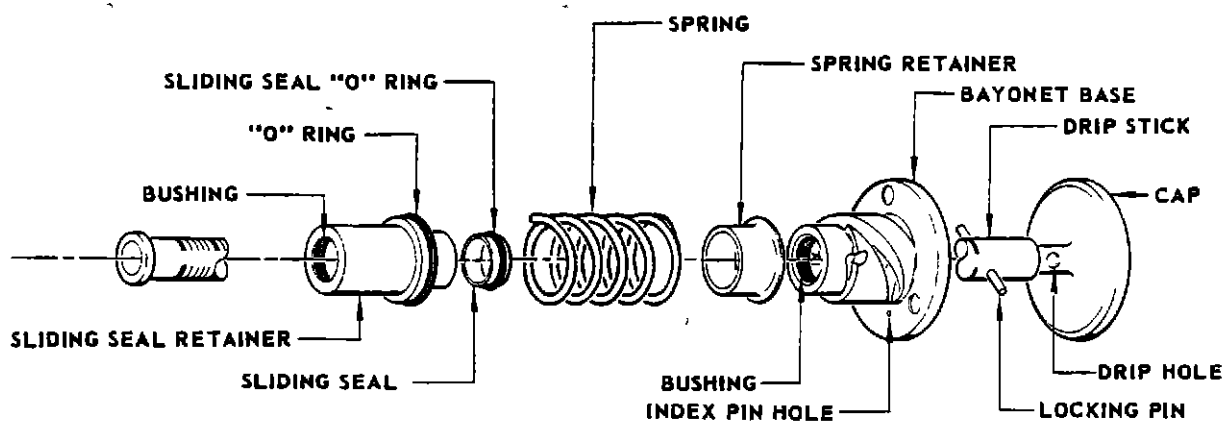
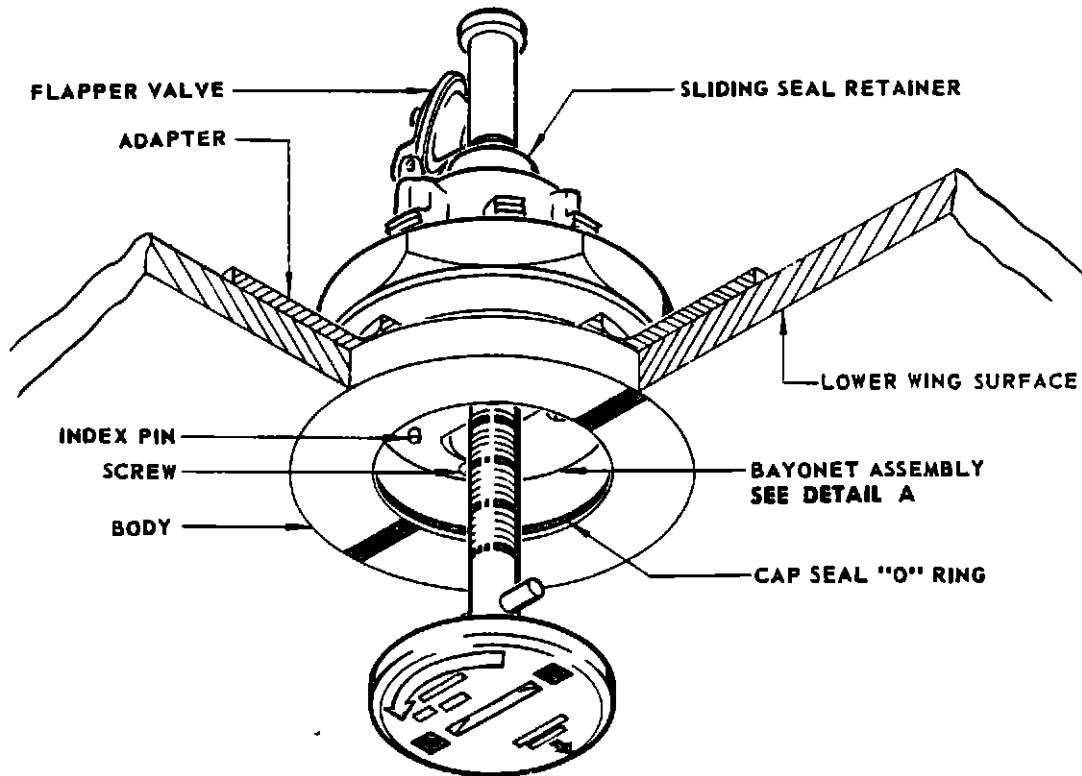
- (1) Turn drip stick cap and extend drip stick until it bottoms. (See figure 201.)
- (2) Plug drip hole in cap.
- (3) Loosen three screws mounting bayonet.
- (4) Remove two screws.
- (5) Holding bayonet against spring pressure remove last screw.

NOTE: Spring exerts a load of approximately 5 pounds.

- (6) Pull drip stick and bayonet free of adapter fitting.
- (7) Remove locking pin from drip stick cap.
- (8) Slip bayonet free of drip stick.

B. Install Drip Stick

- (1) Install new O-rings at sliding seal, sliding seal retainer, and cap seal. (See figure 201.)
- (2) Insert drip stick into bayonet assembly (sliding seal retainer, spring, spring retainer, and bayonet base) and attach drip stick cap with locking pin.
- (3) Plug drip hole in cap.
- (4) Insert bayonet assembly into drip stick adapter with stick fully extended all the time.
- (5) Install three bayonet mounting screws. Index pin must be aligned.
- (6) Remove plug from drip hole in cap.
- (7) Push up drip stick, turn and lock drip stick cap.



DETAIL A

Drip Stick Installation
Figure 201

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3. Approved Repairs

A. Repair external fuel leaks at drip stick cap.

- (1) Turn drip cap counterclockwise and withdraw drip stick far enough to remove cap seal O-ring. Plug drip hole in drip stick cap if fuel starts dripping.
- (2) Replace cap seal with new "O" ring, (part number MS 29513-129 or equivalent), lightly lubricated with MIL-H-5606, hydraulic oil, or MIL-L-4343, grease. (See figure 201.)
- (3) If drip hole was plugged, step (1), push drip stick part way up and remove plug.
- (4) Push up drip stick, turn and lock drip cap.

B. Repair fuel leaks around bayonet base when drip stick is withdrawn.

- (1) Remove drip stick from fuel tank. See Removal/Installation.
- (2) Replace outer O-ring on sliding seal retainer with new O-ring lightly lubricated with MIL-H-5606, hydraulic oil, or MIL-L-4343, grease. (See figure 201.)
- (3) Install drip stick in fuel tank.

C. Repair fuel leaks around drip stick.

- (1) Remove drip stick from fuel tank. See Removal/Installation.
- (2) Replace O-ring in sliding seal with new O-ring lightly lubricated with MIL-H-5606, hydraulic oil, or MIL-L-4343, grease. (See figure 201.)
- (3) Replace drip stick if damaged.
- (4) Install drip stick in fuel tank.



MAINTENANCE MANUAL

ELECTRICAL BONDING JUMPER - INSPECTION/CHECK

1. General

- A. This task contains visual and mechanical inspections of the electrical bonding jumpers in the fuel system.
- B. Do not flex, bend or kink the bonding jumpers more than is necessary. If the bonding jumpers are moved too much, it can cause the loss of tin plating on the wire braid of the bonding jumper.
- C. When you inspect the bonding jumpers you may see black or brown deposits on the wire braid. This can occur when there is a deterioration of the tin plating on the bonding jumper and the copper in the wire reacts with the sulfur compounds. This discoloration is not a problem unless the wire braid contains broken strands. If the bonding jumper has broken strands, then you must replace the bonding jumper.
- D. When you inspect the bonding jumpers, inspect for loose clamps and corrosion.

2. Electrical Bonding Jumper Inspection

A. References

- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Procedure

- (1) Defuel all the fuel tanks (AMM 28-0/201).
- (2) Do the "Purging (Air Ventilating)" procedure (AMM 28-0/201).
- (3) Gain access to the fuel tank.
- (4) Visually inspect the bonding jumper and clamp for color and deterioration.
- (5) If the bonding jumper is silver in color and is free from black or brown deposits, then the bonding jumper is satisfactory.
- (6) If the wire braid has black or brown deposits, then inspect the bonding jumper for broken strands.
 - (a) If the wire braid does not have broken strands, then the bonding jumper is satisfactory.
 - (b) If the wire braid has broken strands, then do this task: "Electrical Bonding Jumpers Replacement".
- (7) Try to turn the bonding jumper lugs and tube clamps, if applicable, with light finger pressure.
 - (a) If the bonding jumper is loose, rework the electrical bond path (SWPM 20-20-00).



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3. Electrical Bonding Jumpers Replacement

A. References

- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Procedure

- (1) Remove the bonding jumper.
 - (a) Keep all the parts necessary for the installation of the bonding jumper.
- (2) For the bonding jumpers used to bond electrical equipment, follow the applicable installation procedure in the AMM.
- (3) For the bonding jumpers used to bond mechanical equipment or tubing, install the new bonding jumper and hardware (SWPM 20-20-00).
 - (a) Make sure the mating surface(s) are correctly prepared.
 - (b) Make sure the bonding jumper installation gives adequate clearance from the structure, tubing or all fuel system parts.

NOTE: This will prevent abrasion

- (4) Do the "Electrical Integrity Check of the Fuel System Bond Path" procedure.

4. Electrical Integrity Check of the Fuel System Bond Path

NOTE: SWPM 20-20-00 defines the measurement processes necessary for installation of electrical bonding hardware. The fuel system tubing and components often incorporate multiple electrical bonds in series between the component and the primary structure. The measurement of the tubing or component bond is a separate requirement.

A. References

- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH

C. Procedure

- (1) For bonding jumper hardware installations, do the resistance measurement for electrical integrity (SWPM 20-20-00).
 - (a) Measure the bonding resistance from each bonding jumper terminal to the adjacent tube.
 - (b) Make sure the probes of the bonding meter touch each conductive surface through any protective finish.
 - (c) Make sure the resistance from each terminal to the adjacent tube is less than 0.001 ohm (1 milliohm).



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NOTE: SWPM 20-20-00 requires that each metal-to-metal faying surface have a resistance of less than 0.0005 ohm (0.5 milliohm). Each jumper terminal normally has two faying surfaces in series in its conductive path. (The jumper terminal to the washer and the washer to the tube.)

- (2) For the fuel system tubing or components, do the subsequent steps.
 - (a) Measure the total resistance from the tubing or component, to the adjacent primary structure.
 - (b) Make sure the resistance is 0.010 ohm (10 milliohm) or less.

5. Return the Airplane to Its Usual Condition

A. Procedure

- (1) Refuel all the fuel tanks (AMM 12-1-41/201).
- (2) Make sure there are no fuel leaks (AMM 28-2-0/101).
- (3) Put the airplane back to a serviceable condition.

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FUEL SUMP DRAIN COCK - MAINTENANCE PRACTICES

1 Removal/Installation Fuel Sump Drain Cock

A. Equipment and Materials

- (1) Wrench Assembly - F65834, or equivalent
- (2) Cleaning Solvent

B. Remove Fuel Sump Drain Cock

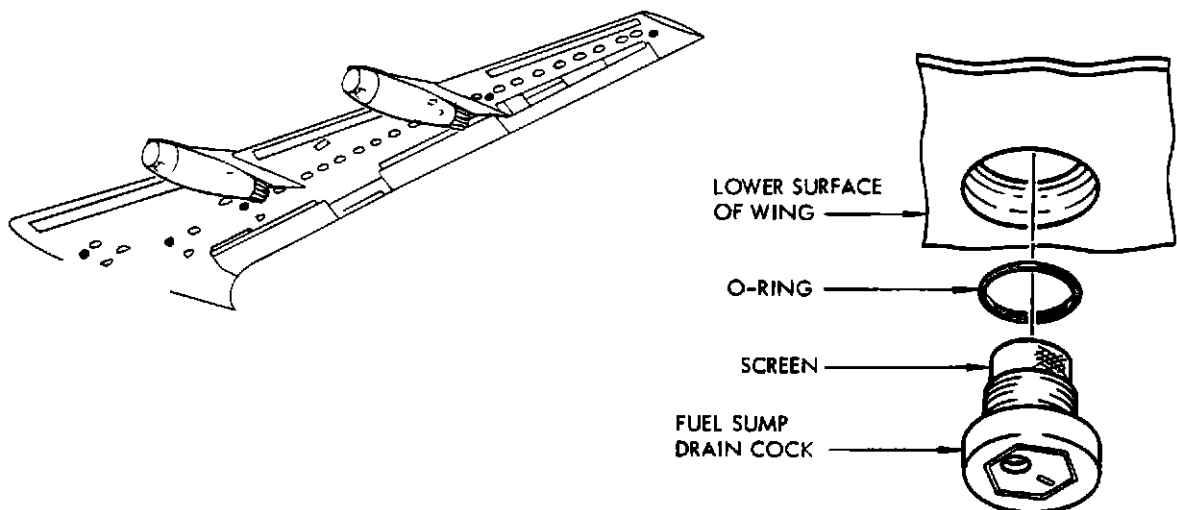
- (1) Apply external power to airplane.
- (2) Defuel applicable tank. Refer to Servicing Fuel System, 28-0.
- (3) Remove external power from airplane.
- (4) Using F65834 wrench assembly remove fuel sump drain cock.

C. Install Fuel Sump Drain Cock

- (1) Wash drain cock in solvent until screen and drain cock are free of all foreign material.
- (2) Install new O-ring on drain cock.
- (3) Apply MIL-G-6032 grease to the drain cock threaded area only.

CAUTION. APPLY MIL-G-6032 GREASE SPARINGLY TO PREVENT COMPOUND FROM MIXING WITH FUEL.

- (4) Install drain cock using F65834 wrench, torque to 120 to 170 pound-inches.





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INTEGRAL FUEL TANKS - DESCRIPTION AND OPERATION

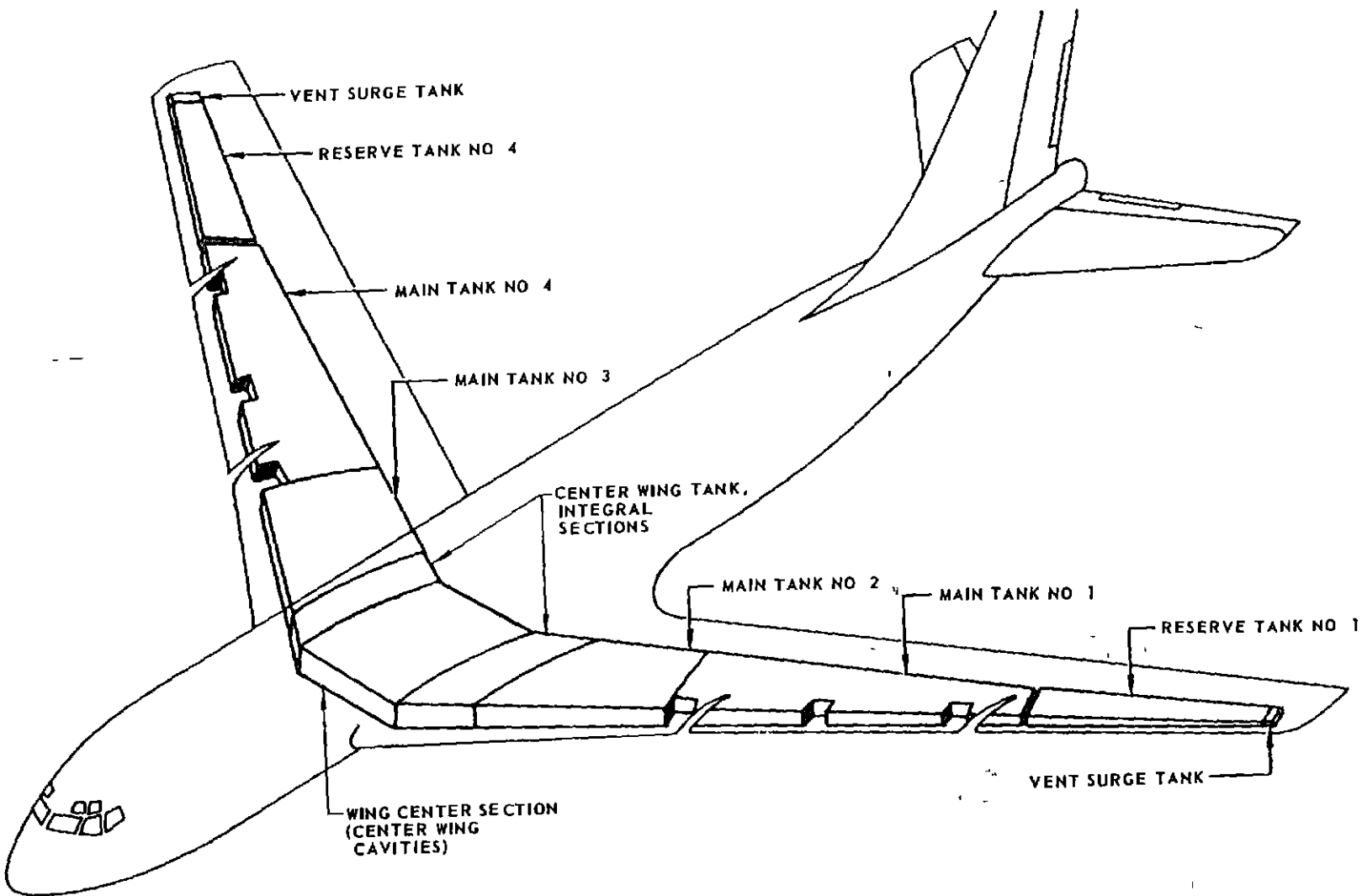
1. General

- A The integral fuel tanks provide the major portion of the fuel supply storage capacity. The tanks are located in the interspar area of each wing, and the ribs serve as baffle plates.
- B The integral fuel tanks are identified in figure 1 as main tanks No. 1, 2, 3, and 4, reserve tanks No. 1 and 4 and center wing tank. All main tanks and the two reserve tanks are integral with the wing structure. The center wing tank is comprised of two integral sections at the inboard wing roots and a center section which contains removable fuel cells. The center wing cavity is divided into compartments for the installation of bladder-type removable fuel cells. Fuel flows in all three sections. A full description of the removable fuel cells is given in 28-3-0.
- C A reserve tank is located in the outboard section of each wing. Main tanks No. 1 and 2 are located in the left inboard wing section and main tanks No. 3 and 4 are located in the right inboard wing section. The integral sections of the center wing tank are located at the wing roots in the left and right inboard wing sections.
- D The main tanks, reserve tanks and integral sections of the center wing tank use the sealed structure of the wing to maintain a fluid-tight boundary. This is accomplished primarily by close metal to metal fit of all parts, integrally sealed fasteners and by the application of sealing compound to the structure.
- E Located within each fuel tank are the fuel lines, pumps, valves, vents, drains, and electrical equipment for the operation of the fuel system. Fuel system equipment is described elsewhere in this chapter. Refer to the chapter table of contents for the section numbers of the equipment.
- F Access to all equipment installed in the fuel tanks is provided for by access panels in the lower wing surface and by openings in the wing ribs which allow personnel to move through the ribs for inspection and maintenance.

2. Main Fuel Tanks

- A Main tanks No. 1 and 2 are in the left inboard wing section, main tanks No. 3 and 4 are in the right inboard wing sections. The tanks are separated from each other by end ribs, structurally sealed fluid-tight by the use of sealing compound, and sealed fasteners. Intermediate wing ribs serve as baffle plates. Some of the wing ribs have access openings in them to provide access to equipment and tubing located in the main tanks which is not directly accessible through access panels in the bottom of the tanks. These rib access openings are covered with structural members which must be removed before personnel can gain access to the equipment.

FOR FUEL TANK CAPACITIES, REFER TO
 28-0 "FUEL SYSTEM"



Fuel Tank Arrangement
 Figure 1



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3. Reserve Fuel Tanks

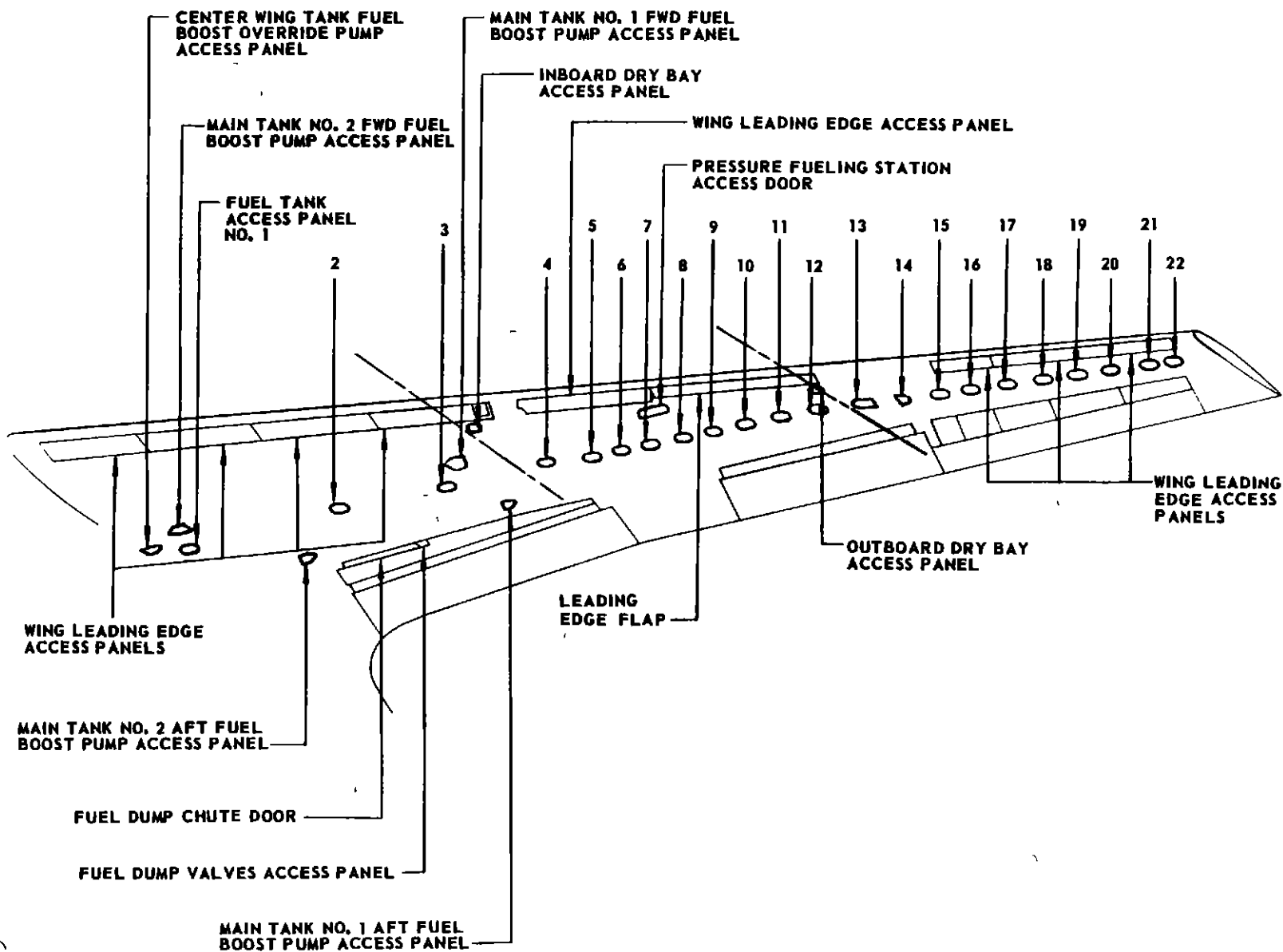
- A The two reserve fuel tanks, No. 1 and 4, store fuel and supply the fuel to main tanks No. 1 and 4 respectively by gravity flow as required. Both tanks are integral with the wing structure. The tanks are located in the interspar area of the left and right outboard wing sections. The tanks are separated from main tanks No. 1 and 4 by wing ribs and each tank is sealed fluid-tight by the use of sealed fasteners and sealing compound. Each tank is divided by wing ribs which serve as baffle plates. Access panels in the bottom of the tanks between the ribs provide access to fuel system equipment located within the tanks.

4. Center Wing Tank

- A. The center wing tank consists of three sections; two integral sections located in the left and right inboard wing roots, and a center section which contains removable fuel cells. See 28-3-0, Removable Fuel Cells, and 28-4-0, Center Wing Cavity. Fuel in the tank is supplied to any or all engines when the appropriate fuel manifold valves in the fuel lines are opened. The two integral sections of the tank are sealed fluid-tight by the use of sealed fasteners and sealing compound. Each integral section is divided into three compartments by two wing ribs in which openings are provided for maintenance purposes. A tank access panel is located between the wing ribs in the bottom of the tank.

5. Fuel Tank Access Panels (See figure 2.)

- A. Access to integral fuel tank equipment and tubing is provided by removable access panels in the lower wing panel. For ease in identifying the panels and referencing them throughout this chapter they are numbered 1 through 22 starting with 1 at the wing root, and going outboard to the wing tip. Reserve tank access panels (No. 15 through 22) are installed in the bottom of the wing between every two ribs. Main tanks No. 1 and 4 have panels No. 4 through 14. Main tanks No. 2 and 3 have two panels (No. 2 and 3) in the bottom of the wing. The center wing tank has four access panels, one in each integral section and two beneath fuel cells No. 2 and 5.
- B. There are two kinds of tank access panels, machined and cast aluminum.
- (1) Machined panels are installed with seal rings which contain molded rubber seals fitted into grooves on both sides of the ring. All machined panels are clamped by screws installed in nutplates mounted on the upper surface of the panel.
 - (2) Cast panels are mounted on the inside of the tanks and clamped by a clamp ring and screws to the lower wing panels. A molded rubber seal, fitted into a groove on the mating surface of each panel, acts as a static-type fluid seal. Bonding jumpers are optional if knitted aluminum gaskets and/or clamp rings with bare surfaces are installed.
 - (3) On some airplanes these panel installations are optional, while on others their use is restricted. Panels No. 2, 7, 12, and 20 contain dripstick assemblies.



Fuel Tank Access Panels
 Figure 2



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6. Rib Access Openings (See figure 3.)

- A. Rib access openings are provided in the ribs of the main tanks and integral sections of the center wing tank to provide access to equipment and tubing not directly accessible through the fuel tank access panels. They enable personnel to enter the tank at one of the fuel tank access panels and go through the rib opening to gain access to equipment located between ribs in areas that have no underwing access panels.
- B. For ease in identifying the location of rib access openings in the text, they are numbered 1 through 13 starting at the wing root and going outboard. Due to stress loads, all of these openings are partially covered with structural members consisting of angles and tee sections. Opening No. 12 in the inboard canted web, and openings No. 11 and 13, have structural reinforcing plates attached to the opening with angle and tee sections. These angles and tees are primary wing structure and must be treated as such.

(1) Rib Access Opening No. 1

- (a) Access opening No. 1 provides access to the center wing tank fuel quantity tank units and compensator tank unit, override boost pump, override pump check valve, crossfeed manifold, and vent ducts. Access is gained through fuel tank access panel No. 1.

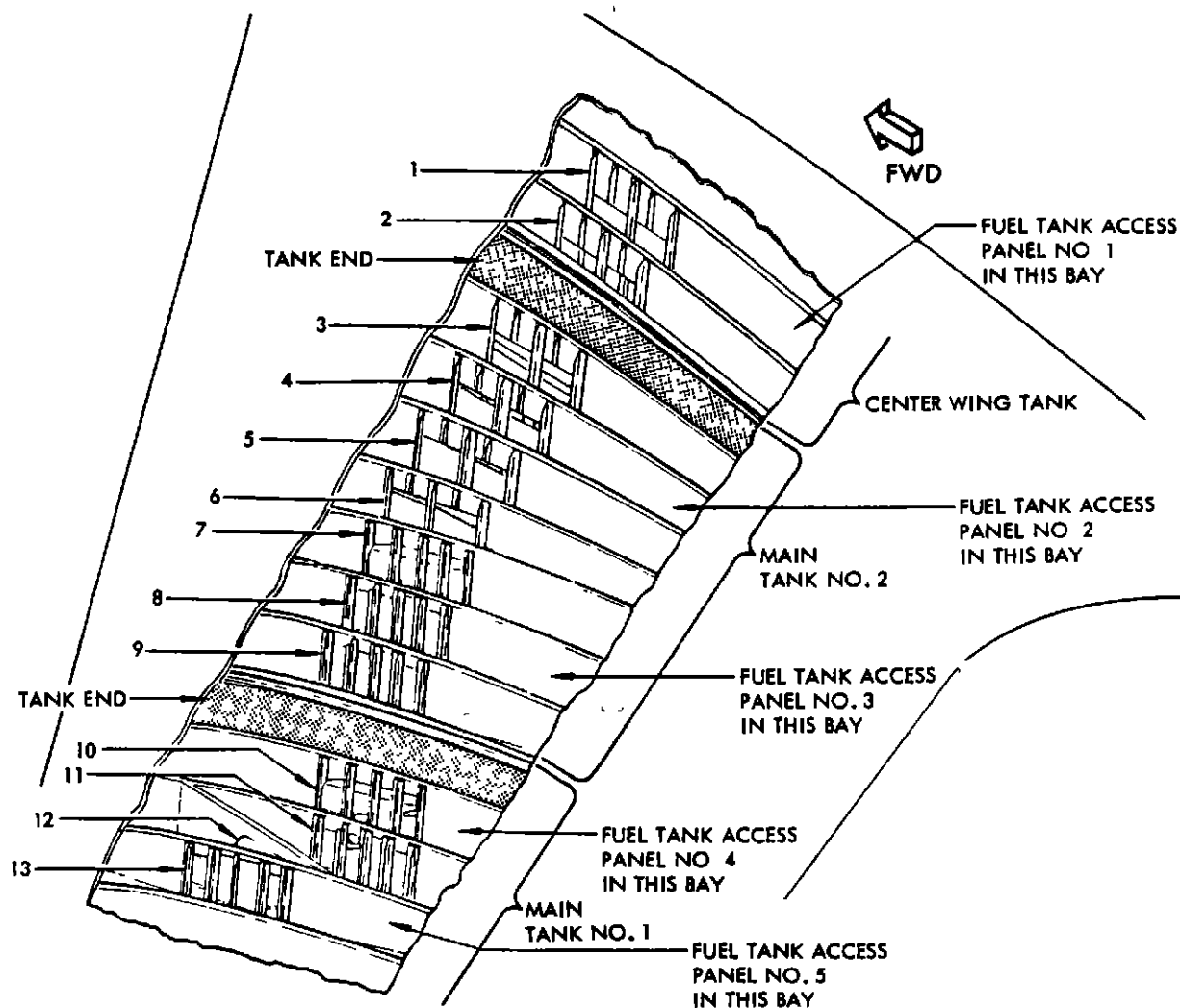
(2) Rib Access Opening No. 2

- (a) Access opening No. 2 provides access to main tanks No. 2 and No. 3 forward boost pump vent line and pump removal valve, the center wing tank engine fuel feed line, fueling level control shutoff valve, pressure fueling line, drain check valve, fuel manifold, and vent float valve. Access is gained through fuel tank access panel No. 1.

(3) Rib Access Opening No. 3

- (a) Access opening No. 3 provides access to main tanks No. 2 and No. 3 aft boost pump vent line and pump removal valve, engine fuel feed line, dual check valve, fuel manifold, pressure fueling lines, fuel dump lines, vent ducts and drain lines, baffle check valves and fuel quantity compensator tank unit. Fuel tank access panel No. 2 is used to gain access to opening No. 4 and then into opening No. 3.

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Rib Access Openings
 Figure 3

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- (4) Rib Access Opening No. 4
 - (a) Access opening No. 4 provides access to main tanks No. 2 and No. 3 engine fuel feed lines, pressure fueling lines, fuel manifold, pressure sensing lines, fuel quantity tank unit, vent duct, drain lines, and baffle check valves. It also provides access to opening No. 3. Access is gained through fuel tank access panel No. 2.
- (5) Rib Access Opening No. 5
 - (a) Access opening No. 5 provides access to fuel manifold, engine fuel feed lines, pressure fueling lines, fuel dump lines, and vent ducts. It also provides access to opening No. 6. Access is gained through fuel tank access panel No. 2.
- (6) Rib Access Opening No. 6
 - (a) Access opening No. 6 provides access to engine fuel feed lines, pressure fueling lines, fuel dump lines, fuel manifold, and vent ducts. Access is gained through opening No. 5 or No. 8 and 7.
- (7) Rib Access Opening No. 7
 - (a) Access opening No. 7 provides access to fuel manifold line, vent ducts, pressure fueling lines, engine fuel feed lines, and fuel dump lines. Access is gained through opening No. 8
- (8) Rib Access Opening No. 8
 - (a) Access opening No. 8 provides access to fuel manifold line, pressure fueling lines, engine fuel feed lines, fuel dump lines, and vent ducts. It also provides access to openings No. 6 and 7. Access is gained through fuel tank access panel No. 3.
- (9) Rib Access Opening No. 9
 - (a) Access opening No. 9 provides access to pressure fueling lines, fuel manifold line, engine fuel feed lines, vent ducts, fuel dump lines, fueling level control shutoff valve, tank No. 1 or 4 forward boost pump vent line and pump removal valve, and vent float valve. Access is gained through fuel tank access panel No. 3.



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- (10) Rib Access Opening No. 10
 - (a) Access opening No. 10 provides access to pressure fueling lines, engine fuel feed lines, fuel manifold line, vent ducts, tank No. 1 or 4 aft boost pump vent line and pump removal valve, fuel dump line, dual check valve, and baffle check valves. Access is gained through fuel tank access panel No. 4.
- (11) Rib Access Opening No. 11
 - (a) Access opening No. 11 provides access to pressure fueling lines, engine fuel feed lines, baffle check valves, and vent ducts. It also provides access to opening No. 12. Access is gained through fuel tank access panel No. 4.
- (12) Rib Access Opening No. 12
 - (a) Access opening No. 12 is in the canted rib. This opening provides access to pressure fueling lines, engine fuel feed lines, and vent ducts. It is necessary to go through opening No. 11 to gain access to opening No. 12.
- (13) Rib Access Opening No. 13
 - (a) Access opening No. 13 provides access to pressure fueling lines, engine fuel feed line, vent ducts, and fuel quantity tank unit. Access is gained through fuel tank access panel No. 5.

7. Fuel Tank Sealing

A General

- (1) Integral fuel tank sealing is the means by which the structural members of the wing can be used to form a fuel-tight cell. This is accomplished through the use of wing skin, spars, ribs, stiffeners, stringers, and doublers as the periphery of the tanks, and applying sealing materials at areas where these members join. Sealing materials are generally synthetic rubber; either in molded form (O-rings, gaskets, etc.), or in an uncured state (for brush or gun application). Use of sealant is held to a minimum to avoid excess weight.
- (2) Main fuel tanks No. 1, 2, 3, and 4, reserve tanks No. 1 and 4, and the integral sections of the center wing tank use the sealed structure of the wing to maintain a fuel boundary. This is accomplished primarily by close metal to metal fit of all parts, by sealed fasteners, and by the application of sealing compound to the structure. Optimum sealing is made possible by the use of open section stiffeners throughout the wing which eliminate blind areas. Fillet sealing is used at the spars, fuel vent ducts, and skin splice stiffeners. Rivet seals are achieved by control and orientation of the driven head.
- (3) Assembly of spar webs, chords, and rib end attachments permit fillet sealing on the tank side. All fillets are on-pressure side seals and are located at areas of minimum deflection. Fasteners installed through the tank end ribs are double sealed. This is because pressure develops on either side of the tank at different times. Bolts or lockbolts are used in high load areas and are sealed with seal caps and filleting materials.
- (4) Molded rubber seals are used to seal fuel tank access panels. O-rings are used to seal removable plumbing fittings, primary tension bolts, and fuel system components which penetrate the fuel tank walls.

B. Definition of Sealing Terms

- (1) **ABSOLUTE SEAL** -- A level of sealing which requires that all seams, joggles, slots, holes, and fasteners that pass through the seal plane be sealed.
- (2) **ALUMINUM WOOL CAULKING** -- The process of plugging a hole, channel, or other void of large cross section with aluminum wool impregnated with sealant.



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- (3) BACKUP SEAL -- A secondary seal which offers support to a primary seal.
- (4) BASE COMPOUND -- The major component of a sealing material used in conjunction with corresponding curing compound (accelerator) to produce a fuel-resistant sealant.
- (5) CURING COMPOUND (ACCELERATOR) -- Internal curing agent for sealant.
- (6) EMERGENCY SEAL -- A seal which backs up a primary seal so as to become functional when primary seal failure occurs and safely controls leakage.
- (7) FAYING SURFACE SEAL -- A seal effected by the sandwiching of sealant between mating surfaces of assemblies.
- (8) FIRST FILLET -- A small bead of sealant applied over the precoat to ensure complete contact and cover seams or joints.
- (9) FULL BODIED FILLET -- A combination of first and second fillet.
- (10) INJECTION -- Filling of holes or channels by forcing sealant into a void or cavity.
- (11) ISOLATION SEAL -- A seal placed for the purpose of confining and tracing fuel leakage.
- (12) PREASSEMBLY SEAL -- Sealant material applied during assembly of structure, such as a faying surface or prepack seal.
- (13) PRECOAT -- A thin layer of brushable sealant applied on surface to be sealed for improving adhesion qualities of the first fillet.
- (14) PREPACKED SEAL -- A quantity of sealant applied prior to assembly which fills voids and cavities.
- (15) PRIMARY SEAL -- Applied sealant directly in line of contact with fuel.
- (16) RAISED SEAL PLANE -- A new seal plane established at a point farther from the tank exterior than the original seal plane to repair a preassembly seal.
- (17) RE-ENTRANT FILLET EDGE -- An overlapping quantity of sealant not in close contact with adjacent sealant or structure which is a potential leak source through the seal plane.



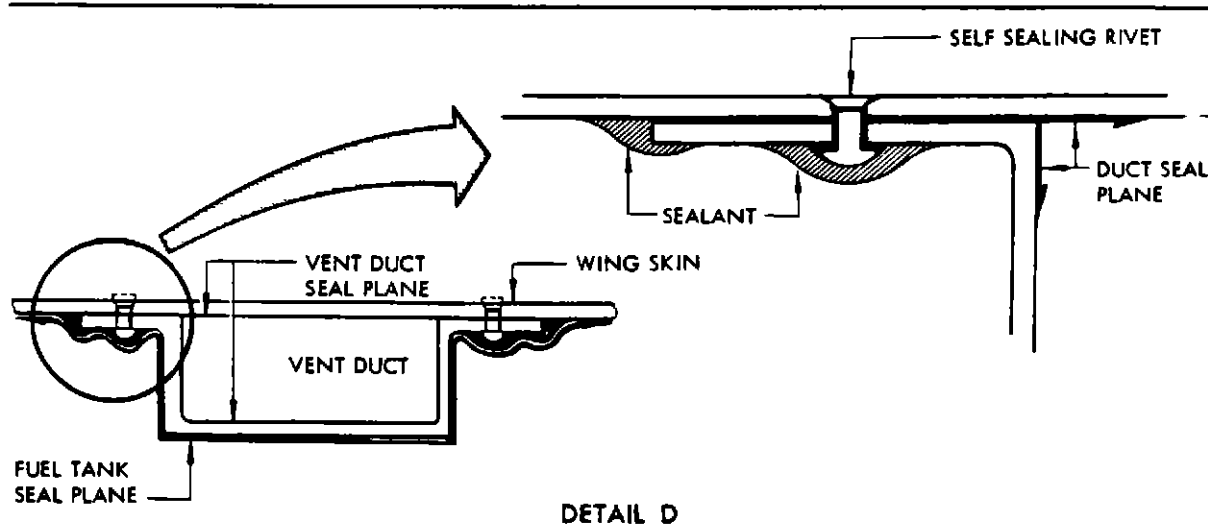
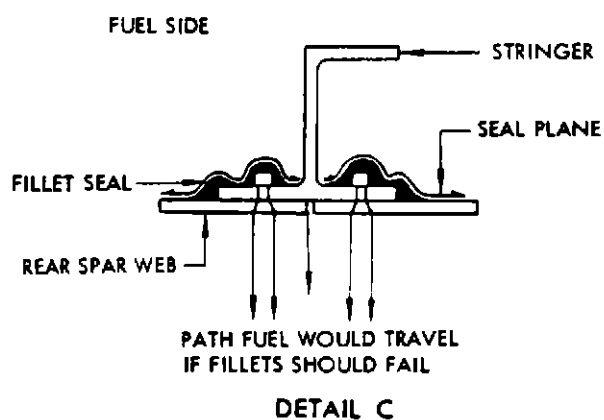
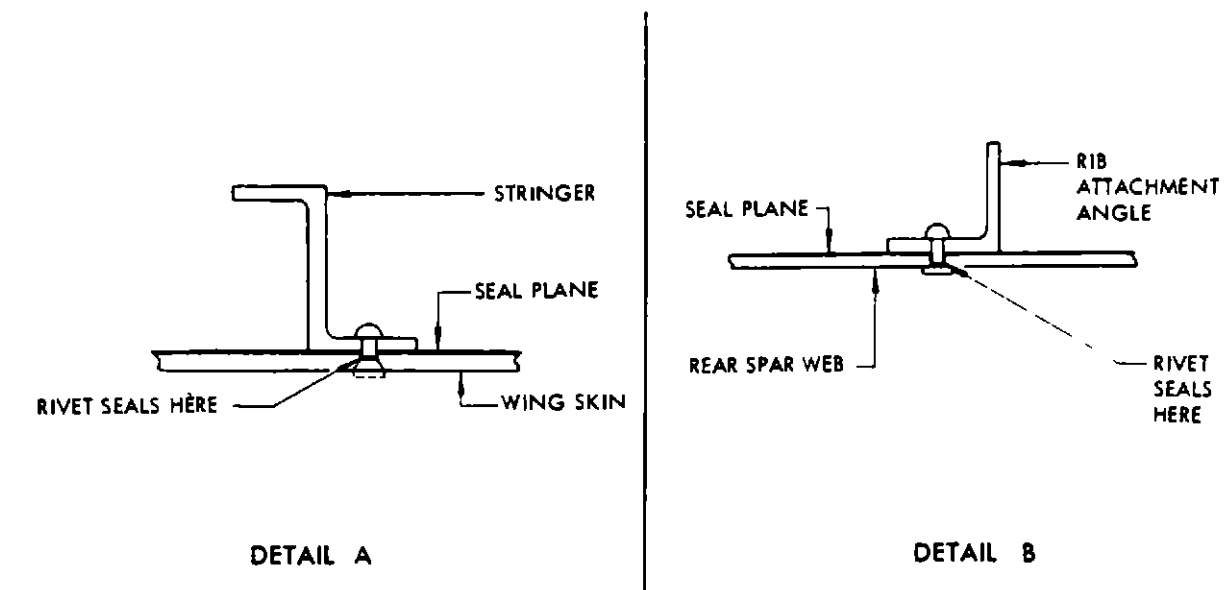
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- (18) REPAIR SEAL -- A seal placed for the purpose of limiting the amount of sealing required to repair a fuel leak.
- (19) SEALANT -- Mixture of base compound and curing compound (accelerator) which will cure to a firm fuel-resistant material.
- (20) SEAL PLANE -- The interior surfaces of the tank, comprised of structure, sealed fasteners and sealant, which actually contain the fuel.
- (21) SEALANT STOP BOLT -- Bolt installed through an injection seal to provide support for a seal.
- (22) SECOND FILLET -- A bead of sealant applied over the first fillet.
- (23) SECONDARY SEAL -- Sealant applied behind and in conjunction with a primary seal to confine fuel.
- (24) SQUEEZE-OUT LIFE -- Length of time sealant remains suitable for structure assembly in faying surface seal application.
- (25) TACK-FREE TIME -- That point of time in the curing of a sealant or a topcoat at which the material does not stick to a dry knuckle pressed lightly against the sealant or topcoat and withdrawn.
- (26) TOPCOAT -- A continuous film which offers corrosion protection to metal surfaces and general protection for sealant against bacteria present in hydrocarbon fuels.
- (27) WET-SIDE SEALING -- Sealing which is accomplished by applying sealant to fasteners or seams on the fuel side (wet side or inside) of a fuel tank.

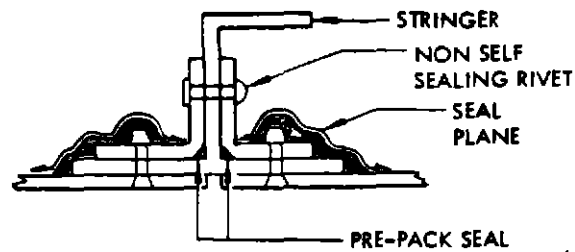
C Typical Examples of Seal Planes

- (1) The basic principle of fuel tank sealing is the establishment of a seal plane. The seal plane encompasses the tank structure and sealed components beyond which fuel is not permitted. Typical examples of seal planes are as follows:
 - (a) The most common example of using fasteners to obtain the seal plane is in the stringer to skin application shown in detail A, figure 4. The fuel is held in the tank by the metal to metal fit of the rivet head upset into a countersunk hole. Leaks in these areas are caused by leaking fasteners. This principle is also used in rib attachments to the spars as shown in detail B, figure 4.

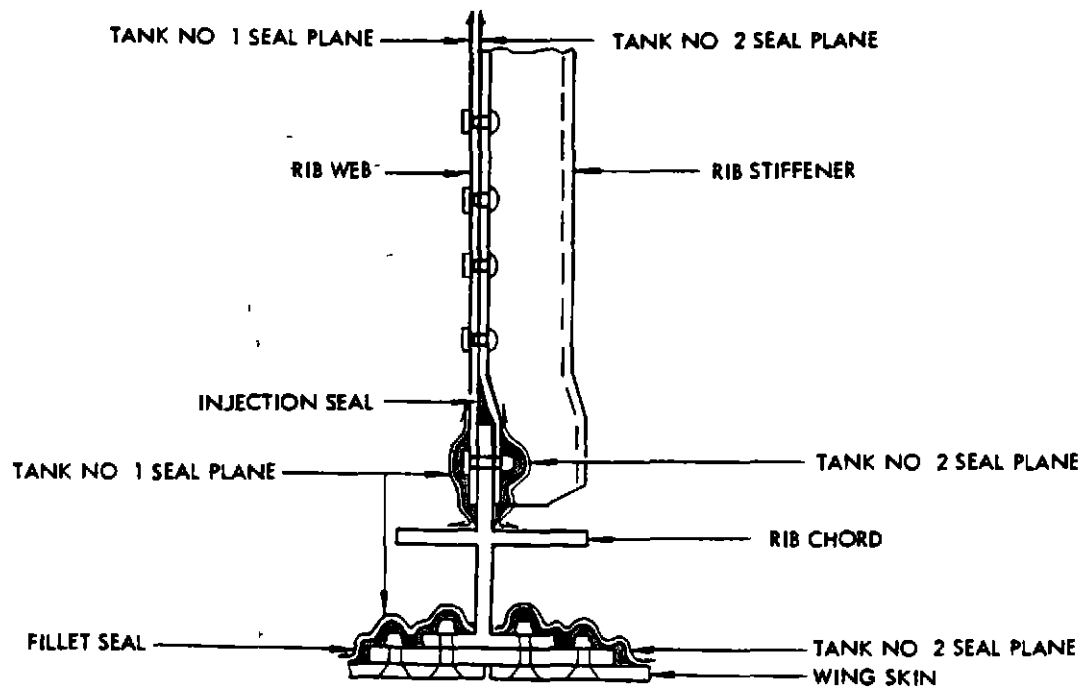
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DETAIL E



DETAIL F



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- (b) In areas where the skin is spliced, the seal plane cannot be maintained by fasteners alone, because fuel would still flow under the stringer and leak out at the splice. (See detail C, figure 4.) To prevent this the seal plane is raised by the addition of fillets along stringer and around fasteners. Leaks in this area would be caused by a breakdown of the fillet seals.
- (c) An absolute seal is required to isolate the spanwise vent ducts from all surrounding areas. The ducts must be sealed against external leakage and also against leakage between the vent system and the fuel tanks. Detail D, figure 4 shows a typical vent duct seal plane application with both interior and exterior seal planes noted. The enlarged view shows that the seal plane is maintained by self sealing rivets and by sealant. The upset head of the rivets prevent fuel in the vent duct from seeping out. Fillet sealing along the edge of the vent duct and over the manufactured head of the rivets prevents fuel from entering the duct through these two points. Fuel in the vents is also prevented from leaking back into the tank.
- (d) In areas where several parts are fastened together, such as a skin splice at a stringer, the seal plane is kept close to the skin by the use of prepack seals. (See detail E, figure 4.) In this case, the prepacked seal is applied at the chamfered corners of the angles during assembly. This eliminates fillet sealing along the top edges of the angles and around the nonself-sealing rivets. Note that failure of any of the seals would result in fuel leakage between mating surfaces and out through the skin splice or out between the fastener shank and the hole.
- (e) At the tank end ribs between main tanks No. 1 and 2, 3 and 4, the seal plane is maintained at the rib chord with an injection seal between the rib web and rib stiffener. (See detail F, figure 4.) Fuel is allowed to flow between the mating surfaces of the web and stiffener to the top of the rib chord where the flow is checked by the injection seal. Fuel is thus prevented from flowing between the junction of the rib web, stiffener and rib chord, and along the rib chord surface to areas where it could leak through. The rib stiffener and rib web are joined with rivets which seal near the upset head.

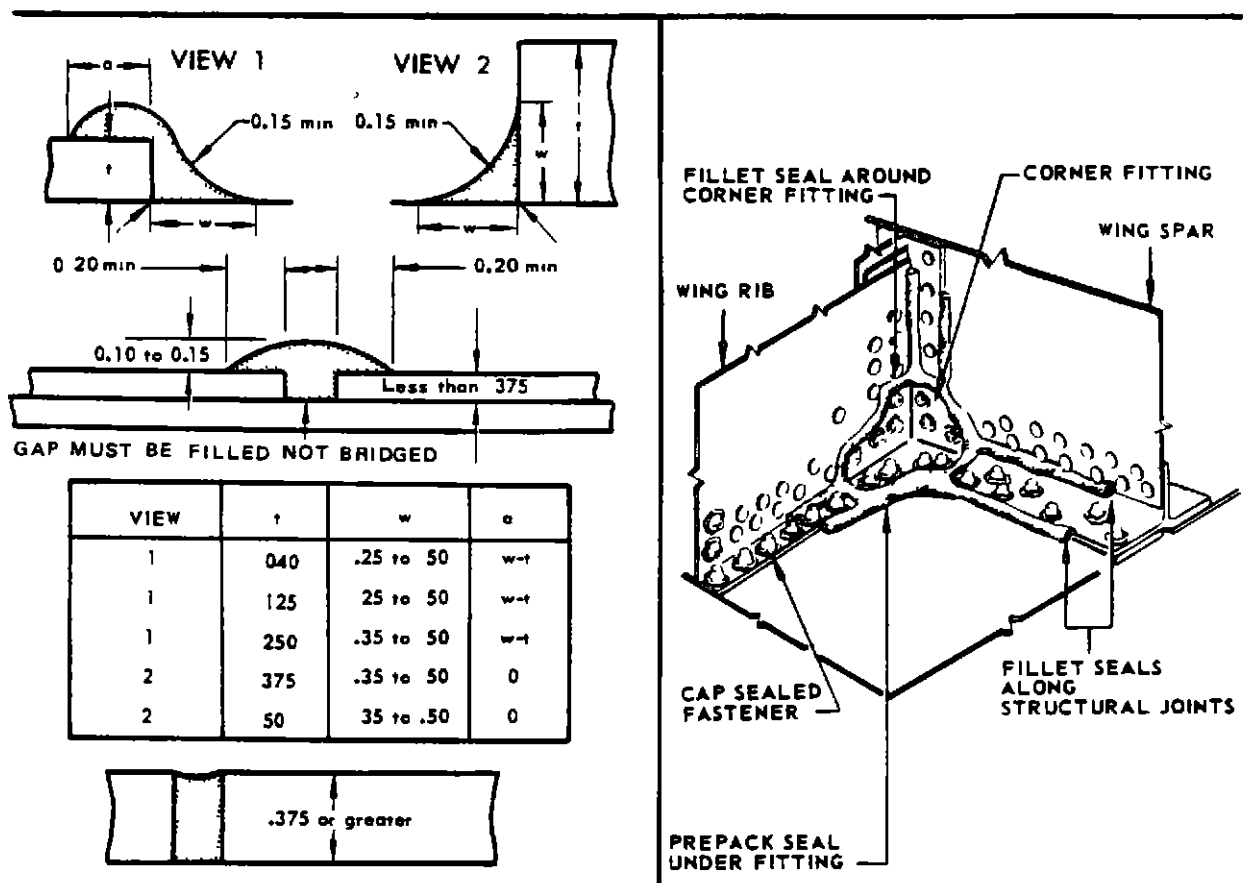
D Types of Seals

(1) Emergency Seals

- (a) Emergency seals are used as a back up seal to direct flow of fuel to an external drain in the event of a primary seal failure. The removable fuel cells in the wing center section are considered primary seals.

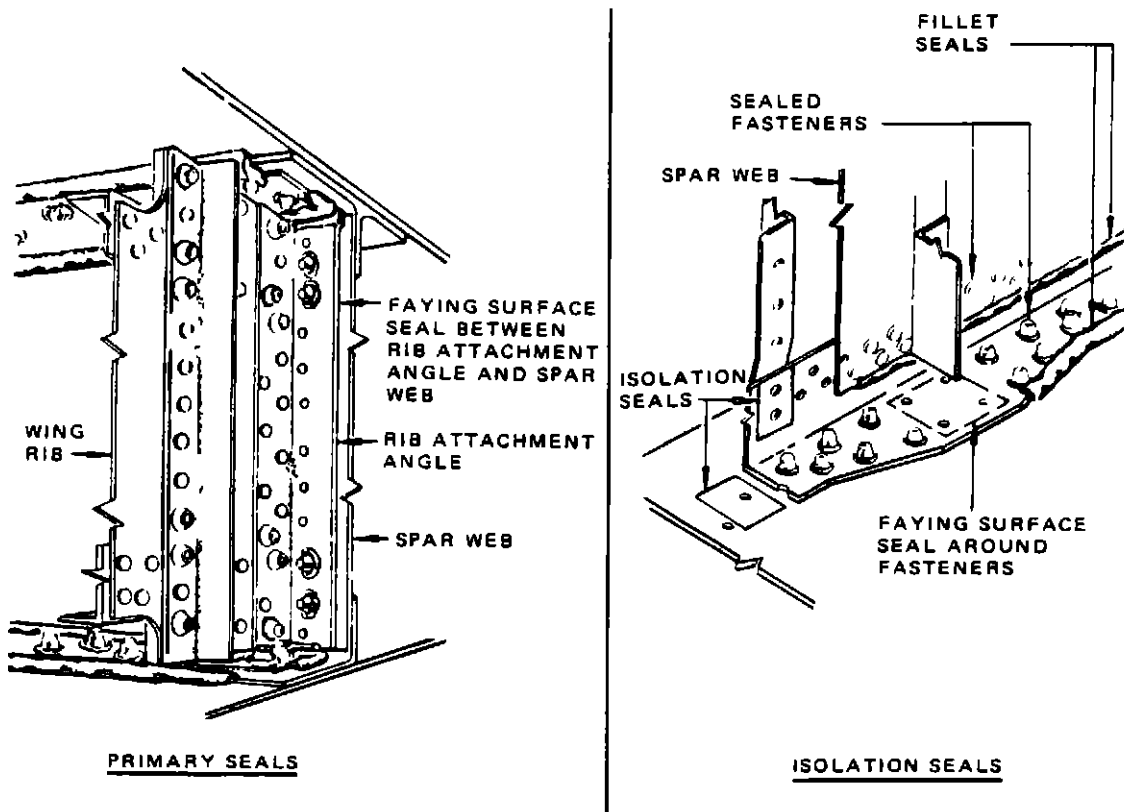
(2) Fillet Seal

- (a) The basic sealant application to fuel tank structure is the fillet seal. Fillet seals are used to cover structural joints along stiffeners, stringers, tank walls, and wing spars, and to seal around fittings on tank walls and in corners. The dimensions shown in figure 5 represent typical finished fillet shapes for various gages. Fillets conform to the dimensions as nearly as possible since the shape of a fillet determines how long it will last in service. A typical application of fillet seals in a tank corner is also shown in figure 5.



(3) Faying Surface Seals (See figure 6.)

- (a) Faying surface seals perform several functions in fuel tank sealing. As primary seals, they are used between surfaces where an absolute seal cannot be economically obtained by the use of sealed fasteners and fillets. A faying surface seal around a fastener prevents the fuel from reaching the fastener area. It does not entirely seal the fastener which must also be sealed. Faying surface seals are especially used to seal areas that will be hard or impossible to seal after assembly. They are also frequently used as isolation seals between the front and rear spar chords and wing skin. They are spaced along the spar chord. Therefore a leak along the spar chord can be isolated between the seal that had stopped the flow of fuel and forced it into view and the next isolating seal upstream. Isolation seals will be found only in dry areas, that is, areas beneath structure where primary sealing is designed to prevent fuel from flowing.

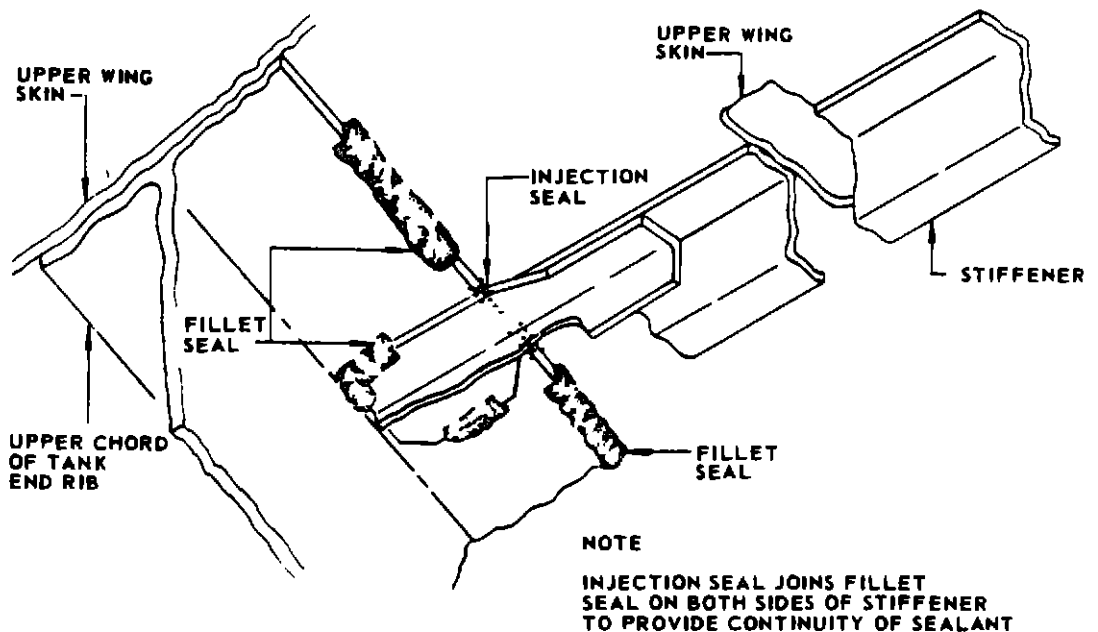


Faying Surface Seals
Figure 6

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(4) Injection Seals (See figure 7.)

- (a) Holes, joggles, channels, and other voids caused by buildup of structure in the fuel tank boundaries are normally filled by injection seals. Injection seals may be applied to provide continuity where fillet seals are interrupted by structure. Holes, joggles, and channels along seams which are to be fillet sealed are also injected full of sealant to provide a backup seal to support the primary fillet seal. Voids and channels of large cross sections are packed with aluminum wool caulking to provide additional strength to the seal.



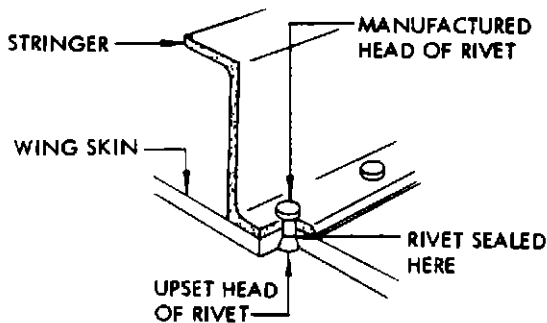
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(5) Prepack Seals

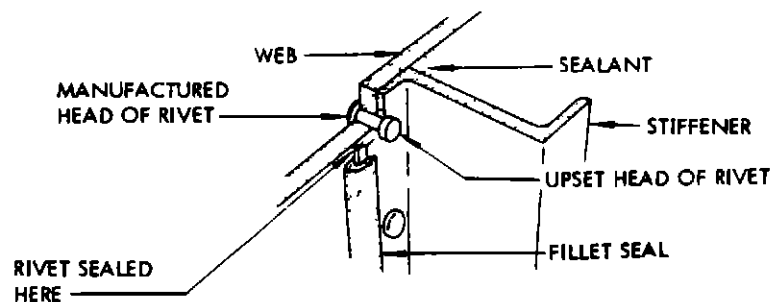
- (a) Prepack seals are used to fill voids in the tank structure which cannot be reached by the injection method. These voids are packed with sealant before they are closed by the assembly of structural members.

(6) Self-Sealing Rivets (See figure 8.)

- (a) Aluminum alloy rivets are used extensively in fuel tank structure. These rivets are considered self-sealing only if correctly installed. The hole clearance is critical and close tolerance rivets are installed in close tolerance holes. The orientation of rivets and their position with respect to the seal plane is also critical. Detail A illustrates a typical installation of a self-sealing rivet. This rivet is upset into a countersunk close tolerance hole. To seal, the rivet must be driven high, which means that the upset head is slightly larger than the countersunk portion of the hole. The portion of the countersunk head which protrudes above the skin is then removed with a rivet shaver. Actual sealing of the rivet takes place around the bucked head at the bottom of the countersink. This is important in determining how the rivet should be oriented on the seal plane. Countersunk or round head rivets installed in a close tolerance hole and bucked in the normal manner are also considered self-sealing. Sealing of the rivet takes place around the shank just under the bucked head. (See detail B.)



DETAIL A



DETAIL B

Rivet Sealing
Figure 8



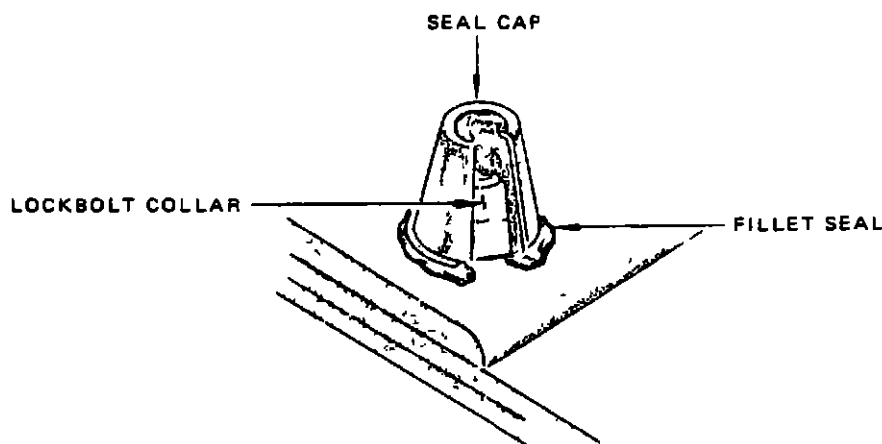
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(7) Fastener Seals (See figure 9.)

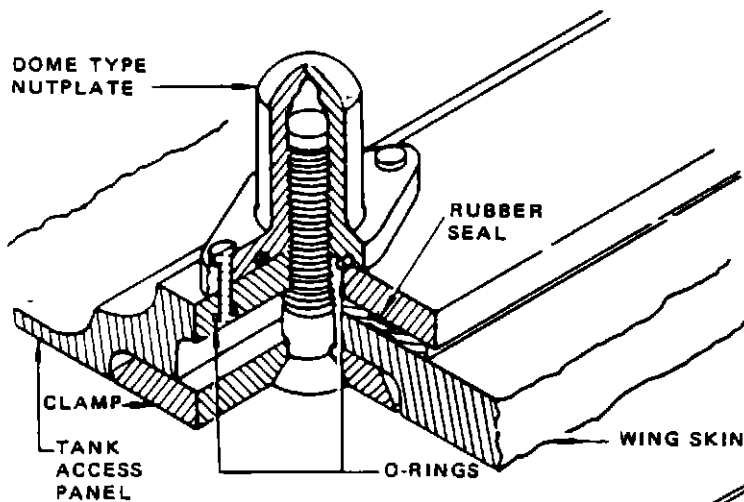
- (a) Since lockbolts are not self-sealing, sealant must be applied to prevent leakage. The most common application of sealant is to the end of the fastener on the "wet" side of the tank structure. Current practice dictates that fillet seals and seal caps be used. Repairs to leaking lockbolts should conform to this method.

(8) Removable Component Seals (See figure 10.)

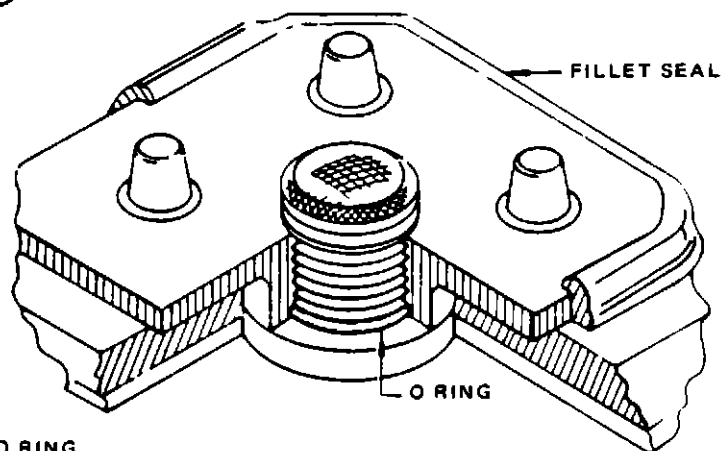
- (a) The type of sealing used for removable components which penetrate the fuel tanks is determined by their use in the tank structure. Bolts which carry primary tension loads are sealed with O-rings installed under special washers. Bolts that require removal in service are sealed with standard seal washers. Other bolts are sealed by applying seal caps or fillets of sealant to the end of the bolt on the "wet" side of the tank. Where bolts that protrude through the tank wall are used to secure removable components to the outside surface of the tank wall, self-sealing nutplate installations are used to provide fastener sealing. The nutplate installation consists of a dome type, O-ring sealed, nutplate installed with O-ring sealed rivets installed in a single thickness of material. Fuel sump drain valves and fuel quantity measuring sticks are installed in fittings attached to the wing lower skin in each fuel tank. Fittings are attached to the wing skin by self-sealing rivets and are sealed by a fillet seal around their periphery. Sealing between the drain valves or measuring sticks and their fittings is accomplished by installing O-rings during installation. Bulkhead fittings in the fuel lines are sealed with O-rings in a similar manner. Fuel tank access panels are sealed by a molded rubber seal ring between the panel and the wing skin.



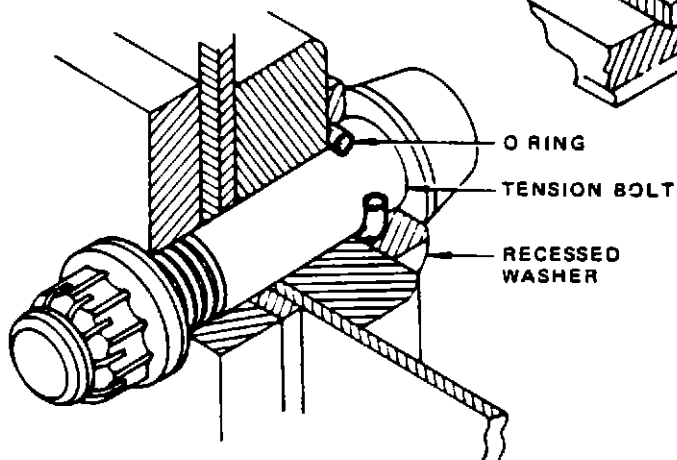
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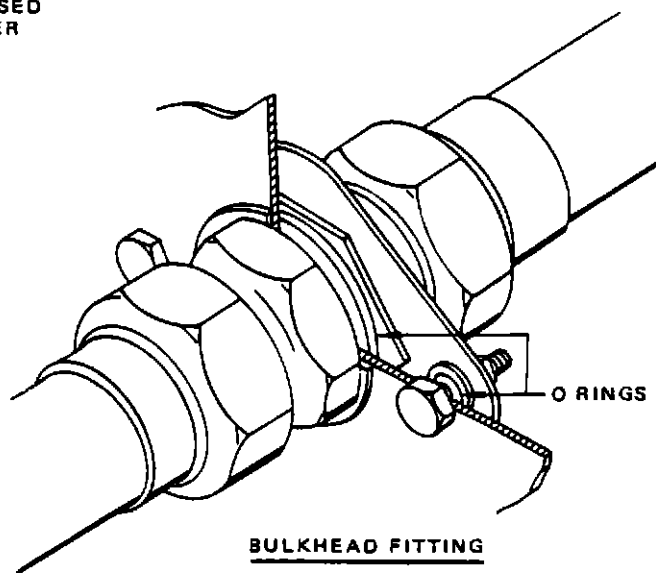
NUTPLATE



FUEL SUMP DRAIN COCK



TENSION BOLT



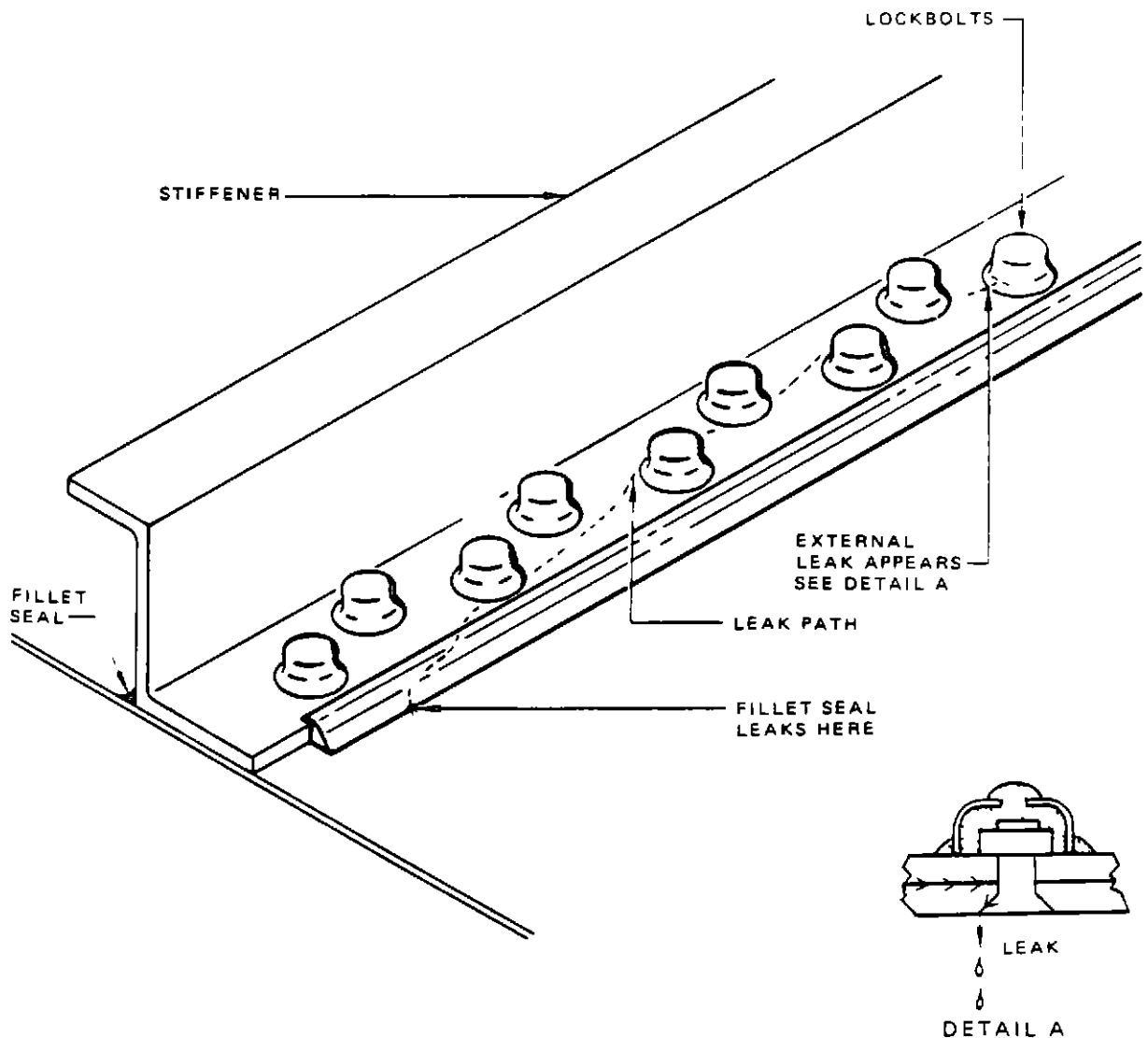
BULKHEAD FITTING

Removable Component Seals
Figure 10

2
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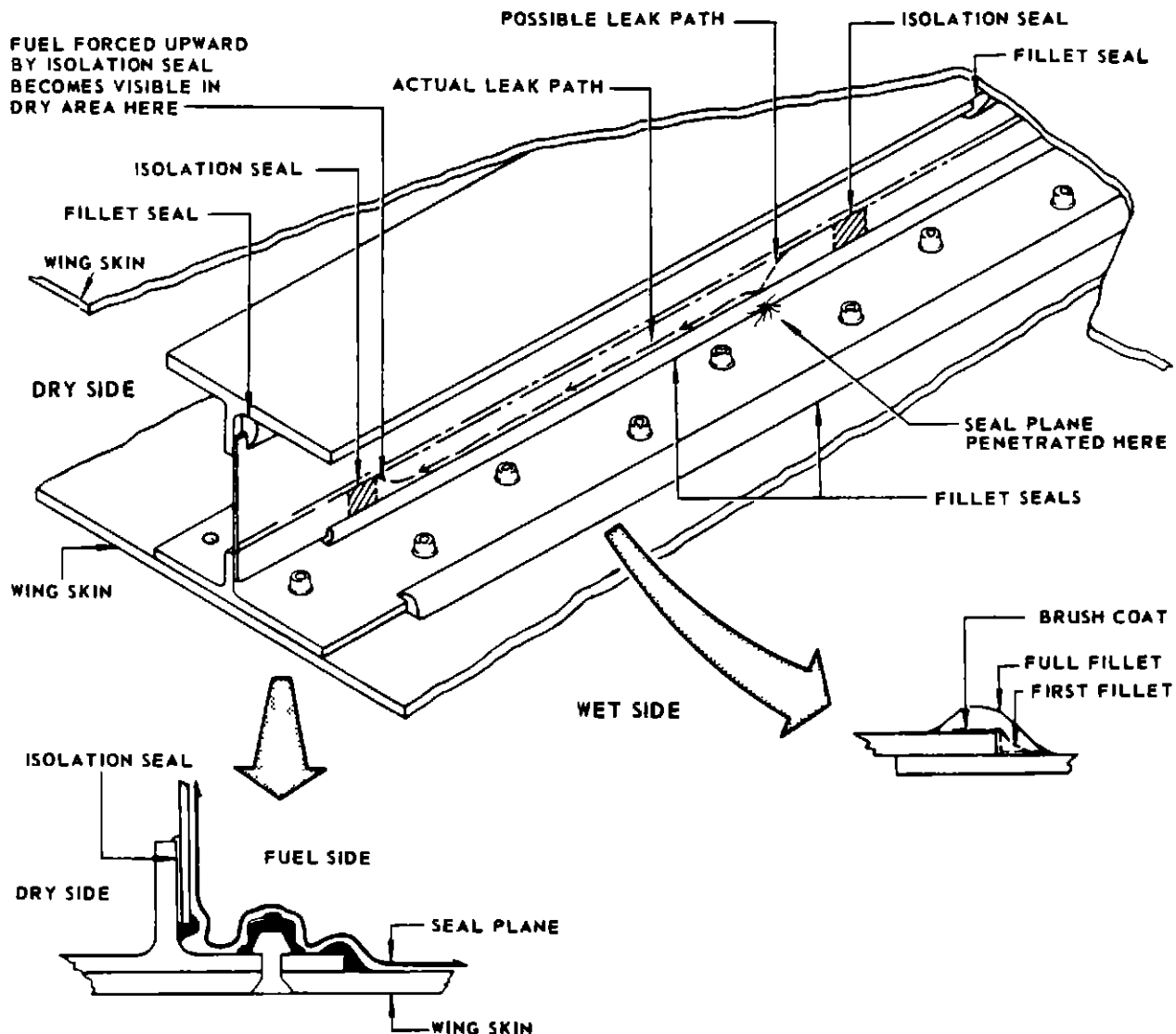
8. Integral Fuel Tank Leak Detection

- A. Fuel has a very low surface tension and viscosity; therefore, it is able to penetrate the slightest flaw in the seal plane. Because fuel under pressure will flow in all directions, sealing is a problem involving three dimensions. Figure 11 illustrates a typical fuel leak situation in the seal plane. Fuel flowing under the sealed stringer will eventually reach a point where it can penetrate the wing skin. The seal plane is maintained by a continuous fillet along the entire length of the stringer and in the area of the lockbolts.



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- B Isolation seals assist in locating leaks by limiting the distance fuel can flow between structural members. Figure 12 illustrates a typical leak situation on a wing spar. Fuel from this type of leak has been found to travel in the spar area instead of becoming visible near the point of seal plane penetration. However, when the leaking fuel reaches an isolation seal, it is forced outwards and becomes visible. In this case the leak path is confined to the area between the two isolation seals shown in figure 12. It is not necessary to know the position of these seals, knowing the location of the seals will, however, greatly assist in the location of seal plane penetration.



Typical Effect of Isolation Seal
Figure 12



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9. Leak Evaluation and Repair Requirements

A. Fuel leakage from a tank is divided into four groups to provide a means of evaluating the safety of flying the airplane with fuel leaks present. The four groups are stain, seep, heavy seep, and running leak. Each group is determined by a visual examination of wetted area around the leak source. Wetted areas must be wiped clean after each examination for accurate re-evaluation of leak. The size patterns of leaks illustrated in figures 13 and 14 are based on an examination 15 minutes after leak was first noticed and area wiped clean. In figure 13 the four groups of leaks are evaluated as follows.

- (1) A stain is a leak where the wetted area is not over 1-1/2 inches wide after the time interval noted above has elapsed.
- (2) A seep is a leak where the wetted area is not over 4 inches after time interval noted above has elapsed.
- (3) A heavy seep is a leak where the wetted area is no larger than 6 inches after the time interval noted above has elapsed.
- (4) A running leak is any leak in excess of a heavy seep. Fuel will usually reappear immediately after being wiped dry and can run or drip from a surface.

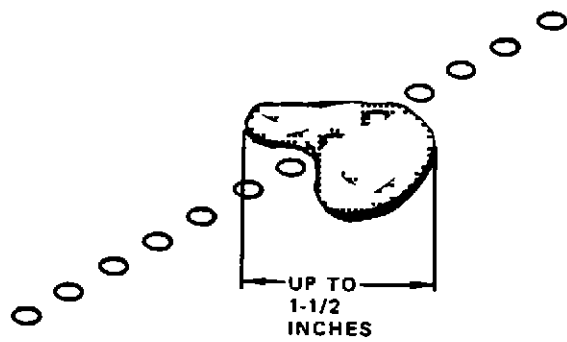
B. Figure 14 gives in tabulated form the various leakage categories and the repair actions required.

WARNING. CAREFUL EXAMINATION MUST BE MADE TO ENSURE THAT THE LEAK IS NOT PROGRESSING TO A CRITICAL AREA OF THE AIRPLANE, OR THAT THERE IS NO POSSIBILITY OF FUEL BEING BLOWN INTO THE FUSELAGE AREAS

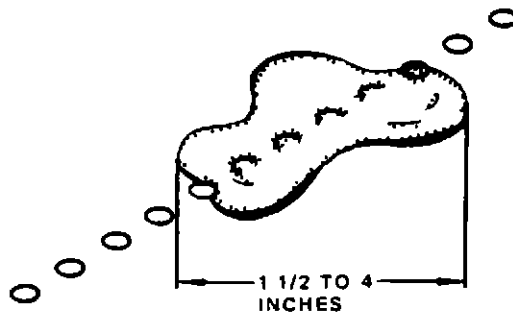
10. Causes of Leaks

A Improper Preparation of Surface

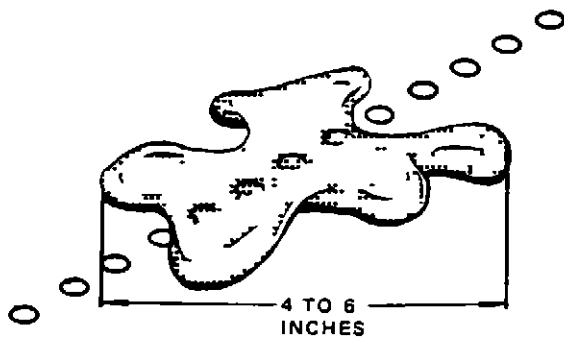
- (1) Leakage exists only when a fault in the sealing provides a path through the sealant barrier (seal plane). Since jet fuel has a low surface tension and viscosity, it can leak through extremely small openings and travel for a considerable distance. Foreign material such as grease, metal chips, human hair, loose paint, wax, or oil will reduce the adhesive bond sufficiently to cause premature failure. All surfaces must be completely free of foreign material before sealant is applied.



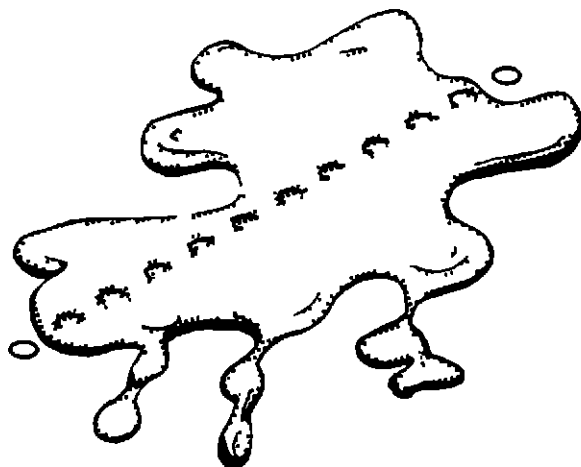
STAIN



SEEP



HEAVY SEEP



RUNNING LEAK

Fuel Leak Size Patterns
 Figure 13

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LEAKAGE LOCATION	STAIN	SEEP	HEAVY SEEP	RUNNING LEAK
Exposed well ventilated areas where leakage cannot progress to a potential fire source. Upper and lower wing surfaces	①	①	②	③
Semienclosed - partially ventilated areas. Rear spar	①	② Two places maximum	③	③
Enclosed nonventilated areas. Front spar, dry bays and fueling bay	①	② Two places maximum	③	③
Enclosed nonventilated area. Wing lower surface and leading edge above nacelles	②	③	③	③
Exterior boost pump cavity	①	② One place maximum	③	③
Wing center section tank pressurized zone (Ref 28-3-0 for removable fuel cell leakage allowance)	④	④	④	④
① No repair action required; frequent inspections must be made to assure that leak does not progress. ② No immediate repair required. Frequent inspection must be made to assure that leak does not progress. Repair must be made on next airplane layup. ③ Immediate repair is required to at least ① or ② classification. ④ Immediate repair is required. No leakage allowed.				

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Fuel Leak Evaluation
Figure 14

28-2-0
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B. Improper Mixing or Storage of Sealants

- (1) Synthetic rubber forms the base for most sealing compounds. The manufacturer adds different ingredients that control strength, curing time, plasticity, work life, and fuel resistance. Sealants are supplied in two parts; base material and curing compound (accelerator). Extreme care must be taken to ensure that only the proper proportions and the curing compound (accelerator) recommended by the manufacturer are used. Any variation from the manufacturer's instructions will change the physical properties of the mixture. This may produce a seal failure and tank leakage. Sealing compounds can be stored on the shelf before mixing with curing compound. After a specified period of time it is outdated and is tested for curing capabilities before use. Some sealants can be stored under refrigeration for short times after being mixed with curing compound. After the storage time on mixed sealant has elapsed it must be discarded. Old sealant will not flow or stick properly thereby producing an unsatisfactory sealing job and a leak.

C. Improper Application of Sealants

- (1) Application of sealant is important. The manufacturer's recommendations must always be followed. When a brush precoat is recommended it must be applied. Elimination of precoat or any steps in sealant application impair the sealant's ability to seal properly. Air bubbles in sealant burst in time and provide a void or pin hole for fuel to leak through. If structure gaps are bridged, instead of being filled, voids in sealant are left. Re-entrants provided by overlapping sealant and lack of good faired contact with all surfaces will allow a leak in time. Application of sealant not in accordance with the manufacturer's recommendations will cause integral tank leaks.

D. Loose Fastener

- (1) Loose fasteners may initiate a fuel leak by allowing movement in a fabricated assembly. Excess movement may crack faying surface seals which will provide a fuel path through the seal plane. Loose rivets will not maintain a self-sealing status. The integral fuel tank design incorporates interference fits in close tolerance holes for fasteners installed in tank boundaries. All replacements of these fasteners must maintain this requirement.

E. Improper Installation of Fittings

- (1) Fittings and connections that are attached or pass through tank boundaries are sealed with O-rings. When O-rings are installed they can be pinched, scored, twisted, or otherwise improperly installed, causing leaks.



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11. Methods of Leak Detection

- A The following methods are acceptable means of tracing a leak from where it appears on the outside of an integral fuel tank to the source on the inside. The methods appear in the order of increasing difficulty and they should be tried in that order, if possible.

CAUTION. THE VACUUM METHOD SHOULD ONLY BE USED AS A LAST RESORT SINCE IT IS POTENTIALLY HAZARDOUS TO STRUCTURE.

NOTE. Refer to Integral Fuel Tank - Trouble Shooting for detail description of the following methods.

(1) Visual Method

- (a) The area inside the tank from which the leak appears to be coming is examined. Examination may reveal the cause of leakage in the form of missing or faulty sealing. In many instances, this method will not reveal the cause of leakage and the following method will prove to be the most rapid.

(2) Air Hose and Internal Bubble Method

- (a) A stream of air is directed at the point of leakage on the outside of the tank while at the same time the suspected area inside the tank is brushed with soap solution.

CAUTION: DO NOT USE A SOAP SOLUTION WHICH WILL CORRODE ALUMINUM OR DETERIORATE THE SEALANT. SOLUTION MUST BE WIPED CLEAN AFTER CHECK.

(3) Air Hose and External Bubble Method

- (a) This method is the same as the internal bubble method, except that the air is applied at the inside point and the soap solution applied at the outside.

(4) Dye Injection Method

- (a) This method is particularly useful when very small leaks cannot be detected by the air methods. Dye is forced through the leak path into the tank from the exterior leak point. One man enters the tank to observe the flow of dye from the internal leak source. The flow of dye can more readily be detected if fluorescent dye and an ultra-violet light, which causes the dye to glow, is used.



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(5) Vacuum Method

- (a) This method should be used only as a last resort after the other methods have failed. The vacuum method is complicated, time consuming, and potentially hazardous to structure. A vacuum is applied to the tank and a dye solution to the external leak point. The leak point is kept wet for one-half hour and the vacuum on the tank for one hour. Examination of the interior of the tank should reveal the leak source. For method of vacuum application, refer to Integral Fuel Tank - Trouble Shooting.

WARNING: DO NOT EXCEED THE MAXIMUM SAFE NEGATIVE PRESSURE.

(6) Pressure Test

- (a) If the vacuum test fails to show the leak source, the exterior outflow point should be verified by the pressure test. For method of pressure application, refer to Integral Fuel Tank - Trouble Shooting.

WARNING: DO NOT EXCEED THE MAXIMUM SAFE PRESSURE.

- (b) The pressure test will verify both the tank and the outflow point. Once the tank has been closed and sealed and equipment assembled to perform the vacuum test, it is easy to reverse the procedure and pressurize. When the tank is correctly pressurized, bubble solution applied to the exterior leak point will indicate the exterior outflow point. If the pressure test shows the exterior outflow point to be different from the one used in the vacuum test, then the vacuum test should be repeated using the new outflow point. Should the pressure test show the exterior outflow point to be the original one, then the vacuum test should be repeated on this point using a longer period under vacuum.

(7) Methods for Use in Special Locations

- (a) A leak detection method for use in boost pump forging areas involves the use of a dam full of water around the forging and the pressurizing of the boost pump cavity. Hollow bolt methods of leak detection are best suited to finding leaks in areas of structural buildup.



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INTEGRAL FUEL TANKS - TROUBLE SHOOTING (LEAK DETECTION)

1. General

- A. Integral fuel tank fuel leaks are usually the result of improper fitting installation, failed or damaged sealant, improperly installed or damaged O-rings, loose fasteners, and electrical or equipment installations that pass through tank boundaries not being properly installed.
- B. Fuel leakage from a tank is divided into four groups to provide a means of evaluating the safety of flying the airplane with fuel leaks present. The four groups are stain, seep, heavy seep, and running leak. Refer to Integral Fuel Tank - Approved Repairs for size patterns and evaluation of leaks.
- C. The various methods used to locate a leak are described in detail in subsequent paragraphs.

2. Equipment and Materials

- A. Flashlight - Explosion Proof
- B. Light - Extension, Explosion Proof
- C. Ultra-Violet Light - Explosion Proof (suitable for use with the following fluorescent dyes)
- D. Dye, Fluorescent Dye Pigment, OS-31 (intense green) OS-80 (bluish white), Shannon Luminous Material Co., 7354 Santa Monica Blvd., Hollywood Calif
- E. Red Dye - Oil Red O (solvent red No. 27) Blue Dye - Brilliant Oil Blue BMA (Solvent Blue No. 16), Allied Chemical and Dye Corp., 61 Broadway, New York 6, N Y.
- F. Special Leak Tracing Device F71329, or equivalent
- G. Pressure Box (Fabricated) (See figure 102)
- H. White Talcum Powder
- I. Absorbent Cotton Cloths
- J. Soap Solution - Noncorrosive
 - (1) Tereco 210 (thin), Tereco 211 (thick), and Tereco 602 - Technical Research Co., Seattle, Washington
 - (2) Turco Car Shampoo - Turco Products Incorporated, Seattle, Washington



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- K. Air Supply - 90 to 100 psig
- L. Air Supply - 0 to 10 psig
- M. Camel Hair Brush or equivalent
- N Boost Pump Cavity Test Door F71327, or equivalent
- O Closure Plugs

CAUTION: ATTACH RED, COTTON WEBBING, STREAMERS TO ALL PLUGS USED IN THE TANK.

- (1) Squeeze plugs: 1-1/2 inch, 1-3/4 inch, and 2-1/2 inch
- (2) Plugs AN806-6 and AN806-8
- (3) Caps AN929A16 and AN929A12
- (4) Doweling, 1 inch diameter, cut to length as required with rubber caps on each end.

P. Tank Test Panel - Fabricate as shown in figure 107

Q. Safety Relief Manometer - Fabricate as shown in figure 110

R Compressed air source, not less than 6 psig delivering more than 350 cubic feet of air per minute; or vacuum source, creating not less than 8.5 inches of mercury (or 110 inches of water) of vacuum and removing more than 350 cubic feet of air per minute.

3. Localizing External Fuel Leaks - Talcum Powder Method

A. Before defueling and entering any fuel tank which has a fuel leak, attempt to locate and isolate all fuel leaks in the affected tank. Every effort should be made to isolate and repair all fuel leaks regardless of classification each time a tank is opened to repair a leak. To localize an external leak using talcum powder, proceed as follows:

- (1) Remove aerodynamic smoother if applied over affected seams or joints. Wipe leak area dry using absorbent cotton cloth. Blow out all wet seams and corners.

CAUTION: HOLD AIR HOSE 1/2 INCH MINIMUM FROM STRUCTURE TO PREVENT DAMAGE TO SEALS THAT ARE NOT FAULTY.

- (2) Dust suspected area immediately with talcum powder using a soft bristle camel hair brush.
- (3) Observe dusted area carefully for signs of discoloration around fasteners.



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- (4) Mark each leaking fastener and repeat same procedure at successive locations until each external leak is localized.
- (5) Study wing structure and decide which paths fuel might have traveled to arrive at point of detection. Note structural patterns adjacent to leak area. Any structural buildup is a possible leak path and fuel may flow in structure outside the tank boundaries. Talcum powder test should result in elimination of some areas originally considered to be possible leak sources.

NOTE: Localizing the leakage area will greatly reduce the time required to discover the actual point of leak

- (6) If the leak is near a tank boundary and there is some doubt as to which tank is leaking, refer to the following paragraphs, Determining Leaking Tank.
- (7) If the external leak point cannot be determined by the above methods, the internal pressure and bubble method should be used, but only as a last resort. Refer to Internal Pressure and Bubble Method, paragraph 6.G

4. Determining Leaking Tank

A. Leaks occurring at or near tank end ribs which are common to two separate integral tanks may be coming from either of the tanks. To determine which tank is leaking, use one of the two following methods.

(1) Dye Method

- (a) Add red or blue dye to the fuel in one of the tanks. The mixture solution is one ounce of dye powder to 100 gallons of fuel. First mix the dye powder with a small amount of fuel to obtain a properly mixed solution, then add the solution to the tank.
- (b) Observe tank exterior for evidence of dye indicating a leak in the tank containing dye

NOTE: It is not necessary to flush tank after test as dye is not harmful to the engines.

(2) Defueling Method

- (a) Visually examine the leak to enable an educated guess to be made as to which tank is leaking and defuel this tank. (Say tank A.) Refer to Fuel System - Maintenance Practices, 28-0. (Tanks A and B are tanks immediately adjacent to the leak.)



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- (b) After allowing time for fuel to drain, check for leak. If leak has stopped, then tank A is the leaky tank. If leak continues, complete step (c).
- (c) Defuel the adjacent tank (tank B) and fuel tank A. If leak stops, tank B is the leaky tank. If leak continues, both tanks are leaking.

5. Determining Nonsealant Leaks

A. General

- (1) Fuel leaks in the main tanks will often be the result of improper installation of tubing components at the tank boundaries. Leaks may also be found at electrical connections that pass through the front and rear spars. Fittings that are attached to ribs at tank ends are sealed with O-rings as are all other connections and fittings that pass through any tank boundaries. Stiffeners, and rib end fittings at the front and rear spars, are sealed in part by fasteners that attach them to the wing skin and spars. These are all possible leak sources. Equipment and tube connection leaks at tank ends and along the spars will almost always be caused by a faulty O-ring or improper installation.

B. Locating Nonsealant Leaks - Talcum Powder Method

- (1) This procedure deals only with determining whether or not a leak is caused by equipment or fittings at tank boundaries. If equipment or fittings are not the leak source, it must come from a compound sealed or fastener sealed origin. If a tank boundary connection is suspected of a leak, proceed as follows:
 - (a) Provide a container of white talcum powder and a thick bristled camel hair brush for dusting powder on the suspected leak source. Have plenty of clean, dry cotton cloths available.
 - (b) Wipe up leak area thoroughly with absorbent cotton cloths.
 - (c) Wipe connection thoroughly using three or four changes of cloth in the process. It must be completely dry.
 - (d) Immediately dust connection with talcum powder.
 - (e) The first trace of fuel touching the talcum will cause it to turn neutral.
 - (f) If no change is immediately apparent in the talcum, wipe the surrounding area that was previously wiped dry and dust talcum over entire area.
 - (g) Observe the dusted area closely for the first signs of change in the talcum.



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- (h) If talcum changes color at connection, the leak has been isolated. See applicable paragraph for removal and replacement of the component.
- (i) If fuel discolors talcum at another location, for instance at a lockbolt or rivet installation, there is a possibility of it being a contributor to the leak also. Leaks in the bottom of the wing around access doors can usually be attributed to a faulty O-ring in the access door. The nutplates that retain some access door attaching screws, are O-ring sealed and a possible leak source also, and should be examined when a leak is discovered in the access door area.

6. Locating Leak Source in Defueled Tank

A After locating the exit point of the leak on the exterior and preparing the tank for entry, the next step is to locate the source of the leak inside the tank. This consists of an examination of the interior, marking visible defects in sealant, and application of one or more of the leak detection methods.

B Visual Check

- (1) Defuel applicable fuel tank and prepare it for entry. Refer to Fuel System - Maintenance Practices, 28-0.
- (2) Remove fuel tank access panels and structure members from over rib access openings as required. Refer to 28-2-1 and 28-2-11.
- (3) Examine leak area carefully for faulty sealing, such as loose fasteners and cracked or loose fillets. Use mirrors to observe seals which are not otherwise completely visible.
- (4) Check locations where injection seals have been installed to provide continuity for fillet seals.
- (5) Look for channels which might have been bridged by sealant rather than filled.
- (6) Check fillet seals for adhesion. Fillets suspected of poor adhesion may be checked by rubbing faired edges with a pencil eraser or by the application of a maximum of 100 psi air pressure through a nozzle placed 1/2 inch minimum from the fillet. These checks will loosen a fillet which has poor adhesion.

NOTE. Fillets which do not have good adhesion should be removed as soon as they are discovered. Cut a section through the loose fillet and strip off by pulling it away from the structure. Continue to strip off fillet until it breaks apart. A fillet which has proper adhesion will pull apart rather than pull away from the tank structure.



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- (7) Check for cracks or distortion of tank structure
- (8) Visible defect in sealing or structure is not necessarily origin of fuel leak. Continue visual examination until entire area has been carefully checked. Any visible defect should be repaired to prevent subsequent deterioration and fuel leakage

C. Air Hose and Bubble Method

- (1) If leak source has not been definitely isolated by a visual check, it may be revealed by application of a soap solution to the outside of the tank. This procedure requires two men, one outside and one inside the tank. Proceed as follows:

WARNING: BLOW OUT AIR HOSE TO REMOVE ANY FOREIGN MATERIAL.

- (a) With the tank prepared for entry as described in Fuel System - Maintenance Practices, 28-0, one man should enter the tank with air pressure hose equipped with nozzle and capable of delivering air pressure at approximately 90 to 100 psig.

NOTE: A system of communication shall be arranged before entering tank to indicate when air pressure is to be applied and shut off

- (b) Man outside of tank should apply noncorrosive soap solution to exterior of tank over area where fuel leak has been observed.
- (c) Man inside tank should apply air pressure approximately 1/2 inch from fastener seals, fillets, and edge of faying structure. See figure 101.

CAUTION: HOLD AIR HOSE 1/2 INCH MINIMUM FROM SEALS AND STRUCTURE. HIGH PRESSURE AIR APPLIED DIRECTLY MAY DAMAGE OR LOOSEN SEALS WHICH ARE NOT FAULTY.

- (d) Area noted by talcum powder test should be tested thoroughly. Man applying bubble solution to exterior of tank should observe closely for signs of bubbling solution.
- (e) If bubbles are observed, mark area inside and outside of tank and continue test until area has been completely covered.
- (f) Recheck area where bubbles were noted to make certain that leak has been isolated. Mark exact location of leak.
- (g) Wipe up bubble solution using damp cloth.

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- (h) If steps (g) through (f) have not resulted in discovery of leak source, repeat procedure using bubble solution inside tank and applying air pressure to external seams and joints which were wetted by leaking fuel.
- (i) After completion of the above procedure, make certain that interior of tank is thoroughly cleaned of bubble solution
Mark leak source

D. Pressure Box Application

- (1) To locate small leaks which require application of air pressure for longer periods of time, a pressure box may be fabricated. (See figure 102.)

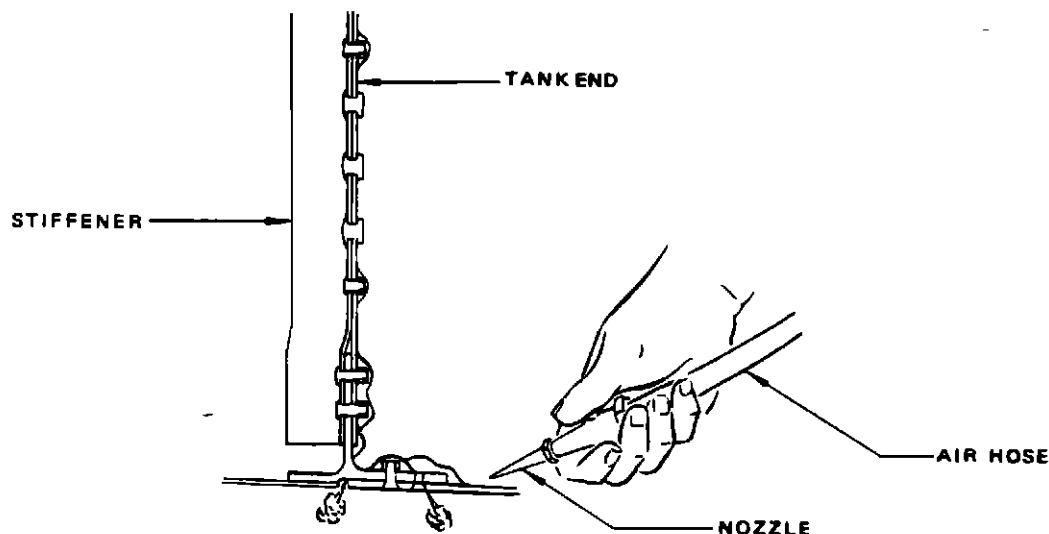
CAUTION· MAXIMUM PRESSURE ALLOWABLE IN THE BOX IS 4 PSIG.

THE AIRPLANE WING MUST NOT BE LOWERED BY ANY MEANS WHILE BOX IS IN POSITION EXAMPLE: FUEL TANKS MUST NOT BE REFUELED OR TIRE PRESSURES REDUCED.

EXCESSIVE JACKING UP OF BOX MUST BE AVOIDED

APPLY AIR PRESSURE TO BOX SIMULTANEOUSLY WITH APPLICATION OF LOAD TO THE BOX TO PREVENT DAMAGE TO WING PANEL

- (2) If the air hose and bubble method has not isolated the leak source, the dye injection method should be tried.

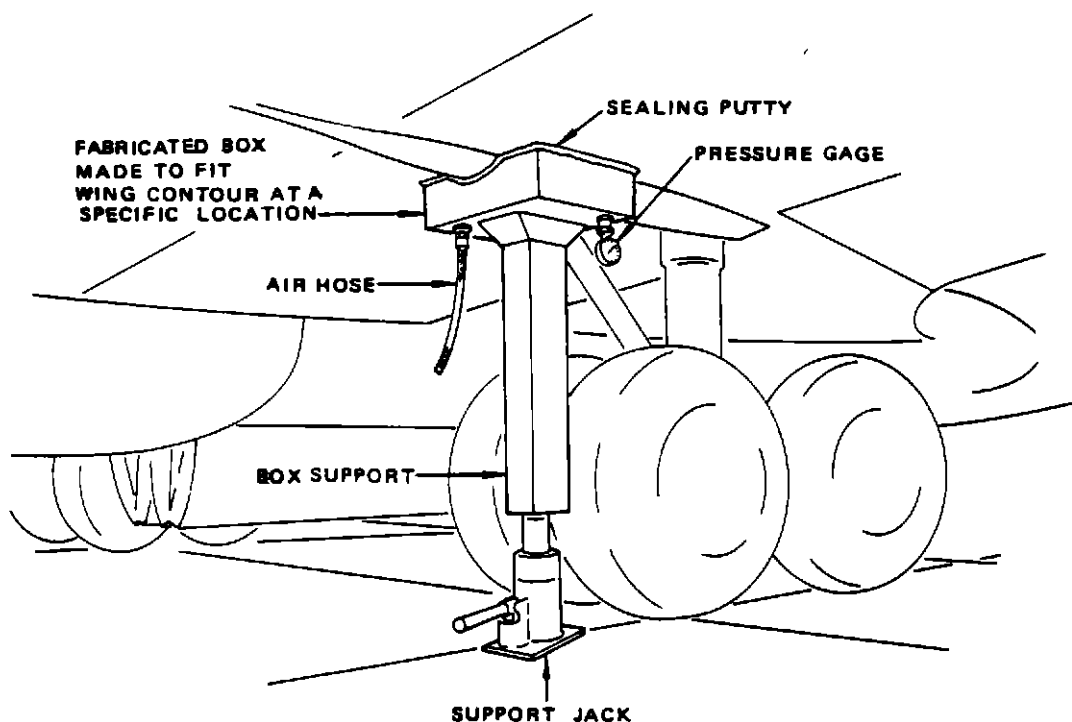


Leak Detection Air Hose and Bubble Method
Figure 101

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E. Dye Injection Method

- (1) This method consists of injecting dyed fuel through the external leak point to the leak source inside the tank by use of a leak tracing device. (See figure 103.) Use Red Dye - Oil Red O (Solvent red No 27), Blue Dye - Brilliant Oil Blue BMS (solvent blue No 16). Mix one ounce of dye to 100 gallons of fuel, a stronger solution may be used if necessary to facilitate leak detection.
- (2) Fluorescent dye Shannon OS-31 or OS-80 mixed one ounce dye to one gallon fuel, and an ultraviolet light, may also be used for this method of leak detection.
- (3) With tank prepared for entry per Fuel System - Maintenance Practices, 28-0, and leakage tracing device F71329 located as close as practical to test area, proceed as follows:
 - (a) Follow instructions in lid of leakage tracing device for use of items in the box. If a substitute tool is used follow applicable instructions in order to obtain the desired results.



Pressure Box Application
Figure 102

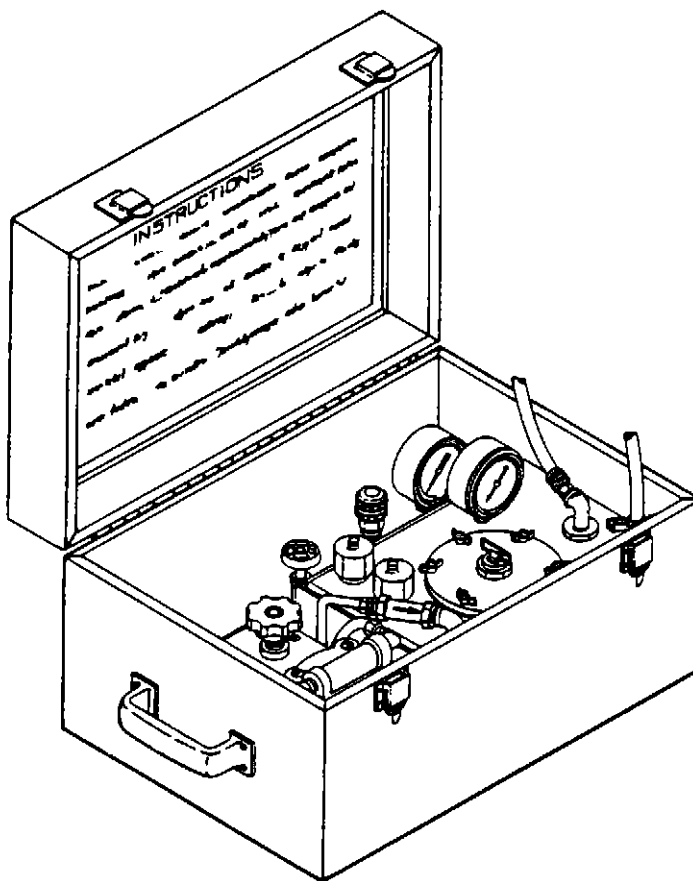


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- (b) After complying with all tank safety precautions in Fuel System - Maintenance Practices, 28-0, enter tank and observe suspected leak area for indication of dye.

CAUTION: MONITOR DYE CONTAINER GAUGE AND EQUIPMENT WHILE IT IS IN POSITION.

- (c) Continue dye pressure application as long as required to allow dyed fuel to travel leak path.
- (d) When dye appears inside tank, mark point of appearance.
- (e) Trace possible leak path or paths and locate possible seal plane penetration. A sketch of possible leak paths should be made to aid in coordinating sealing repair and prevent the possibility of overlooking an isolation, or prepack seal in the structure.
- (f) If dye injection method fails to locate leak, try the vacuum and dye method.



Leakage Tracing Device
Figure 103



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F. Vacuum and Dye Method

- (1) The vacuum and ultraviolet light method is one of the most accurate methods of locating the leak source on the inside of the tank. When the ultraviolet light is not available a color dye may be used instead of fluorescent dye as a leak tracer.

CAUTION· THE VACUUM AND DYE METHOD SHOULD BE USED ONLY AFTER ALL OTHER METHODS HAVE FAILED.

NOTE· The vacuum and dye method, is not normally required in the tracing of leaks designated as Heavy Seep or Running Leak. See paragraphs 6.C., 6.D., and 6.E. for methods recommended for these leaks.

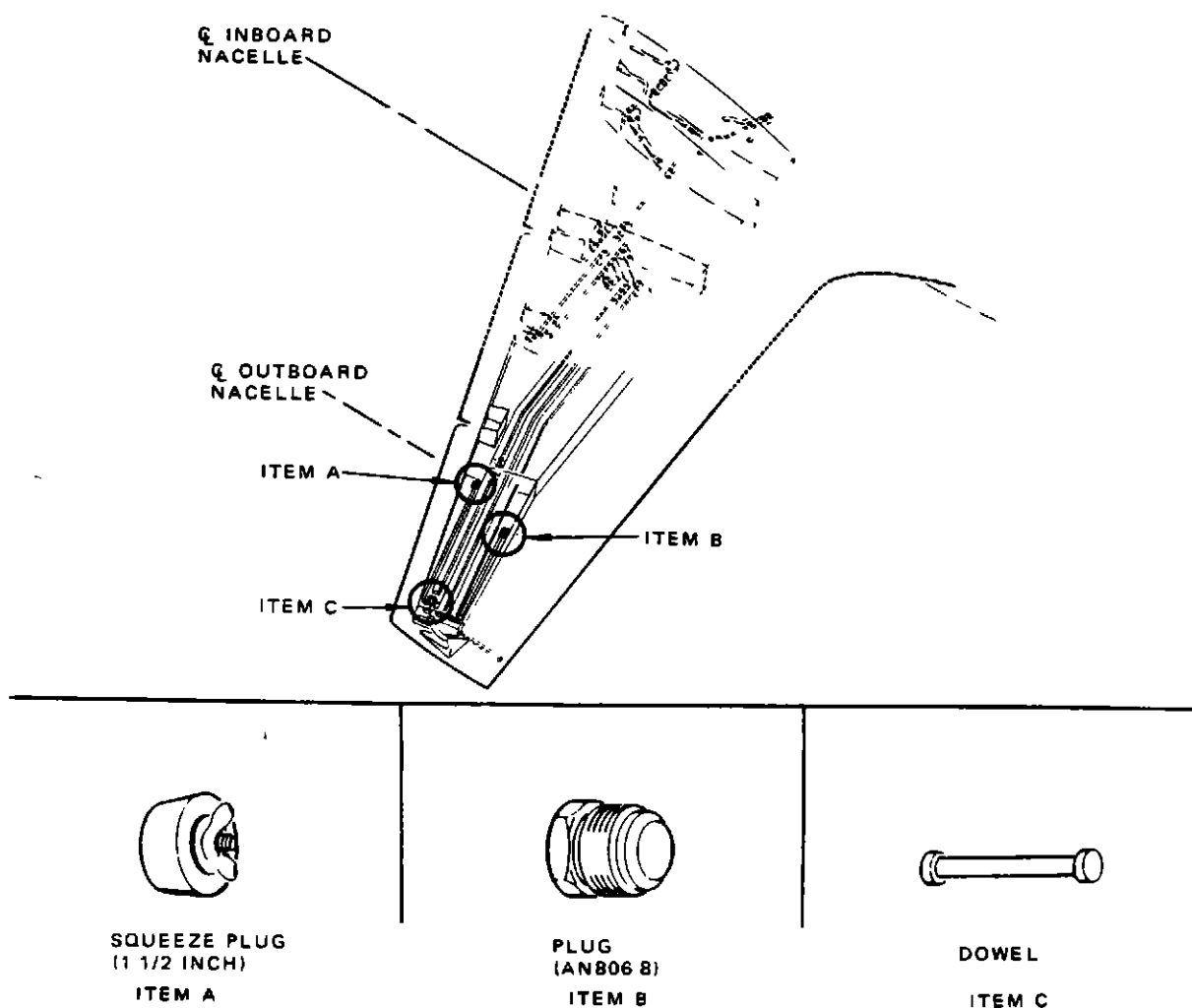
(2) Prepare for Leak Check - Pressure or Vacuum Method

(a) Prepare Reserve Tank No. 1 or 4. (See figure 104.)

- 1) Defuel reserve tank No. 1 or 4. Refer to Fuel System - Maintenance Practices, 28-0.
- 2) Close applicable reserve tank transfer valve
- 3) Close applicable reserve tank fueling manual shutoff valve.
- 4) Purge tank as given in Fuel System - Maintenance Practices, 28-0.
- 5) Before entering tank comply with Fuel System - Maintenance Practices, 28-0, on wetted fuel tank entrance precautions.
- 6) Remove fuel tank access panel No. 15 to gain access to reserve tank vent tube.
- 7) Block end of reserve tank vent tube with 1-1/2 inch squeeze plug (item A)
- 8) Remove fuel tank access panel No. 22 and enter tank to gain access to vent float valve.
- 9) Remove check valve and cap end of surge tank drain line with AN806-8 plug (item B).
- 10) Manually close vent float valve and prop in closed position using suitable length of 1 inch dowel, rubber capped on each end (item C).
- 11) Remove air blower equipment from tank.
- 12) Install tank test panel (figure 107) in any access opening No. 15.

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- 13) Install all other tank access panels.
 - 14) Install fueling overwing port cap
 - 15) The tank is now ready for leak testing by pressure or vacuum method.
- (b) Prepare Main Tank No 1 or 4. (See figure 105)
- 1) Close applicable reserve tank transfer valve.
 - 2) Close No 1 or 4 engine fuel shutoff valve.
 - 3) Close tank No. 1 or 4 fuel manifold valve.



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Reserve Tanks No. 1 and 4 Closure Plugs
Figure 104

28-2-0
Page 111

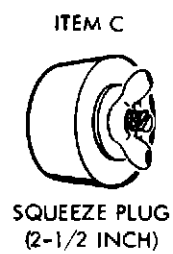
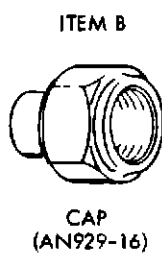
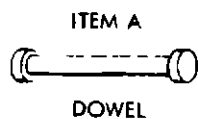
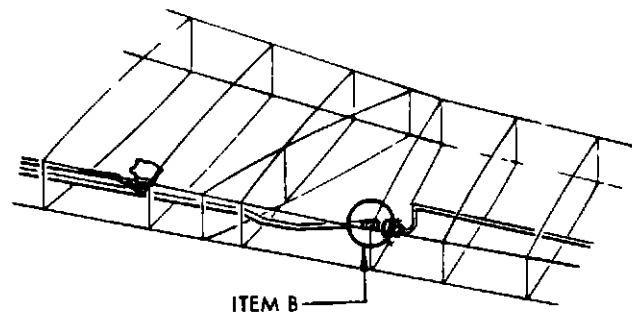
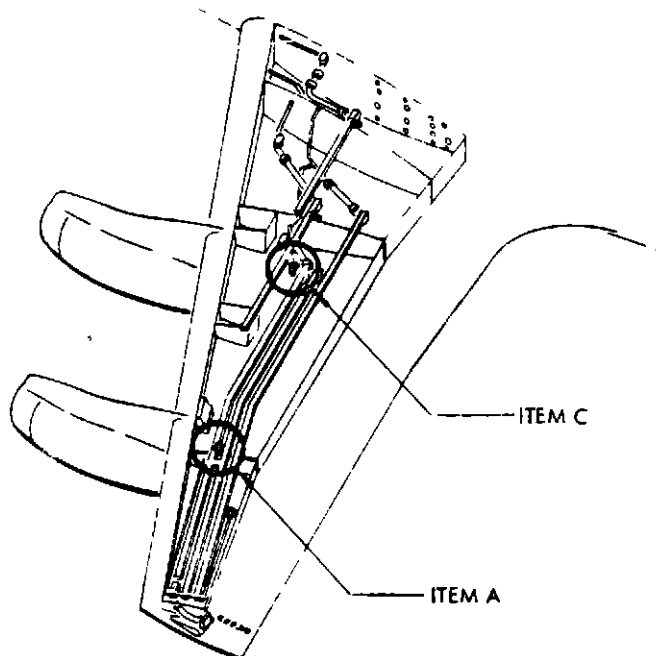


MAINTENANCE MANUAL

- 4) Check that main tank No. 1 or 4 fuel dump valve is in closed position.
- 5) Close main tank No. 1 or 4 fueling manual shutoff valve.
- 6) Defuel applicable tank. Refer to Fuel System - Maintenance Practices, 28-0.
- 7) Purge No. 1 or 4 tank.
- 8) Before entering tank comply with wetted fuel tank entrance precautions.
- 9) Remove fuel tank access panel No. 14 to gain access to main tank No. 1 or 4 vent float valve.
- 10) Manually close vent float valve and prop in closed position using suitable length of 1 inch dowel, rubber capped on each end.
- 11) Disconnect pressure fueling line on inboard side of rib and cap end of line with AN929-16 (item B).
- 12) Remove fuel tank access panel No. 4, enter tank and remove structural members from rib access opening No. 10 and/or 11 to gain access to vent port elbow connection.
- 13) Disconnect elbow at first connection forward of vent duct. Remove seal ring from tube and replace with squeeze plug (item C). Reconnect vent tubing.
- 14) Replace all rib access opening structural members. Refer to Rib Access Openings, 28-2-11.

CAUTION· RIB ACCESS OPENING STRUCTURAL MEMBERS ARE PRIMARY STRUCTURE. IT IS IMPORTANT THAT ANY STRUCTURE REMOVED BE PROPERLY REINSTALLED

- 15) Remove air blower equipment from tank.
- 16) Install tank test panel (figure 107) in access opening No. 4.
- 17) Replace all other fuel tank access panels.
- 18) Install fueling overwing port cap.
- 19) Tank is now ready for leak testing by pressure or vacuum method.



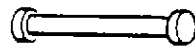
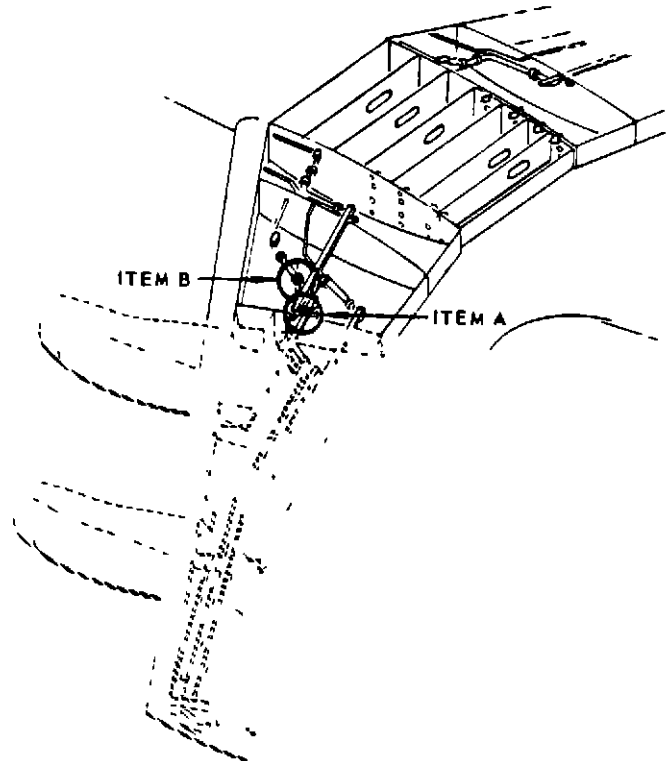


MAINTENANCE MANUAL

- (c) Prepare main tank No. 2 or 3. (See figure 106.)
- 1) Close No 2 or 3 engine fuel shutoff valve.
 - 2) Close main tank No. 2 or 3 fueling manual shutoff valve
 - 3) Determine that main tank No. 2 or 3 fuel dump valve is closed.
 - 4) Defuel tank No. 2 or 3. Refer to Fuel System - Maintenance Practices, 28-0.
 - 5) Purge No 2 or 3 tank.
 - 6) Before entering tank comply with wetted fuel tank entrance precautions. Refer to Fuel System - Maintenance Practices, 28-0.
 - 7) Remove fuel tank access panel No. 3 and enter tank.
 - 8) Gain access to fuel vent float valve by removing structural members over rib access opening No. 9.
 - 9) Manually close vent float valve and prop in closed position with suitable length of 1 inch dowel, rubber capped on each end (item A)
 - 10) Gain access to vent port elbow connections by removing structural members from rib access openings No. 6, 7, and 8.
 - 11) Disconnect elbow forward of vent duct. Remove seal ring from tube and replace with squeeze plug (item B).
 - 12) Replace all rib access opening structural members. Refer to Rib Access Openings, 28-2-11.
- CAUTION:** RIB ACCESS OPENING STRUCTURAL MEMBERS ARE PRIMARY STRUCTURE. IT IS IMPORTANT THAT ANY STRUCTURE REMOVED BE PROPERLY REINSTALLED.
- 13) Remove air blower equipment from tank.
 - 14) Install test panel (figure 107) in access panel opening.

MAINTENANCE MANUAL

- 15) Replace all other fuel tank access panels.
- 16) Install fueling overwing port cap.
- 17) Tank is now ready for leak testing by pressure or vacuum method.



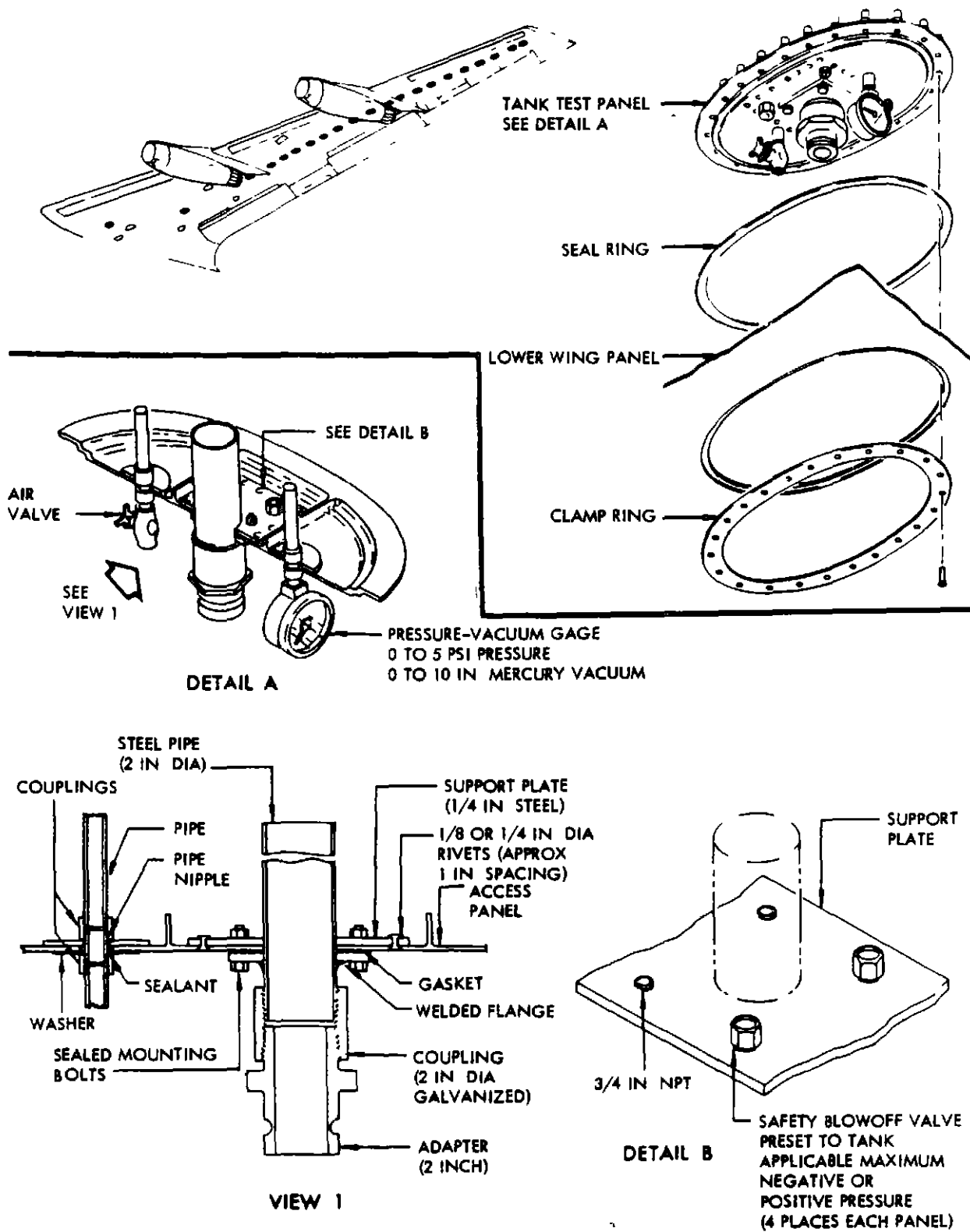
DOWEL

ITEM A



SQUEEZE PLUG
(2-1/2 INCH)

ITEM B



Integral Fuel Tank Test Panel
Figure 107

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MAINTENANCE MANUAL

(3) Perform Leak Check

- (a) Apply dye solution with a camel hair brush or syringe to the external leak point. On the upper surface a dam may be formed with putty to support the dye mixture for prolonged leak test, or a plastic bag full of dye may be taped on the lower surface to keep the external leak point covered.
- (b) Connect safety relief manometer to the tank test door. (See figure 108.)

WARNING. MAKE SURE THAT SAFETY RELIEF MANOMETER OPERATES SAFELY BY BLOWING INTO MANOMETER HOSE AND NOTING THAT WATER LEVEL FLUCTUATES. CHECK THAT OPEN END OF MANOMETER IS COMPLETELY FREE OF ANY OBSTRUCTION.

- (c) Connect vacuum hose to air valve on tank test door.
- (d) Fill manometer with water to height H corresponding to test pressure.

NOTE: Use of colored water or a small floating ball facilitates observation of water level in manometer. Antifreeze solution may be used when pressure checking in very cold weather.

CAUTION: DRAIN MANOMETER COMPLETELY IMMEDIATELY AFTER PRESSURE CHECKING IN COLD WEATHER. MAKE CORRECTION TO WATER COLUMN HEIGHT WHEN USING ANTIFREEZE SOLUTION.

- (e) Open air valve to apply vacuum. Observe water level and partially close air valve to slow down movement of lower level as it approaches lower bend of manometer tube.
- (f) Apply vacuum to tank for one hour and keep leak point wet with dye for the first one-half hour.

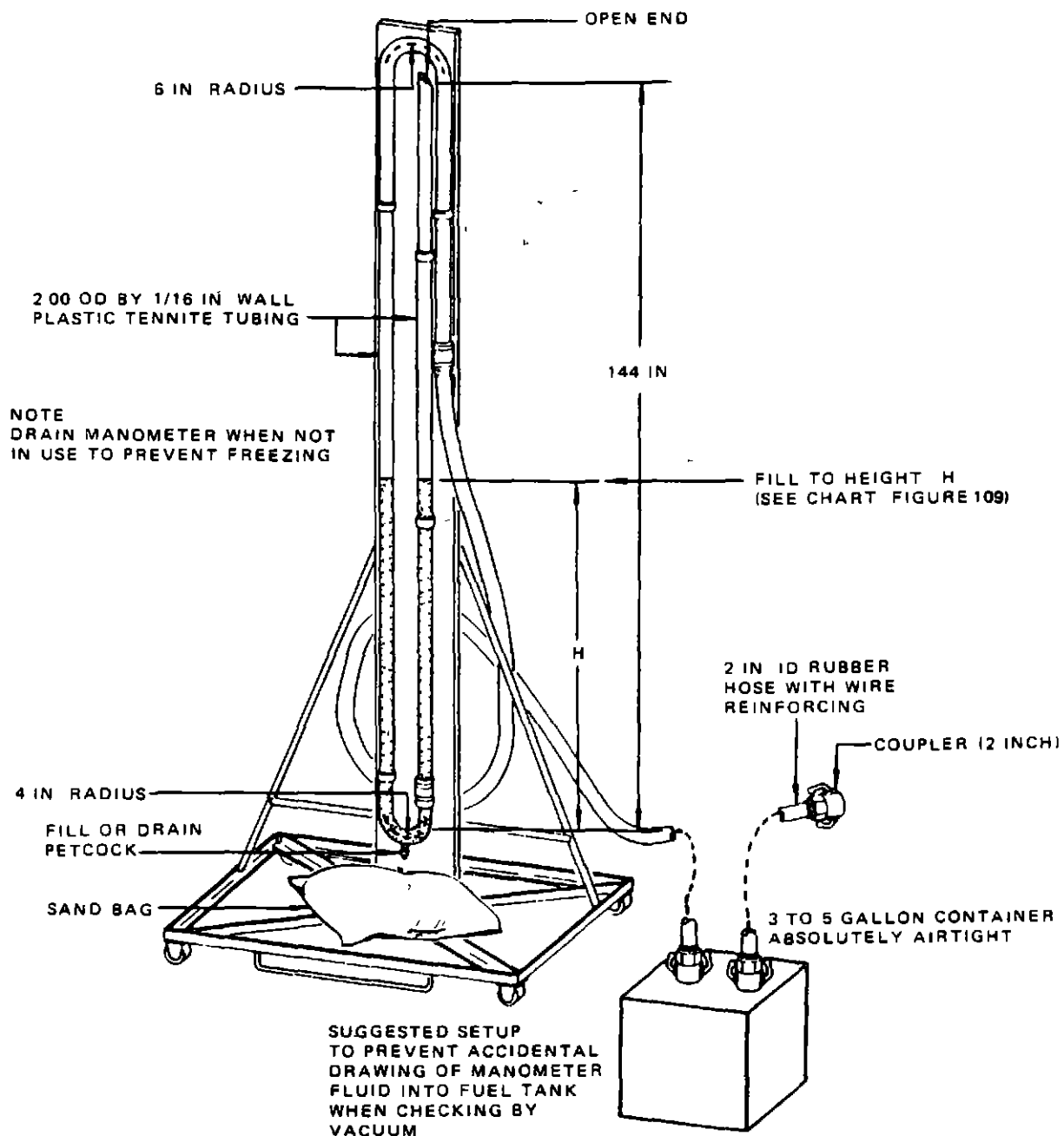
WARNING: DO NOT EXCEED THE MAXIMUM SAFE NEGATIVE PRESSURE OF MINUS 10 INCHES OF WATER.

- (g) Close air valve as soon as the lower level passes the bend. The upper level should not reach open end or upper bend of manometer.

CAUTION: EXCESSIVELY RAPID VACUUM WOULD DRAW MANOMETER FLUID IN FUEL TANK.

- (h) Deleted

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MAINTENANCE MANUAL



Safety Relief Manometer
 Figure 108

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- (i) Deleted
- (j) Remove vacuum from tank and prepare for entry.

WARNING: OBSERVE ALL TANK ENTRY PRECAUTIONS AS DESCRIBED IN FUEL SYSTEM - MAINTENANCE PRACTICES, 28-0. ALL LIGHTS USED INSIDE FUEL TANKS MUST BE EXPLOSION PROOF.

- (k) Inspect the interior of the tank with an explosion proof ultraviolet light. Shannon OS-31 will glow an intense green and OS-80 will glow bluish-white.
- (l) If no fluorescent dye appears on inside of tank, a check should be made of suspected external leak point using the Internal Pressure and Bubble Method. If a new external leak point is found, the vacuum and dye method shall be repeated on the new leak point. If no new leak point is found, the vacuum and dye method shall be repeated on the original point using a longer time period under vacuum.
- (m) Mark leak point inside of tank.
- (n) A sketch of possible leak paths may be made. This will aid in coordinating sealing repair and prevent the possibility of overlooking an isolation, or prepack seal in the structure.
- (o) If the internal leak point is detected, refer to Integral Fuel Tanks - Approved Repairs for repair procedure.

G. Internal Pressure and Bubble Method

- (1) Where difficulty is experienced localizing leaks on the outside surface of the wing, the fuel tank may be pressurized and a bubble solution applied to the wing. Observation of the surface for bubbles, should reveal the external leak points.

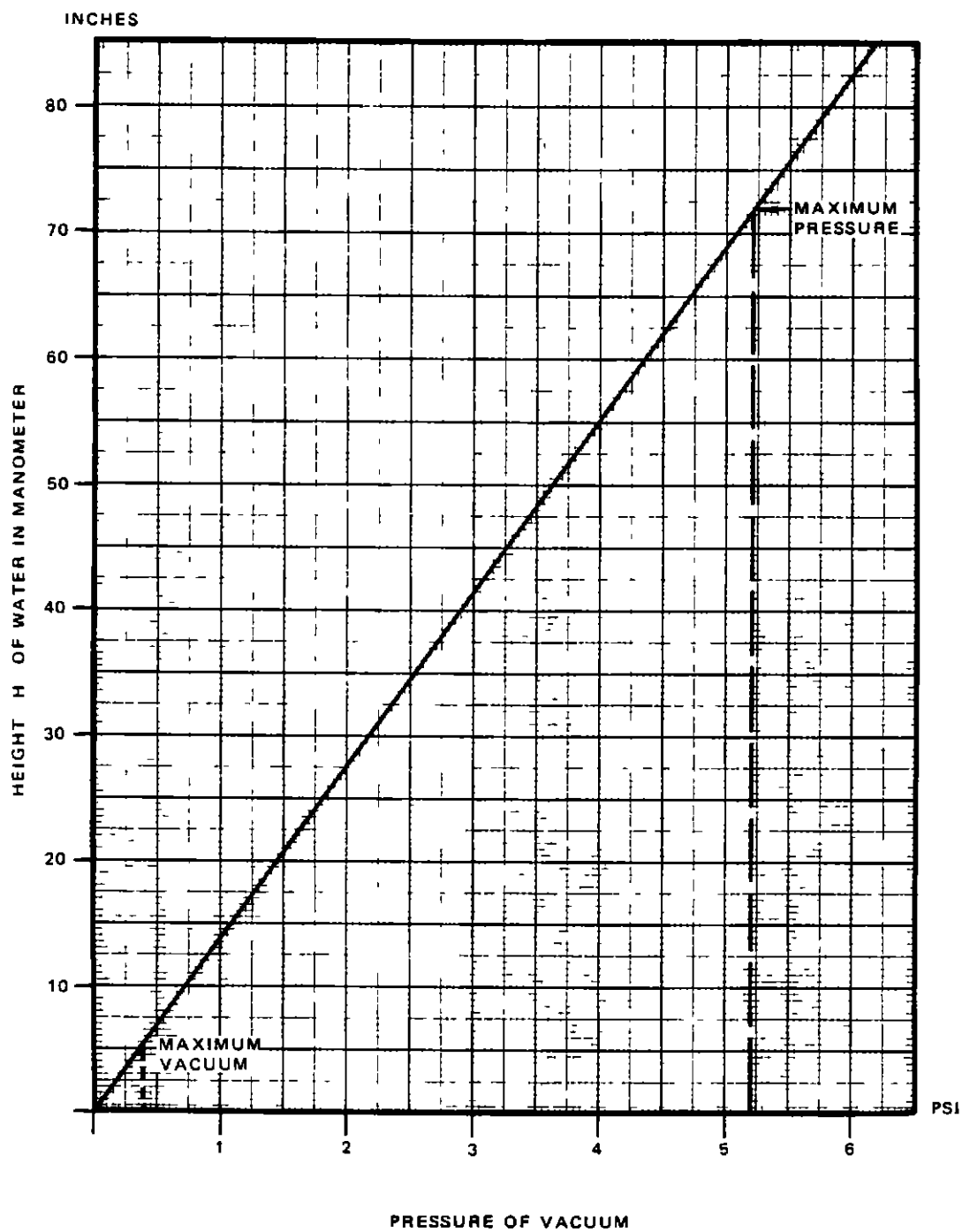
WARNING: THE TANK PRESSURIZATION METHOD OF ISOLATING A LEAK POINT SHOULD NOT BE TRIED UNTIL ALL OTHER METHODS HAVE BEEN APPLIED. OBSERVE ALL SAFETY PRECAUTIONS FOR TANK ENTRY AS DESCRIBED IN FUEL SYSTEM - MAINTENANCE PRACTICES, 28-0. DO NOT EXCEED MAXIMUM SAFE PRESSURE OF 5.20 PSIG.

NOTE: If the vacuum and dye method has just been completed, the tank would be almost ready for pressurization.

- (a) When the tank is properly pressurized, apply bubble solution to the exterior surface and watch for bubbles.

NOTE: Size of leak may be such that bubbles form very slowly. Patience and constant observation may be required to detect leak.

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Safety Relief Manometer Water Column - Pressure Chart
 Figure 109



MAINTENANCE MANUAL

- (b) Mark location of bubbles, remove bubble solution from surface with a damp rag, and depressurize the tank.
 - (c) Establish the internal leak source using one of the methods described in the preceding text.
- (2) Prepare Center Wing Tank Including Bladder Cells (Pressure Test Only) (See figure 110.)

CAUTION. THIS PROCEDURE PREPARES THE CENTER WING TANK FOR PRESSURE TEST ONLY DO NOT APPLY VACUUM (NEGATIVE PRESSURE) WHICH WOULD DESTROY BLADDER CELLS.

- (a) Check that both center wing tank fuel dump shutoff valves are closed.
- (b) Close both center wing tank fueling manual shutoff valves.
- (c) Defuel center wing tank. See Fuel System - Maintenance Practices, 28-0.
- (d) Remove center wing tank LH and RH fuel boost override pump access panels and place pump removal valve handles in CLOSED position.
- (e) Purge tank. See Fuel System - Maintenance Practices, 28-0.
- (f) Before entering tank comply with wetted fuel tank entrance precautions.
- (g) Remove LH fuel tank access panel No. 1.
- (h) Gain access to LH vent float valve by removing structural members over rib access opening No. 2.
- (i) Manually close vent float valve and prop in closed position using suitable length of 1 inch dowel rubber capped on each end (item A).
- (j) At tank end fitting for main tank vent drain line, disconnect fitting and install AN929A12, cap.
- (k) In same cavity, disconnect LH inboard vent port elbow forward of vent duct. Remove seal ring from tube and replace with squeeze plug (item C) to block vent duct.

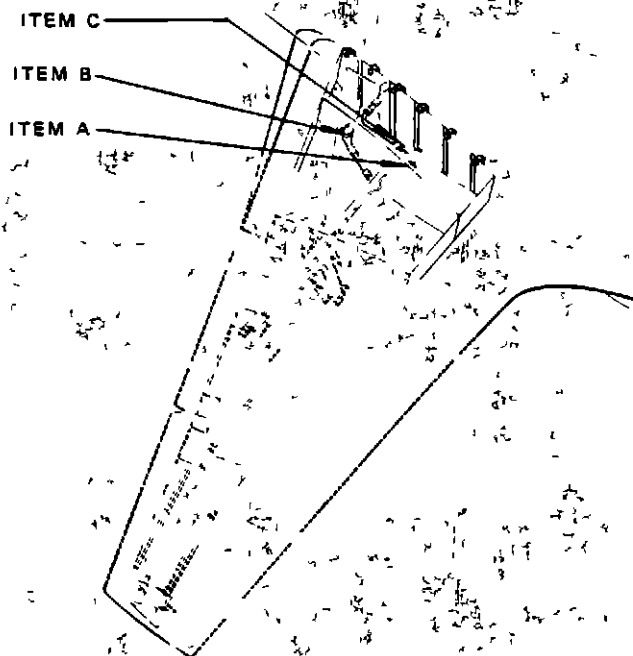


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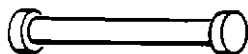
- (l) Replace all rib access opening structural members in left-hand integral section. Refer to Rib Access Openings, 28-2-11.

CAUTION: RIB ACCESS OPENING STRUCTURAL MEMBERS ARE PRIMARY STRUCTURE. IT IS IMPORTANT THAT ANY STRUCTURE REMOVED BE PROPERLY REINSTALLED.

- (m) Install LH fuel tank access panel.
- (n) Repeat steps (g) through (l) at center wing tank RH integral section.
- (o) Install tank test panel (figure 107) in RH access opening No. 1.
- (p) Remove air blower equipment from tank.
- (q) Install fueling overwing port cap at RH integral section. Tank is now ready for leak testing by pressure only.

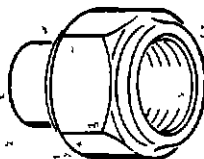


ITEM A



DOWEL

ITEM B



CAP
AN929A12

ITEM C



SQUEEZE PLUG (2 1/2 INCH)

Center Wing Tank Closure Plugs
Figure 110



MAINTENANCE MANUAL

H. Special Method for Use at Boost Pump Forgings

- (1) Leaks in boost pump forging areas can usually be found most readily by pressurizing the boost pump cavity. Proceed as follows:
 - (a) Prepare the tank for entry. Refer to Fuel System - Maintenance Practices, 28-0.
 - (b) Check that boost pump drain cock is closed.
 - (c) Check that boost pump removal valve is closed. On airplanes with screw operated valves, close valve by rotating screws counterclockwise. Refer to 28-7.

CAUTION: ALWAYS OPERATE THE SCREWS TOGETHER WITHIN ONE TURN OF EACH OTHER TO PREVENT DAMAGE TO THE FLAPPER.

- (d) Install boost pump cavity test door per figure 111.
- (e) Enter the tank and construct a dam around the boost pump. (See figure 111.)
- (f) Seal the construction with putty and fill with water.
- (g) Connect regulated air pressure supply with safety relief. The air supply should come either through a F71329 leakage tracing device or have a safety relief manometer fitted into the system. See figure 111.
- (h) Apply 5 psi air pressure to boost pump cavity.

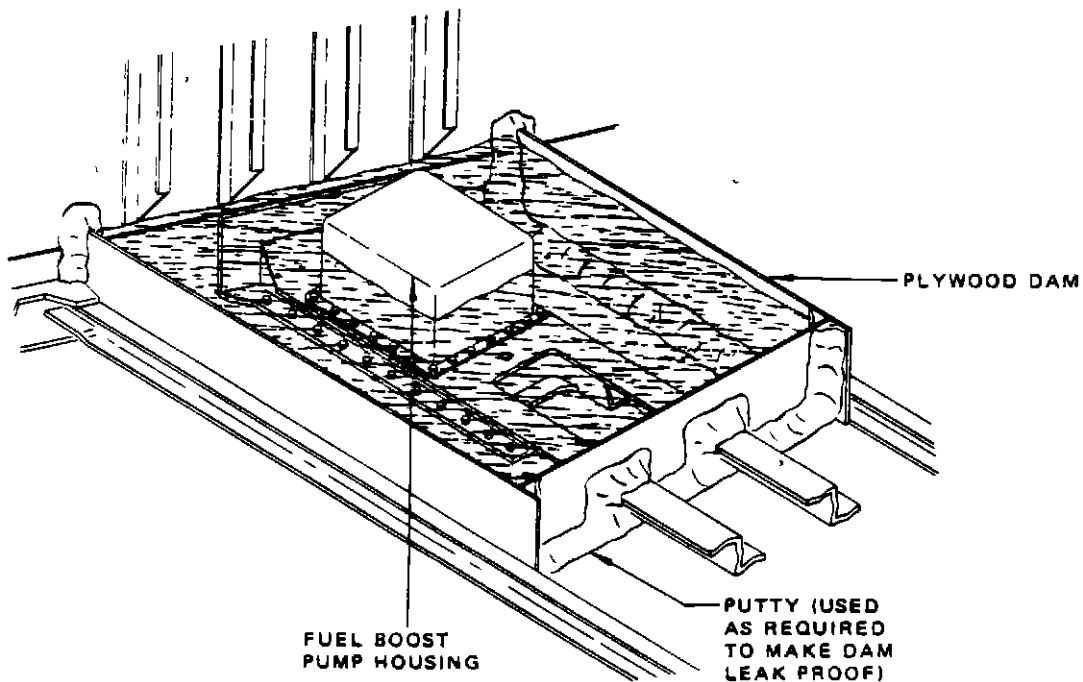
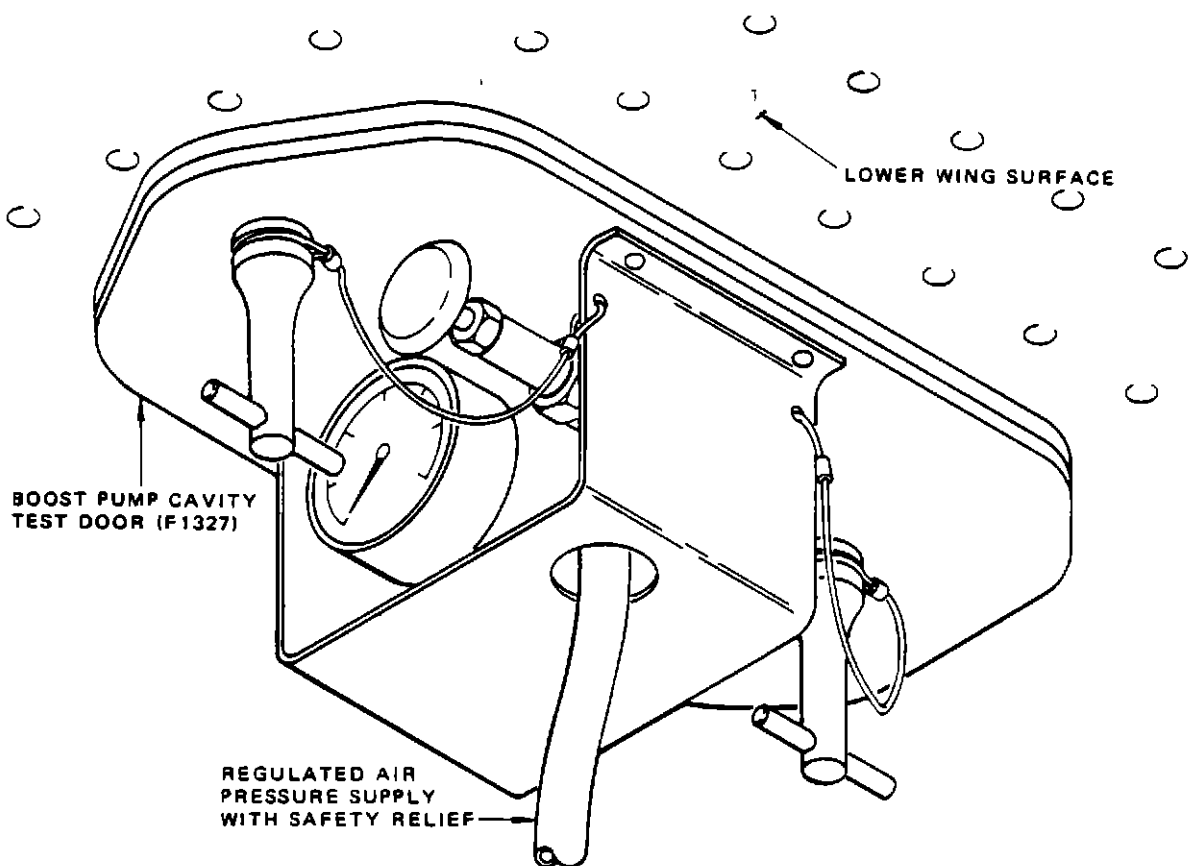
CAUTION: MONITOR THE EQUIPMENT AT ALL TIMES TO ENSURE THAT THE 5 PSI PRESSURE IS NOT EXCEEDED.

- (i) Observe water for bubbles and mark their location.

I. Hollow Bolt Methods for Use in Areas of Structural Buildup

- (1) Hollow Bolt - Air and Bubble Method. (This method should be tried before Hollow Bolt and Dye Injection Method.)
 - (a) Prepare the tank for entry. Refer to Fuel System - Maintenance Practices, 28-0.
 - (b) Remove a good fastener from area being checked. All removal and installation of fasteners to be in accordance with Structural Repair Manual.

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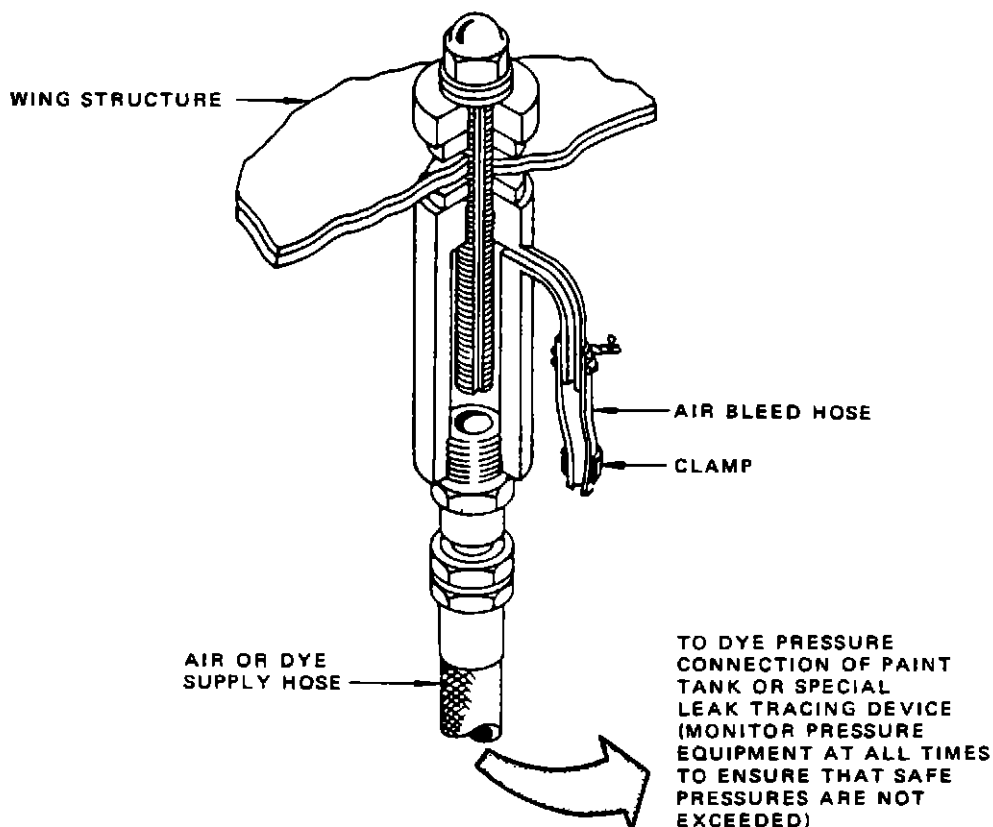
Leak Detection In Boost Pump Forging Areas
 Figure 111

MAINTENANCE MANUAL

- (c) Install hollow bolt fastener in fastener hole. (See figure 112.) Check that air bleed hose clamp is closed.
- (d) Connect regulated air pressure supply with safety relief The air supply should come either through a F71329 leakage tracing device or have a safety relief manometer fitted into the system.
- (e) Apply soap solution to suspected leak area inside tank.
- (f) Turn on air pressure to 4 psi.

CAUTION: MONITOR THE EQUIPMENT AT ALL TIMES TO ENSURE THAT THE 4 PSI PRESSURE IS NOT EXCEEDED.

- (g) Observe suspected leakage area inside tank for bubbles and mark their location. If results are not obtained within approximately 20 minutes, the soap solution should be wiped off and the following method tried.





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- (2) Hollow bolt dye injection method (to be used after unsuccessful attempt to locate leak by hollow bolt-air and bubble method).
 - (a) If leakage tracing device F71329 was used in previous test, follow instructions on box cover for applying dye pressure to the bolt. If substitute equipment was used, proceed as required to obtain the desired results.
 - (b) Suggested dyes are:
 - Red Dye - Oil Red O (solvent red No. 27)
 - Blue Dye - Brilliant Oil Blue EMS (solvent blue No. 16)
 - Shannon OS-31 (Flourescent - intense green)
 - Shannon OS-80 (Flourescent - bluish white)
 - NOTE: Dye mixtures are as follow:
Red and Blue dye - one ounce of dye to 100 gallons of fuel. A stronger solution may be used to facilitate leak detection.
Shannon OS-31 or OS-80 - one ounce of dye to one gallon of fuel
 - (c) When the dye appears in the tank, mark the point of penetration.

7. Leak Path Analysis

- A. After the external leak point and the internal leak source have been located, the point of seal plane penetration must be traced. The area where the bubble or dye appears internally should indicate the true point of seal plane penetration, except in the case of a failure of a hidden seal. In many cases the failure of an injection, prepack or hidden type of seal, will allow fuel to enter and travel within the structure to appear at a point quite distant from the leak source. Repairing the apparent leak area, where the bubbles or dye appear, and not the failed hidden seal may mean a temporary fix which will have to be redone frequently until the true point of penetration of the seal plane is located. To prevent this situation, a fuel leak should be studied for all possible leak paths between external and internal appearance points.

NOTE. As an alternative to repairing a hidden seal, the seal plane may be raised.



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- B. The seal plane is the barrier that prevents escape of the fuel from the tank. When this seal plane is penetrated the faying surfaces of all structure on the other side of the seal plane becomes wet. The wetted area extends in all directions from the point of penetration until it is stopped by an injection, faying surface or prepack type hidden seal. Fillet seals act as sides to a channel formed in the structure through which the fuel will flow. Since there are no seals on the other side of the seal plane, any fuel that has penetrated the seal plane will leak out where the least resistance exists. For instance, a row of fasteners in the channel may be wet, but the leak will appear at only one fastener. It has the least resistance. If the leaking fastener were sealed, then the fastener having the next least resistance will leak, and so on. Studying the leak path will show how the fuel got from the point of seal plane penetration to the outside. To get a thorough understanding of the leak, study the tank structure and sealant.



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INTEGRAL FUEL TANKS - CLEANING/PAINTING

1. General

A. Fungus growths present in hydrocarbon fuels attach to and corrode fuel tank sides. The fungus growths can be removed by entering the tank and hand scrubbing the tank sides with a fibre brush and water, or steam cleaning the tank as outlined in paragraph 4. The use of wet steam also helps to remove fuel fumes and to locate loose or deteriorated topcoating, which will peel or blister.

B. Detection of fungus

(1) When tanks are still wet, the presence of fungus may be evident as a black sludge or as a slimy material. When the tanks are dry, the presence of fungus may be evident as solid deposits on the tank surfaces. These deposits may also be black when wet, but turn light brown when dry. If fungus is present, it will most likely be found in the lower portions of the tanks, such as sump areas. The growth is usually limited to the lower panel of the wing and areas immediately adjacent to the lower panel where water may be expected to accumulate. The growths in turn, may contribute to corrosion of the structure. For removal of corrosion refer to Chapter 51, General Repair Procedures in Structural Repair Manual.

2. Equipment and Materials

A. Source of saturated steam

B. Source of cold water (at approximately 50 psi)

C. Steam outlet nozzle - trigger T-jet, Spraying Systems Co., 3203A Randolph St., Bellwood, Illinois, or equivalent

NOTE: It is recommended that the teflon bushing of this nozzle be replaced by a brass bushing which can be made locally. The nozzle is designed to have a source of saturated steam and a source of cold water attached and each supply is to be adjusted by a set of valves such that when the nozzle is opened, a working spray of 100 psi and with a temperature not to exceed 150°F can be maintained about 6 inches from nozzle end.

D. Full face supplied air type respirator, U.S. Bureau of Mines Approved

E. Rubber pants, boots and jackets

F. Asbestos gloves - Jackson Products, 31739 Mound Rd., Warren, Mich., or equivalent

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3 Precautions for Use of Wet Steam

- A. Operator should be protected with asbestos gloves, full face mask and asbestos or rubber hood.
- B. "Dead man" valve and second operator on steam line outside of tank.
- C. Ventilate tanks using air movers. Continue ventilation during tank cleaning to assist dissipation of steam vapors.
- D. Do not direct the steam at one place on the surface for any length of time. Several rapid passes are better than one slow pass. The speed of the pass over an area should be approximately 6 inches per second.
- E. Do not direct the steam at the feathered edge of the sealing compound as this tends to loosen the joint. Use a working spray of approximately 100 psi not to exceed 150°F at tank surfaces as prolonged concentration of heat on the sealant is very destructive.

4. Clean Integral Fuel Tanks

- A. Defuel and purge applicable tank. Refer to Fuel System - Maintenance Practices, 28-0.
- B. Remove fuel sump drain cock. Refer to Fuel Sump Drain Cock - Maintenance Practices, 28-1-51.
- C. Start at the outboard end of tank and work inboard directing the steam from the nozzle at an angle of approximately 45 degrees to, and at a distance of 6 to 10 inches from the surfaces being cleaned, floating the foreign material toward the inboard end and out the sump drain.
- D. Ensure that tank is free of all loosened fungus.
- E. Mop up all residual water.
- F. Ventilate with air movers and tank will normally dry in approximately 3 hours.
- G. Install fuel sump drain cock.
- H. Remove purging equipment.
- I. Check fuel tank for fungus damage. If repair is necessary, refer to the structural repair manual.
- J. Check fuel tank for sealant damage. If repair is necessary, refer to Integral Fuel Tank - Approved Repairs.
- K. Return airplane to normal condition by closing access panels.

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INTEGRAL FUEL TANK - APPROVED REPAIRS

1. General

- A After the fuel leak source has been located the method of repair must be decided upon. The following paragraphs describe a few typical repair methods.
- (1) Failed fillet or fastener seal - All faulty sealant material must be removed, surfaces thoroughly cleaned, and new sealant applied to produce a seal of the same size and shape as the original seal.
 - (2) Failed faying surface or prepack seal - Since repair to this type of seal requires disassembly of structure or removal of fasteners, all such removals must be accomplished as directed in the Structural Repair Manual. Another method of repair for this type of leak is to raise the seal plane. The new seal plane must completely isolate the failed seal from fuel, but the seal plane should not be raised any more than necessary as this can add an extensive amount of sealant, so in many cases structure removal and replacement is the best method.
 - (3) Failed injection seal - All faulty sealant material must be removed and channel must be thoroughly clean. Channels must be completely filled with sealant. Trapped air will cause a void and be cause for rejection of sealing job. As an option the failed injection seal may be repaired by raising the seal plane.

B. Handling and Curing of Sealant Materials

- (1) The importance of mixing, handling, and storing of sealants cannot be overemphasized. Any deviation from accepted procedures are not permitted, as poor sealing can cause the loss of airplane and personnel. Sealants must be thoroughly mixed with curing compound (accelerator) as directed on manufacturer's container. Brush type sealant should not be mixed before it is ready to be used as it has a comparatively short work life. When sealant is not being used it should be kept covered. Do not use any kind of thinner at any time.

WARNING· DO NOT COMPROMISE WITH INSTRUCTIONS. IF SEALANT DOES NOT GO ON SMOOTHLY, DISCARD IT AS FURTHER USE WILL CAUSE A POOR SEALING REPAIR.



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- (2) There are three classes of BMS 5-26 sealant.
 - (a) Class A - Sealing and repair material suitable for brush application.
 - (b) Class B - Sealing and repair material suitable for application by sealant gun or spatula.
 - (c) Class C - Use only as a faying surface sealant where a long squeeze-out life is required; suitable for application by sealant gun or spatula.
- (3) Dash numbers for class A and B material are used to designate the minimum application time in hours at 77°F (25°C) and 50 percent relative humidity.

Example: Class A-1/2 designates a brushable material having an application time of not less than 1/2 hour. Class B-2 designates an extrusion-gun material having an application time of not less than 2 hours.
- (4) Dash numbers for class C material designates the "squeeze-out" life in hours. (See figure 801.)
- (5) Squeeze-out Life of Sealing Compound
 - (a) Squeeze-out life is the maximum time interval allowed between the initial thaw-out of frozen material or mixing of nonfrozen material and the final fastening of the mating surfaces. (See figure 801.)

BMS 5-26 at 60° - 80°F (15.6° - 26.7°C) Temperature	
Class	Squeeze-Out Life
B-2	6 hours
B-4	12 hours
C-24	24 hours
C-48	48 hours

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(6) Storing Unmixed Sealing Compound

- (a) Unmixed packaged sealant stored longer than six months is outdated and should be retested prior to using. A satisfactory check for outdated sealant is to mix a container of base material with its curing compound (accelerator) and, at room temperature determine the time required for a sample application to become tack-free. Compare this time with the maximum allowable tack-free time given in figure 803. If this time exceeds the maximum allowable, sealant should be discarded. Sealant should be stored at temperatures between 35°F (17°C) and 80°F (26.7°C) for best results.

(7) Mixing Sealing Compound

WARNING SEALANT MATERIALS ARE HIGHLY TOXIC. ALL MIXING MUST BE DONE IN WELL VENTILATED AREAS

- (a) Mix only the amount of sealant required for the job to be done. A balance scale with graduated weights should be available for mixing unless the small kits with proper amount of curing compound (accelerator) and sealant in one package are used. All equipment used in the mixing process must be clean.

NOTE: Prior to mixing, determine what class of sealant is to be used in area of repair. Refer to 3.A (20)

- 1) Place amount of base compound to be used on scale and balance with weights.
- 2) Add to weights an additional amount of weight to give curing compound-to-base compound ratio as called out on manufacturer's sealant container
- 3) Balance scale by adding curing compound on top of base compound.

NOTE: Always use curing compound with base compound from same repair kit. Do not mix contents of one repair kit with that of another kit

- 4) Mix curing compound and base compound (minimum of 5 minutes) until sealant of solid uniform color is obtained. If mixing machine is not available use clean spatula.

CAUTION: AVOID INCORPORATING AIR INTO SEALANT DURING MIXING PROCESS.

- 5) Place sealant in tube or can which has been cleaned with MEK and sealant is now ready for use.



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(8) Storing Mixed Sealing Compound

- (a) Refrigeration may be used for prolonging the work life of mixed sealant providing the refrigerator is capable of maintaining temperatures of -20°F (-28.9°C) or lower. Freshly mixed material will keep in a usable condition for several days at -20°F , any leftover material must be discarded. Figure 802 shows the type of material, and length of time it can be stored at various temperatures. If HMS 5-26, Class B or Class C sealant is not used immediately it can be stored in a tube type container or sealing gun tube under refrigeration. After thawing, the sealant must not again be refrigerated. HMS 5-26, Class A sealant shall not be subjected to freezing temperatures and therefore cannot be stored.
- (b) Each container so stored must contain the following information.
- 1) Vendor's Designation
 - 2) HMS Designation, Class and Application Time of Material
 - 3) Vendor Batch Number
 - 4) Date of Mix and Expiration Date of Usage
 - 5) Mix Number
 - 6) Mixer's Identification

HMS 5-26 CLASS B AND C	
-20°F	-40°F
7 days	21 days



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(9) Sealing Compound Curing (See figure 803.)

- (a) BMS 5-26 sealant must be allowed to cure for a minimum time corresponding to the work time of the sealant before adding topcoating to adjacent structure. Ideal conditions for curing is a well ventilated area with ambient temperature of 77°F (25°C). Humidity is a very important factor in cure times and the relative humidity in the area should be known at all times during operations are in progress. Desired relative humidity is 50 (± 5) percent. Humidity below 40 percent will retard curing so that it may be necessary to circulate moistened warm air 120°F (49°C) maximum over the sealed area, or prewarm structure to be sealed, or both. Any water added to the air to increase humidity must contain less than 100 parts per million total solids and less than 10 parts per million of chlorides. Curing time may be reduced by using the above means or by applying an overcoat of BMS 5-26, Class A-1/2, over the finished seals.

WARNING: USE OF WARM AIR IS EXTREMELY DANGEROUS UNLESS ALL SAFETY PRECAUTIONS ARE OBSERVED. NEVER START OR STOP AIR BLOWER WITH AIR HOSE INSIDE FUEL TANK.

CAUTION: SEALANT SHALL NOT BE APPLIED WHEN TEMPERATURE OF STRUCTURE IS BELOW 50°F (10°C) OR ABOVE 140°F (60°C).

BMS 5-26			
DASH NUMBER	CLASS A		
	WORK TIME (HOURS)	TACK-FREE TIME (HOURS)	CURE TIME (HOURS)
-1/2	1/2	12	45
-2	2	36	72
DASH NUMBER	CLASS B		
	WORK TIME (HOURS)	TACK-FREE TIME (HOURS)	CURE TIME (HOURS)
-1/2	1/2	12	45
-2	2	36	72
-4	4	48	90
DASH NUMBER	CLASS C CURING RATE		
-24	7 DAYS		
-48	14 DAYS		

NOTE: TIMES SHOWN ARE BASED ON 50 (± 5%) RELATIVE HUMIDITY AND 77° ± 2°F (23.9° - 26.1°C) TEMPERATURE.



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- (b) Using the table in figure 803 with relative humidity kept constant, times vary according to temperature in that for every 20°F (11.1°C) rise, the tack-free and cure times are approximately one-half as long and for every 20°F drop, the tack-free and cure times are approximately doubled.

NOTE: If sealing is being accomplished where the humidity is exceedingly high, the temperature of the metal surface being sealed must exceed the ambient temperature to prevent condensation of water on surface to be sealed. Surface to be sealed must be dry.

C. Handling and Curing of Topcoating Material

- (1) The mixing, handling, and storing of topcoating is of extreme importance. Any deviations from accepted procedures are not permitted. Topcoating has a very short pot life, therefore when not in use, keep the containers of mixed material tightly closed.
- (2) There are two types of topcoating:
 - (a) EC776SR - Sealant cannot be applied over this type. Area not to be topcoated must be masked off
 - (b) Finch 454-4-1 - Sealant can be applied over this type so no masking is necessary.
- (3) Storing Unmixed Topcoating Material
 - (a) Maximum storage life from date of manufacture for EC776SR is six months; for Finch 454-4-1 is twelve months
 - (b) Store Finch 454-4-1 at temperatures between 60°F (15.6°C) and 90°F (32.2°C).
 - (c) Store EC776SR at temperatures between 50°F (10°C) and 90°F (32.2°C).

(4) Mixing Topcoating

WARNING: TOPCOAT MATERIAL IS EXTREMELY TOXIC. ALL MIXING MUST BE DONE IN MECHANICALLY VENTILATED AREAS BY QUALIFIED PERSONNEL WEARING RESPIRATORS; PERSONS NOT WEARING RESPIRATORS MUST NOT BE ALLOWED IN AREA.

NOTE: All equipment and containers used during mixing must be clean and must not be lined or coated with organic material.

- (a) Finch 454-4-1 has a very short pot life, 8 hours at 75° ($\pm 5^\circ$) F, and should therefore be mixed in small batches. It is supplied in two component kits consisting of 3 parts, by volume, of base component (Finch 454-4-1) and 1 part by volume of catalyst (CA-109).

NOTE: Catalyzed coatings shall stand a minimum of one hour prior to application.

- 1) Mix the base component thoroughly. Agitate on a Red Devil Shaker or equivalent for 10 minutes prior to mixing.
- 2) While stirring, slowly add 1 part, by volume, of catalyst (CA-109) to 3 parts, by volume, of base compound.

NOTE: Always use materials from the same kit.

- 3) Mix the combined materials thoroughly before applying.
- 4) Up to 1 part by volume of thinner (TL-52) may be added to adjust viscosity
- 5) Immediately after mixing, mark the container with the date and hour of mixing and the date and hour the pot life expires.

CAUTION: MIXED TOPCOATING WHOSE POT LIFE HAS EXPIRED MUST NOT BE USED AND MUST BE DESTROYED DO NOT MIX MORE MATERIAL THAN WILL BE USED IN 8 HOURS.

NOTE: Containers of unmixed topcoating materials must be kept tightly closed, once opened the contents will gradually thicken and gel.

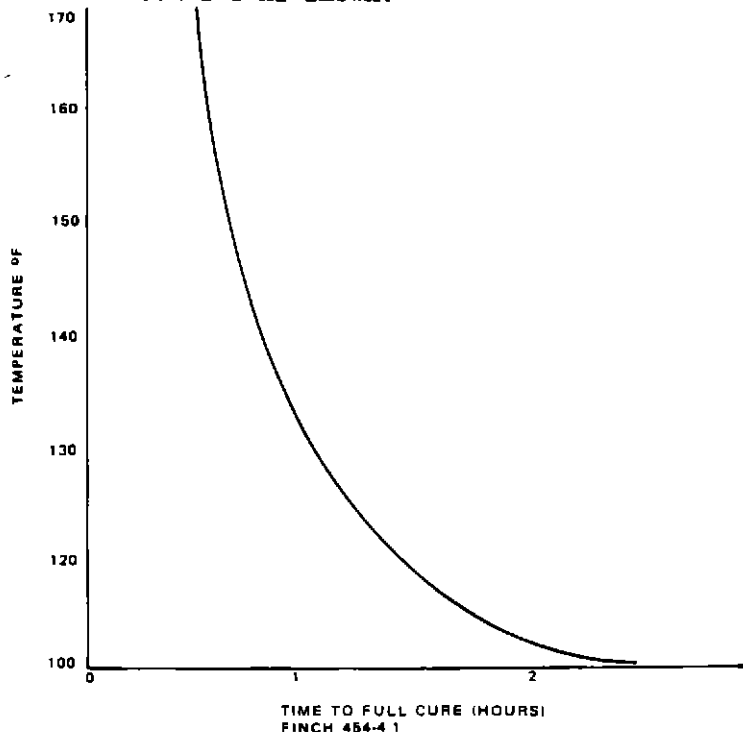
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(b) EC776SR

- 1) EC776SR shall be stirred to produce a uniform mixture immediately prior to application.
- 2) Mixing operation shall be performed in a designated area by approved personnel.
- 3) Care must be taken to avoid inclusion of air in the mix during stirring operation. Shaking on a paint shaker is not permitted.

(5) Topcoat Curing

- (a) EC776SR requires moisture in the atmosphere for complete cure. Finch 454-4-1 can be cured in dry atmosphere; however, all coatings need adequate ventilation during cure.
- (b) Maximum relative humidity during cure shall not be high enough to cause condensation.
- (c) For Finch 454-4-1
 - 1) Between coats - allow 30 minutes cure at ambient temperature or per the following chart. Allow the coating to flash off a minimum of 30 minutes prior to accelerated curing.
 - 2) Full cure of Finch coating may be accomplished under any of the conditions shown.



(d) For EC776SR

- 1) Between coats - allow at least 30 minutes and preferably 1 hour at ambient temperature before applying second coat.
- 2) Allow 8 hours drying time before handling or fueling tanks.

NOTE: Drying can be accelerated by circulating warm air 120°F (49°C) maximum over topcoated surface.

WARNING: USE OF WARM AIR SUPPLY IS EXTREMELY DANGEROUS UNLESS ALL SAFETY PRECAUTIONS ARE OBSERVED. NEVER START OR STOP AN AIR BLOWER WITH AIR HOSE INSIDE THE FUEL TANK.

2. Nonsealant Leaks Approved Repairs

A Equipment and Materials

- (1) Air blower (explosion proof), with sufficient flexible hose to reach all areas inside fuel tank. Capacity to be 90 to 100 cubic feet per minute
- (2) Exhaust fan (explosion proof centrifugal), with approximately 75 feet of 3-inch diameter flexible suction hose and sufficient delivery hose to carry exhausted air outside hanger or working area
- (3) Respirator (full face supplied air type) - U.S. Bureau of Mines approved
- (4) Sealing tool - fabricate per figure 807
- (5) Gasoline (white), VV-G-109
- (6) Naphtha, TT-N-95
- (7) Methyl Ethyl Ketone (MEK), TT-M-261
- (8) Petrolatum, VV-P-236
- (9) Rubber Cement, B.F. Goodrich No. 4

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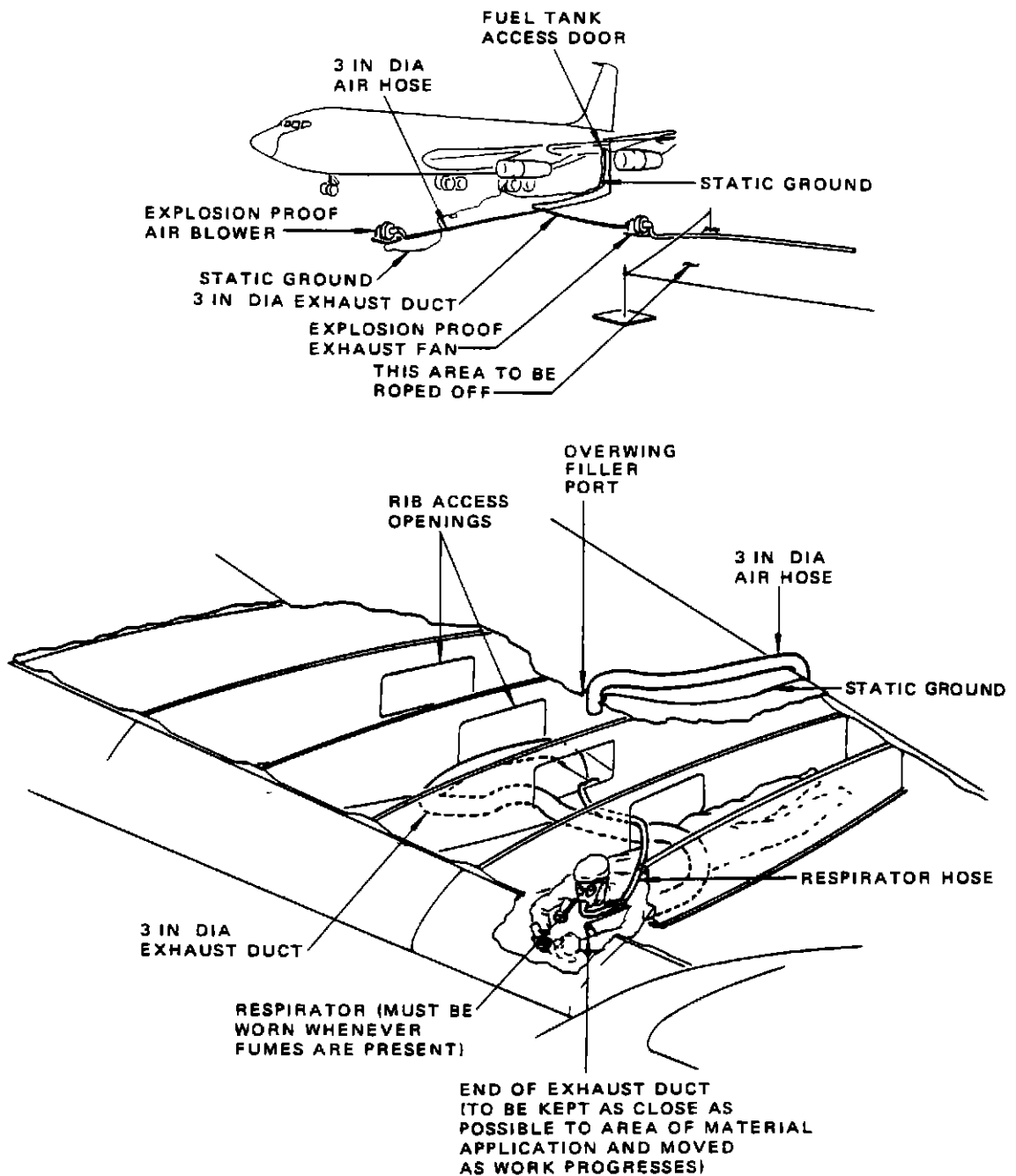
B. Prepare Tank for Nonsealant Leak Repair

- (1) Defuel and purge applicable tank. Refer to Fuel System - Maintenance Practices, 28-0.
- (2) Position air blower and exhaust fan at least 30 feet from open tank. (See figure 804.)
- (3) Insert end of supply hose from air blower into overwing filler port. Support end of hose as required with shot bags.
- (4) Insert sufficient suction hose into tank to enable end of hose to be located as close as possible to work area.
- (5) Position end of delivery hose from exhaust fan outside of hanger, downwind and clear of doorway.
- (6) Attach approved ground wire to all hoses in contact with airplane and ground to an approved grounding provision.
- (7) Start air blower and exhaust fan.
- (8) Enter tank taking in required tools and replacement parts, such as O-rings, gaskets, rivets, etc.

C. Repair of Nonsealant Leaks

- (1) O-rings are used to seal removable plumbing fittings, primary tension bolts, fuel tank access doors, and fuel system components which penetrate fuel tank walls. Some fuel tank access doors are sealed with a molded rubber seal ring, if any of these seals develop a leak the door should be replaced. If any O-ring seals develop a leak they should be replaced as follows:
 - (a) Install O-ring
 - 1) Obtain proper O-ring replacement. Ascertain that cure date is less than 48 months prior to current date.
 - 2) Remove used O-ring from assembly.
 - 3) Clean O-ring groove and flat surface of the two assembly parts with MEK and wipe dry with clean gauze. (See figure 805.)
 - 4) Examine O-ring groove and adjoining flat surface for cuts, scratches, dents, distortions, and foreign material. Defective fittings must be repaired or replaced.

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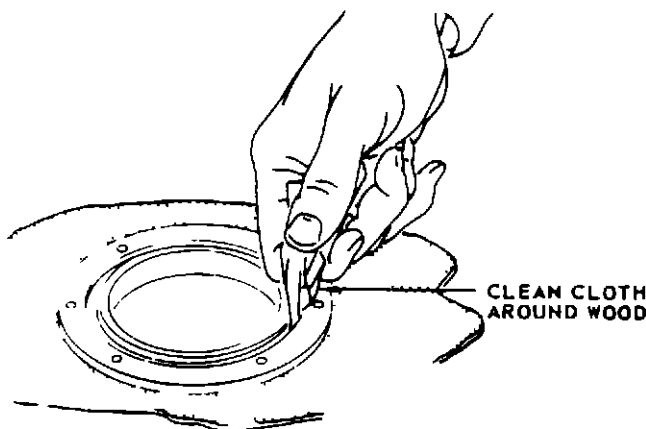
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- 5) Check new O-ring for defects, if defective discard it
- 6) Stamp rubber cure date of O-ring on assembly in which it is installed
- 7) Check O-ring fit in groove. See figure 806 for proper fit.
- 8) Install O-ring and assemble part
- 9) In the assembly of parts where difficulty is experienced holding an O-ring in position, it may be cemented into the groove as follows:

- a) Clean and examine parts as directed in steps 3) through 7)
- b) Apply a light coating of B.F. Goodrich No. 4 rubber cement.
- c) Apply a light coating of the same cement to the surface of the O-ring

NOTE B.F. Goodrich No 4 rubber cement can be thinned by adding white gasoline, VV-G-109 or naphtha, TT-N-95.

- d) When cement on O-ring and in the groove becomes "tacky," turn O-ring cement side down and press into groove



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e) Remove excess cement from flat surface of fitting by rubbing the thumb or finger over the surface. Cement will roll or peel off

f) Assemble parts.

NOTE: As an option a thin film of petrolatum VV-P-236 may be applied to O-ring.

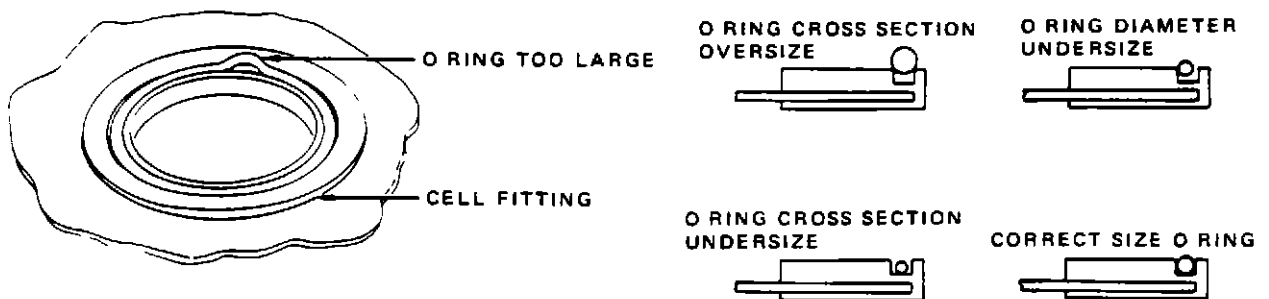
(2) Self-sealing rivets are used extensively in skin panels in the integral tank area. If a leak is discovered to originate at a rivet, the rivet should be replaced. Refer to Structural Repair Manual for removal and installation procedures. The presence of fuel around a rivet does not necessarily mean that particular rivet is leaking

(a) Temporary repair of self-sealing rivets.

NOTE: For fuel leaks at mechanically sealed rivets only

1) This method uses a locally fabricated tool, figure 807, with a rivet gun supplying pressure required to force sealant around leaking rivet.

- a) Strip paint from around leaking rivet using emery cloth or an approved chemical paint remover
- b) Clean tool and surface of wing with MEK. Do not touch surface with fingers after cleaning.
- c) Mark surface of wing to indicate position of tool during use.



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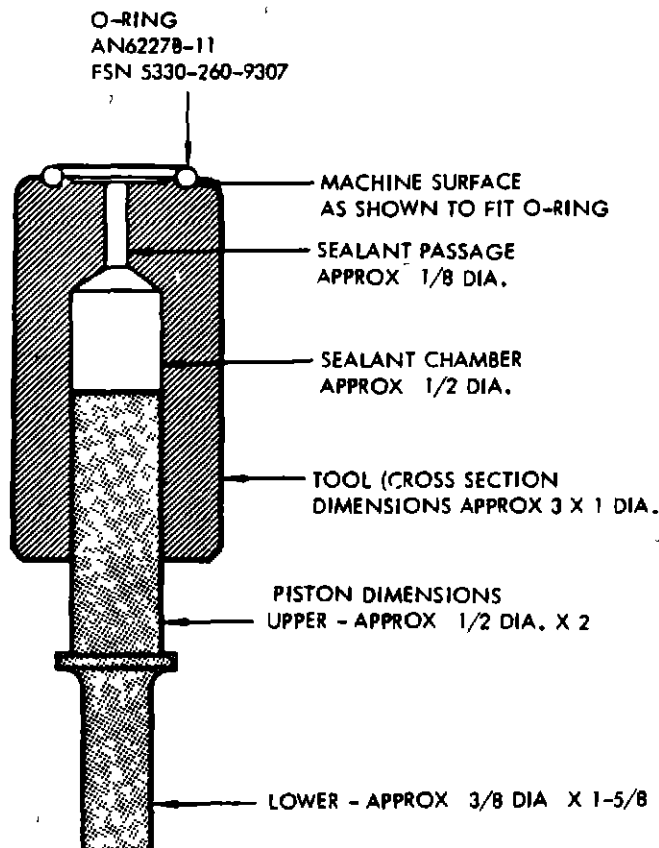
- d) Fill tool with prepared MIL-S-8802, Class A sealant.
- e) Insert tool into a small rivet gun.
- f) Place O-ring of tool on wing skin in marked location.
- g) Actuate rivet gun for several minutes to force sealant around leaking rivet.

CAUTION: ALWAYS KEEP TOOL PERPENDICULAR TO WING SKIN TO PREVENT SKIN DAMAGE.

- h) Check repair for leaks. If leak persists repeat the process and recheck. If rivet has to be replaced, refer to Structural Repair Manual.

NOTE: Rivets repaired by this temporary method should be permanently repaired next time fuel tank is entered.

- i) Clean sealant from tool and wing with MEK taking care not to disturb freshly sealed area.



Tool for Temporary Repair
Figure 807

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3. Sealant Leaks in Tank Structure Approved Repairs

A. Equipment and Materials

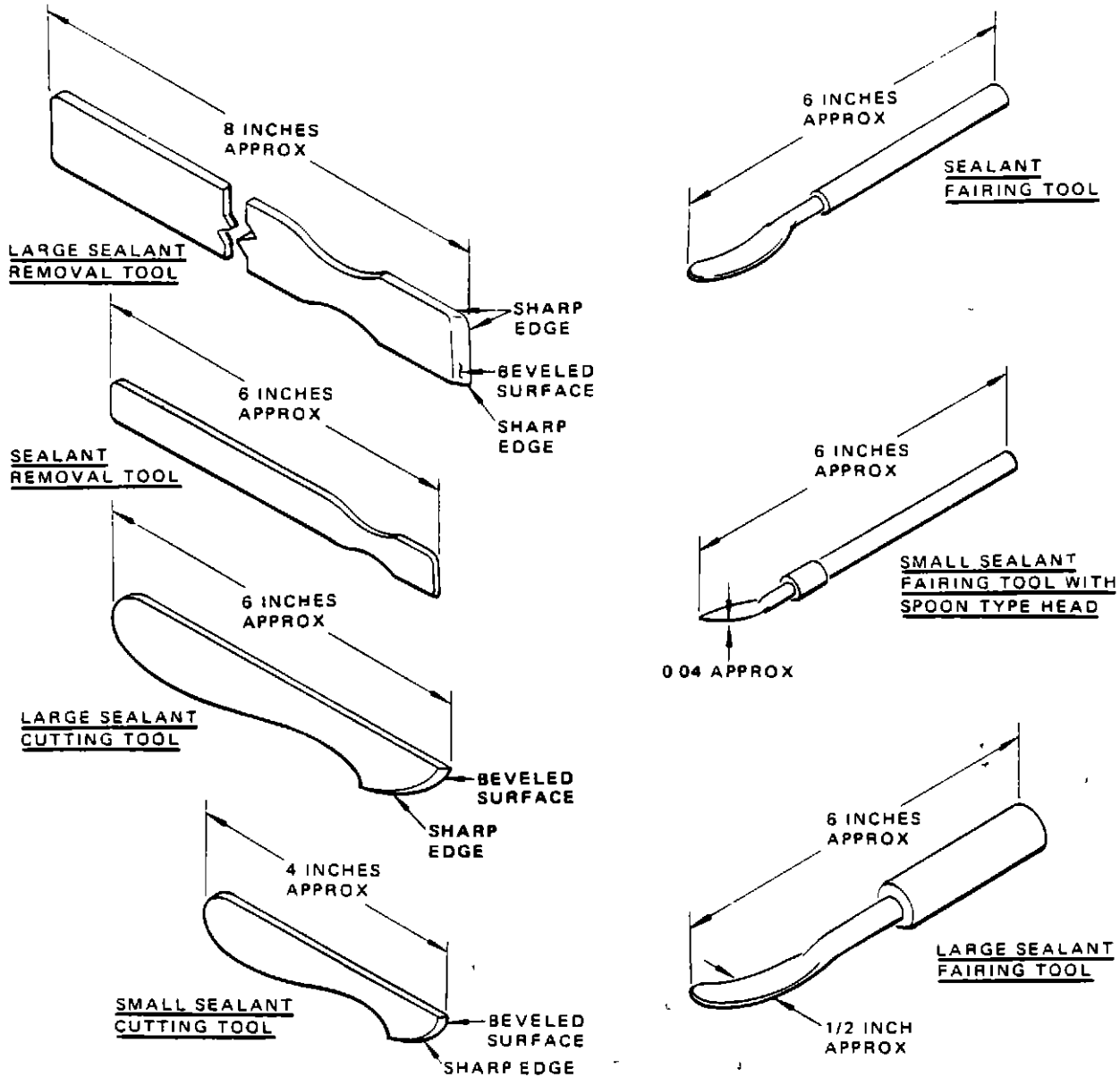
NOTE: All equipment used for application of sealing compound must be clean. It is essential that equipment be thoroughly cleaned after each sealing job. Two part compounds, those mixed with a curing compound (activator), will harden and make cleaning of equipment extremely difficult.

- (1) Air blower (explosion proof), with sufficient flexible hose to reach all areas inside fuel tank. Capacity to be 90 to 100 cubic feet per minute.
- (2) Exhaust fan (explosion proof centrifugal), with approximately 75 feet of 3-inch diameter flexible suction hose and sufficient delivery hose to carry exhausted air outside hanger or working area.
- (3) Funnel brush
- (4) Gauze pads (unsterilized) - all material shall contain less than 0.75% oil by carbon tetrachloride extraction.
- (5) Gloves (neoprene rubber)
- (6) Metal seal covers
- (7) Paint brushes
- (8) Pipe cleaners
- (9) Polyethylene wash bottles, nozzles, cartridges, and plungers
- (10) Respirator (full face supplied air type) - U.S. Bureau of Mines approved
- (11) Sealant fairing tools (See figure 808.)
 - (a) These tools may be made of 1/4 inch diameter bronze or steel welding rod and may be plated to improve the smoothness.
- (12) Sealant removal and cutting tools (See figure 808)
 - (a) These tools should be made of hardwood or metal no harder than 2024-T3 aluminum.

CAUTION: SPECIAL CARE WILL BE NECESSARY TO AVOID SCRATCHING TANK SURFACES IF CUTTING TOOLS ARE MADE OF 2024-T3.

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SEALANT REMOVAL AND CUTTING TOOLS

NOTE

THESE TOOLS SHOULD BE MADE OF HARDWOOD OR METAL NO HARDER THAN 2024-T3 ALUMINUM TO REDUCE THE POSSIBILITY OF DAMAGING THE STRUCTURE

SEALANT FAIRING TOOLS

NOTE

THESE TOOLS MAY BE MADE OF 1/4 INCH DIA BRONZE OR STEEL WELDING ROD AND MAY BE PLATED TO IMPROVE THE SMOOTHNESS

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- (13) Sealing gun
- (14) Abrasive paper - 320 grit or finer
- (15) Alodine 1200 Powder - Specification MIL-C-5541
- (16) Aluminum wool
- (17) Cement and Catalyst, Eastman 910
- (18) Cleaning Solvent (BMS 11-7)
- (19) Methyl Ethyl Ketone, TT-M-261
- (20) Sealant (BMS 5-26)
 - (a) Class A - For brush application
 - (b) Class B - For sealing gun application
 - (c) Class C - For sealing gun application

B Clean surface to be sealed.

WARNING: KEEP SOLVENTS AWAY FROM HEAT, SPARKS, AND OPEN FLAME USE WITH ADEQUATE VENTILATION. KEEP CONTAINERS CLOSED WHEN NOT IN USE. AVOID PROLONGED BREATHING OF VAPORS OR REPEATED CONTACT WITH SKIN

- (1) Surface to be sealed must be cleaned prior to application of sealing compound. Many impurities form a film over metal which is not visible but which prevents proper adhesion of sealant. For this reason even those surfaces which appear to be clean must be cleaned immediately prior to application of sealant.
 - (a) Remove all old sealant precoat with aluminum wool and MEK.
 - (b) Clean surface with MEK using clean bristle brush and gauze pads. Clean adjacent sealant and an area at least twice as wide as area to be covered by sealant.
 - (c) Apply MEK with saturated gauze pad then wipe dry with clean gauze pad. Repeat until drying gauze remains clean.



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- (d) Immediately prior to applying sealant, clean surface with EM-11-7 solvent and wipe dry.

CAUTION DO NOT ALLOW CLEANERS TO DRY ON SURFACE DO NOT TOUCH AREA WITH FINGERS

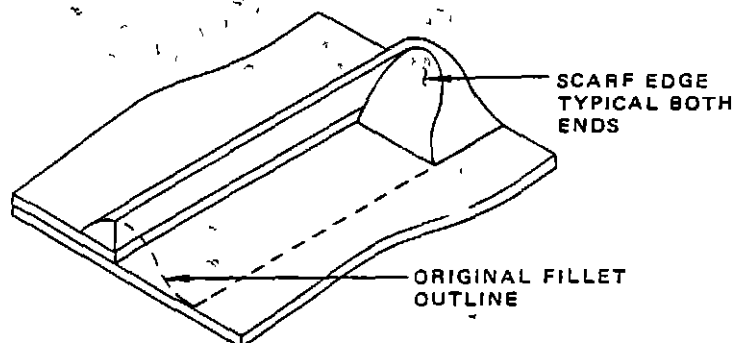
- (10) When repair is completed, leave tank immediately.
- (11) If more work is to be done in tank, leave exhaust duct end as close as possible to repaired area and continue to exhaust toxic vapors. If all work is completed, install tank access panels per Fuel Tank Access Panels, 28-2-1.

C Repairs to various type seals are given below

(1) Repair fillet seal

(a) Remove faulty sealant.

- 1) Provide sealant cutting tools similar to those shown in figure 808.
- 2) Cut faulty section from fillet as shown in figure 809. Slope cuts at ends of section so that new sealant will lap remaining portions of old fillet. Avoid abrupt changes in cross section.
- 3) Assure that all loose cuts or flaps are removed. If fillet adhesion is good, it is not necessary to cut sealant down to bare metal.



Fillet Seal Removal
Figure 809



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- (b) If surface to be resealed was damaged during removal of old sealant, it must be realodized before new sealant is applied.

WARNING: PERSONNEL MUST WEAR RESPIRATOR AND RUBBER OR NEOPRENE GLOVES WHEN USING ALODIZE SOLUTION. ALL RAGS OR PAPERS WHICH HAVE HAD CONTACT WITH ALODIZE SOLUTION SHOULD BE SOAKED IN WATER BEFORE DISCARDING.

- 1) Prepare alodize solution as follows
 - a) Measure 1 gallon of distilled water, or water having a solids content of less than 50 ppm, into a clean stainless steel container.
 - b) Add 3 ounces of Alodine 1200 powder Specification MIL-C-5541. (Roll the powder container to mix the ingredients thoroughly before using.)
 - c) Stir until powder is dissolved. A small amount of insoluble material may settle which can be disregarded.
 - d) Allow solution to stand at least 1 hour before use
- 2) Remove burrs or chips from surface and smooth out nicks or scratches.
- 3) Surfaces to be alodized must be cleaned with MEK.

WARNING: CLEANERS ARE HIGHLY TOXIC, CORRECT USE OF VENTILATING EQUIPMENT MUST BE ENFORCED.

- 4) Apply Alodine solution to cleaned metal surface by brush, swab, spray, swatches of saturated blotting paper, or a clean cellulose sponge.

NOTE: If solution does not spread smooth or evenly the metal surface is not properly cleaned.

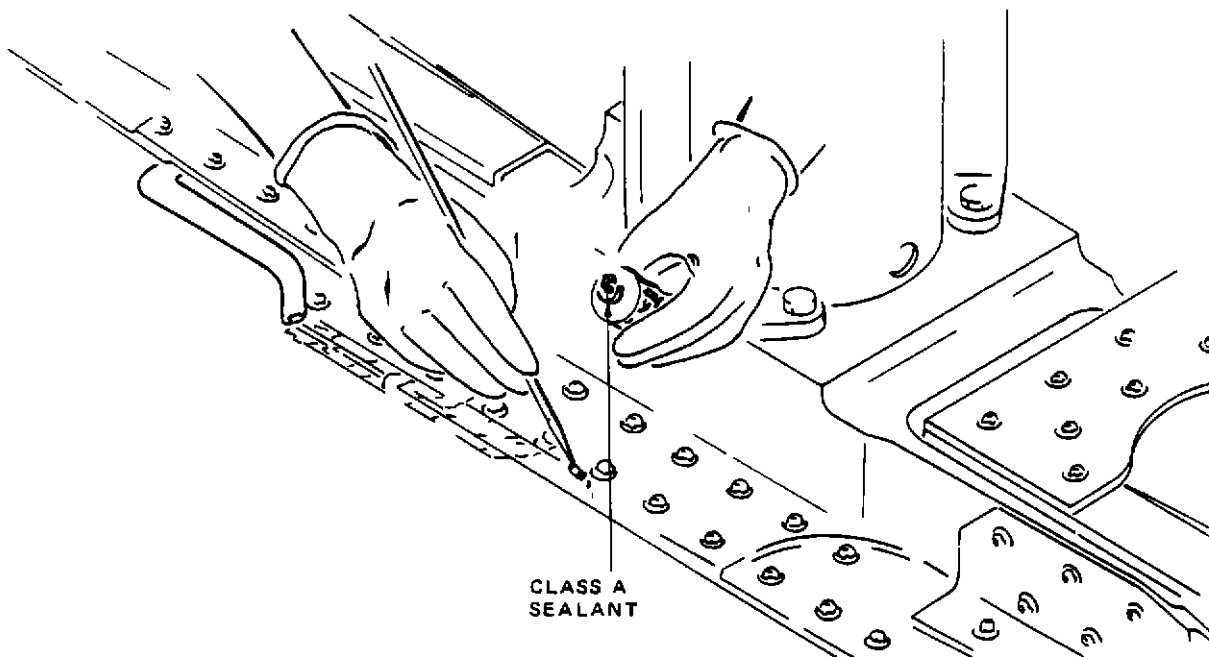
- 5) Maintain a continuous wet film on surface of work area until coating is formed, which may take 1 to 5 minutes, depending on temperature.
- 6) Remove excess Alodine solution by thoroughly flushing with clean water or gently wiping with wet soft cloths or sponges. Dry at ambient temperature.

- (c) Clean surface to be sealed. Refer to paragraph 3.B.

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(d) Apply new fillet seal.

- 1) Prior to fillet sealing, all fasteners in area to be sealed must be installed. All bolts torqued to their respective values as retorquing is not permitted after sealing. Use proper nozzle for sealing gun, small nozzle for small fillet and large nozzle for large fillet. To assure selecting the correct tools for the job to be done, set up a locally fabricated condition to simulate the job. This can usually be done with cardboard or similar material. Class B sealant is used for all fillet sealing following a precoat of Class A sealant.
- 2) Apply a precoat of properly accelerated Class A sealant to the surface with a stiff bristled brush. Scrub well into crevices and over entire length to be sealed. (See figure 810.) Precoat should cover an area one-half inch wide on each side of the seam. No ridges or voids are allowed.



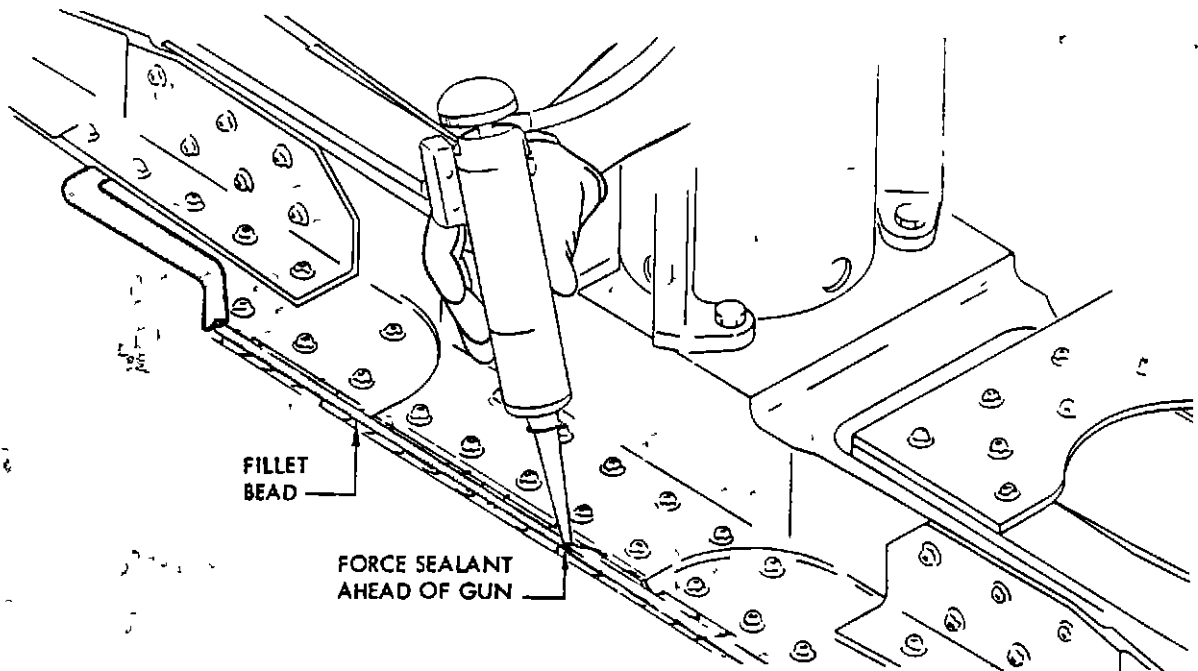
Application of Precoat
Figure 810



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- 3) With extrusion gun apply a small fillet of Class B sealant as shown in figure 811.
- 4) When a nozzle tip is used it shall be pointed into the seam and shall be maintained nearly perpendicular to the line of travel.

CAUTION: SEALANT MUST BE APPLIED CAREFULLY TO AVOID TRAPPING AIR IN FILLET. OPERATE GUN SO THAT A BEAD OF SEALANT IS CONTINUALLY FORCED AHEAD OF NOZZLE TIP IN THE DIRECTION OF NOZZLE TRAVEL.



Application of First Fillet
Figure 811

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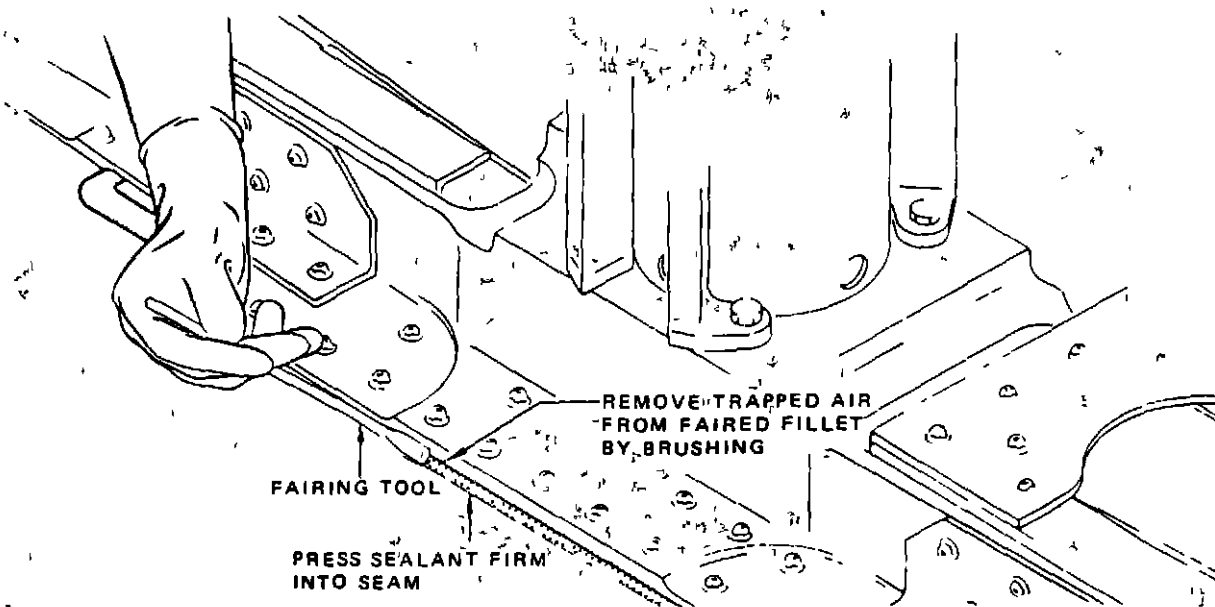
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- 5) Using a fillet fairing tool, press the first fillet firmly into position as shown in figure 812. Work the entire beaded section.

CAUTION: FAIRING TOOL MUST BE CLEAN. USE NO SOLUTION OR LUBRICANT TO MAKE IT SLIDE SMOOTHLY OVER SEALANT. WIPE TOOL FREQUENTLY WITH CLEAN GAUZE TO AID IN FAIRING OPERATION.

- 6) If first fillet has cured but is not clean, then it must be cleaned before application of a second fillet. Refer to paragraph 3.B.

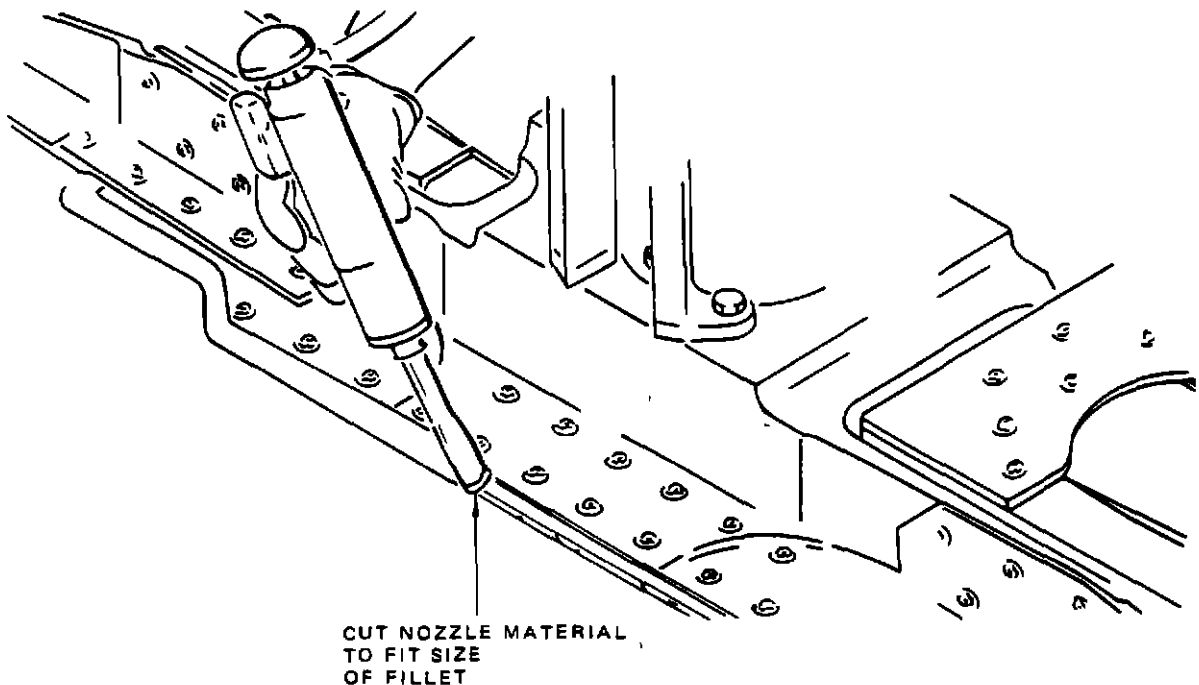


Pressing First Fillet Into Seam
Figure 812

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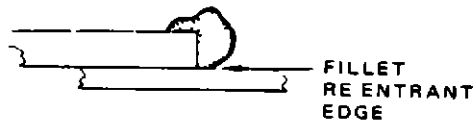
- 7) Apply second application of Class B sealant to produce a full bodied fillet as shown in figure 813. A larger nozzle will be required than was used for first fillet. If an extruded nozzle head is used, make cuts in nozzle to fit fillet and make it conform to dimensions given in figure 814. If extruded head nozzle is not used, use a fairing tool as required to make sealant conform to full-bodied fillet dimensions.

NOTE: Good sealant application requires patience as well as proper technique. Keep sealing gun nozzle close to work to prevent air bubbles. If a fillet extrusion head is used, it shall be pressed firmly against the part in such a position that maximum thickness of fillet will be directly over the edge.

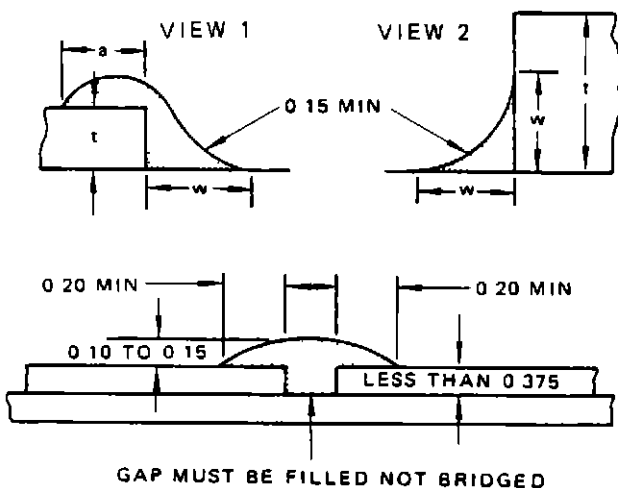


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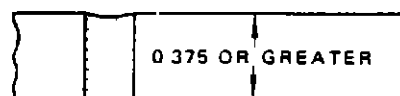
- 8) Work out any evident air bubbles.
- 9) Fillet re-entrant edges are not acceptable. (See figure 814.)
- 10) A typical finished fillet seal with dimensions is shown in figure 814.
- 11) Topcoat as required.



RE ENTRANT FILLETS



VIEW	t	w	a
1	0.040	0.25 TO 0.50	w t
1	0.125	0.25 TO 0.50	w t
1	0.250	0.35 TO 0.50	w t
2	0.375	0.35 TO 0.50	0
2	0.50	0.35 TO 0.50	0



Re-entrant Fillets and Dimensions of Full Bodied Fillet
Figure 814

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- (2) Repair fastener seals. (Refer to Structural Repair Manual for replacement of fasteners.)

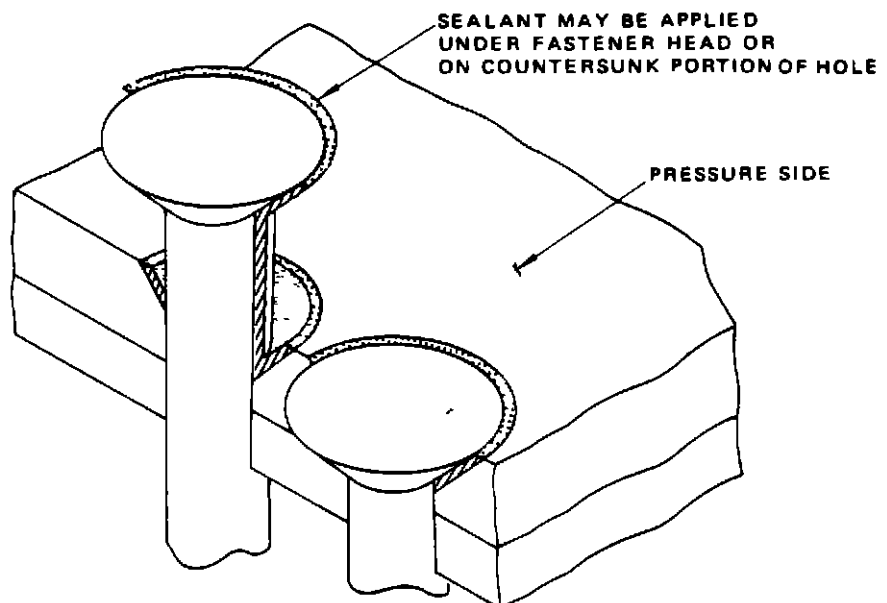
(a) Repair Underhead Sealed Fasteners

- 1) Underhead sealing is used to seal fasteners with countersunk heads which are not sealed by driving orientation, seal covers, seal ring washers, or fillet sealing. If a leak is discovered to originate at an underhead sealed fastener, the fastener must be removed and replaced. Replacement of fasteners must be conducted as directed in the Structural Repair Manual. The underhead seal is applied as follows:

- a) Clean fastener and countersunk portion of hole with cleaning solvent.
- b) Apply a coat of Class B sealant, approximately 1/32 inch thick, under fastener head or on countersunk portion of hole and install fastener immediately. (See figure 815.)
- c) Torque, drive, or pull fastener immediately following installation. When applying torque, nuts should be turned rather than bolts.

NOTE: Fasteners which are underhead sealed must not be retightened after the sealant has cured.

- d) Clean extruded sealant from flush face side





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(b) Temporary Repair of Underhead Sealed Fasteners

NOTE For fuel leaks at underhead sealed fasteners or mechanically sealed rivets only

- 1) The tool, fabricated locally, (detail A, figure 816) serves as a pressure chamber eliminating the need for cutting or drilling. The temporary repair shall be accomplished in the following manner:

- a) Clean surface of adapter using emery cloth if necessary.
- b) Strip paint from around leaking fastener by using emery cloth or an approved paint remover. Clean surface with MEK. Do not touch surface with fingers after cleaning.

WARNING: SUPPLY PLENTY OF VENTILATION WHEN USING MEK AS IT IS HIGHLY TOXIC.

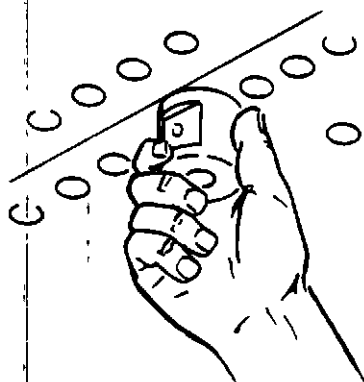
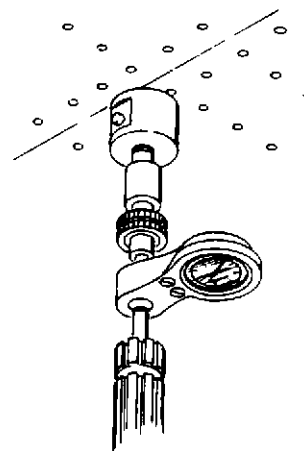
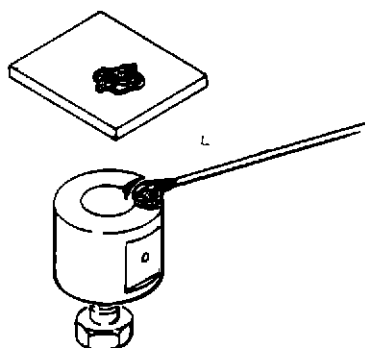
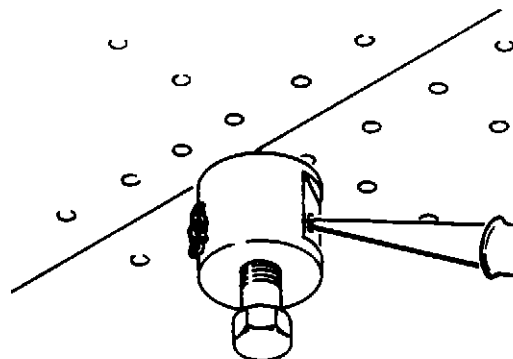
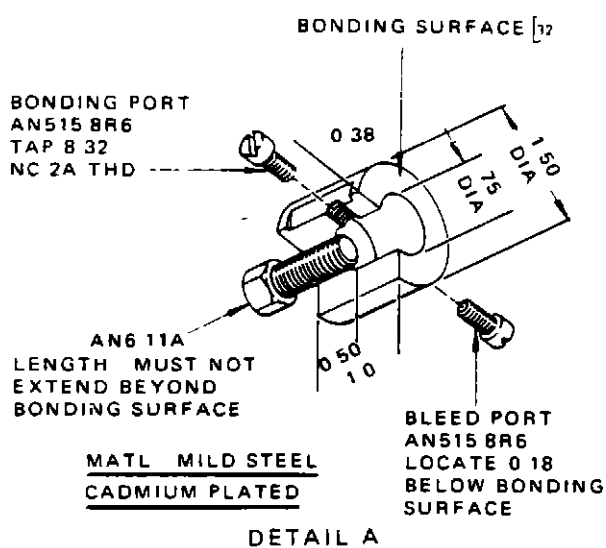
- c) Using a cotton-tipped stick, apply a thin coat of Eastman 910 adhesive to bonding surface of adapter.
Step 1

WARNING: DO NOT ALLOW ADHESIVE TO COME IN CONTACT WITH THE SKIN, AS IT IS INJURIOUS TO SKIN.

- d) Center adapter over fastener and firmly press adapter against wing skin for 10 seconds. Release hold on adapter and allow it to stand for 15 minutes. Step 2
- e) Remove screw from loading port and back off bleed port screw until one more turn will remove it.
- f) Remove pressure bolt, allow any accumulated fuel to drain, and reinstall bolt approximately 12 turns (1/2 inch).
- g) Inject MIL-S-8802, Class A sealant in loading port until sealant extrudes from bleed port. Step 3.
- h) Tighten loading and bleed port screw.
- i) Torque pressure bolt to 5 pound-inches and maintain for 5 minutes.

CAUTION: DO NOT EXCEED 5 POUND-INCHES OF TORQUE TO PRESSURE BOLT.

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Temporary Repair Procedure
Figure 816

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- j) Remove adapter by tapping side of adapter with a small hammer or mallet.
- k) Check fastener for leakage.
- l) Clean sealant from wing and adapter using MEK. Do not attempt to clean adhesive from wing surface; the adhesive will weather off in 1 to 2 weeks.

(c) Repair fillet sealed fasteners.

- 1) Leaking fastener fillet seals are repaired by replacing the faulty sealant. Proceed as follows:
 - a) Using sealant cutting tool, cut around base of fastener to separate sealant from structure.
 - b) Grasp seal with pliers and pull away from fastener end. Most of seal should be removed by this process.
 - c) Cut away remaining sealant. Small quantities of sealant which adhere firmly to fastener need not be removed.

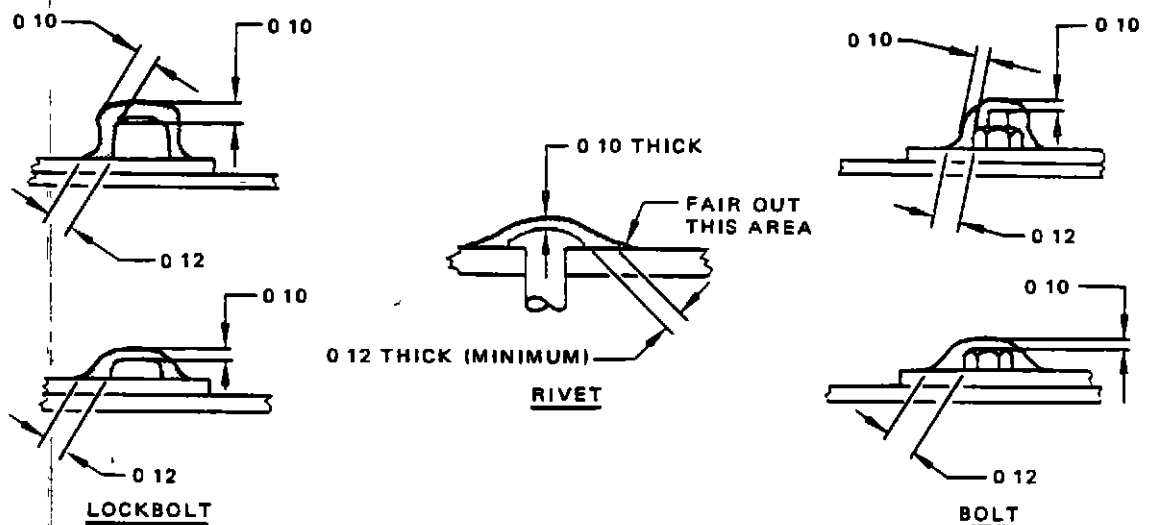
NOTE: Bolts must be torqued before applying sealant. Tightening during or after sealing is not permitted

- d) Clean fastener and surrounding area with cleaning solvent.
- e) Apply a precoat of properly mixed Class A sealant to fastener and area extending 1/2 inch in all directions from fastener. Use a stiff bristled brush and scrub sealant on surfaces and into crevices.
- f) Allow precoat to cure until tack-free.
- g) Using an extrusion gun or spatula, apply a coat of Class B sealant around and over fastener.
- h) Work sealant with fairing tool until fillet seal dimensions given in figure 817 are obtained.
- i) Carefully inspect for holes, bubbles, or voids in sealant. If any of these exist repeat procedure.
- j) Topcoat as required.

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(d) Repair cover sealed fasteners.

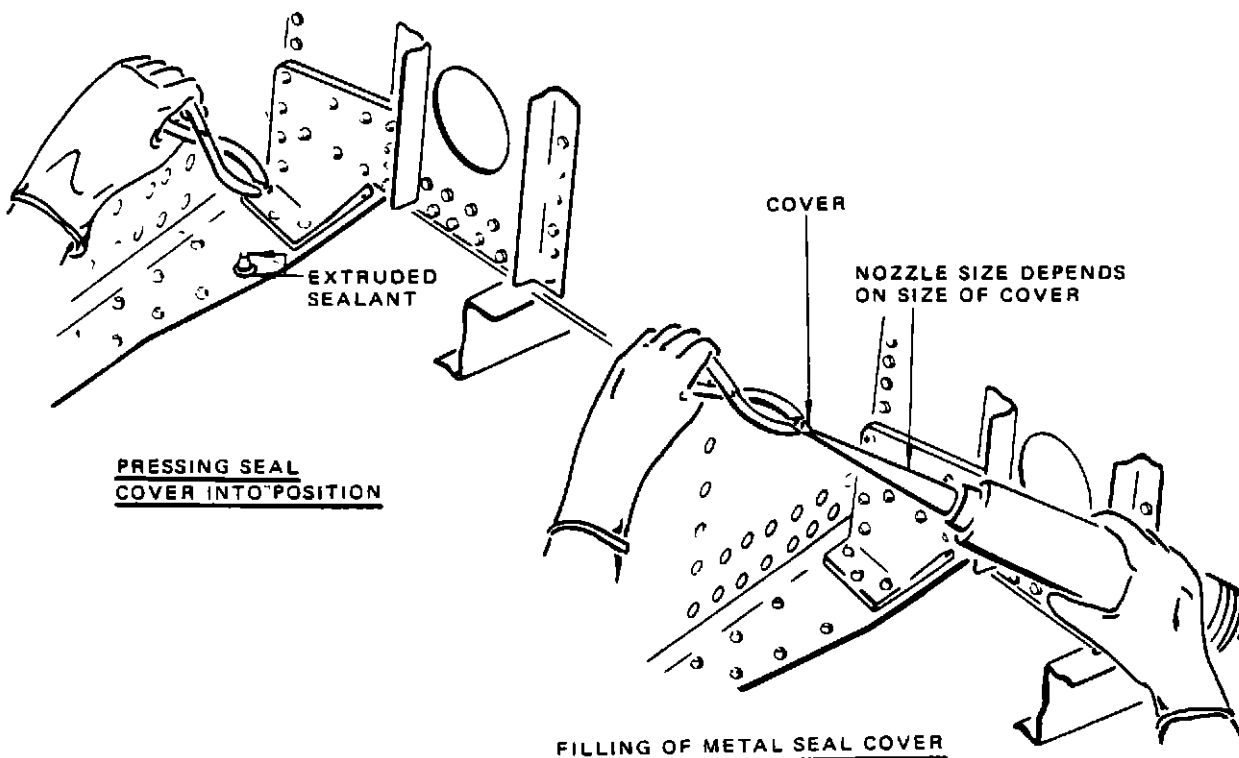
- 1) To replace a metal cover seal on lockbolts and bolts, proceed as follows.
 - a) Using a sealant cutting tool, cut around and under seal cover, to separate sealant from structure.
 - b) Grasp seal cover with pliers and pull up and away from fastener end. Most of sealant should be removed by this process.
 - c) Cut away remaining sealant. Small quantities of sealant which adhere firmly to fastener need not be removed.
 - d) Clean seal covers, fastener ends, and structure area with cleaning solvent.
 - e) Apply precoat to area using Class A sealant. Brush into crevices with smooth strokes of brush, leaving no ridges or voids.





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- f) Using correct size and shape of seal cover, fill cover two-thirds full of Class B sealant with a sealing gun or clean spatula. (See figure 818.) Sufficient sealant must be used to ensure extrusion around base and through hole in top of cover
- g) Press sealant in cover to ensure no void is left.
- h) Press cover down over fastener until flange on cover contacts structure as shown in figure 818.
- i) Fair extruded sealant around top of cover removing excess sealant. Use clean cheesecloth for wiping fairing tool.



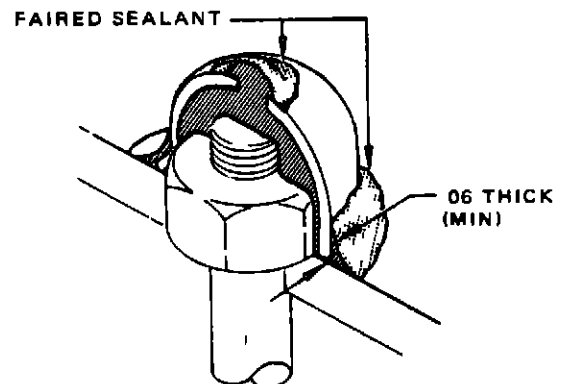
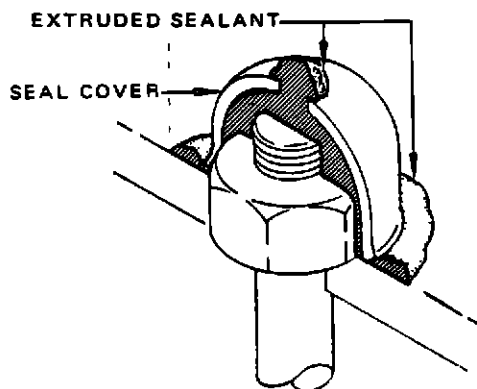
Metal Seal Cover Installation
Figure 818

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- j) Holding cover in position, fair extruded sealant around base flange. Keep cover centered over bolt. Do not let it move.

NOTE When adjacent seal covers, structure, or sealant fillets interfere with normal application of a seal cover, up to 25 percent of the area of the cover to be applied may be trimmed around the base and up the sides to facilitate a fit. The same installation instructions as outlined in steps g) through j) above shall be observed. See figure 819 for correct dimensions of finished job.

- k) Topcoat as required.

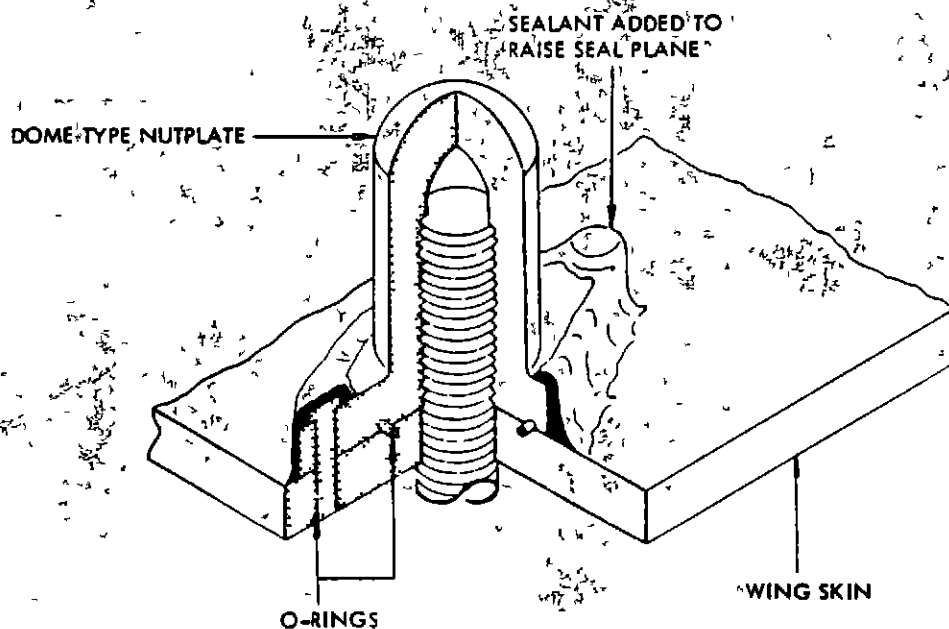


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(e) Repair sealed nutplates. (See figure 820.)

- 1) Sealed nutplates that leak should be repaired by fillet sealing the nutplates and rivets to raise the seal plane at the nutplate. Some nutplates may already be sealed in this manner, in which case it will only be necessary to replace faulty sealant. Refer to paragraph 3.C.(1). Raising the seal plane is accomplished as follows:
 - a) Use MEK and clean gauze pads to remove any topcoat from nutplate and surrounding surface.
 - b) Clean area with cleaning solvent.
 - c) Apply a precoat of properly mixed Class A sealant to cleaned area. Use a stiff bristled brush and scrub sealant on surfaces and into crevices.
 - d) Using an extrusion gun or spatula, apply Class B sealant around nutplate and over rivet heads.
 - e) Work sealant with fairing tool to obtain fillet seal dimensions shown in figure 817.
 - f) Topcoat as required.



Repair of Sealed Nutplate
Figure 820



MAINTENANCE MANUAL

(3) Repair injection seals.

(a) Repair failed injection seal by removing faulty sealant and applying a new injection seal or by raising seal plane to isolate faulty seal from fuel. Refer to paragraph 3.C.(5).

(b) Remove faulty sealant.

1) Remove sealant from short injection channels with a hooked wire and small cutting tools. Longer injection channels require disassembly of structure which must be accomplished per the Structural Repair Manual. Regardless of the removal procedure used, abide by the following:

a) Clear injection channel all the way through since trapped air will prevent complete filling of the channel with sealant.

b) Exercise caution not to damage structure during sealant removal process.

c) If surface is damaged, refinish per paragraph 3.C.(1)(b).

(c) Clean injection channel.

1) Clean channel with cleaning solvent and pipe cleaners or funnel brushes.

2) Wipe surface dry with clean pipe cleaners. Repeat until drying pipe cleaner remains clean.

3) Clean channel at least once more after visible evidence of impurities has been removed and the surfaces are thought to be clean.

(d) Apply new injection seal.

1) The following tools are required: fairing tool, pipe cleaners, and an extrusion gun with injection nozzle attached

2) Make sure channel is thoroughly cleaned.

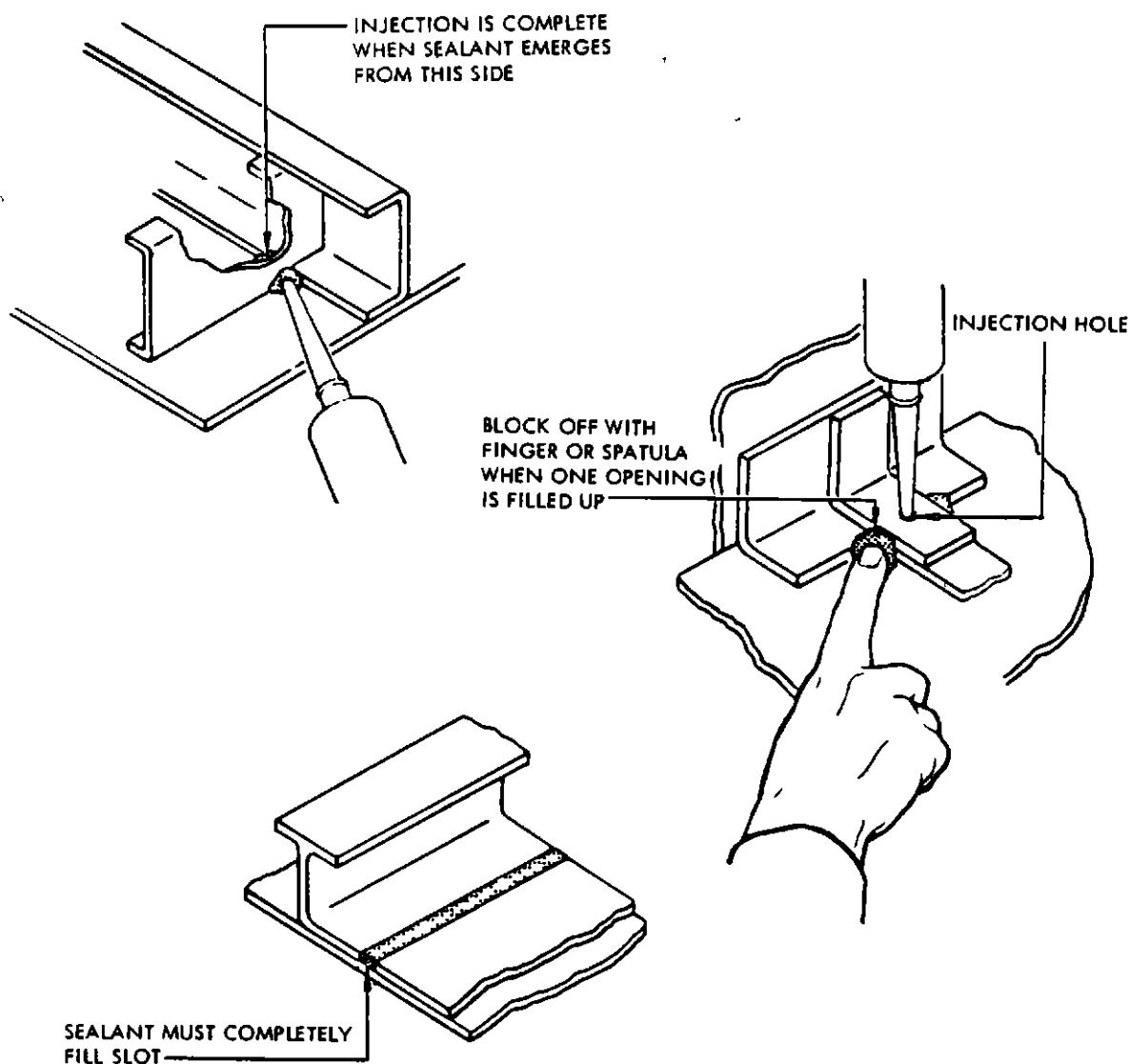
3) Apply a precoat of Class A sealant to surfaces of channel using pipe cleaners or a long bristled pencil brush.

NOTE: Do not plug channel with Class A sealant as this will prevent flow of final injection sealant into cavity. If channel cross section is 0.07 inch or less, precoat need not be applied.

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- 4) Inject Class B sealant into one end of channel and fill until sealant emerges from all other openings. Completely fill joggles and channels that require continuity of seal or block-off seal. (See figure 821.)

CAUTION: ENSURE THAT GUN HAS ENOUGH SEALANT TO MAKE COMPLETE SEAL AT ONE INJECTION WITHOUT ANY BREAK. STOPPING AND STARTING WILL CAUSE AIR BUBBLES IN SEAL AND IS CAUSE FOR REJECTION OF JOB.





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- 5) Remove excess sealant with a fairing tool and smooth out ends of seal.
 - 6) Inspect finished job for poor adhesion and air bubbles. Rework any discrepant area per the above procedure.
 - 7) Sealant must be faired out gradually into area that is to be fillet sealed.
 - 8) Topcoat as required.
- (4) Repair prepack and faying surface seals.
- (a) Since any repair of a prepack or faying surface seal requires the removal of structure or fasteners, such repairs must be accomplished per the Structural Repair Manual. A leak in a prepack or faying surface seal may be repaired by sealing completely around structural part and sealing fasteners involved. This method involves raising the seal plane; therefore, should be carefully considered before incorporation.
 - (b) To replace a failed prepack seal, proceed as follows:
 - 1) Disassemble structure surrounding seal as per Structural Repair Manual.
 - 2) Remove all sealant from prepacked cavity with sealant cutting tools and suitable plastic scrapers.
 - 3) Complete all preassembly operations such as hole drilling and burring. Refinish damaged surface per paragraph 3.C.(1)(b).
 - 4) Clean parts with cleaning solvent.
 - 5) Apply a coat of Class B sealant to one of the parts. Shape sealant with a fairing tool to general contours of cavity. Sufficient sealant must be applied to ensure complete filling of the cavity.
 - 6) Assemble parts within sealant work life.
 - 7) Topcoat as required.



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(c) To replace a failed faying surface seal, proceed as follows:

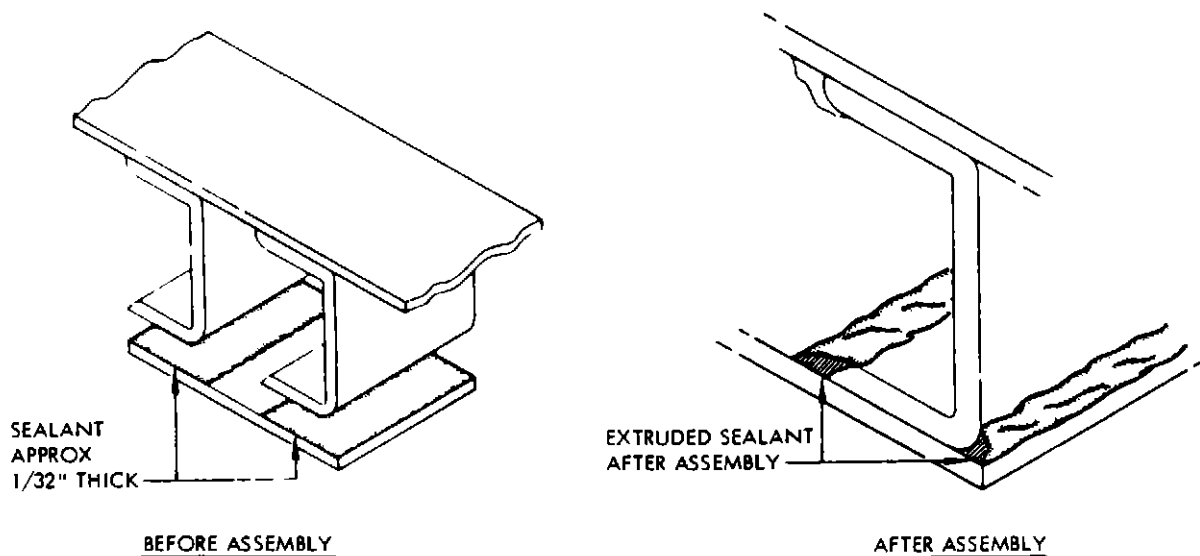
- 1) Disassemble structure surrounding seal per Structural Repair Manual.
- 2) Remove all sealant from faying surfaces with sealant cutting tools and suitable plastic scrapers.
- 3) Complete all preassembly operations such as hole drilling and burring. Refinish damaged surface per paragraph 3.C.(1)(b).
- 4) Clean faying surfaces with cleaning solvent.
- 5) Apply a coat of Class B sealant to one faying surface with an extrusion gun or a spatula. Spread sealant over entire surface to obtain a uniform coating approximately 1/32 inch thick. (See figure 822.)

NOTE: Do not use Class A sealant.

- 6) Assemble parts within sealant work life.
- 7) Fair out extruded sealant to leave a smooth fillet along joint (See figure 822.)

NOTE Sufficient sealant must be applied to ensure a continuous extrusion on both sides of joint after assembly of faying surfaces.

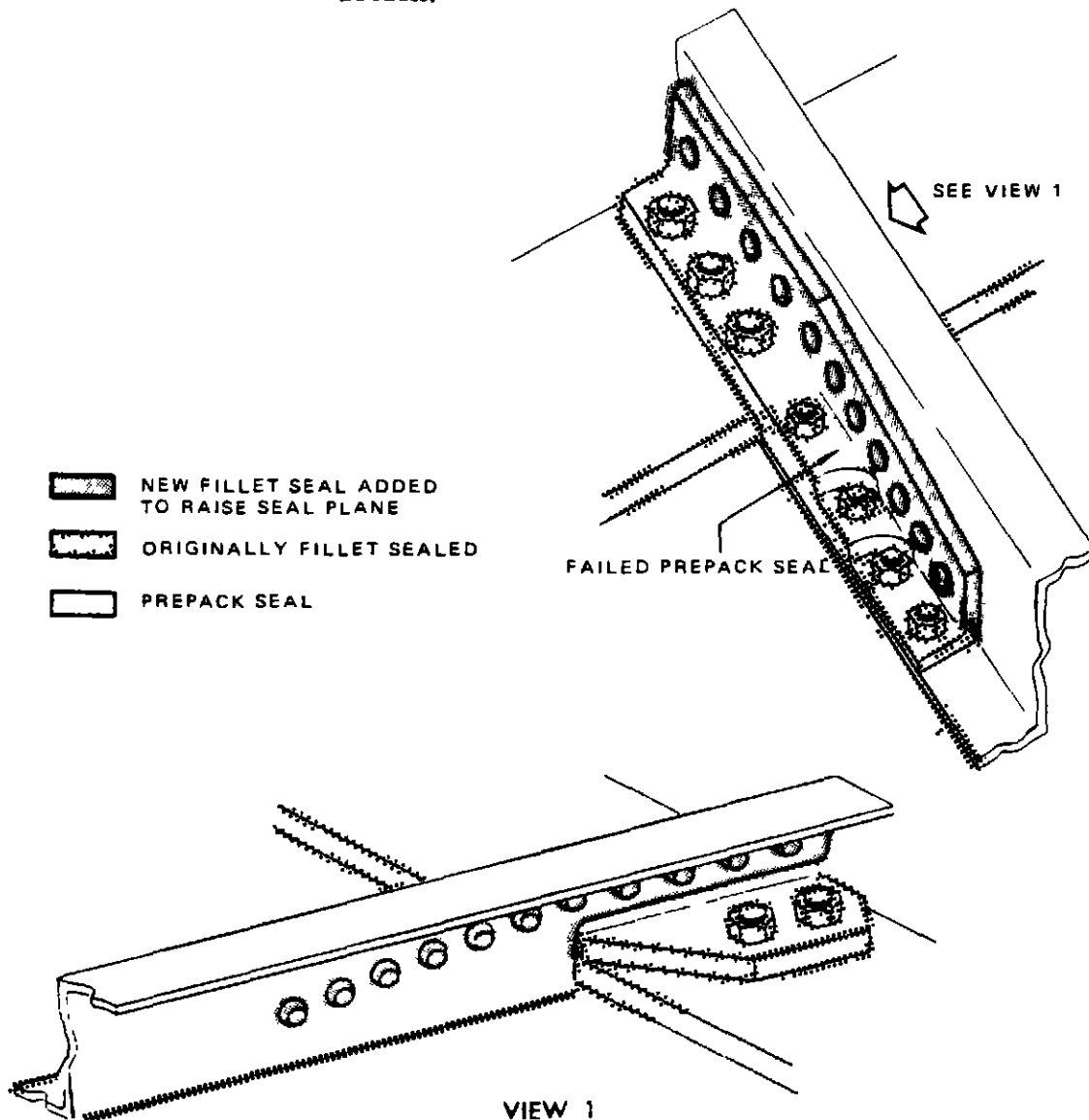
- 8) Topcoat as required.



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(5) Raising the seal plane

- (a) As an option to replacing an injection, prepack, or faying surface seal, the seal plane may be raised (relocated) to isolate the failed seal from fuel.
- 1) Structure surrounding failed seal must be carefully reviewed to determine the point to which seal plane must be raised. New seal plane will be established by fillet sealing around structure that surrounds seal and sealing fasteners which pass through structure. Figure 823 shows a typical repair of a failed seal by raising the seal plane. Raising the seal plane can involve an extensive amount of sealant addition so in many cases structure removal and replacement of failed seal will be the best action.



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D. Topcoating

NOTE: Topcoating is applied to all structure and sealing, on the bottom of the tank and for a minimum height of 2-1/2 inches, on the tank walls and webs.

(1) Equipment and Materials

(a) Paint brushes

(b) Spray Equipment

1) DeVilbiss Model MBC or JGA - The DeVilbiss Company, 300 Phillips Avenue, Toledo 1, Ohio

2) Binks Model 7 or 18 - Binks Manufacturing Company, 3114 West Carroll Avenue, Chicago 12, Illinois

NOTE: Equipment having equivalent capacities and characteristics may be used in place of listed equipment.

(c) Catalyst - Finch CA-109

(d) Cleaning cloths - Acceptable cleaning cloths are cheesecloth, surgical gauze, or new white rags.

(e) Cleaning Solvent, General Purpose, BMS 3-2

(f) Cleaning Solvent, Presealing, BMS 11-7

(g) Filter Paper - 5 Micron

(h) Masking Tapes

1) CP-11, CP-42, or RP-52 - Shuford Mills, Inc., Hickory, North Carolina or Crown Zellerbach Company, Seattle, Washington

2) No. 703 or No. 733 - Permacel Tape Corporation, New Brunswick, New Jersey

3) No. 50, Protex, Mask Off Company, Monrovia, California

(i) Methyl Ethyl Ketone (MEK), TT-M-261

(j) Methyl Isobutyl Ketone, TT-M-268



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- (k) Thinner, TL-52
- (l) Thinner (Lacquer), TT-T-266
- (m) Toluene (Toluol), TT-T-548
- (n) Topcoating
 - 1) EC776SR - Minnesota Mining and Manufacturing Company, 2501 Hudson Avenue, St. Paul, Minnesota
 - 2) Finch 454-4-1-Finch Paint and Chemical Company, Torrance, California

(2) Prepare for Topcoating

- (a) Check that all equipment is perfectly clean, equipment previously used for other materials must be washed thoroughly with lacquer thinner or methyl ethyl ketone.

WARNING: SUPPLY PLENTY OF VENTILATION WHEN USING THESE CLEANERS AS THEY ARE HIGHLY TOXIC.

- (b) Prior to application of EC776SR, clean surfaces to be topcoated with methyl ethyl ketone or methyl isobutyl ketone. Cleaning should include an area larger than that to be topcoated.
- (c) Prior to application of Finch 454-4-1 the following two-step cleaning procedure shall be performed. Step 1) shall be performed within 72 hours of application and step 2) shall be performed immediately prior application and only on an area which can be conveniently worked without recontaminating the surfaces during application of topcoating.
 - 1) Clean surface to be topcoated with a clean cloth wetted with toluene-methyl ethyl ketone solvent blend (1:1 toluene: MEK by volume). Wipe surface dry with clean cloth before solvent evaporates.

NOTE: This step shall be repeated until no soils are visible on cloth. There may be some pickup of yellow pigment on previously coated surfaces. This is not considered soil.

- 2) Clean surface to be coated with a clean cloth wetted with BMS 11-7 solvent. Wipe surface dry with clean cloth before solvent evaporates.



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- (d) Take particular care to remove solvent or moisture from corners or crevices.
- (e) Check that sufficient topcoating material is available to complete the application.
- (f) Only those masking tapes listed above shall be used on surfaces requiring protection during application of topcoating.

CAUTION: ALL MASKING TAPE MUST BE REMOVED AFTER APPLICATION IF COMPLETED.

(3) Application of Topcoating

WARNING. TOPCOATING MATERIALS ARE EXTREMELY TOXIC. CORRECT USE OF VENTILATING EQUIPMENT MUST BE ENFORCED. A RESPIRATOR MUST BE WORN BY PERSONNEL INSIDE OF TANK. DO NOT GET IN EYES OR ON SKIN. WASH HANDS BEFORE EATING OR SMOKING. KEEP AWAY FROM SOURCES OF IGNITION.

CAUTION: DO NOT APPLY TOPCOAT BEFORE END OF SEALANT WORK TIME HAS BEEN REACHED. (SEE FIGURE 803.) TOPCOATING SHALL NOT BE APPLIED WHEN TEMPERATURE OF PARTS OR STRUCTURE IS LOW ENOUGH TO CAUSE CONDENSATION OF MOISTURE.

NOTE. Topcoating must not be applied to fuel system tubing, clamps, O-ring surfaces, valves, measuring sticks, tank units, wiring, boost pumps, filler caps, bladder cells, or any other nonstructural components.

For minor repairs either EC776SR or Finch 454-4-1 topcoating may be used.

(a) EC776SR

CAUTION. EC776SR MUST NOT BE APPLIED IF TEMPERATURE OF STRUCTURE IS BELOW 50°F (10°C) OR ABOVE 125°F (51.7°C), ATMOSPHERIC TEMPERATURE IS BELOW 65°F (18.3°C) OR ABOVE 100°F (37.8°C), NOR WHEN RELATIVE HUMIDITY EXCEEDS 85%.

1) By brush

- a) Apply thin film with soft bristle paint brush, brush in one direction as much as practicable.



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- b) Do not use fast scrubbing motions or repeated brushing out of wet coating, to avoid air bubbles, pickup, or voids.
 - c) Make sure that applied topcoating overlaps any adjacent topcoating previously applied
- 2) Film thickness of 0.001 to 0.004 inch is allowable over sealant. Film thickness of .005 to .015 is preferred on structure.
 - 3) Allow 8 hours for topcoating to dry before handling or fueling tanks.

NOTE: Drying can be accelerated by circulating warm air 120°F (49°C) maximum over the topcoated surface.

WARNING: USE OF WARM AIR SUPPLY IS EXTREMELY DANGEROUS UNLESS ALL SAFETY PRECAUTIONS ARE OBSERVED. NEVER START OR STOP AIR BLOWER WITH AIR HOSE INSIDE FUEL TANK.

- 4) Damaged, improperly applied, or deteriorated topcoat must be removed and replaced. Damage is usually in the form of scraping or scuffing. Improper application generally results in pin holes in the topcoating. Deteriorated topcoat may be indicated by chalkiness, parching, wrinkling, or cracking. The affected topcoat must be removed with methyl ethyl ketone and clean gauze pads. New topcoat must then be applied.

(b) Finch 454-4-1

CAUTION: TOPCOATING MUST NOT BE APPLIED AT TEMPERATURES BELOW 50°F OR ABOVE 100°F NOR WHEN RELATIVE HUMIDITY EXCEEDS 75 PERCENT.

NOTE. Spray application of topcoating is recommended and should be used wherever possible.

1) By brush.

- a) Apply thin film (approximately 0.0005 inch) with SOFT bristle paint brush, brush in one direction as much as practicable.
- b) Do not use fast scrubbing motions or repeated brushing out of wet topcoating to avoid air bubbles, pickup, or voids.



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- c) Allow to dry for a minimum of 30 minutes.
 - d) Apply second thin film in same manner as first coat.
 - e) Make sure that applied topcoating overlaps any adjacent topcoating previously applied.
- 2) By spray.

NOTE: This material may be sprayed satisfactorily as supplied by vendor.

- a) Set spray gun to 40-60 psig air pressure and 5 to 20 psig fluid pressure for Binks guns and 45-55 psig air pressure and 5 to 10 psig fluid pressure for DeVilbiss guns.
 - b) Spray topcoating on entire surface to be coated in a wet continuous film.
 - c) Allow to dry for a minimum of 30 minutes.
 - d) Apply second coat in same manner as first coat.
 - e) Make sure that applied topcoating overlaps adjacent topcoating previously applied.
- (f) Cleanup after Topcoating
- 1) Clean equipment with methyl ethyl ketone immediately after use.
 - 2) Soak brushes in methyl ethyl ketone immediately after use. Discard brushes when bristles become stiff.

WARNING: SUPPLY PLENTY OF VENTILATION WHEN USING MEK AS THIS MATERIAL IS HIGHLY TOXIC.

4. Inspection and Closure of Repaired Fuel Tanks

- A. Any time an integral fuel tank has been entered it must be given a thorough inspection before closure. If repair sealant has been applied, the tanks must be carefully cleaned and inspected before closure. The following steps shall be used for closure of repaired integral fuel tanks:

WARNING: COMPLY WITH ALL TANK ENTRY PRECAUTIONS AS GIVEN IN FUEL SYSTEM - MAINTENANCE PRACTICES, 28-0.

- (1) Remove all coverplates, plugs, and equipment used in leakage isolation tests.

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- (2) Remove all tools, solvent containers, rags, and brushes used for sealant repairs.

NOTE: A checklist should be maintained recording all tools, equipment, material, and personnel as they enter and leave the tank. The checklist should be verified before tank closure.

- (3) Vacuum clean the repaired tank thoroughly to remove lint and pieces of old sealant. If tank is wet with fuel, wipe the contaminated areas clean with cotton rags or sponges.

WARNING: ALL EQUIPMENT AND HOSES USED IN OR NEAR THE OPENED FUEL TANK MUST BE PROPERLY GROUNDED.

- (4) Inspect all repair sealant for proper application.
- (5) Replace any rib braces or structure removed for accessibility.
- (6) Install access doors.

5. Fueling Repaired Integral Fuel Tanks

- A. Integral fuel tanks repaired and topcoated shall not be refueled until the topcoat applied to sealant or structure has cured. Under normal conditions, 8 hours for EC776SR, and 10 hours for Finch 454-4-1 are required for topcoat to cure before fueling. For accelerated cure times for Finch 454-4-1, refer to Topcoat Curing.
- B. Integral fuel tanks repaired without topcoating may be refueled immediately providing the pressure of the refueling stream is not directed against the new sealant, and providing the fuel temperature is above 50°F (10°C). If the fuel temperature is below 50°F it will be necessary to allow the sealant to cure to tack-free before refueling.
- C. Fill repaired integral tank with fuel. See Fueling, 12-1-41. Check the external leak area periodically for four hours. There shall be no leakage.

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8. Fueling Repaired Integral Fuel Tanks

- A. Integral fuel tanks repaired and topcoated shall not be refueled until the topcoat applied to sealant or structure has cured. Under normal conditions, 8 hours for EC776SR, and 10 hours for Finch 454-4-1 are required for topcoat to cure before fueling. See figure 823 for accelerated cure times for Finch 454-4-1.
- B. Integral fuel tanks repaired without topcoating may be refueled immediately providing the pressure of the refueling stream is not directed against the new sealant, and providing the fuel temperature is above 50°F (10°C). If the fuel temperature is below 50°F it will be necessary to allow the sealant to cure to tack-free before refueling.
- C. Fill repaired integral tank with fuel. See Fueling, 12-1-41. Check the external leak area periodically for four hours. There shall be no leakage.



MAINTENANCE MANUAL

FUEL TANK ACCESS PANELS - REMOVAL/INSTALLATION

1. General

- A. Access panels installed in the lower wing panels are removed to allow access to the integral fuel tanks. There are two types of access panels, cast and machined.
- B. Cast panels (figure 401) are sealed by a molded rubber seal fitted into a groove on the panel mating surface. The panels are retained by clamp rings and mounting screws. Clamp rings are installed using either anticorrosion grease, phenolic rub strips, or a knitted aluminum gasket to reduce chafing. Cast panels installed using clamp rings with phenolic rub strips are bonded to the wing structure by a bonding jumper. The bonding jumper is optional for panels installed with a knitted aluminum gasket or clamp ring having a bare aluminum faying surface.
- C. Machined panels (figure 402) are installed with a seal ring, fabricated from aluminum or phenolic impregnated fabric laminate. The seal ring has molded rubber seals, fitted into grooves on both sides, which act as a static fluid seal. The panels are retained by clamp rings and mounting screws. Clamp rings are installed using either anticorrosion grease, phenolic rub strips, or a knitted aluminum gasket to reduce chafing. Machined panels installed using a clamp ring with phenolic rub strips, are bonded to the wing structure by a bonding jumper. The bonding jumper is optional for panels installed with a knitted aluminum gasket or clamp ring having a bare aluminum faying surface.

2. Removal/Installation Cast Fuel Tank Access Panels

A. Equipment and Materials

- (1) Anticorrosion Grease - Aero Shell No. 14

NOTE: No substitutes are allowed for the Aero Shell No. 14 grease

- (2) Aliphatic Naphtha

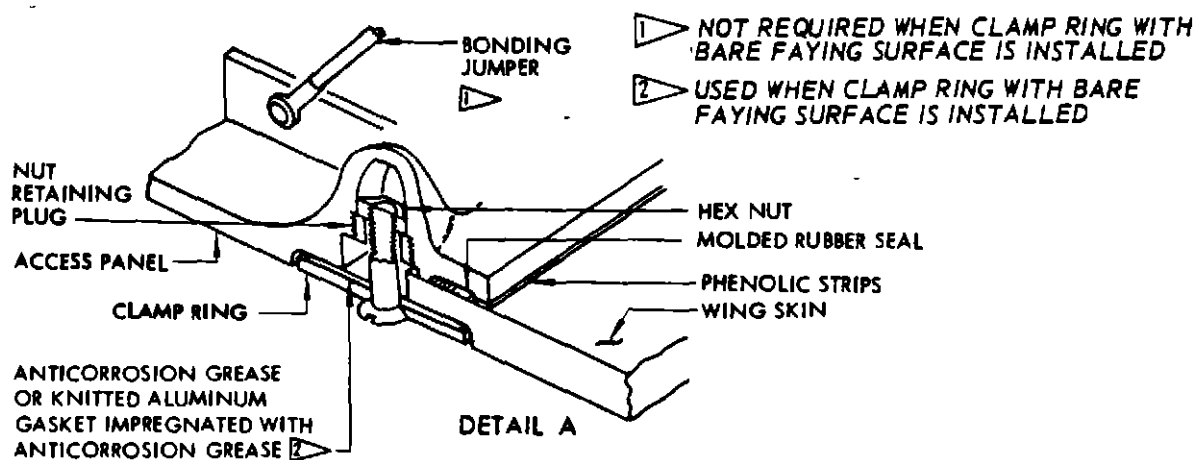
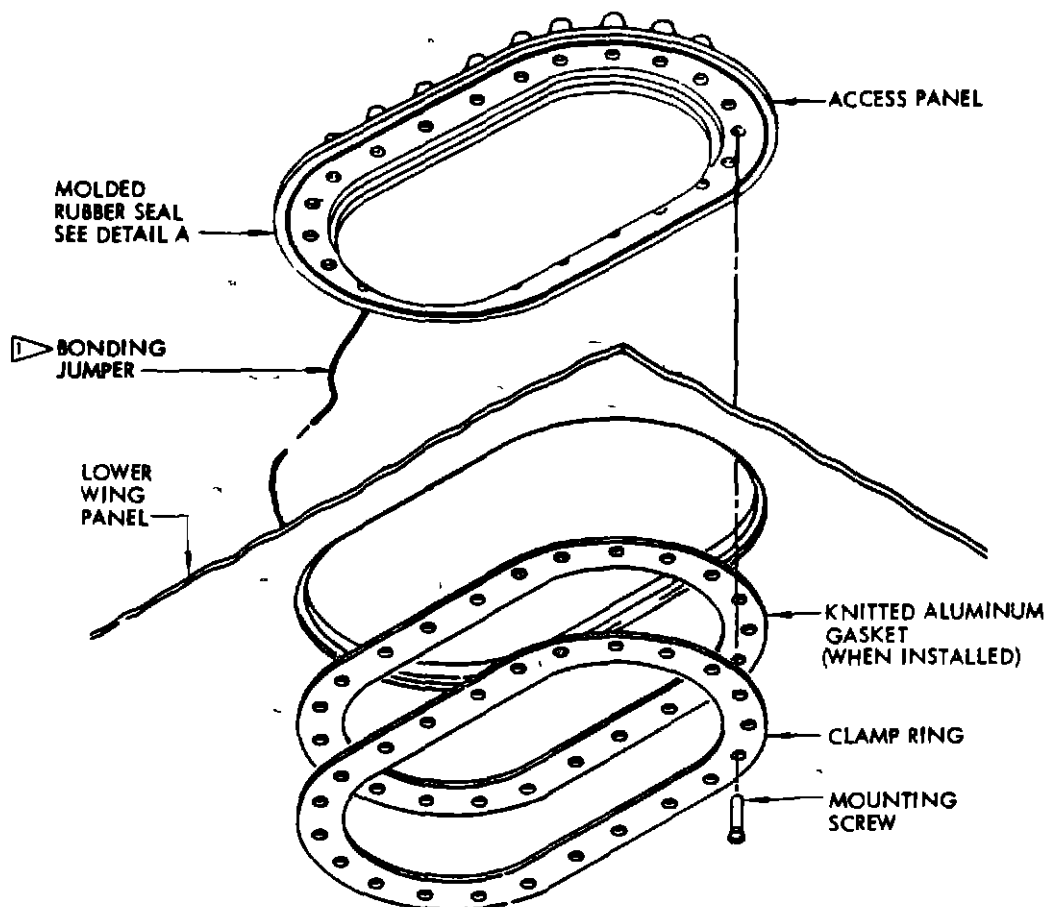
B. Prepare Cast Fuel Tank Access Panel for Removal

- (1) Defuel applicable tank. Refer to Fuel System - Maintenance Practices, 28-0.

WARNING: AVOID EXPLOSIVE AND TOXIC HAZARDS OF FUEL VAPORS. COMPLY WITH ALL SAFETY MEASURES GIVEN IN FUEL SYSTEM - MAINTENANCE PRACTICES, 28-0

- (2) On panels equipped with a dripstick, pull dripstick out to its limiting stop.

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Cast Fuel Tank Access Panel Installation
Figure 401

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C Remove Cast Fuel Tank Access Panel

- (1) Support clamp ring and remove mounting screws. (See figure 401.) Place all screws in a container.
- (2) Remove clamp ring and knitted aluminum gasket (if used) and place in flat container. Use care in handling.
- (3) Push up on access panel and remove from fuel tank.

CAUTION: DO NOT PRY PANEL. IF PANEL STICKS, LOOSEN BY TAPPING AROUND EDGE WITH RUBBER Mallet

THE LOWER SURFACE OF THE ACCESS PANEL FLANGE AND THE UPPER SURFACE OF THE SKIN AROUND THE ACCESS PANEL OPENING ARE SEALING SURFACES DO NOT SCRATCH OR DAMAGE.

- (4) Disconnect bonding jumper if installed.
- (5) Install rubber protector around wing skin access panel opening.

D Prepare Cast Fuel Tank Access Panel for Installation

- (1) Remove rubber protector from access panel opening.
- (2) Thoroughly clean access panel opening and access panel sealing surface using a clean lint-free cloth moistened with naphtha.
- (3) Check access panel for serviceability of phenolic strips and molded rubber seal ring. Replace the access panel if there is any doubt of their condition.

CAUTION: DO NOT APPLY CEMENTS OR SEALERS OF ANY KIND TO RUBBER SEAL OR SEALING SURFACES.

NOTE: Rubber seal, when immersed in fuel may expand and become oversize. Seal ring will return to its original size if allowed to dry.

- (4) Thoroughly clean clamp ring using a clean lint-free cloth moistened with naphtha.
- (5) If clamp ring with phenolic rub strip is used, check phenolic for serviceability.
- (6) If knitted aluminum gasket is used, clean gasket using a clean lint-free cloth moistened with naphtha.



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- (7) Check knitted aluminum gasket for serviceability.
- (8) Replace gasket if there is any doubt of its condition.
 - (a) Place knitted aluminum gasket carrier tray package face up on a flat surface.
 - (b) Peel paper cover from carrier tray.
 - (c) Position clamp ring over gasket (countersunk end of holes face up) so that clamp ring and gasket holes align. Press clamp ring on gasket until clamp ring is firmly in contact with gasket.

NOTE: Holes are not symmetrical.

- (d) Remove clamp ring, gasket, and release strip from carrier tray as a unit. Place unit, gasket side up, on a flat surface.
 - (e) Peel release strip from gasket.

E. Install Cast Fuel Tank Access Panel

- (1) Connect bonding jumper, if installed, to access panel.

NOTE: If clamp ring with phenolic rub strip is used, the bonding jumper must be installed. If bonding jumpers are retained they should be maintained in serviceable condition.

- (2) Place access panel inside tank and position it over opening.
 - (3) If clamp ring with bare faying surface is installed, apply liberal coat of anticorrosion grease to faying surface of clamp ring or; if knitted aluminum gasket originally removed is reused, apply liberal coat of anticorrosion grease to both surfaces of gasket.
 - (4) Position gasket (if used) and clamp ring. Install mounting screws, starting from centerline and working toward ends of panel, removing excess grease from mounting screws.

CAUTION: EXCESS GREASE AHEAD OF MOUNTING SCREWS MAY DAMAGE PANEL BECAUSE OF HYDRAULIC PRESSURE GENERATED BY THE GREASE

- (5) Tighten mounting screw to 35 to 50 pound-inches.
 - (6) On access panels equipped with dripsticks, push dripstick in and secure for flight.



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3. Removal/Installation Machined Fuel Tank Access Panels

A. Equipment and Materials

- (1) Corrosion Preventive Compound - MIL-C-11796, Class 3 or equivalent
- (2) Anticorrosion Grease - Aero Shell No. 14 (MIL-J-25537)

NOTE: No substitutes are allowed for the Aero Shell No. 14 grease.

- (3) Aliphatic Naphtha

B. Prepare Machined Fuel Tank Access Panel for Removal

- (1) Defuel applicable tank. Refer to 28-0, Servicing Fuel System.

WARNING: AVOID EXPLOSIVE AND TOXIC HAZARDS OF FUEL VAPORS. COMPLY WITH ALL SAFETY MEASURES GIVEN IN 28-0, SERVICING FUEL SYSTEM.

- (2) On panels equipped with dripsticks, pull dripstick out to its limiting stop.

C. Remove Machined Fuel Tank Access Panel

- (1) Perform steps 2.C.(1) through 2.C.(4), except refer to figure 402.
- (2) Remove seal ring from fuel tank.
- (3) Install rubber protector around wing skin access panel opening.

D. Prepare Machined Fuel Tank Access Panel for Installation

- (1) Perform steps 2.D.(1) through 2.D.(2).
- (2) Thoroughly clean seal ring and seal surfaces.
- (3) Check seal ring for damage, or deterioration of rubber insert. Replace seal ring assembly if there is any doubt of its condition.

NOTE: The seal ring rubber insert, when immersed in fuel may expand and become oversized. Seal will return to original size if allowed to dry. Do not attempt to straighten a damaged seal ring assembly.



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- (4) If aluminum seal ring is used, apply corrosion preventive compound to upper and lower surfaces of ring.

CAUTION: DO NOT APPLY CEMENTS OR SEALERS OF ANY KIND TO SEAL RING OR SEAL SURFACE

NOTE: If phenolic seal ring is used, no corrosion preventive compound is required.

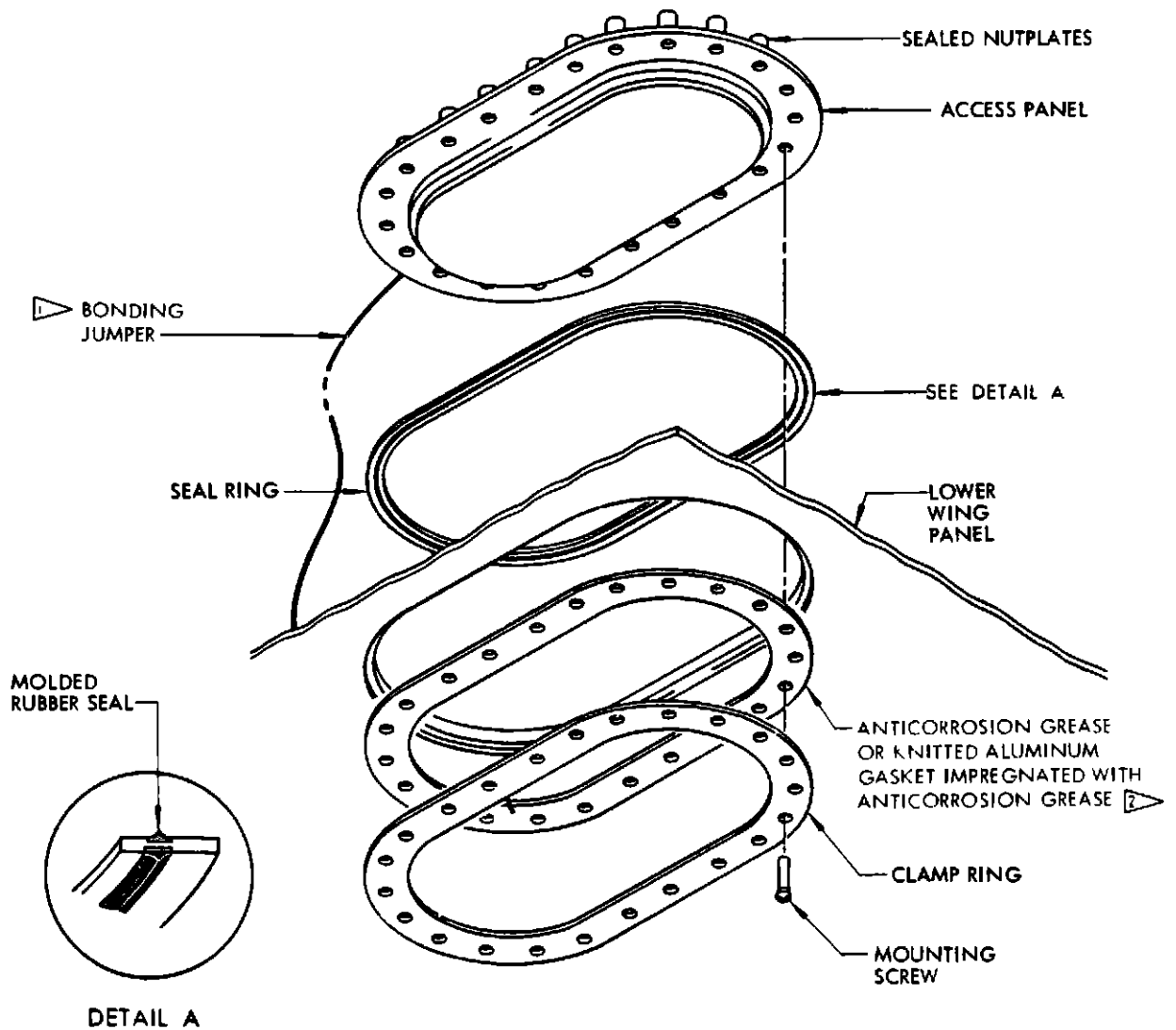
- (5) Perform steps 2.D.(4) through 2.D.(8)(e).

E. Install Machined Fuel Tank Access Panel

- (1) Place seal ring inside fuel tank and center it over access panel opening.
- (2) Perform steps 2.E.(1) through 2.E.(6).

1 NOT REQUIRED WHEN CLAMP RING WITH BARE FAYING SURFACE IS INSTALLED

2 USED WHEN CLAMP RING WITH BARE FAYING SURFACE IS INSTALLED



Machined Fuel Tank Access Panel Installation
Figure 402



RIB ACCESS OPENINGS - MAINTENANCE PRACTICES

1 General

- A To enable maintenance personnel to use the rib access openings the structural members covering these openings must be removed. These members consist of stiffeners and reinforcing plates which are attached to the ribs by bolts. When the openings are no longer in use, the structural members must be installed exactly as they were before removal. The following maintenance procedures cover the steps necessary to insure proper removal and installation.

CAUTION BOLT LENGTHS ARE CRITICAL AND PROPER PLACEMENT OF WASHERS IS IMPORTANT. STIFFENERS AND REINFORCING PLATES ARE STRESSED STRUCTURAL MEMBERS.

2 Removal/Installation Structural Members - Access Openings No. 1, 2, 3, 5, 6, 7, 9 and 10

- A. Remove Structural Members - Access Openings No. 1, 2, 3, 5, 6, 7, 9 and 10 (See figures 201 through 206)

- (1) Support stiffeners and remove mounting bolts

CAUTION DO NOT DROP STIFFENERS AS DAMAGE TO INTEGRAL TANK SEALING MAY RESULT.

- (2) Place bolts, nuts, and washers (when applicable) in containers to prevent losing them in tank

NOTE To facilitate installation, identify and keep stiffeners, stiffener mounting bolts and washers separate

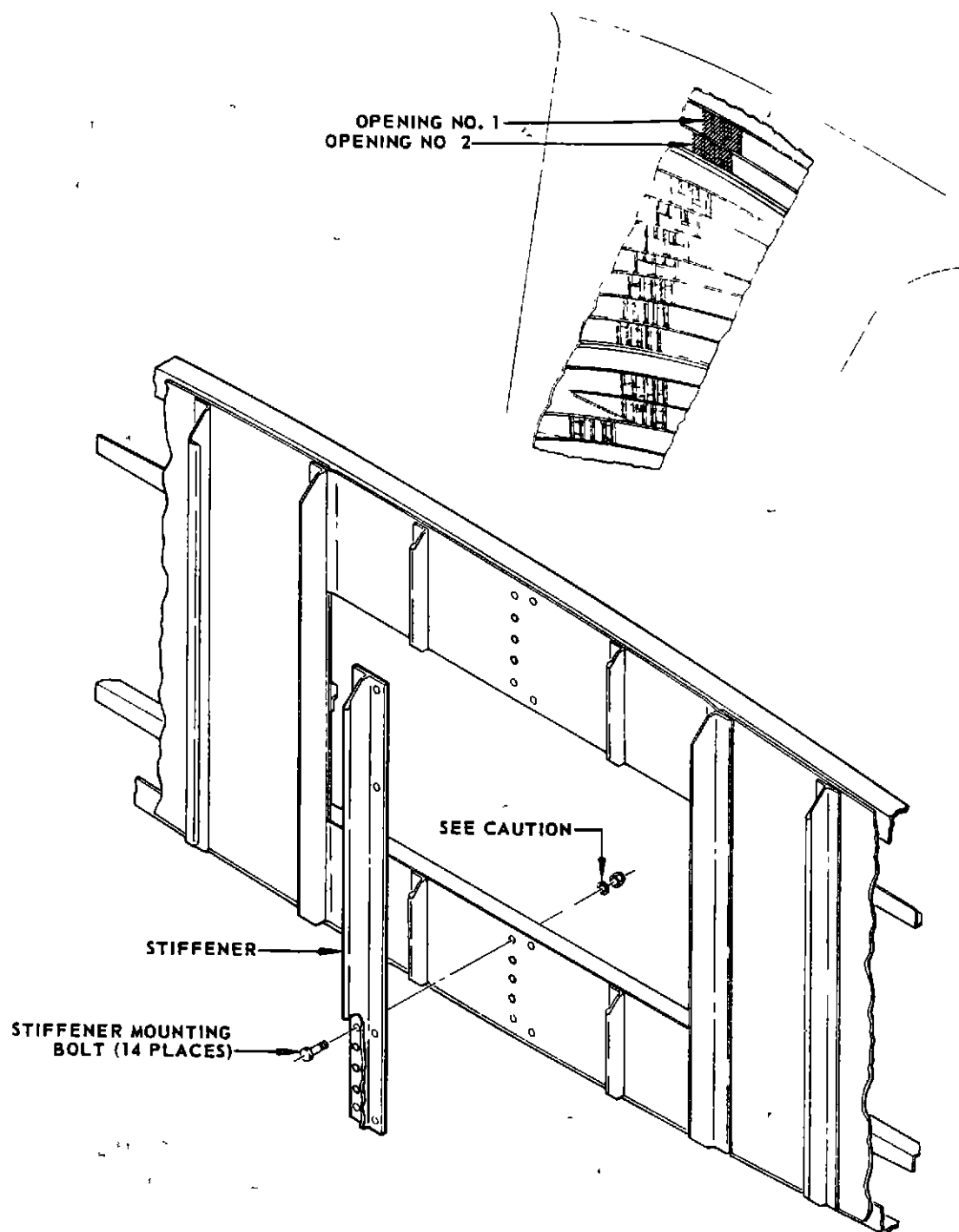
- (3) Stow stiffeners so that they will not damage integral tank sealing.

- B Install Structural Members - Access Openings No. 1, 2, 3, 5, 6, 7, 9 and 10 (See figures 201 through 206)

- (1) Position stiffeners as shown in respective figure

- (2) Install mounting bolts, washers (when applicable) and nuts.

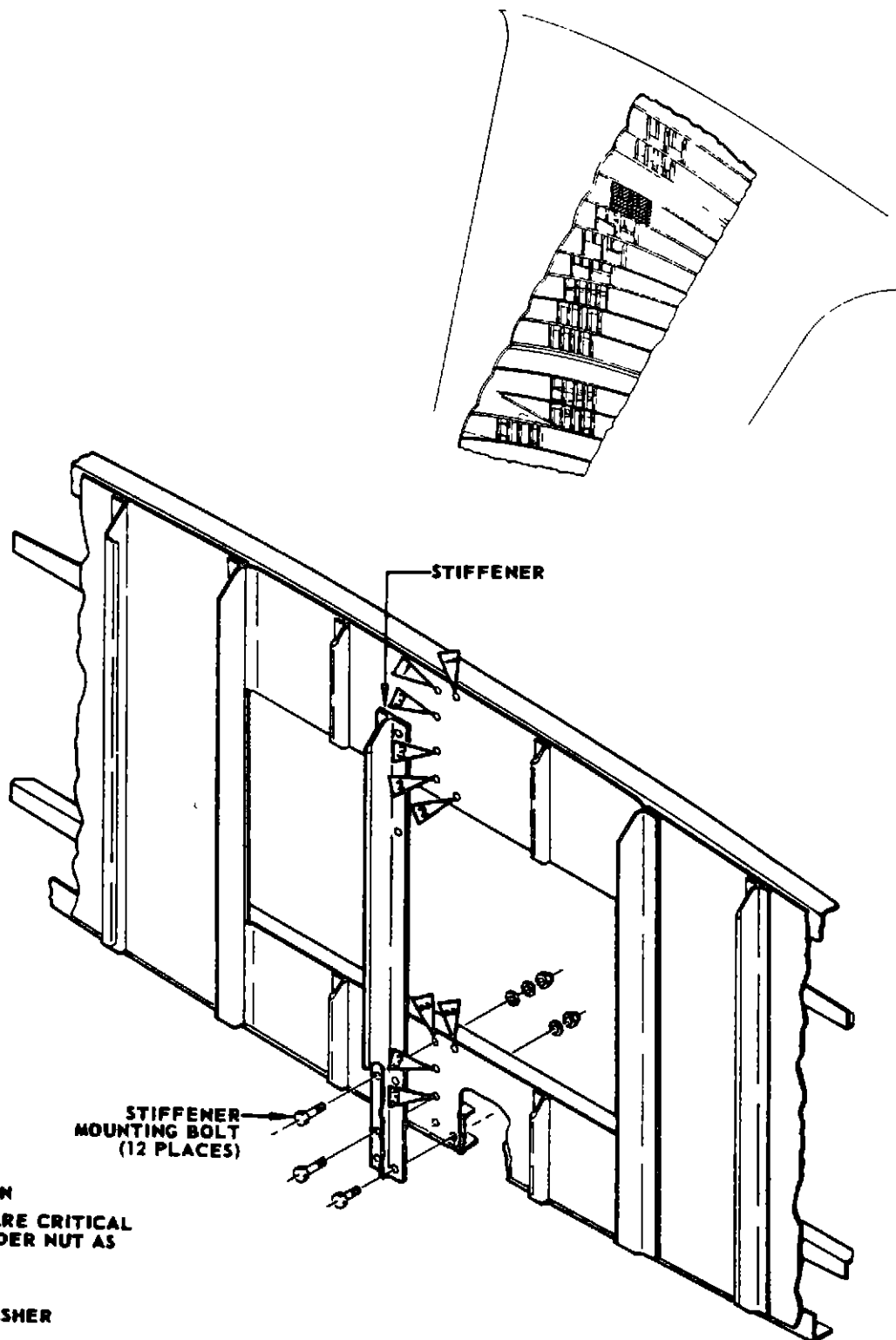
CAUTION BOLT LENGTHS ARE CRITICAL AND PROPER PLACEMENT OF WASHERS IS IMPORTANT. STIFFENERS ARE STRESSED STRUCTURAL MEMBERS. SEE RESPECTIVE FIGURE FOR WASHER POSITIONS.



CAUTION
BOLT LENGTHS ARE CRITICAL
USE WASHER UNDER NUT FOR
ACCESS OPENING NO 2 ONLY

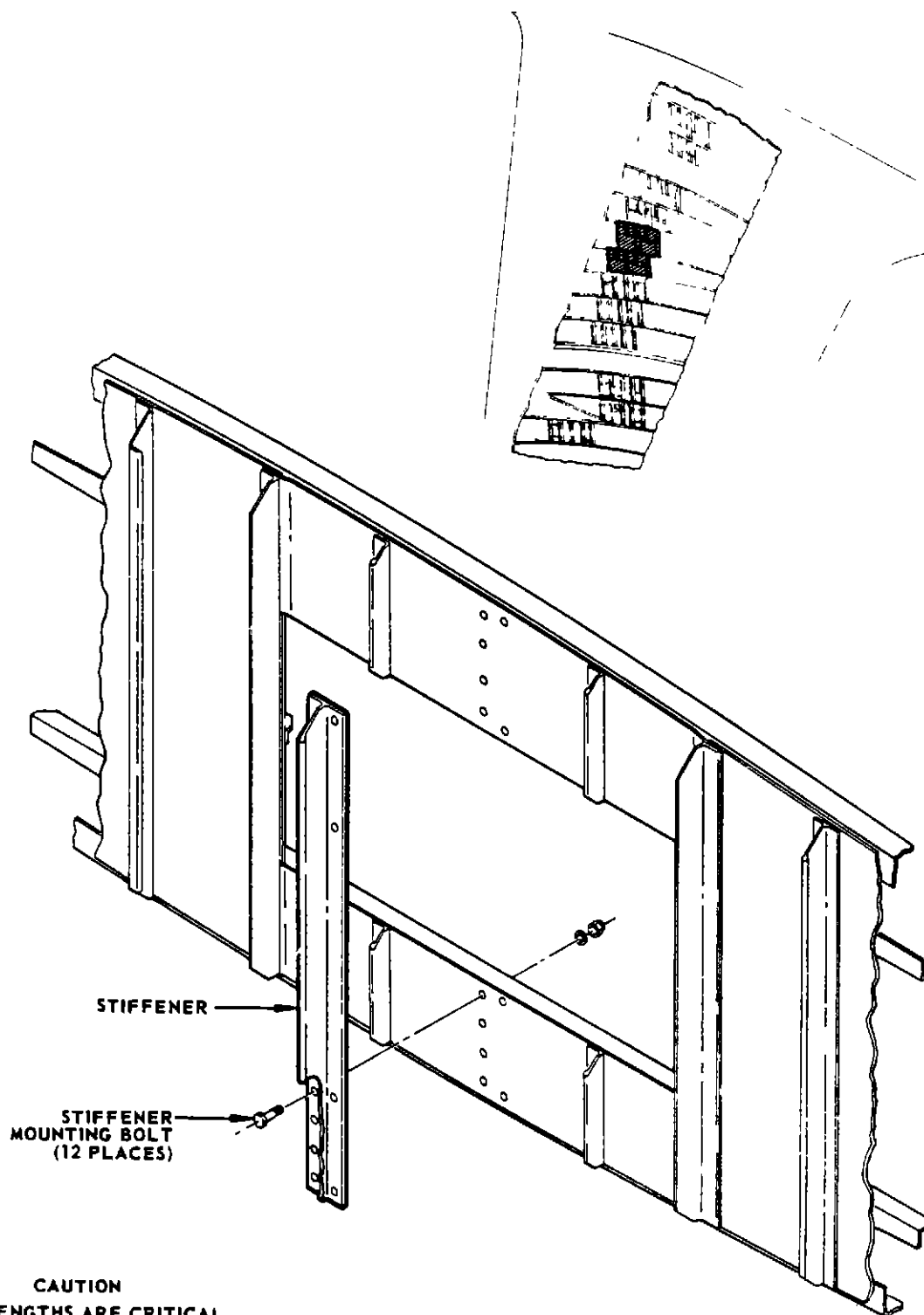
Structural Member Installation - Rib Access Openings No 1 and 2

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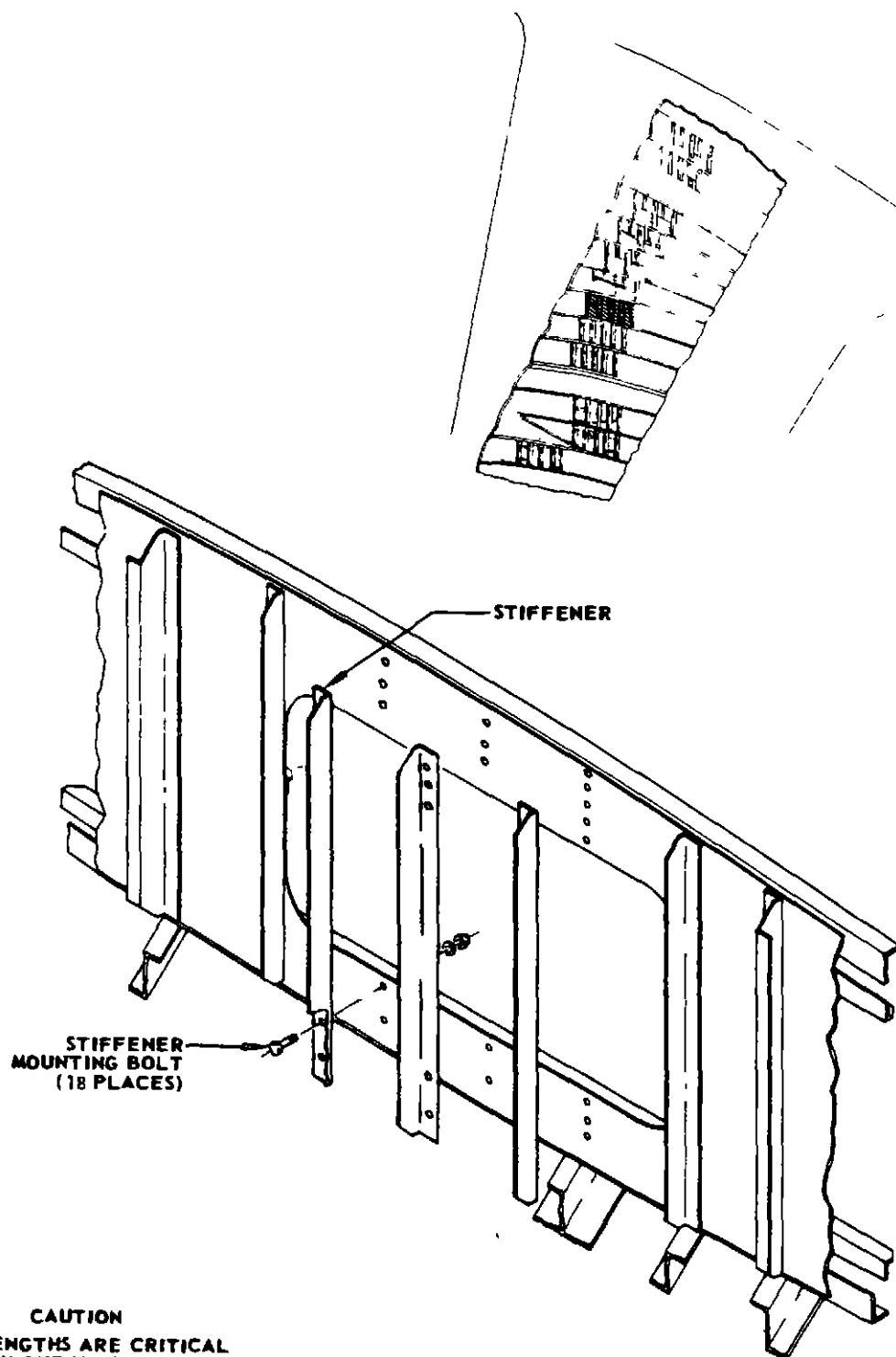


CAUTION
BOLT LENGTHS ARE CRITICAL
USE WASHERS UNDER NUT AS
NOTED

-  ONE WASHER
-  TWO WASHERS
-  THREE WASHERS

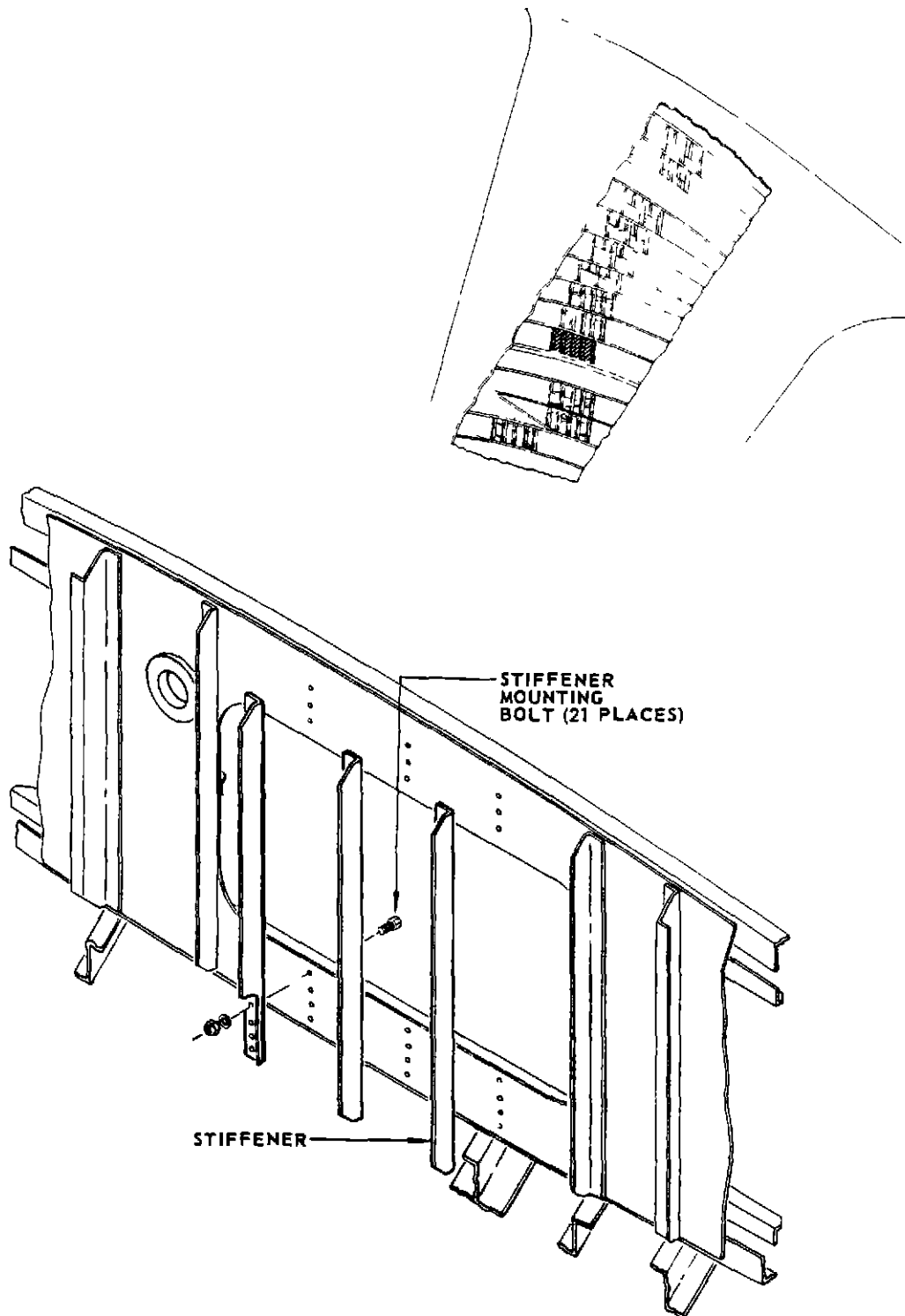


CAUTION
BOLT LENGTHS ARE CRITICAL
USE ONLY ONE WASHER UNDER
EACH NUT



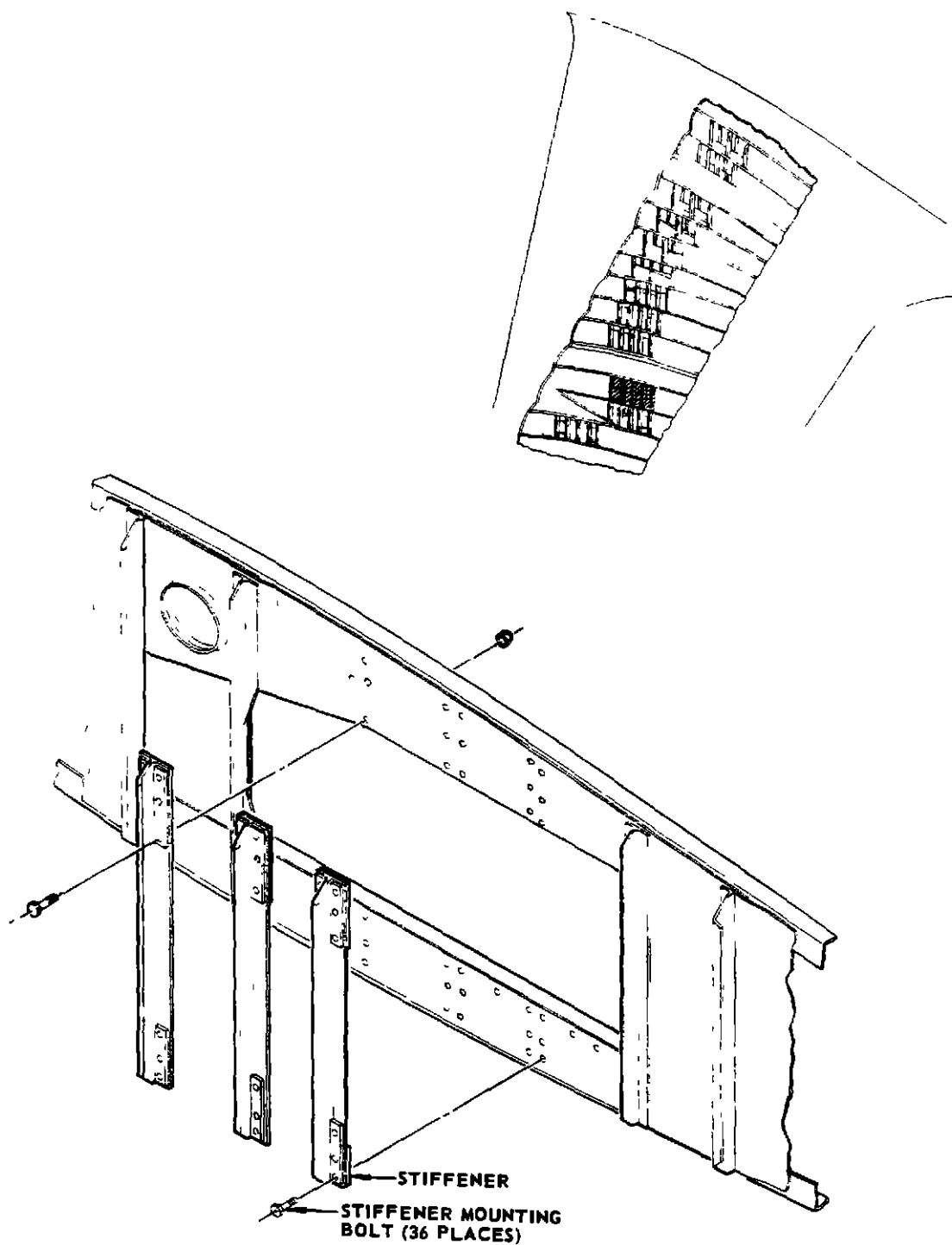
CAUTION
BOLT LENGTHS ARE CRITICAL
USE ONLY ONE WASHER UNDER
EACH NUT

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CAUTION

**BOLT LENGTHS ARE CRITICAL
USE ONLY ONE WASHER UNDER
EACH NUT**



CAUTION
BOLT LENGTHS ARE CRITICAL
USE WASHERS AS REQUIRED

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Revised

Structural Member Installation - Rib Access Opening No. 10
Figure 206

28-2-11
Page 207

3 Removal/Installation Structural Members - Access Opening No 4

A Remove Structural Members - Access Opening No. 4 (See figure 207.)

- (1) Disconnect aft tank unit at upper and lower installation bolts
Stow unit next to rib

CAUTION HANDLE TANK UNIT WITH CARE. DAMAGE TO UNIT WILL AFFECT
ITS ACCURACY IN SENSING FUEL QUANTITY.

- (2) Support stiffener and remove mounting bolts.

CAUTION DO NOT DROP STIFFENER. DAMAGE TO INTEGRAL TANK SEALING
MAY RESULT.

- (3) Place bolts, nuts and washers in container to prevent losing them in
tank

NOTE To facilitate installation, identify and keep stiffeners,
stiffener mounting bolts, and washers separate.

- (4) Stow stiffener so that it will not damage integral tank sealing

B Install Structural Members - Access Opening No 4 (See figure 207)

- (1) Position stiffener as shown in figure 207
- (2) Install stiffener mounting bolts washers and nuts

CAUTION BOLT LENGTHS ARE CRITICAL AND PROPER PLACEMENT OF WASHERS
IS IMPORTANT. STIFFENER IS A STRESSED STRUCTURAL MEMBER.
SEE FIGURE 207

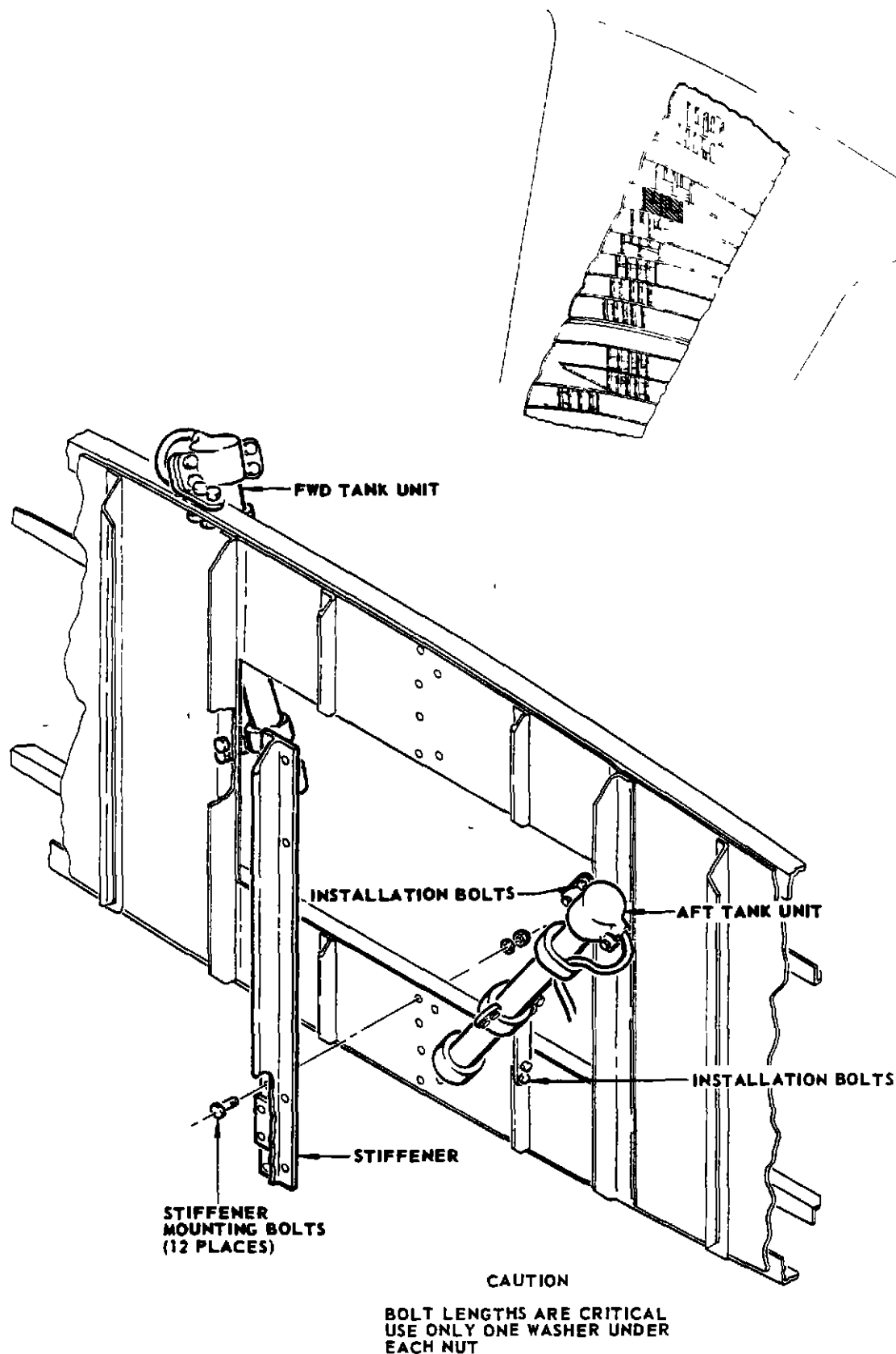
- (3) Install aft tank unit. (See figure 207)

4 Removal/Installation Structural Members - Access Opening No 8

A. Remove Structural Members - Access Opening No 8 (See figure 208)

- (1) Disconnect tank unit at upper and lower installation bolts Stow
unit next to rib

CAUTION. HANDLE TANK UNIT WITH CARE. DAMAGE TO TANK UNIT WILL
AFFECT ITS ACCURACY IN SENSING FUEL QUANTITY.



- (2) Support stiffeners and remove mounting bolts.

CAUTION DO NOT DROP STIFFENERS AS DAMAGE TO INTEGRAL TANK SEALING MAY RESULT.

- (3) Place bolts, nuts and washers in containers to prevent losing them in tank.

NOTE: To facilitate installation, identify and keep stiffeners, stiffener mounting bolts, plate mounting bolts and washers separate.

B. Install Structural Members - Access Opening No. 8 (See figure 208.)

- (1) Position stiffeners as shown in figure 208 and install stiffener mounting bolts, washers and nuts.

CAUTION: BOLT LENGTHS ARE CRITICAL AND PROPER PLACEMENT OF WASHERS IS IMPORTANT. STIFFENERS ARE STRESSED STRUCTURAL MEMBERS. SEE FIGURE 208.

- (2) Install tank unit. (See figure 208)

5 Removal/Installation Structural Members - Access Openings No 11 and 12

A Remove Structural Members - Access Openings No. 11 and 12 (See figures 209 and 210.)

- (1) Support reinforcing plate assembly and remove mounting bolts and nuts.

CAUTION DO NOT DROP REINFORCING PLATES, AS DAMAGE TO INTEGRAL TANK SEALING MAY RESULT.

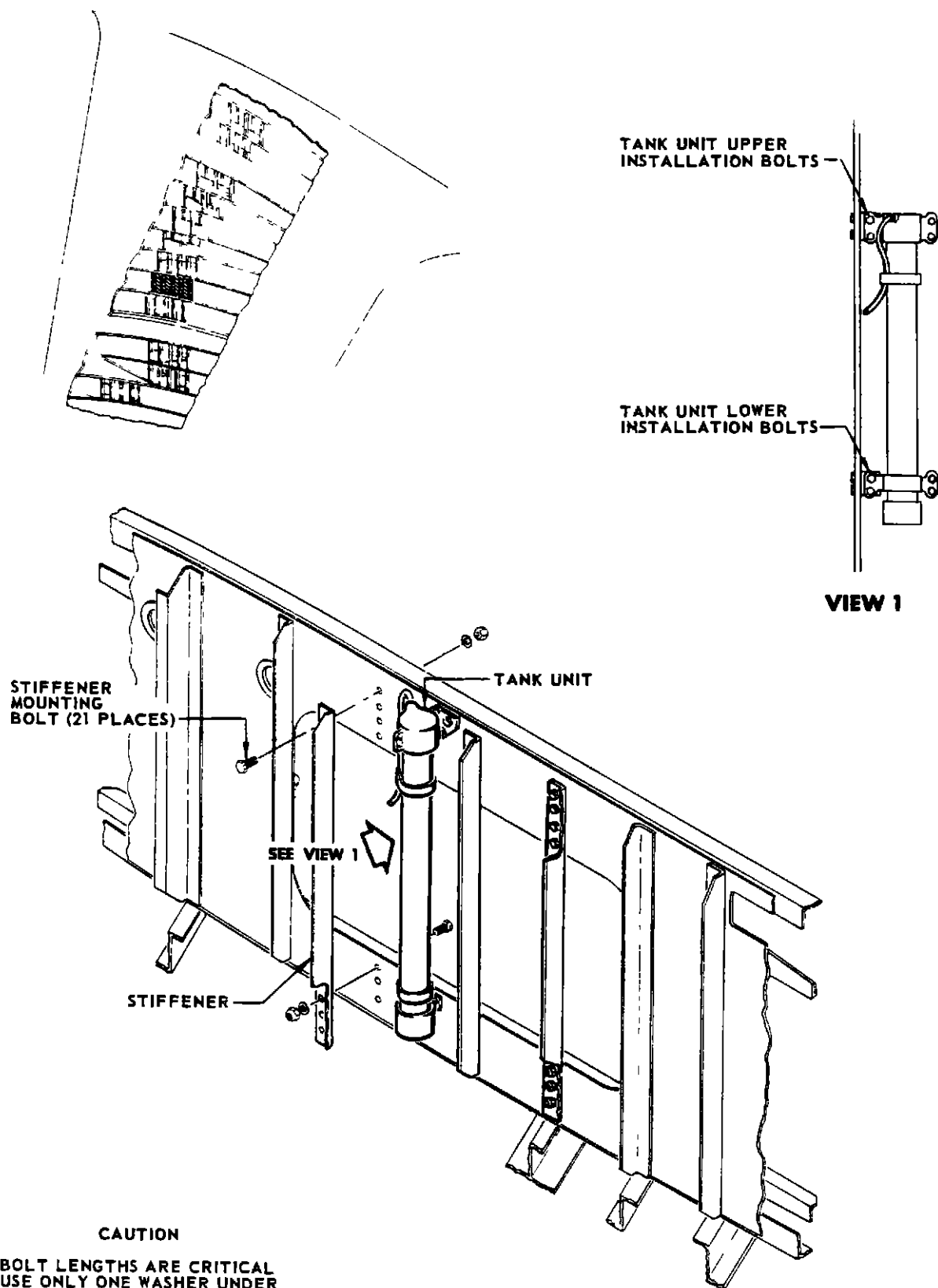
- (2) Place bolts and washers in container to prevent losing them in tank
- (3) Stow reinforcing plate so that it will not damage integral tank sealing

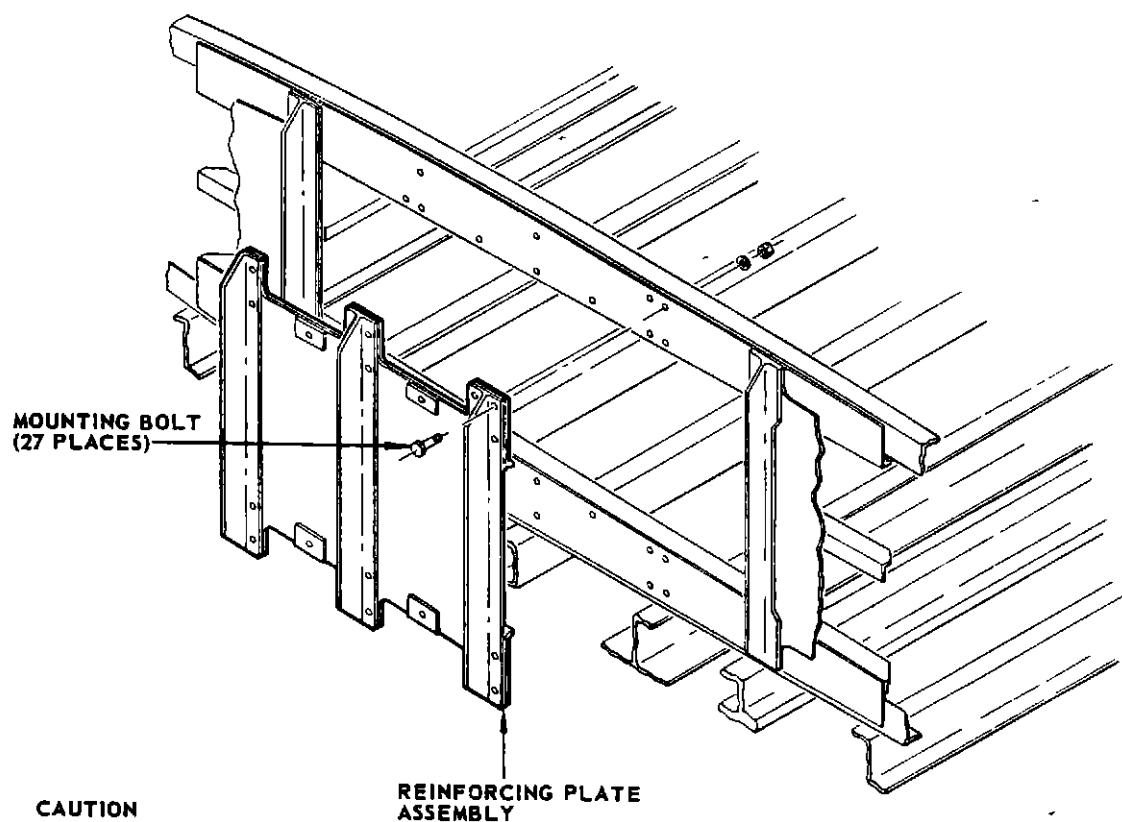
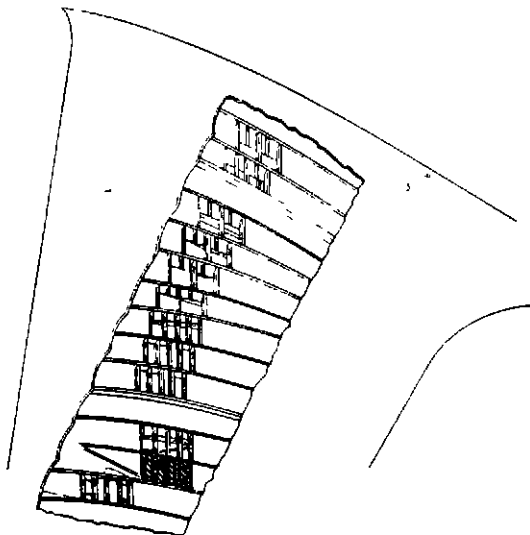
B. Install Structural Members - Access Openings No. 11 and 12 (See figures 209 and 210.)

- (1) Position reinforcing plates
- (2) Install bolts with one washer under each nut

CAUTION BOLT LENGTHS ARE CRITICAL AND PROPER PLACEMENT OF WASHERS IS IMPORTANT. REINFORCING PLATES ARE STRESSED STRUCTURAL MEMBERS.

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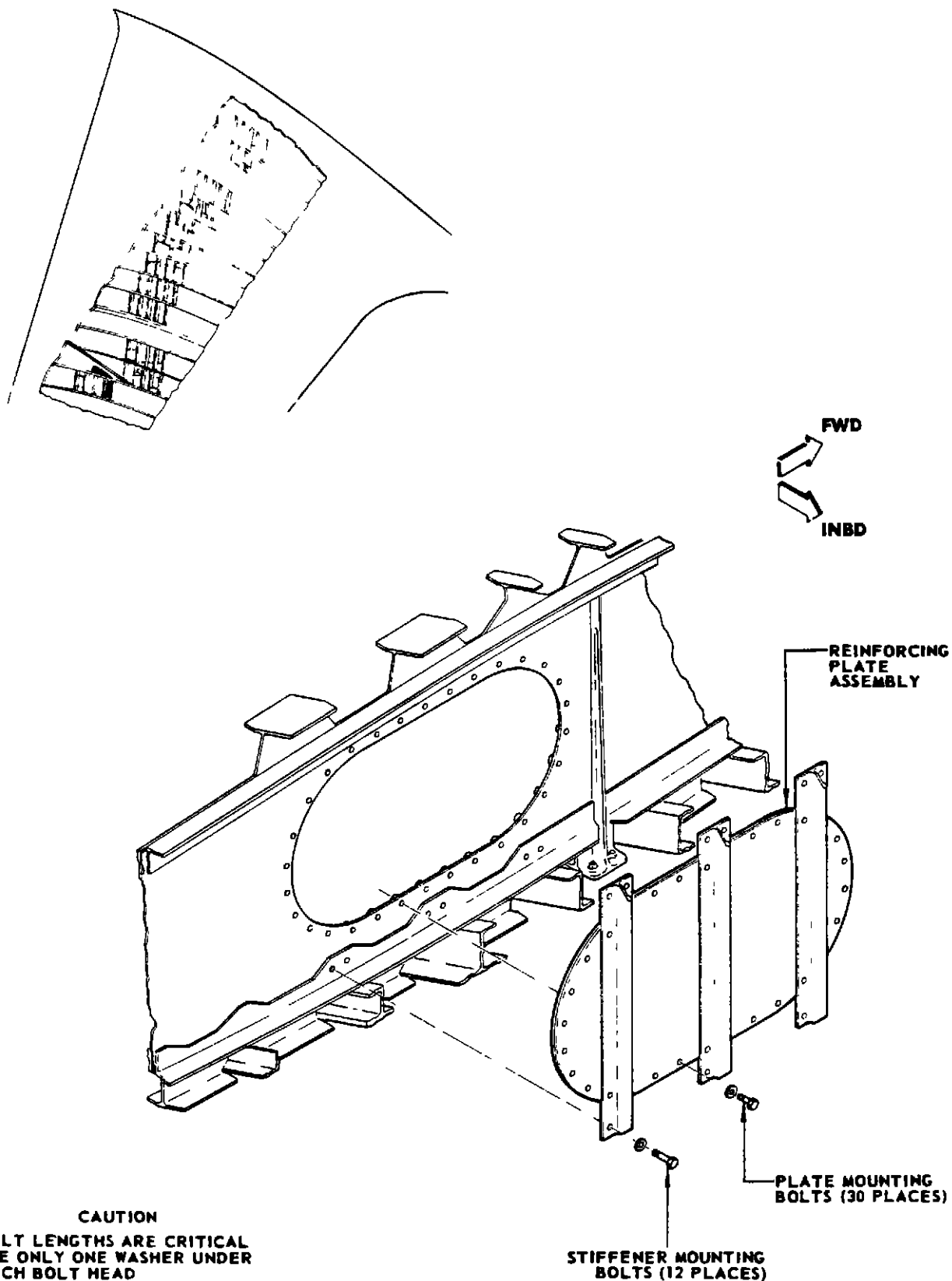




CAUTION

BOLT LENGTHS ARE CRITICAL
USE ONLY ONE WASHER UNDER
EACH NUT

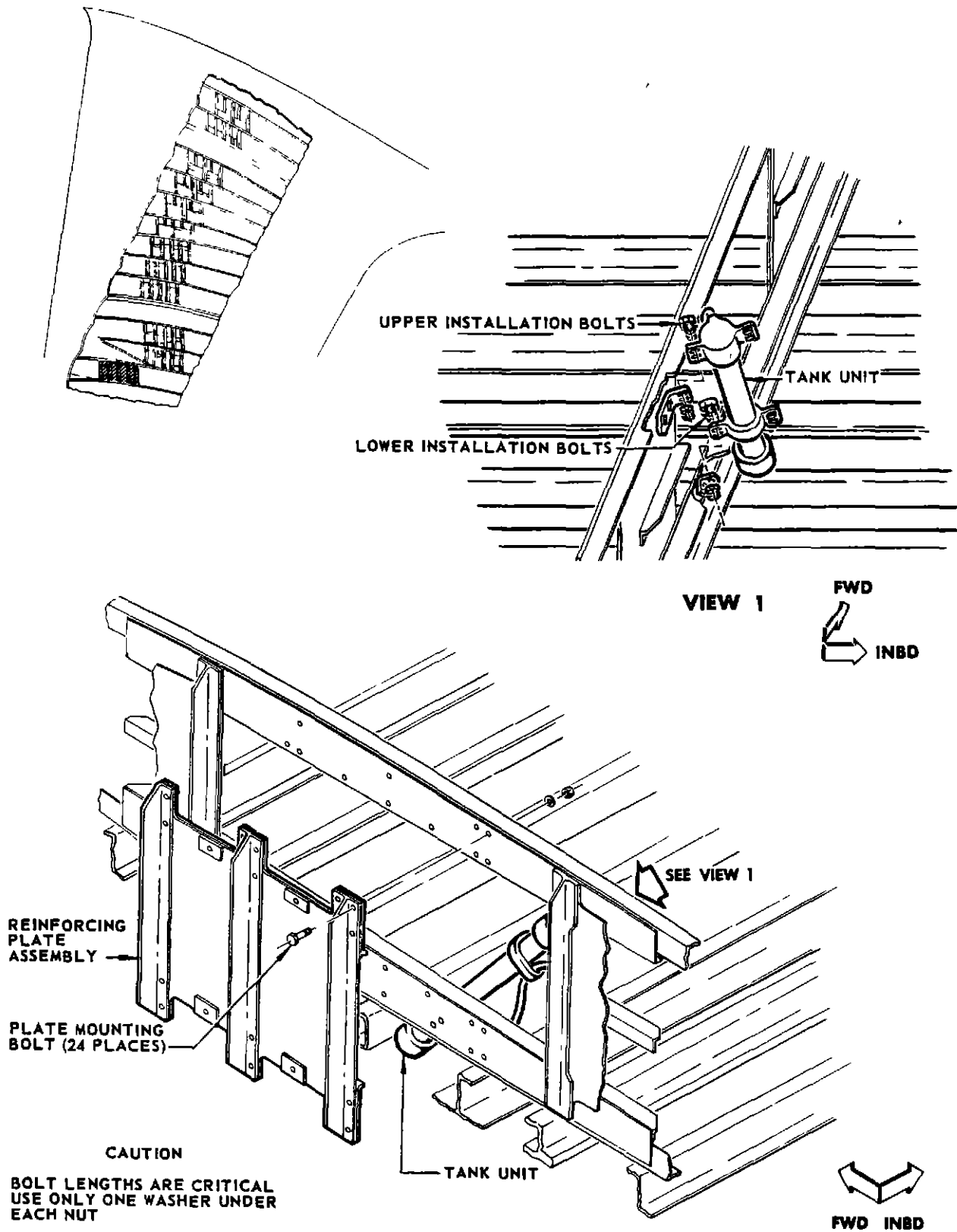
Structural Member Installation - Rib Access Opening No 11
Figure 209



⑥
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Structural Member Installation - Rib Access Opening No 12
Figure 210

28-2-11
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6 Removal/Installation Structural Member - Access Opening No. 13

A Remove Structural Member - Access Opening No 13 (See figure 211.)

- (1) Support reinforcing plate assembly and remove stiffener mounting bolts, plate mounting bolts and washers

CAUTION. DO NOT DROP REINFORCING PLATE ASSEMBLY, AS DAMAGE TO INTEGRAL TANK SEALING MAY RESULT.

- (2) Place bolts and washers in container to prevent losing them in tank.

NOTE: To facilitate installation, identify and keep the reinforcing plate assembly, plate mounting bolts, stiffener mounting bolt, nuts and washers separate

- (3) Stow reinforcing plate assembly so that it will not damage integral tank sealing
- (4) Disconnect tank unit at upper and lower installation bolts. (See view 1) Stow unit next to rib

CAUTION: HANDLE TANK UNIT WITH CARE. DAMAGE TO UNIT WILL AFFECT ITS ACCURACY IN SENSING FUEL QUANTITY.

B Install Structural Member - Access Opening No.13 (See figure 211.)

- (1) Install tank unit.
- (2) Position reinforcing plate assembly.
- (3) Install stiffener and plate mounting bolts with one washer under each bolt head

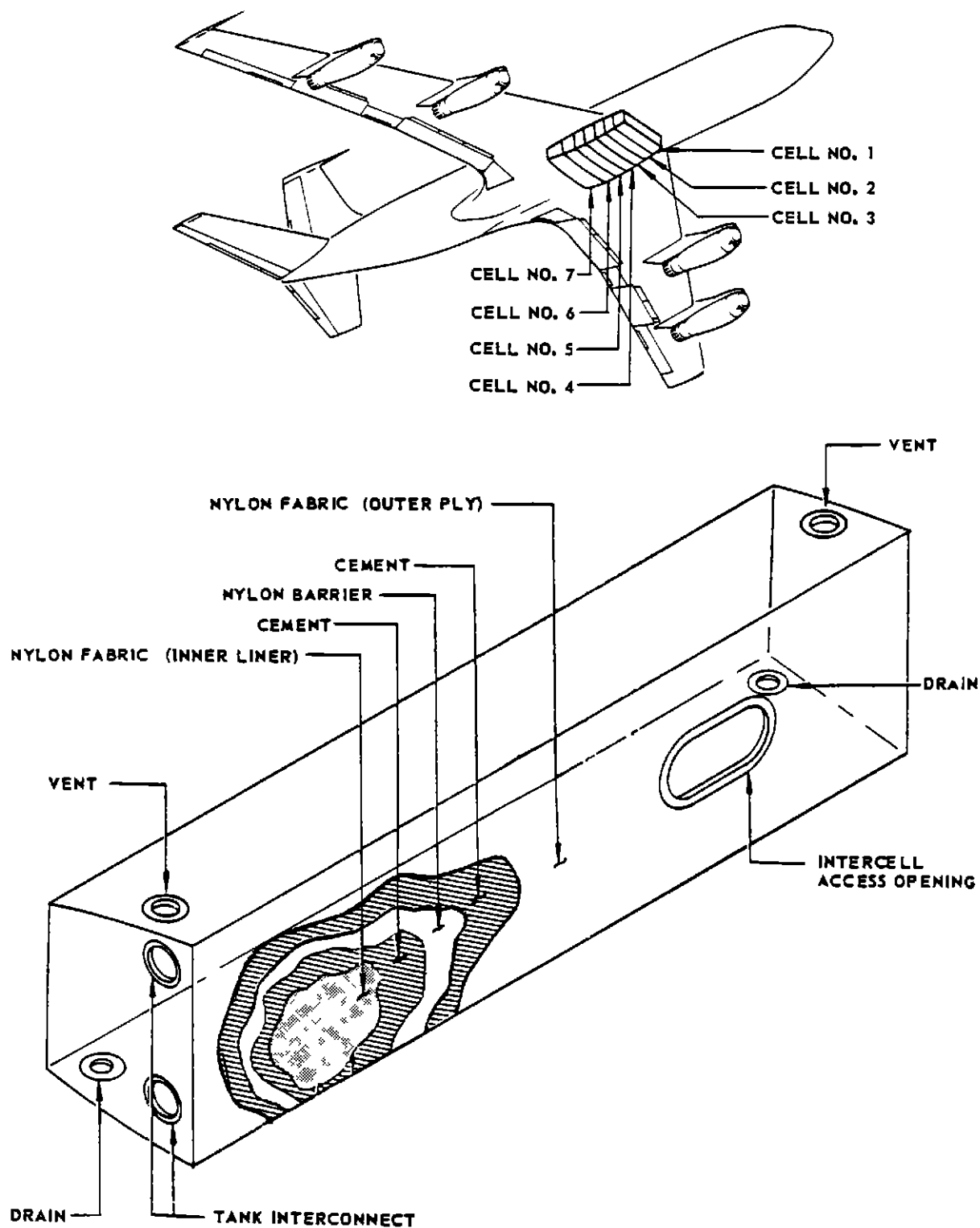
CAUTION: BOLT LENGTHS ARE CRITICAL AND PROPER PLACEMENT OF WASHERS IS IMPORTANT. REINFORCING PLATE ASSEMBLY IS A STRESSED STRUCTURAL MEMBER.

END

REMOVABLE FUEL CELLS - DESCRIPTION AND OPERATION

1. General

- A. The removable fuel cells carry the fuel in the center section of the center wing tank. The cells are located in the center wing cavity which is divided by spanwise beams into seven separate cavities for the installation of up to seven fuel cells. The number of fuel cells installed can be varied and will depend on planned airplane utilization. Cut-outs in the spanwise beams serve as intercell access openings and allow personnel to move from one cell to the other. Interconnect openings in the ends of the fuel cells open into the two integral sections of the center wing tank so that all together, the fuel cells and integral sections form one sectionalized center wing tank.
- B. For ease in identifying the fuel cells and cavities in the text they are numbered 1 through 7, starting with 1 at the front spar and being consecutively numbered going aft to the rear spar, as shown in figure 1.
- C. The fuel cells are non-self sealing and are of very light weight construction. Extreme care must be exercised in handling. Three primary layers of material, cemented together, make up a fuel cell. These are a nylon fabric inner liner, a nylon barrier, and a nylon fabric outer ply. (See figure 1.) The purpose of the inner liner is to contain the fuel and also act as a protective cover for the nylon film barrier. The nylon film barrier prevents fuel from diffusing through the cell wall and the outer retainer ply gives strength to the cell and also gives protection to the nylon barrier. The innerliner and outer ply are made of rubber impregnated nylon fabric. This material is very strong but naturally not impervious to sharp objects, chafing or rubbing against metal or rough objects or any material that would tend to damage thin rubber sections.
- D. In the airplane cavity, each fuel cell is laid on nylon backing board and then attached to the cavity structure with nylon lacing cords. The cords run through ferrules attached to the outer periphery of the cell and through eye bolts and anchors attached to the cavity structure. Several chords of different lengths are required to secure each cell. The length of each cord depends on the size and shape of the individual cell, and the length between the anchor eye-bolt and the tie off eye-bolt.

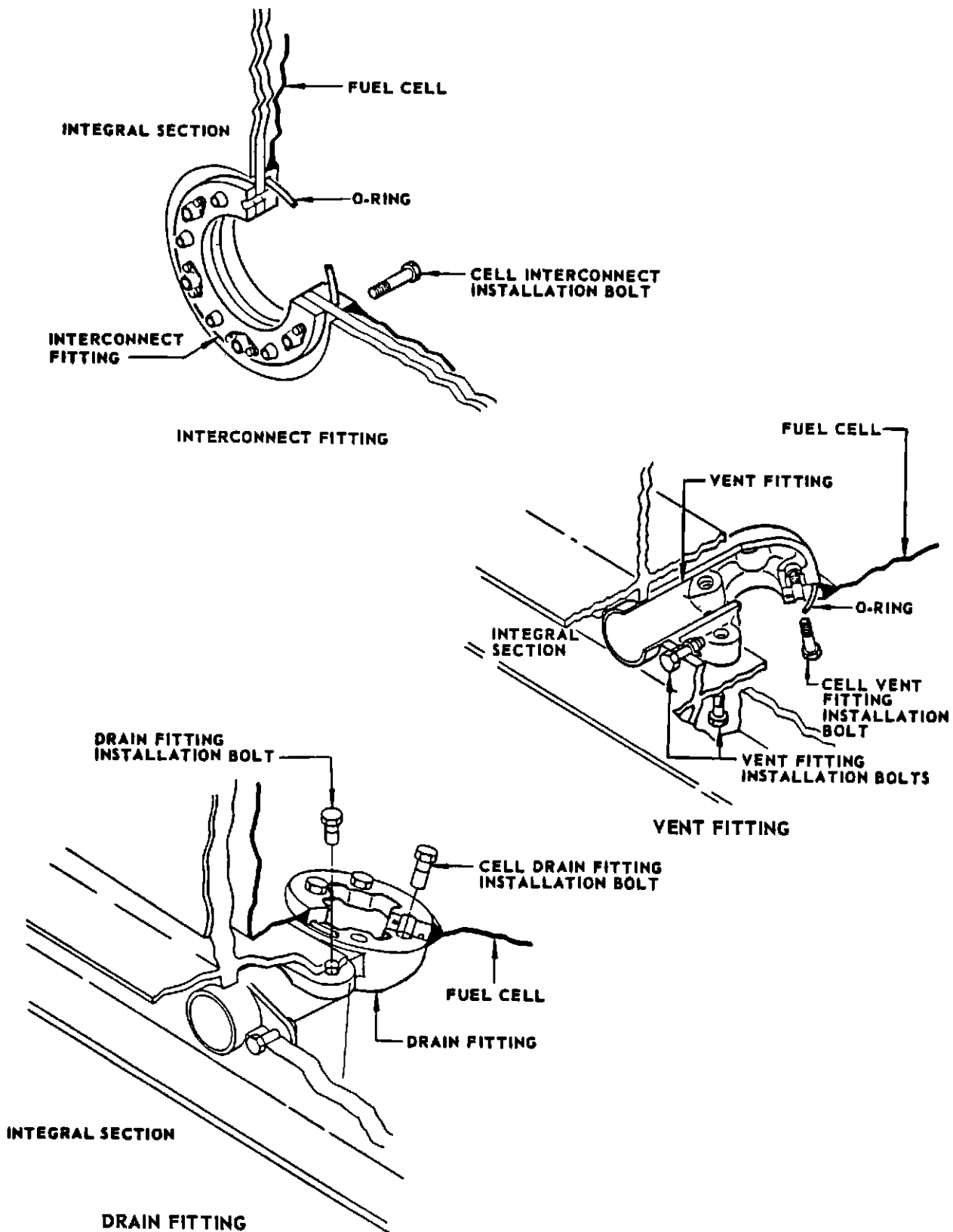


Removable Fuel Cells Location
Figure 1

- E. The knots used to anchor the fuel cell lacing cord in the anchor and eye-bolt fittings are tied in a specific manner to insure maximum protection from slipping or pulling off the fittings. Anchor knots are used for tying the cord to the first fitting and tie-off knots are used at the last fitting. In some instances it is necessary to run two cords through an eye-bolt or anchor the cord around the shank of the eye-bolt and run another cord through. In the latter cases the cord running through the eye-bolt tends to hold the anchor cord in position.
- F. Each fuel cell is equipped with interconnect, vent and drain fittings which mate with fittings in the center wing tank integral sections and cavity structure. (See figure 2.) All fuel cell fittings are metal fittings molded to and forming the surface of cell opening. Each fitting or its mating surface has a groove for the installation of a rubber O-ring which acts as a static gasket type of seal. To function as a fuel tight seal, the O-ring must be compressed between two metal surfaces having a high degree of smoothness. One of these surfaces is the bottom of the fitting O-ring groove and the other is the sealing surface in the fitting mating part. Some of the fittings are attached to the mating part with bolts installed in nutplates while others have steel thread inserts for the installation of attaching bolts.
- G. Two fuel cell access openings are provided in the center wing section to enable maintenance personnel to enter the cavities and remove, install or inspect the fuel cells. One is located in the bottom of cavity No. 2 and the other in the bottom of cavity No. 5. The openings are covered by fuel cell access panels.
- H. As there are only two fuel cell access openings, intercell access openings are provided in the individual cells. The openings allow movement of personnel doing maintenance work inside the cells. The access openings between fuel cells No. 4 and 5, No. 5 and 6, and No. 6 and 7 are covered with removable baffle plates.

2. Fuel Cell Access Panels

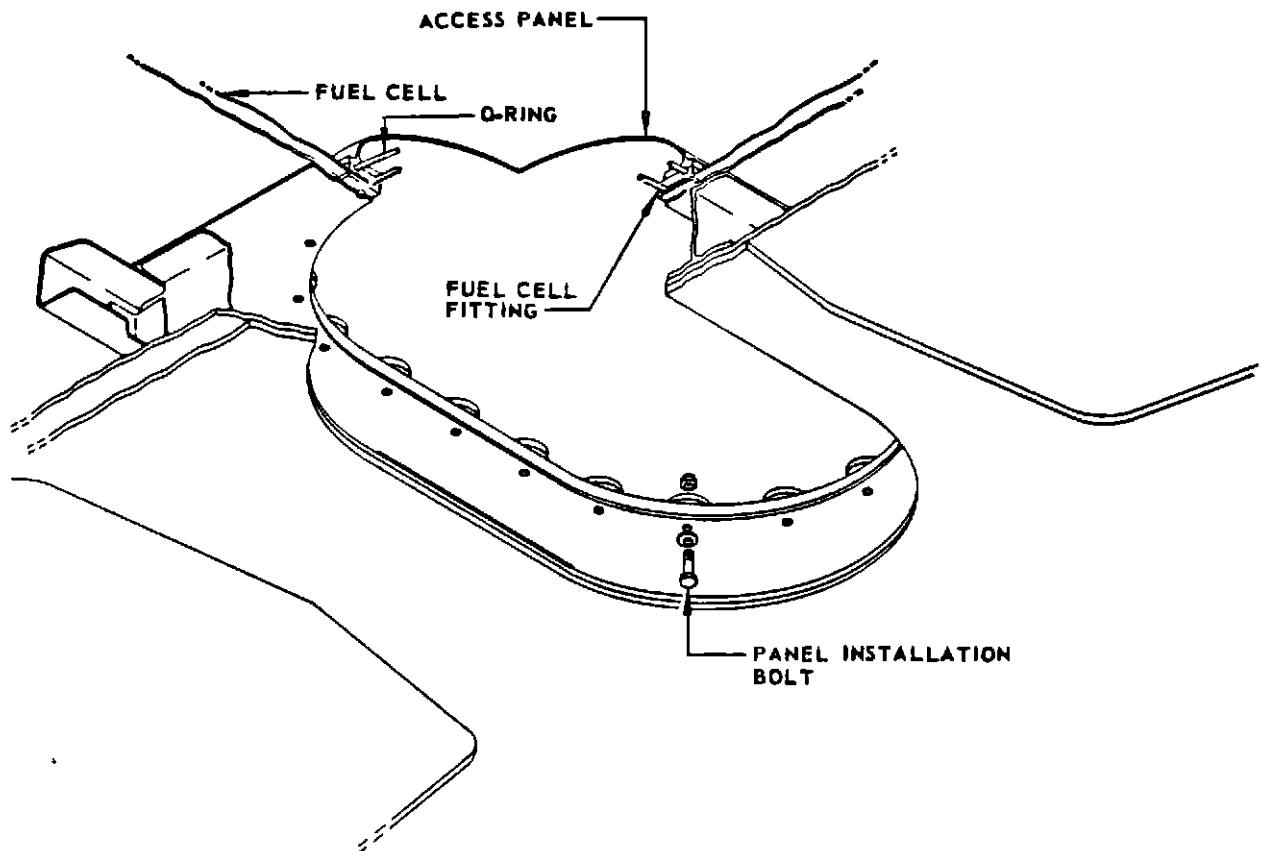
- A. The fuel cell access panels are installed on the bottom of fuel cell cavities No. 2 and 5. (See figure 3.) Access to the panels is on the right hand side of the fuselage in the air conditioning equipment compartment. The panels are O-ring sealed and bolted to the inner surface of the fuel cell access opening fitting and to the center wing cavity structure. Removal of the access panels permits removal or installation of the fuel cells and also allows personnel to enter the cells for inspection and maintenance.



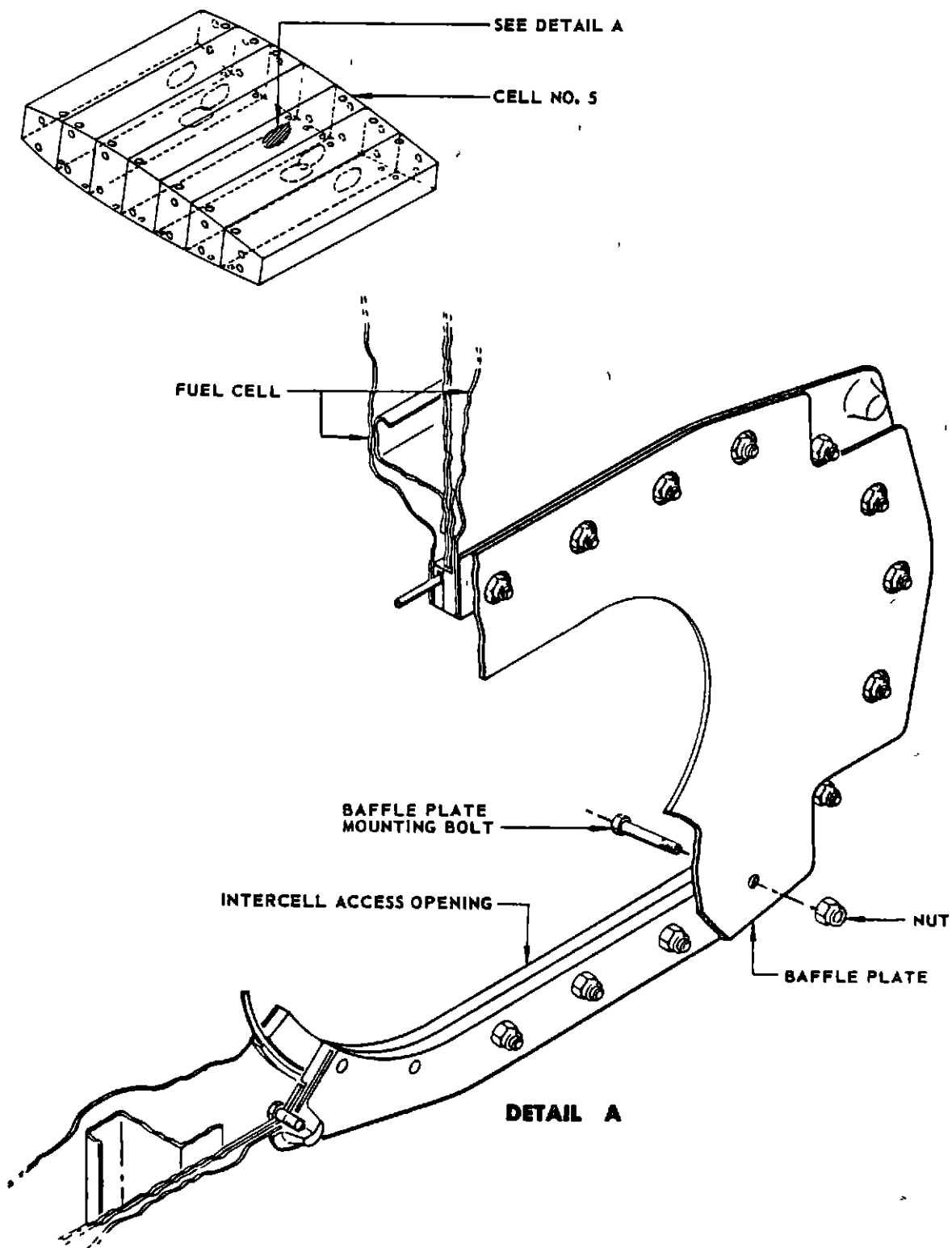
Interconnect, Vent, and Drain Fittings
Figure 2

3. Intercell Baffle Plates

- A. The intercell baffle plates (figure 4 and 5) are installed at the intercell access openings between fuel cells No. 4 and 5, No. 5 and 6, and No. 6 and 7. The purpose of the baffle plates is to act as a barrier to fuel surges which would otherwise exert excessive pressure on the spanwise beam between cells No. 3 and 4 in which there is no access opening. The baffle plates are installed with the same bolts which bolt the intercell access opening fittings together. The baffle plate between cells No. 4 and 5, is attached by bolts and nuts. The baffle plates between cells No. 5 and 6, and No. 6 and 7, are attached by bolts into nutplates.



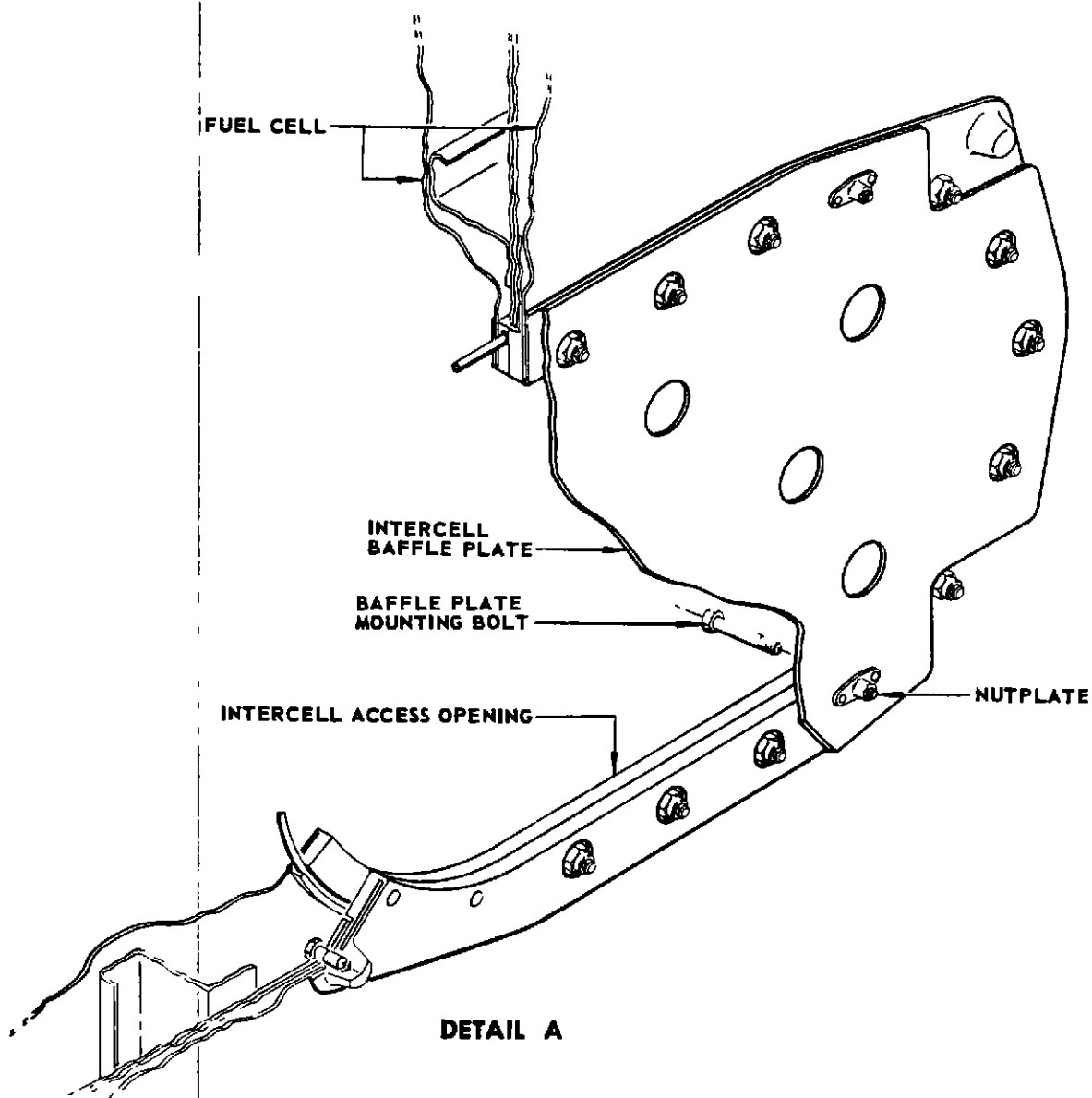
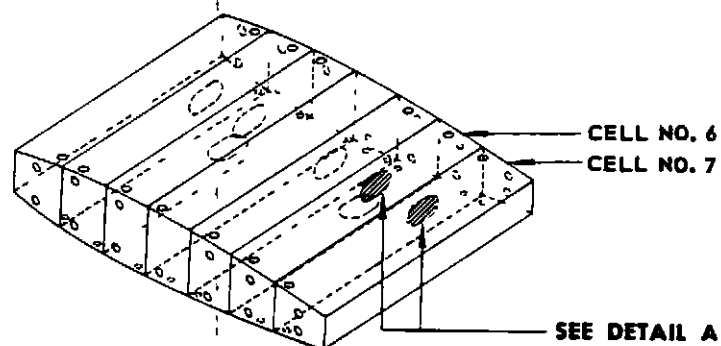
Fuel Cell Access Panels
Figure 3



Intercell Access Opening and Baffle Plate (Cell No. 5)
Figure 4

FUEL
Removable Fuel Cells
Description and Operation

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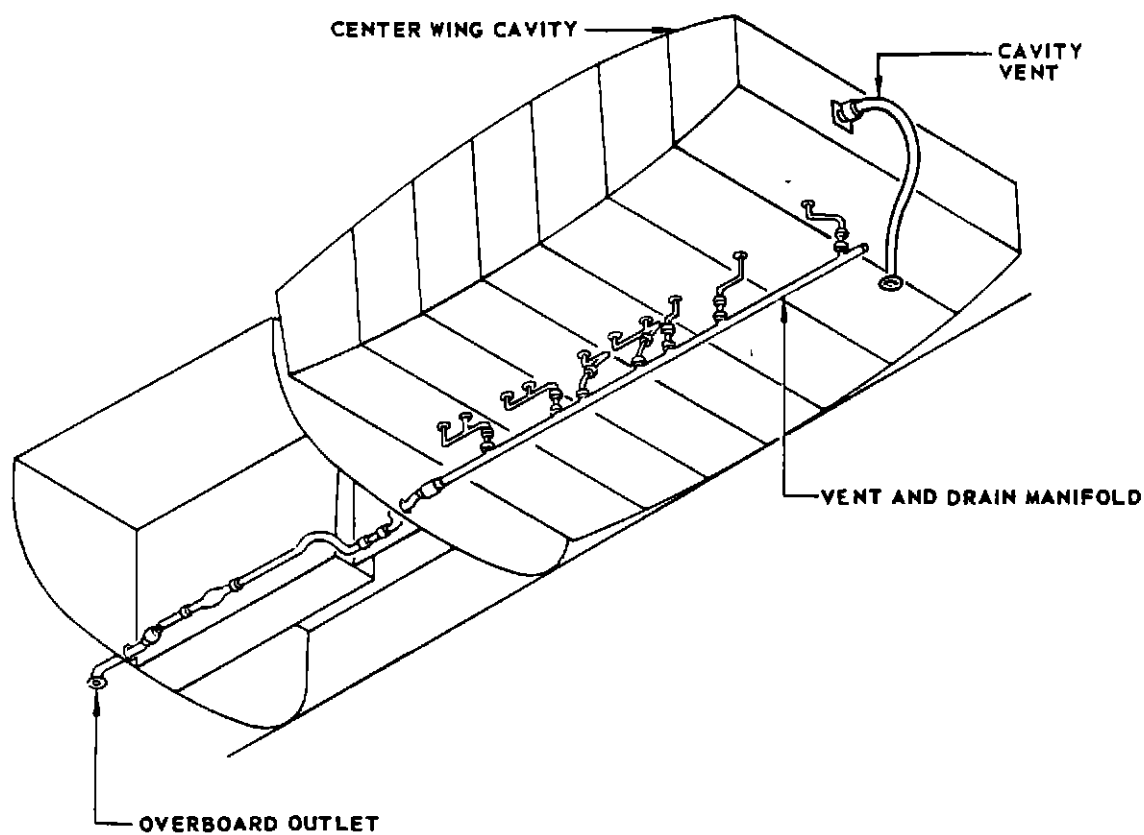
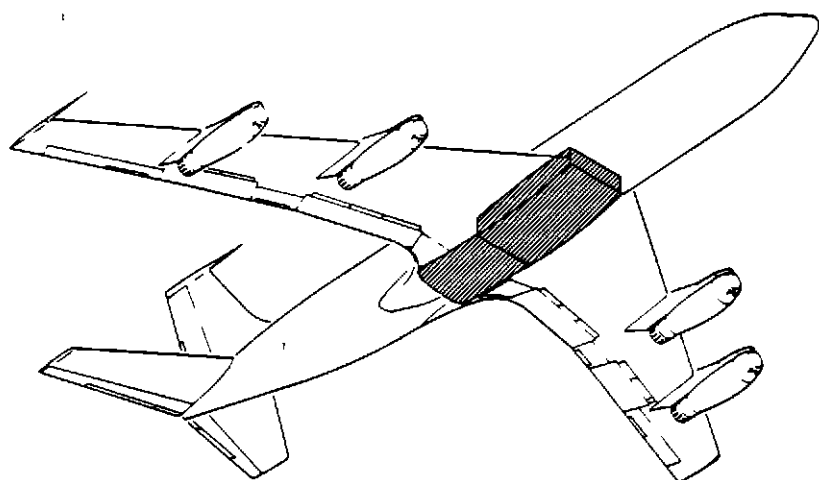
⑥ Intercell Access Openings and Baffle Plates (Cells No. 6 and 7)
March 15/59 Figure 5



REMOVABLE FUEL CELLS - TROUBLE SHOOTING

1. General

- A. Trouble shooting of removable fuel cells will be concerned with the tracing and locating of fuel leaks. A thorough knowledge of the installation of the fuel cells, related equipment and tubing, and the arrangement of the cavity drain system (figure 101), is the most important factor in detecting the location of fuel leaks
- B. Each fuel cell has an individual cavity drain which can be easily disconnected beneath the center wing cavity. Each drain is connected to a common drain manifold and overboard outlet. When fuel is observed at the overboard outlet the individual cell cavity drains can be disconnected and checked for dripping or seeping fuel.
- C. The fuel cell center wing cavities are isolated from each other by sealing the structure in the bottom of the fuselage and a portion of the wall to keep all leaking fuel in the cavity and routed to the common drain manifold and overboard outlet. However, damaged sealant or leaking fasteners could allow fuel to seep between cavities. Evidence of fuel leakage could then be noted at a cavity drain where there was no leakage from the fuel cell in that cavity. Leaks of this type will require a thorough investigation of all cells and cavities concerned.
- D. The following trouble shooting chart outlines a general procedure for tracing and locating fuel cell leaks and can be applied to one or all cell leaks. It is advisable to attempt to trace fuel leaks to the cell or cells causing the leak before draining and opening the center wing tank



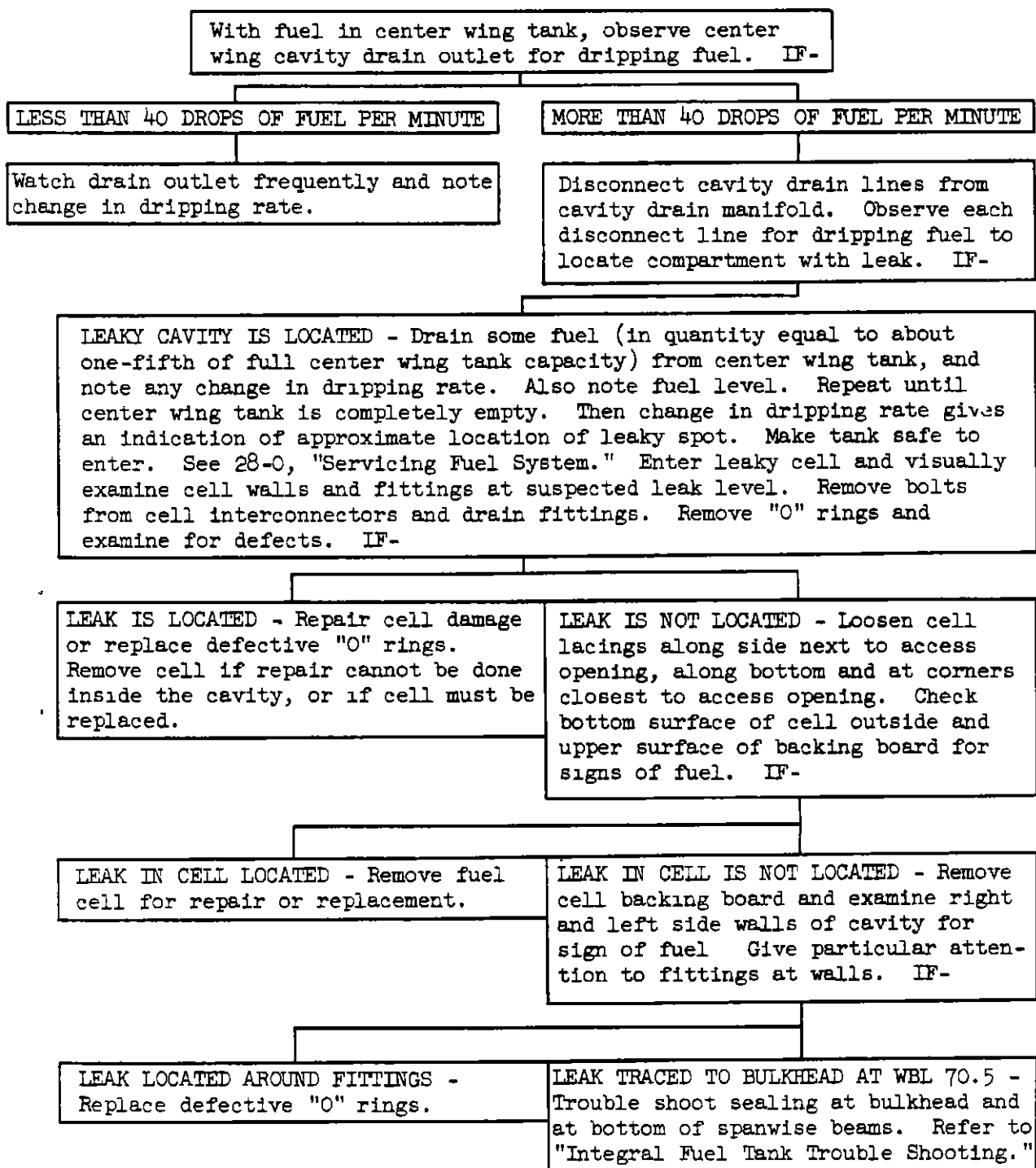
Center Wing Cavity Vent and Drain
Figure 101



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2 Removable Fuel Cells Trouble Shooting Chart

WARNING FUEL AND FUEL VAPORS CONSTITUTE A POTENTIAL HEALTH AND EXPLOSION DANGER. OBSERVE ALL PRECAUTIONS FOR TANK ENTRY AND CLOSURE. REFER TO 28-0, "SERVICING FUEL SYSTEM."



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REMOVABLE FUEL CELLS - REMOVAL/INSTALLATION

1. General

- A. The fuel cells are supported in the airplane cavities by lacing cords strung through lacing tabs on the cells and eyebolts and anchor fittings on the structure. To facilitate installation, the anchor and support points for the cords are identified by a letter and number system as shown in lacing diagrams for each cell. As an example, in fuel cell No. 1 lacing diagram, figure 418, the support point with the symbol and nomenclature $\square A1$, means that cord A is anchored at that point. Nomenclature A2, A3, A4 indicates the sequence of lacing to be followed for cord A. The last, or tie-off point is identified by the highest number in the series and a triangular symbol, thus $\triangle A13$
- B. The following procedures cover the steps necessary to remove and install the fuel cells. Procedures are given for all seven of the cells which can be installed in the seven cavities. If it is desired to remove and install an individual cell, follow the procedures for that particular cell and the applicable steps in the paragraphs on the adjacent cells that must be complied with in some instances. After installation, fuel cells must be checked for leaks.

2. Special Tools and Equipment

- A. Nylon Lacing Cord, MIL-C-5040, Type III
- B. Solvent - Methyl Isobutyl Ketone
- C. Naphtha
- D. Cement - Rubber Cement No. 4, B.F. Goodrich Co , Los Angeles, California

3. Fuel Cell Handling Precautions

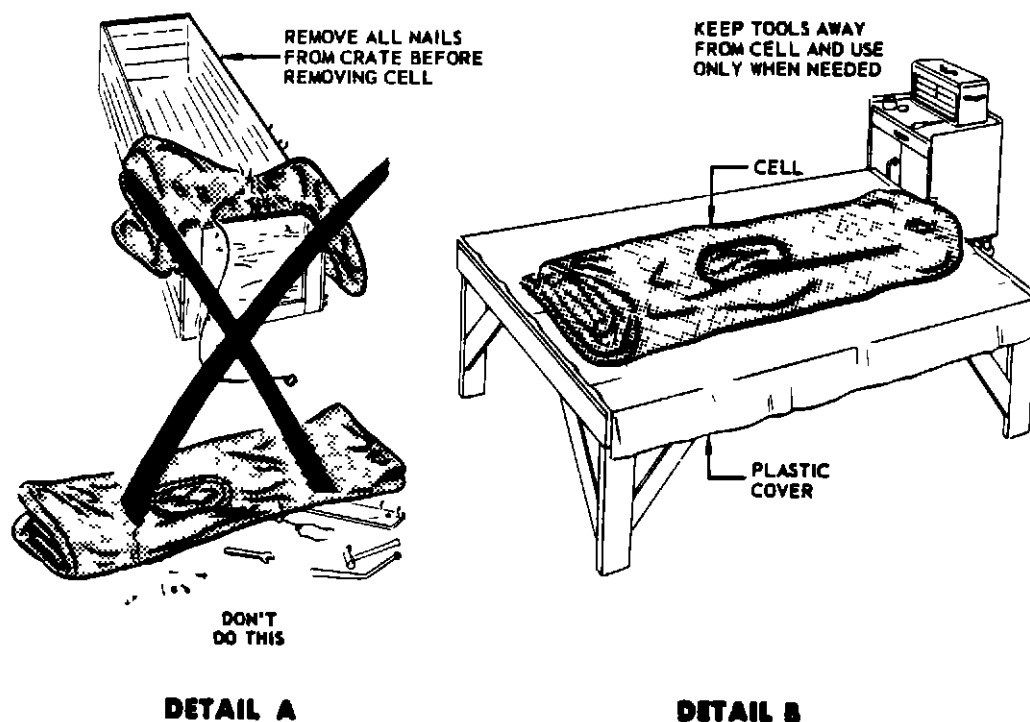
- A. Extreme care must be exercised when removing or installing a fuel cell of light construction as they are easily damaged. The following handling precautions must be complied with:
- (1) Allow fuel cell to remain in shipping crate, package or container until required. Do not stack unpacked cells.
 - (2) Cells exposed to cold temperature (below 65°F) must be warmed to room temperature (above 65°F).
 - (3) Before removing cell from crate, check for any sharp objects or nails which could rip or penetrate fuel cell. (See detail A, figure 401.)

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FUEL
Removable Fuel Cells
Removal/Installation

- (4) Carry cell from one location to another, preferably in folded condition.

CAUTION: DAMAGE WILL RESULT IF A FUEL CELL IS DRAGGED ACROSS THE FLOOR. DO NOT USE CELL FITTINGS FOR LIFTING. DO NOT STEP OR STAND ON A FOLDED CELL.



Fuel Cell Handling
Figure 401

- (5) Unfold or fold fuel cell on smooth, clean, plastic covered padded surface, larger than cell, or clean canvas or cardboard. (See detail B, figure 401.)
- (6) All cell fitting openings must be covered with smooth plywood or cardboard secured in place with masking tape, to protect exposed fitting surface. (See detail A, figure 402.)



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- (7) When folding cell into package small enough to enter fuel cell opening, or for storage purposes, proceed as follows
 - (a) Fold sides of cell inward, approximately in center. (See detail B, figure 402)
 - (b) Overlap side folds.
 - (c) Tie with cotton web straps. Use easily disengaged slip knot. (See detail C, figure 402.)
- (8) Make sure rubber protectors are installed around access opening. (See detail D, figure 402.)
- (9) Fold fuel cell just prior to inserting or removing from airplane cavity. Use three men to carry cell into cavity.

CAUTION DO NOT FOLD A CELL ABUSIVELY OR UNNECESSARILY. DO NOT FOLD ACROSS OR BESIDE ANY FITTING DAMAGE TO CELL STRUCTURE OR FITTING WILL RESULT.

4. Remove Fuel Cells

A. Prepare for Fuel Cell Removal

- (1) Prepare for entry into center wing tank.

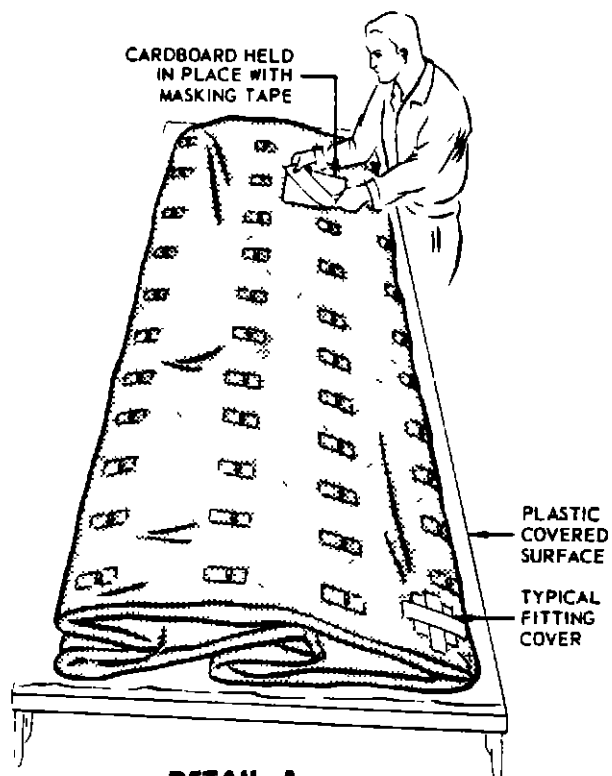
WARNING. EXPLOSIVE AND TOXIC DANGERS OF VAPORS IN VICINITY OF FUEL TANKS WHICH HAVE CONTAINED FUEL ARE OF SUCH POTENCY THAT SEVERAL PRECAUTIONS MUST BE FOLLOWED BY PERSONNEL BEFORE ENTERING ANY WETTED OR DRY TANK FOR MAINTENANCE PURPOSES

Refer to Servicing Fuel System, 28-0.

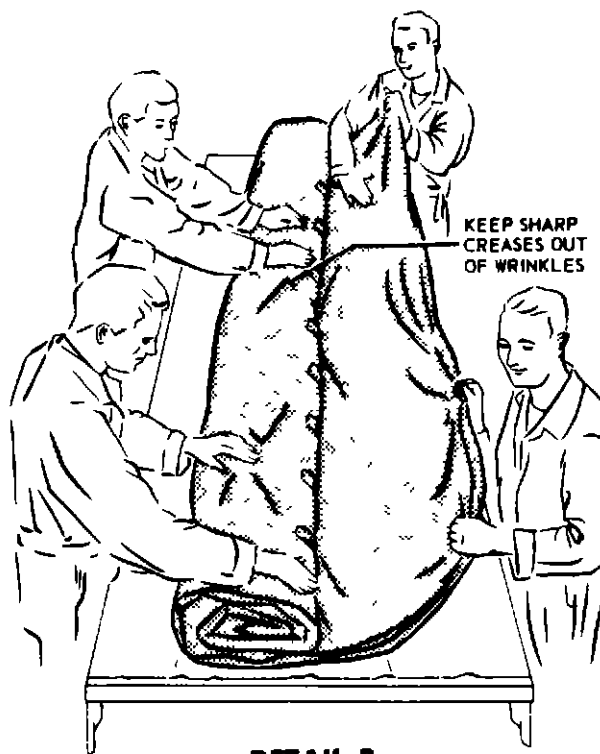
- (2) Remove air conditioning equipment necessary for tank access. Refer to Air Conditioning, Chapter 21.
- (3) Enter applicable fuel cell and visually check around cell interior for possible defects. Mark all suspected areas with chalk or silver colored pencil. If necessary, repair as described in Removable Fuel Cells - Approved Repairs.

WARNING USE ONLY EXPLOSION-PROOF SHIELDED LIGHTS IN AND AROUND FUEL CELLS DO NOT ALLOW LIGHT TO REST AGAINST CELL WALL

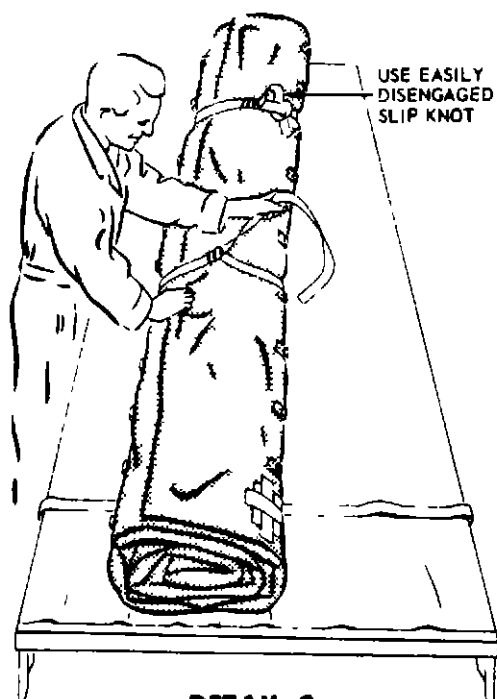
NOTE: If cell is to remain undisturbed in aircraft without fuel for a period greater than thirty days, cell interior must be coated with clean SAE 10-20 engine oil to preserve the inner liner. Do not permit oil to pool or puddle, remove any excess that remains after application.



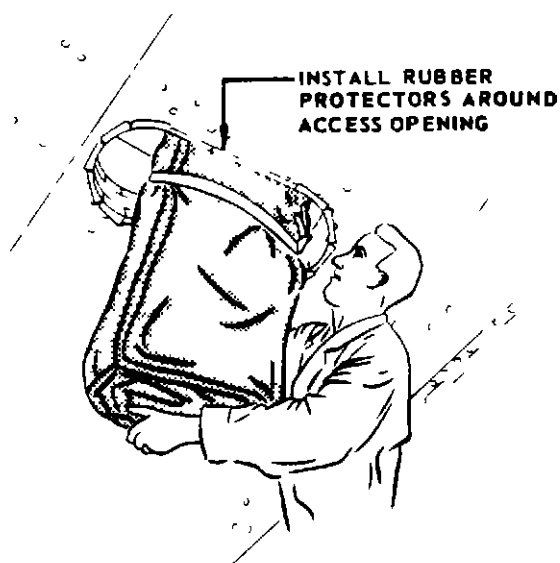
DETAIL A
Installing Fitting Covers



DETAIL B
Folding Fuel Cell



DETAIL C
Tying Fuel Cell



DETAIL D
Placing Cell in Cavity

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B. Remove Fuel Cell No. 1, 2, 3, 5, 6 and 7.

- (1) Gain access to fuel cell through applicable fuel cell access opening.
- (2) Remove bolts from tank interconnects, vent and drain fittings at left end of cell. (See figure 403.)
- (3) Place all fasteners in container to prevent losing them in tank.
- (4) Remove bolts from tank interconnects, vent and drain fittings at right end of cell. (See figure 403.) Place all fasteners in container to prevent losing them in tank.
- (5) Remove bolts and nuts holding intercell access opening fittings together. Place all fasteners in container.

NOTE: When removing fuel cell no. 2, 5 or 6, it is necessary to remove bolts from fore and aft intercell access openings. When removing cell no. 5, 6 or 7, the baffle plates will be removed in step (5) above. Refer to 28-3-11, "Remove Baffle Plates".

- (6) If cells no. 1, 2, 5, 6 or 7 are being removed, it is necessary to remove four bolts retaining intercell access opening fitting to structure.
- (7) Untie lacing at all tie-off points around the intercell access openings.

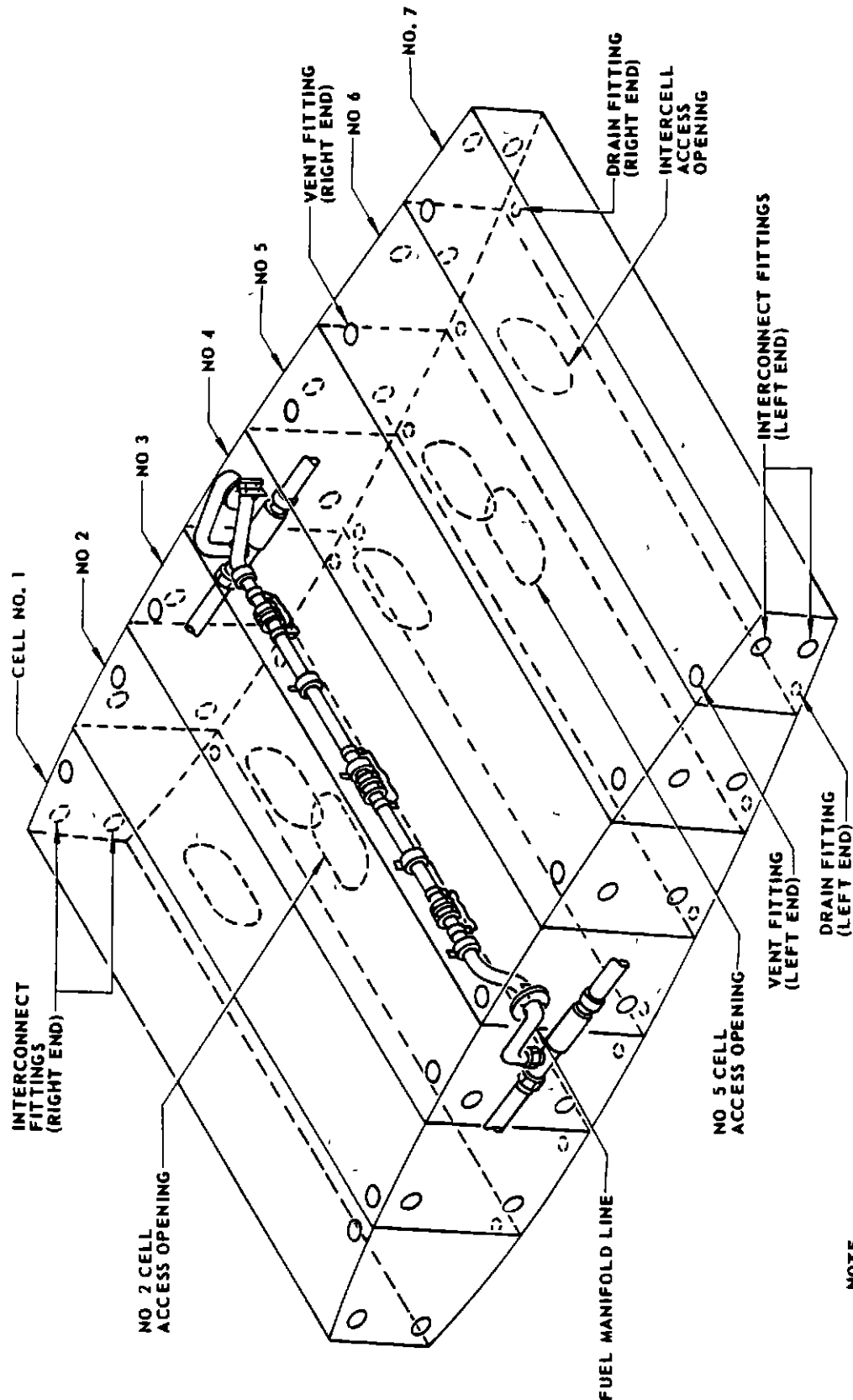
NOTE. In cells no 2 and 5, it is necessary to untie lacing at two points either side of the fuel cell access panel opening, concurrently with step (7). See applicable lacing diagram.

- (8) Push in on cell at intercell access opening to get slack in lacing cords. Cords will slip through eyebolts and anchors that retain them.

NOTE: When removing cell no 2, 5 or 6, push in on cell at front access opening to gain slack in cords.

- (9) Crawl into cavity going to right. Proceed around cell, unlacing right-hand end and working towards left end of cell.

CAUTION: DO NOT HANDLE CELL IN SUCH A MANNER AS TO CAUSE SHARP CREASES. KEEP IT AS LOOSE AS POSSIBLE WHILE UNTIEING LACING. DO NOT CRAWL OVER CELL.



NOTE
FITTINGS ARE POSITIONED
AT LEFT AND RIGHT END
OF EACH CELL AS SHOWN

Fuel Cell Fitting Location
Figure 403



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- (10) Remove cords from cell ferrules, roll into neat coil, tie with masking tape and hang at individual anchor points. Replace any frayed or damaged cords.
- (11) Cover edges of intercell access opening with masking tape.
- (12) Cover all fuel cell fitting openings with cardboard held in place with masking tape similar to that shown in detail A, figure 402.
- (13) Fold cell similar to that shown in detail B, figure 402.
- (14) Position three cotton web straps around cell similar to that shown in detail C, figure 402, and tie lightly.
- (15) Remove fuel cell from airplane cavity, taking care to prevent cell from rubbing against structure.
- (16) Following removal, the cells are to be cleaned inside and outside with a lint-free clean cloth moistened with warm water.
- (17) If it is evident that the cell will not be reinstalled and fueled for a period greater than 10 days, spray or swab the inner liner with a thin coat of SAE 10-20 engine oil. This will prevent the inner liner from cracking or drying out. Do not permit oil to pool or puddle. Remove any excess which remains.

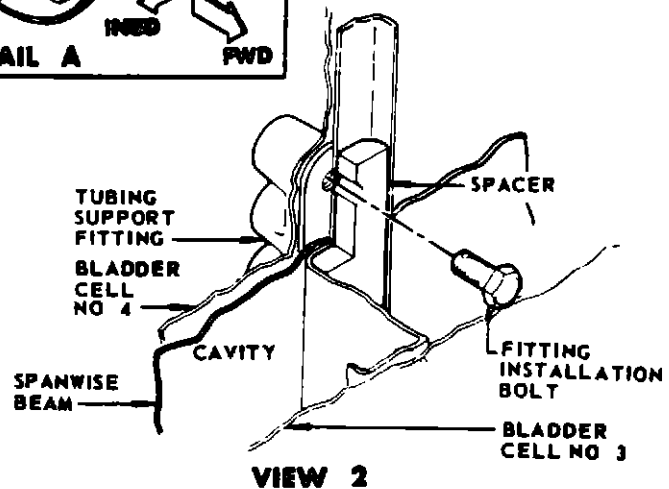
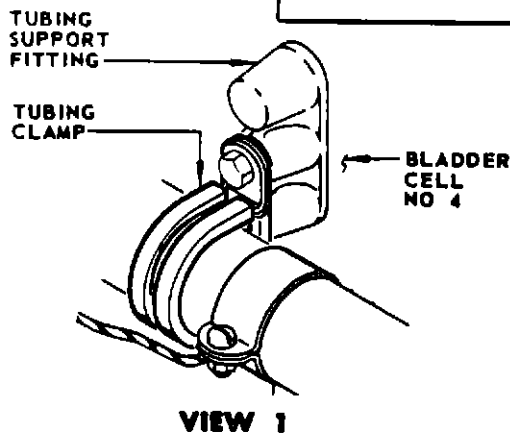
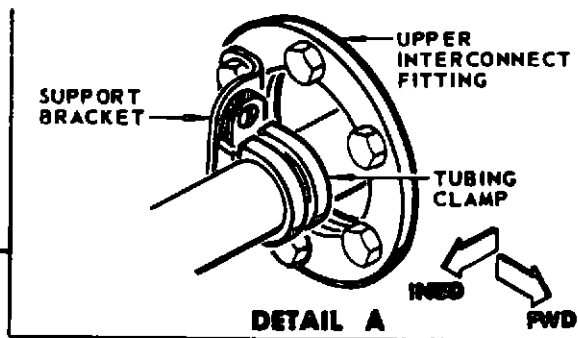
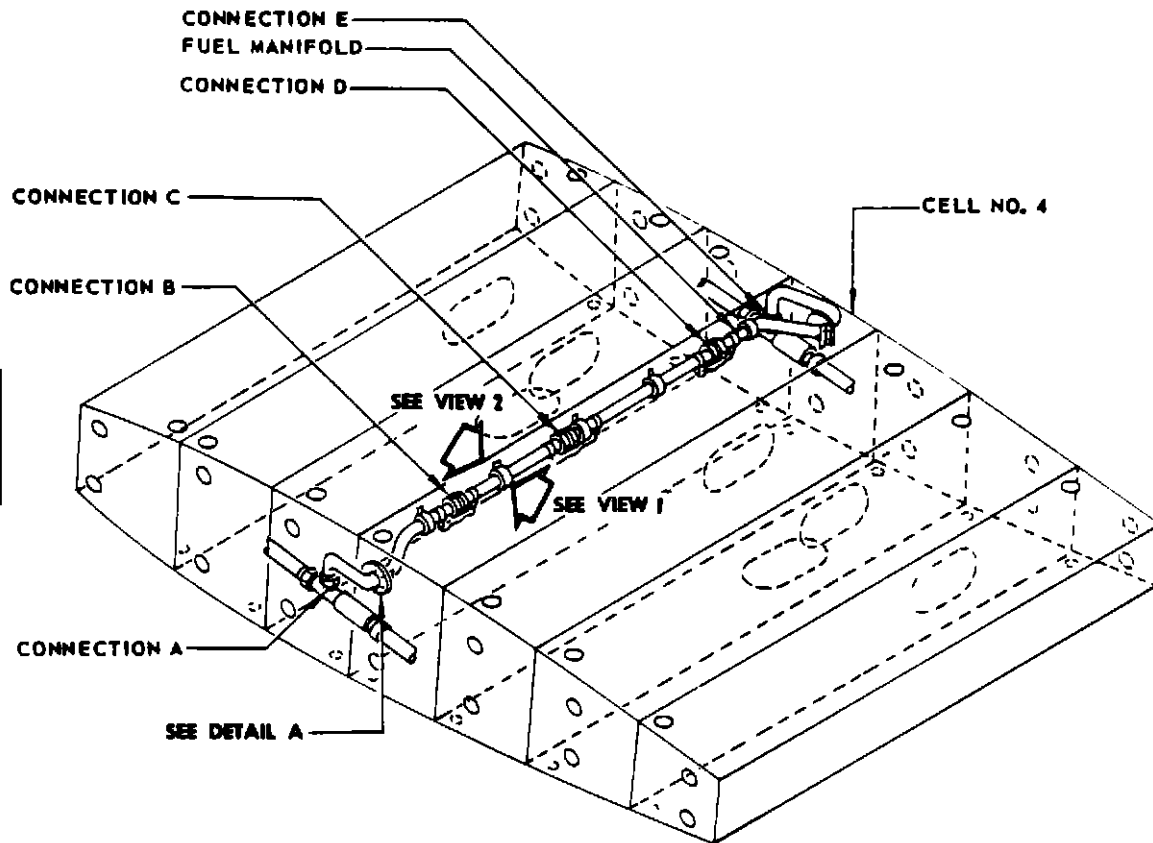
C Remove Fuel Cell No. 4

- (1) Remove No. 5 cell access panel and No. 5 cell forward baffle plate to gain access to cell No. 4. Refer to 28-3-1 and 28-3-11

NOTE Place all loose parts in marked containers to prevent loss of parts or damage to cell and to facilitate installation.

- (2) Remove crossfeed fuel manifold. (See figure 404.)
 - (a) Gain access to left integral section and disconnect crossfeed manifold at connection A, figure 404.
 - (b) Disconnect manifold at connections B, C, and D, figure 404.
 - (c) Remove tubing clamp to support bracket at left upper interconnect fitting.
 - (d) Remove clamp mounting bolts which retain the two left-hand portions of the manifold to tubing fittings at the front of the cell. (See view 1, figure 404.)

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Fuel Cell No 4 Tubing Installation
Figure 404



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- (e) Remove tubing from fuel cell and place on bottom of integral section out of way.

CAUTION. DO NOT DROP TUBING DAMAGE TO INTEGRAL FUEL TANK SEALING MAY RESULT.

- (f) Gain access to right integral section and disconnect fuel manifold at connection E, figure 404.
 - (g) Remove tubing clamp to support bracket at right upper interconnect fitting.
 - (h) Remove clamp mounting bolts which retain two right-hand portions of manifold to tubing fittings at front of cell
 - (i) Remove tubing from fuel cell and place on bottom of integral section out of way.
- (3) Remove bolts from tank interconnects, vent, and drain fittings at left end of cell (See figure 403.)
 - (4) Remove bolts from the tank interconnects, vent and drain fittings at right end of cell. (See figure 403.)
 - (5) Unlace bladder cell No. 3 as necessary and enter cavity No. 3, remove the bolts and spacers that retain the fittings on which the fuel manifold line is supported on the forward side of cavity No. 4. (See view 2, figure 404.)
 - (6) On cell No. 4, remove bolts retaining intercell access opening fittings to gain access to lacing tie-off points around opening.
 - (7) Untie lacing at all tie-off points around intercell access opening.
 - (8) Untie lacing at one place on bottom of cell.
 - (9) Push in on cell at intercell access opening to get slack in lacing cords. Cords will slip through eyebolts and anchors that retain them.
 - (10) Crawl into cavity going to right. Proceed around cell unlacing right end and working towards left end of cell.



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- (11) Remove cords from cell, roll into a neat coil, tie with masking tape and hang at individual anchor points. Any frayed or damaged cord must be replaced with new cord.
- (12) Cover edges of intercell access opening with masking tape.
- (13) Cover all fuel cell fitting openings with cardboard held in place with masking tape, similar to that shown in detail A, figure 402.
- (14) Fold cell. Similar to that shown in detail B, figure 402.
- (15) Position three cotton web straps around cell similar to that shown in detail C, figure 402.
- (16) Remove fuel cell from airplane cavity, taking care to prevent cell from rubbing against structure.
- (17) Repeat steps 4.B.(16) and 4.B.(17).

5. Install Fuel Cells

A. Prepare for Cell Installation

- (1) Prepare fuel cell cavity.
 - (a) Check cavity backing board for raw edges, cracks, or otherwise defective or damaged areas. There shall be no raw edges of backing board in contact with cells. See 28-4-1 for replacement of damaged backing boards
 - (b) Cover edges of access openings through which cell must pass during installation with rubber protectors or equivalent.

CAUTION: THE SURFACE OF THE SKIN AROUND THE ACCESS PANEL OPENING IS A SEALING SURFACE. A SCRATCH MAY RESULT IN FUEL LEAKAGE. OPENING MUST HAVE PROTECTORS INSTALLED AS SOON AS ACCESS PANEL IS REMOVED.

- (c) Replace all backing board screws that have damaged, sharp or jagged recesses.



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- (d) Clean the cavity thoroughly. Use a vacuum cleaner to clean off all surfaces of structure where chips, dirt, grit or foreign material may be lodged.
- (e) Check all cell bulkhead fittings for loose nutplates.

NOTE: Loose nutplates on the cell bulkhead fittings are a source of fuel leakage. Check thoroughly around nutplates.

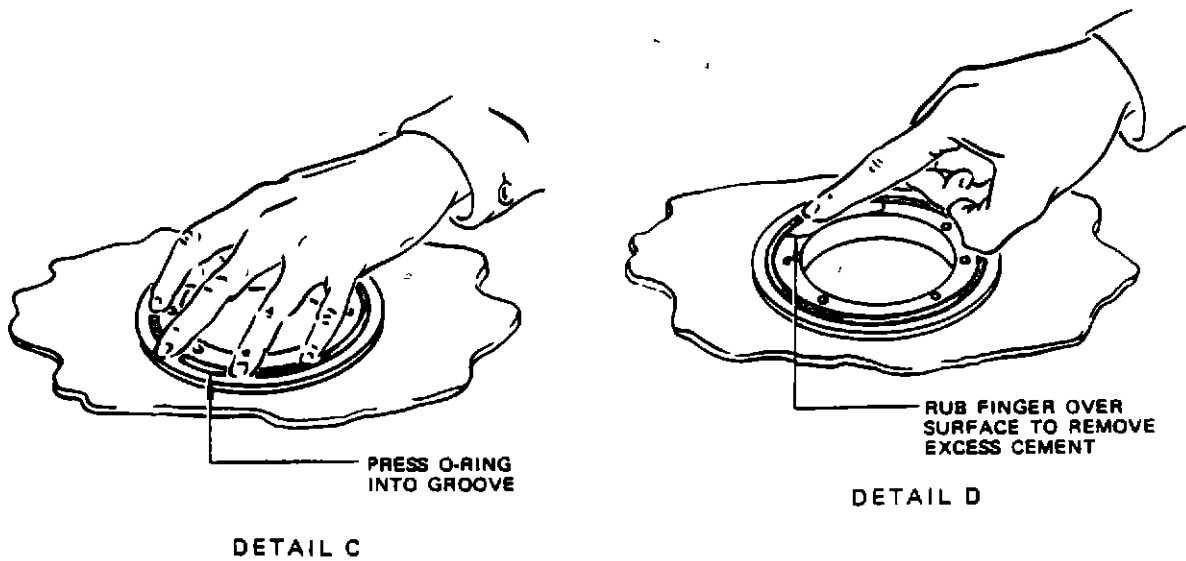
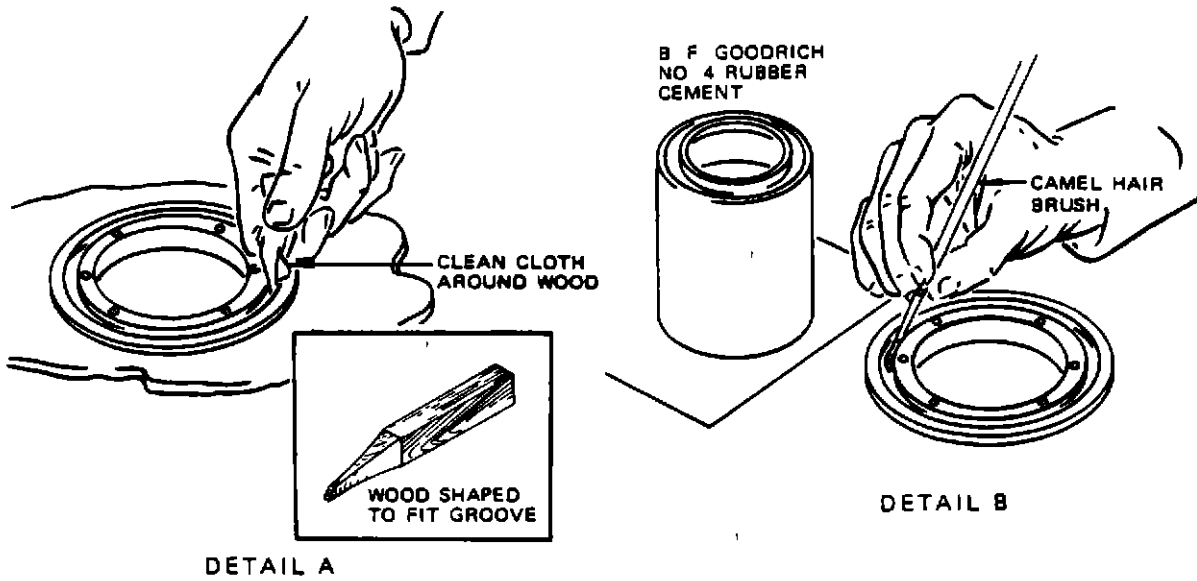
(2) Prepare Fuel Cell

- (a) Comply with fuel cell handling precautions as described in paragraph 3, "Fuel Cell Handling Precautions".
- (b) Unfold cell carefully. This is necessary to install rubber O-rings seals in cell fittings.

NOTE. The sealing surfaces of the fittings may be covered with "metallic tape" discs during shipping. Prior to installation, these discs are to be removed. Should any of the adhesive from the tape be transferred to the surface of the fitting, it should be removed with gasoline.

- (c) Wipe outside and inside surface of cell with warm water dampened clean cloth. While wiping check surfaces for scratches, cuts, abrasions or obvious damage.
- (d) Check all lacing tabs. Run 1/4-inch twist drill through each tab to insure that hole will accommodate nylon lacing cord.
- (e) Check the external surface of each cell fitting to insure they are clean. Remove rubber particles and foreign material with a swab lightly dampened with methyl isobutyl ketone.
- (f) Install new O-rings in all fuel cell fitting grooves. (See figure 405.) Proceed as follows:
 - 1) Examine O-ring for cuts, abrasions, distortions and deposits of foreign material. If defective, discard the O-ring.

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- 2) Check O-ring fit in cell fitting O-ring groove. O-ring should fit groove correctly with no distortion or kinks
 - 3) Clean cell fitting O-ring groove. Use a pointed wood stick with the sharp end covered with a clean cloth dampened with naphtha. Check cell fitting for cuts, scratches, dents, distortion and foreign material. (See detail A.)

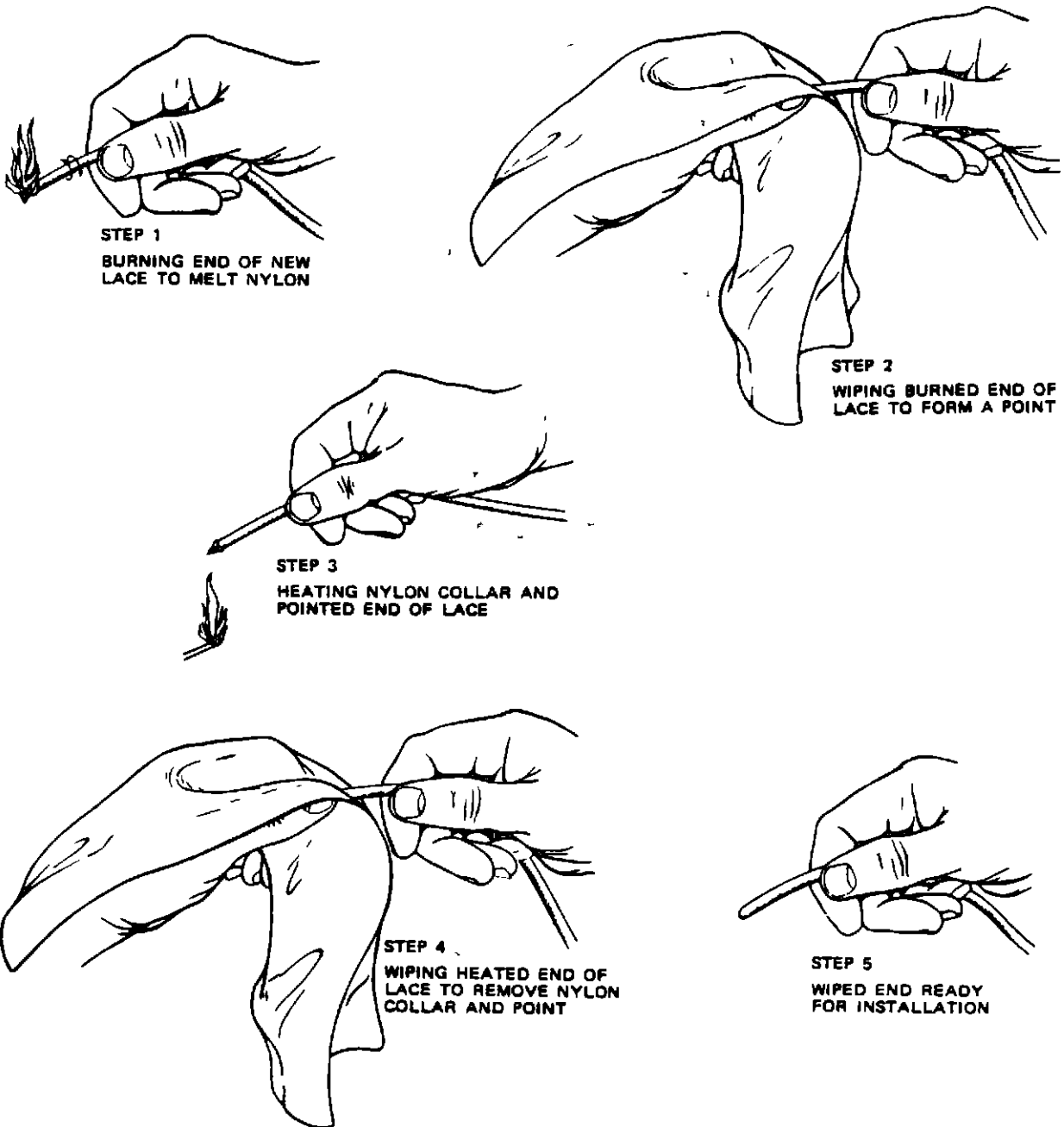
NOTE. A cell having defective O-ring grooves must be replaced
 - 4) Clean the O-ring and flat surface of the cell fitting with naphtha
 - 5) Remove the naphtha film from the O-ring groove and all fitting by wiping with a lint-free cloth dampened with water
 - 6) Apply a light coating of B.F. Goodrich No 4 rubber cement to the O-ring groove with a camel hair brush. (See detail B.)
 - 7) When cement in the O-ring groove becomes tacky, press O-ring into groove. (See detail C.)
 - 8) Remove excess cement from the flat surface of the cell fitting by rubbing the thumb or finger over the surface. The cement will roll or peel off. (See detail D.)
- (g) Tape cardboard patches over all bulkhead fittings after O-rings have been installed. This will protect the O-rings during installation of the cell.
- (h) Prepare new lacing cords. (See figure 406.)
- 1) Layout the cord lengths between the anchor and tie-off points shown on the applicable cell lacing diagram. Allow an additional 24 inches in length for tying off and anchoring and for the slack between lacing locations.

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- 2) Prepare end of new lacing cord for installation. Proceed as follows:

WARNING: THIS LACING CORD PREPARATION MUST BE PERFORMED IN AN EXPLOSION SAFE AREA.

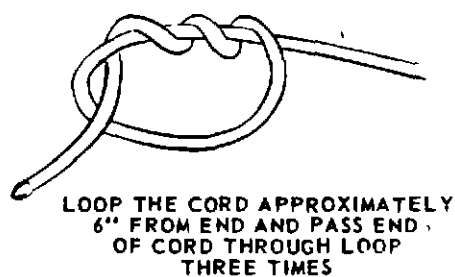
- a) Burn each end of the cord to melt the nylon. (See step 1.)



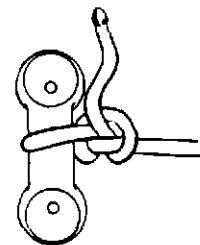
- b) Wipe each end of the cord with a rag, while hot, pulling the melting nylon to a point. (Step 2.)

WARNING TAKE CARE NOT TO ALLOW THE SKIN TO COME IN CONTACT WITH LIQUID NYLON. SEVERE BURNS WILL RESULT.

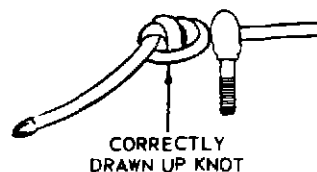
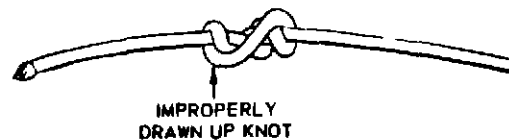
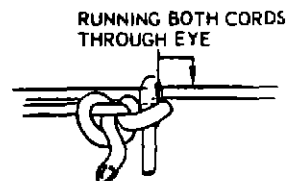
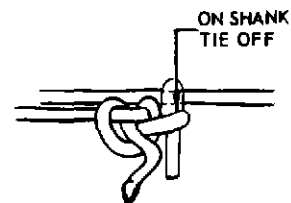
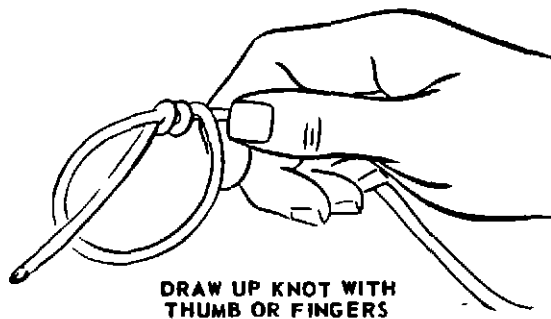
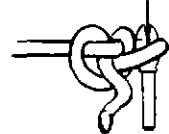
- c) Remove the hard point and collar formed in step 2 by slightly heating the burned nylon and wiping smooth and round with a cloth. (Steps 3, 4 and 5.)



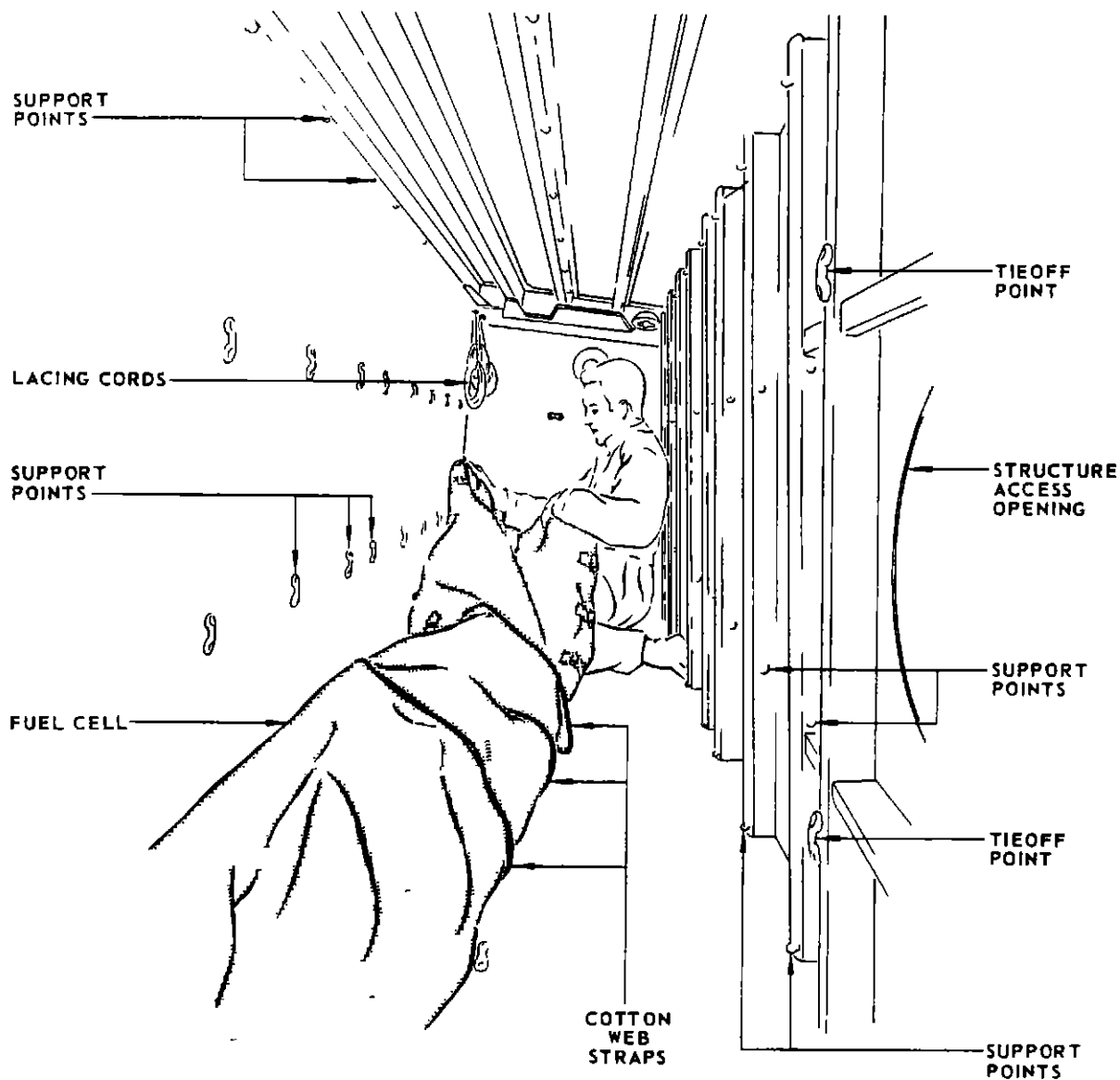
ANCHOR



THROUGH EYE



- d) Coil the new lacing cord into a small roll, tie with masking tape and hang at the applicable anchor point in the cell cavity.



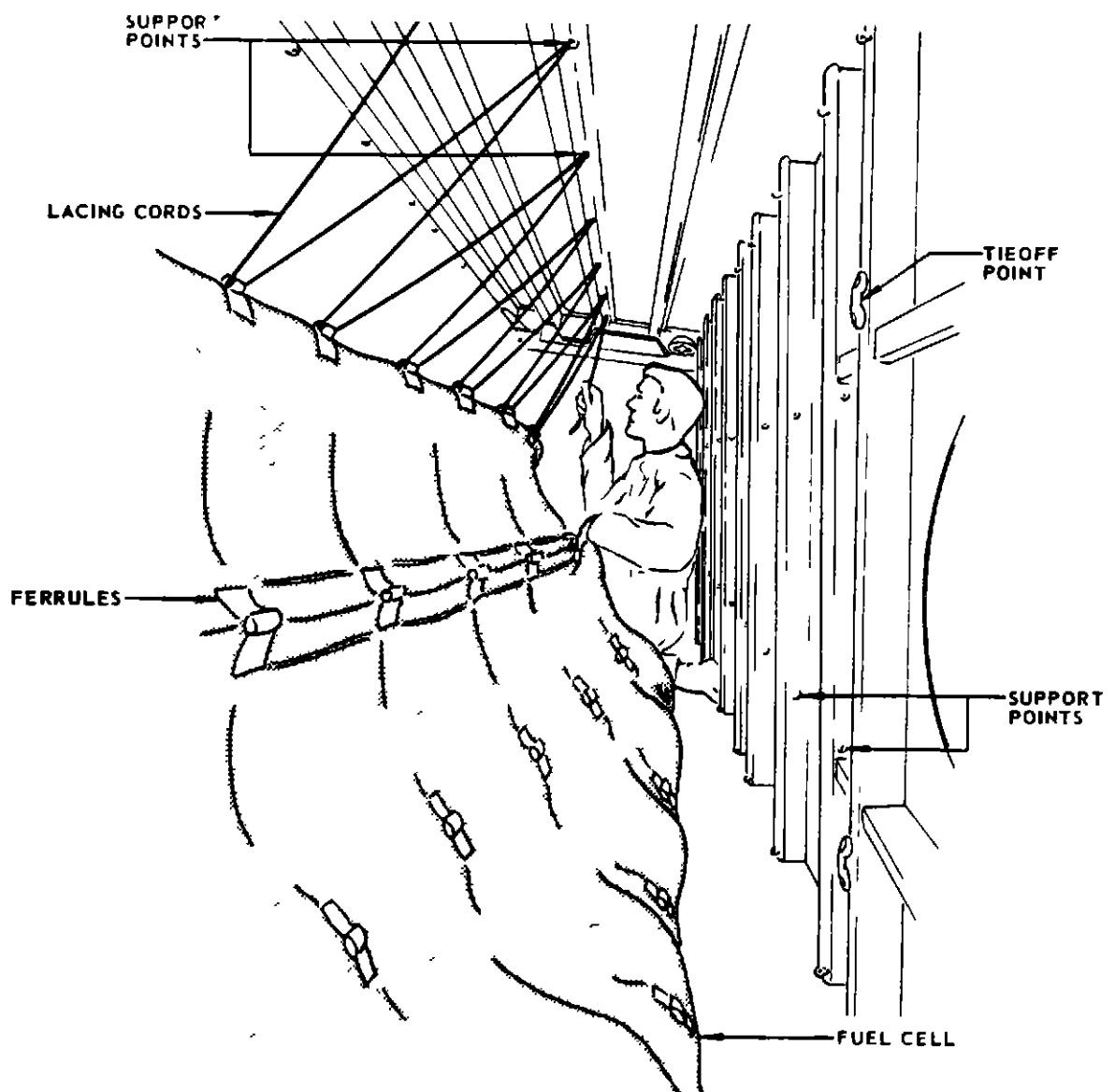
Fuel Cell Unfolding
Figure 407

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- (1) Fold, tie and place fuel cell in the cavity as described in paragraph 3.

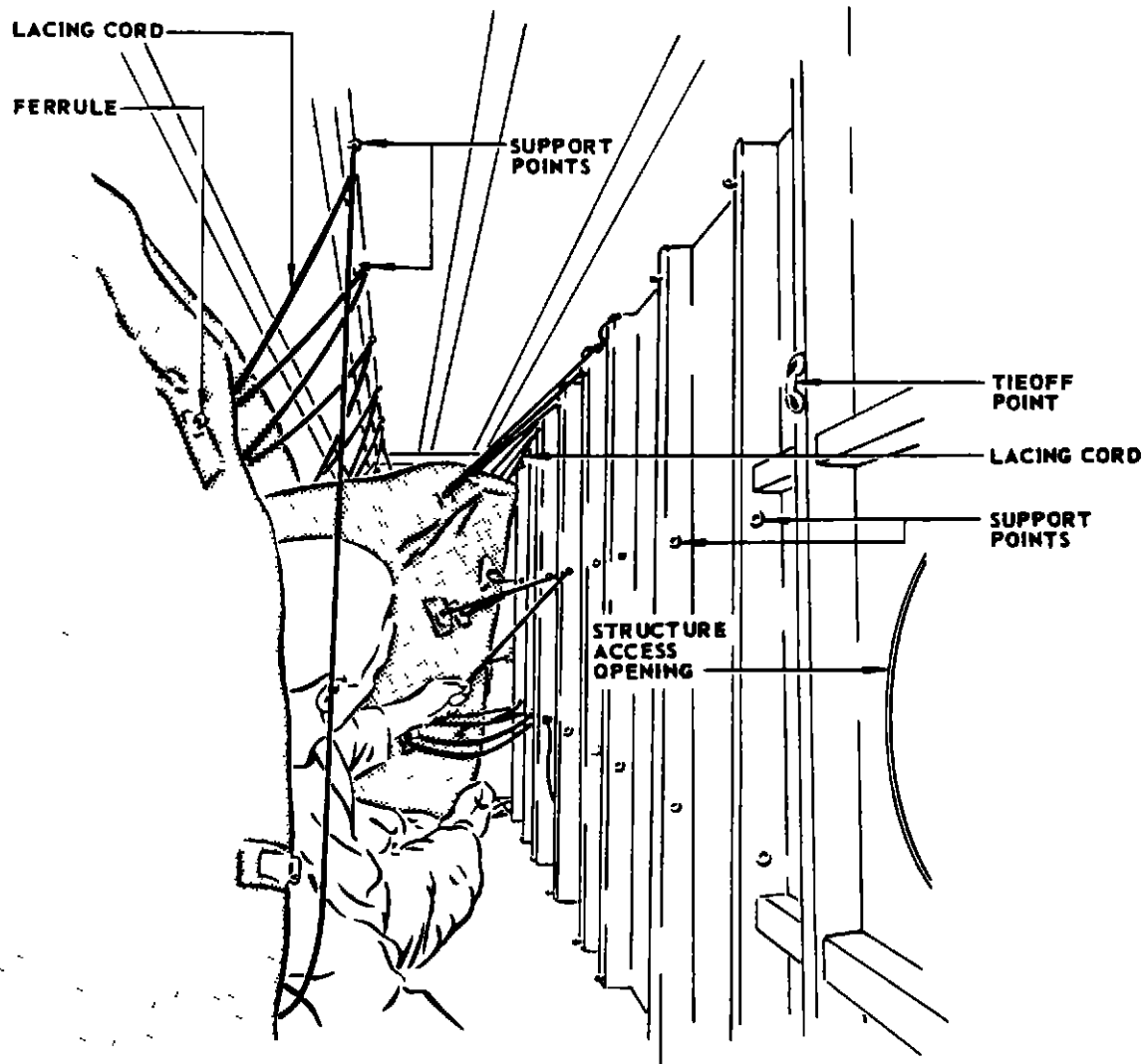
B. Install Fuel Cell No. 1 (See figures 407 through 417.)

- (1) Remove the cotton web straps and unfold the cell.
- (2) Remove cardboard patches over bulkhead cell fittings. Check that new O-rings are properly installed.



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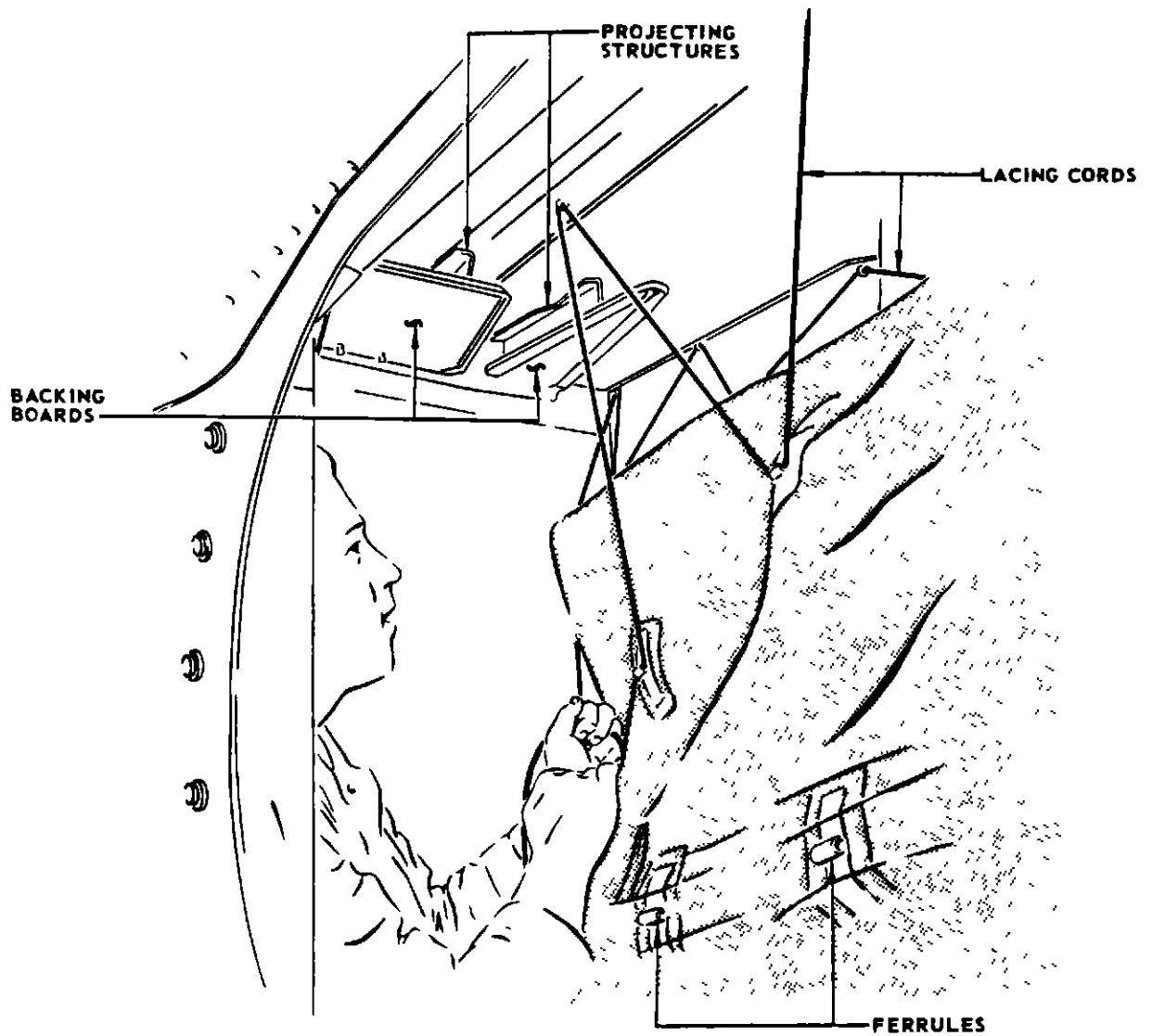


FUEL

Removable Fuel Cells

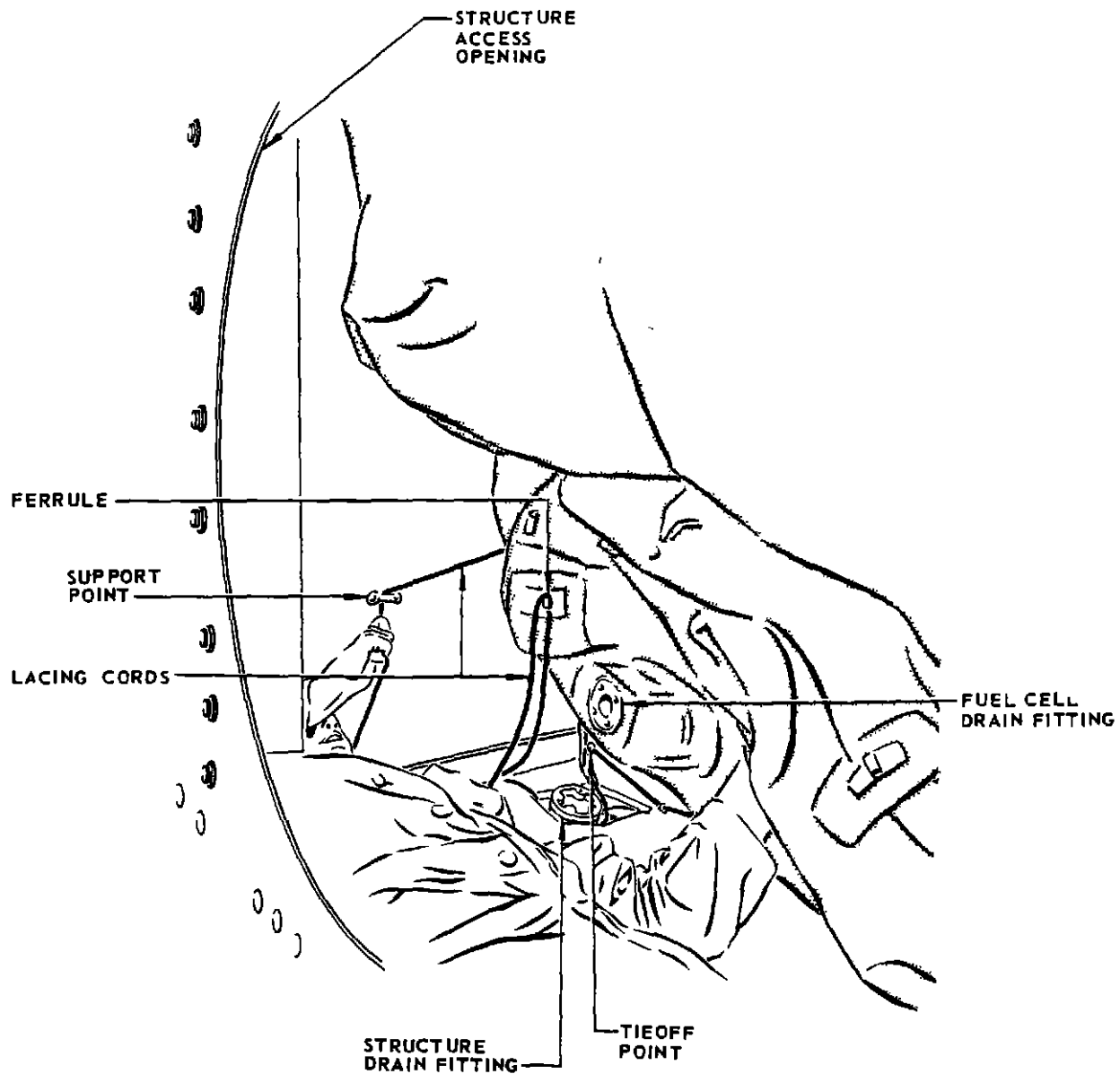
Removal/Installation

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FUEL
 Removable Fuel Cells
 Removal/Installation



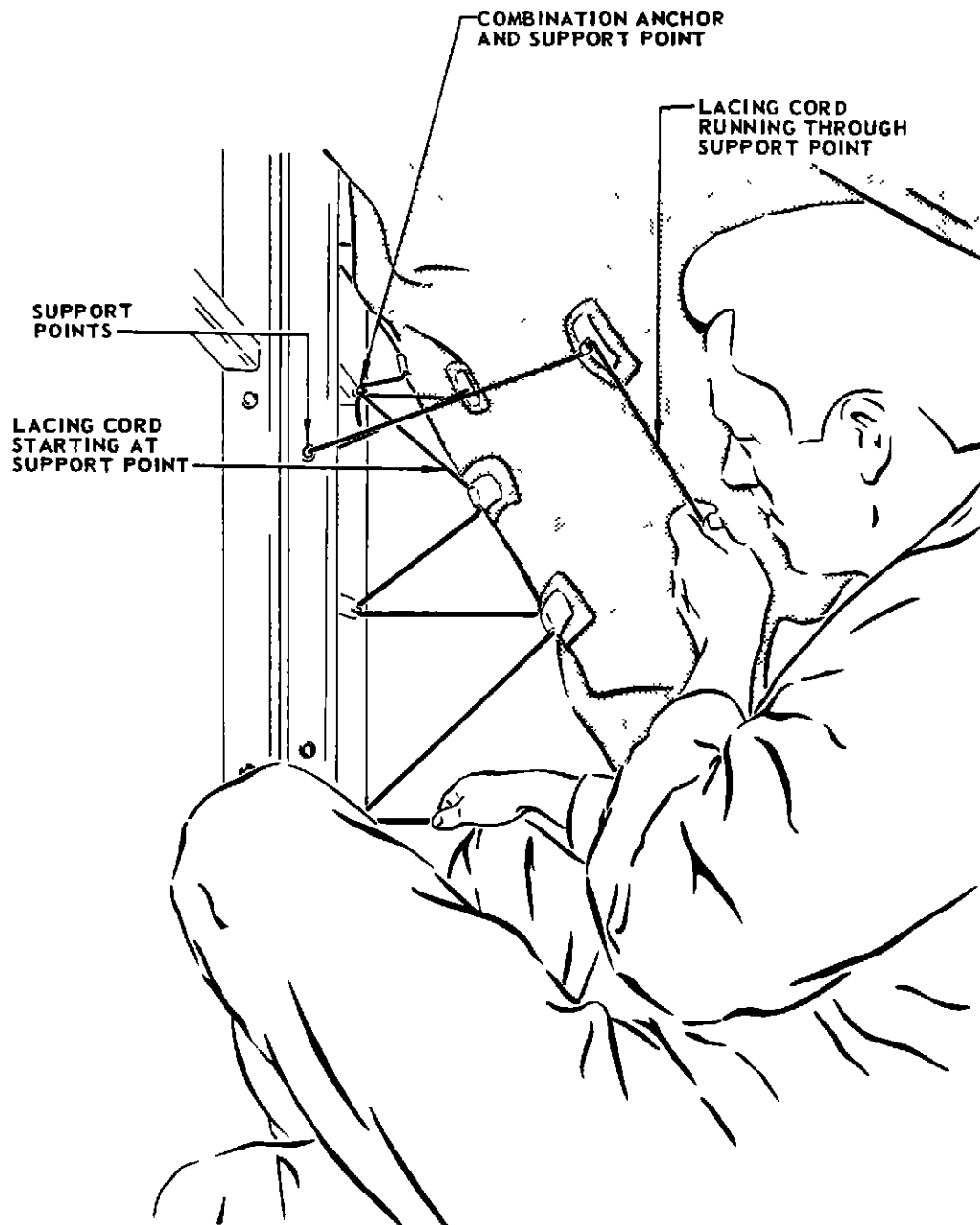
Lower Corner Fuel Cell Lacing
 Figure 411

FUEL

Removable Fuel Cells

Removal/Installation

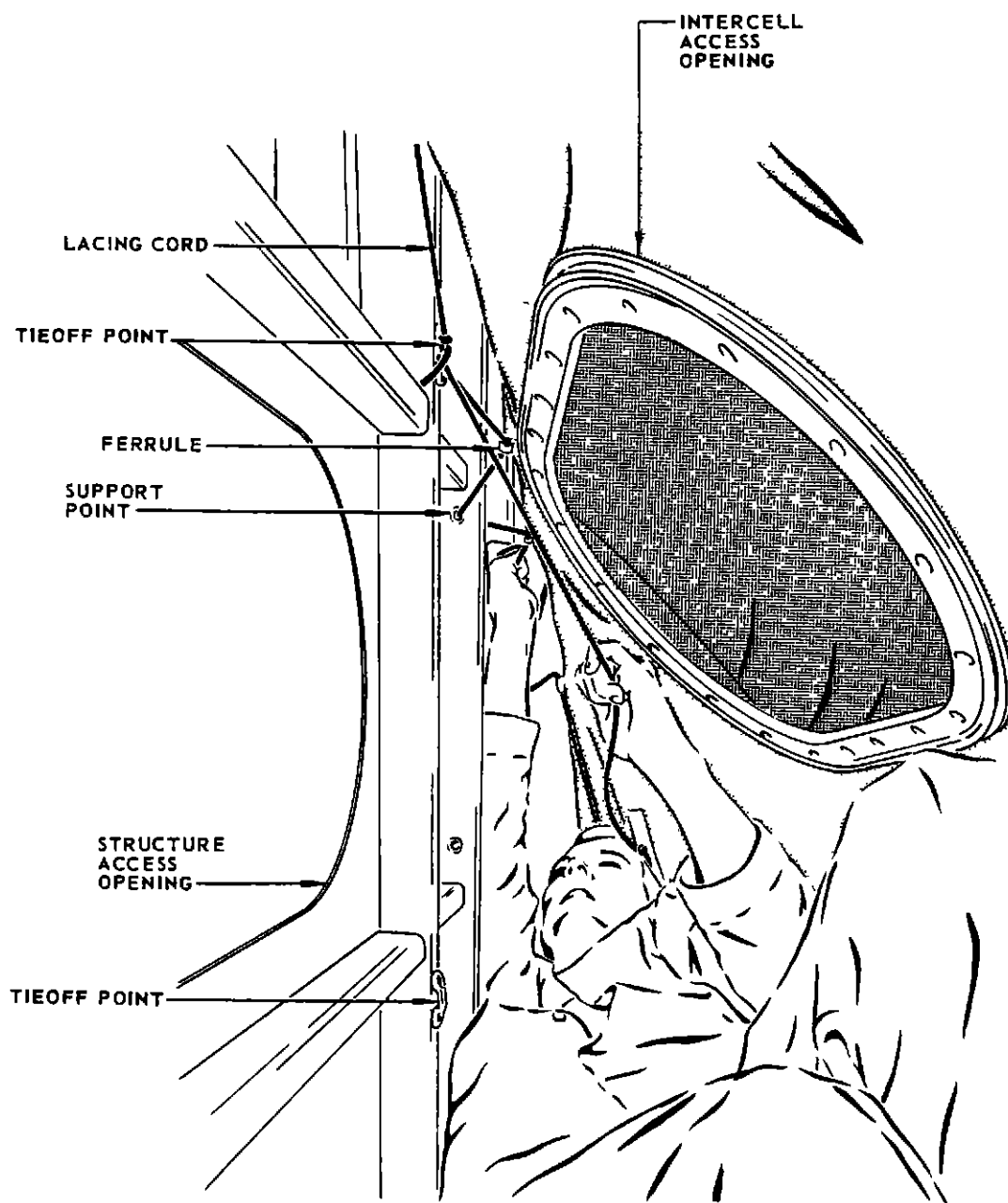
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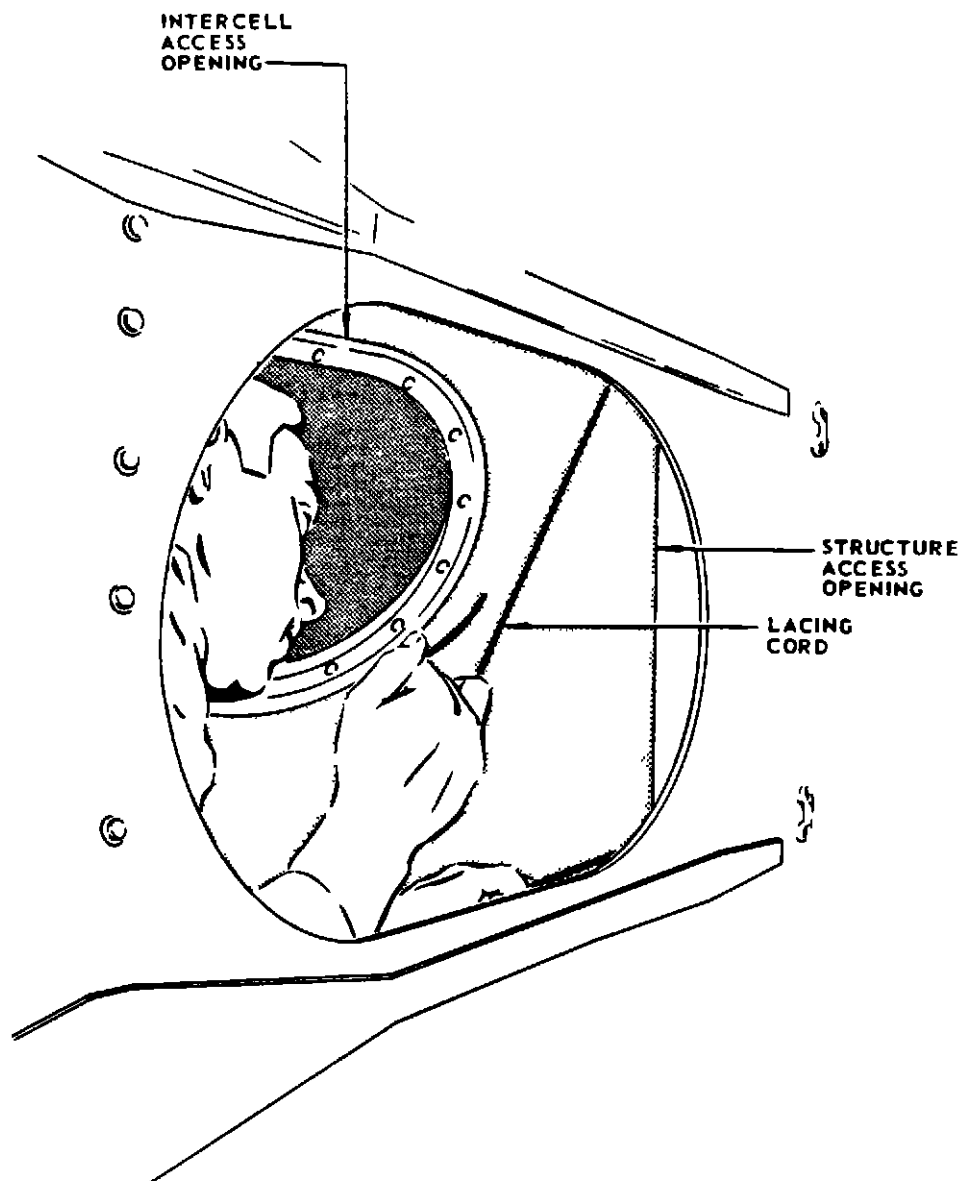


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Combination Anchor and Support Point Lacing
Figure 412

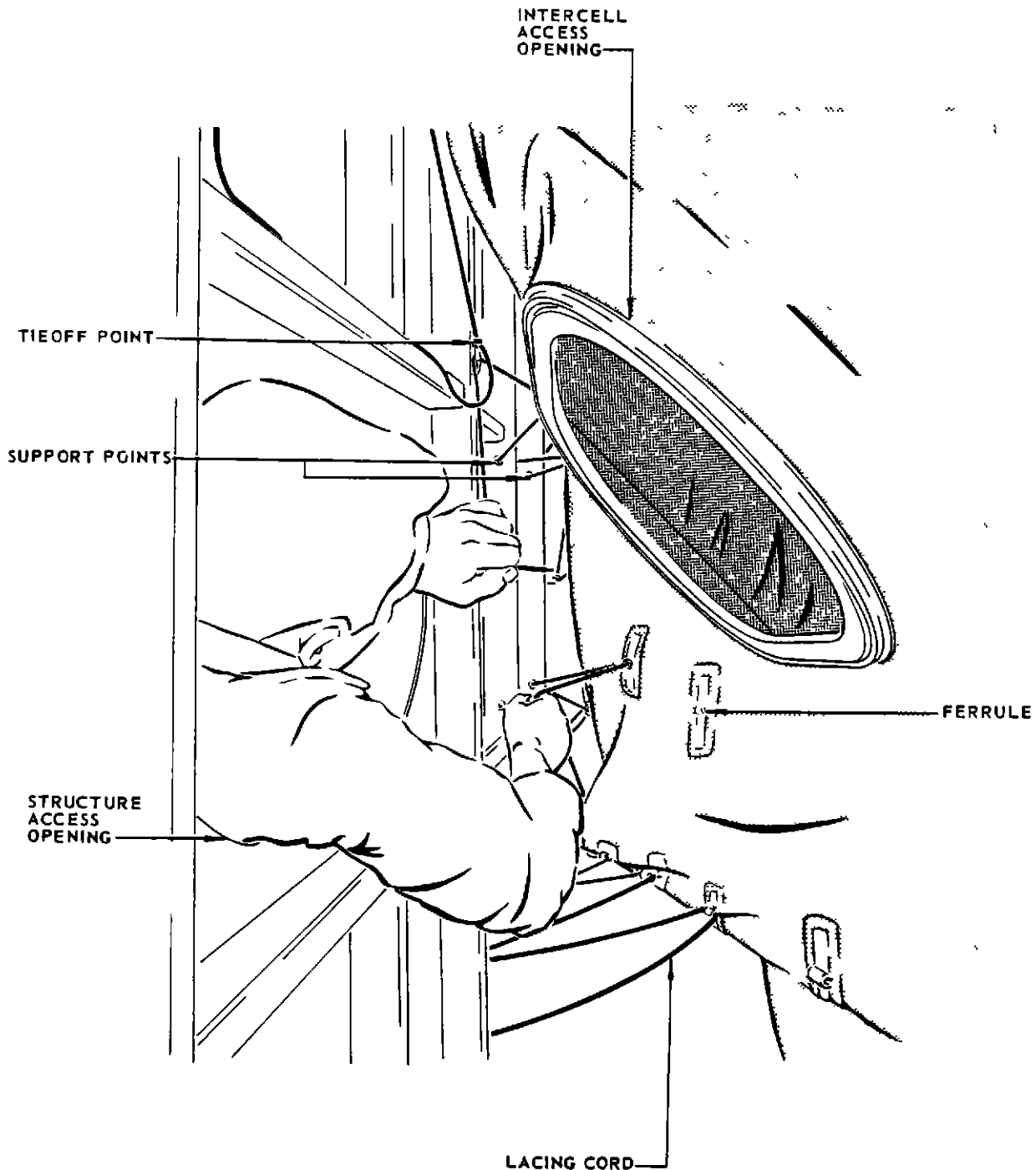
28-3-0
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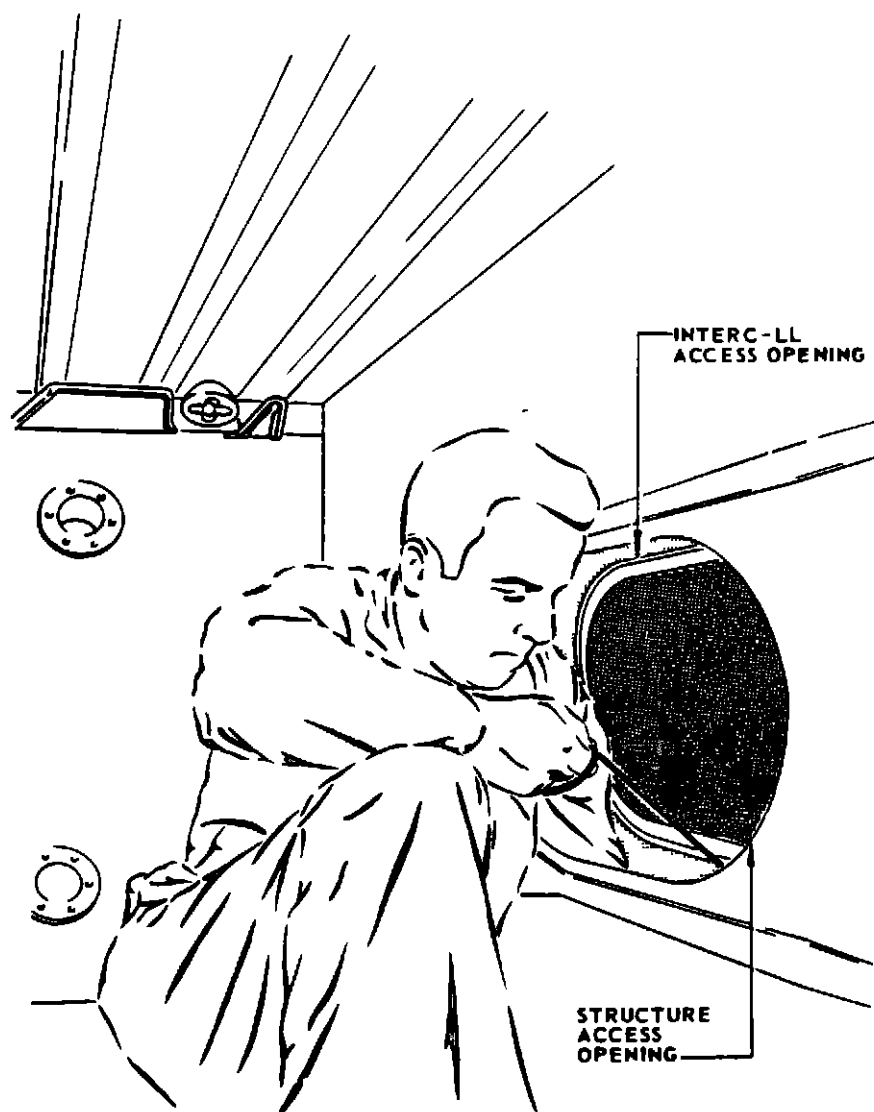
Access Opening Lacing Tie-Off From Inside Cavity
Figure 414



Access Opening Lacing Tie-Off From Outside Cavity
Figure 415

FUEL
Removable Fuel Cells
Removal/Installation

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Final Lacing Tie-Off
Figure 416

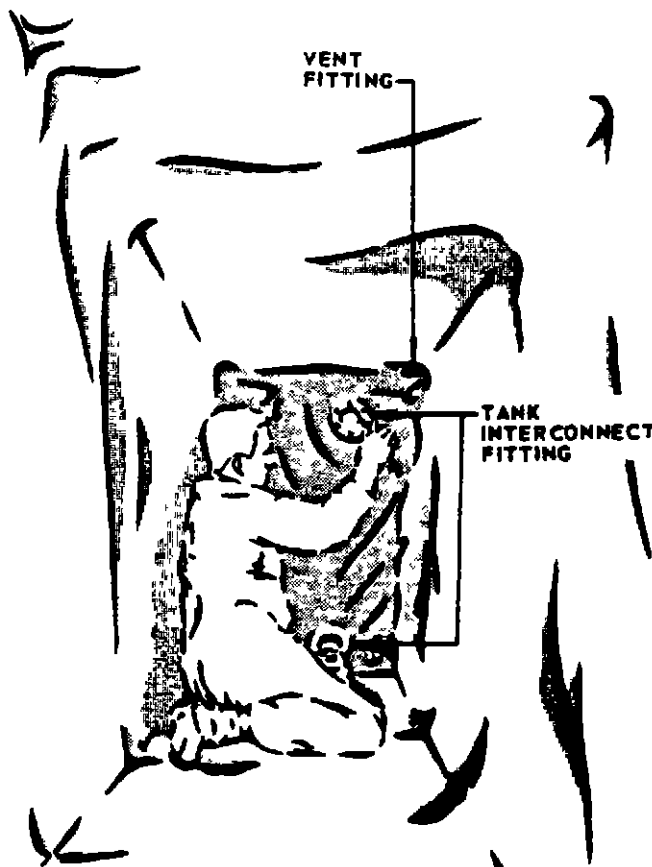
28-3-0
Page 425

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- (3) Proceed to the left side of the cavity to the anchor point for cord A. (See figure 418.) Lace cord A back to its tie-off point and tie off. This will allow cell to drape in the cavity. Laces should be taut after they are tied off.

NOTE. Do not miss any lacing points.

- (4) Lace cord B to its tie-off point and tie off. The cell now drapes in the cavity enabling man to move around it with ease.
- (5) Lace front of cell by stringing cords C, D, E, F, G, H, I and J in that order to their tie-off points. Take up slack in each cord and tie off.
- (6) Lace ends and bottom of cell by stringing cords K, L, M and N to their tie-off points and tying off.
- (7) Lace back of cell by stringing cords O, P, Q, R, S, T and U to their tie-off points around the intercell access opening. Tie all cords loosely.
- (8) Enter the cell and install bolts in the vent, drain and interconnect fittings at left and right ends of the cell. Torque all bolts 50 to 70 pound-inches. (See figure 419.)



Interior Fuel Cell Fitting
Figure 417

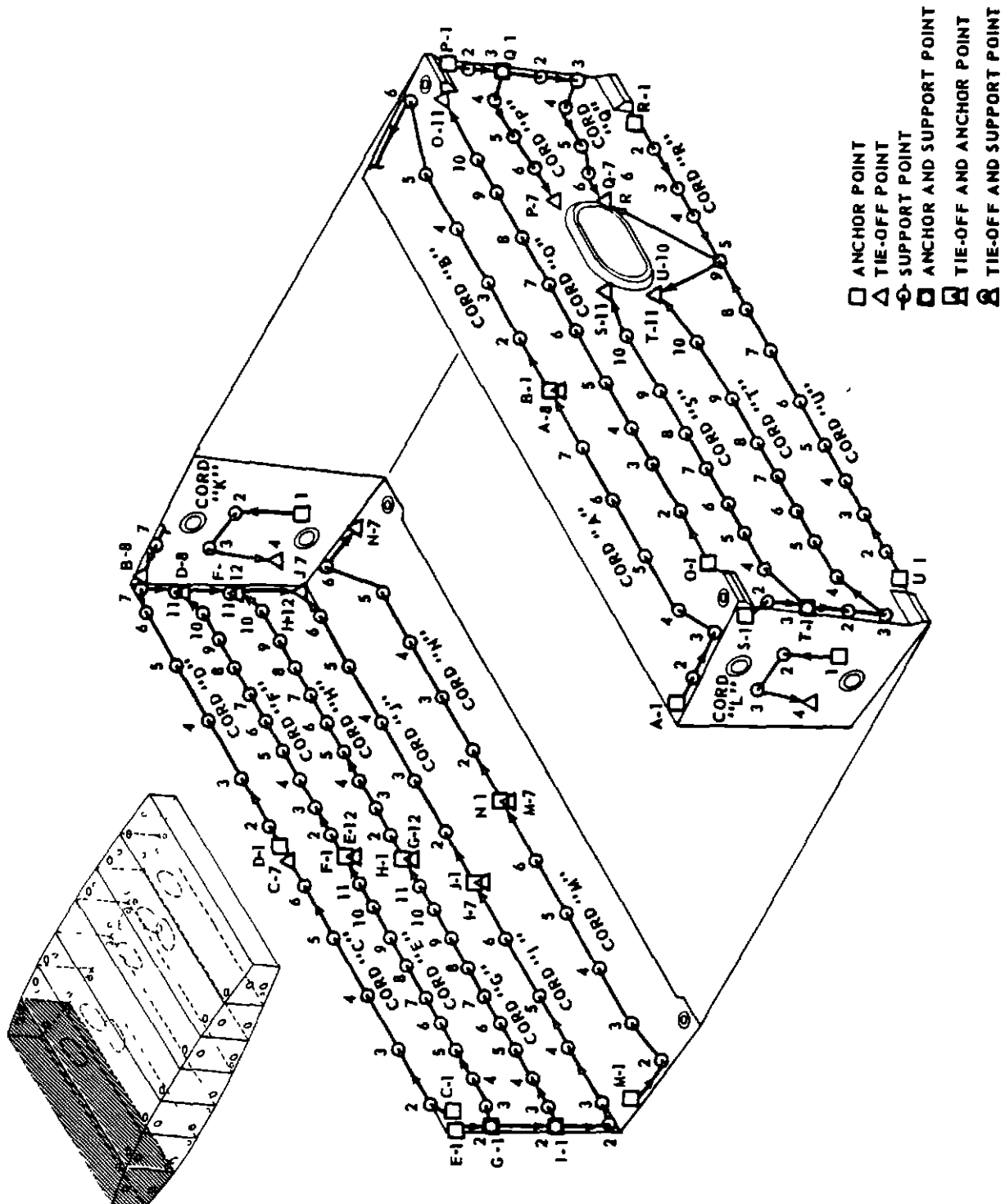


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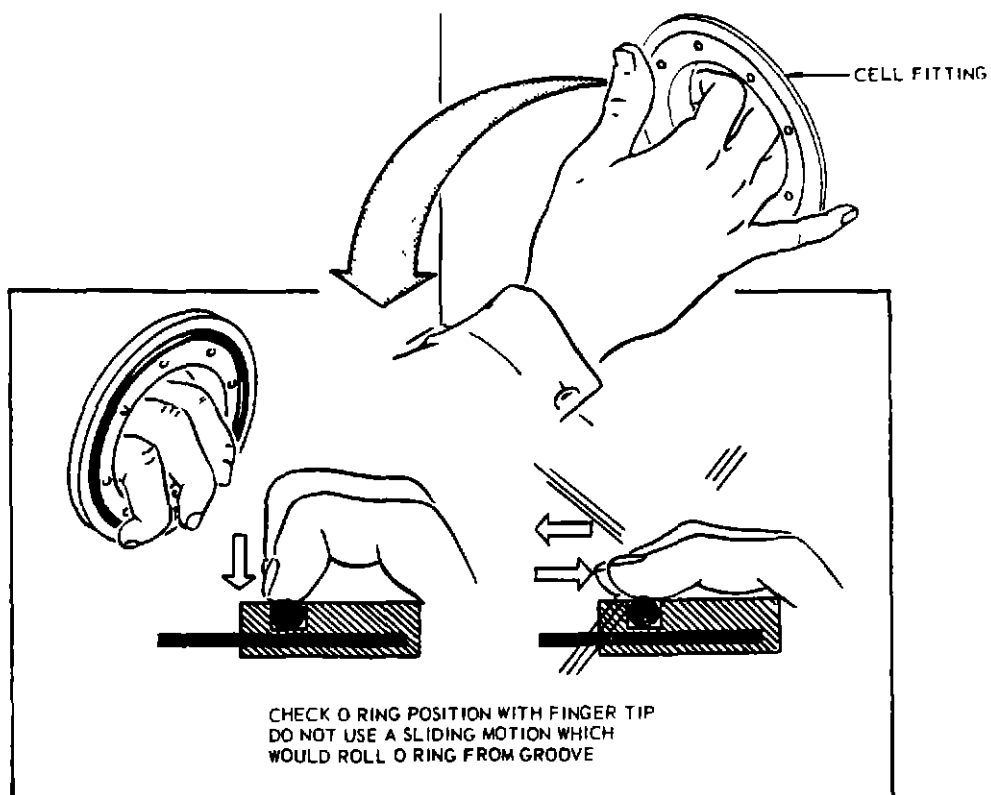
- (9) Lockwire all bolts at vent and drain fittings.
- (10) Enter the cavity for cell No. 2 and tie off cords O, P, Q, R, S, T and U in that order, around the access opening
- (11) Remove masking tape on edge of access opening structure.
- (12) Attach No 1 cell access opening fitting to No. 2 cell forward access opening fitting. Torque all bolts 50 to 70 pound-inches.
- (13) With a water dampened and lint-free clean cloth, wipe down the interior of the cell. Check for any loose pieces of lockwire or any foreign material left in the cell.
- (14) Install wing access panel. Refer to Fuel Cell Access Panels, 28-3-1.
- (15) Check cell installation for leakage as follows.

NOTE As an alternate method, check for leaks using the pressure or vacuum method per 28-2-0, Integral Fuel Tanks - Trouble Shooting.

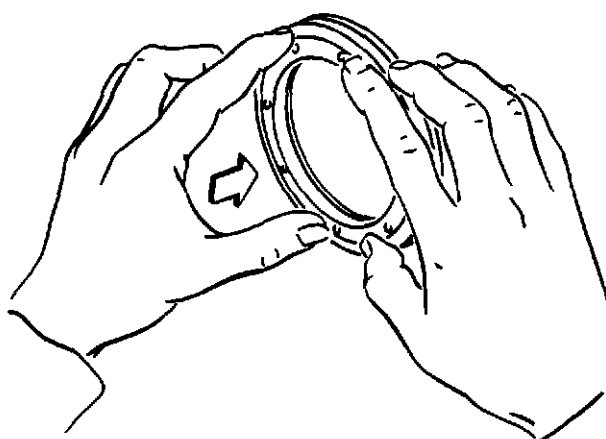
- (a) Fill center wing tank with fuel to maximum capacity.
- (b) Let airplane stand for two to three hours after fueling
- (c) Check for leakage at cavity drain port.
 - 1) If no leakage is observed, airplane may be flown provided the system is monitored carefully the following 24 hours whenever the airplane is on the ground.
 - 2) If leakage is observed, and the rate is less than 40 drops per minute, wait for an hour and check leakage rate again. If leakage rate has not increased, airplane may be flown per restriction of step 1) above. If leakage rate has increased, monitor leakage until leakage rate has stabilized. If leakage rate stabilizes at less than 40 drops per minute, airplane may be flown per restriction of step 1) above.
 - 3) If leakage is observed and the rate is more than 40 drops per minute, determine and correct source of leakage per instructions in Removable Fuel Cells - Trouble Shooting.



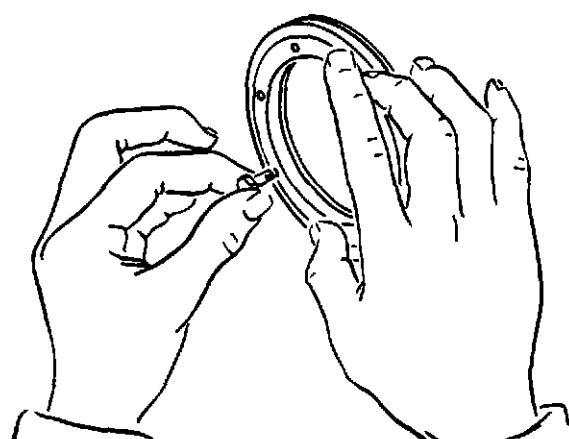
No 1 Fuel Cell Lacing Diagram
Figure 418



STEP 1



STEP 2

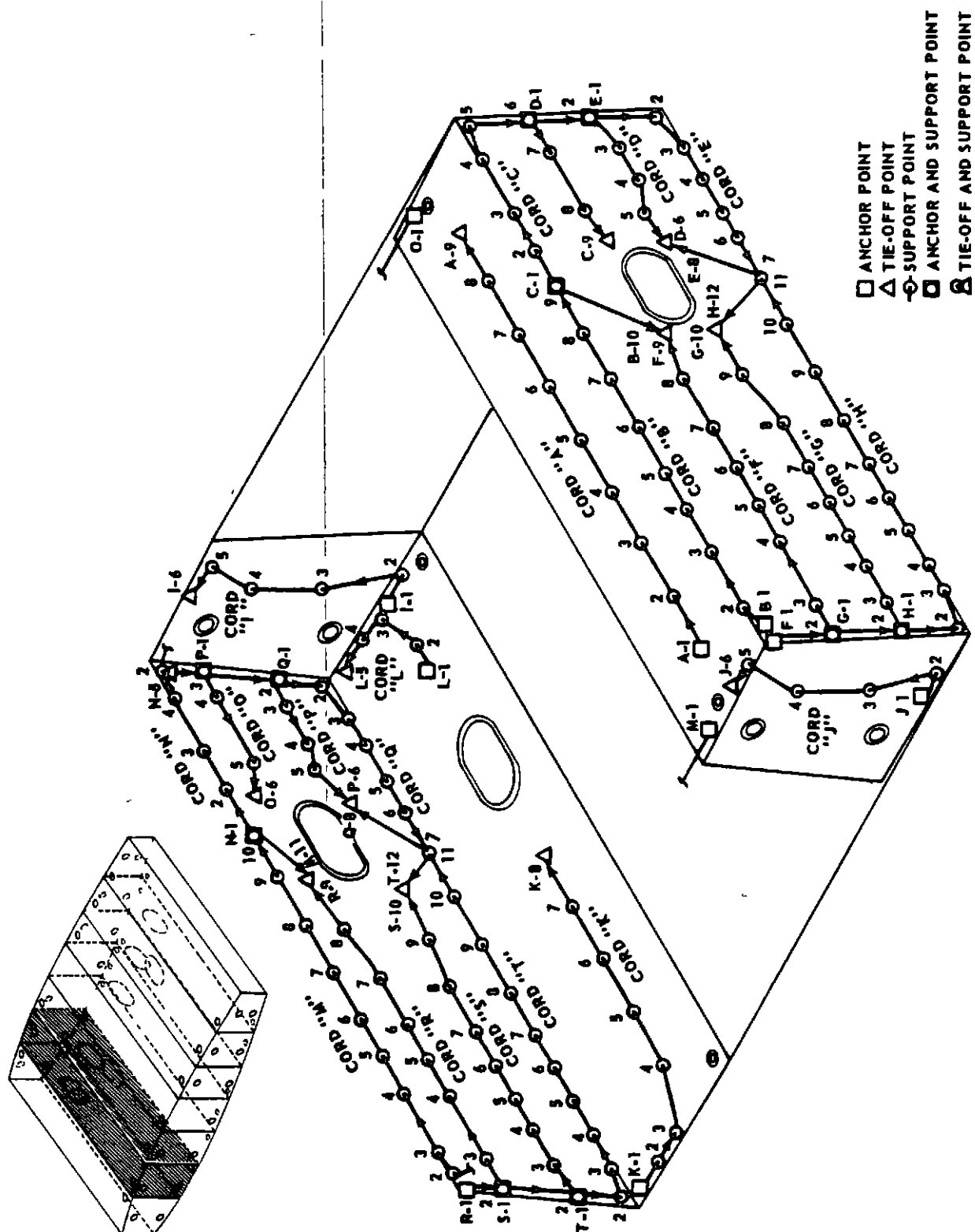


STEP 3

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- (16) Install air conditioning equipment. Refer to Chapter 21.
- C Install Fuel Cell No 2 (See figures 407 through 417)
- (1) Remove the cotton web straps and unfold the cell.
 - (2) Remove cardboard patches over bulkhead cell fittings and check that new O-rings are properly installed.
 - (3) Proceed to the left side of the cavity to the anchor point for cord A. (See figure 420.) Lace cord A back to its tie-off point and tie off. This will allow cell to drape in the cavity. Laces should be taut after they are tied off.
- NOTE: Do not miss any lacing points.
- (4) Lace back of cell by stringing cords B, C, D, E, F, G and H, in that order, back to their tie-off points around the aft intercell access opening. Tie all cords loosely
 - (5) Lace cords I and J on the ends of the cell, to their tie-off points and tie off.
 - (6) Lace cords K and L on bottom of cell, to their tie-off points and tie off.
 - (7) Lace front of cell by stringing cords M, N, O, P, Q, R, S and T, in that order, back to their tie-off points around the forward intercell access opening. Tie all cords loosely.
 - (8) Enter the cell and install bolts in the vent, drain and interconnect fittings at the left and right ends of the cell. Torque all bolts 50 to 70 pound-inches. (See figure 419.)
 - (9) Enter cell No. 3 and at the aft intercell access opening of cell No. 2, take up the slack in cords B, C, D, E, F, G and H, in that order, and tie off
 - (10) Install bolts in aft intercell access fittings as follows: (See figure 201, 28-3-11.)



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No. 2 Fuel Cell Lacing Diagram
Figure 420

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- (a) Attach No. 2 cell access opening fitting to structure using four bolts and washers installed from cell No. 3 cavity. Torque bolts 50 to 70 pound-inches.
 - (b) Attach No. 2 cell aft access opening fitting to No. 3 cell forward fitting using twenty bolts and nuts. Torque values for all bolts are 50 to 70 pound-inches.
 - (11) Enter cell No. 1 and at the forward intercell access opening of cell No. 2 take up slack in cords M, O, P, Q, R, S and T, in that order, and tie off.
 - (12) Install bolts in forward intercell access fittings as follows:
(See figure 201, 28-3-11.)
 - (a) Attach No. 2 cell access opening fitting to structure using four bolts and washers installed from cell No. 1 cavity. Torque bolts 50 to 70 pound-inches.
 - (b) Attach No. 2 cell forward access opening fitting to No. 1 cell aft fitting using twenty bolts and nuts. Torque values for all bolts are 50 to 70 pound-inches.
 - (13) Enter the cell and torque all bolts in vent, drain and interconnect fittings 50 to 70 pound-inches.
 - (14) Lockwire all bolts at vent and drain fittings.
 - (15) With a clean, damp and lint-free cloth, wipe down the interior of the cell. Check for any loose pieces of lockwire or any foreign material.
 - (16) Install wing access panel. Refer to 28-3-1, "Install Access Panels."
 - (17) Check fuel cell installation for leakage per paragraph 5.B.(15).
 - (18) Install air conditioning equipment. Refer to Chapter 21.
- D. Install Fuel Cell No. 3 (See figures 407 through 417.)
- (1) Remove cotton web straps and unfold the cell.
 - (2) Remove cardboard patches over bulkhead cell fittings and check that new O-rings are properly installed.

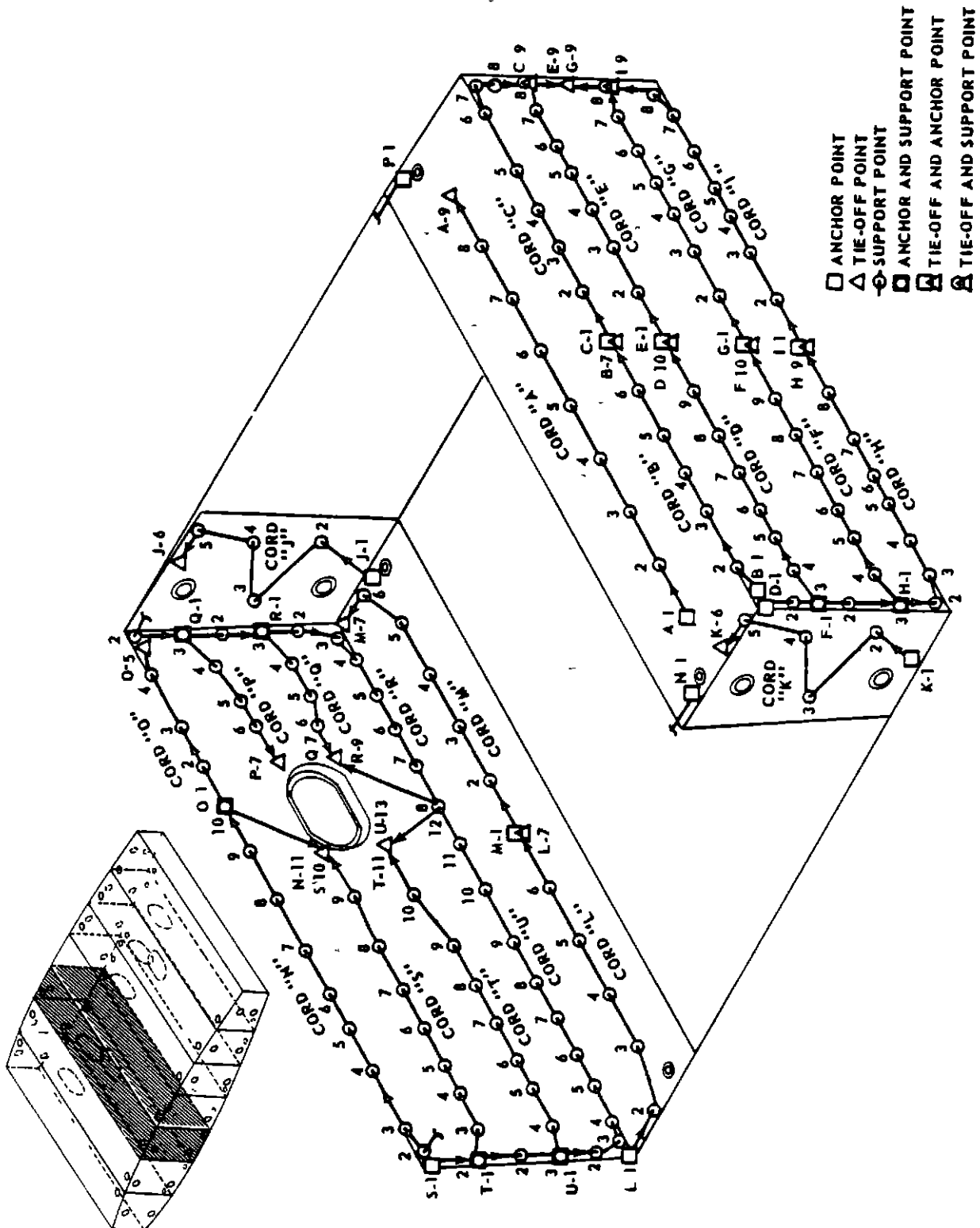


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- (3) Proceed to the left side of the cavity to the anchor point for cord A. Lace cord A back to its tie-off point and tie off. Laces should be taut after they are tied off. This will allow cell to drape in the cavity. (See figure 421)

NOTE: Do not miss any lacing points.

- (4) Lace back of cell by stringing cords B, C, D, E, F, G, H and I to their tie-off points in that order. Tie off all cords.
- (5) Lace ends and bottom of cell by stringing cords J, K, L and M to their tie-off points. Tie off all cords in that order.
- (6) Lace front of cell by stringing cords N, O, P, Q, R, S, T and U to their tie-off points in that order, around the intercell access opening. Tie each cord loosely.
- (7) Enter the cell and install bolts in vents, drain and interconnect fittings at left and right ends of the cell. Torque all bolts 50 to 70 pound-inches. (See figure 419)
- (8) Lockwire all bolts in vent and drain fittings.
- (9) Enter cell No. 2. Take up slack in cords N, O, P, Q, R, S, T and U in that order, around the intercell access opening, and tie off.
- (10) Remove tape on edge of intercell access opening.
- (11) Attach No. 2 cell aft access opening fitting to No. 3 cell fitting using twenty bolts and nuts. Torque all bolts 50 to 70 pound-inches.
- (12) Wipe down the interior of the cell with a water dampened, clean, lint-free cloth.
- (13) Check around the interior of the cell for any loose pieces of lockwire or any foreign material in the cell.
- (14) Install the wing access panel. Refer to 28-3-1, "Install Access Panels."
- (15) Check fuel cell installation for leakage per paragraph 5.B (15)
- (16) Install air conditioning equipment. Refer to Chapter 21



No. 3 Fuel Cell Lacing Diagram
Figure 421



E. Install Fuel Cell No. 4 (See figures 407 through 417.)

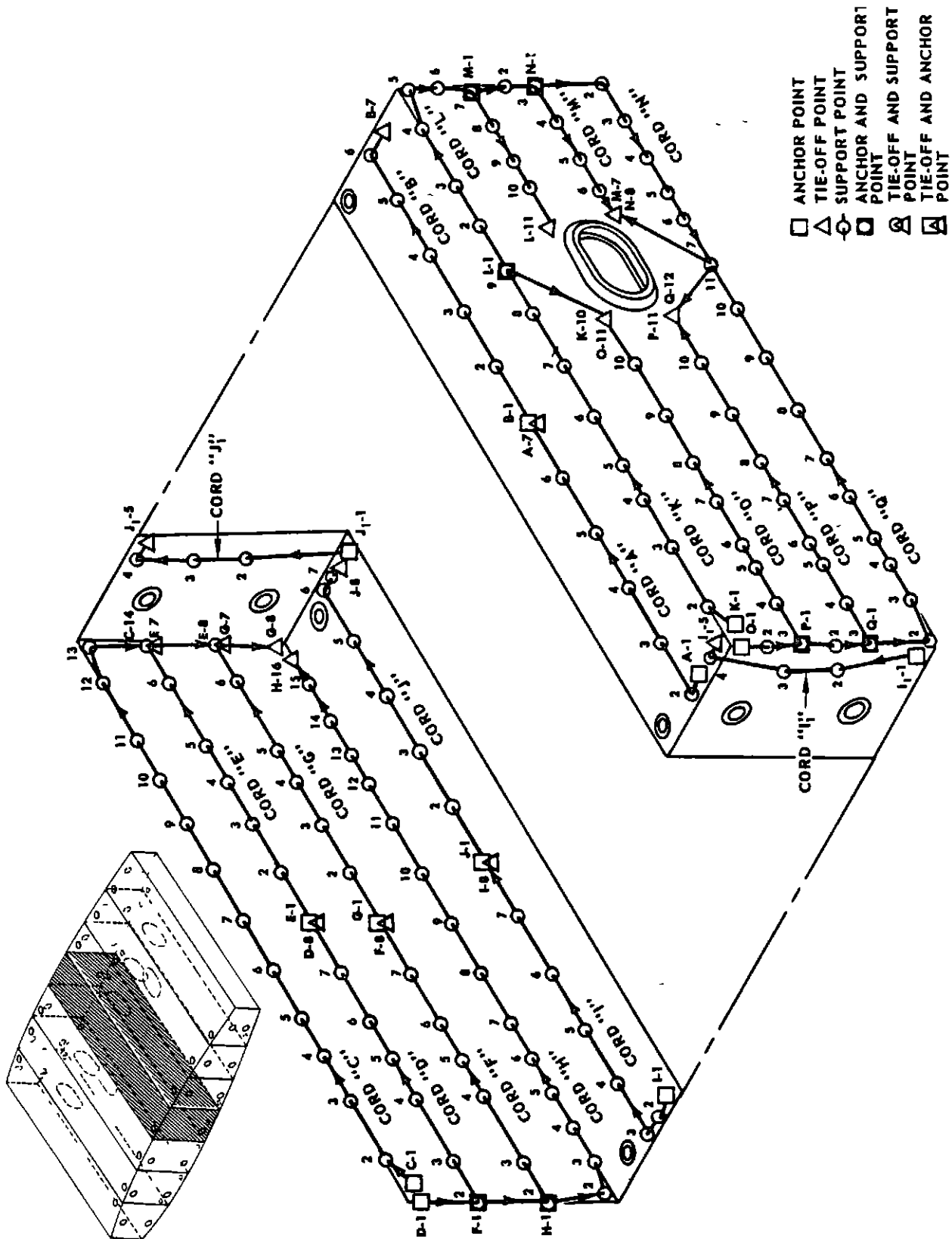
- (1) Remove the cotton web straps and unfold the cell.
- (2) Remove cardboard patches covering fuel cell fittings and check that new O-rings are properly installed.
- (3) Proceed to the left side of the cavity to the anchor point for lacing cord A. (See figure 422.)
- (4) Lace cords A and B back to their tie-off points and tie off. This will allow cell to drape in the cavity. Laces should be taut after they are tied off.

NOTE: Do not miss any lacing points.

- (5) Lace cord C back to its tie-off point and tie off.
- (6) Install the bolts that retain the fittings on which the fuel manifold line is installed on the forward side of cavity No. 4. (See figure 404.)

NOTE: This procedure requires the services of two men; Man A in cell No. 4 and Man B in the cavity for cell No. 3. If fuel cell No. 3 is installed in the airplane, this must be removed to enable Man B to gain access to the aft side of No. 3 cavity.

- (a) Man A: Press against fittings in cell No 4.
 - (b) Man B: Install bolts in fittings Man A will hold against the cavity bulkhead. Torque bolts.
- (7) Lace cords D, E, F, G and H in that order back to their tie-off points and tie off.
 - (8) Lace cords I, J, I₁, J₁ to their tie-off points and tie off.
 - (9) Lace front of cell by stringing cords K, L, M, N, O, P and Q in that order to their tie-off points around the intercell access opening. Tie all cords loosely.
 - (10) Enter the cell and install bolts in the vent, drain and interconnect fittings at the left and right ends of the cell. Torque all bolts 50 to 70 pound-inches. (See figure 419.)



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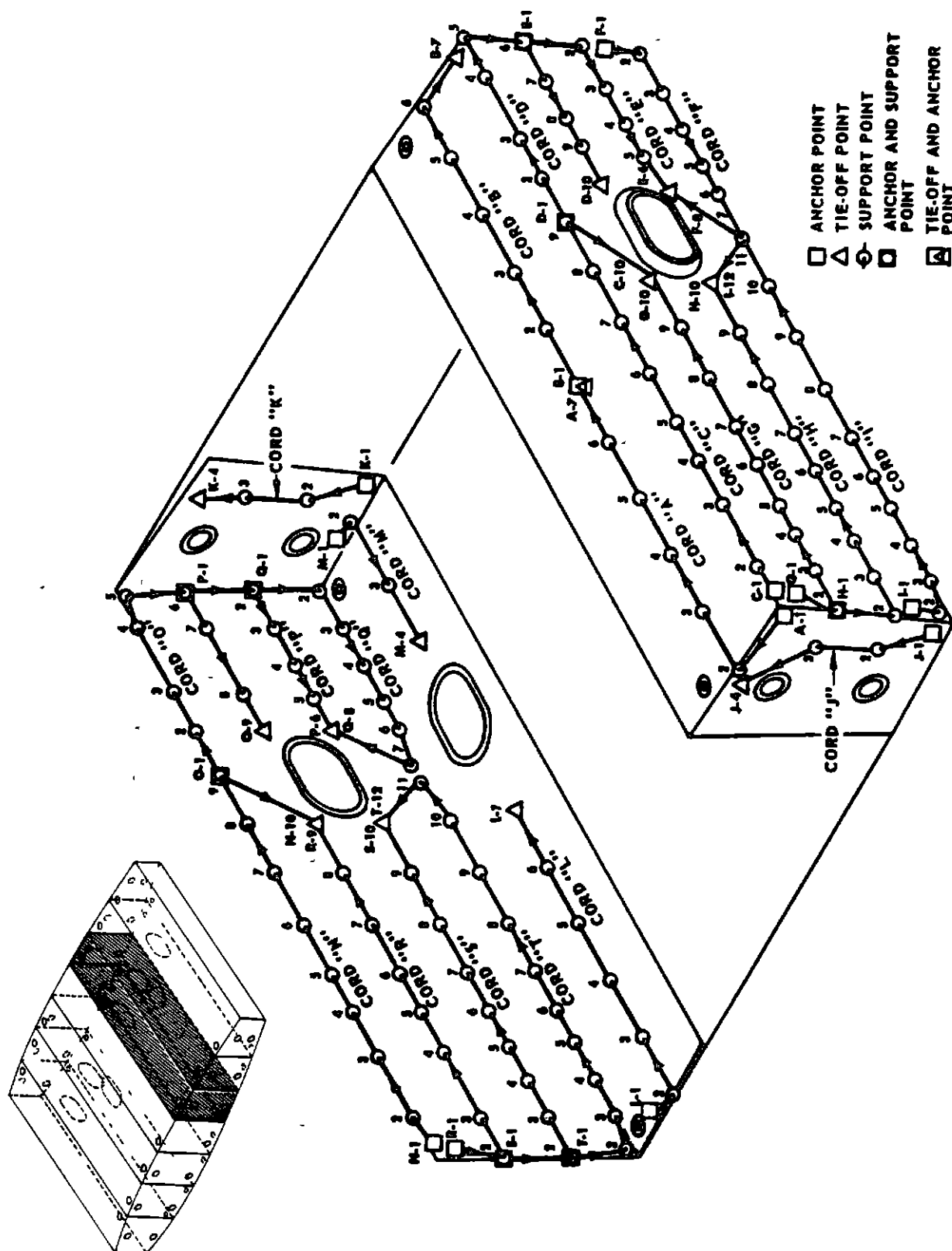
- (11) Lockwire all bolts in vent and drain fittings.
- (12) Enter cell No. 5, take up slack in cords K, L, M, N, O, P and Q around the access opening and tie off in that order.
- (13) Attach the No. 4 cell access opening fitting to No. 5 cell forward fitting using sixteen bolts and nuts. Torque values for all fasteners are 50 to 70 pound-inches.
- (14) Install fuel manifold support brackets at the left and right upper interconnect fitting. (See detail A, figure 404.)
- (15) Install fuel manifold line. (See figure 404.) Two men are required for this procedure: Man A stationed in the integral section and Man B in cell No. 4. Proceed as follows:
 - (a) Man A: Gain access to the left integral section and pass tubing through the upper interconnect fitting to Man B inside the cell.
 - (b) Man A: Connects tubing at connection A, shown in figure 404. Install lockwire and bonding jumper.
 - (c) Man B: Install tubing clamp and attach tubing to the first support fitting at the front of the cell.
 - (d) Man B: At the upper left interconnect fitting install tubing clamp. Position clamp on tubing support bracket and install screw and nut. (See detail A, figure 404.)
 - (e) Man A: Gain access to the right integral section and pass tubing through the upper interconnect fitting to Man B inside the cell.
 - (f) Man A: Connects tubing at connection E shown in figure 404. Install lockwire and bonding jumper.
 - (g) Man B: Install tubing clamp and attach tubing to the support fitting at front of the cell. Man A can now leave the integral section and help Man B install the remainder of the tubing in the cell.
 - (h) Man B: At the upper right interconnect fitting, install tubing clamp. Position clamp on tubing support bracket and install screw and nut. (See detail A, figure 404.)

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- (i) Man A and B: At the tubing connections marked B, C and D in figure 404, install coupling rings and connect up the tubing.
 - (j) Install lockwire and bonding jumpers at the connections marked B, C and D.
 - (k) Man A and B: Install tubing clamps. Position clamps on tubing support fittings at the front of the cell and install bolts. Lockwire all fitting bolts. (See view 1, figure 404.)
 - (16) With a water dampened and lint-free clean cloth, wipe down the interior of the cell. Check for any loose pieces of lockwire or any foreign material left in the cell.
 - (17) Install fuel cell baffle plate over the access opening using four bolts, nuts and washers. Refer to 28-3-11, "Install Baffle Plates."
 - (18) Install wing access panel. Refer to 28-3-1, "Install Access Panels."
 - (19) Check fuel cell installation for leakage per paragraph 5.B.(15).
 - (20) Install air conditioning equipment. Refer to Chapter 21.
- F. Install Fuel Cell No. 5 (See figures 407 through 417.)
- (1) Remove cotton web straps and unfold the cell.
 - (2) Remove cardboard patches over cell fittings and check that new O-rings are properly installed.
 - (3) Proceed to the left side of the cavity. Lace cords A and B back to their tie-off points and tie off. Laces should be taut after being tied off. This will allow the cell to drape in the cavity. (See figure 423.)
- NOTE. Do not miss any lacing points.
- (4) Lace aft side of cell by stringing cords C, D, E, F, G, H and I, in that order, to their tie-off points around the aft intercell access opening. Tie off all cords.
 - (5) Proceed to the front of the cell. Lace cords K and J and tie off both cords.
 - (6) Lace cords L and M, to their tie-off points on each side of the wing access panel and tie off.

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Removal/Installation

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No. 5 Fuel Cell Lacing Diagram
Figure 423

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- (7) Enter the cell and loosely install bolts in the fittings at the left and right ends of the cell. Do not tighten. (See figure 419.)
 - (8) Lace front of cell by stringing cords N, O, P, Q, R, S and T in that order, to their tie-off points around the forward intercell access opening. Tie off all cords.
 - (9) Install bolts in forward access opening fitting as follows: (See figure 201, 28-3-11.)
 - (a) From the cell No. 4 cavity, install four bolts with washers in the No. 5 cell forward access opening fitting. Torque all bolts 50-70 pound-inches.
 - (b) Attach cell No. 5 forward access fitting to cell No. 4 aft fitting using sixteen bolts and nuts. Torque all bolts 50 to 70 pound-inches.
 - (c) Install baffle plate at the forward access fitting with four bolts. Refer to 28-3-11, "Install Baffle Plates."
 - (10) Attach cell No. 5 aft access opening fitting to cell No. 6 forward access opening fitting using sixteen bolts and nuts. (See figure 201, 28-3-11.)
 - (11) Install baffle plate at the aft access opening fitting with four bolts. Refer to 28-3-11, "Install Baffle Plates."
 - (12) Torque all bolts in vent, drain and interconnect fittings 50 to 70 pound-inches.
 - (13) Lockwire all bolts in vent and drain fittings.
 - (14) With a clean, damp and lint-free cloth, wipe down the interior of the cell. Check for any foreign material of any kind in the cell.
 - (15) Install wing access panel. Refer to 28-3-1, "Install Access Panels."
 - (16) Check fuel cell installation for leakage per paragraph 5.B.(15).
 - (17) Install air conditioning equipment. Refer to Chapter 21.
- G. Install Fuel Cell No. 6 (See figures 407 through 417.)
- (1) Remove cotton web straps and unfold the cell.
 - (2) Remove cardboard patches over bulkhead cell fittings and check that new O-rings are properly installed.



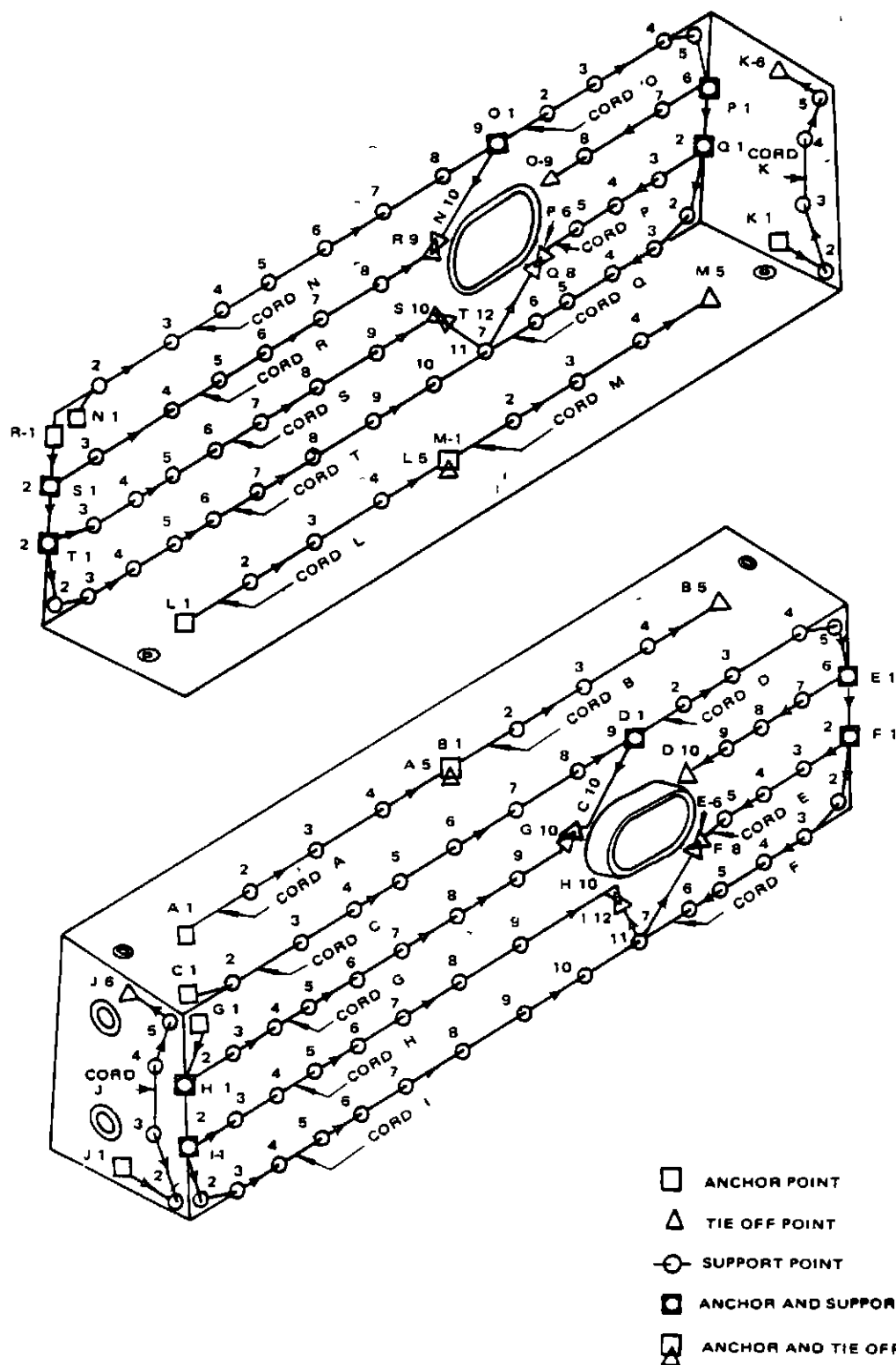
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- (3) Lace cords A and B to their tie-off points and tie off. Laces should be taut after being tied off. This will allow the cell to drape in the cavity. (See figure 424.)

NOTE· Do not miss any lacing points.

- (4) Lace aft side of cell by stringing cords C, D, E, F, G, H and I, in that order, to their tie-off points and tie off.
- (5) Lace cords K and J and tie off both cords.
- (6) Lace cords L and M to their tie-off points and tie off.
- (7) Enter the cell and loosely install bolts in fittings at left and right ends of the cell. Do not tighten. (See figure 419.)
- (8) Lace front of cell by stringing cords N, O, P, Q, R, S and T, in that order, to their tie-off points and tie off.
- (9) Install bolts in the forward access opening fitting as follows:
Refer to 28-3-11, Install Baffle Plates.
 - (a) From cell No. 5 cavity, install four bolts with washers in cell No. 6 forward access opening fitting. Torque all bolts 50-70 pound-inches.
 - (b) Attach cell No. 6 forward access fitting to cell No. 5 aft fitting using sixteen bolts and nuts. Torque all bolts 50 to 70 pound-inches.
 - (c) Install baffle plate at the forward access fitting with four bolts.
- (10) Attach cell No. 6 aft access opening fitting to cell No. 7 forward access opening fitting using sixteen bolts and nuts.
- (11) Install baffle plate at the forward access fitting with four bolts. Refer to 28-3-11, Install Baffle Plates.

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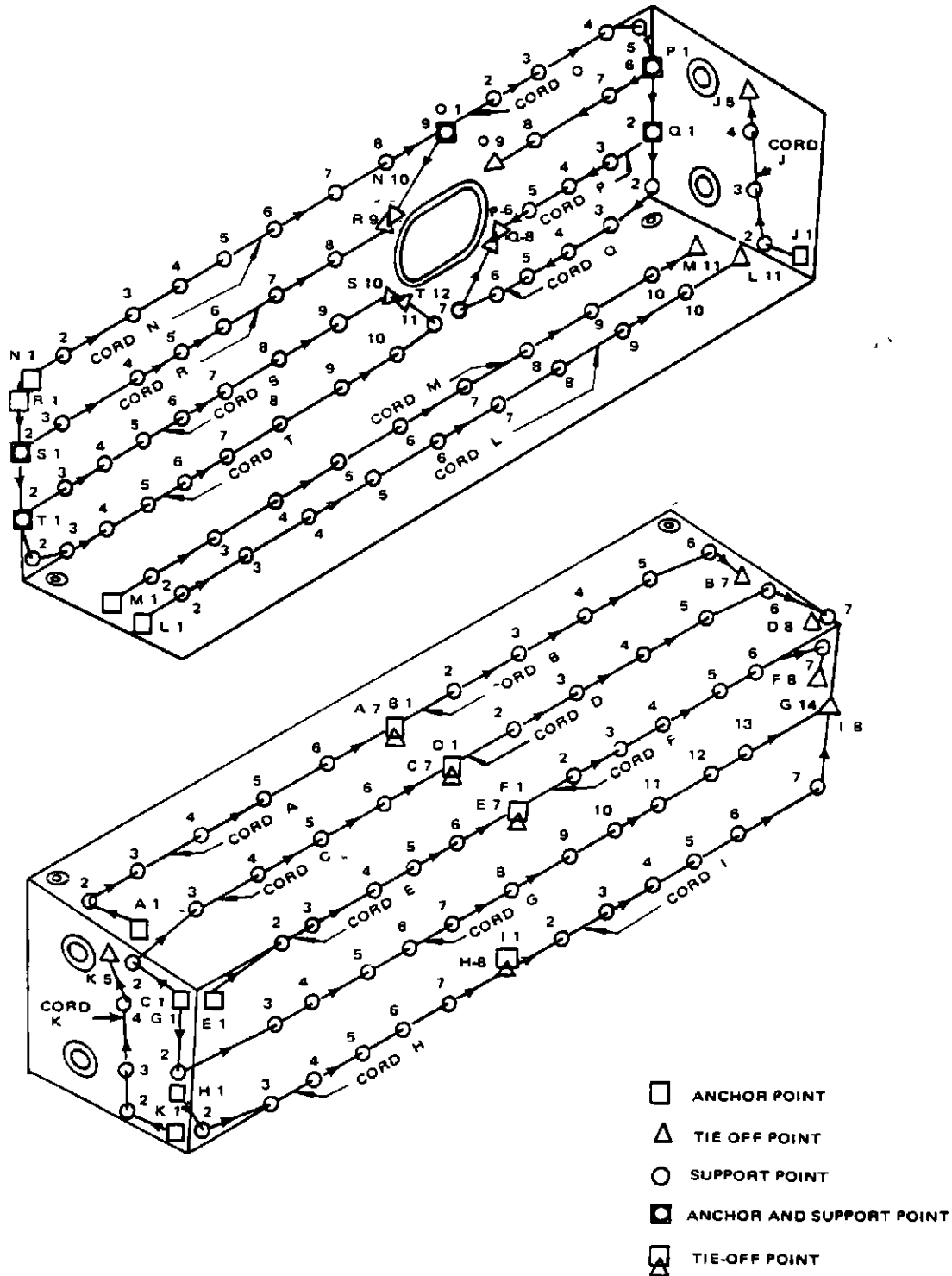
No. 6 Fuel Cell Lacing Diagram
 Figure 424



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- (12) Torque all bolts in vent, drain, and interconnect fittings 50 to 70 pound-inches
 - (13) Lockwire all bolts in vent and drain fittings.
 - (14) With a clean, damp, and lint-free cloth, wipe down the interior of the cell. Check for foreign material in the cell.
 - (15) Install wing access panel. Refer to 28-3-1, Install Access Panels.
 - (16) Check fuel cell installation for leakage per paragraph 5.B (15)
 - (17) Install air conditioning equipment. Refer to Chapter 21.
- H Install Fuel Cell No. 7 (See figures 407 through 417.)
- (1) Remove cotton web straps and unfold cell.
 - (2) Remove cardboard patches over bulkhead cell fittings and check that new O-rings are properly installed.
 - (3) Lace cords A and B to their tie-off points and tie off. This will allow the cell to drape in the cavity. Laces should taut after being tied off. (See figure 425.)
- NOTE Do not miss any lacing points.
- (4) Lace cords C, D, E, F, G, H and I, in that order, to their tie-off points and tie off.
 - (5) Lace cords J and K at the ends of the cell and tie off.
 - (6) Lace cords M and L to their tie-off points and tie off
 - (7) Lace front of cell by stringing cords N, O, P, Q, R, S, and T, in that order, to their tie-off points and tie off.
 - (8) Enter cell and install bolts in vent, drain, and interconnect fittings at the left and right ends of the cell Torque all bolts 50 to 70 pound-inches. (See figure 419.)
 - (9) Lockwire all bolts in vent and drain fittings.

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- (10) Wipe down the interior of the cell with a water dampened and lint-free clean cloth. Check for any loose pieces of lockwire or any foreign material left in the cell.
- (11) Install bolts in the access opening fitting as follows: Refer to figure 201, 28-3-11.
 - (a) Attach cell No. 7 forward fitting to structure using four bolts and washers installed from cell No. 6 cavity. Torque all bolts 50 to 70 pound-inches.
 - (b) Attach cell No. 7 forward fitting to cell No. 6 aft fitting using sixteen bolts and nuts. Torque all bolts 50 to 70 pound-inches.
- (12) Install baffle plate using four bolts. Refer to 28-3-11, "Install Baffle Plates."
- (13) Install wing access panel. Refer to 28-3-1, "Install Access Panels."
- (14) Check fuel cell installation for leakage per paragraph 5.B.(15).
- (15) Install air conditioning equipment. Refer to Chapter 21



REMOVABLE FUEL CELLS - INSPECTION/CHECK

1. General

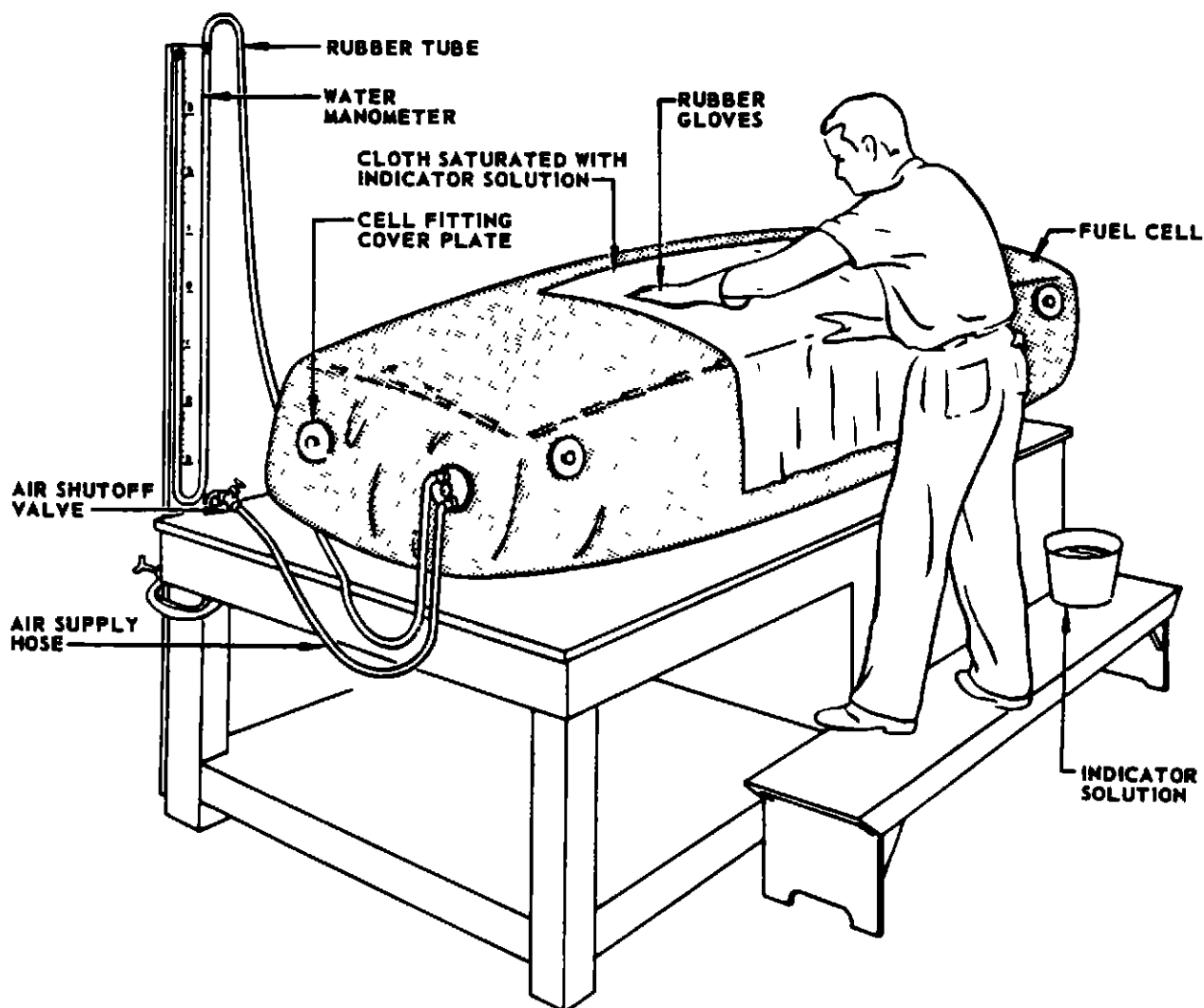
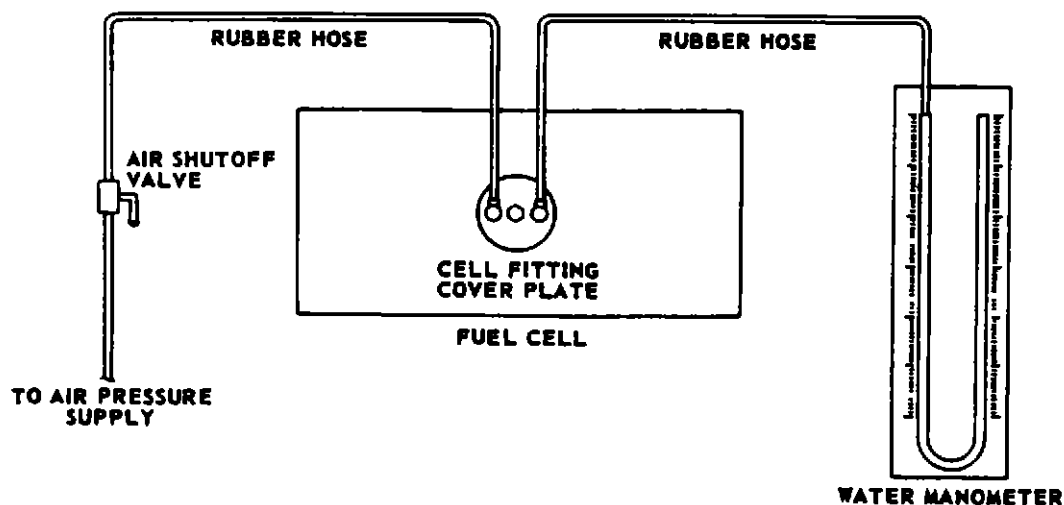
- A. The fuel cell must be pressure checked after repair of fuel cell injuries extending through the cell wall, and in the locating of fuel leaks. Pressurizing of the cells is done with the fuel cell removed from the airplane cavity. It is then necessary to plug all cell openings, using closure plates and rubber expansion plugs. One closure plate shall have fittings for air pressure source and manometer line. The following paragraphs describe two methods available for pressure checking the fuel cells.

2. Special Tools and Equipment

- A. Closure Plates - Aluminum plate, 1/4 inch thick; plate size governed by fuel cell fitting bolt circle and/or O-ring groove dimensions. One plate having air pressure and manometer fittings.

NOTE. Closure plates must have rounded edges and a smooth surface in O-ring area.

- B. Plugs - Rubber type expansion plugs
- C. Air pressure source - capable of supplying up to 1 psig
- D. Manometer - 15" water type, open end "U" manometer
- E. Rubber gloves (or equivalent)
- F. Torque Wrench - Snap-on type (0-150 inch/pound)
- G. Silver colored pencil-marking (Eagle brand or equivalent)
- H. Soap - Liquid type, commercial hand soap
- I. Phenolphthalein crystals
- J. Ammonia - Commercial or household ammonia (28% concentration)
- K. Ethyl alcohol
- L. Brush - Large camel hair brush (6" approximately)



Fuel Cell Chemical Leak Test
Figure 601

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3. Prepare Fuel Cell for Pressure Check (See figure 601)

A. Remove Fuel Cell from Aircraft Cavity (Refer to "Removal/Installation")

WARNING THE EXPLOSIVE AND TOXIC DANGERS OF VAPORS IN THE VICINITY OF FUEL CELLS WHICH HAVE CONTAINED FUEL ARE OF SUCH POTENCY THAT SEVERAL PRECAUTIONS MUST BE FOLLOWED BY PERSONNEL BEFORE ENTERING ANY WETTED OR DRY CELL FOR MAINTENANCE PURPOSES.

B. Place fuel cell upon a smooth, clean work table.

C. Plug all openings, except the one that will have the air pressure line attached, with closure plates or rubber expansion plugs. Torque values for the fasteners are 50 to 70 pound-inches.

WARNING. FUEL CELLS WHICH HAVE CONTAINED FUEL CONTAIN DANGEROUS EXPLOSIVE AND TOXIC VAPORS. USE ONLY EXPLOSION PROOF AND SHIELDED LIGHTS. AVOID PROLONGED INHALING OF VAPORS.

4. Pressure Check Fuel Cell

A. Soap Solution Method

- (1) Plug the remaining opening with the closure plate having connections for air pressure line and manometer tube
- (2) Attach air pressure line and manometer tube and introduce 1/2 psi pressure (14 inches of water measured on the open "U" type manometer) into the cell
- (3) Make a soap solution by adding liquid hand soap to water (approximately 20 parts of water to 1 of soap).
- (4) With large camel hair brush, apply soap solution to the entire exterior surface of the fuel cell. Check entire surface and around fittings for evidence of bubbling

NOTE. Bubbles caused by painting the solution can easily be distinguished from bubbles caused by leaks because the latter will continue to foam if leakage is present. Examine cell carefully during this operation.

- (5) Mark any observed leaks with a silver colored pencil.
- (6) After completion of test, wash soap solution completely from the inflated cell and dry with a clean cloth before deflating

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Inspection/Check

- (7) All leaks in a fuel cell must be repaired. Refer to "Removable Fuel Cells - Approved Repairs" for repair procedure.

B Phenolphthalein - Ammonia Solution Method

CAUTION: RUBBER GLOVES MUST BE WORN DURING THIS PROCEDURE.

- (1) Pour commercial or household ammonia (28% concentration) on absorbent cotton at the rate of 3 cubic centimeters per cubic foot of cell capacity, with a minimum of 10 cc's.
- (2) Place saturated cloth inside the cell and plug the opening with the closure plate having connections for air pressure line and manometer tube.
- (3) Soak approximately three yards of balloon cloth in an indicator solution made up of 1/2 gallon of water, 1/2 gallon of ethyl alcohol and 40 grams of phenolphthalein crystals.
- (4) Wring out the balloon cloth and spread it evenly over area to be checked.
- (5) Apply 1/2 psi pressure to the cell at the pressure line connection (14 inches of water measured on the open "U" type manometer).

CAUTION DO NOT EXCEED 1/2 PSI PRESSURE UNLESS A CAGE OR JIG IS USED.

- (6) Leakage through the fuel cell wall will be indicated by the appearance of red spots on the balloon cloth. Press the cloth down to insure detection of minute leaks.
 - (7) Resoak the balloon cloth in the indicator solution to remove the red spots and re-use in progressively checking all area of the fuel cell.
 - (8) Mark all leak areas with a silver colored pencil.
- NOTE:** Check the fitting locations closely making certain that any leaks at these points are not caused by improper installation of the closure plates.
- (9) After the test, remove all plates and test equipment. Allow cell to air out before entering.
 - (10) All leaks in the fuel cell must be repaired. Refer to "Removable Fuel Cells - Approved Repairs" for repair procedure.

END



FUEL CELL ACCESS PANELS - MAINTENANCE PRACTICES

1. General

- A. Two access openings are provided in the center wing cavity to enable maintenance personnel to enter the fuel cells. Both are located on the right hand side of the air conditioning pack compartment, one in the bottom of fuel cell cavity No. 2 and the other in the bottom of cavity No. 5. The openings are covered by an O-ring sealed access panel which is bolted to the inner surface of the fuel cell fitting.

2. Removal/Installation Fuel Cell Access Panels

A. Remove Access Panels (See figure 201.)

- (1) Check that center wing tank is empty.

WARNING AVOID EXPLOSIVE AND TOXIC HAZARDS OF FUEL VAPORS. COMPLY WITH ALL INSTRUCTIONS GIVEN IN 28-0, ON WETTED FUEL TANK ENTRY PRECAUTIONS.

- (2) Remove mounting bolts and nuts and place them in container.

- (3) Raise access panel and tilt sideways to allow removal.

CAUTION. THE ACCESS PANEL FITTING SURFACE IS A CRITICAL SEALING SURFACE. DO NOT DROP ACCESS PANEL OR ALLOW IT TO HIT AGAINST STRUCTURE. INSTALL RUBBER PROTECTORS AROUND OPENING IMMEDIATELY ACCESS PANEL IS REMOVED TO PREVENT DAMAGE BY PERSONNEL ENTERING AND LEAVING THE TANK. A SCRATCH MAY CAUSE LEAKAGE OR THE FATIGUE STRENGTH OF THE SKIN MAY BE WEAKENED.

B. Install Access Panels (See figure 201.)

- (1) Clean fuel cell access opening fitting O-ring groove. Use pointed piece of wood with sharp end covered with cheese cloth moistened with naphtha.

- (2) Install O-ring in access opening fitting.

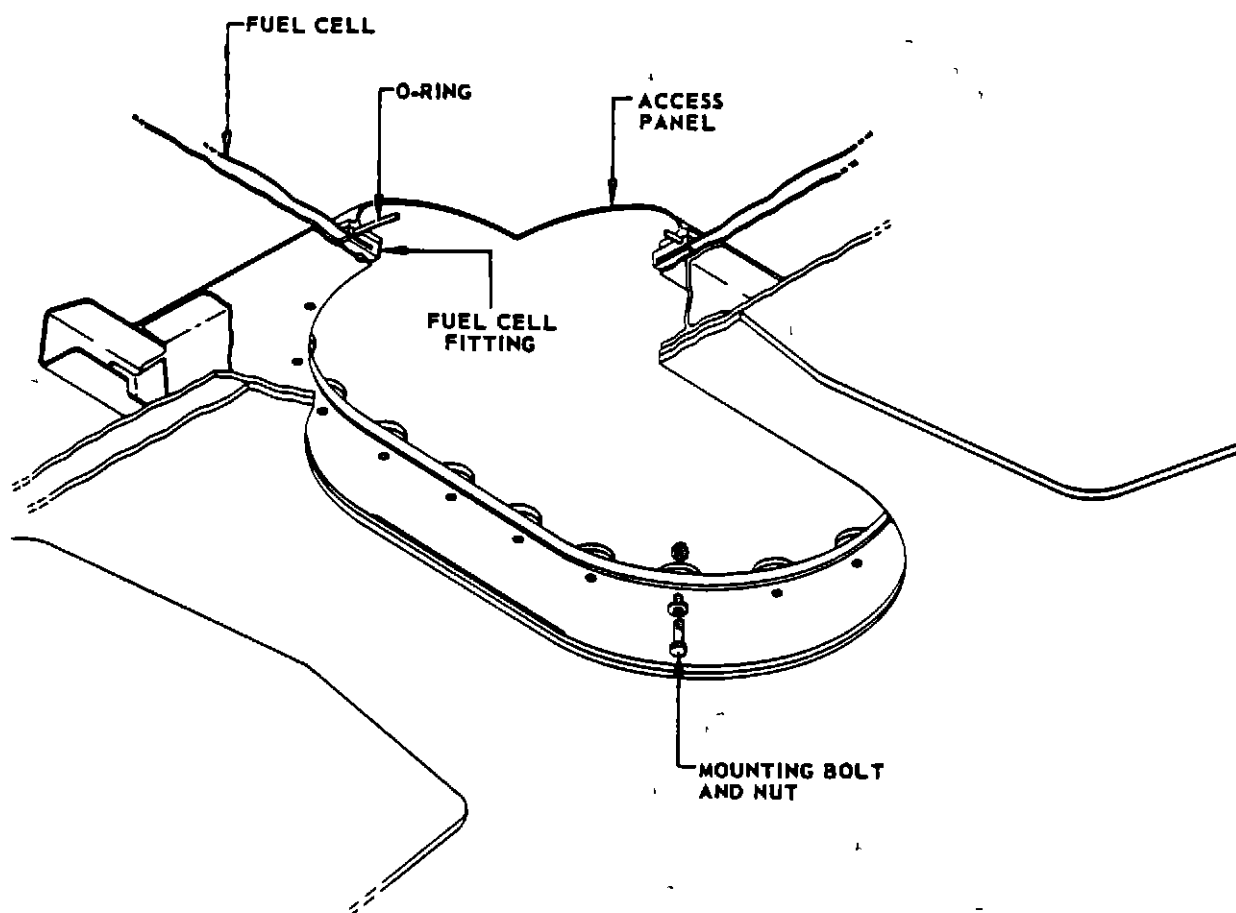
NOTE Apply no cement or sealers when installing O-ring.

- (3) Thoroughly clean access panel fitting surface with clean cloth moistened with naphtha.

- (4) Place access panel inside cell and center it over opening.

- (5) Install mounting bolts and nuts.

NOTE Torque values for all bolts are 50-70 inch-pounds.



Fuel Cell Access Panel Installation
Figure 201

END



INTERCELL BAFFLE PLATES - MAINTENANCE PRACTICES

1. General

- A. To enable maintenance personnel to use the intercell access openings between fuel cells no. 4, 5, 6 and 7, the baffle plates covering these openings must be removed. The baffle plate in cell no 5 is attached to the cell access opening fitting by four bolts, nuts and washers. Those in cells no 6 and 7, are attached to the cell access opening fitting by bolts which install into nutplates.

2. Removal/Installation Baffle Plates

- A. Remove Baffle Plates (See figure 201 and 202.)

- (1) Support baffle plate and remove fasteners.

CAUTION· DO NOT DROP BAFFLE PLATE AS DAMAGE TO FUEL CELL MAY RESULT.

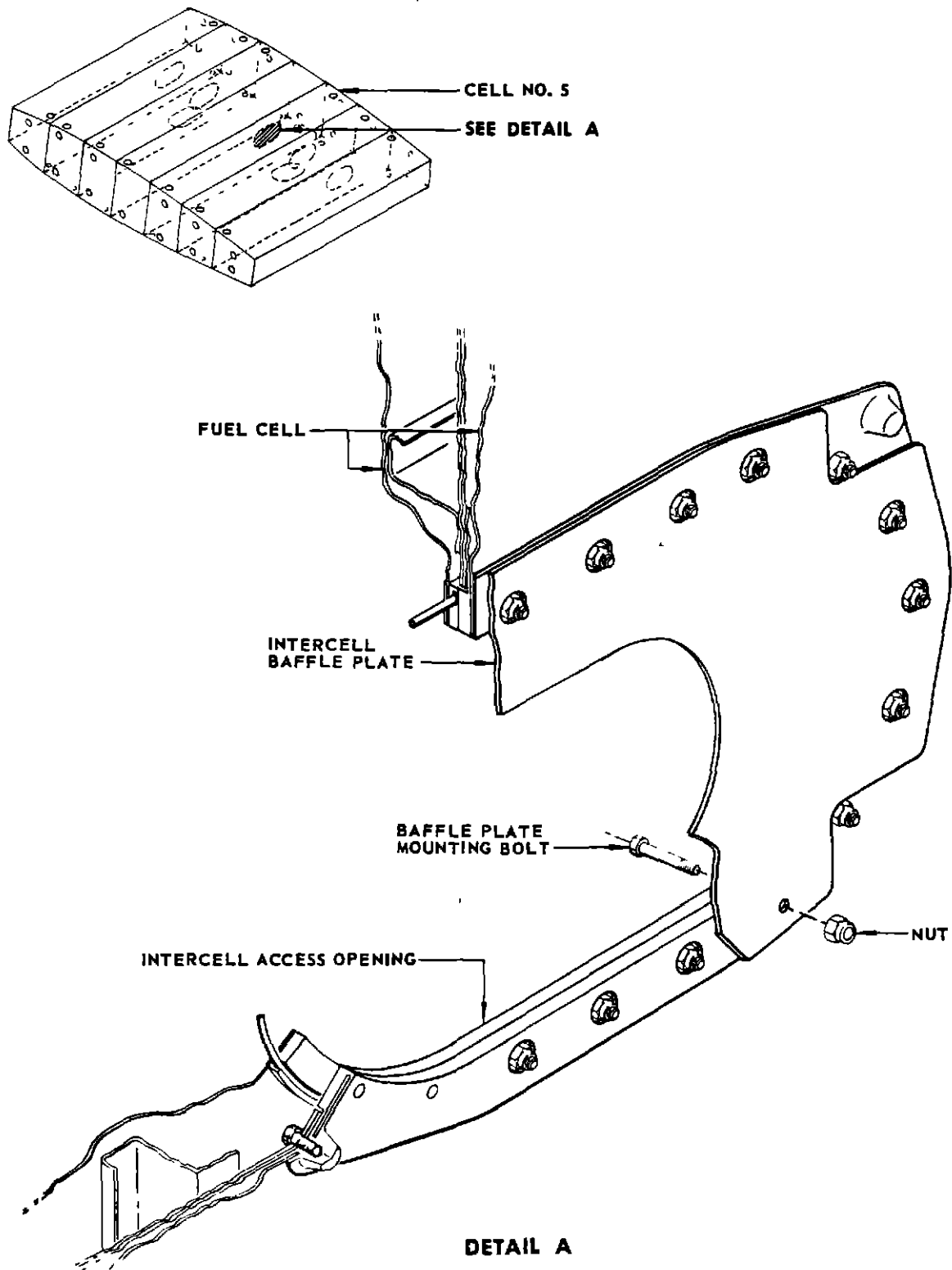
- (2) Place fasteners in a container to prevent losing them in fuel cell

- (3) Stow baffle plate so that it will not damage fuel cell innerliner.

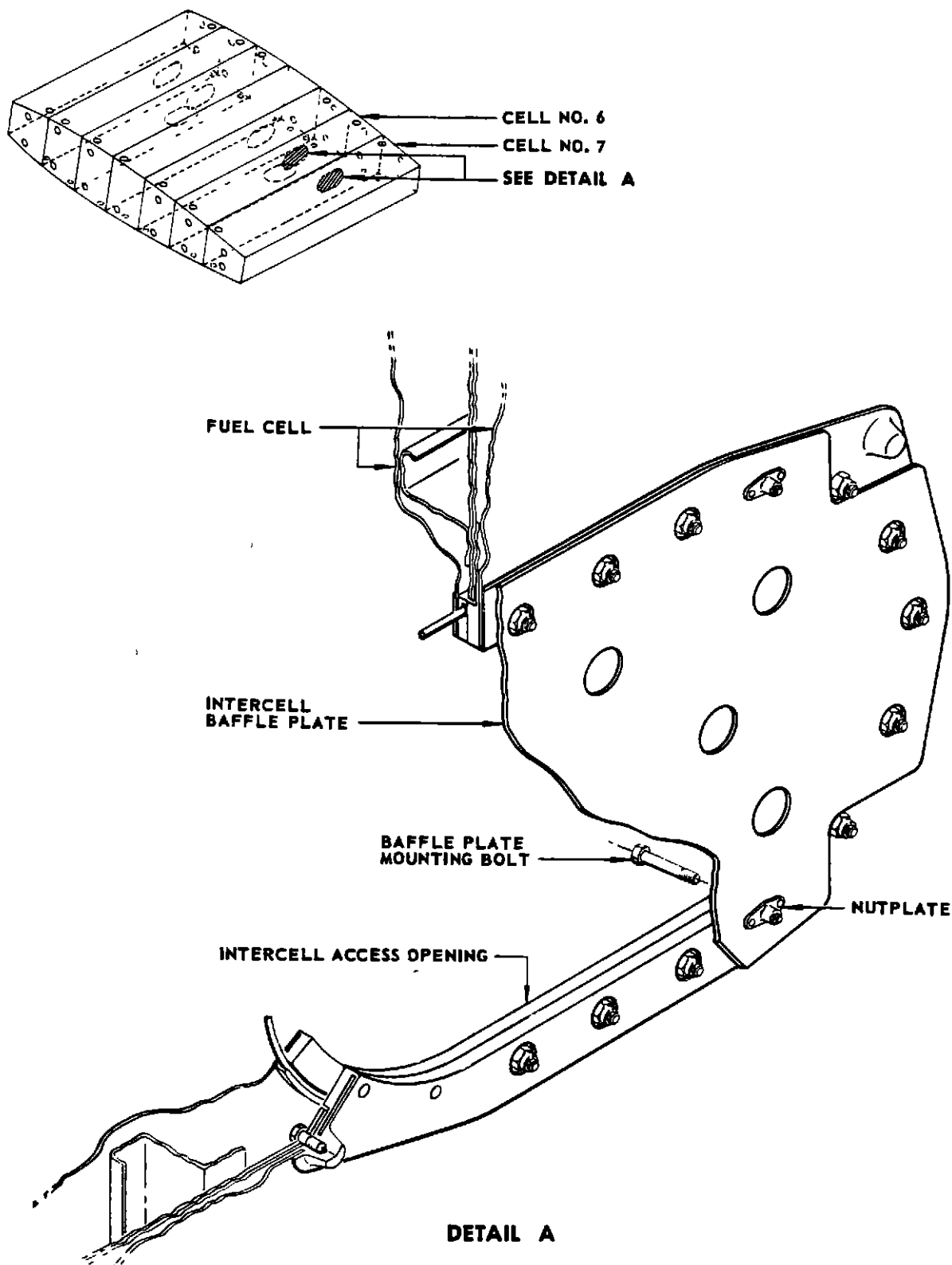
- B Install Baffle Plates (See figure 201 and 202.)

- (1) Position baffle plate over the intercell access opening.

- (2) Install fasteners.



Intercell Baffle Plate Installation (Cell No 5)
Figure 201



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InterCell Access Opening and Baffle Plate
Installation (Cells No. 6 and 7)
Figure 202

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FUEL CELL - STORAGE

1. General

- A. In the event the cell must be stored after repair, or before repairs can be carried out, steps must be taken to preserve the inner cell wall, to prevent checking or cracking of the impregnated rubber coated innerliner.
- B. The cells should remain in their containers until ready to be installed. Containers may be stacked but not to the extent that the bottom container is collapsed. Stock should be arranged so that the oldest cells are used first.
- C. Cells should be protected from sunlight, exposure, grit, dirt, and other foreign materials at all times.

2. Equipment and Materials

- A. SAE 10-20 Engine Oil
- B. Moisture-proof paper, polyethylene material, or canvas
- C. Container - Suitable to hold fuel cell without crushing
- D. Masking tape
- E. Camel hair brush
- F. Supply of clean lint-free cotton cloth

3. Prepare Fuel Cell for Storage

- A. Cells which have contained fuel should be preserved in the following manner prior to placing them in storage.
 - (1) Clean cell by washing thoroughly with warm water.
 - (2) The innerliner or inner surface of the cell should be coated with a light coat of SAE 10-20 engine oil. Do not permit oil to pool or puddle; remove any excess that remains after application.
 - (3) After the application of oil, cover all fitting openings with protective covers made of cardboard or other suitable material, taped into place over the fitting seal surface.

CAUTION: FUEL CELL FITTING SURFACES ARE CRITICAL SEALING AREAS. A SCRATCHED SURFACE MAY RESULT IN A FUEL LEAK. HANDLE FUEL CELL WITH EXTREME CARE.

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4. Store Fuel Cell

- A. Fold cell as smoothly and lightly as possible with the least number of folds, and with wadding between folds.
- B. Select a container which is the same size as the folded cell. This should be done to ensure that the cell does not shift when the container is moved.
- C. Check the container for foreign material that might damage the cell. Line the container with cardboard or heavy paper.
- D. Wrap the cell in moisture-proof paper and place it in the container. If necessary, place paper in the container to fill up all voids to ensure that the cell will not shift.
- E. Store the container in a suitable warehouse area, at a moderate temperature and humidity.



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REMOVABLE FUEL CELLS (GOODYEAR BTC-12 AND BTC-17) - APPROVED REPAIRS

1. General

- A. The fuel cell repair work outlined below is limited to the repair of Goodyear bladder cells constructed of BTC-12 or BTC-17 material and with damage which can be repaired by the "hot" or "cold" method using cements, without the use of jigs or molds. The hot repair method requires the use of heating units for curing. In the cold repair method, the cement is air cured.
- B. These repairs are designed to make the fuel cell serviceable in the shortest possible time after leakage or damage is discovered. No temporary repair procedures are to be used.
- C. Normally, the fuel cell must be removed from the cavity for repairs. However, injuries on the interior surface of the cell wall may be satisfactorily repaired, providing they are definitely surface injuries and no penetration through the nylon barrier or cell wall has been made.
- D. The repair of Goodyear bladder cells is restricted to authorized personnel. Authorized personnel are those who have been certified and trained by Goodyear representatives or those who have received their training from persons who have been certified.

NOTE: Manufacturers procedures and recommendation should be followed if different from or not indicated in the following procedures.

- E. Following a leak repair, the cell should be leak checked before installation. See 28-3-0, Removable Fuel Cells - Inspection Check.
- F. Fuel cell repair limitations.
 - (1) Fuel cell repairs permitted are as follows:
 - (a) Punctures, small cuts, or holes extending through the cell wall which are less than 4 inches in length or diameter.

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- (b) Blisters and/or ply separations.
 - 1) Blisters may or may not affect the serviceability of a fuel cell. Many factors should be considered before making a decision to repair or leave a fuel cell with blisters in service. Pattern location, size, and leakage are the main factors affecting a fuel cell with blisters. Blisters on the bottom and lower sides of the cell are subject to more pressure from the head of fuel than those in the top and upper sides of the cell. The following general rules may be used as a guide in determining the serviceability of a fuel cell containing blisters:
 - a) Fuel cells which have blisters, acquired while in service, 1 inch or less in diameter and located in the cell walls, which have not leaked, need not be repaired.
 - b) All other blisters should be repaired.
 - (c) Channels, loose seams, loose accessory parts, ferrules (fitting flanges, etc.).
 - (d) Removal and replacement of ferrules or fittings (not to include vent and drain fittings, intercell access opening fittings or access panel fittings).
 - (e) Small cuts and holes, which do not damage the nylon barrier, less than 4 inches in length or diameter.
 - (f) Scrapes or scuffing on cell surfaces.
 - (g) Cell fitting surface damage.
- (2) Fuel cell repairs not permitted are as follows:
 - (a) Replacement, relocation or addition of a cell fitting, except interconnect fittings.
 - (b) All injuries occurring in a corner formed by three interconnecting planes.
 - (c) Any repair which affects the interchangeability of the fuel cell.
 - (d) Holes or cuts larger than 4 inches diameter or length.



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- (3) Repairs which appear to exceed the scope of the repair procedures listed must be referred to the fuel cell manufacturer for evaluation. When difficult contours are encountered and repair material FT-136 cannot be used, return the cell to manufacturer for repair.

G. Materials Handling

- (1) All materials, including cells, are to be protected from dirt contamination, sunlight, exposure, and excessive heat or cold while in storage. Storage temperature should be from +30 to +85°F.
- (2) The repair cement, code 1895C, referred to in this text is prepared just prior to using by mixing one quart of 1492C with 25cc of 1465C accelerator. Smaller quantities may be obtained by mixing half amounts accurately measured.

CAUTION: CODE 1895C CEMENT REQUIRES THOROUGH MIXING TO OBTAIN FULL ADHESIVE VALUES.

- (3) Repair cement 1895C has a pot life of 16 hours after mixing.
- (4) The unmixed 1492C and 1465C have a shelf life of 6 months from date of packaging.

CAUTION: ALL CONTAINERS USED FOR CEMENTS OR SOLVENTS SHOULD BE PROPERLY IDENTIFIED.

H. Cell Handling

NOTE: Prevent needless damage by exercising common sense in all handling of cells.

- (1) Folding or collapsing of cells is necessary to place them in containers for storage, install in airframe cavities, or carry from place to place. Temperature during this operation should be 20°F or above.
- (2) Protect fitting seal surface from contact with cavities during removal or installation. Use protective covers over fitting seal when practical.
- (3) Do not carry cells by fittings. Maintain original cell contours or folds when folding for crating, installing in airframe cavities, or handling in the repair area.

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- (4) The cells to be repaired should be placed on a well lighted table. Maintain natural contours, if possible, while repairing. Prevent contact with sharp edges, corners, dirty floors, or other surfaces.
- (5) Do not stack cells unless they are in containers.

I. Cell Repair Precautions

- (1) Remove shoes before entering a cell. Protect cell from tools, hot lights, etc., when working inside or around cell.
- (2) Avoid stepping on folds or creases in cells.
- (3) Repair area must be well ventilated.

WARNING: DO NOT PERMIT SMOKING OR OPEN FLAME NEAR REPAIR AREA OR CELLS.

- (4) Avoid contamination from foreign material, dust, etc.
- (5) Avoid trapping air during all stitching operations.

2. Hot Repair Procedure

A. Equipment and Materials

NOTE. Accessories and fittings for replacement will be ordered in accordance with requirements of the individual cell. Phenol plates, phenol plate assemblies, and phenol test equipment can be ordered as required by customer. Group 1 (Material) and Group 2 (Equipment) are packaged as complete groups and should be ordered as Group 1, Group 2, or both.

- (1) Repair Kit 2Fl-3-35213 (Group 2 Equipment) Goodyear Tire and Rubber Company, Aviation Products Division, Akron, Ohio 44316. The repair kit consists of the following items:
 - (a) Abrasive cloth, 120 grit, aluminum oxide, three-m-ite, elektro-cut (1 sheet)
 - (b) Abrasive cloth, 320 grit, aluminum oxide, three-m-ite, elektro-cut (1 sheet)

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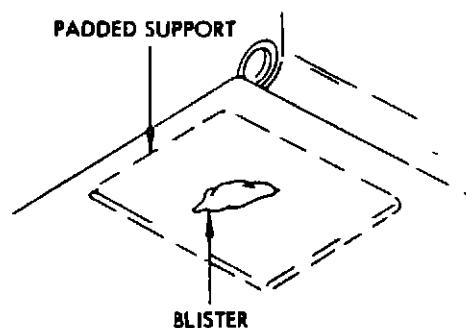
- (c) Balloon or broad cloth, white (2 yards)
- (d) C-clamps, 6 inch (6)
- (e) Polyethylene pail, 8 to 10 quarts (1)
- (f) Paint brush, 1 inch (1)
- (g) Roller, 1/4 inch x 3/4 inch diameter flat gooseneck (1),
Hoggson Pettis, New Haven, Connecticut
- (h) Stitcher, 1/32 inch x 3/4 inch diameter gooseneck (1), Hoggson
Pettis, New Haven, Connecticut
- (i) Scale, 12 inch, straight edge (1)
- (j) Scissors, 4 inch, curved nail (1 pair)
- (k) Shears, 10 inch snub nose (1 pair)
- (l) Electric Timer, Rhodes Mark Time #78105, or equivalent (1)
- (m) Light, Vapor Proof, with 25 foot cord (1)
- (n) Motor, Electric, Black and Decker #725, 2250 RPM, 1.9A 115V, or
equivalent (1)
- (o) Abrasive Arbor, Dumore R421003, 1/4 inch drive, 1 inch diameter
x 1 inch length, or equivalent (1)
- (p) Sanding Sleeve, 3M three-m-ite, 1 inch x 1 inch 80-100 grit or
equivalent (6)
- (q) Heated Repair Iron, 290 degrees temperature setting. Drawing
2F1-2-25721 (1)
- (r) Soft Aluminum Plates, 1/8 inch thick, 6 inch x 6 inch (6)
- (s) Filler Plug. Drawing 2F1-2-14251 (1)
- (2) Neoprene Rubber Gloves
- (3) Silver Colored Marking Pencil
- (4) Goodyear Repair Kit 2F1-3-35123 (Group 1 Materials) Goodyear Tire
and Rubber Company, Aviation Products Division, Akron, Ohio 44316.
The repair kit consists of the following items:

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- (a) Repair Material - FT-136, Reinforced Sandwich Nylon - 2 square yards
 - (b) Airfoam, 1/4 inch fabric backed - 2 square yards
 - (c) Repair Cement - Code 1492C - 1 quart
 - (d) Accelerator for 1492C Cement - Code 1465C - 25cc
 - (e) Lacquer - Code 5053C - 1 quart
 - (f) Solvent - Methyl Ethyl Ketone - 1 quart
 - (g) Soapstone, Powdered or Mica - 2 pounds
 - (h) Ethyl Alcohol - Commercial Grade, 95% denatured - 2 gallons
 - (i) Phenolphthalein - Analytical Grade - 2 ounces
 - (j) Ammonia - Commercial Grade, 27% Concentrate - 1 pint
- (5) Alodine 1200 Solution

B. Prepare to Repair Fuel Cell

- (1) Defuel and purge fuel tank prior to entering cell. Refer to 28-0, Defueling and 28-20-0, Fuel Storage System - Maintenance Practices.



Fuel Cell Support Pad
Figure 801



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- (2) If cell must be removed from cavity for repair, refer to Removable Fuel Cells - Removal/Installation for this procedure.

WARNING FUEL CELLS WHICH HAVE CONTAINED FUEL CONTAIN DANGEROUS EXPLOSIVE AND TOXIC VAPORS. USE ONLY EXPLOSION-PROOF AND SHIELDED LIGHTS. POWER TOOLS MUST BE AIR-DRIVEN. WEAR A COTTON COVERALL SNUG AT WRISTS AND ANKLES, WITH NON-SPARKING ZIPPER. REMOVE SHOES AND WEAR THERMO SOCKS.

- (3) Place fuel cell upon a smooth, clean, padded work table, if removed from airplane cavity for repair.

NOTE: Repair work on fuel cells must be accomplished in a warm dry place. Ideal conditions for cell repair are 70 to 80°F with 50% humidity. High humidity and low temperature will cause moisture condensation to form on cemented surfaces and make adhesion of repair patches impossible.

- (4) Cells must be thoroughly cleaned with warm water before attempting any repair.
- (5) After cleaning, the fuel cell must be thoroughly dried. The process can be hastened by keeping the cell in a warm dry place and using an air hose inside the cell.
- (6) Support the fuel cell around the injury so that the cell will be in a natural flat position during repair. Supports shall be smooth, well padded and clean. (See figure 801.)

C. Repair Fuel Cell

- (1) Tools to be used in the repair of fuel cells are illustrated in figure 802.

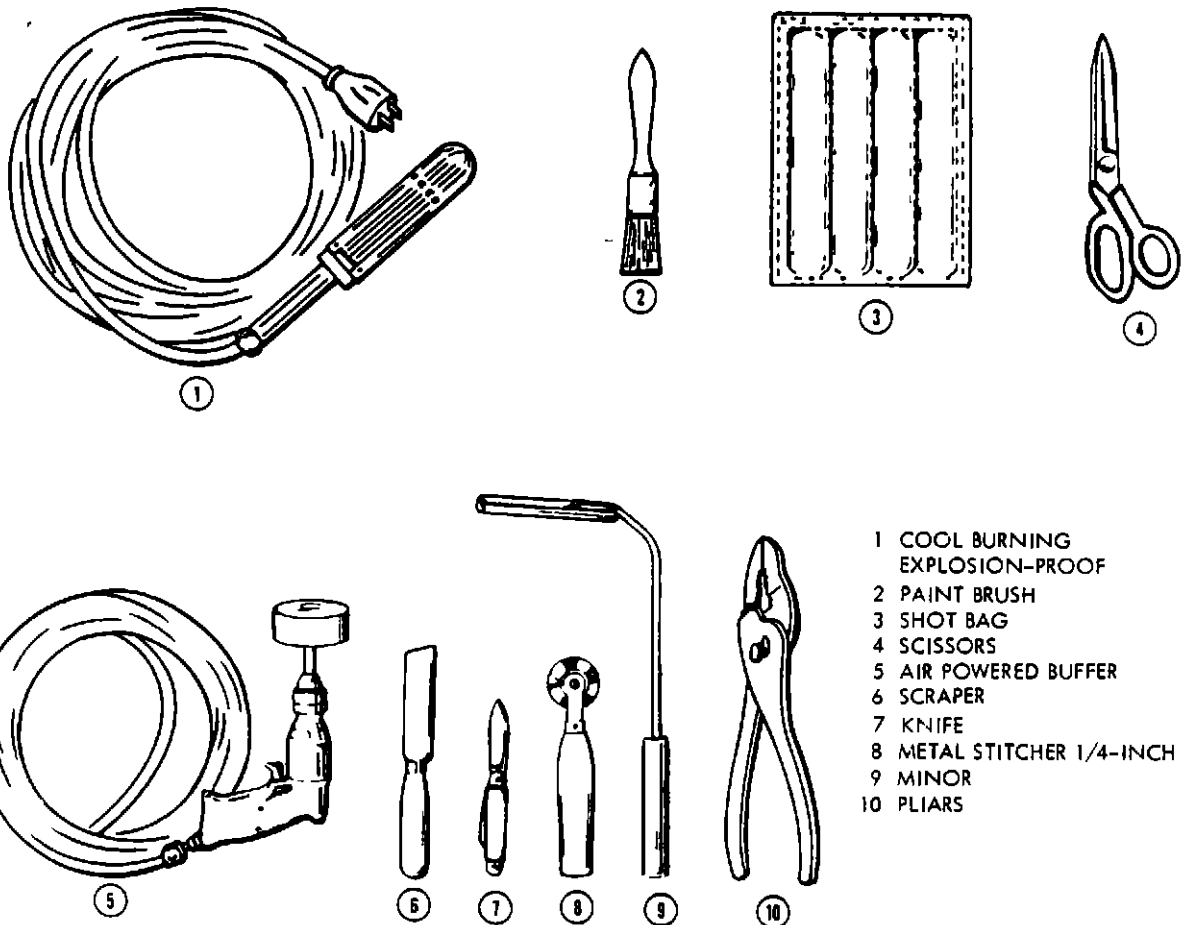
NOTE: The use of a hypodermic needle is prohibited in all fuel cell repairs.

- (2) Materials to be used in the repair of fuel cells are listed in paragraph 2.A.(4) and (5).
- (3) Stir cement thoroughly before using and stir frequently while in use to maintain proper consistency. Cements which are jellied, lumpy, too thin or possess any abnormal characteristics should not be used.

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(4) Hot Repair Method

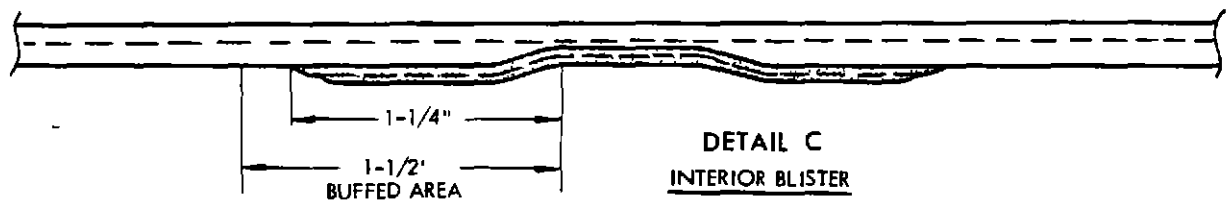
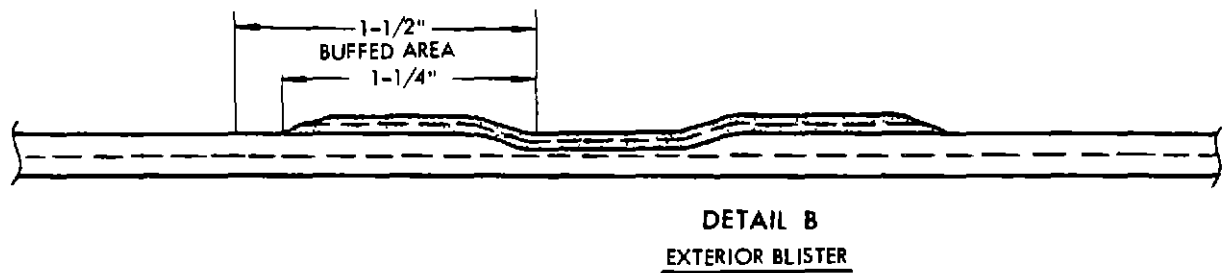
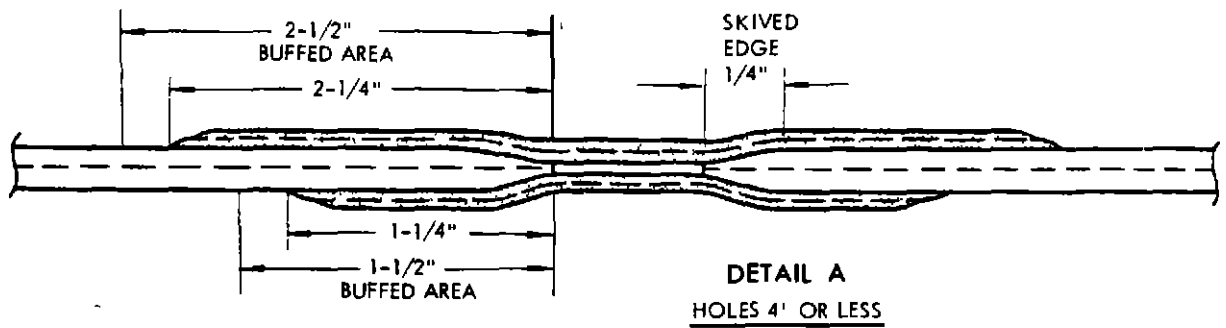
- (a) Holes or Cuts Extending Through Cell Wall (smaller than 4 inches in length or diameter).
- 1) Cut and trim loose ply and jagged edges of the injury by skiving away the loose material to form a smoothly rounded outline. The skived edges shall be tapered approximately 1/4 inch. (See figure 803.)
 - 2) Prepare repair patches. (See detail A, figure 803.)
 - a) For inside cell surface, cut a cover patch of FT-136 repair material to extend at least 1-1/2 inches in all directions from edge of injury.



- 1 COOL BURNING
EXPLOSION-PROOF
- 2 PAINT BRUSH
- 3 SHOT BAG
- 4 SCISSORS
- 5 AIR POWERED BUFFER
- 6 SCRAPER
- 7 KNIFE
- 8 METAL STITCHER 1/4-INCH
- 9 MINOR
- 10 PLIARS

Fuel Cell Repair Tools
Figure 802

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- b) For outside cell surface, cut a cover patch of repair material to extend at least 2 inches in all directions from edge of injury.

NOTE: All patches shall be cut by skiving the edge. Each patch shall have a smoothly rounded outline. (See detail A, figure 804.)

- c) Lightly buff the "down" side only of the two repair patches.

NOTE: For buffing, use an air-powered buffer, or hand sander, with a fine emery cloth of 120 grit.

- d) Wash the buffed surface of each patch using a clean cloth moistened with solvent, until all buffing dust is removed.

- 3) Lightly buff inside and outside cell surface around injured area to remove shine from cell surface.

NOTE: Buffing for any repair must not extend more than 1/4 inch in all directions beyond the patch outline. Use an air-powered buffer, or hand sand the area, with a fine emery cloth of 120 grit. Use only enough pressure to remove gloss on cell surface. Extreme care must be taken not to injure cell further while buffing.

- 4) Wash the buffed areas, using a clean cloth moistened with solvent. Wash until all grit and buffing dust is removed.

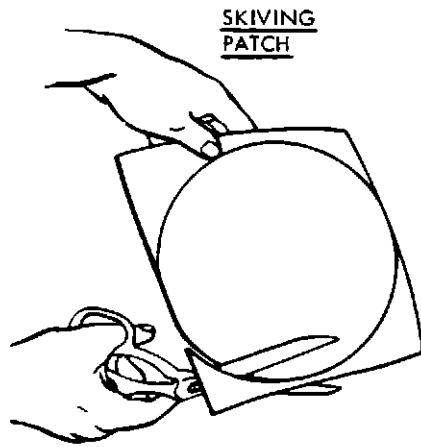
WARNING. THE VAPORS FROM SOLVENTS AND RUBBER CEMENTS ARE DANGEROUSLY TOXIC. AVOID PROLONGED INHALING OF THESE VAPORS.

- 5) Apply patch to outside cell surface.

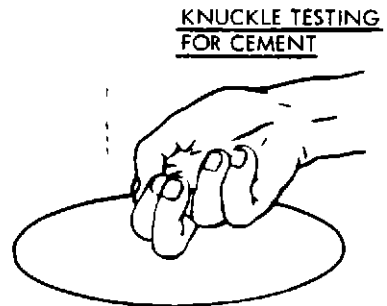
- a) Apply four coats of Code 1895C cement evenly and thinly, to the outside buffed surface of the cell and one side of the larger repair patch, with paint brush.

- b) Allow each coat to dry completely.

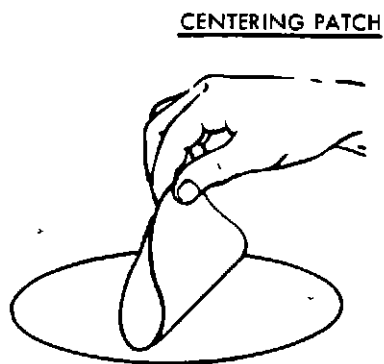
NOTE: To determine if the cement is dry, press a knuckle gently against the surface and withdraw it. If no cement sticks to the knuckle the surface is dry. (See detail B, figure 804.)



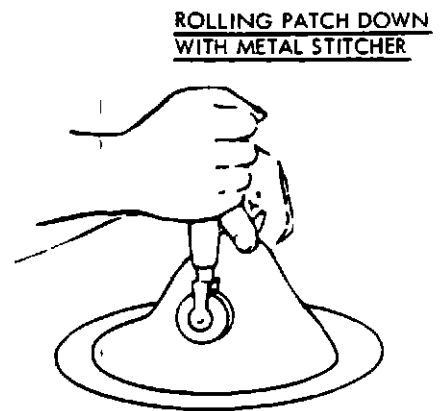
DETAIL A



DETAIL B



DETAIL C



DETAIL D



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- c) Center the repair cover patch over the cell injury immediately after fourth coat is dry to touch. Do not allow air to be trapped under patch.

NOTE: Trapped air blisters may be removed by using a looped wire wet with methyl ethyl ketone snaked under cover patch to blister. Close opening created between cell wall and cover patch with fingers behind loop as wire is slowly withdrawn.

- d) Roll patch firmly down starting at the center of the patch and working to the outer edge. Dust with soapstone to prevent sticking during cure. (See details C and D, figure 804.)
- e) Cover one smooth surface of two 1/8-inch thick aluminum plates with 1/4-inch fabric backed airfoam, fabric side out. Use tape to hold airfoam in place.

CAUTION: PLATES MUST BE LARGER THAN THE COVER PATCH. AIRFOAM MUST LAP EDGES OF PLATE FOR PROTECTION.

- f) Fold cell adjacent to cover patch.
- g) Place prepared plates, one over cover patch area and one on opposite side, fabric side against cover patch or cell surface.
- h) Center a heated repair iron on plate over cover patch. Secure assembly with a C-clamp. Tighten clamp finger-tight.

CAUTION: MAKE SURE THAT CELL FOLD IS NOT CLAMPED BETWEEN PLATES. THIS WOULD CAUSE A HARD PERMANENT CREASE.

- i) Connect repair iron into electric outlet and cure for 60 minutes.
- j) After cure time has elapsed, allow repair iron to cool to touch, then remove C-clamps.
- k) Check entire patch for blistering or poor adhesion.

NOTE: Any patch showing signs of blistering or poor adhesion must be removed with a clean, lint-free cloth moistened with solvent. If the patch is undamaged it may be reworked.

- l) Paint all outside cover patches with one coat of outside lacquer, Code 5053C.



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- 6) Apply patch to inside cell surface.
 - a) Repeat steps 5) a) through 5) 1) above and apply smaller repair patch to inside cell surface.
- 7) Pressure test fuel cell for leakage before installation in airplane cavity and filling with fuel. Refer to Removable Fuel Cells - Inspection/Check.

NOTE: All hot patch repairs may be inspected, air tested, and installed as soon as the repair is cool.

(b) Blisters and Hole or Cut not Extending through Cell Wall

- 1) Repair interior or exterior surface blister, hole, or cut.
 - a) Cut and trim loose ply and jagged edges of the injury by skiving away the loose material to form a smoothly rounded outline. (See figure 803, details B and C.)
 - b) Cut a patch of FT-136 repair material to extend 1-1/2 inches in all directions from edge of injury.
 - c) Apply patch to inside and outside surface of cell. Use procedure described in paragraph 2.C., steps (4)(a)1) through (4)(a)7).

(c) Loose Seams

- 1) If an effective bond width of one inch is maintained, the loose seam may be trimmed.
- 2) If the effective bond width is less than one inch, prepare the cell for repair using procedures described in paragraph 2.B.
- 3) Apply repair patch to inside or outside cell surface, depending upon location of injury. Use procedure described in paragraph 2.C , steps (4)(a)1) through (4)(a)7).

(d) Fuel Cell Lacing Ferrule Repair

- 1) Remove damaged lacing ferrule as follows.
 - a) Mark exact location of lacing tab with silver-colored marking pencil.



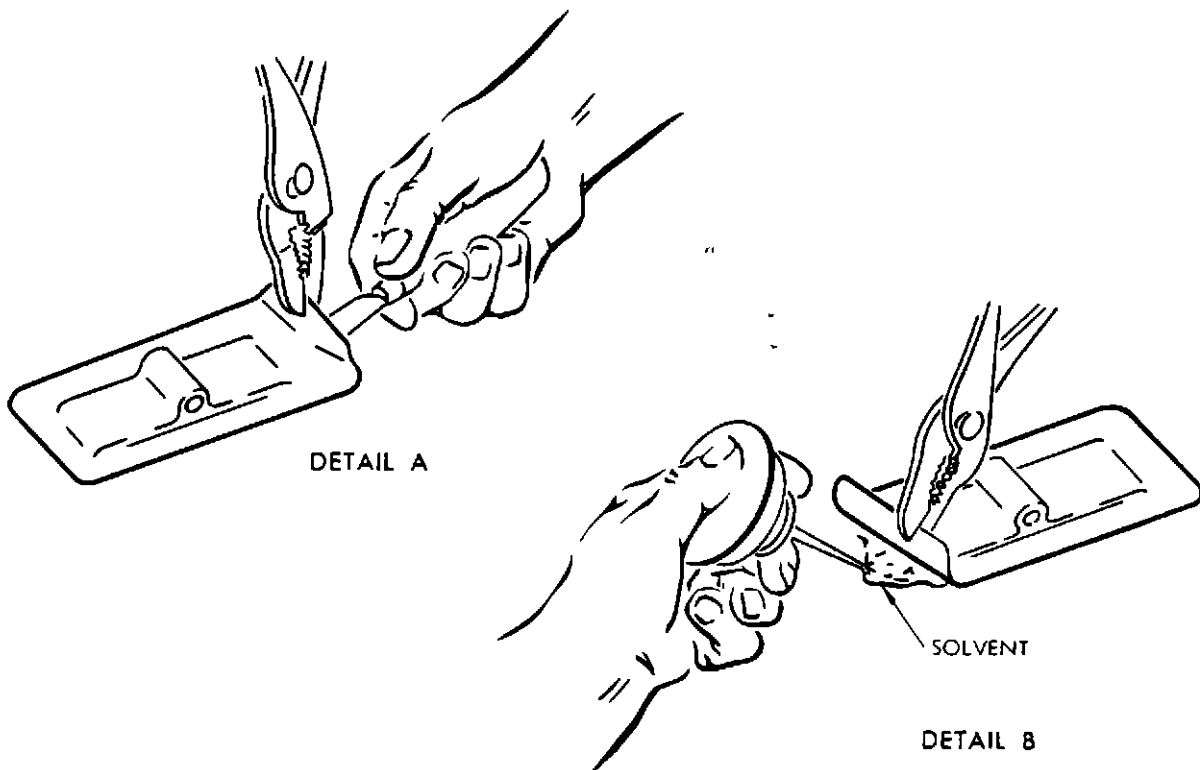
MAINTENANCE MANUAL

- b) Apply a small quantity of solvent to the outer edge of the lacing tab collar to loosen it.

CAUTION USE METHYL ETHYL KETONE SPARINGLY. EXCESSIVE AMOUNTS WILL DESTROY THE CELL MATERIAL.

- c) Raise and loosen the tab collar edge with a blunt tool or knife with rounded end. (See detail A, figure 805.)
- d) Pull on the loosened edge of the tab collar with a pair of pliers while applying more solvent between lacing tab collar and cell. (See detail B, figure 805.)
- e) Progressively remove lacing tab from cell surface.
- 2) Clean the area thoroughly with solvent and allow to dry completely.
- 3) Buff an area on the cell surface one inch larger all around than the size of the lacing ferrule collar.

CAUTION: EXERCISE EXTREME CARE IN BUFFING SO THAT OUTER PLY OF FUEL CELL IS NOT DAMAGED. USE AIR-POWERED BUFFER OR BUFF BY HAND WITH 120 GRIT EMERY CLOTH



Fuel Cell Lacing Ferrule Removal
Figure 805



MAINTENANCE MANUAL

- 4) Buff the "down" side of the new lacing ferrule.
- 5) Apply four even coats of 1895C repair cement each to the buffed area of the cell and the "down" side of the new lacing tab.
- 6) Allow both cemented surfaces to dry completely between coats.

NOTE: To determine if the cement is dry, press a knuckle gently against the surface and withdraw it. If no cement sticks to the knuckle the surface is dry enough. (See detail B, figure 804.)

- 7) Position lacing ferrule on fuel cell in same position as old lacing tab.
- 8) Roll lacing tab collar firmly down with 1/32-inch metal stitcher or 1/4-inch roller, starting from the center and working to the outer edge to remove trapped air.
- 9) Prepare a 1/8-inch aluminum plate by cutting out a hole in the plate to clear the protruding ferrule tube. Cover with 1/4-inch fabric backed airfoam, fabric side out. Use tape to hold airfoam in place.
- 10) Prepare a back-up plate similar to step 9), except that a hole is not required.
- 11) Place aluminum plates, prepared in steps 9) and 10) above, over the new ferrule and the backup plate on the opposite surface of the cell wall.

CAUTION: CARE MUST BE TAKEN TO ENSURE THAT THE AIRFOAM EXTENDS BEYOND THE PLATE IN ALL DIRECTIONS.

- 12) Apply a heated repair iron to each side of the ferrule tube and secure with a C-clamp. Tighten C-clamp finger-tight.
- 13) Connect repair iron into electric outlet and cure for 60 minutes.
- 14) After cure time has elapsed, allow repair iron to cool to touch, then remove C-clamps.
- 15) Check repair for blistering or poor adhesion.

NOTE: Any repair showing signs of blistering or poor adhesion must be reworked.

- 16) Paint repair with one coat of outside lacquer, Code 5053C.



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(e) Loose Fitting Flange (Inside or Outside Cell Surface)

- 1) Buff the cell and the "down" surface of the loose flange lightly.

CAUTION. EXERCISE EXTREME CARE IN BUFFING SO THAT FURTHER DAMAGE TO CELL DOES NOT RESULT. USE 120 GRIT EMERY CLOTH WITH AN AIR-POWERED BUFFER OR HAND SANDER.

- 2) Wash the buffed area using a clean cloth moistened with solvent. Wash until all buffing dust and grit is removed.
- 3) Apply four coats of 1895C repair cement to each surface using a paint brush. Allow cement to dry completely between coats.

NOTE. To determine if cement is dry, press a knuckle gently against the cemented surface and withdraw it. If no cement sticks to the knuckle, the surface is dry. (See detail B, figure 804.)

- 4) Stitch down the loose flange. Use a 1/4-inch roller or 1/32-inch metal stitcher.
- 5) Cover one smooth surface of two 1/8-inch thick aluminum plates with 1/4-inch fabric backed airfoam, fabric side out. Use tape to hold airfoam in place.

CAUTION. PLATES MUST BE LARGER THAN DAMAGED AREA. AIRFOAM MUST LAP EDGES OF PLATE FOR PROTECTION.

- 6) Place prepared plates, one over the repaired area and one on opposite side, fabric side against repaired surface or cell surface.
- 7) Center a heated repair iron on plate over repaired area. Secure assembly with a C-clamp. Tighten clamp finger-tight.
- 8) Connect repair iron into electric outlet and cure for 60 minutes.
- 9) After cure time has elapsed, allow repair iron to cool to touch, then remove C-clamps.
- 10) Check repair for blistering or poor adhesion.

NOTE. Any repair showing signs of blistering or poor adhesion must be reworked



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- 11) Paint all outside repairs with one coat of outside lacquer, Code 5053C.

(f) Fuel Cell Fitting Replacement - Two Flange Type

NOTE: All multiplane fittings such as vent, drain, or raised interconnect door fittings should be returned to the manufacturer for repair.

- 1) On the fuel cell wall, mark exact location of fitting by drawing distinct straight lines at 90 degrees through center of fitting to be removed and new fitting. Use silver-colored marking pencil.
- 2) Cut fitting out of the cell by cutting around the edge of the metal insert with a knife held perpendicular to the cell wall.
- 3) Remove the outside fitting flange using pliers and solvent or by buffing away the flange.
- 4) Buff the interior and exterior cell wall surface around the hole. The interior buffed area to be approximately 2-3/4 inches larger diameter than the flange diameter. The exterior buffed area to be approximately one inch larger diameter than the flange diameter. Buff the edge of hole smooth and adjust to the fitting throat. Wash entire buffed area with a clean cloth moistened with solvent to remove dirt and buffing dust.
- 5) Use four coats 1895C repair cement on each contacting surface of the cell wall and fitting flanges. Allow to dry thoroughly after each coat of cement is applied.
- 6) Buff both surfaces of the bottom flange, the inside surface of the top flange, the fitting throat and approximately 1/2 inch in from the edge on the outside surface of the top flange.
- 7) Insert the fitting into the hole and line up with previously marked rotation lines on fuel cell wall.
- 8) Activate the cement using a clean cloth moistened with solvent. The tack point is very critical. Avoid activating too large an area at one time.
- 9) When cement is tacky, stitch the fitting flange down starting at the throat and working toward the edge. Do not trap air. Stitch one flange completely down before starting on the second flange.



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- 10) Cut the inside collar of FT-136 repair material. It is to lap onto the fitting flange 1-1/4 ($\pm 1/8$) inches and the cell wall 1-1/4 ($\pm 1/8$) inches. Buff gum side of repair material and clean with solvent.
- 11) Cement the collar and contacting area of the fitting and cell wall with four coats of 1895C repair cement. Allow to dry thoroughly after each coat of cement.
- 12) Activate the cemented areas using a clean cloth moistened with solvent. See step 8).
- 13) Stitch down thoroughly. Do not trap air. See step 9).
- 14) Make two 1/8-inch aluminum plates with an inside diameter equal to the fitting throat being replaced. The outside diameter of the plate is to be 1/2 inch larger than the inside collar, or approximately 3-1/4 inches larger than the flange diameter. Chamfer sharp edges with a file.
- 15) Cut two plate pads from 1/4-inch fabric-backed airfoam 1/2 inch larger than the outside diameter of plate and 1/2 inch smaller than the inside diameter of plate. Center pad on plate, fabric side out and tape in place with masking tape or other suitable tape. Dust fabric surface with soapstone and rub into cloth.
- 16) Center the padded plates over applied fitting, one inside and one outside, and tape in position to restrict movement. The dusted fabric side is to be against the repair.
- 17) Apply as many heating units as possible to both plates. Stagger units inside and out to distribute heat equally. Use C-clamps to exert approximately 40 psi on the plate surface. Do not allow heating units to extend off the plate. On small diameter fittings one larger bolt and two large washers can be used for pressure.
- 18) Plug in the cure irons and cure for 2-1/2 hours.
- 19) Cool curing irons and cell until cool enough to handle without gloves. Any method of cooling may be used.
- 20) Remove irons and plates and inspect repair for possible defects.



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- 21) Any loose collar edges may be trimmed provided there is a minimum lap of one inch.
- 22) Any looseness under the collar may be repaired by inserting the looped end of a wire under the collar and into the area of separation. Use solvent to loosen the collar and allow the loop to enter. Use the wire to push cement into the loose area.
 - a) When loose area and the channel are full of cement, push the excess cement out of the channel by probing the collar.
 - b) Start at the loose area and work to the edge of the collar.
 - c) Apply cure plates and irons to cover the repaired area. Tighten the C-clamps and plug in the cure irons for one hour.
 - d) Allow to cool as above and remove irons and plates. As an alternate, the area may be air cured by clamping the plates on the defects and allowing it to set for 12 hours.

CAUTION: MAXIMUM NUMBER OF REPAIR CURES ON A SPECIFIC AREA IS THREE.

NOTE: If proper curing irons are not available, cell must be returned to manufacturer for fitting replacement.

(g) Fuel Cell Fitting Replacement - Single Flange Type

- 1) On the fuel cell wall, mark exact location of fitting by drawing distinct straight lines at 90 degrees through center of fitting to be removed and new fitting. Use silver-colored marking pencil.
- 2) Cut fitting out of the cell by cutting around the edge of the metal insert with a knife held perpendicular to the cell wall.
- 3) Buff the edge of the cutout hole on a bevel to the outside surface of the cell wall. Buff the cell exterior surface one inch larger diameter than the hole.



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- 4) Buff the interior cell surface 2-3/4 inches larger diameter than the hole. Wash all buffed areas with a clean cloth and solvent to remove dirt and buffing dust.
- 5) Buff both surfaces of the fitting flange and clean with solvent.
- 6) Use four coats 1895C repair cement on each contacting surface of the cell wall and fitting flange. Allow to dry thoroughly after each coat of cement is applied.
- 7) Insert the fitting into the hole and line up with previously marked rotation lines. Fitting is inside cell against first ply.
- 8) Activate the cement using a clean cloth moistened with solvent. The tack point is very critical. Avoid activating too large an area at one time.
- 9) When cement is tacky, stitch the fitting flange down starting at the throat and working toward the edge. Do not trap air.
- 10) Cut the inside collar of FT-136 repair material. It is to lap onto the fitting flange 1-1/4 ($\pm 1/8$) inches and the cell wall 1-1/4 ($\pm 1/8$) inches. Buff gum side of FT-136 material and clean with solvent.
- 11) Cut a donut ring collar of FT-136 repair material 3/4-inch wide to fit over exterior cut edge of hole and against edge of fitting seal surface.
- 12) Cement the collars and contacting area of the fitting and cell wall with four coats 1895C repair cement. Allow to dry thoroughly after each coat of cement.
- 13) Activate the cemented areas using a clean cloth moistened with solvent.
- 14) Stitch collars down thoroughly in their respective locations. Do not trap air.
- 15) Make two 1/8-inch aluminum plates with an inside diameter equal to the fitting throat being replaced. The outside diameter of one plate is to be 1/2 inch larger than the inside collar. Chamfer sharp edges with a file.



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- 16) Cut two plate pads from 1/4-inch fabric-backed airfoam 1/2 inch larger than the outside diameter of plate and 1/2 inch smaller than the inside diameter of plate. Center pad on plate, fabric side out and tape in place with masking tape or other suitable tape. Dust fabric surface with soapstone and rub into cloth.
- 17) Center the padded plate over applied fitting, one inside and one outside, and tape in position to restrict movement. The dusted fabric side is to be against the repair.
- 18) Apply as many heating units as possible to inside plate. Stagger units inside to distribute heat equally. Use C-clamps to exert approximately 40 psi on the plate surface. Do not allow heating units to extend off the plate. On small diameter fittings, one larger bolt and two larger washers can be used for pressure.
- 19) Plug in cure irons and cure for 2-1/2 hours.
- 20) Cool curing irons and cell until cool enough to handle without gloves. Any method of cooling may be used.
- 21) Remove irons and plates and inspect repair for possible defects.
- 22) Any loose collar edges may be trimmed provided there is a minimum lap of one inch.
- 23) Any looseness under the collar may be repaired by inserting the looped end of a wire under the collar and into the area of separation. Use solvent to loosen the collar and allow the loop to enter. Use the wire to push cement into the loose area.
 - a) When loose area and the channel are full of cement, push the excess cement out of the channel by probing the collar.
 - b) Start at the loose area and work to the edge of the collar.
 - c) Apply cure plates and irons to cover the repaired area. Tighten the C-clamps and plug in the cure irons for one hour.



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- d) Allow to cool as above and remove irons and plates. As an alternate, the area may be air cured by clamping the plates on the defect and allowing it to set for 12 hours.

CAUTION. MAXIMUM NUMBER OF REPAIR CURES ON A SPECIFIC AREA IS THREE.

NOTE. If proper curing irons are not available, cell must be returned to manufacturer for fitting replacement.

D. Restore Fuel Cell to Normal Configuration

- (1) Remove all tools, rags, and materials used in repairing fuel cell.
- (2) Clean cell thoroughly with clean lint-free cotton cloths dampened with water.
- (3) If cell has been removed from airplane for repair, prepare it for reinstallation. Refer to Removable Fuel Cells - Removal/Installation.

3. Cold Repair Procedure

A. Equipment and Materials

- (1) Same as Hot Repair Procedure List except for the Heated Repair Iron and Soft Aluminum Plates.

B. Prepare to Repair Fuel Cell

- (1) Defuel and purge fuel tank prior to entering cell. Refer to 28-0, Defueling and 28-20-0, Fuel Storage System - Maintenance Practices.
- (2) If cell must be removed from cavity for repair, refer to Removable Fuel Cells - Removal/Installation for this procedure.

WARNING: FUEL CELLS WHICH HAVE CONTAINED FUEL CONTAIN DANGEROUS EXPLOSIVE AND TOXIC VAPORS. USE ONLY EXPLOSION-PROOF AND SHIELDED LIGHTS. POWER TOOLS MUST BE AIR-DRIVEN. WEAR A COTTON COVERALL SNUG AT WRISTS AND ANKLES, WITH NON-SPARKING ZIPPER. REMOVE SHOES AND WEAR THERMO SOCKS.



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- (3) Place fuel cell upon a smooth, clean, padded work table, if removed from airplane cavity for repair.

NOTE: Repair work on fuel cells must be accomplished in a warm dry place. Ideal conditions for cell repair are 70 to 80°F with 50% humidity. High humidity and low temperature will cause moisture condensation to form on cemented surfaces and make adhesion of repair patches impossible.

- (4) Cells must be thoroughly cleaned with warm water before attempting any repair.
- (5) After cleaning, the fuel cell must be thoroughly dried. The process can be hastened by keeping the cell in a warm dry place and using an air hose inside the cell.
- (6) Support the fuel cell around the injury so that the cell will be in a natural flat position during repair. Supports shall be smooth, well padded and clean. (See figure 801.)

C. Repair Fuel Cell

- (1) Tools to be used in the repair of fuel cells are illustrated in figure 802.

NOTE: The use of a hypodermic needle is prohibited in all fuel cell repairs.

- (2) Materials to be used in the repair of fuel cell are listed in paragraph 2.A.(4) and (5).
- (3) Stir cement thoroughly before using and stir frequently while in use to maintain proper consistency. Cements which are jellied, lumpy, too thin or possess any abnormal characteristics should not be used.
- (4) Use the same procedure as called out in Hot Repair Procedure except do not apply heat.
- (5) All "cold patch" repairs must be sealed by applying two coats of 1895C repair cement to cover repaired area, including the buffed surface. Allow the first coat to dry completely before applying second coat.
- (6) Allow fuel cell to remain undisturbed for 24 hours before handling.

NOTE: Clamping is not required on repair.

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- (7) Coat outside cover patches with one coat of outside lacquer, code 5053C after 24-hour air cure time has elapsed.
- (8) All "cold patch" repairs must air cure for 72 hours before fueling.
- (9) Cell Fitting Surface Damage
 - (a) Lightly buff the area with a fine abrasive (crocus cloth or equivalent) to remove any scratches or gouges.

CAUTION. FUEL CELL FITTING SURFACE IS A CRITICAL SEALING AREA. ENSURE THAT FLATNESS IS MAINTAINED DURING BUFFING PROCEDURE. DO NOT ATTEMPT TO REPAIR ANY DAMAGE WHICH EXTENDS INTO O-RING GROOVE.

- (b) Treat the reworked surface with Alodine 1200 solution without dilution or adulteration, as follows:

WARNING. ALODINE SOLUTION IS A CORROSIVE CHEMICAL, AND CAN CAUSE SEVERE BURNS TO SKIN AND EYES. RUBBER GLOVES MUST BE WORN WHEN HANDLING THIS SOLUTION. AVOID SPLASHING. SOLUTION SPLASHED IN THE EYES MUST BE WASHED OUT WITH WATER FOLLOWED BY AN EYE-WASH OF BORIC ACID; OBTAIN MEDICAL AID IMMEDIATELY.

- 1) Mask off a 2-inch area surrounding the buffed fitting surface with adhesive cloth tape.
- 2) Clean the buffed fitting surface by wiping thoroughly with a clean cloth saturated with solvent.
- 3) Cold rinse the surface thoroughly with a clean cloth moistened with clean water.
- 4) Apply alodine solution to the repaired surface with a nylon brush. Solution must be thin enough to be applied evenly and liberally.

CAUTION: CARE MUST BE TAKEN THAT ALODINE SOLUTION DOES NOT COME IN CONTACT WITH ANY UNMASKED AREA OF THE FITTING OR THE FUEL CELL WALL. DO NOT ATTEMPT TO BRUSH THE SOLUTION OUT LIKE PAINT.



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- 5) Maintain a continuous wet film of alodine for a minimum of five minutes. A visible light golden color coating should be produced.
- 6) Remove excess alodine solution by thoroughly flushing with clean cold water followed by lightly wiping with clean cotton cloth or warm air drying.

CAUTION: SWABS USED FOR APPLYING OR REMOVING ALODINE SOLUTION CONSTITUTE A FIRE HAZARD WHEN DRY. IMMEDIATELY AFTER USE, THEY SHOULD BE THOROUGHLY SOAKED IN WATER BEFORE DISCARDING. WASH THE NYLON BRUSH OUT IN CLEAN WATER.

D. Restore Fuel Cell to Normal Configuration

- (1) Remove all tools, rags, and materials used in repairing fuel cell.
- (2) Clean cell thoroughly with clean lint-free cotton cloths dampened with water.
- (3) If cell has been removed from airplane for repair, prepare it for installation. Refer to Removable Fuel Cells - Removal/Installation.



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REMOVABLE FUEL CELLS (FIRESTONE) - APPROVED REPAIRS

1. General

- A. The bladder cell repair work outlined below is limited to Firestone bladder cells. Cell damage can be repaired by the "cold" method using cements, jigs, molds, or fixtures, without the use of hot vulcanizing equipment.
- B. These repairs are designed to make the fuel cell serviceable in the shortest possible time after leakage or damage is discovered. No temporary repair procedures are to be used.
- C. Normally, the fuel cell must be removed from the cavity for repairs. However, injuries on the interior surface of the cell wall may be satisfactorily repaired, providing they are definitely surface injuries and no penetration through the nylon barrier or cell wall has been made.
- D. The repair of Firestone bladder cells is restricted to authorized personnel. Authorized personnel are those who have been certified and trained by Firestone representatives or those who have received their training from persons who have been certified as above.

NOTE: Manufacturers procedures and recommendation should be followed if different from or not indicated in the following procedures.

- E. Following a leak repair, the cell should be leak checked before installation.

F. Fuel Cell Repair Limitations

(1) Fuel cell repairs permitted are as follows:

- (a) Punctures, small cuts or holes extending through the cell wall which are less than 10 inches in length or diameter.

(b) Blisters and/or ply separations.

- 1) Blisters may or may not affect the serviceability of a fuel cell. Many factors should be considered before making a decision to repair or leave a fuel cell with blisters in service. Pattern locations, size, and leakage are the main factors affecting a fuel cell with blisters. Blisters on the bottom and lower sides of the cell are subject to more pressure from the head of fuel than those in the top and upper sides of the cell. The following general rules may be used as a guide in determining the serviceability of a fuel cell containing blisters:



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- a) Fuel cells which have blisters, acquired while in service, 1/2 inch or less in diameter and are located in the cell walls and have not leaked, need not be repaired.
- b) Fuel cells which have not been in service but have blisters 1/4 inch or less in diameter, and a maximum of one blister per square foot of cell area, with a minimum of 6 inches between blisters, which are located in cell walls, need not be repaired. The cell may be placed in service.
- (c) Channels, loose seams, delaminations, or ply separations.
- (d) Loose accessory parts, ferrules (fittings, flanges, etc.).
- (e) Removal and replacement of ferrules or fittings (not to include vent and drain fittings, intercell access opening fittings or access panel fittings).
- (f) Small cuts and holes, which do not damage the nylon barrier, less than 10 inches in length or diameter.
- (g) Scrapes or scuffing on cell surfaces.
- (h) Cell fitting surface damage.
- (2) Fuel cell repairs not permitted are as follows:
 - (a) Replacement, relocation, or addition of a cell fitting.
 - (b) All injuries occurring in a corner formed by three interconnecting planes.
 - (c) Any repair which affects the interchangeability of the fuel cell.
 - (d) Blisters or ply separations larger than 25 square inches in area.
 - (e) Holes or cuts larger than 10 inches diameter or length.
- (3) Repairs which appear to exceed the scope of the repair procedures given below must be referred to the fuel cell manufacturer for evaluation.



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G. Materials Handling

- (1) All materials, including cells, are to be protected from dirt, contamination, sunlight, exposure, and excessive heat or cold while in storage. Storage temperature should be from +45 to +75°F.

H. Cell Handling

NOTE: Prevent needless damage by exercising common sense in all handling of cells.

- (1) Folding or collapsing of cells is necessary to place them in containers for storage, install in airframe cavities, or carry from place to place. Temperature during this operation should be 20°F or above.
- (2) Protect fitting seal surface from contact with cavities during removal or installation. Use protective covers over fitting seal when practical.
- (3) Do not carry cells by fittings. Maintain original cell contours or folds when folding for crating, installing in airframe cavities or handling in the repair area.
- (4) The cell to be repaired should be placed on a well lighted table. Maintain natural contours, if possible, while repairing. Prevent contact with sharp edges, corners, dirty floors, or other surfaces.
- (5) Do not stack cells unless they are in containers.

I. Cell Repair Precautions

- (1) Remove shoes before entering a cell, and protect cell from tools, hot lights, etc. when working inside or around them.
- (2) Avoid stepping on folds or creases in cells.
- (3) Repair area must be well ventilated.

WARNING: DO NOT PERMIT SMOKING OR OPEN FLAME NEAR REPAIR AREA OR CELLS.

- (4) Avoid contamination from foreign material, dust, etc.
- (5) Avoid trapping air during all stitching operations.

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2. Equipment and Materials

A. Special tools required for fuel cell repair are illustrated in figure 801.

NOTE: Items B. through O. may be purchased from Firestone Tire and Rubber Co., Los Angeles, California.

- B. Sheet, Buna Gum Rubber, 0.035 gauge, cured (No. PF-10030)
- C. Sheet, Nylon Fabric, 0.018 gauge, cured (No. PF-10034)
- D. Sheet, Buna Gum Rubber "Nylon Sandwich," 0.030 gauge (No. PF-10056)
- E. Sheet, Buna N gum fitting stock, 0.020 to 0.030 gauge, uncured (No. 90348)
- F. Sheet, Nylon Fabric, 0.021 gauge, cured (PF-10066)
- G. Tape, Cotton Fabric, cured, 0.021 gauge (No. PF-10035)
- H. Cement, Aromatic Fuel Resistant (No. 95577)
- I. Cement, Fitting Repair, Buna N (No. 90349)
- J. Cement, Fitting Repair, Buna N (No. L-706)
- K. Cement, Aromatic Fuel-Resistant, vulcanizing type (No. 95195)
- L. Solvent, Methyl Ethyl Ketone (No. RP-6079)
- M. Solvent, Methyl Isobutyl Ketone (No. RP-7172)
- N. Solution - Alodine, (Chemical Kit No. 120), American Chemical Paint Co., Ambler, Pa.
- O. Solution - Deoxidine (No. 605), American Chemical Paint Co.
- P. Solvent, Methyl Chloroform (No. M-50)
- Q. Fitting, loops, tabs, and other accessory parts ordered per Firestone Tire and Rubber Co.
- R. Explosion Proof Electric Air Heater/Blower - Coats Model GA75-2A, CAM Industries Inc., 18250 - 68th Ave. S., Kent, Washington, 98031, or equivalent
- S. Neoprene rubber gloves
- T. Soap Paste - Specification No. PS-598
- U. Marking Pencil - Silver colored

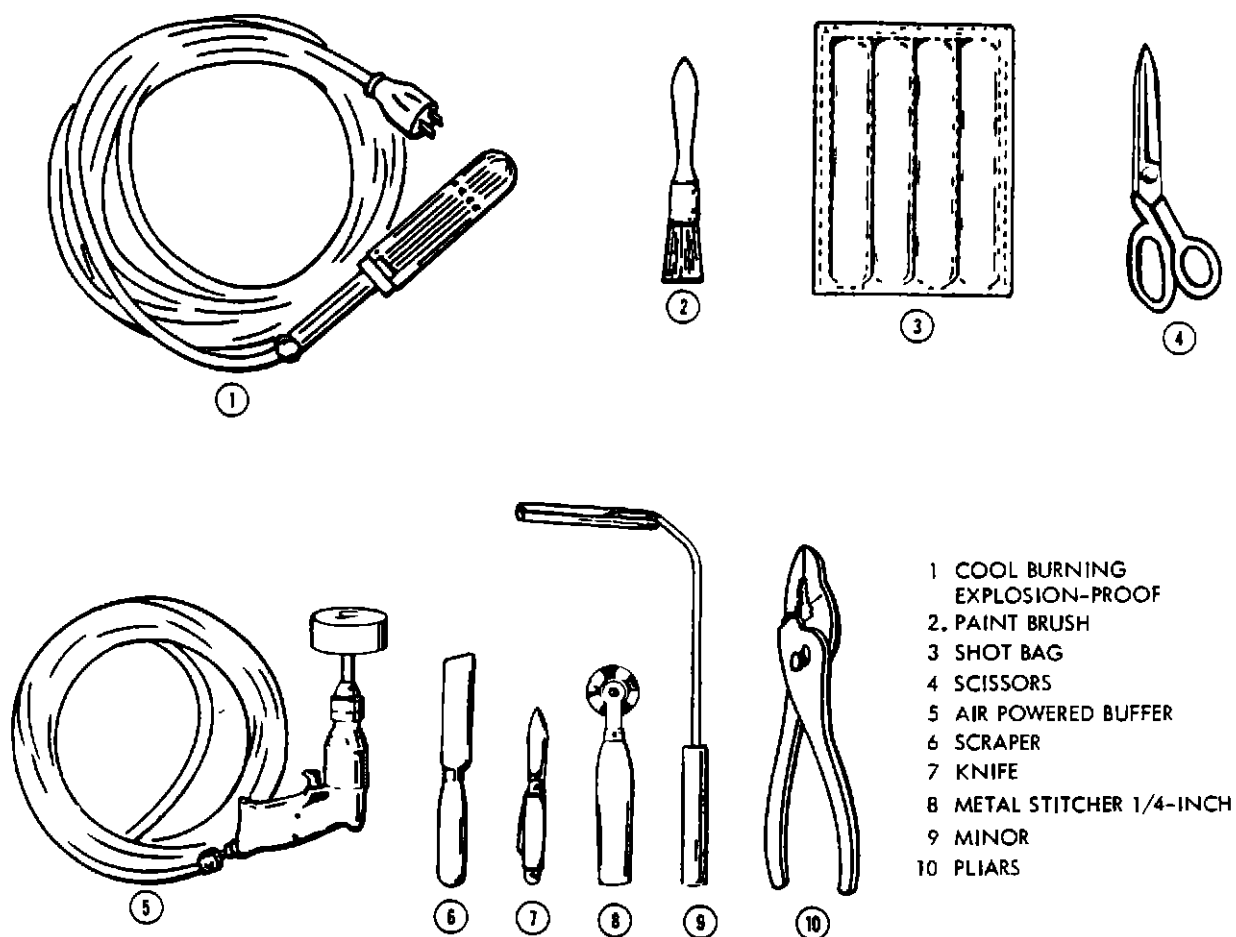
NOTE: Substitution of material shall not be made without permission of fuel cell manufacturer.

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3. Prepare to Repair Fuel Cell

- A. The fuel cell must first be drained, purged and vented before removal from the aircraft cavity for repair or before personnel can enter the cell to carry out repairs not requiring removal. Refer to Removable Fuel Cells - Removal/Installation for this procedure.





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B. Prepare fuel cell.

WARNING: FUEL CELLS WHICH HAVE CONTAINED FUEL CONTAIN DANGEROUS EXPLOSIVE AND TOXIC VAPORS. USE ONLY EXPLOSION-PROOF AND SHIELDED LIGHTS. POWER TOOLS MUST BE AIR DRIVEN. WEAR A COTTON COVERALL SNUG AT WRISTS AND ANKLES, WITH NONSPARKING ZIPPER. REMOVE SHOES AND WEAR THERMO SOCKS.

- (1) Place fuel cell upon a smooth, clean, padded work table, if removed from airplane cavity for repair.

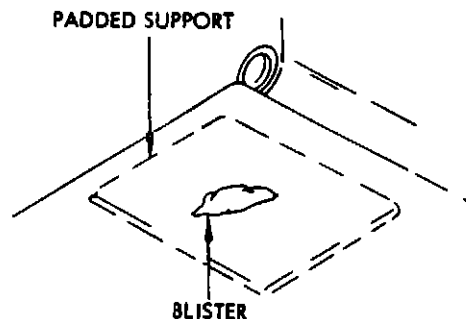
NOTE: Repair work on fuel cells must be accomplished in a warm dry place. Ideal conditions for cell repair are 70 to 80°F with 50% humidity. High humidity and low temperature will cause moisture condensation to form on cemented surfaces and make adhesion of repair patches impossible.

- (2) Cells must be thoroughly cleaned before attempting any repair. The following procedures shall be used to clean the cells:

- (a) Smaller areas, may be cleaned with a lint-free cloth moistened with solvent.

WARNING: VAPORS FROM AIRCRAFT FUELS, SOLVENTS, AND RUBBER CEMENTS ARE DANGEROUSLY TOXIC. AVOID PROLONGED INHALING OF THESE VAPORS. KEEP CEMENT AND ACTIVATOR IN CLOSED CONTAINERS WHEN NOT IN USE AND DO REPAIR WORK IN OPEN VENTILATED AREAS.

- (b) Large scale cleaning shall be accomplished with a solution of Soap Paste, Specification No. PS-598, and hot water not exceeding 180°F in temperature. After cleaning remove all soap residue with a clean hot water rinse, temperature of the water not to exceed 180°F.
 - (c) After cleaning, the fuel cell must be thoroughly dried. The process can be hastened by keeping the cell in a warm, dry place, or by blowing dry air inside the cell.
 - (d) Support fuel cell around the injury so that the cell wall will be in a natural flat position during repair. Supports shall be smooth, well padded and clean. (See figure 802.)



Fuel Cell Support Pad
Figure 802

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C. Prepare Fuel Cell Repair Tools and Material

- (1) Tools to be used in the repair of fuel cells are illustrated in figure 801.

NOTE: The use of a hypodermic needle and a spot heater (hot plate) is prohibited in all fuel cell repairs.

- (2) Materials to be used in the repair of fuel cells are listed in paragraph 2.
- (3) Stir cement thoroughly before using and stir frequently while in use to maintain proper consistency. Cements which are jellied, lumpy, too thin, or possess any abnormal characteristics should not be used.

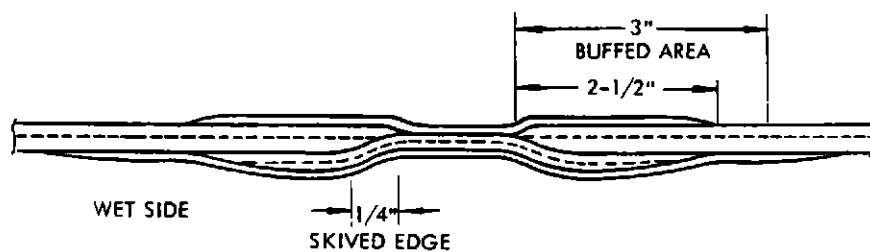
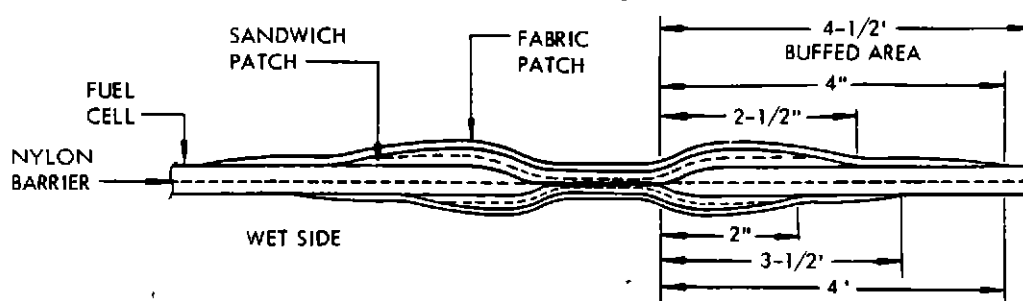
NOTE: Use only fresh cement and keep containers capped when not in use. Make sure can is marked with the correct stock number. Substitution of material shall not be made without permission from fuel cell manufacturer.

4. Repair Fuel Cell

A. Holes or Cuts Extending through Cell Wall (larger than 2 inches in any direction)

- (1) Cut and trim loose ply and jagged edges of the injury by skiving away the loose material to form a smoothly rounded outline. The skived edges shall be tapered approximately 1/4 inch. (See figure 803.)
- (2) Prepare repair patches. (See figure 803.)
 - (a) For inside cell surface.
 - 1) Cut a patch of nylon sandwich material to extend 2 inches in all directions from edge of injury.
 - 2) Cut a patch of fabric material to extend 3-1/2 inches in all directions from edge of injury.

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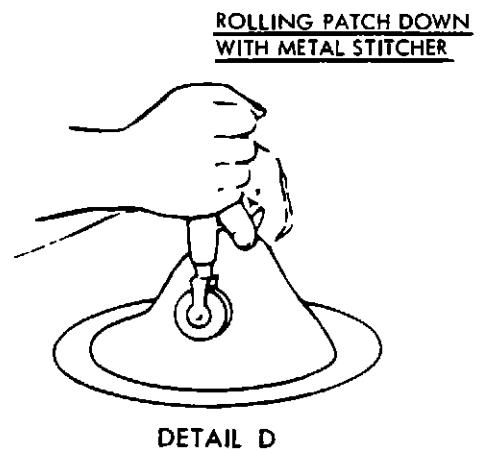
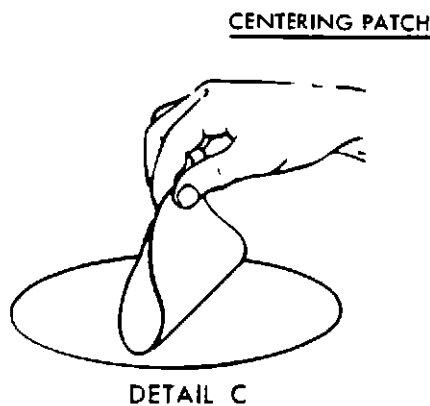
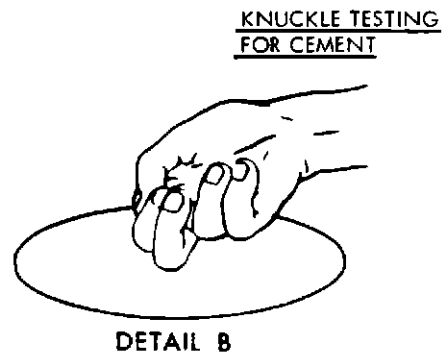
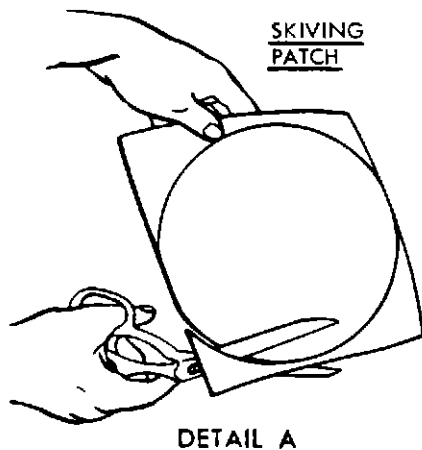
NOTE
 DIMENSIONS GIVEN ARE
 TYPICAL FOR BOTH HOLE
 AND BLISTER REPAIR

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(b) For outside cell surface.

- 1) Cut a patch of nylon sandwich material to extend 2-1/2 inches in all directions from edge of injury.
- 2) Cut a patch of fabric material to extend 4 inches in all directions from edge of injury.

NOTE: All patches shall be cut by skiving the edge. Each patch shall have a smoothly rounded outline. (See figure 804.)





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- 3) Lightly buff "down" side only of the two fabric patches and both sides of the two nylon sandwich patches.

NOTE: For buffing, use an air-powered buffer, or hand sander, with a fine emery cloth of 120 grit.

- 4) Wash the buffed surface of each patch using a clean cloth moistened with solvent, until all buffing dust is removed.

- (3) Lightly buff inside and outside cell surface around injured area.

NOTE: Buffing for any repair must extend 1/2 inch in all directions beyond the patch outline. Use an air-powered buffer, or hand sand the area, with a fine emery cloth of 120 grit. Use only enough pressure to remove gloss on cell surface. Extreme care must be taken not to injure cell further while buffing.

- (4) Wash buffed areas, using a clean cloth moistened with solvent. Wash until all grit and buffing dust is removed.

WARNING: VAPORS FROM SOLVENTS AND RUBBER CEMENTS ARE DANGEROUSLY TOXIC. AVOID PROLONGED INHALING OF THESE VAPORS.

- (5) Apply patches to inside cell surface.

- (a) Apply cement evenly and thinly, to inside buffed surface of cell and one side of the smaller nylon sandwich patch, with paint brush.

- (b) Allow cemented surfaces to dry completely.

NOTE: To determine if cement is dry, press a knuckle gently against the surface and withdraw it. If no cement sticks to the knuckle the surface is dry. (See figure 804.)

- (c) Repeat steps (a) and (b) and apply a second coat of cement to both surfaces. Allow to dry completely.

- (d) Activate cemented surfaces by lightly wiping both cell and sandwich patch with a clean lint-free cloth moistened with solvent. Allow cement to become slightly "tacky."

NOTE: To determine if cement is "tacky" press a knuckle gently against cemented surface. A few threads of cement should stick to the knuckle. (See figure 804.)



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(e) Center sandwich patch over cell injury and stitch down with a 1/4 inch hand roller. Roll patch firmly down starting from the center of the patch and working to outer edge to remove trapped air. (See details C and D, figure 804.)

(f) Allow sandwich patch to set for a minimum of one hour.

(g) Check entire patch for blistering or poor adhesion.

NOTE: Any patch showing signs of blistering or poor adhesion must be removed using a clean cloth moistened with solvent. If patch is undamaged it may be reworked.

(h) Repeat steps (a) through (g) and apply the smaller fabric cover patch over the sandwich patch.

(i) Seal cover patch and patch edge by applying two coats of cement to cover repaired area, including buffed surface. Allow first coat to dry completely before applying second coat.

(6) Apply patches to outside cell surface.

(a) Repeat steps (5)(a) through (5)(i) and apply larger nylon sandwich and fabric cover patch to outside cell surface.

(7) Allow 24 hours before handling the fuel cell, before installation, or before filling with fuel.

NOTE: Pressure test fuel cell for leakage before installation in airplane cavity. Refer to Removable Fuel Cells - Inspection/Check.

B. Holes or Cuts Extending through Cell Wall (less than 2 inches in all directions)

(1) Apply a nylon sandwich and a fabric cover patch to inside cell surface. Use procedure described in paragraph A. steps (1) through (5).

(2) Apply a single fabric cover patch to outside cell surface as follows:

(a) Cut a patch of fabric material to extend 2-1/2 inches in all directions from edge of defect.

NOTE: Patch shall be cut by skiving or feathering the edge and shall have a smoothly rounded outline. (See figure 804.)



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- (b) Lightly buff "down" side of fabric patch and fuel cell surface around defect.

NOTE: Buffing must extend for 1/2 inch in all directions beyond fabric patch size. Exercise extreme care in buffing so outer ply of cell is not damaged. Use air-powered buffer or buff by hand with 120 grit emery cloth.

- (c) Wash buffed surface of patch and cell using a clean cloth moistened with solvent. Wash until all buffing dust and grit is removed.
- (d) Apply two coats of cement with paint brush to both the "down" side of fabric patch and buffed area of the fuel cell. Allow cement to dry completely between coats.

NOTE: To determine if cement is dry press a knuckle gently against the cemented surface and withdraw it. If no cement sticks to the knuckle the cement is dry. (See figure 804.)

- (e) Activate the two cemented surfaces by lightly wiping with a clean lint-free cloth moistened with solvent. Allow solvent to become slightly "tacky."

NOTE: To determine if cement is "tacky" press a knuckle gently against cemented surface. A few threads of cement should stick to the knuckle.

- (f) Center the fabric patch over the defect and firmly roll down using a 1/4 inch stitcher or roller. Work from center of patch to the outer edge to remove all trapped air. (See figure 804.)
- (g) Allow patch to set a minimum of one hour.
- (h) Check entire fabric patch for blistering or poor adhesion.

NOTE: If patch shows signs of blistering or poor adhesion it must be removed using a clean cloth moistened with solvent. Rework patch if undamaged.

- (i) Seal patch and patch edge with two coats of cement. Allow first coat to dry completely before applying second coat.



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- (3) Allow 24 hours before handling fuel cell, before installation, or before filling with fuel.

NOTE: Fuel cell must be pressure tested before installation in airplane cavity. Refer to Removable Fuel Cells - Inspection/Check.

C. Blisters and Hole or Cut not Extending through Cell Wall

- (1) Repair interior surface blister, hole, or cut.
 - (a) Apply a nylon sandwich and a fabric cover patch to interior surface only. Use procedure described in paragraph A. steps (1) through (5).
- (2) Repair exterior surface blister, hole, or cut.
 - (a) Apply a nylon sandwich and a fabric cover patch to inside surface of cell. Use procedure described in paragraph A. steps (1) through (5).
 - (b) Apply a single patch of fabric material to outside surface as described in paragraph B.(2).
- (3) Allow 24 hours before handling the fuel cell, before installation, or before filling with fuel.

NOTE: Fuel cell must be pressure tested before installation in airplane cavity. Refer to Removable Fuel Cells - Inspection/Check.

D. Loose Edge or Channel in Splice or Seam

- (1) If an effective bond width of one inch is maintained, accomplish repair by one of the following methods. Both methods may be used on either interior or exterior cell surface.
 - (a) Method A
 - 1) Cut away loose area by skiving.
 - 2) Buff area lightly using an air-powered buffer or hand sander with a fine emery cloth of 120 grit.
 - 3) Wash buffed area using a clean cloth or swab moistened with solvent. Wash until all buffing dust is removed.



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- 4) Apply two seal coats of cement to edge of seam and buffed area, using a paint brush. Allow cement to dry completely between coats.

NOTE: To determine if cement is dry, press a knuckle gently against the cemented surface and withdraw it. If no cement sticks to the knuckle, the surface is dry. (See figure 804.)

(b) Method B

- 1) Buff cell and "down" surface of the loose splice or seam lightly.

CAUTION: EXERCISE EXTREME CARE IN BUFFING SO THAT FURTHER DAMAGE TO CELL DOES NOT RESULT. USE 120 GRIT EMERY CLOTH WITH AN AIR-POWERED BUFFER OR HAND SANDER.

- 2) Wash buffed area using a clean cloth moistened with solvent. Wash until all buffing dust and grit is removed.
- 3) Apply two coats of cement to both the cell and "down" surface of loose splice or seam using paint brush. Allow cement to dry completely between coats.
- 4) Activate the two cemented surfaces by lightly wiping with a clean lint-free cloth moistened with solvent. Allow cement to become slightly "tacky."

NOTE: To determine if cement is "tacky" press a knuckle gently against cemented surface. A few threads of cement should stick to the knuckle. (See figure 804.)

- 5) With cemented surfaces in "tacky" condition, stitch down the loose seam or splice. Use a 1/2 inch roller or apply shot-bag (canvas bag filled with No. 8 lead shot, weighing approximately 25 pounds) over the defect. Allow shot-bag to remain in place for one hour.

- (c) Allow 24 hours before handling fuel cell, before installation, or before filling with fuel.



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- (2) If effective seam bond width is less than one inch accomplish repair as follows

(a) Loose edge or channel inside fuel cell.

- 1) Apply a nylon sandwich and a fabric cover patch to the interior surface only. Use procedure described in paragraph A., steps (1) through (5).
- 2) Allow 24 hours before handling fuel cell, before installation, or before filling with fuel.

(b) Loose edge or channel outside fuel cell.

- 1) Apply a single patch of fabric material to the exterior cell surface only, to extend 2-1/2 inches in all directions from edge of defect. Use the procedure described in paragraph B.(2).
- 2) Allow 24 hours before handling the fuel cell, before installation, or before filling with fuel.

E. Scraping or Scuffing of Innerliner or Outerply Surface

- (1) Buff damaged area lightly using an air-powered buffer or hand sander, with fine emery cloth of 120 grit.

NOTE: Extreme care must be taken not to buff through the fabric cords of the cell wall or to injure the cell further while buffing.

- (2) Brush coat buffed area with an even coat of cement.

- (3) Allow cement to dry completely.

NOTE: To determine if cement is dry, press a knuckle gently against the surface and withdraw it. If no cement sticks to the knuckle, the surface is dry. (See figure 804.)

- (4) Apply a second even coat of cement and allow to dry completely.

F. Fuel Cell Lacing Tab Repair

- (1) Remove damaged lacing tab using one of the following methods:

(a) Solvent method.

- 1) Mark exact location of lacing tab with silver colored marking pencil.

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- 2) Apply a small quantity of solvent to outer edge of lacing tab collar to loosen it.

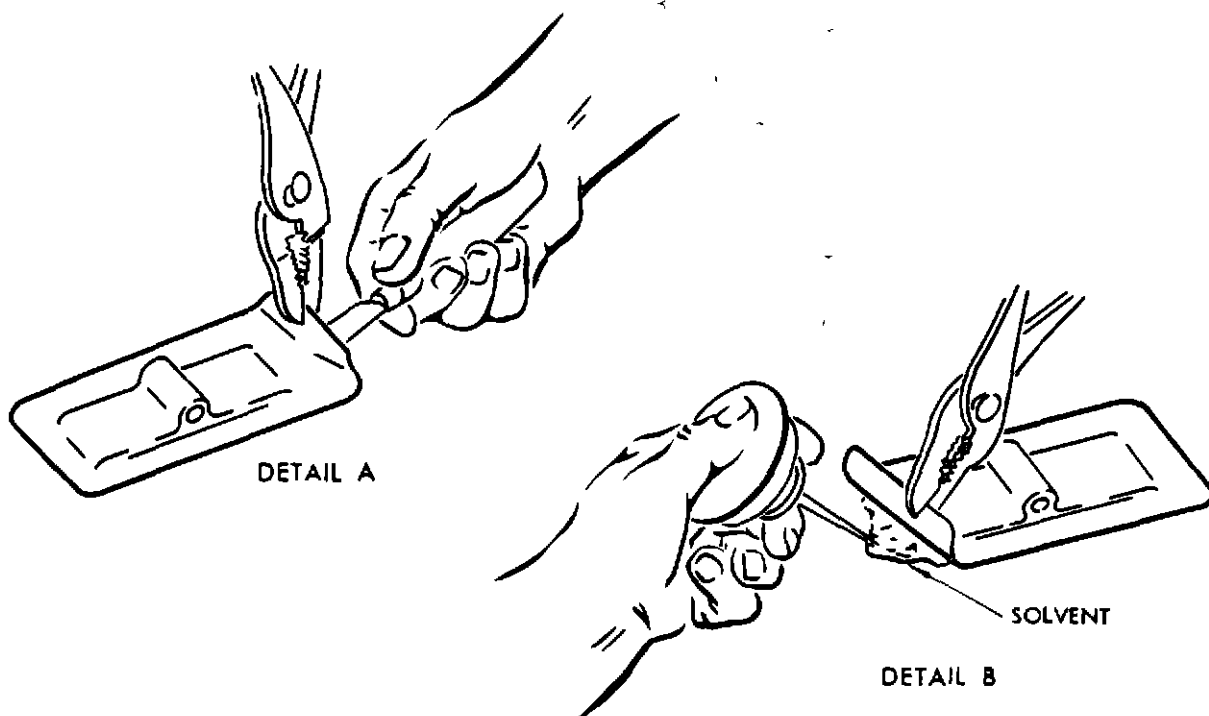
NOTE: Avoid using an excessive amount of solvent. Damage to fabric coating of cell will occur.

- 3) Raise and loosen the tab collar edge with a blunt tool or knife with rounded end. (See figure 805.)
- 4) Pull on the loosened edge of the tab collar with a pair of pliers while applying more solvent between lacing tab collar and cell. (See figure 805.)
- 5) Progressively remove lacing tab from cell surface.

(b) Heat lamp method.

- 1) Mark exact location of lacing tab with silver colored marking pencil.
- 2) Hold a heat lamp (250 watt bulb) a minimum of eight inches away from fuel cell surface long enough to soften up the lacing tab collar, or until collar and cell surface are very hot to the touch.

CAUTION: EXCESSIVE HEAT WILL INJURE THE NYLON BARRIER AND CELL WALL.



Fuel Cell Facing Tab Removal
Figure 805



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- 3) Raise and loosen tab collar edge with a blunt tool or knife with rounded end. (See figure 805.)
 - 4) Pull on loosened edge of the tab collar with a pair of pliers, being careful not to damage cell wall.
 - 5) Progressively remove lacing tab from cell surface.
- (2) Clean area thoroughly with solvent and allow to dry completely.
 - (3) Buff an area on the cell surface one inch larger all around than the size of the lacing tab collar.

CAUTION: EXERCISE EXTREME CARE IN BUFFING SO THAT OUTER PLY OF FUEL CELL IS NOT DAMAGED. USE AIR-POWERED BUFFER OR BUFF BY HAND WITH 120 GRIT EMERY CLOTH.

- (4) Buff "down" side of new lacing tab.
- (5) Apply two even coats of cement each to buffed area of cell and "down" side of new lacing tab.
- (6) Allow cemented surfaces to dry completely between coats.

NOTE: To determine if cement is dry, press a knuckle gently against the surface and withdraw it. If no cement sticks to the knuckle surface is dry. (See figure 805.)

- (7) Activate cemented surfaces by lightly wiping with a clean lint-free cloth moistened with solvent. Allow cement to become slightly "tacky."

NOTE: To determine if cement is "tacky" press a knuckle gently against surface. A few threads of cement should stick to the knuckle. (See figure 804.)

- (8) Position lacing tab on fuel cell in same position as old lacing tab.
- (9) Roll lacing tab collar firmly down with 1/4 inch metal stitcher or roller, starting from the center and working to outer edge to remove trapped air.
- (10) Allow lacing tab to set a minimum of 1 hour.
- (11) Apply two seal coats of cement to lacing tab edge and surrounding area of cell. Allow the first coat to dry completely before applying second coat.
- (12) Allow 24 hours before handling fuel cell.

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G. Cell Fitting Surface Damage

- (1) Lightly buff area with a fine abrasive (crocus cloth or equivalent) to remove any scratches or gouges.

CAUTION: FUEL CELL FITTING SURFACE IS A CRITICAL SEALING AREA. ENSURE THAT FLATNESS IS MAINTAINED DURING BUFFING PROCEDURE. DO NOT ATTEMPT TO REPAIR ANY DAMAGE WHICH EXTENDS INTO O-RING GROOVE.

- (2) Treat reworked surface with alodine solution as follows:

WARNING: ALODINE SOLUTION IS A CORROSIVE CHEMICAL, AND CAN CAUSE SEVERE BURNS TO SKIN AND EYES. RUBBER GLOVES MUST BE WORN WHEN HANDLING THIS SOLUTION. AVOID SPLASHING. SOLUTION SPLASHED IN THE EYES MUST BE WASHED OUT WITH WATER FOLLOWED BY AN EYE-WASH OF BORIC ACID; OBTAIN MEDICAL AID IMMEDIATELY.

- (a) Mask off a 2 inch area surrounding the buffed fitting surface with adhesive cloth tape.
- (b) Degrease buffed fitting surface by wiping thoroughly with a clean cloth saturated with M-50 solvent. Allow solvent to dry completely.
- (c) Swab surface with deoxidine solution. Allow solution to dry completely.

NOTE: Deoxidine and alodine solution must be kept safely stored in capped bottles. Polyethylene cups (or equivalent) must be used in dispensing these solutions. Discard solutions left over after repair procedure.

- (d) Cold rinse surface thoroughly with a clean cloth moistened with clean water.
- (e) Apply alodine solution to repaired surface with a nylon brush. Solution must be thin enough to be applied evenly and liberally.

CAUTION: CARE MUST BE TAKEN THAT ALODINE SOLUTION DOES NOT COME IN CONTACT WITH ANY UNMASKED AREA OF THE FITTING OR THE FUEL CELL WALL. DO NOT ATTEMPT TO BRUSH THE SOLUTION OUT LIKE PAINT.



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- (f) Maintain a continuous wet film of alodine for a minimum of five minutes. A visible coating should be produced.
- (g) Remove excess alodine solution by thoroughly flushing with clean cold water followed by lightly wiping with clean cotton cloth or warm air drying.

CAUTION: SWABS USED FOR APPLYING OR REMOVING ALODINE SOLUTION CONSTITUTE A FIRE HAZARD WHEN DRY. IMMEDIATELY AFTER USE, THEY SHOULD BE THOROUGHLY SOAKED IN WATER BEFORE DISCARDING. WASH THE NYLON BRUSH OUT IN CLEAN WATER.

5. Restore Fuel Cell to Normal Configuration

- A. Remove all tools, rags, and materials used in repairing fuel cell.
- B. Clean cell thoroughly with clean lint-free cotton cloths dampened with water.
- C. If cell has been removed from airplane for repair, prepare it for installation. Refer to Removable Fuel Cells - Removal/Installation.

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REMOVABLE FUEL CELLS (GOODYEAR BTC-49) - APPROVED REPAIRS

1. General

- A. The following procedure establishes approved practices for repair of low temperature Vithane fuel cells manufactured by the Goodyear Tire and Rubber Company. These cells are bladder construction type known as construction BTC-49. This procedure is written specifically for repair of this construction and variations of the same and is not applicable to any other type construction.
- B. Any violation of the procedures as outlined below will void the Goodyear Tire and Rubber Company warranty.
- C. The repair of Goodyear low temperature Vithane cells is restricted to authorized personnel. Authorized personnel are those who have been certified and trained by Goodyear representatives, or those who have received their training from persons who have been certified and trained by Goodyear representatives.
- D. Following a leak repair, the cell should be leak checked before installation. See 28-12-1, Removable Fuel Cells - Inspection/Check.
- E. Materials Handling

- (1) All materials are to be protected from dirt contamination, sunlight, and excessive heat or cold while in storage. Containers are to be tightly capped and stored between +30°F to +85°F temperature.
- (2) The repair cement, code 2370C, referred to in this text is prepared immediately prior to use by mixing repair cement 2370C (179cc) with cross-linker 2371C (45cc).

CAUTION: 2370C REPAIR CEMENT REQUIRES THOROUGH MIXING TO OBTAIN FULL ADHESIVE VALUES.

- (3) Repair cement has a pot life of 20 minutes after mixing. The unmixed 2370C and 2371C have a shelf life of 6 months from date of packaging.

CAUTION. ALL CONTAINERS FOR CEMENTS AND SOLVENTS SHOULD BE PROPERLY IDENTIFIED.



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F. Cell Handling

- (1) Prevent needless damage by exercising common sense care in all handling of cells.
- (2) Folding or collapsing of cells is necessary to place them in containers for storage, install in airframe cavities or carry from place to place.
- (3) Protect fitting seal surface from contact with cavities during removal or installation. Use protective covers over fitting seal when practical.
- (4) Remove shoes before entering a cell, and protect cell from tools, hot lights, etc. when working inside or around them.
- (5) Avoid stepping on folds or creases in cells.
- (6) Do not carry cells by fittings. Maintain original cell contours or folds when refolding for boxing, rolling to insert in airframe cavities, or handling in the repair area.
- (7) The cells to be repaired should be placed on a well-lighted table. Maintain natural contours, if possible, while repairing. Prevent contact with sharp edges, corners, dirty floors, or other surfaces.
- (8) Repair area must be well ventilated.

WARNING: DO NOT PERMIT SMOKING OR OPEN FLAME NEAR REPAIR AREA OR CELLS.

- (9) Do not stack cells.

G. Cell Repair Precautions

- (1) Remove shoes before entering a cell. Protect cell from tools, hot lights, etc., when working inside or around cell.
- (2) Avoid stepping on folds or creases in cells.
- (3) Repair area must be well ventilated.

WARNING: DO NOT PERMIT SMOKING OR OPEN FLAME NEAR REPAIR AREA OR CELLS.

- (4) Avoid contamination from foreign material, dust, etc.
- (5) Avoid trapping air during all stitching operations.



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2. Equipment and Materials

A. Equipment

NOTE: Following items of equipment can be obtained as part of Goodyear Repair Kit 2F1-3-35620. They are identified as Group 2 Materials.

- (1) Paint Brush, 1 inch
- (2) Roller, 1 inch dia. x 3/4 inch flat or equivalent
- (3) Aluminum plates, 1/4 x 6 x 6 inches (2 each)
- (4) Cure iron (set at 240°F) (2F1-3-25721)

NOTE: Cure iron 2F1-3-25721 comes in two different temperature settings. Check that iron being used has 240°F temperature stamp on it.

NOTE: Accessories - order per individual cell requirements.

Phenol plates, phenol plate assemblies and phenol test equipment can be order as required by customer.

Alodine 1200 is to be ordered as required from cell manufacturer or from local stock.

B. Materials

- (1) Goodyear Repair Kit 2F1-3-35620 (Group 1 Materials) Goodyear Tire and Rubber Company, Aviation Products Division, Los Angeles, California, or Akron, Ohio
 - (a) 23700 repair cement (1 pint cans, 179cc in each can). Quantity: 8 cans.
 - (b) 2371C cross-linker (2 oz bottles, 45cc in each bottle). Quantity: 8 bottles.
 - (c) Methyl Ethyl Ketone (1 pint cans). Quantity: 2 cans.
 - (d) FT-168 repair fabric (sheet 12 x 12 inches). Quantity: 2 sheets.
 - (e) Cellophane (sheet 12 x 24 inches)
 - (f) Foam rubber cloth back (sheet 12 x 12 inches). Quantity: 2 sheets.
- (2) Alodine 1200 - Order as required from Goodyear or from local stock.
- (3) Fuel cell accessories - Order per individual cell requirements from Goodyear.

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3. Prepare to Repair Fuel Cell

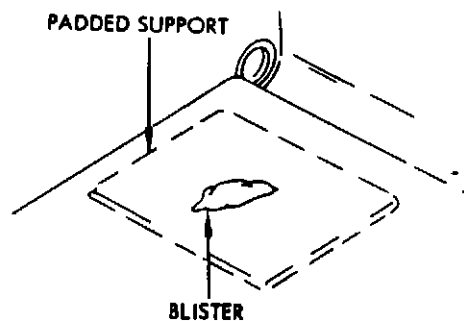
- A. Defuel and purge fuel tank prior to entering cell. Refer to 28-0, Defueling and 28-20-0, Fuel Storage System - Maintenance Practices.
- B. If cell must be removed from cavity for repair, refer to Removable Fuel Cells - Removal/Installation for this procedure.

WARNING: FUEL CELLS WHICH HAVE CONTAINED FUEL CONTAIN DANGEROUS EXPLOSIVE AND TOXIC VAPORS. USE ONLY EXPLOSION-PROOF AND SHIELDED LIGHTS. POWER TOOLS MUST BE AIR-DRIVEN. WEAR A COTTON COVERALL SNUB AT WRISTS AND ANKLES, WITH NONSPARKING ZIPPER. REMOVE SHOES AND WEAR THERMO SOCKS.

- C. Place fuel cell upon a smooth, clean, padded work table, if removed from airplane cavity for repair.

NOTE: Repair work on fuel cells must be accomplished in a warm dry place. Ideal conditions for cell repair are 70 to 80°F with 50% humidity. High humidity and low temperature will cause moisture condensation to form on cemented surfaces and make adhesion of repair patches impossible.

- D. Cells must be thoroughly cleaned with warm water before attempting any repair.
- E. After cleaning, the fuel cell must be thoroughly dried. The process can be hastened by keeping the cell in a warm dry place and using an air hose inside the cell.
- F. Support the fuel cell around the injury so that the cell will be in a natural flat position during repair. Supports shall be smooth, well padded and clean. (See figure 801.)



Fuel Cell Support Pad
Figure 801

4. Repair Fuel Cell

A. General

- (1) Repair fuel cell damage that is in accord with the following limitations by the application of repair patches.
 - (a) FT-168 repair fabric is for repair of simple contours only. That is, contour should have two plane curvature only. Patches referred to in this text are of this material.
 - (b) Inside patches are to lap defect edges 2 inches in each direction.
 - (c) Outside patches are to lap defect 2-1/4 inches in each direction.
 - (d) Outside patches are to be applied and cured prior to applying an inside patch.
 - (e) Blisters between inner liner and fabric larger than 1/4 inch in diameter require an outside and an inside patch.
 - (f) Separations between outer plies larger than 1 inch in diameter require an outside and inside patch. Holes and punctures require an outside and inside patch.
 - (g) Slits or tears up to 3 inches maximum length require an outside and inside patch.
 - (h) External abraded or scuffed areas without fabric damage require an outside patch only.
 - (i) A loose lap may be trimmed, provided that a 1 inch effective bond remains.
 - (j) Air cure repair patches are to remain clamped and undisturbed for 72 hours at room temperature of approximately 75°F.

CAUTION: FOR EACH 10° DROP IN TEMPERATURE FROM 75°F, ADD 25 PERCENT CURE TIME. EXAMPLE: AT 64°F, CURE FOR 90 HOURS.
 - (k) All heat cured patches are ready for use when cool.
 - (l) Fitting repairs are confined to loose flange edges, seal surface rework and missing coat stock.



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(m) The maximum number of heat cure repairs in the same area are four. Patches shall not overlap. If several injuries are found in the same area, further investigation to determine cause of damage should be made.

(n) Patches shall have 100 percent adhesion.

B. Repair Patch Application - Heat Cure Method

- (1) Prepare exterior cell wall and exterior patch first. Cut repair patch from FT-168 material to size required to ensure proper lap over injury in all directions. (See limitations.) Hold shears at an angle to produce a beveled edge (feather) patch. Round corners of patch. Dull side or gum contact face of repair patch should be the largest surface after beveling.
- (2) Wash 1 square foot of cell wall surrounding injury and contact side of repair patch with a clean cloth soaked with Methyl Ethyl Ketone solvent.
- (3) Abrade cell wall surface about injury and contact side of patch with fine emery cloth to remove shine.
- (4) Repeat Methyl Ethyl Ketone washings two more times, a total of three washings each surface.
- (5) Tape a piece of cellophane inside cell over injury.
- (6) When all the above preparatory work has been done and cell has been positioned for patch application on repair table, mix the 2370C cement (179cc) with the cross-linker 2371C (45cc), and stir mixture thoroughly.
- (7) Brush one even coat of mixed repair cement on the cell wall around injury and on the contact side of repair patch. Allow to dry for 15 minutes.
- (8) Repeat a second mixing of repair cement and brush a second coat.

CAUTION: DO NOT USE FIRST CAN OF MIXED CEMENT FOR THIS COAT.



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- (9) Allow cement to dry approximately 5 minutes and then center patch over injury. Lay repair patch by rolling down on surface from center or edge without trapping air. Hold the unrolled portion of repair patch off the cemented surface until roller contact ensures an air free union. At this time repair patch may be moved by hand on wet surface to improve laps. Do not lift repair patch, slide it.

CAUTION: MAKE SURE CELLOPHANE INSIDE CELL OVER INJURY REMAINS IN PLACE AS ANY CEMENT WILL STICK CELL WALLS TOGETHER WITHOUT IT AS A SEPARATOR.

- (10) Cover one smooth surface each of two aluminum plates (plates must be larger than patch), with 1/4 inch fabric backed airfoam, fabric side out. Tape airfoam in place. Foam must cover edges of plate for protection.
- (11) Fold cell adjacent to patch and place prepared plates, one over repair patch, and one on opposite side.
- (12) Center a cure iron on the plate over the repair patch. Secure the assembly with a C-clamp. Tighten by hand. Check cement flow to determine pressure.

CAUTION: MAKE SURE THAT CELL FOLD IS NOT CLAMPED BETWEEN PLATES. THIS WOULD CAUSE A HARD PERMANENT CREASE. ALSO MAKE SURE THAT PATCH DOES NOT MOVE WHEN CLAMP IS TIGHTENED.

- (13) Connect cure iron into electric outlet and cure repair for 2 hours. After 2 hours cure, unplug cure iron from outlet and allow iron to cool 15 minutes. Then remove C-clamp. Wet cellophane to remove from repair.
- (14) Inside patch is applied same as above procedure, except for size of repair patch (see limitations), after outside patch has been cured.

CAUTION: SUCCESS OF APPLYING BOTH AN OUTSIDE AND INSIDE REPAIR PATCH SIMULTANEOUSLY IS DOUBTFUL, AND NOT RECOMMENDED.

C. Repair Patch Application - Air Cure Method

- (1) Follow procedure for heat cure method, except omit cure iron and cure each patch per air cure limitations (minimum 72 hours).



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D. Rework of Metal Fitting - Sealing Surfaces

- (1) Rub off roughness of affected area with a fine file or fine emery cloth. Treat reworked area.
- (2) Clean metal surface using a clean cloth dipped in Methyl Ethyl Ketone. Moisten cleaned surface with clean cloth dipped in water. Apply alodine 1200 solution, undiluted, to the affected area with a small nylon brush. Allow solution to dry until a light golden color appears. When coating has been formed, remove excess solution by wiping with a clean water moistened cloth. Wipe dry.

WARNING: DO NOT ALLOW SOLUTION TO COME IN CONTACT WITH HANDS, EYES OR CLOTHING.

E. Accessory Replacement

- (1) Obtain cured repair accessory from manufacturer.
- (2) Mark location of old accessory and preserve markings for guide lines to locate new part.
- (3) Remove old accessory by gradually loosening an edge with a blunt probe like instrument.
- (4) When a loose edge is created, grasp accessory by loose edge with pliers and gently pull accessory off cell wall. Be careful not to pull cell lap open while peeling accessory off. Pull from blind side of a cell lap toward the exposed edge.
- (5) Buff the cell surface under accessory with emery cloth to smooth roughness and prepare for cement.

NOTE: Removal of old accessory will probably leave an uneven cavity and surface.

- (6) Prepare replacement accessory by buffing and washing contact surface. Also wash cell surface. (See repair patch.)
- (7) Apply mixed 2370C repair cement to both surfaces being sure to level cavity left by removal of old accessory.
- (8) Roll new accessory into place with a repair patch and place suitable padded plates in position to ensure adequate pressure when clamped. Use cellophane separator to prevent cement sticking in the wrong place.
- (9) Cure as with repair patch using either cure method.

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F. Defects Repair

(1) Blisters

- (a) Remove loose material by buffing or trimming. Apply an outside and inside repair patch.

(2) Holes, Punctures, Cuts, Tears, and Deep Abraded Areas

- (a) Trim away any ragged material and apply an outside and an inside repair patch.

(3) Loose Seams

- (a) Buff loose edge and contact surface with emery cloth. Wash three times with Methyl Ethyl Ketone. Apply 2370C mixed cement two coats as with repair patch. Clamp and cure. Either method may be used. See repair patch. Loose seams may be trimmed if minimum lap remains.

(4) Loose Fitting Flange - Inside

- (a) Buff edge of flange and contact surface under flange. Apply 2370C mixed repair cement, cellophane, padded plates and clamp. Follow procedure as outlined for repair patch, except for patch itself.

(5) Missing Coat

- (a) Buff surface with emery cloth. Wash three times with Methyl Ethyl Ketone. Apply 2370C mixed cement two coats as with repair patch. Clamp and cure. Either method described in repair patch may be used.

(6) Looseness Against Metal

- (a) Prepare metal as per metal fitting-sealing surfaces. Apply 2370C mixed cement and cure.

5. Restore Fuel Cell to Normal Configuration

- A. Remove all tools, rags, and materials used in repairing fuel cell.
- B. Clean cell thoroughly with clean lint-free cotton cloths dampened with water.
- C. If cell has been removed from airplane for repair, prepare it for installation. Refer to Removable Fuel Cells - Removal/Installation.

CENTER WING CAVITY - DESCRIPTION AND OPERATION

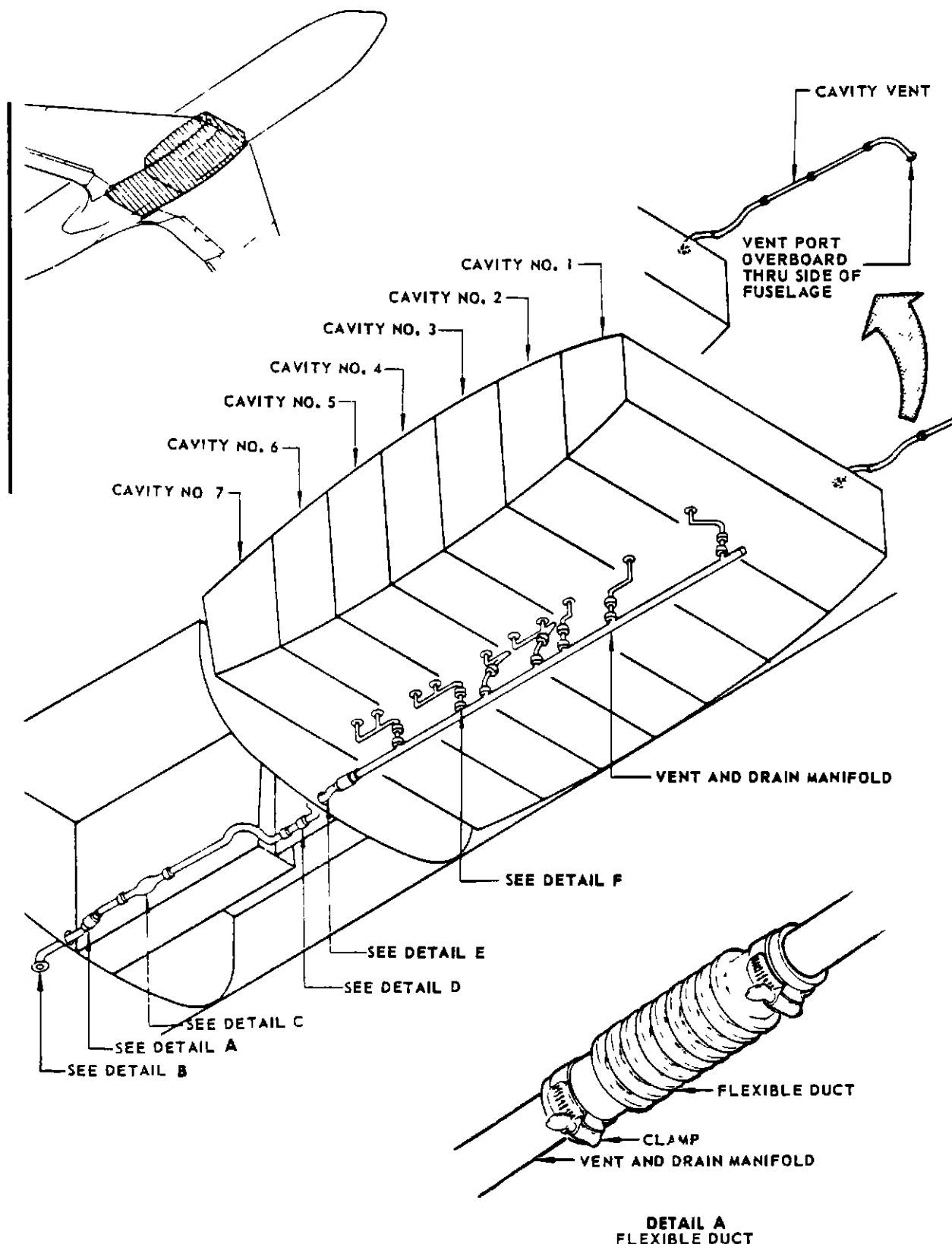
1. General

- A. The center wing cavities accommodate the bladder type removable fuel cells. Seven individual cavities are provided for the installation of up to seven fuel cells. Refer to 28-3-0, "Removable Fuel Cells". The cavities are all located between left and right body buttock lines 70.5 and body stations 600K and 820. Spanwise beams separate one cavity from another. For ease in identifying the location of the cavities in the text, they are numbered 1 through 7 starting with 1 at station 600K and being consecutively numbered going aft. (See figure 1.)
- B. Center wing tank lower and upper stiffeners run spanwise through each cavity. To protect the removable fuel cell from damage, the lower stiffeners are completely covered by backing boards, the upper stiffeners are covered only at the extreme left and right ends of the cavity.
- C. Each cavity incorporates the necessary fittings and openings for the fuel cells. Cut-outs in the spanwise beams serve as intercell access openings and also allow maintenance personnel to move from one cavity to another. In addition, cavities No. 2 and 5 have cut-outs in the bottom which serve as center wing tank access openings.
- D. A vent and drain system is provided for each center wing cavity to prevent accumulation of moisture either from condensation or from fuel cell leakage. The drain fittings are located between the stiffeners in the cavity lower floor panel. Beneath the lower panel, the drains are connected by tubing and flexible hose to a manifold which is routed overboard aft of the left main landing gear wheel well. (See figure 1.) Additional venting is provided by a vent at the top front of No. 1 cavity with an outlet in the side of the fuselage forward of the left wing root.
- E. The center wing cavities are isolated from each other by sealing the structure in the bottoms and a portion of the wall. The reason for this is to confine fuel which leaks from any fuel cell to its respective cavity. This facilitates locating the leaking cell.

2. Center Wing Cavity Fuel Cell Fittings

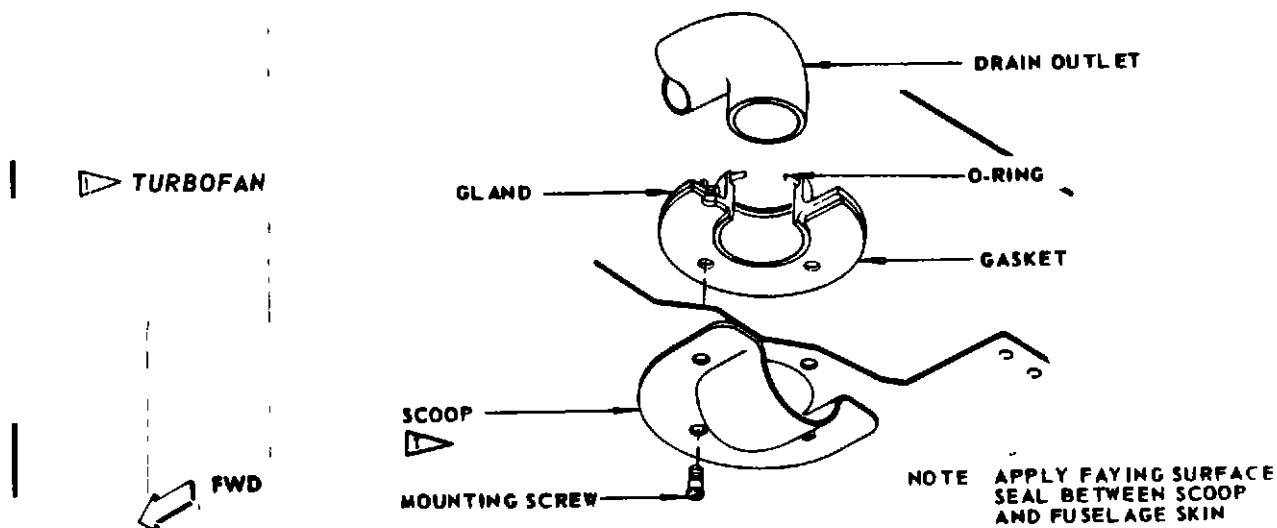
- A. Each fuel cell cavity incorporates the necessary interconnect, vent and drain openings and fittings for the fuel cells. (See figure 2.) The interconnect fittings are attached to the cavity end ribs by lockbolts. The vent fittings are located in the left and right top corners of the cavity. They form an interconnect between the cavity (or the fuel cell when these are installed) and the integral sections of the tank. The vent fitting is bolted to structure in the integral section. The drain fittings are located in the bottom of the cavities at the left and right aft corners. These fittings are also bolted to structure in the integral section.

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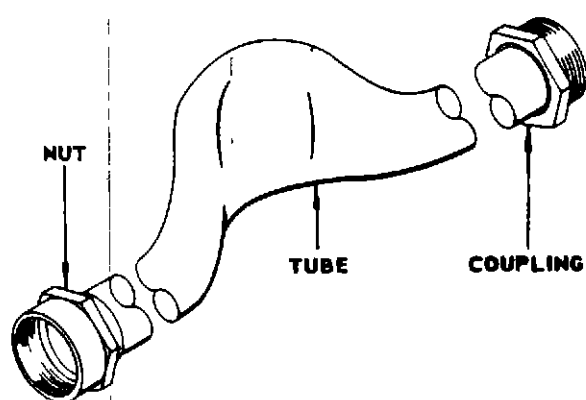


Center Wing Cavity Vents and Drains
Figure 1 (Sheet 1 of 2)

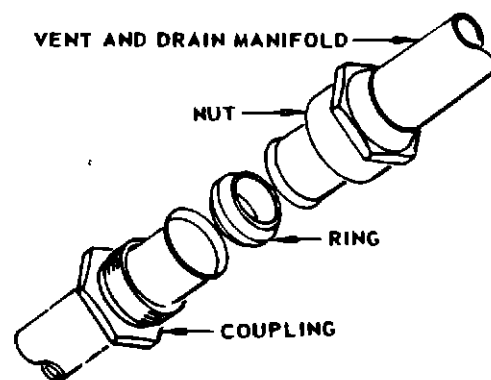
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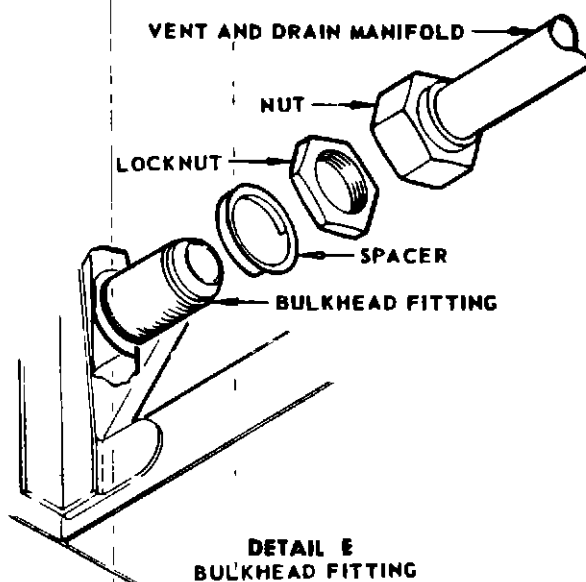
DETAIL B
OVERBOARD OUTLET



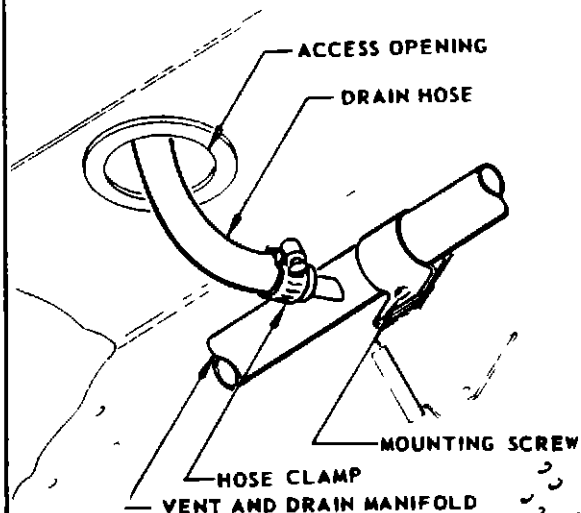
DETAIL C
TUBE ASSEMBLY-CAVITY DRAIN



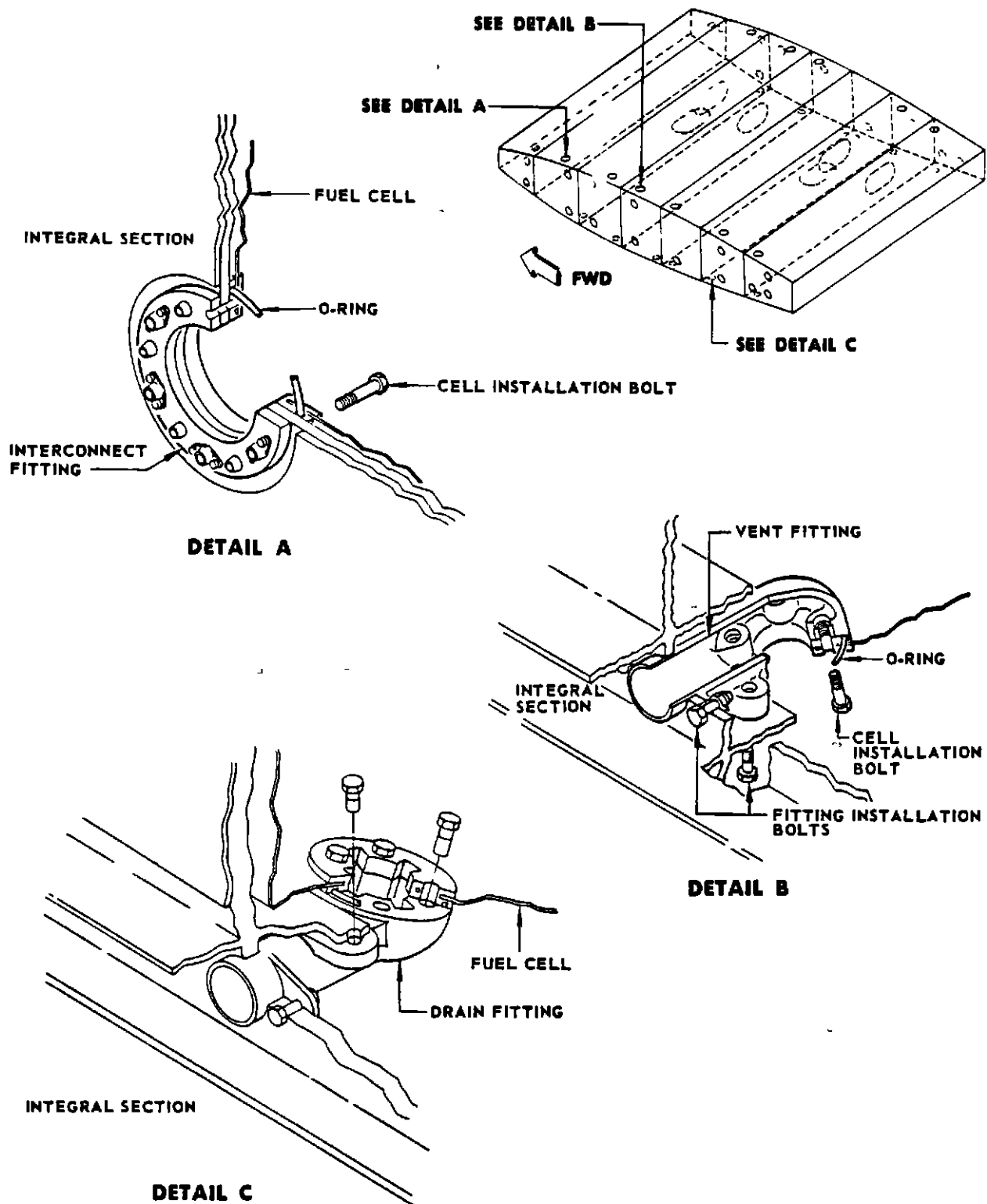
DETAIL D
MANIFOLD FITTING



DETAIL E
BULKHEAD FITTING



DETAIL F
HOSE CONNECTION



Interconnect, Vent and Drain
Figure 2



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3. Center Wing Cavity Vents and Drains (See figure 1.)

- A. The center wing cavity vent and drain system prevents accumulation of moisture either from condensation or from fuel cell leakage. The cavities are isolated by sealing the structure in the bottom and a portion of the wall to keep leaking fuel in the cavity and routed to individual cavity drains. The cavity drains between the stiffeners in the lower panel are connected to a drain manifold by flexible tubing. The drain manifold is routed along the right side of the keel beam in the main landing gear wheel well to an overboard drain fitting aft of the wheel well. This drain line also supplies ventilation to center wing section cavities. All tubing connections are standard union couplings or bulkhead elbows. An additional vent line is installed at the front of cavity No. 1. This vent line has an outlet in the lower surface of the fuselage forward of cavity No. 1.

4. Center Wing Cavity Sealing

- A. An absolute fuel seal is required for the entire bottom surface and for 1.5 inches up on the front spar, rear spar, and all spanwise beams. Sealant is applied to isolate the cavities so that leaking fuel is routed to individual cavity drains and into the cavity drain manifold. Elsewhere in the cavities, an intermediate fuel seal is required. See Integral Fuel Tank - Approved Repairs, 28-2-0.

5. Center Wing Cavity Backing Board

- A The purpose of backing board is to prevent the fuel cell from chafing against bare stiffeners. Backing board consists of nylon resin impregnated material which softens and expands when soaked in water at room temperature. The board contracts and hardens after drying.



CENTER WING CAVITY - MAINTENANCE PRACTICES

1 Inspection/Check Center Wing Cavity

A. General

- (1) A pressure check of the center wing cavity should be carried out to insure that the sealed structure of the cavity will withstand fuselage pressurization. Should the pressure inside the cavity become excessive when the fuselage is pressurized it is possible that damage to fuel cells or cell fittings will result. Pressure checking of the cavity is performed with all fuel cells installed, leak tested and empty, and with all wing center section access panels in place. It is then necessary to pressurize the cabin. By installing a pressure gauge at a cavity drain outlet, it is then possible to check the resultant pressure inside the cavity with fuselage pressurized. The following maintenance procedures cover the steps necessary to insure a satisfactory pressure test of the cavity.

B. Equipment and Materials

- (1) Pressure sensing equipment to measure 4 inches of water

C. Check Center Wing Cavity

- (1) Defuel the center wing tank. Refer to "Servicing Fuel System", 28-0
- (2) Check removable fuel cells and cavity for leaks. Refer to 28-3-0, "Removable Fuel Cells." Check for defective backing boards.

NOTE: All fuel cell leaks must be repaired before pressure checking of cavity can begin.

- (3) After defueling and checking for leaks, replace all fuel cell access panels.
- (4) Disconnect drain line of cavity No. 1 at drain manifold and install pressure sensing equipment.
- (5) Block the manifold connection from which drain line was disconnected in step (4).

NOTE: Do not plug the overboard drain outlet aft of the main landing gear wheel well

- (6) Pressurize the fuselage. Refer to "Fuselage Pressure Leakage", Chapter 53.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD THE FUSELAGE PRESSURE BE ALLOWED TO EXCEED 8.6 PSI.

- (7) Monitor pressure inside center wing cavity. Pressure shall stabilize and shall not exceed four inches of water above ambient pressure.
- (8) After completing pressure check restore cavity drain system and airplane to normal operating configuration.
 - (a) Depressurize fuselage. Refer to Chapter 53, "Fuselage Pressure Leakage".
 - (b) Remove block from drain manifold connection (step 5) and remove pressure sensing equipment.
 - (c) Connect drain line of cavity No. 1 to drain manifold.

END

CENTER WING CAVITY BACKING BOARD - MAINTENANCE PRACTICES

1 General

- A The center wing cavity backing board must be soaked in water at room temperature to facilitate installation. The board will soften and stretch after soaking in water permitting installation of backing board fasteners. Installation must take place within 1 1/2 hours after removal of board from water because of rapid shrinkage of the backing board when drying.

2 Removal/Installation Backing Board

A Remove Backing Board

- (1) Defuel center wing tank Refer to "Servicing Fuel System", 28-0
- (2) Remove fuel cell Refer to "Removable Fuel Cells", 28-3-0
- (3) Remove screws attaching backing board to cavity stiffeners
- (4) Remove backing board

B Install Backing Board

- (1) When installing existing backing board, submerge board in water at room temperature, using suitable rust resistant container and soak board for approximately 8 hours
- (2) Install backing board within one and one half hours after removal from water.
- (3) Attach backing board to cavity structure with screws.

NOTE The required soaking time will be shortened if board (new or existing) is soaked in water at approximately 55°C (130°F). Do not use warmer temperatures.

3. Deleted

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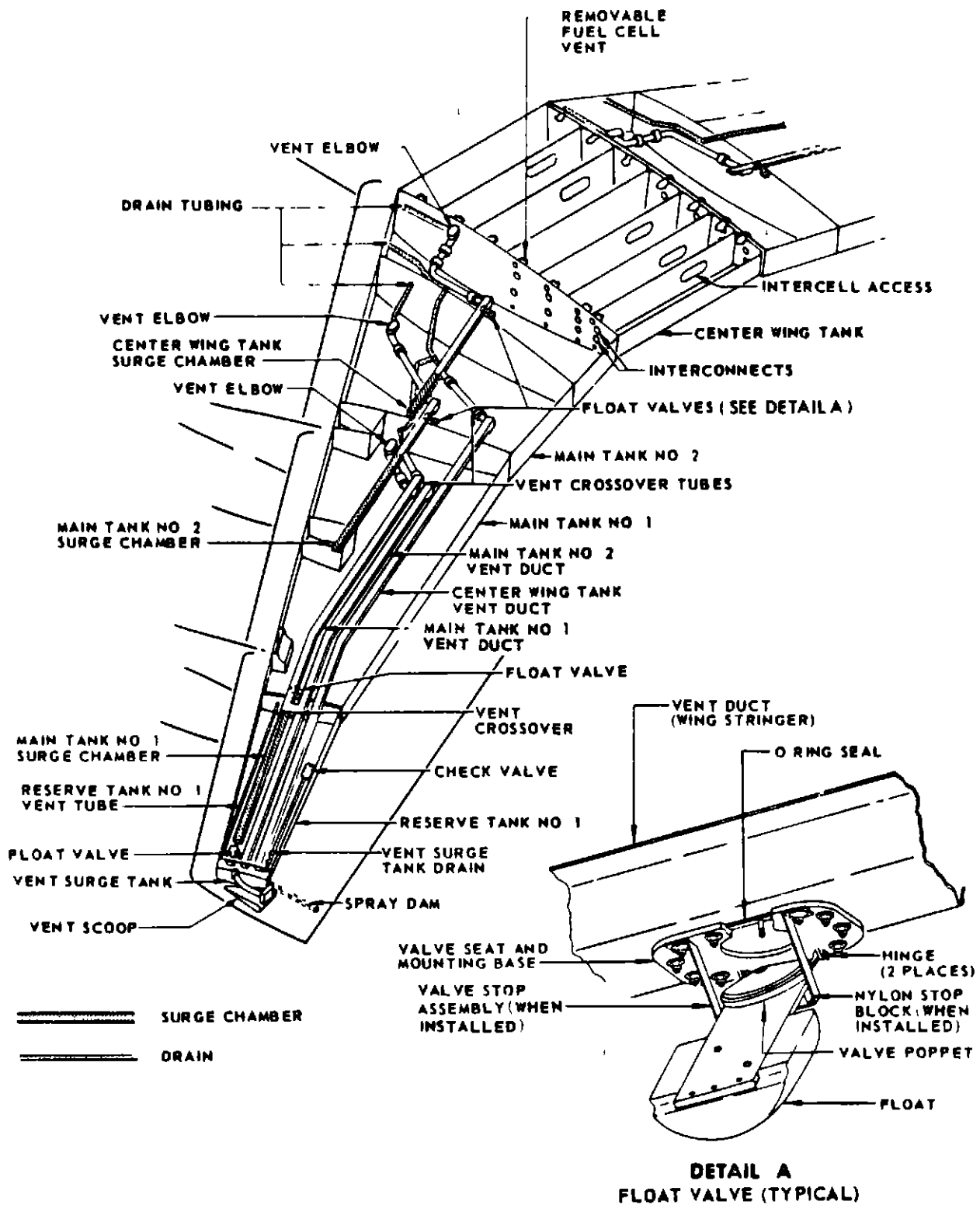
FUEL VENT SYSTEM - DESCRIPTION AND OPERATION

1. General

- A. The fuel vent system provides positive venting of the integral fuel tanks and removable fuel cells to atmosphere during the various attitudes of the airplane. Venting of the fuel tanks is accomplished with sealed hat-shaped upper wing skin stiffener ducts, interconnected with appropriate drain and vent tubing. This spanwise interconnected system is vented into a vent surge tank and overboard through a vent scoop at the wing tip. (See figure 1.)
- B. The expansion space above the fuel in the tank shifts according to the different attitudes of the airplane. During normal take-off, high angle climb or acceleration, expansion space shifts to the forward inboard corner of the tanks. During normal climb, level flight or descent the expansion space is in the outboard center portion of the tanks. To provide adequate venting to atmosphere under any operating condition, inboard and outboard vent ports are provided in these areas in each tank and are so located that at least one port is open to the expansion area at all times. The inboard port is open at all times, and the outboard port is protected by a float valve since fuel could enter the vent system through the outboard port, at body centerline pitch attitude above $12^{\circ}30'$, and flow overboard. Each inboard vent port is connected by 2 5/8 inch tubing to an elbow flange which is bolted over an aperture in the bottom of the spanwise vent ducts.
- C. The sealed spanwise vent ducting forms an integral part of the wing tanks vent system. Portions of these sealed ducts are used to connect vent ports in the tanks to atmosphere through the surge tank and the vent scoop. Other portions of the sealed ducts act as surge chambers to trap fuel surging into the vent system during rapid attitude changes or rolling of the airplane. Fuel trapped in the surge chambers drains back into the tank when normal flying attitude is established. Fuel surges too large to be trapped in the surge chambers are directed by the vent system to surge tanks located near the wing tips. Fuel in the surge tanks will drain back into the reserve tanks through the check valves located near the rear spar in the reserve tanks.
- D. The removable fuel cells which comprise the center portion of the center wing tank are vented into the integral sections of the center wing tank through openings at the top of the cells. The center wing tank cavities, in which the fuel cells are installed, are vented through a system of vent and drain lines to an overboard outlet located beneath the fuselage. For center wing cavity vents and drains, refer to 28-4-0.
- E. The ram air vent scoop applies impact pressure to the vent system during flight. This pressure insures against negative pressure conditions in the tanks during altitude changes and decrease fuel vaporization.

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Fuel Vent System
Figure 1



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2. Fuel Vent Float Valves

- A. The fuel vent float valves prevent fuel from entering the vent ports located in the outboard center area of each wing tank. The valve consists of a float mounted on an arm hinged to a mounting base. The mounting base is installed over the vent port on the lower surface of the sealed vent duct. (See figure 1) A valve stopper attached to the float arm incorporates a seal which contacts and seals the vent port when the valve is closed. The valve, when installed, is held in the normally open position by the weight of the float and float arm. On airplanes where fitted, a nylon stop, cradled in a U-shaped bracket attached to the valve mounting base, limits the downward travel of the float. As fuel rises in the tank, the float rises closing the valve aperture. When the fuel level recedes the valve reopens.

3 Fuel Vent Scoop

- A. The fuel vent scoops (figure 2) located outboard of No. 1 and 4 reserve tanks, are the overboard vents for the vent system. Each scoop consists of a recessed vent scoop panel mounted in the lower surface of the wing, and a plenum chamber with screened air inlet connected by a ram air duct to the vent surge tank. The diverging sidewalls of the slotted plenum chamber insure that ram air will be applied to the vent system during all flight attitudes of the airplane. The design of the scoop is such that icing conditions have minimum effect on ram air pressure.

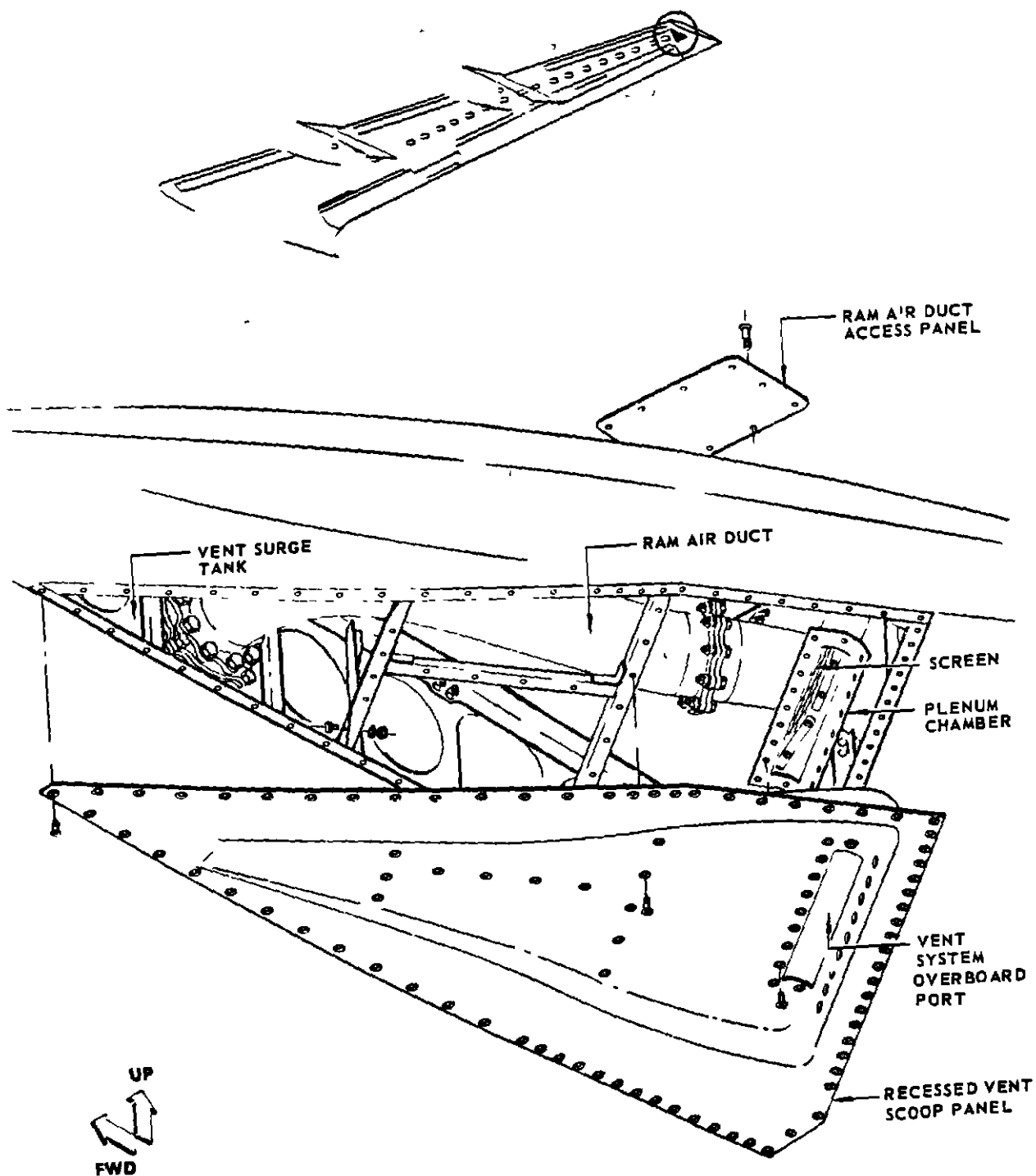
4 Vent Surge Tank

- A. A five gallon surge tank outboard of each wing reserve tank provides fuel surge capacity for the vent system. The purpose of the surge tank is to accommodate fuel surges too large to be trapped in the surge chambers during rapid attitude changes of the airplane. This integral tank incorporates a connection to atmosphere through the vent scoop and a drain connection to the reserve tanks. A check valve in this drain line prevents reverse flow from the reserve tanks back into the surge tanks.

5. Vent System Tubing, Couplings and Bulkhead Fittings

- A. Wing tank vent system tubing connections are of two types: couplings employing standard NAS and MS tube fittings, and unions and couplings using seal type bulkhead unions and retainers. The bulkhead fittings are used in the vent drain line at the inboard end of each main tank. Standard tube end fittings connect to the bulkhead union which is held in place by a retainer bolted to the bulkhead. O-ring seals are provided at the bulkhead union and at the retainer bolts.

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Fuel Vent Scoop
Figure 2

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- B. Vent crossover tubes at the inboard end of main tanks No. 1 and 4 connect the inboard and outboard hat shaped upper wing skin vent ducts. Each crossover tube consists of 2.5 inch tubing connected at each end to an elbow flange. The elbow flanges are bolted and sealed to the vent ducts. The tube connections and equipment in the vent system must be lockwired to prevent loosening and subsequent fuel leakage.
- C. All vent system tubing and equipment is electrically bonded to the airframe with bonding jumpers or by faying surface bonding, where equipment is mounted on airframe structure. Individual tubing is bonded to structure with bonding clamps and jumpers. Where tubing is connected, both tubes are bonded to the same point on the airframe.

6. Vent System Sealing

- A. The wing tank vent system is sealed in all areas where fuel leakage might occur. Seal applications are designed to prevent external leakage and also to prevent leakage between tank and vent areas. Sealing is accomplished by the use of a sealant compound which is applied around structural fasteners, between faying surfaces, and along the edges of structural members and equipment. For complete instructions covering sealing applications, leakage detection and isolation, and sealing repairs for any portion of the vent system, see 28-2-0, Integral Fuel Tanks.



FUEL VENT SYSTEM - MAINTENANCE PRACTICES

1. Inspection/Check Fuel Vent System

A. General

- (1) The fuel vent system must be pressure checked after performing maintenance on vent system which required that sealing be replaced and when fuel leakage is traced to vent system. Pressure checking of fuel vent system is accomplished by sealing off all fuel vent inlets and outlets with special fittings, and by applying air pressure to vent system through a hose connection. During this pressure check, temperature variations should be kept to a minimum.

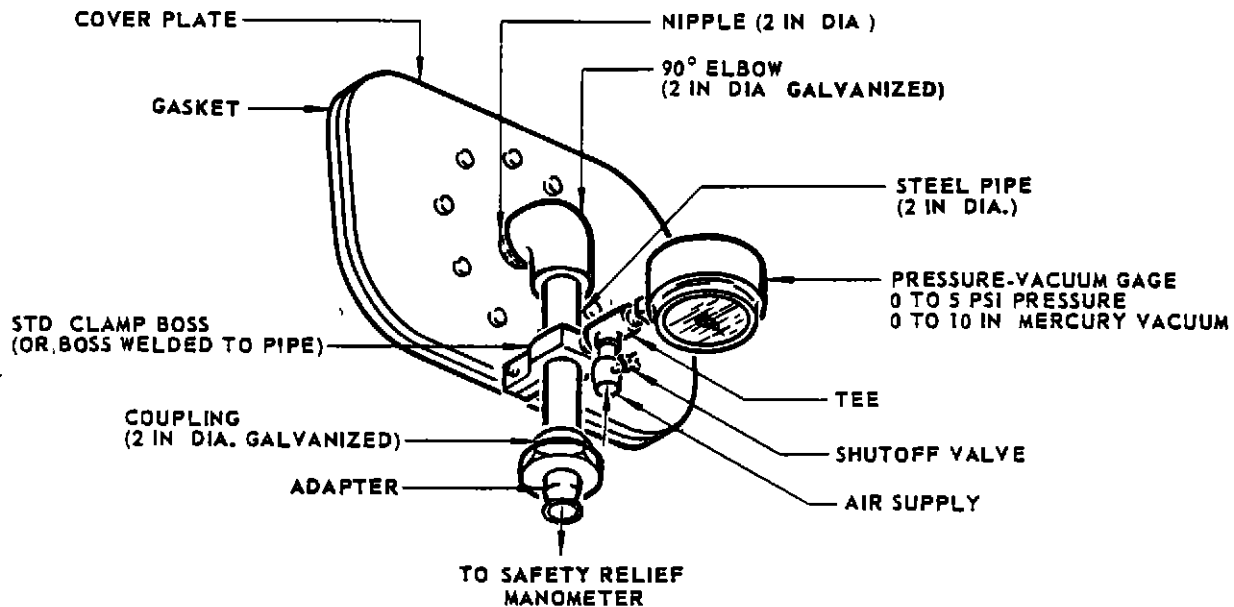
B. Equipment and Materials

- (1) Ground Air Supply - 0 to 5 psi.
- (2) Closure Items.
 - (a) Four dowels with rubber caps - 1-inch dowel stock cut to suitable length.
 - (b) Three squeeze plugs - 2-1/2 inch.
 - (c) One squeeze plug - 1-1/2 inch.
 - (d) One plug - AN806-8.
 - (e) One cap - AN929-12.
- (3) Safety Relief Manometer. (See 28-2-0, figure 207 for fabrication and servicing.)
- (4) Cover Plate Assembly. Fabricate per figure 201.

C. Prepare for Vent System Pressure Check

- (1) Defuel all tanks on side of airplane to be checked and prepare for entry into tanks. Refer to "Servicing Fuel Tanks," 28-0.

WARNING. EXPLOSIVE AND TOXIC DANGERS OF VAPORS IN VICINITY OF BOTH WET AND DRY FUEL TANKS ARE OF SUCH POTENCY THAT SEVERAL PRECAUTIONS MUST BE FOLLOWED BEFORE DRAINING AND ENTERING TANK.



Cover Plate Assembly
Figure 201

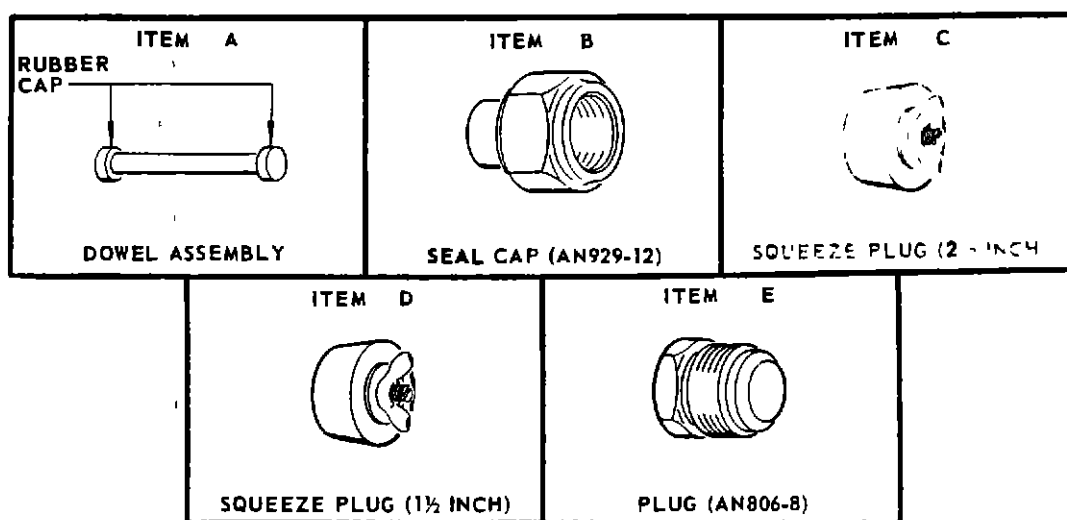
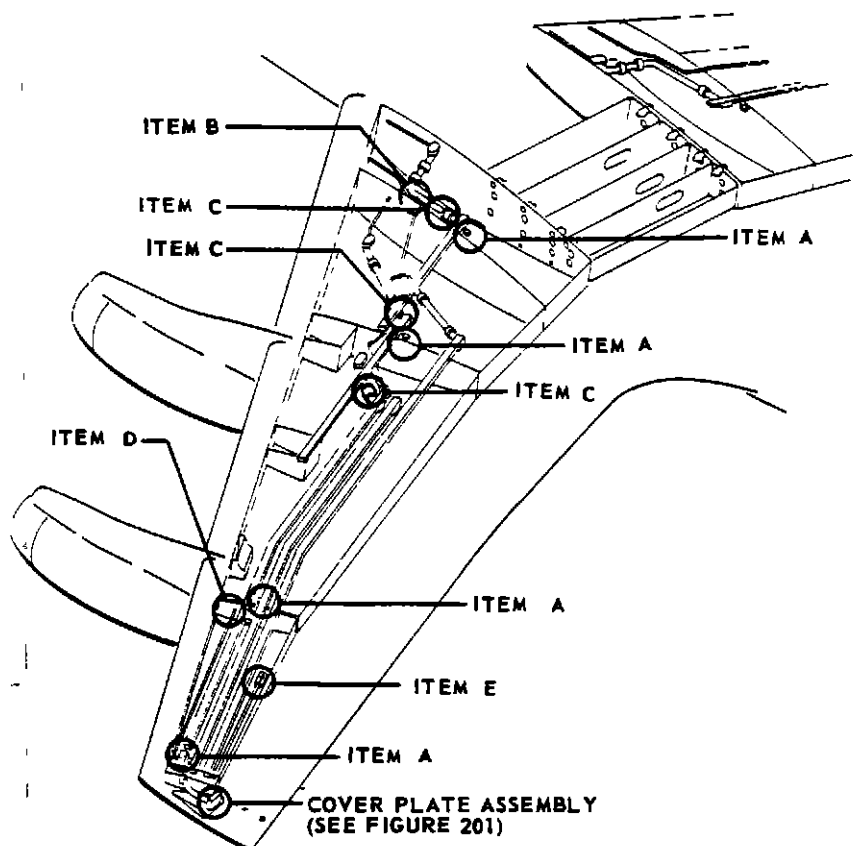
(2) Manually close all float valves.

(a) Gain access to applicable float valves using access panels and openings given below.

FLOAT VALVES	FUEL TANK ACCESS PANELS (Figure 2, 28-2-0)	RIB ACCESS OPENINGS (Figure 3, 28-2-0)
Reserve Tanks No. 1 or 4	No. 22	- -
Main Tanks No. 1 or 4	No. 14	- -
Main Tanks No. 2 or 3	No. 2	No. 9
Center Wing Tank	No. 1	No. 2

(b) Prop float valves in closed position using suitable length of one inch dowel (item A, figure 202).

- (3) When in center wing tank propping float valve closed, disconnect drain line from vent crossover tubes and install seal cap (item B, figure 202) at bulkhead fitting.



- (4) Disconnect vent elbows and plug vent tubing leading to vent ports
- (a) Gain access to applicable connections using access panels and openings given below.

VENT TUBE CONNECTIONS	FUEL TANK ACCESS PANELS (Figure 2, 28-2-0)	RIB ACCESS OPENINGS (Figure 3, 28-2-0)
Main Tanks No. 2 or 3	No. 2	No. 9
Main Tanks No. 1 or 4	No. 4	No. 11
Center Wing Tank	No. 1	No. 2

- (b) Disconnect vent elbow.
- (c) Remove seal ring from tube and insert squeeze plug (item C, figure 202).
- (5) Remove fuel tank access panel No. 15 and gain access to reserve tank vent tube.
- (6) Block end of reserve tank vent tube with 1-1/2 inch squeeze plug (item D, figure 202)
- (7) Remove fuel tank access panel No. 22 to gain access to surge tank check valve.
- (8) Remove surge tank check valve and block end of surge tank drain with standard plug, AN806-8 (item E, figure 202).
- (9) Install cover plate assembly (figure 201) over surge tank vent duct as follows:
- (a) Remove bolts attaching vent scoop panel and remove panel.
- (b) Remove bolts attaching ram air duct access panel to gain access to vent duct flange coupling.
- (c) Remove ten bolts in flanged coupling. Remove two bolts attaching plenum chamber to support bracket on each side of chamber. Remove plenum chamber and O-ring seal.
- (d) Install cover plate (figure 201) over ram air duct using ten bolts removed from flanged coupling. (See figure 203.)



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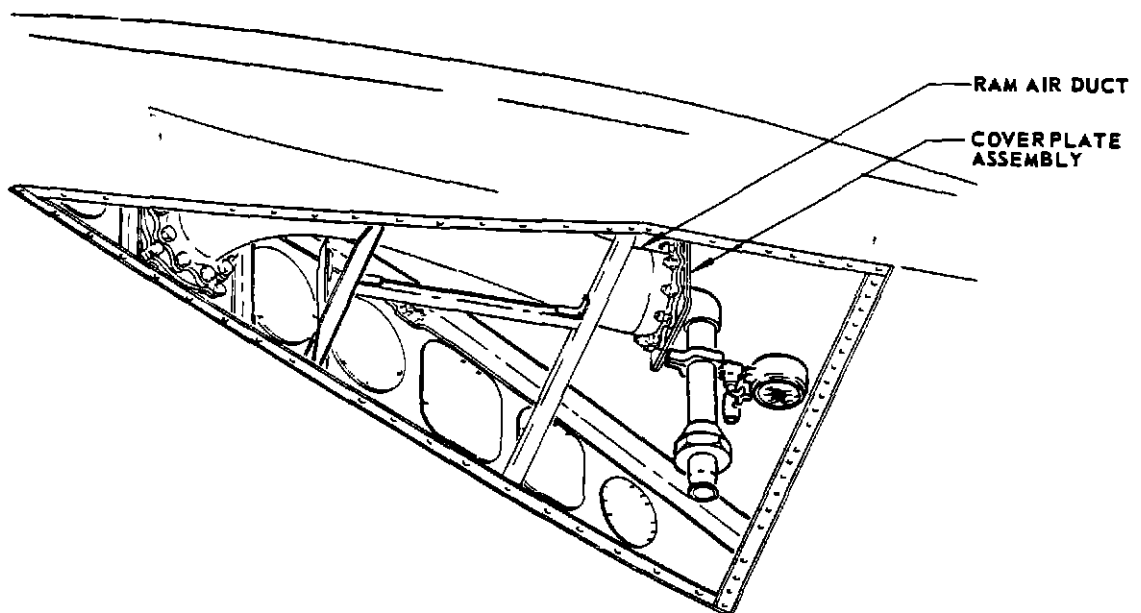
- (10) Connect ground air supply and safety manometer to fittings on coverplate assembly. (See figure 204.)

D. Pressure Check Fuel Vent System

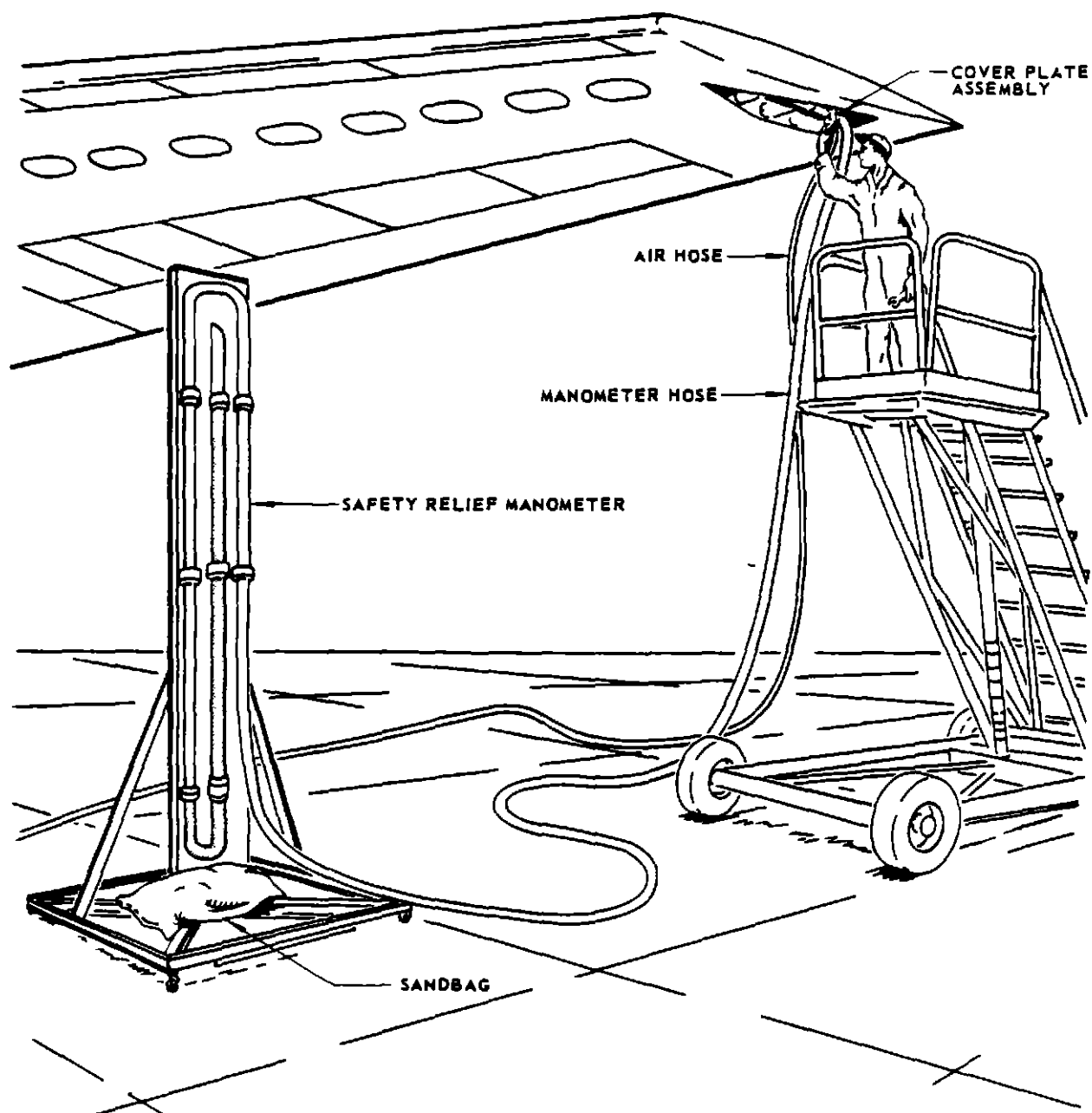
- (1) Pressurize vent system to 5 psi maximum. Allow time for pressure to stabilize and record pressure readings.
- (2) Set manometer to relieve at 5.2 psi. (See figures 110 and 111, 28-2-0.
- (3) Maintain system at constant temperature for 30 minutes. At end of this period take pressure reading.
- (4) If pressure drop has occurred, indicating leakage in vent system, refer to 28-2-0, Integral Fuel Tanks, for isolation and repair of leaking vent duct seals.
- (5) After completing check, remove dowels, seal caps, squeeze plugs, standard plug and coverplate assembly and restore system to normal configuration.

CAUTION. SERIOUS DAMAGE TO WING STRUCTURE WILL RESULT WHEN PERFORMING PRESSURE FUELING OPERATION IF CLOSURE PLUGS ARE NOT REMOVED FROM VENT SYSTEM AFTER COMPLETING PRESSURE CHECK.

- (6) Install structural members at rib access openings and fuel tank access panels. Refer to 28-2-1 and 28-2-11.



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Fuel Vent System Pressure Test Setup
Figure 204

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FUEL VENT FLOAT VALVES - MAINTENANCE PRACTICES

1. Removal/Installation Fuel Vent Float Valve

A. Remove Fuel Vent Float Valve (See figure 201.)

- (1) Defuel applicable fuel tank. Refer to "Servicing Fuel System," 28-0.
- (2) Gain access to applicable float valves using access panels and openings given below.

FLOAT VALVES	FUEL TANK ACCESS PANELS (Figure 2, 28-2-0)	RIB ACCESS OPENINGS (Figure 3, 28-3-0)
Reserve Tanks No. 1 or 4	No. 22	- -
Main Tanks No. 1 or 4	No. 14	- -
Main Tanks No. 2 or 3	No. 2	No. 9
Center Wing Tank	No. 1	No. 2

- (3) Support float valve and when installed, support stop assembly and remove nuts and washers from mounting studs. If O-ring seal has adhered to tank vent duct, remove seal.

CAUTION. DO NOT DROP FLOAT VALVE OR STOP ASSEMBLY. DAMAGE TO INTEGRAL FUEL TANK SEALING MAY RESULT.

- (4) Place all fasteners in a container to prevent losing them in tank.

B. Install Fuel Vent Float Valve (See figure 201)

- (1) Thoroughly clean faying surfaces of valve mounting base and vent duct with a clean cloth moistened with naphtha and wipe dry with lint free cloth.

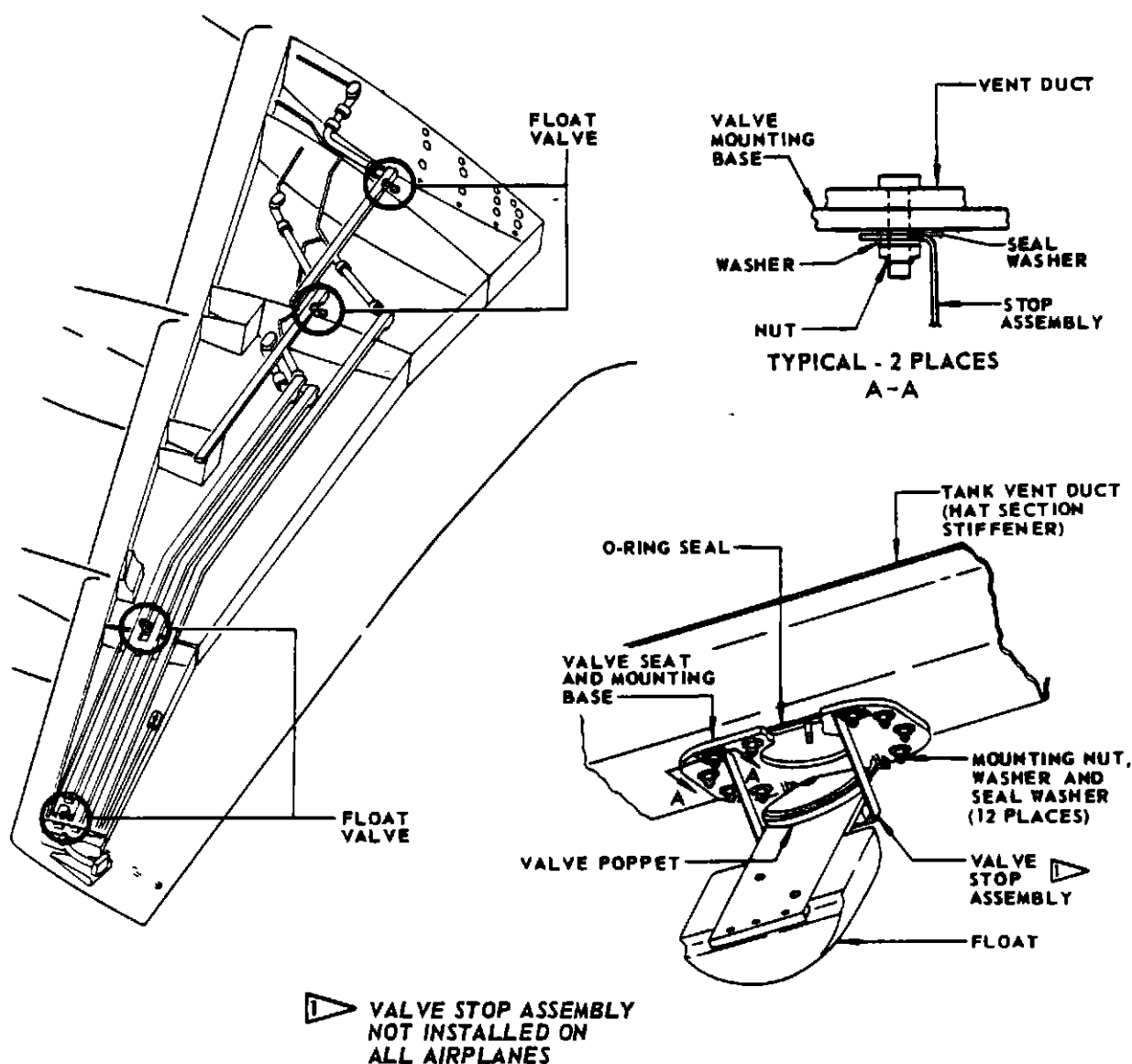
NOTE. Faying surfaces are bonding surfaces. Good electrical contact is required.

- (2) Install O-ring in mounting base.

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- (3) Place float valve assembly on mounting studs so that float is aft of mounting base. Install one seal washer, one plain washer and nut in that order, on each of the twelve mounting studs. On airplanes using stop assembly, install stop assembly as shown in figure 201.
- (4) Raise and lower float arm gently to insure that hinge action is smooth.
- (5) Install structural members at rib access openings if removed, and install fuel tank access panels. Refer to 28-2-1 and 28-2-11.



Fuel Vent Float Valve Installation
Figure 201



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FUEL TANK VENT FLOAT VALVES - INSPECTION/CHECK

1. General

- A. This procedure contains instructions to do a bonding resistance check for each fuel tank vent float valve.

2. Fuel Tank Vent Float Valves - Bonding Resistance Check

A. References

- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH

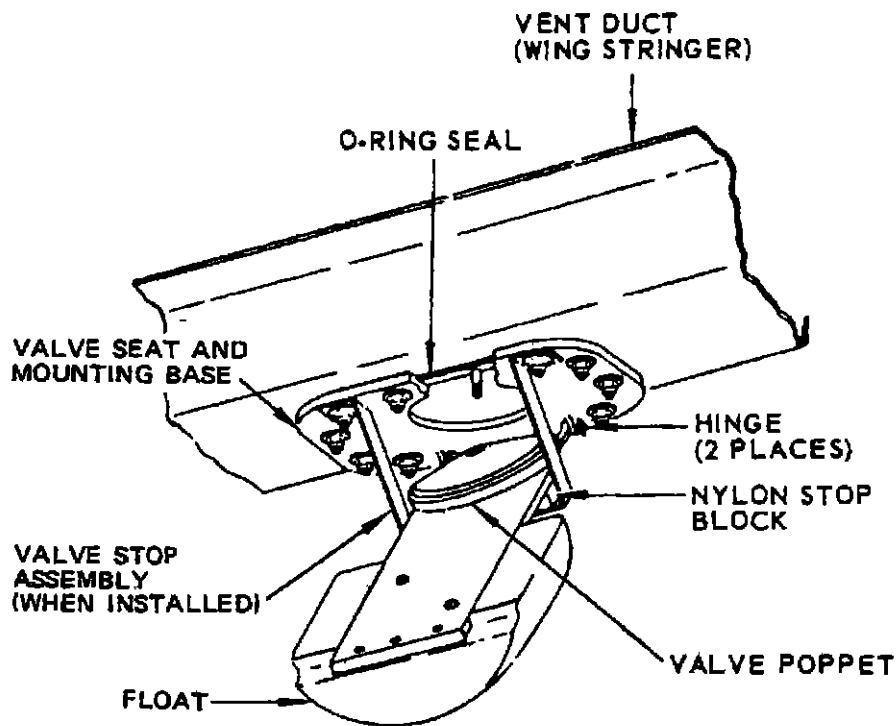
C. Procedure

- (1) Defuel all the tanks (AMM 28-0/201).
- (2) Do the "Purging (Air Ventilating)" procedure (AMM 28-0/201).
- (3) Get access to the applicable float valves (Figure 1) using access panels and openings given below:

FLOAT VALVES	FUEL TANK ACCESS PANELS	RIB ACCESS OPENINGS
Reserve Tanks No. 1 or 4	No. 22	--
Main Tanks No. 1 or 4	No. 14	
Main Tanks No. 2 or 3	No. 2	No. 9
Center Wing Tank	No. 1	No. 2

NOTE: Do the bonding resistance inspection for one tank and then repeat the inspection for the other tanks.

- (4) Measure the electrical bonding resistance from the float valve mounting base to the tank vent duct (SWPM 20-20-00).
- (a) Make sure the bonding resistance is 0.100 ohm (100 milliohm) or less.
- (5) Make sure the tank is clean.
- (6) Install structural members at rib access openings if removed and install fuel tank access panels.
- (7) Refuel all the fuel tanks (AMM 12-1-41/201).
- (8) Make sure there are no fuel leaks (AMM 28-2-0/101).
- (9) Put the airplane back to a serviceable condition.



Float Valve (Typical)
Figure 1

FUEL VENT SCOOP - MAINTENANCE PRACTICES

1 Removal/Installation Fuel Vent Scoop

A General

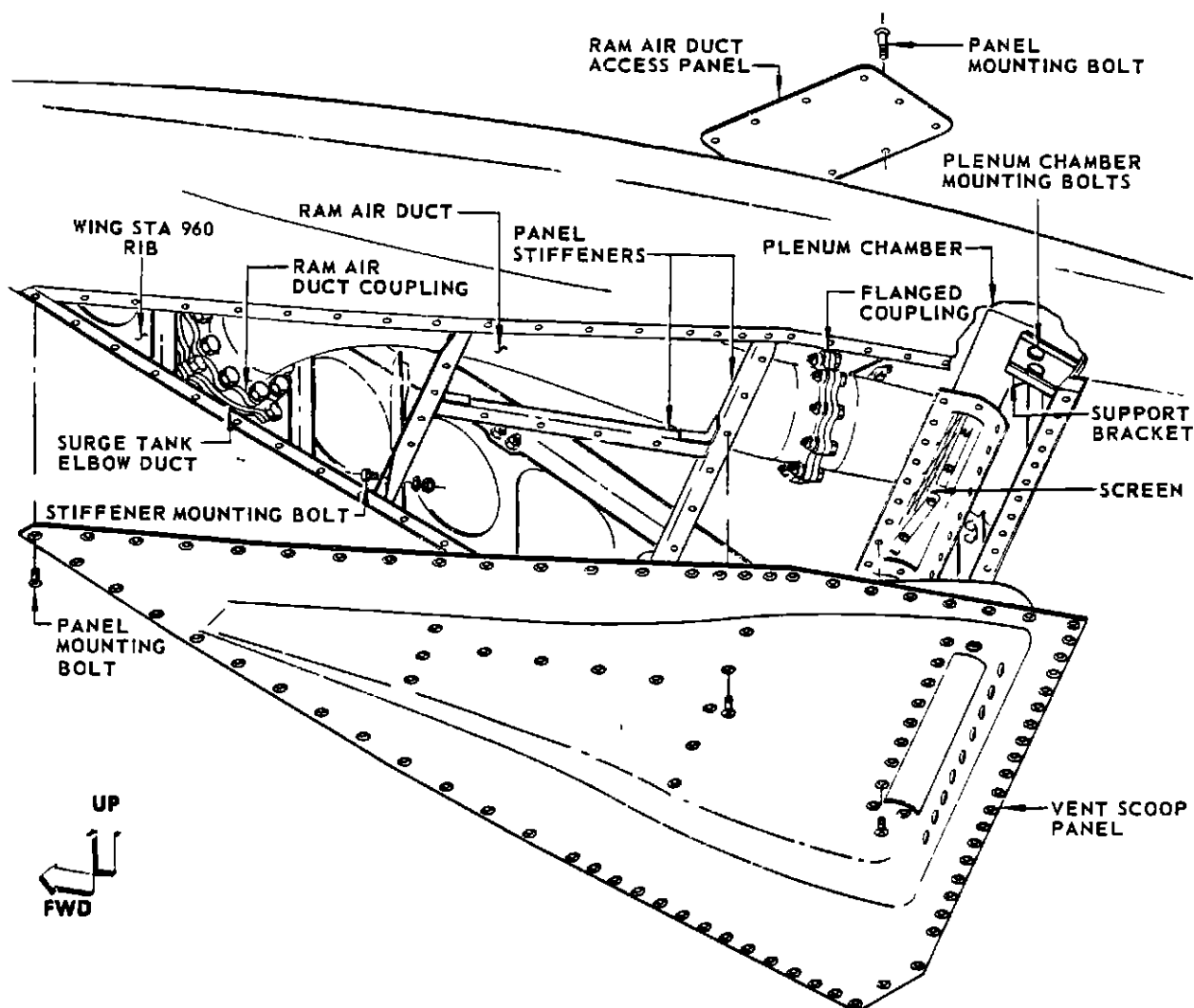
- (1) The vent scoop installation includes the plenum chamber, ram air duct and surge tank elbow duct. Removal of these parts is necessary to gain access to the vent surge tanks located directly outboard of the reserve tanks.

B Remove Fuel Vent Scoop (See figure 201.)

- (1) Remove bolts attaching vent scoop panel and remove panel.
- (2) Remove bolts securing panel stiffeners to airframe and remove stiffeners.
- (3) Remove bolts securing ram air duct access panel and remove panel for access to flanged coupling.
- (4) Remove plenum chamber
 - (a) Remove bolts, nuts and washers in flanged coupling.
 - (b) Remove bolts attaching support bracket to top of plenum chamber at each side of chamber.
 - (c) Remove plenum chamber and O-ring seal.
- (5) Detach ram air duct by removing bolts in coupling at surge tank elbow. Remove O-ring seal.
- (6) Remove bolts attaching surge tank elbow duct to rib. Grasp flange and withdraw duct from surge tank.
- (7) Remove O-ring seal from elbow duct.

C Install Fuel Vent Scoop (See figure 201.)

- (1) Clean all O-ring grooves using pointed wood stick with sharp end covered with clean cloth dampened with naptha.
- (2) Install O-rings in elbow duct and ram air duct.
- (3) Insert surge tank elbow duct through rib structure at surge tank.
- (4) With O-ring seal properly seated in duct flange, position duct so that open end in surge tank is up and install bolts.
- (5) With O-ring seal properly seated in flange, attach ram air duct to surge tank elbow duct.



Fuel Vent Scoop Installation
Figure 201

- (6) With O-ring seal properly seated in flange of ram air duct, position plenum chamber on duct and install bolts and nuts with one washer under each nut.
- (7) Install support brackets at top of plenum chamber with bolts, nuts, and one washer under each nut.
- (8) Install vent scoop panel stiffeners to structure with bolts, nuts, and one washer under each nut.
- (9) Install ram air duct access panel.
- (10) Position vent scoop recessed panel and install bolts that attach panel to airplane structure.

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FUEL VENT SURGE TANK DRAIN SWING CHECK VALVES - REMOVAL/INSTALLATION

1. Remove Fuel Vent Surge Tank Drain Swing Check Valve (See figure 401.)

- A. Defuel and purge applicable fuel tank. Refer to Fuel System - Maintenance Practices, 28-0.

WARNING OBSERVE ALL SAFETY PRECAUTIONS GIVEN FOR DEFUELING, PURGING AND FUEL TANK ENTRY.

- B. Remove access panel 20. Refer to Fuel Tank Access Panels - Maintenance Practices, 28-2-1.

- C. Remove check valve.

- (1) Disconnect drain tube from check valve by backing off coupling nut until free of valve.
- (2) Remove locknut and screw securing check valve mounting clamp to airplane structure and remove check valve and clamp from fuel tank.
- (3) Remove mounting clamp from check valve.

2. Install Fuel Vent Surge Tank Drain Swing Check Valve (See figure 401.)

- A. Install mounting clamp on check valve. Do not install locknut and screw in clamp.

- B. Install check valve.

- (1) Place check valve and clamp in mounting position in fuel tank and loosely install clamp attaching screw and locknut.
- (2) Rotate check valve within clamp until hinge is up.
- (3) Connect drain tube to check valve. Maintain check valve in hinge up position during tightening of coupling nut onto check valve.

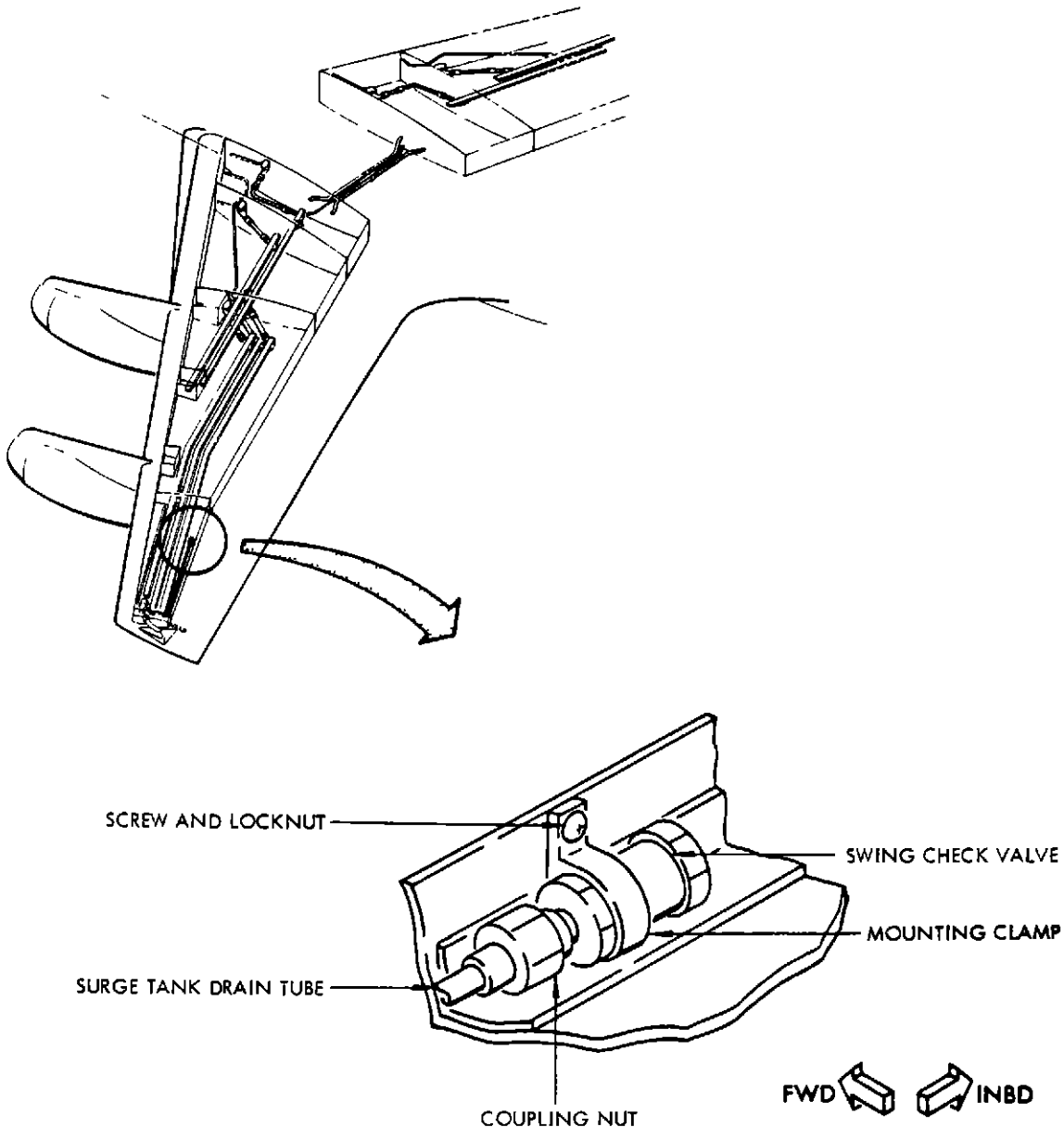
CAUTION CHECK VALVE MUST BE INSTALLED WITH HINGE UP, OTHERWISE VALVE WILL NOT FUNCTION PROPERLY.

- (4) Tighten screw and locknut securing mounting clamp to airplane structure.



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- C. Install access panel 20. Refer to Fuel Tank Access Panels - Maintenance Practices, 28-2-1.
- D. Perform leak test of applicable fuel tank. Refer to Integral Fuel Tanks - Maintenance Practices, 28-2-0.



Fuel Vent Surge Tank Drain Swing Check Valve Installation
Figure 401



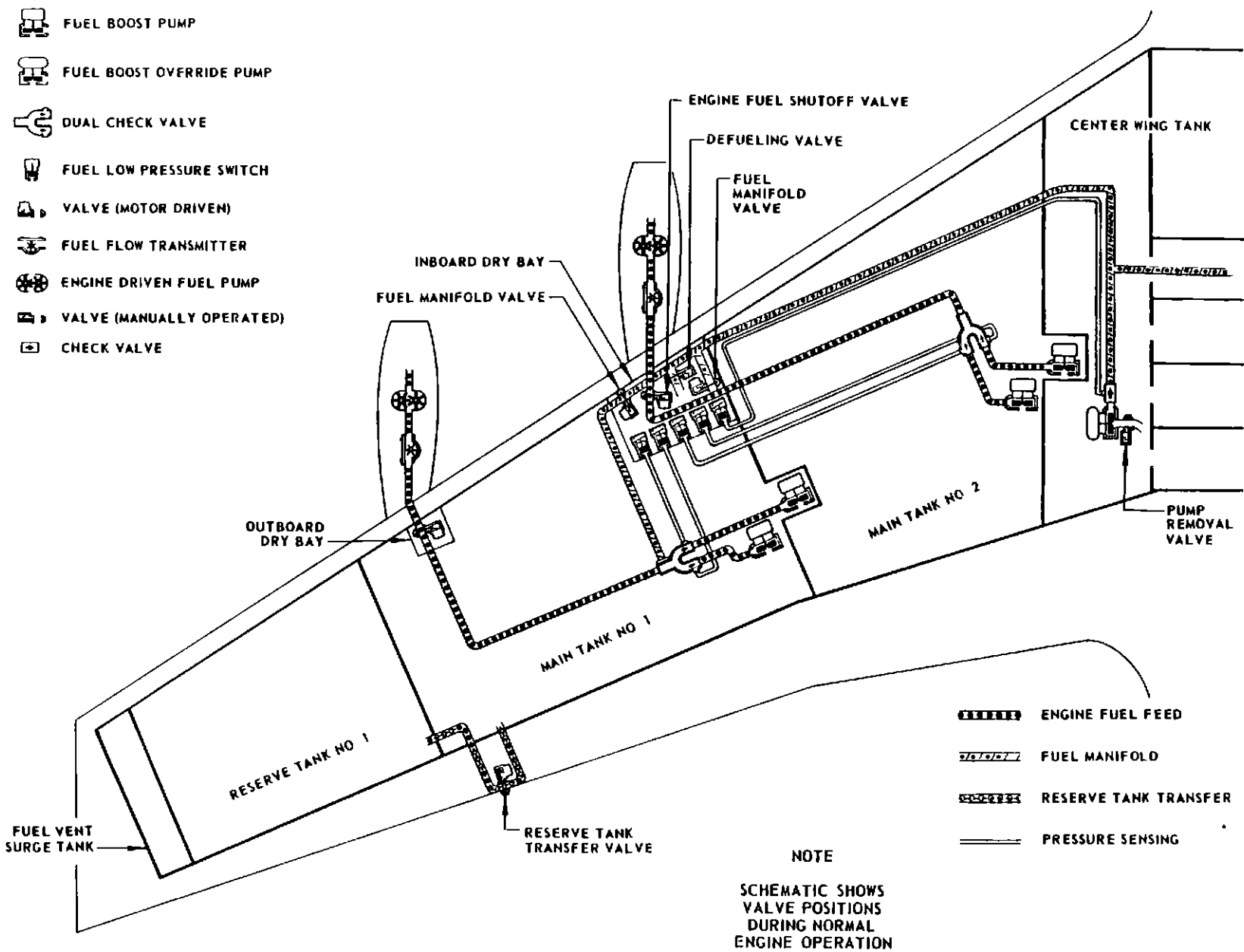
ENGINE FUEL FEED SYSTEM - DESCRIPTION AND OPERATION

1. General

- A. The engine fuel feed system is a system of fuel lines, pumps and valves which distributes fuel to the engines. (See figure 1.) It consists of four main tank to engine fuel feed sub-systems which are interconnected by a fuel manifold, such, that fuel may be delivered from any main tank or center wing tank to any or all engines. The reserve tanks are not connected to the fuel manifold. Fuel from the reserve tanks is gravity fed to main tanks no. 1 and no. 4.
- B. Each fuel tank, except the reserve tanks, is equipped with two a-c powered fuel boost pumps. The pumps are controlled by separate switches and independent circuits, so that engine operation will not be affected by the failure of a single electrical power source. The center wing tank boost pumps, known as the fuel boost override pump, will override the main tank boost pumps to supply fuel to the engines.
- C. Electric motor driven shutoff valves control fuel flow to the engines. The valves are classified into three groups: the valves that shut off fuel to the engines, the valves that control manifold distribution, and the valves that transfer fuel from the reserve tanks to main tanks no. 1 and 4. The names of these valves are respectively: the engine fuel shutoff valves, the fuel manifold valves, and the reserve tank transfer valves.
- D. The engine fuel feed system delivers fuel from the tanks through the fuel feed lines to the engines. (See figure 1.) The controls are centralized on the flight engineer's lower panel (detail A, figure 2), and are laid out in the form of a flow diagram. Electrical power is used to position the valves and to drive the pumps.

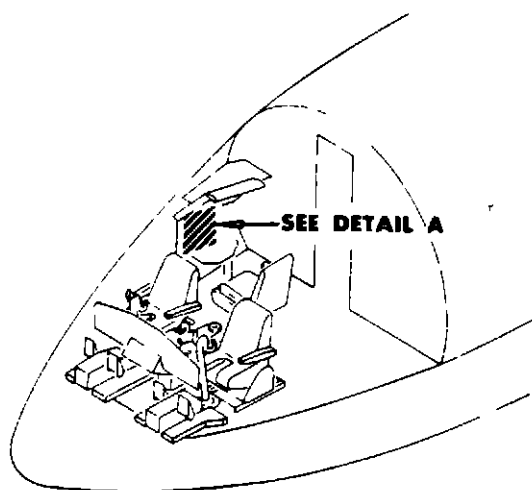
2. Engine Fuel Shutoff Valves

- A. Four engine fuel shutoff valves provide a means of shutting off the supply of fuel to the engines. Each valve is an electric motor driven slide shutoff valve consisting of a valve housing, sliding gate, electric motor and a manual override handle. (See figure 3.) One valve is located in the inboard and outboard dry bays of each wing. (See views 4 and 6, figure 2.) The manual override handle provides a visual means of checking the valve position and a manual means of opening or closing the valve when the motor is not energized. The valve housing incorporates a thermal relief provision to limit the pressure buildup in the fuel manifold. The valves are individually controlled by engine fuel shutoff valve switches on the flight engineer's lower panel and by engine fire switches on the pilots' light shield panel.

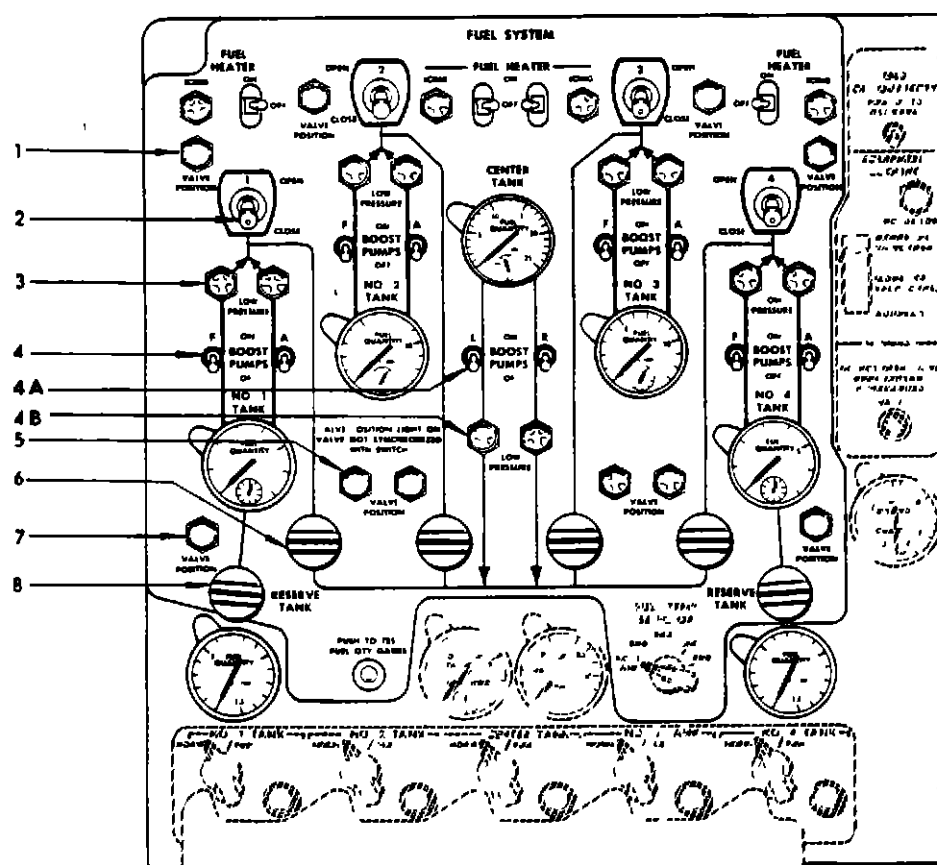


FUEL
Engine Fuel Feed System
Description and Operation

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- 1 ENGINE FUEL SHUTOFF VALVE POSITION LIGHT
- 2 ENGINE FUEL SHUTOFF VALVE SWITCH
- 3 BOOST PUMP LOW PRESSURE WARNING LIGHT
- 4 BOOST PUMP SWITCH
- 4A BOOST OVERRIDE PUMP SWITCH
- 4B BOOST OVERRIDE PUMP LOW PRESSURE WARNING LIGHT
- 5 FUEL MANIFOLD VALVE POSITION LIGHT
- 6 FUEL MANIFOLD VALVE SWITCH
- 7 RESERVE TANK TRANSFER VALVE POSITION LIGHT
- 8 RESERVE TANK TRANSFER VALVE SWITCH



DETAIL A

FLIGHT ENGINEER'S
LOWER PANEL

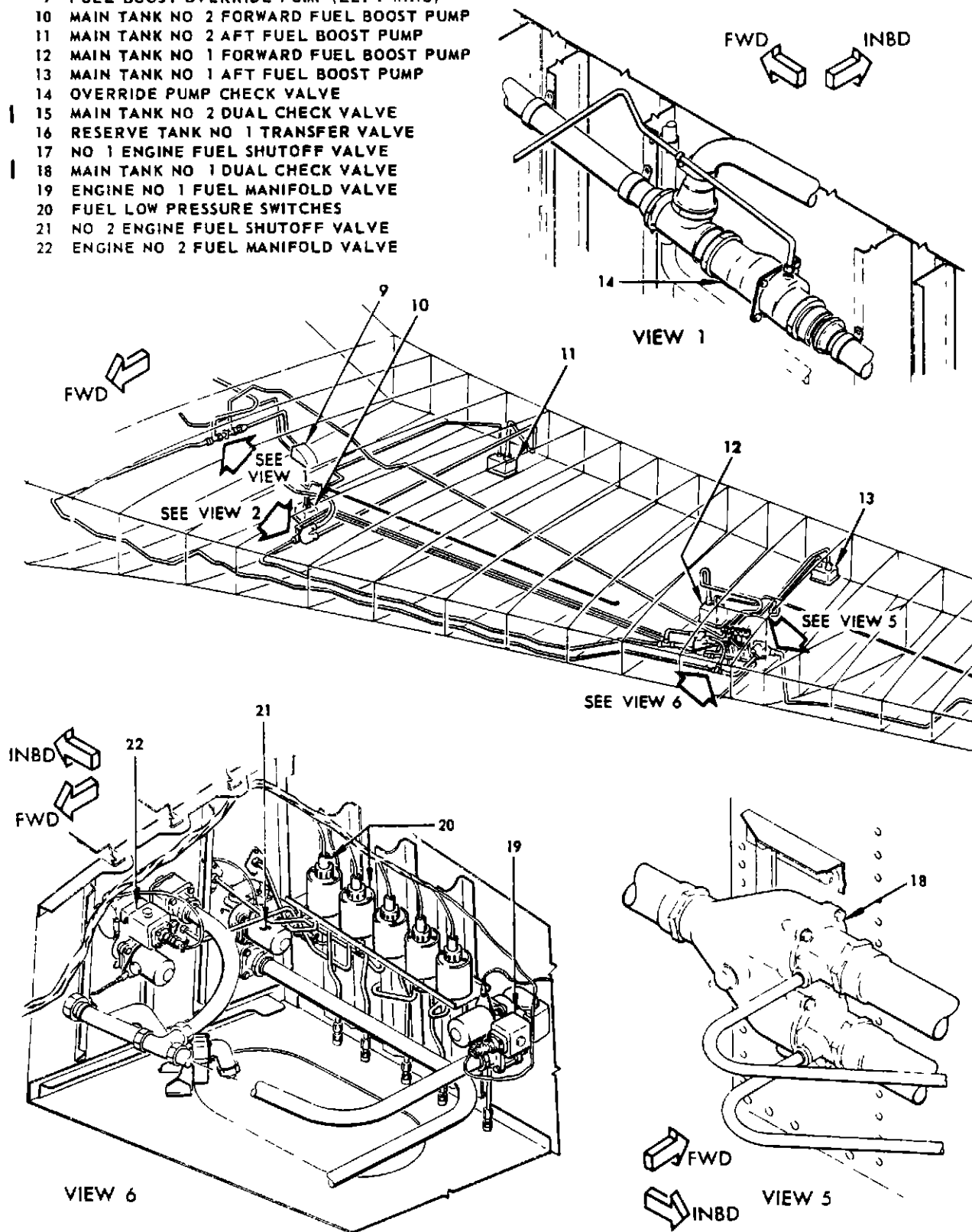
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Engine Fuel Feed System Equipment Location
Figure 2 (Sheet 1 of 3)

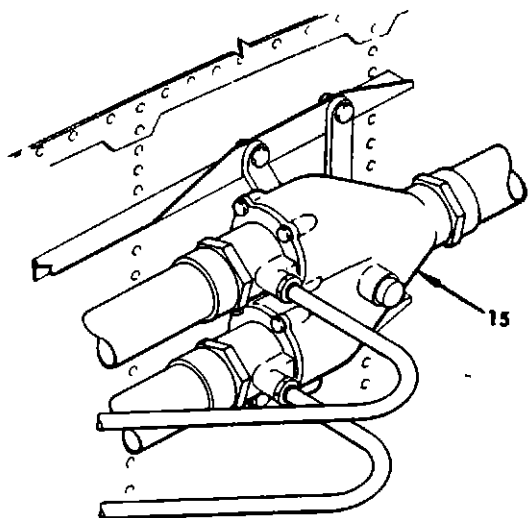
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Page 3

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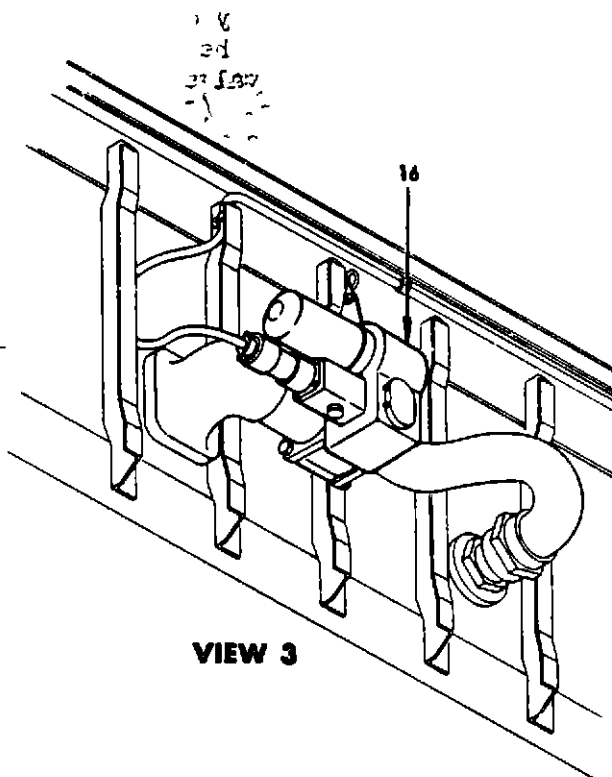
- 9 FUEL BOOST OVERRIDE PUMP (LEFT WING)
- 10 MAIN TANK NO 2 FORWARD FUEL BOOST PUMP
- 11 MAIN TANK NO 2 AFT FUEL BOOST PUMP
- 12 MAIN TANK NO 1 FORWARD FUEL BOOST PUMP
- 13 MAIN TANK NO 1 AFT FUEL BOOST PUMP
- 14 OVERRIDE PUMP CHECK VALVE
- 15 MAIN TANK NO 2 DUAL CHECK VALVE
- 16 RESERVE TANK NO 1 TRANSFER VALVE
- 17 NO 1 ENGINE FUEL SHUTOFF VALVE
- 18 MAIN TANK NO 1 DUAL CHECK VALVE
- 19 ENGINE NO 1 FUEL MANIFOLD VALVE
- 20 FUEL LOW PRESSURE SWITCHES
- 21 NO 2 ENGINE FUEL SHUTOFF VALVE
- 22 ENGINE NO 2 FUEL MANIFOLD VALVE



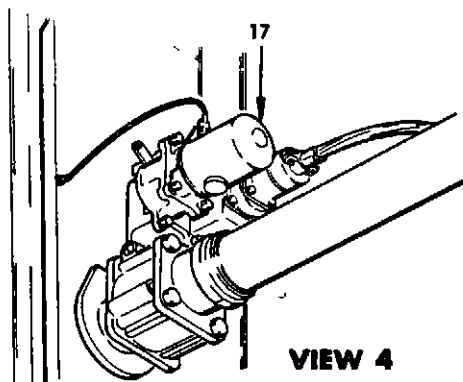
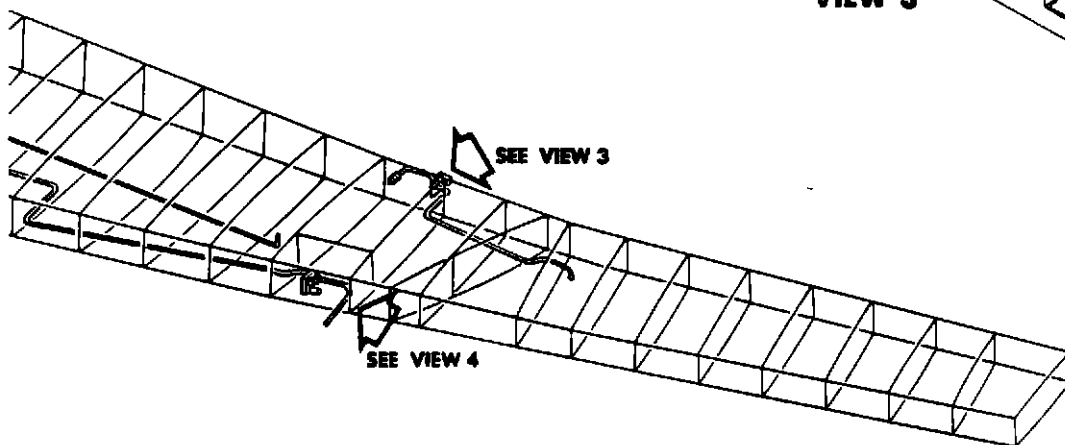
Engine Fuel Feed System Equipment Location
Figure 2 (Sheet 2)



VIEW 2



VIEW 3



VIEW 4



MAINTENANCE MANUAL

3 Fuel Manifold Valves

- A. Four fuel manifold valves provide a means of directing fuel to more than one engine from any one tank except the reserve tanks. These valves are the same type as the engine fuel shutoff valves. (See figure 3.) There is one manifold valve for each engine and the valves are located in the inboard dry bays. (See view 6, figure 2.) The manifold valves are controlled by individual fuel manifold valve switches on the flight engineer's lower panel.

4. Reserve Tank Transfer Valves

- A. The reserve tank transfer valves control the transfer of fuel from the reserve tanks to the outboard main tanks. These valves are the same type as the engine fuel shutoff valves (See figure 3.) There is one transfer valve located in the fuel transfer line between the reserve tank and the outboard main tank of each wing. The valve is in that portion of the line that projects outside of the rear spar. (See view 3, figure 2.) The transfer valves are controlled primarily by the reserve tank transfer valve switches on the flight engineer's lower panel. A secondary control of the transfer valves comes through the fuel dump switches. Refer to 28-22-0, "Fuel Dump System."

5. Fuel Boost Pumps

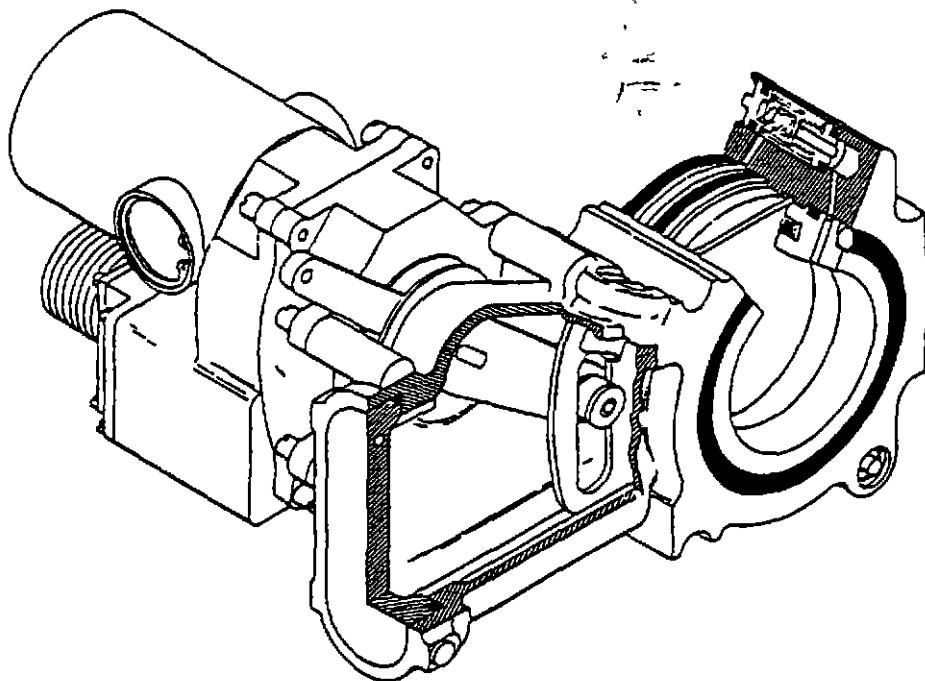
- A. The fuel boost pumps remove fuel from the main tanks and deliver it under pressure via fuel feed lines to its respective engine or by fuel manifold lines to other engines. Each pump (figure 4) is a centrifugal type driven by an electric motor which uses 115/200 volt 3-phase a-c power. The pumps are explosion proof and are located in dog house type covers at the lowest points in the main tanks. The pumps are bolted to the lower wing surface and project up into the pump housings. (See figure 5.) Refer to figure 6 for the locations of the fuel boost pump access panels.
- B. Fuel enters each pump through a flapper type pump removal valve and a wire mesh screen at the inlet port. (See figure 5.) The pump removal valve allows removal of the boost pump without defueling the tank. The screen protects the pump and lines from foreign material. Part of the fuel being pumped is recirculated through the pump to cool the motor and to lubricate the bearings. This fuel discharges through holes in the top of the motor case and mixes with incoming fuel in the pump housing. A vapor discharge line vents the pump housing to the tank. Each pump is operated independently through a fuel boost pump switch on the flight engineer's lower panel.

6. Fuel Boost Override Pumps

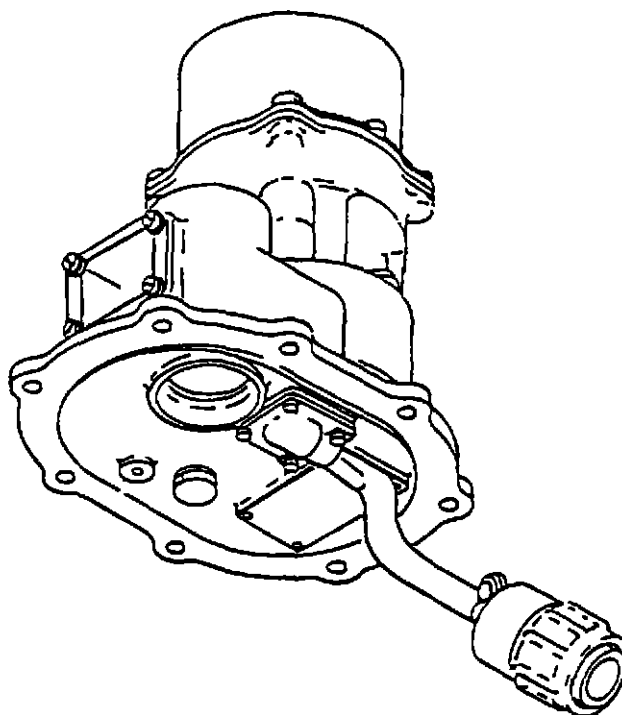
- A. Two fuel boost override pumps remove fuel from the center wing tank and deliver it under pressure to the fuel manifold. The pumps are electric motor driven centrifugal type pumps using 115/200 volt 3-phase a-c power. These pumps are located in the integral sections of the center wing tank, one pump to each integral section. The pumps are clamped to the inboard wall of the override pump dry bay (See figure 7.) Refer to figure 6 for the locations of the fuel boost override pump access panels.

FUEL
Engine Fuel Feed System
Description and Operation

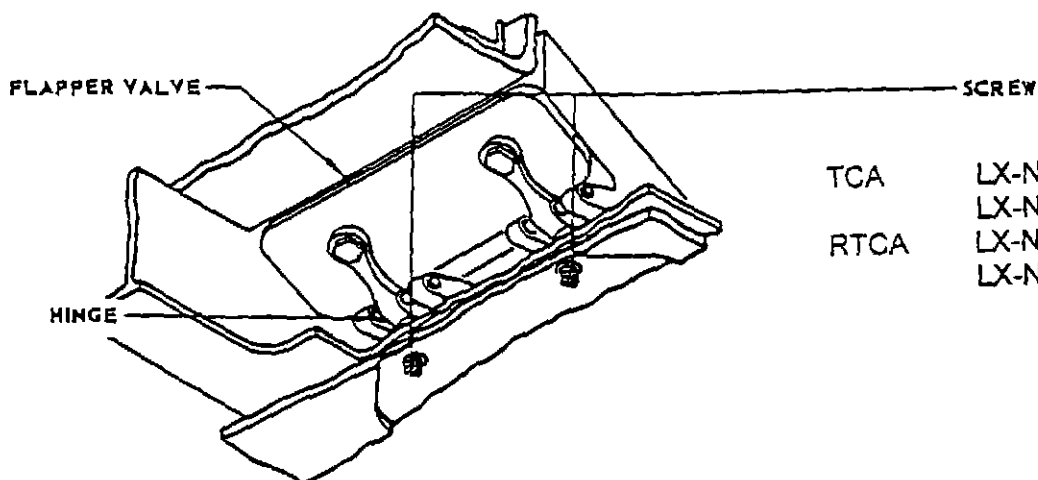
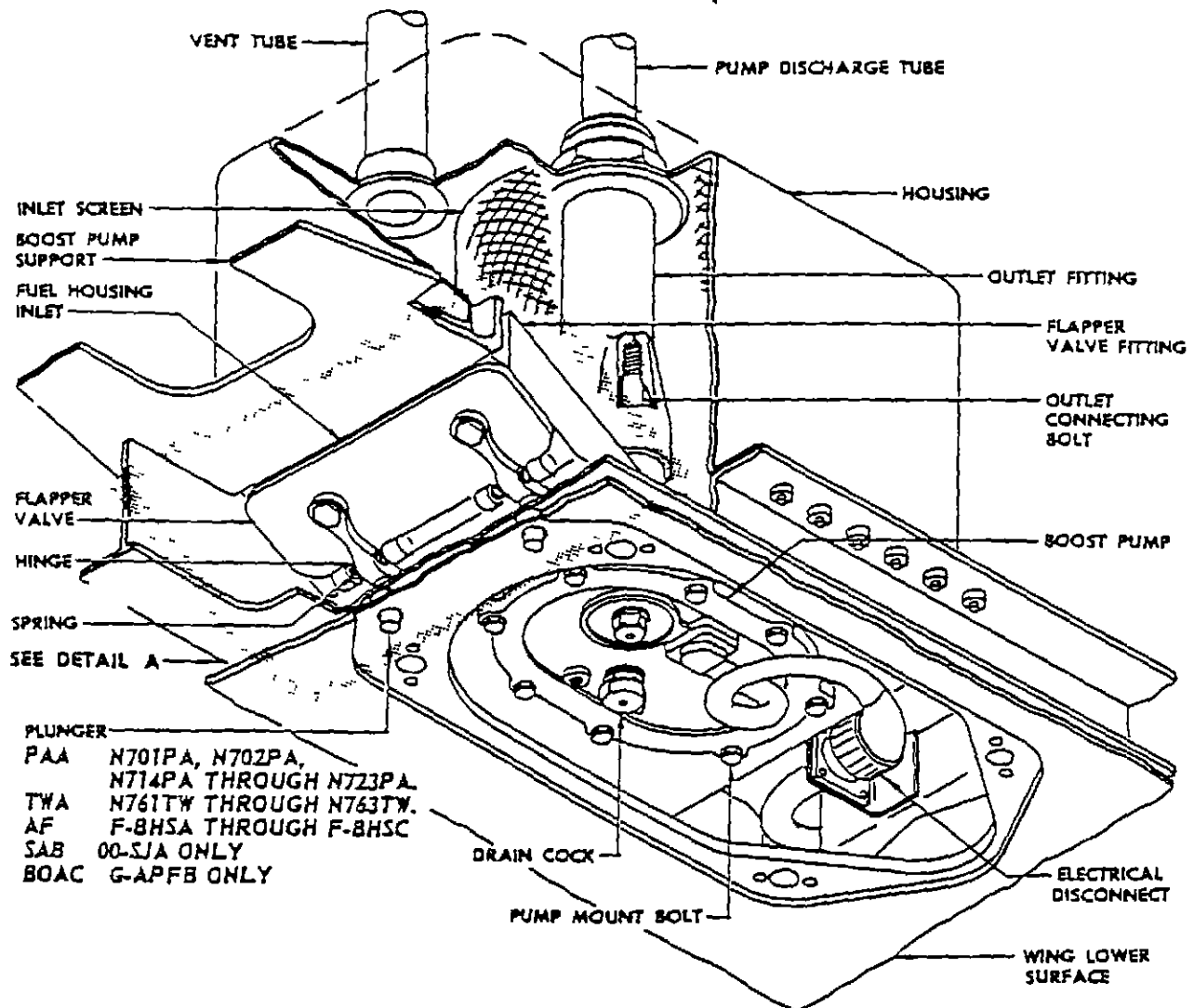
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Typical Fuel Valve
Figure 3



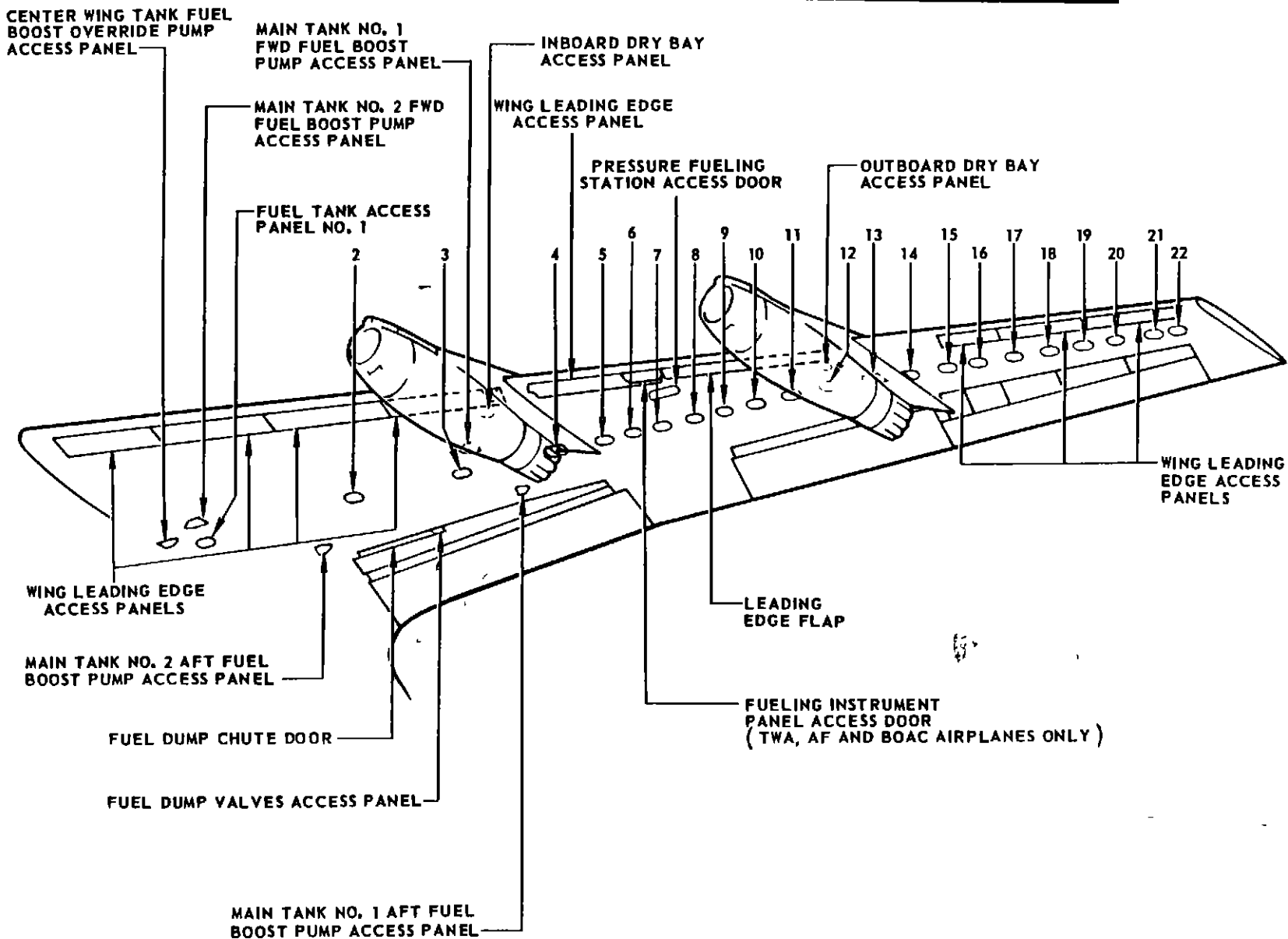
Typical Fuel Boost Pump
Figure 4



TCA	LX-N20198
	LX-N20199
RTCA	LX-N19997
	LX-N20000

DETAIL A

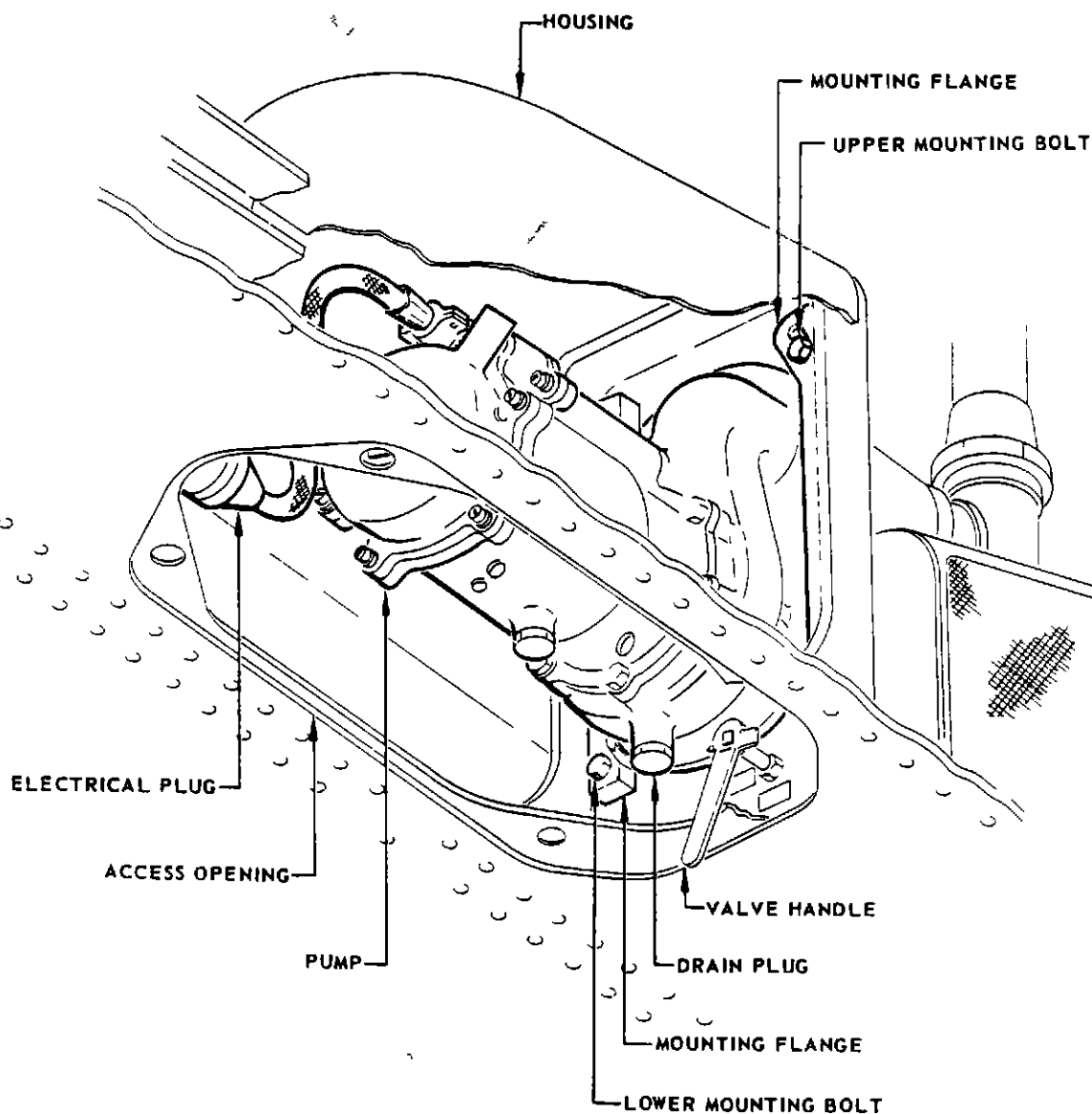
Fuel Boost Pump and Pump Removal Valve
Figure 5



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Revised

Fuel System Access Panels and Doors Location
Figure 6

- B. Fuel enters the pump through a manually operated pump removal valve and wire mesh screen at the inlet port. The pump removal valve allows removal of the override pump without draining the center wing tank. The screen protects the pump and lines from foreign material. Part of the fuel being pumped is circulated through the pump to cool the motor and to lubricate the bearings. This fuel discharges through holes in the top of the motor case and mixes with incoming fuel in the pump housing. A vapor discharge line vents the pump housing to the tank. Each pump is operated independently through a fuel boost override pump switch on the flight engineer's lower panel.



Fuel Boost Override Pump
 Figure 7



7. Pump Removal Valves

A. Fuel Boost Pump Removal Valve (Automatically Operated)

- (1) The flapper type pump removal valve permits removal of the fuel boost pumps without draining the main fuel tanks. These valves are of the hinged flapper type and are located in the inlet to the dog house type boost pump cover. (See figure 5.) They are spring loaded closed, and are open whenever the boost pump access panels are in place.

B. Fuel Boost Pump Removal Valve (Screw Operated)

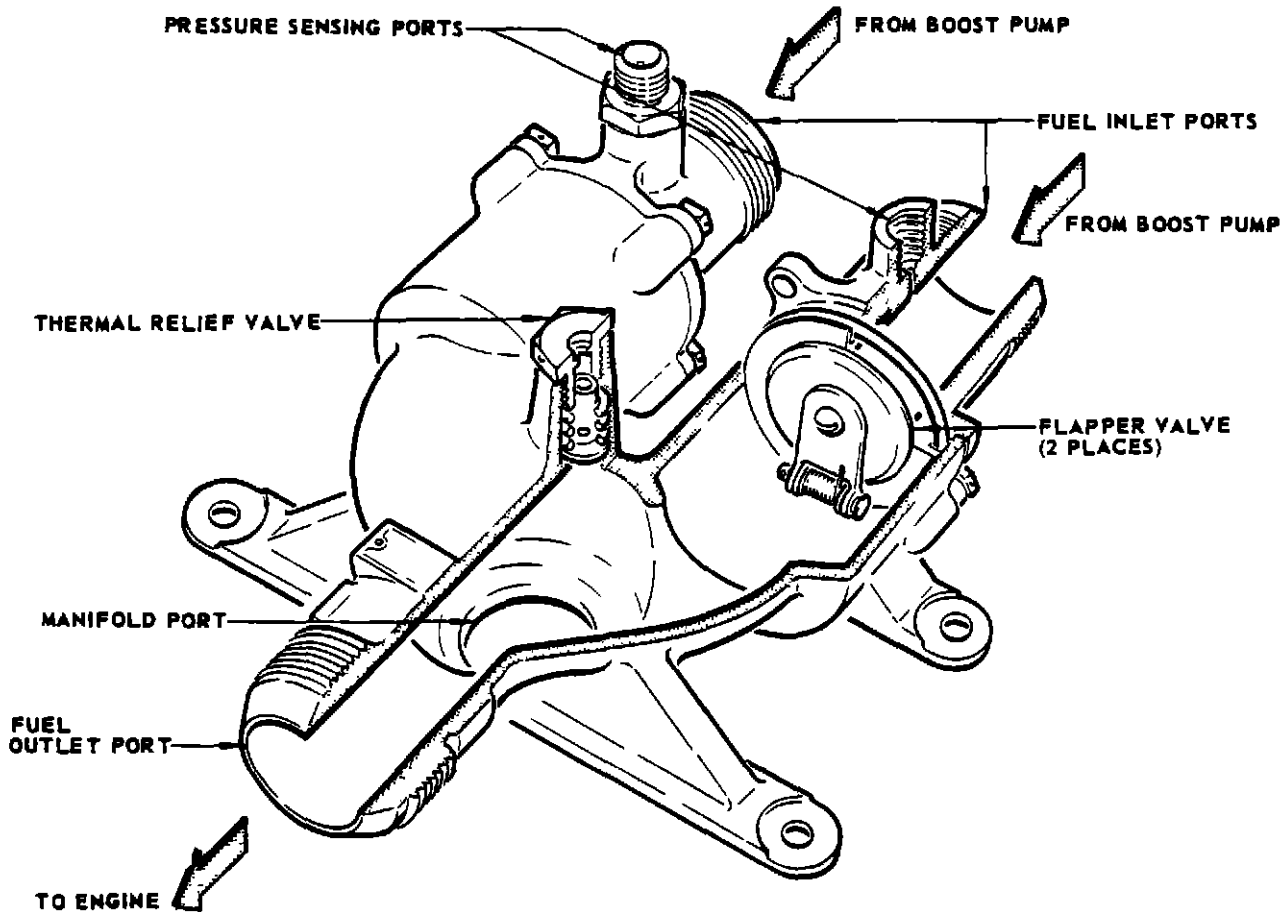
- (1) The flapper type pump removal valve permits removal of the fuel boost pumps without draining the main fuel tanks. These valves are of the hinged flapper type and are located in the inlet to the dog house type boost pump cover. They are manually operated through two screw mechanisms, in the full closed position the screws protrude to prevent installation of the boost pump access panels (see detail A, figure 5.)

C. Fuel Boost Override Pump Removal Valve

- (1) The manually operated pump removal valve permits removal of the fuel boost override pump without draining the center wing tank. These valves are slide shutoff type valves and are located in the inlet lines of the override pumps. The valve handle projects through the wall of the fuel boost override pump dry bay, so that the valve can be manually shutoff from outside the tank. (See figure 7.)

8. Dual Check Valves

- A. Four dual check valves, one in each main tank, prevent reverse flow into the tanks. Each valve consists of a Y-shaped casting having two inlet, one outlet and one manifold port. A flapper valve is fitted in each of the inlet ports which also have connections for the lines to the fuel low pressure switches. A thermal relief valve is mounted in the wall of the outlet port. On the outboard valves the manifold port is connected to the fuel manifold, on the inboard valves this port is not used and is fitted with a seal plate. (See figure 8.)
- B. The complete dual check valve assembly (views 2 and 5, figure 2) is bolted to the structure in the tank. Access to the valves is through the fuel access panels (figure 6) in the lower wing surface. The valves permit the fuel boost pumps to supply fuel to the manifold when the boost pump discharge pressure is greater than the fuel manifold pressure. In addition the valves will prevent reverse flow to the tanks at any time.



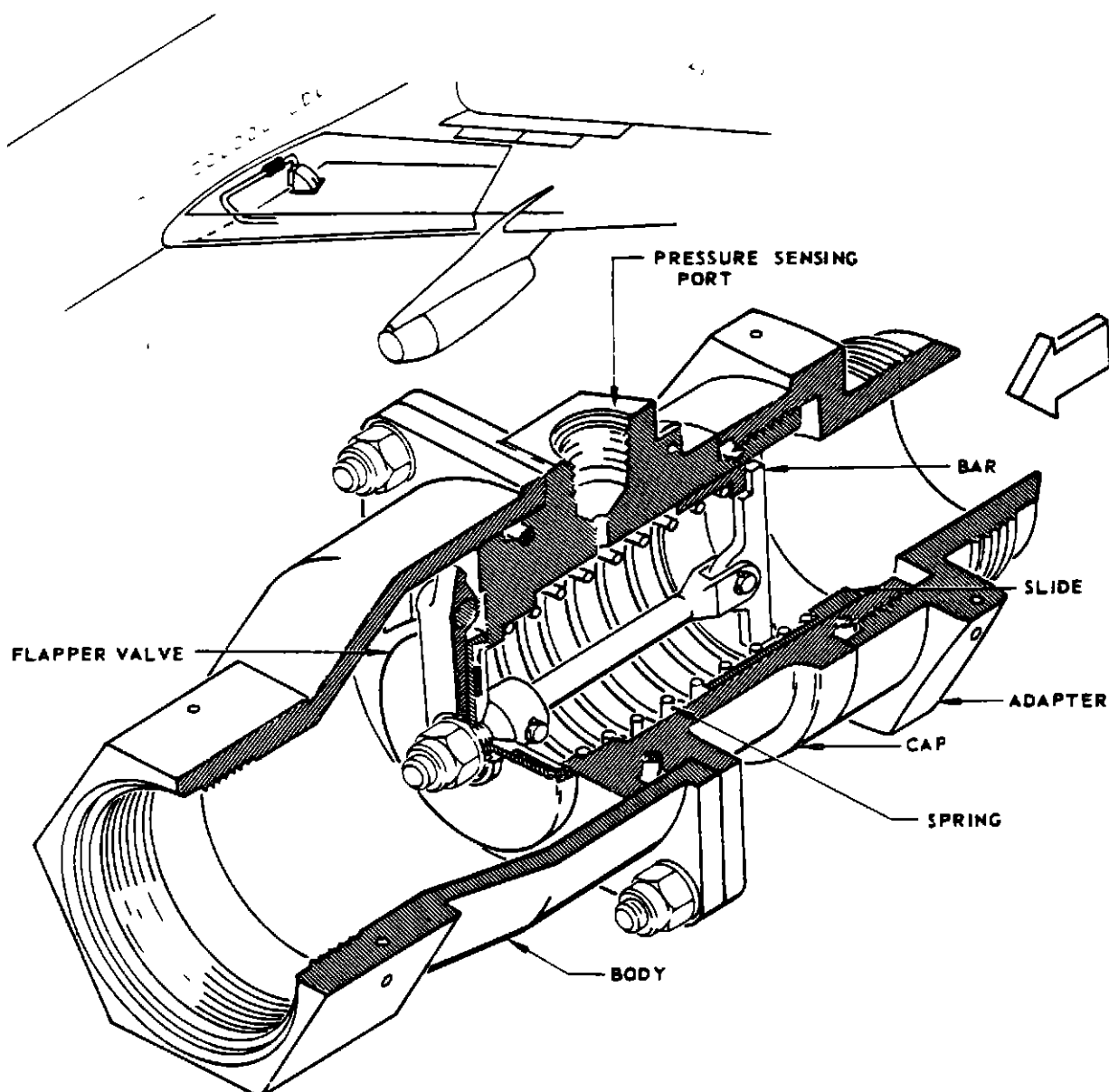
Dual Check Valve
Figure 8

9. Override Pump Check Valve

- A. An override pump check valve prevents reverse flow into the center wing tank when its respective fuel boost override pump is inoperative, or when the center wing tank is empty. The valve assembly consists of a spring loaded closed flapper valve mounted inside a cylindrical housing. The housing has three ports: fuel in, fuel out and a pressure sensing port, which is located upstream of the flapper valve and is connected to a line leading to its respective fuel low pressure warning switch. The valves are located in the override pump discharge lines, where the fuel manifold crosses over to the other wing. (See view 1, figure 2 and also see figure 9.) When the override pump pressure exceeds the fuel manifold pressure by three psi the flapper will open and allow the override pump to supply fuel to the manifold.

10. Fuel Low Pressure Switches

- A. Fuel low pressure warning switches control the fuel low pressure warning lights on the flight engineer's lower panel. Each switch assembly consists of a cylindrical housing containing a diaphragm and a switch. The housing has two ports, one for inlet pressure and one for venting. The pressure inlet port is connected to a sensing line coming from either a dual check valve or an override pump check valve. The venting port is connected to a line leading overboard. These switches are located five in a row on a bracket in each inboard dry bay. (See view 6, figure 2.) When the pump output pressure drops below 5.5 to 6.5 psi, the switch senses this drop in pressure and closes to complete the circuit to energize the warning light.





MAINTENANCE MANUAL

11. Operation

- A. The engine fuel feed system controls are located on the flight engineer's lower panel (detail A, figure 2) which is laid out in the form of a flow diagram. The controls consist of four lock toggle switches for the engine fuel shutoff valves, ten "ON-OFF" toggle switches for the fuel pumps and six rotary type switches for the fuel manifold and reserve tank transfer valves.
- B. All of the valves are operated by 28-volt d-c motors which receive their power through circuit breakers on the essential 28-volt circuit breaker panel (P6). All the pumps are driven by 115/200-volt three-phase 400-cycle power which is supplied through circuit breakers on panels P1, P2, P3 and P4. Pumps in the same tank do not receive power from the same bus. The pump power supply has been arranged so that loss of power to one bus will affect a maximum of three pumps, two boost and one override. The two boost pumps lost will be on opposite sides of the airplane. (See figures 10 and 11.)
- C. Operation of the system is accomplished by opening the desired manifold valves, opening the engine fuel shutoff valves, and starting the pumps. Each pump has a fuel low pressure warning light which is on when the pump is off or below normal pressure, and goes off when the pump is delivering normal pressure. Each valve has a light which comes on while the valve slide is being repositioned.
- D. When the boost pumps are operating, fuel is pumped from the tanks via the fuel feed lines where it is distributed through fuel manifold valves and engine fuel shutoff valves to the engines. The reserve tank transfer valves are kept closed until the fuel quantity in the adjoining main tank is less than 12,000 pounds (5443 kilograms). When this value is reached the fuel transfer valves may be opened.
- E. Control of the engine fuel shutoff valves is assumed by fire switches on the pilots' light shield panel. When the switches are pulled to the "FIRE" position, the engine fuel shutoff valve switches are overridden and the valves close. (See figure 10.)



MAINTENANCE MANUAL

11. Operation

- A The engine fuel feed system controls are located on the flight engineer's lower panel (detail A, figure 2) which is laid out in the form of a flow diagram. The controls consist of four lock toggle switches for the engine fuel shutoff valves, ten ON-OFF toggle switches for the fuel pumps and six rotary type switches for the fuel manifold and reserve tank transfer valves.

NOTE: Monitor any fuel pump low pressure indication light during pump operation and immediately put the fuel pump switch to OFF when a low pressure light(s) comes on and stays on.

When operating the APU unattended for an extended period of time, follow Airplane Maintenance Manual 49-00-2 and 49-00-3 page 201 instructions regarding necessary fuel quantity based on APU fuel burn rate.

When defueling or transferring fuel with minimum backpressure to the pumps, it is possible for a pump low pressure light to illuminate before all fuel is transferred. In one pump fuel tank configurations, monitor the tank quantity and put the pump to OFF if the tank quantity does not change. In two pump fuel tank configurations, put the pump to OFF and continue, and if the remaining pump's low pressure light illuminates, then monitor tank quantity and put that pump to OFF if tank quantity does not change. If each pump's low pressure light illuminates simultaneously, put the aft pump to OFF and continue while monitoring tank quantity and put the forward pump to OFF if tank quantity does not change.

NOTE: Forward pumps can usually supply more fuel on the ground compared to aft pumps.

Only one pump per fuel tank can be operated when a low pressure light is illuminated for that tank and that pump should be put to OFF when the tank quantity does not change.

- B. All of the valves are operated by 26-volt d-c motors which receive their power through circuit breakers on the essential 28-volt circuit breaker panel (P6). All the pumps are driven by 115/200-volt three-phase 400-cycle power which is supplied through circuit breakers on panels P1, P2, P3 and P4. Pumps in the same tank do not receive power from the same bus. The pump power supply has been arranged so that loss of power to one bus will affect a maximum of three pumps, two boost and one override. The two boost pumps lost will be on opposite sides of the airplane. (See figures 10 and 11.)
- C. Operation of the system is accomplished by opening the desired manifold valves, opening the engine fuel shutoff valves, and starting the pumps. Each pump has a fuel low pressure warning light which is on when the pump is off or below normal pressure, and goes off when the pump is delivering normal pressure. Each valve has a light which comes on while the valve slide is being repositioned.

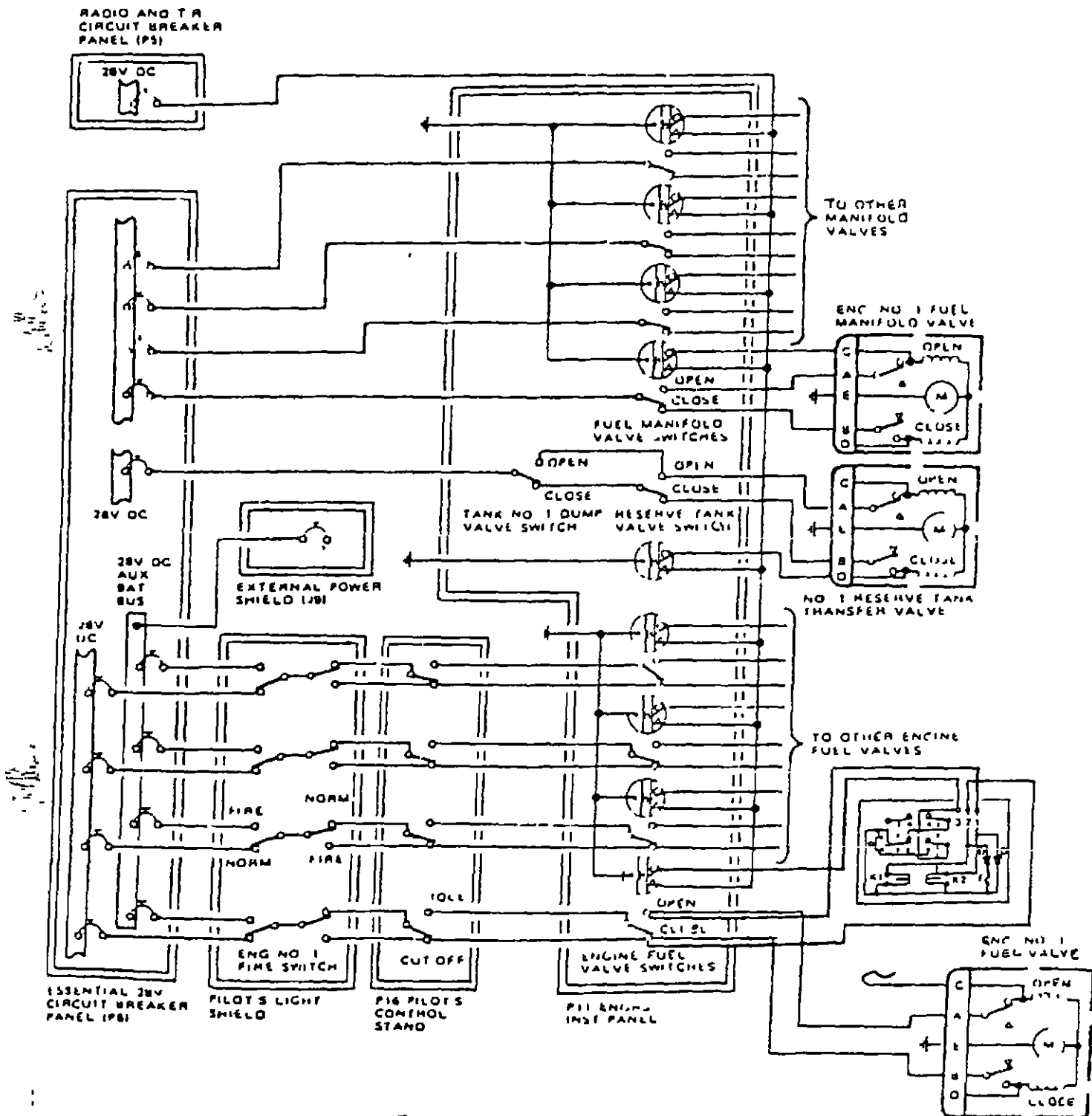


MAINTENANCE MANUAL

- D. When the boost pumps are operating, fuel is pumped from the tanks via the fuel feed lines where it is distributed through fuel manifold valves and engine fuel shutoff valves to the engines. The reserve tank transfer valves are kept closed until the fuel quantity in the adjoining main tank is less than 12,000 pounds (5443 kilograms). When this value is reached the fuel transfer valves may be opened.

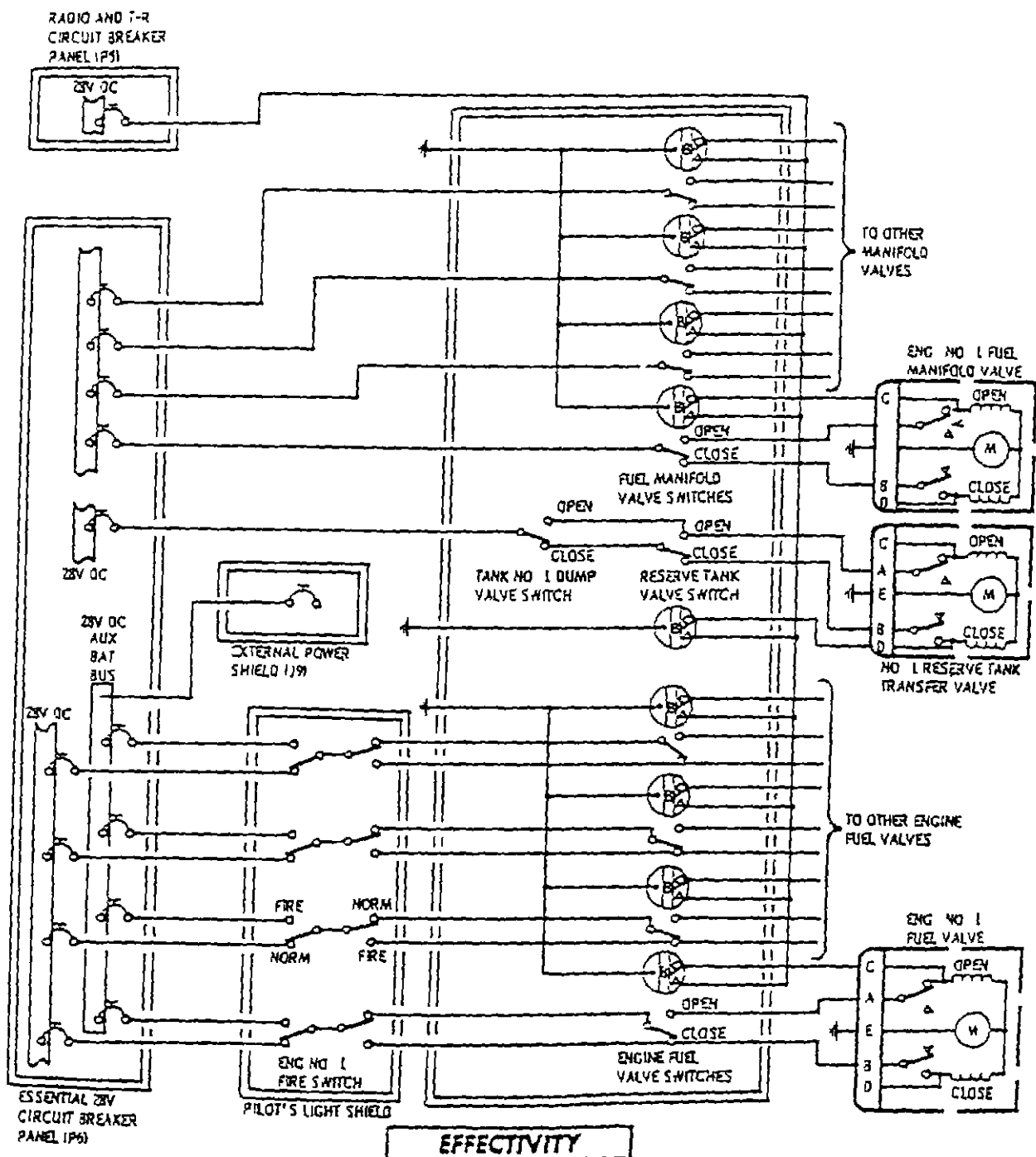
- E. Control of the engine fuel shutoff valves is assumed by fire switches on the pilots' light shield panel. When the switches are pulled to the "FIRE" position, the engine fuel shutoff valve switches are overridden and the valves close. (See figure 10.)

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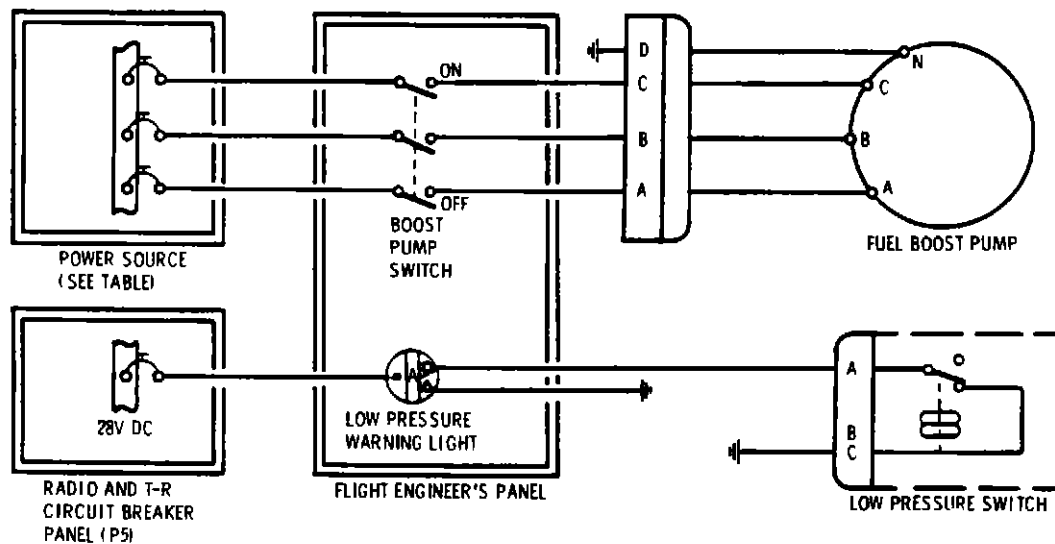
RTCA LX-N19997
LX-N20000

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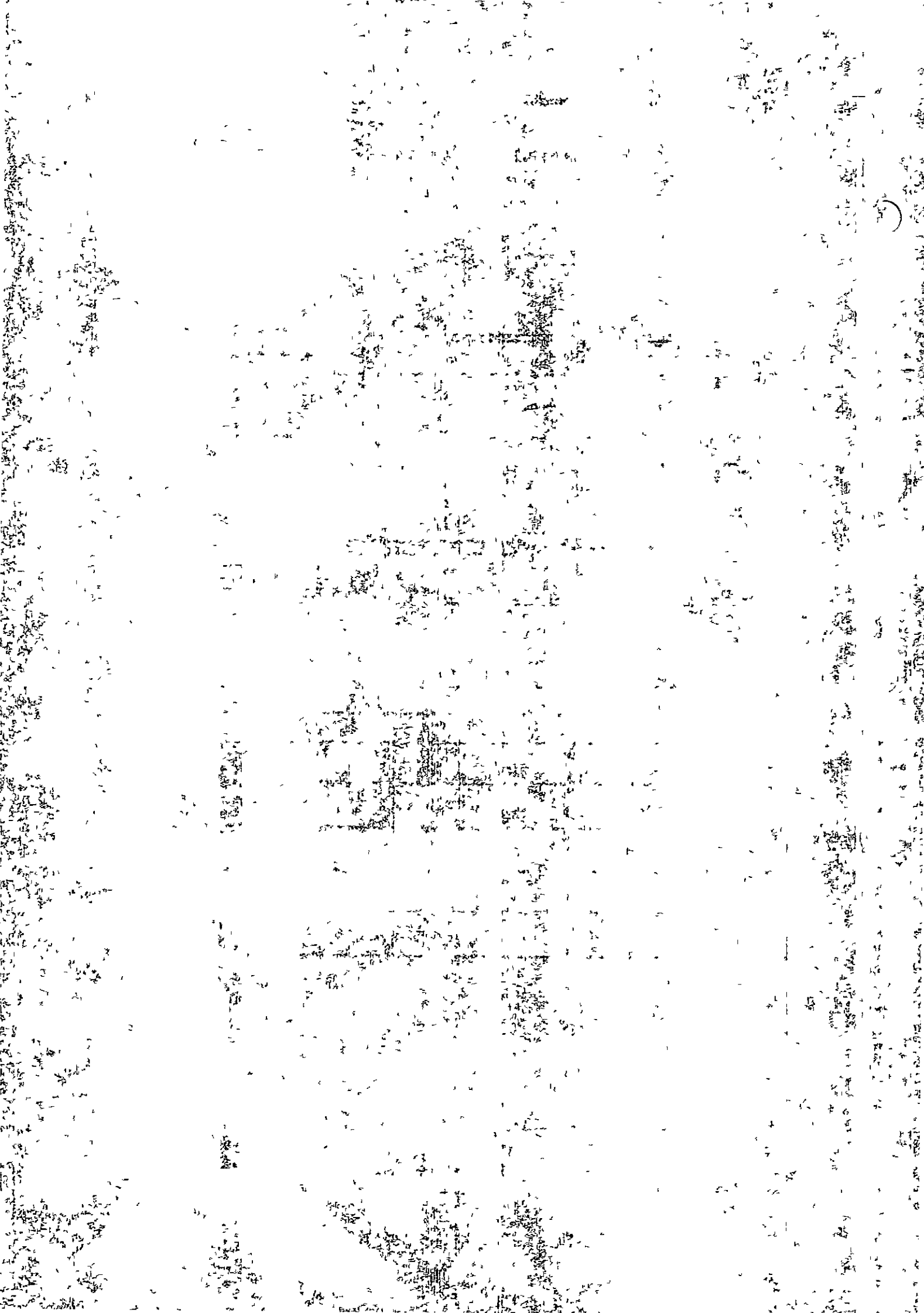


TCA LX-N20198
LX-N20199

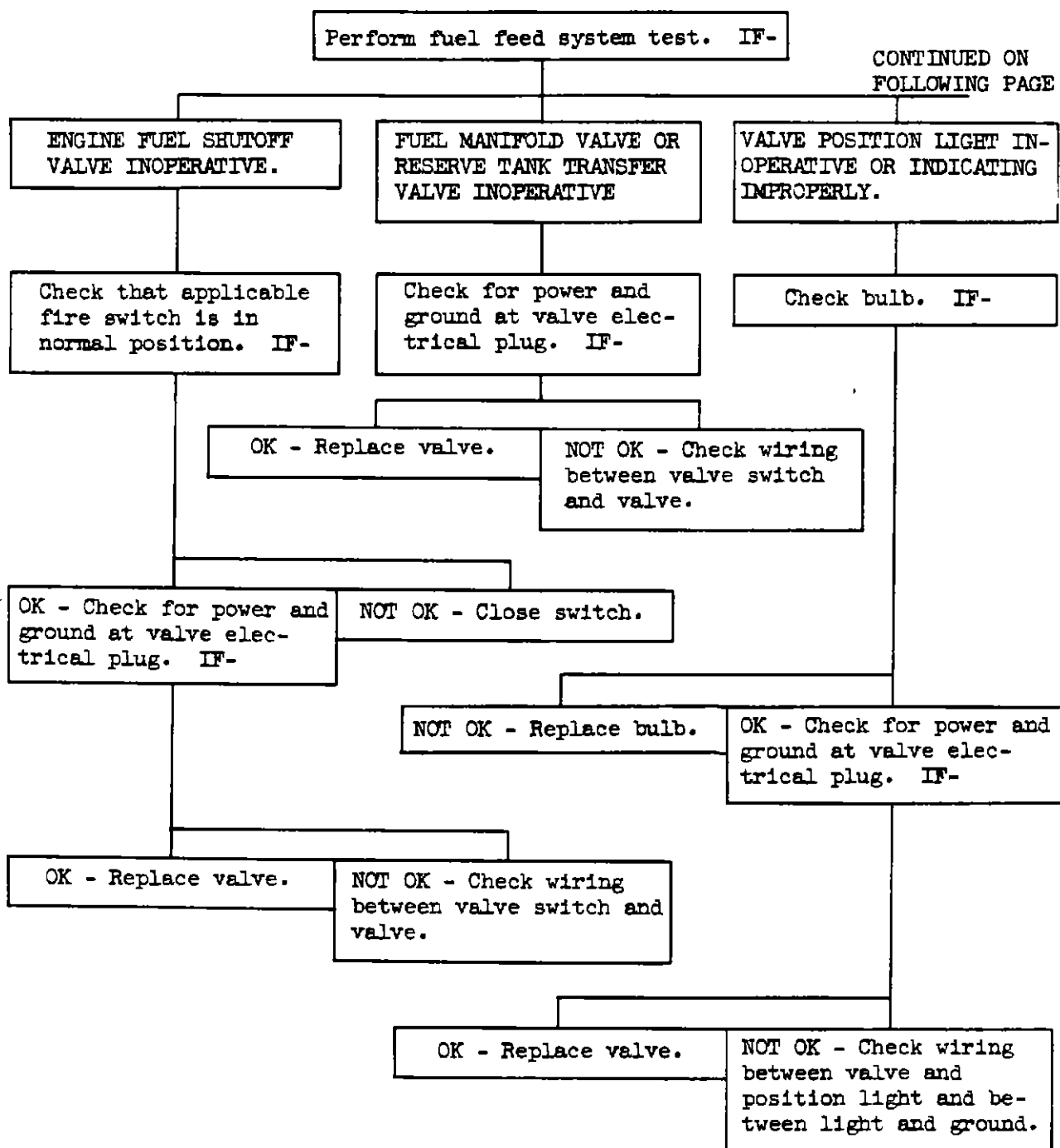
BOEING *707* *Intercontinental*
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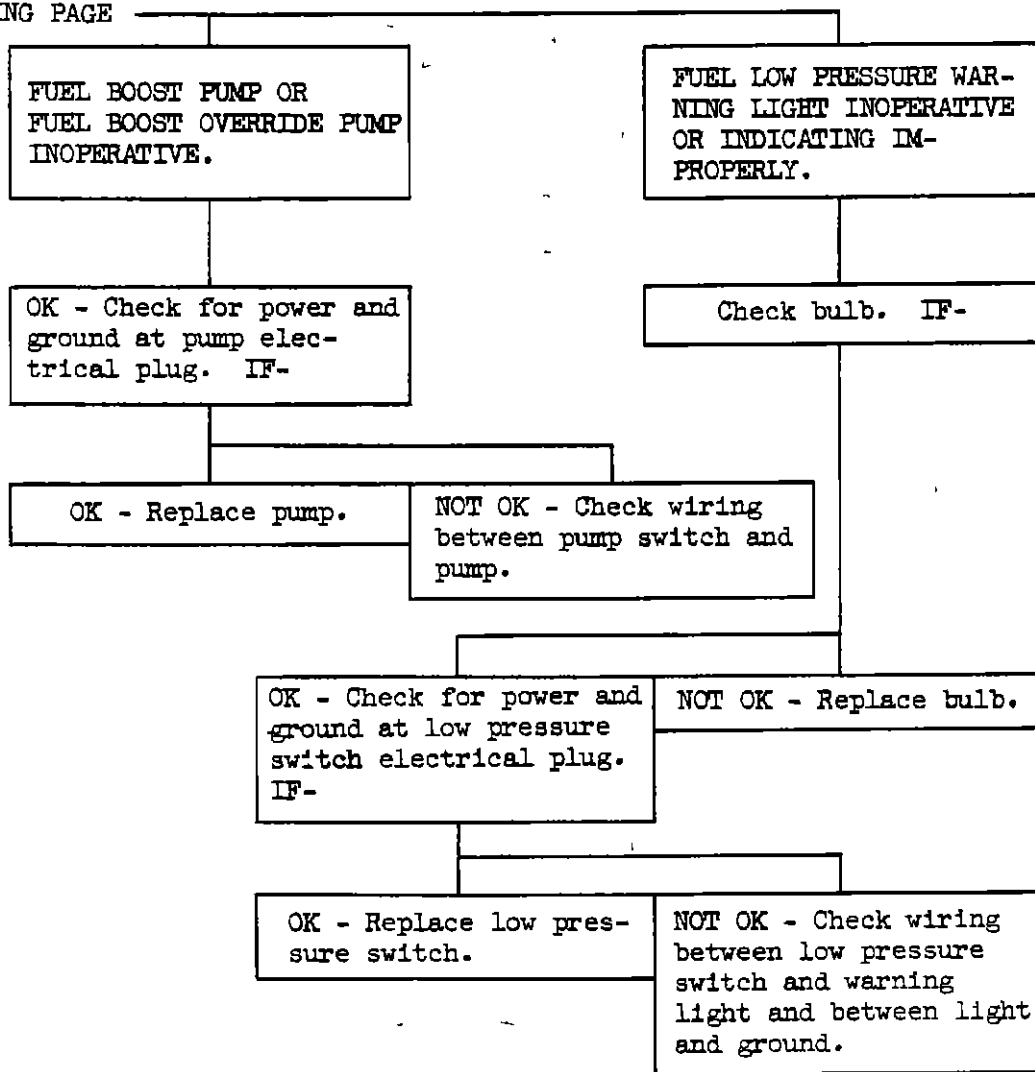
BOOST PUMP POWER SOURCE				
FUEL TANK	CIRCUIT BREAKER PANEL			
	P1	P2	P3	P4
NO 1 MAIN	AFT PUMP			FWD PUMP
NO 2 MAIN		AFT PUMP	FWD PUMP	
NO 3 MAIN		FWD PUMP	AFT PUMP	
NO 4 MAIN	FWD PUMP			AFT PUMP
CENTER WING		LH PUMP	RH PUMP	



ENGINE FUEL FEED SYSTEM - TROUBLE SHOOTING



CONTINUED FROM
 PRECEEDING PAGE



END

ENGINE FUEL SHUTOFF VALVE - MAINTENANCE PRACTICES

1. General

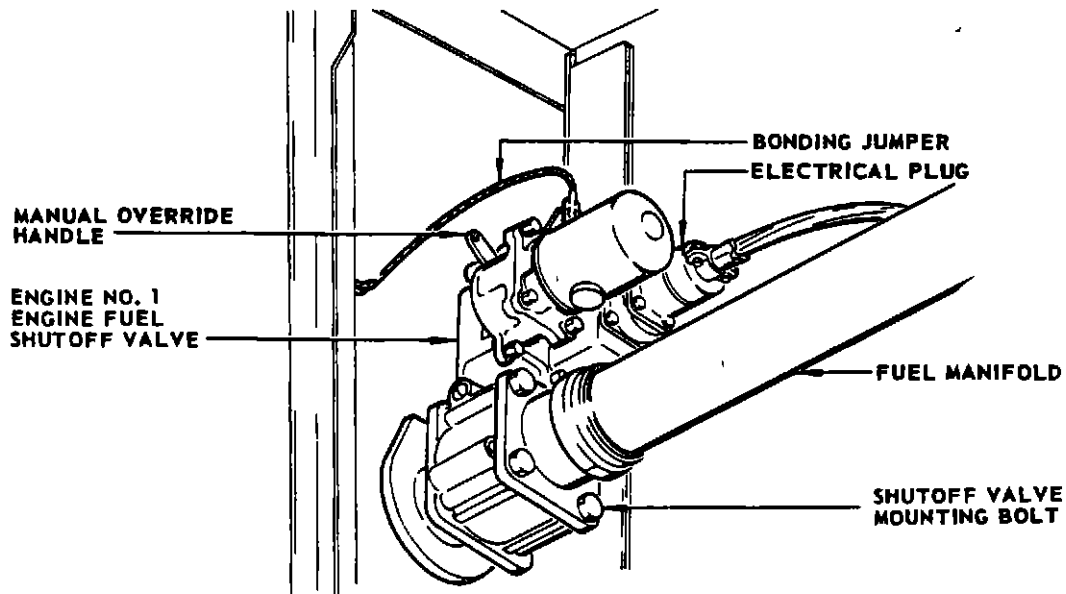
- A. Maintenance practices on all of the engine fuel shutoff valves are basically the same, the only difference being one of location. No. 1 and 4 engine fuel shutoff valves are in the outboard dry bays (figure 201) and no. 2 and 3 valves are in the inboard dry bays (figure 202).

2. Removal/Installation Engine Fuel Shutoff Valves

- A. Remove Engine Fuel Shutoff Valve (See figures 201 and 202.)

- (1) Close all fuel manifold valves except the one related to valve to be removed, and open engine fuel shutoff valve to be removed.
- (2) Disconnect external power from airplane and pull all pump circuit breakers.
- (3) Pull circuit breaker for applicable engine fuel shutoff valve.
- (4) Remove applicable dry bay access panel. (See figure 6, 28-7-0.)
- (5) Disconnect electrical plug from valve.
- (6) Remove both fuel boost override pump access panels and close pump removal valves.

WARNING: BOTH OVERRIDE PUMP REMOVAL VALVES MUST BE CLOSED TO PREVENT CENTER WING TANK FUEL FROM SIPHONING THROUGH FUEL MANIFOLD WHEN DRAINING MANIFOLD AT DEFUELING VALVE.



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- (7) Remove fuel boost pump access panels for tank numbered same as engine fuel shutoff valve to close pump removal valves. On airplanes with screw operated valves close valves by counterclockwise rotation of the screws. Refer to 28-7-62.

WARNING. PUMP REMOVAL VALVES MUST BE CLOSED TO PREVENT FUEL SIPHONING THROUGH FUEL FEED LINE WHEN ENGINE FUEL SHUTOFF VALVE IS REMOVED.

- (8) Verify that valve to be removed is open.
- (9) Drain fuel manifold at defueling valve.
- (10) and (11) Deleted.
- (12) Disconnect bonding jumper from valve.
- (13) Provide suitable container to catch any fuel trapped in lines or valve.
- (14) Remove mounting bolts and slide valve free.

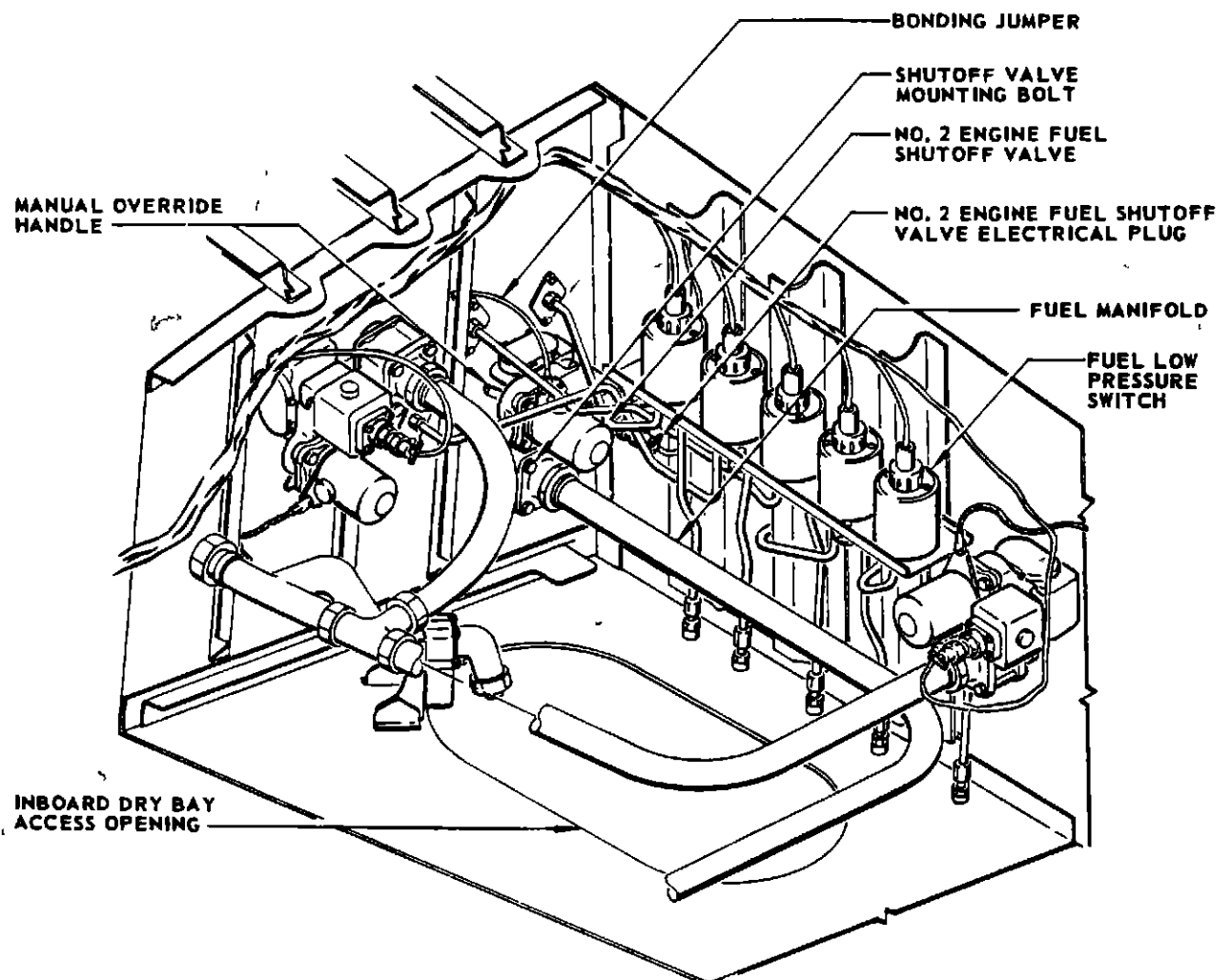
B. Install Engine Fuel Shutoff Valve (See figures 201 and 202.)

- (1) Clean machined surfaces with naphtha and wipe dry with lint free cloth.
- (2) Fit O-rings lightly lubricated with fuel, into grooves on valve and slip valve carefully into position.

CAUTION: EXERCISE CARE SO O-RINGS ARE NOT DISLODGED OR CUT.

- (3) Install mounting bolts!
- (4) Deleted.
- (5) Connect bonding jumper to valve.
- (6) Close and cap defueling valve.
- (7) Open override pump removal valves.
- (8) Open boost pump removal valves.
- (9) Connect electrical plug to valve.
- (10) Close valve circuit breaker
- (11) Connect external power to the airplane.

- (12) Open applicable engine fuel shutoff valve switch and observe that valve override handle moves to "OPEN".
- (13) Close applicable engine fuel shutoff valve switch and observe that valve override handle moves to "CLOSED."
- (14) Install access panels and remove external power from airplane.



Engine Fuel Shutoff Valve Installation - Inboard Dry Bay
Figure 202

END



MAINTENANCE MANUAL

ENGINE FUEL SHUTOFF VALVES - INSPECTION/CHECK

1. General

- A. This procedure contains instructions to do a bonding resistance check for each engine fuel shutoff valve.

2. Engine Fuel Shutoff Valves - Bonding Resistance Check

A. References

- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH

C. Procedure

- (1) Get access to the engine fuel shutoff valves (Figure 1) in the locations given below:

ENGINE FUEL SHUTOFF VALVE	LOCATION
No. 1 and No. 4	Outboard Dry Bays
No. 2 and No. 3	Inboard Dry Bays

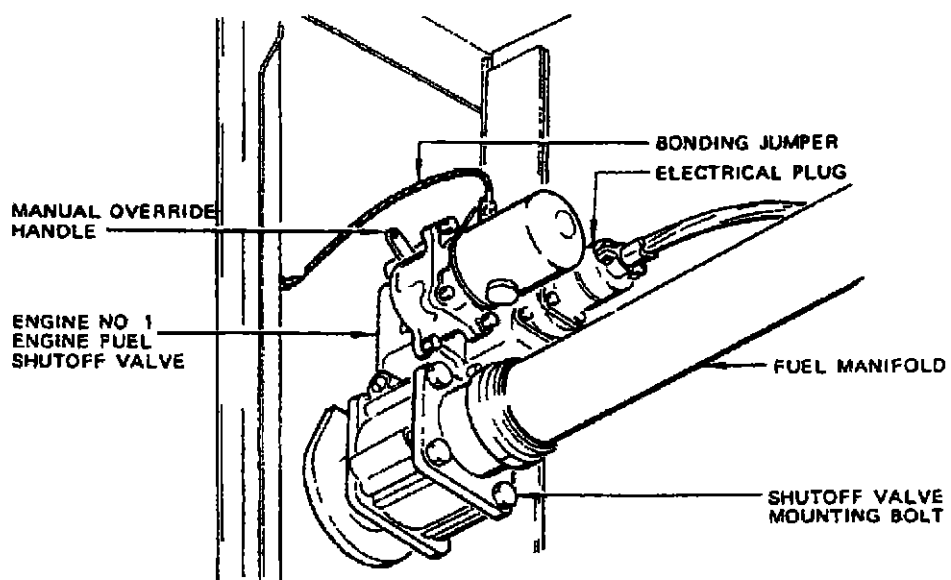
- (2) Measure the electrical bonding resistance between the bonding jumper terminal and the structure (SWPM 20-20-00).

- (a) Make sure the resistance is 0.002 ohm (2 milliohm) or less.

- (3) Measure the electrical bonding resistance between the engine fuel shutoff valve housing and the structure (SWPM 20-20-00).

- (a) Make sure the resistance is 0.002 ohm (2 milliohm) or less.

- (4) Put the airplane back to a serviceable condition. .



Engine Fuel Shutoff Valve Installation - Outboard Dry Bay

Figure 1



MAINTENANCE MANUAL

ENGINE FUEL FEED SYSTEM - MAINTENANCE PRACTICES

1. Adjustment/Test Engine Fuel Feed System

A. General

- (1) Testing of the engine fuel feed system is accomplished in two parts. First all control valves are tested for proper operation, then second, all fuel boost pumps and fuel boost override pumps are tested for proper operation.

B. Test Valves

- (1) With external power connected and the fuel dump valve switches on the flight engineer's auxiliary panel in the "CLOSE" position, close the circuit breakers for the four engine fuel shutoff valves, the four fuel manifold valves and the two reserve tank transfer valves.
- (2) Open and close each of the four engine fuel shutoff valves by operating each engine fuel shutoff valve switch. Verify that the valve position coincides with the valve switch position as noted by the position indicator on each valve.
- (3) On A/C LX-N20198 and LX-N20199, the engine start lever must be in IDLE. Verify that the blue position light for each engine fuel shutoff valve is on during valve transition period. Verify that the light goes out when the valve has completed the opening or closing cycle. On A/C LX-N19997 and LX-N20000, the fuel shutoff valve position light is blue; this light will illuminate bright momentarily when the corresponding valve is in transit. The light will illuminate dim when the respective valve has attained the closed position.
- (4) With each engine fuel shutoff valve open, pull the engine fire switch for each engine. Verify that the engine fuel shutoff valve for each engine closes.
- (5) Close each engine fire switch. Verify that the corresponding engine fuel shutoff valve opens.
- (6) Open and close each of the four fuel manifold valves by operating each fuel manifold valve switch. Verify that the switch position coincides with the valve position as noted by the position indicator on each valve.
- (7) Verify for each valve that the blue position light for each fuel manifold valve is on during the valve transition period, and that the light goes out when the valve has completed the opening or closing cycle.
- (8) Open and close each reserve tank transfer valve, which connects the reserve tank with the adjacent tank, by operating each reserve transfer valve switch. Verify that the valve position coincides with the switch position indicator on each valve.

CAUTION FUEL WILL FLOW FROM RESERVE TANK TO ADJACENT MAIN TANK WHEN TRANSFER VALVE IS OPEN. VERIFY THAT ADJACENT MAIN TANK WILL HOLD QUANTITY OF FUEL TRANSFERRING DURING VALVE CHECK.

- (9) Verify for each valve that the blue position light for each reserve tank transfer valve is on during the transition period, and that the light goes out when the valve has completed the opening or closing cycle.



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C. Test Pumps

- (1) With external power connected, close the circuit breakers for the fuel low pressure warning light, all boost pumps and both fuel boost override pumps. All fuel low pressure warning lights will be on when the pump switches are in the OFF position.
- (2) Close all engine fuel shutoff valves and fuel manifold valves.
- (3) With fuel in each of the main tanks, position main tank no. 1 forward boost pump switch to ON. Verify that its respective fuel low pressure warning light goes out.
- (3a) Monitor any fuel pump low pressure indication light during pump operation and immediately put the fuel pump switch to OFF when a low pressure light(s) comes on and stays on.

When operating the APU unattended for an extended period of time, follow Airplane Maintenance Manual 49-00-2 and 49-00-3 page 201 instructions regarding necessary fuel quantity based on APU fuel burn rate

When defueling or transferring fuel with minimum backpressure to the pumps, it is possible for a pump low pressure light to illuminate before all fuel is transferred. In one pump fuel tank configurations, monitor the tank quantity and put the pump to OFF if the tank quantity does not change. In two pump fuel tank configurations, put the pump to OFF and continue, and if the remaining pump's low pressure light illuminates, then monitor tank quantity and put that pump to OFF if tank quantity does not change. If each pump's low pressure light illuminates simultaneously, put the aft pump to OFF and continue while monitoring tank quantity and put the forward pump to OFF if tank quantity does not change.

NOTE. Forward pumps can usually supply more fuel on the ground compared to aft pumps.

Only one pump per fuel tank can be operated when a low pressure light is illuminated for that tank and that pump should be put to OFF when the tank quantity does not change.

- (4) Repeat step (3) for the aft boost pump in main tank no. 1 with the forward boost pump not operating.
- (5) Repeat steps (3) and (4) for the remaining six boost pumps in the other main tanks.
- (6) With fuel in the center wing tank, position the right fuel boost override pump switch to ON. Verify that its respective fuel low pressure warning light goes out.
- (7) Repeat step (6) for the left fuel boost override pump with the right fuel boost override pump not operating
- (8) With the left fuel boost override pump still operating, open all fuel manifold and engine fuel shutoff valves and check for any evidence of leakage from the valves and lines in the struts and dry bays.
- (9) Shut off all valves and pumps.

END



MAINTENANCE MANUAL

ENGINE FUEL FEED SYSTEM - MAINTENANCE PRACTICES

1 Adjustment/Test Engine Fuel Feed System

A General

- (1) Testing of the engine fuel feed system is accomplished in two parts. First all control valves are tested for proper operation, then second, all fuel boost pumps and fuel boost override pumps are tested for proper operation.

B Test Valves

- (1) With external power connected and the fuel dump valve switches on the flight engineer's auxiliary panel in the "CLOSE" position, close the circuit breakers for the four engine fuel shutoff valves, the four fuel manifold valves and the two reserve tank transfer valves.
- (2) Open and close each of the four engine fuel shutoff valves by operating each engine fuel shutoff valve switch. Verify that the valve position coincides with the valve switch position as noted by the position indicator on each valve.
- (3) On A/C LX-N20198 and LX-N20199, the engine start lever must be in IDLE. Verify that the blue position light for each engine fuel shutoff valve is on during valve transition period. Verify that the light goes out when the valve has completed the opening or closing cycle. On A/C LX-N19997 and LX-N20000, the fuel shutoff valve position light is blue, this light will illuminate bright momentarily when the corresponding valve is in transit. The light will illuminate dim when the respective valve has attained the closed position.
- (4) With each engine fuel shutoff valve open, pull the engine fire switch for each engine. Verify that the engine fuel shutoff valve for each engine closes.
- (5) Close each engine fire switch. Verify that the corresponding engine fuel shutoff valve opens.
- (6) Open and close each of the four fuel manifold valves by operating each fuel manifold valve switch. Verify that the switch position coincides with the valve position as noted by the position indicator on each valve.
- (7) Verify for each valve that the blue position light for each fuel manifold valve is on during the valve transition period, and that the light goes out when the valve has completed the opening or closing cycle.

- (8) Open and close each reserve tank transfer valve, which connects the reserve tank with the adjacent tank, by operating each reserve transfer valve switch. Verify that the valve position coincides with the switch position indicator on each valve

CAUTION FUEL WILL FLOW FROM RESERVE TANK TO ADJACENT MAIN TANK WHEN TRANSFER VALVE IS OPEN. VERIFY THAT ADJACENT MAIN TANK WILL HOLD QUANTITY OF FUEL TRANSFERRING DURING VALVE CHECK

- (9) Verify for each valve that the blue position light for each reserve tank transfer valve is on during the transition period, and that the light goes out when the valve has completed the opening or closing cycle.

C. Test Pumps

- (1) With external power connected, close the circuit breakers for the fuel low pressure warning light, all boost pumps and both fuel boost override pumps. All fuel low pressure warning lights will be on when the pump switches are in the "OFF" position.
- (2) Close all engine fuel shutoff valves and fuel manifold valves.
- (3) With fuel in each of the main tanks, position main tank no. 1 forward boost pump switch to "ON". Verify that its respective fuel low pressure warning light goes out.
- (4) Repeat step (3) for the aft boost pump in main tank no. 1 with the forward boost pump not operating.
- (5) Repeat steps (3) and (4) for the remaining six boost pumps in the other main tanks
- (6) With fuel in the center wing tank, position the right fuel boost override pump switch to "ON". Verify that its respective fuel low pressure warning light goes out
- (7) Repeat step (6) for the left fuel boost override pump with the right fuel boost override pump not operating
- (8) With the left fuel boost override pump still operating, open all fuel manifold and engine fuel shutoff valves and check for any evidence of leakage from the valves and lines in the struts and dry bays
- (9) Shut off all valves and pumps.

END

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FUEL MANIFOLD VALVES - MAINTENANCE PRACTICES

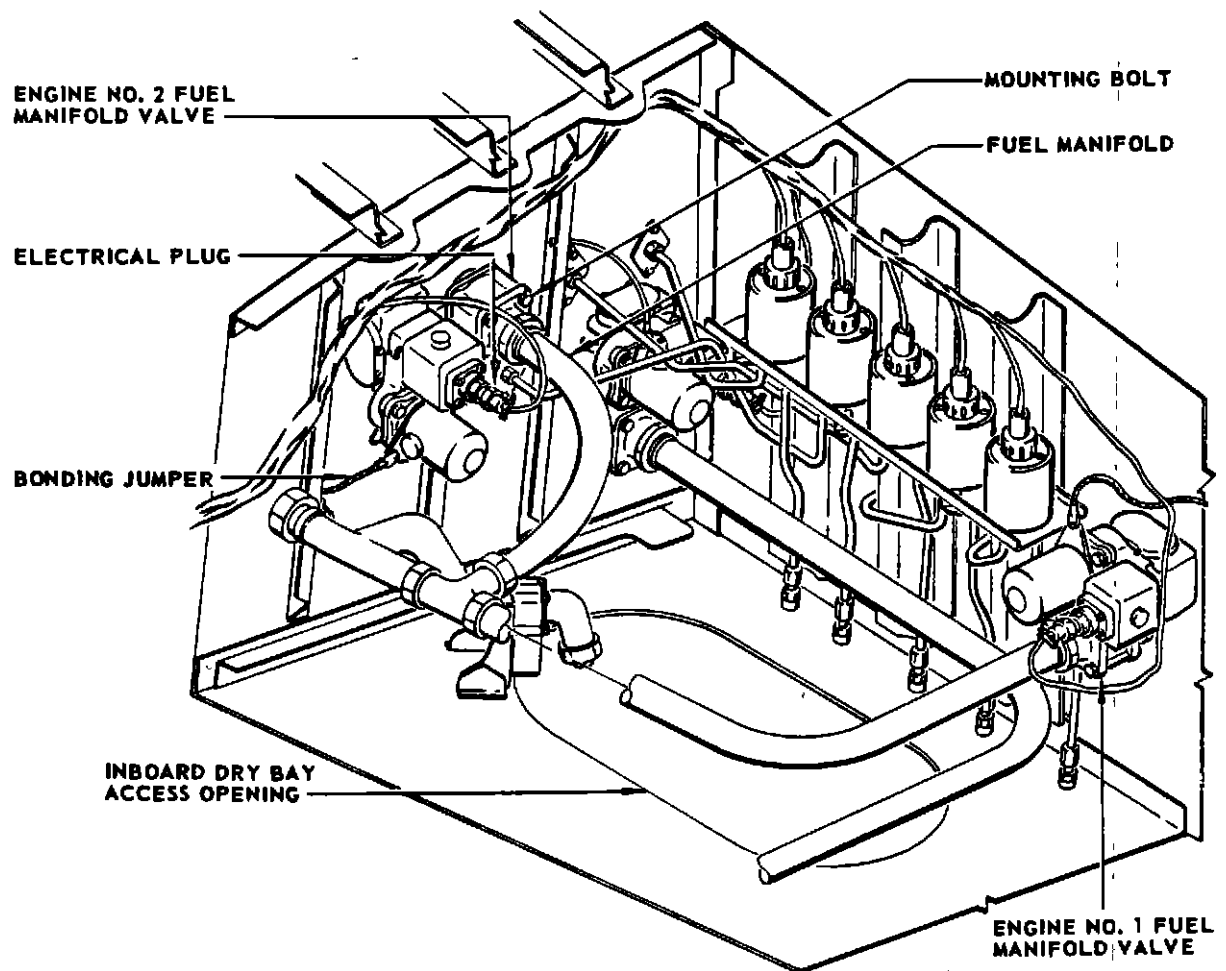
1. General

- A. Maintenance practices on all of the fuel manifold valves are basically the same, the only difference being one of location. Engine no. 1 and 2 fuel manifold valves are in the left inboard dry bay and engine no. 3 and 4 fuel manifold valves are in the right inboard dry bay.

2. Removal/Installation Fuel Manifold Valves

- A. Remove Fuel Manifold Valve (See figure 201.)

- (1) Close engine fuel shutoff valve related to valve to be removed, and close all fuel manifold valves except valve being removed.
- (2) Disconnect external power from airplane, open all pump circuit breakers and open circuit breaker for applicable valve.
- (3) Remove applicable inboard dry bay access panel. (See figure 6, 28-7-0.)



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- (4) Disconnect electrical plug from valve.
- (5) Remove both fuel boost pump access panels, for tank numbered same as fuel manifold valve, to close fuel boost pump removal valves. On airplanes with screw operated valves, close valves by counter clockwise rotation of the screws (Refer to 28-7-62).

WARNING BOTH PUMP REMOVAL VALVES MUST BE CLOSED TO PREVENT SIPHONING THROUGH FUEL MANIFOLD..

- (6) Remove both fuel boost override pump access panels and manually close pump removal valves.

WARNING BOTH OVERRIDE PUMP REMOVAL VALVES MUST BE CLOSED TO PREVENT CENTER WING TANK FUEL FROM SIPHONING THROUGH FUEL MANIFOLD WHEN DRAINING MANIFOLD AT DEFUELING VALVE.

- (7) Verify that valve to be removed is open.
- (8) Provide suitable container to catch any fuel trapped in lines, drains, or valve.
- (9) Drain fuel manifold at defueling valve.
- (10) Deleted.
- (11) Remove bonding jumper from valve.
- (12) Remove mounting bolts and slide valve free.

B. Install Fuel Manifold Valve (See figure 201.)

- (1) Clean machined surfaces with naphtha and wipe dry with lint free cloth.
- (2) Fit O-rings, lightly lubricated with fuel, into grooves on valve and slip valve into position
- (3) Install mounting bolts.
- (4) Connect bonding jumper to valve
- (5) Close and cap defueling valve.
- (6) Open pump removal valves.

- (7) Connect electrical plug to valve.
- (8) Close valve circuit breaker.
- (9) Connect external power to airplane.
- (10) Open applicable fuel manifold valve switch and observe that valve override handle moves to "OPEN."
- (11) Close applicable fuel manifold valve switch and observe that valve override handle moves to "CLOSED".
- (12) Install access panels and remove external power from airplane.

END



MAINTENANCE MANUAL

ENGINE FUEL MANIFOLD VALVE - INSPECTION/CHECK

1. General

- A. This procedure contains instructions to do a bonding resistance check for each engine fuel manifold valve.

2. Engine Fuel Manifold Valve - Bonding Resistance Check

A. References

- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH

C. Procedure

- (1) Get access to the engine fuel manifold valves in the inboard dry bays.
- (2) Measure the electrical bonding resistance between the bonding jumper terminal and the structure (SWPM 20-20-00).
- (a) Make sure the resistance is 0.002 ohm (2 milliohm) or less.
- (3) Measure the electrical bonding resistance between the engine fuel manifold valve housing and the structure (SWPM 20-20-00).
- (a) Make sure the resistance is 0.002 ohm (2 milliohm) or less.
- (4) Put the airplane back to a serviceable condition.

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MAINTENANCE MANUAL

RESERVE TANK TRANSFER VALVES - MAINTENANCE PRACTICES

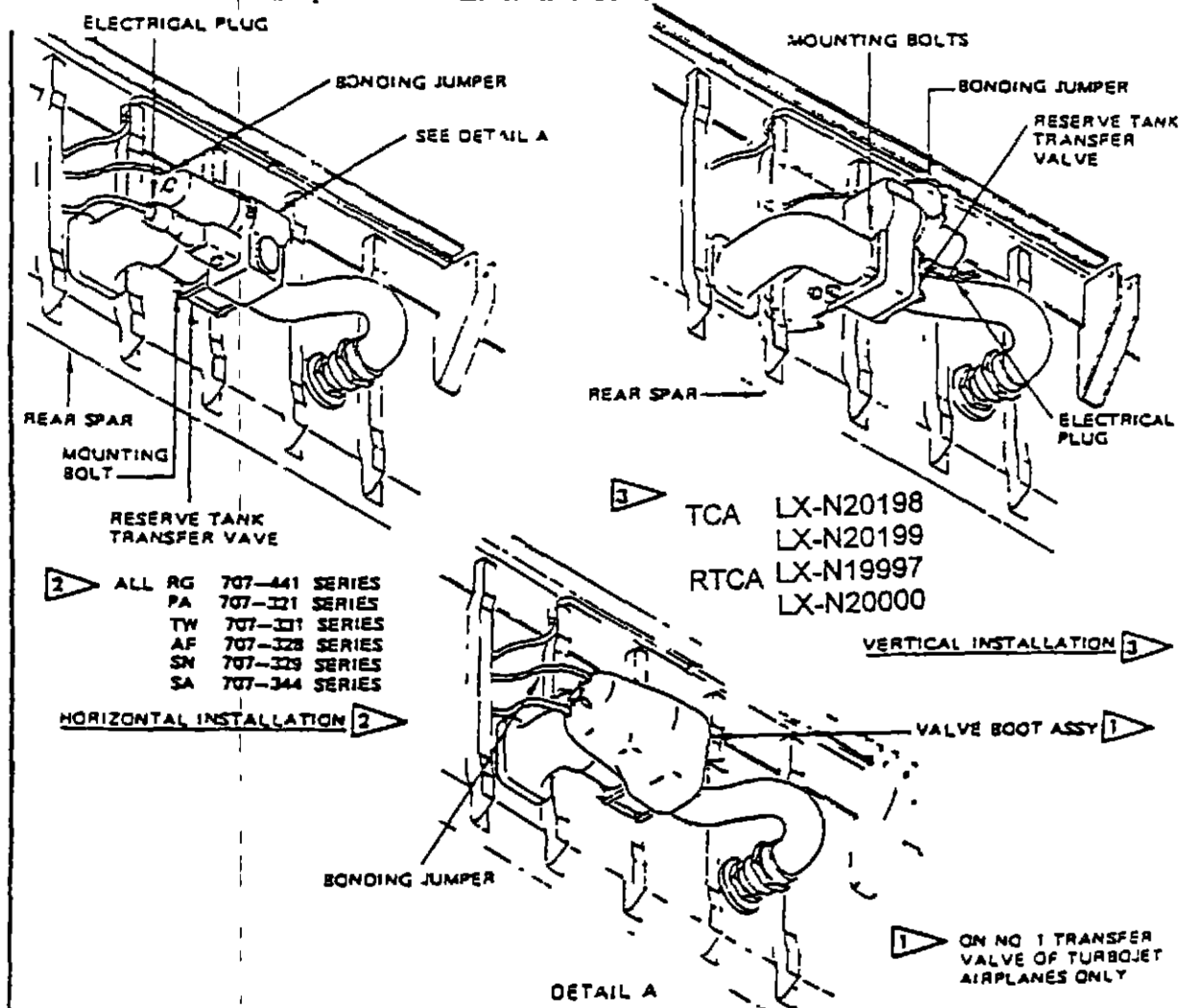
1. General

- A. Maintenance practices on both reserve tank transfer valves are basically the same, the only difference being one of location. Reserve tank No 1 transfer valve is located aft of the rear spar on the left wing and reserve tank No. 4 transfer valve is located aft of the rear spar on the right wing.

2. Removal/Installation Reserve Tank Transfer Valves

- A Remove Reserve Tank Transfer Valve (See figure 201.)

- (1) Defuel applicable reserve tank completely and adjoining main tank down to less than 10,000 pounds (4536 kilograms). Refer to 28-0, Fuel System - Maintenance Practices.



3
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Reserve Tank Transfer Valve Installation
Figure 201
T.R. 28-84

28-7-31
Page 201

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- (2) Gain access to valve by lowering outboard flap and raising outboard spoiler (Ref Chapter 27, Flight Controls).
- (3) Disconnect external power from airplane.
- (4) Open applicable reverse tank transfer valve circuit breaker.
- (5) Unlace valve boot assembly, on No. 1 transfer valve, and slide boot off valve. See detail A, Fig. 201, for airplane effectivities.
- (6) Manually open valve.
- (7) Disconnect electrical plug at valve.
- (8) Disconnect bonding jumper from valve.
- (9) Provide a suitable container to catch any fuel trapped in lines or valve.
- (10) Remove mounting bolts and slip valve free.

B. Install Reserve Tank Transfer Valve (Fig. 201)

CAUTION IMPROPER VALVE INSTALLATION MAY CAUSE TRANSFER VALVE INTERFERENCE WITH FOREFLAP IN RETRACTED POSITION (FIG. 201).

- (1) Clean machined surfaces with naphtha and wipe dry with lint-free cloth.
- (2) Fit O-rings into grooves on valve and slip valve into position.
- (2A) On OO-SJA through OO-SJG, install shield 5-86584-3110 on No. 1 transfer valve.
- (3) Install mounting bolts.
- (4) Slip boot over No. 1 transfer valve bonding jumper and electrical plug. See detail A, Fig. 201, for airplane effectivities.
- (5) Connect bonding jumper to valve.
- (6) Connect electrical plug to valve.
- (7) Install boot on No. 1 transfer valve, lace ends and tie with a square knot.
- (8) Close valve circuit breaker.
- (9) Connect external power to airplane.

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- (10) Open applicable reserve tank transfer valve switch and observe that valve override handle moves to OPEN.
- (11) Close applicable reserve tank transfer valve switch and observe that override handle moves to CLOSED.
- (12) Return outboard flap and outboard spoiler to original positions (Ref Chapter 27, Flight Controls).
- (13) Remove external power from airplane.

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RESERVE TANK TRANSFER VALVE - INSPECTION/CHECK

1. General

- A. This procedure contains instructions to do a bonding resistance check for each reserve tank transfer valve

2. Reserve Tank Transfer Valve - Bonding Resistance Check

A. References

- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH

C. Procedure

- (1) Get access to the reserve tank transfer valves found on the rear spar.
- (2) Measure the electrical bonding resistance between the bonding jumper terminal and the structure (SWPM 20-20-00).
 - (a) Make sure the resistance is 0.002 ohm (2 milliohm) or less.
- (3) Measure the electrical bonding resistance between the reserve tank transfer valve housing and the structure (SWPM 20-20-00).
 - (a) Make sure the resistance is 0.002 ohm (2 milliohm) or less.
- (4) Put the airplane back to a serviceable condition.

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FUEL SHUTOFF VALVE SWITCHES (START LEVER SWITCHES) - REMOVAL/INSTALLATION

EFFECTIVITY

LX-N19997, LX-N20000

1 Prepare to Remove Fuel Shutoff Valve Switches

- A Open all (8) FUEL SHUTOFF AND FUEL SHUTOFF FIRE SHUTDOWN circuit breakers on the P6 ESSENTIAL BUS 28V BUSSES circuit breaker panel
- B Remove upper and lower forward panels (left side) from pilots' control stand (Fig 401)

NOTE Switches are mounted between two brackets in pilots' control stand between left and right lower forward panels. It may also be necessary to remove the right lower forward panel. There are four (4) fuel shutoff valve switches, one for each start lever.

2 Remove Fuel Shutoff Valve Switches

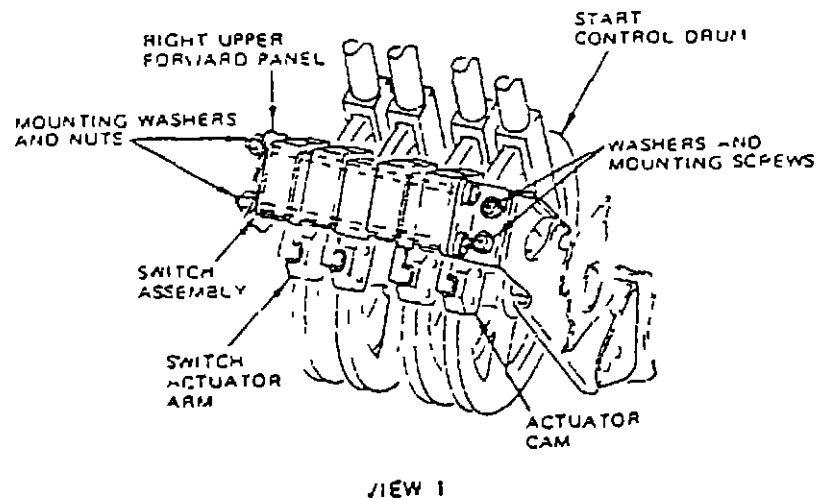
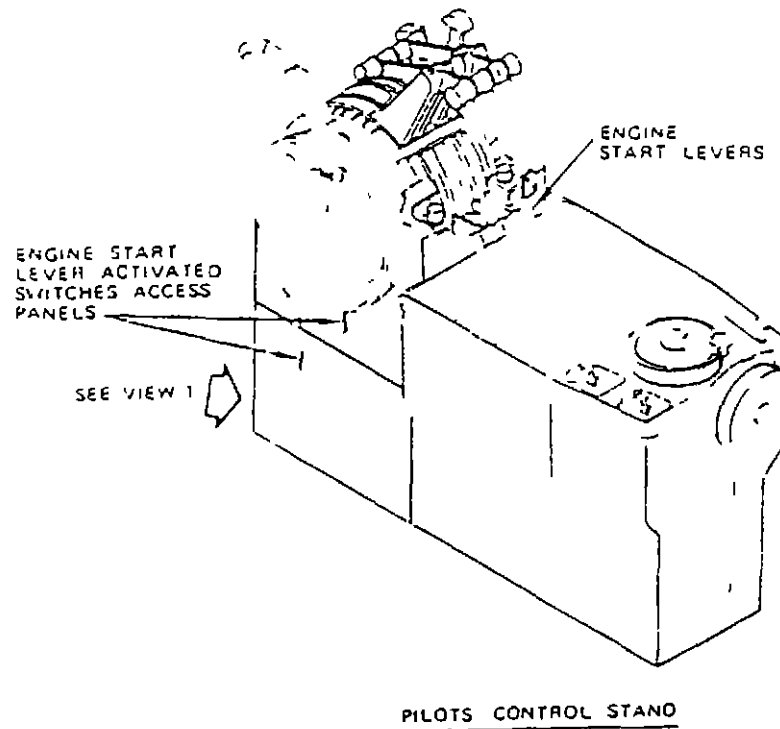
- A Disconnect electrical leads from all switches. Identify leads to facilitate reassembly.
- B Remove mounting washers, nuts and screws. Remove switches, switch actuators and spacers as a unit.

3 Install Fuel shutoff Valve Switches (Fig 401)

- A Position fuel shutoff switches on start control drum and actuator cams and secure with mounting washers, nuts and screws.
- B Connect electrical leads to all switches.
- C Close circuit breakers opened in step 1 A.
- D Adjust and test fuel shutoff valve switches (Ref Adjustment/Test)

4 Return Airplane to Normal Configuration

- A Install upper and lower forward panels (left side) from pilots' control stand.



Fuel Shutoff Valve Switch Installation
Figure 401



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FUEL SHUTOFF VALVE SWITCHES (START LEVER SWITCHES) - ADJUSTMENT/TEST

EFFECTIVITY

LX-N19997, LX-N20000

1 Adjustment - Fuel Shutoff Valve Switches

A General

- (1) The engine start levers must be properly rigged prior to switch adjustments to ensure synchronization of fuel and ignition system operation. Refer to Chapter 76 for engine start lever cable rigging procedures.
- (2) There are four fuel shutoff valve switches, one for each start lever. Perform the adjustment/test for each switch.

B Equipment

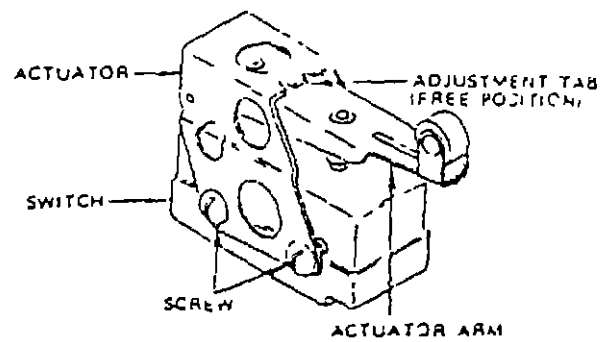
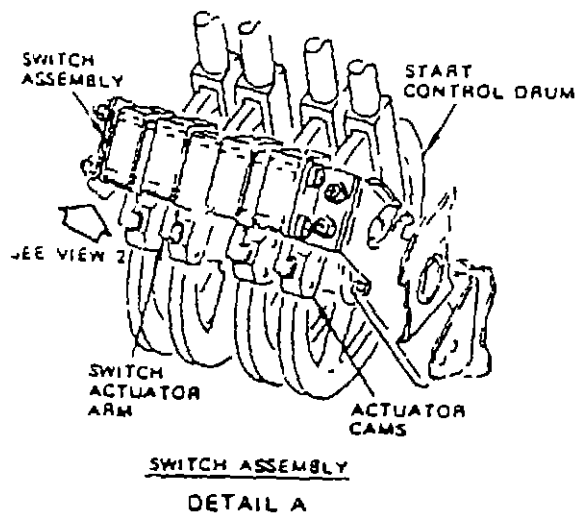
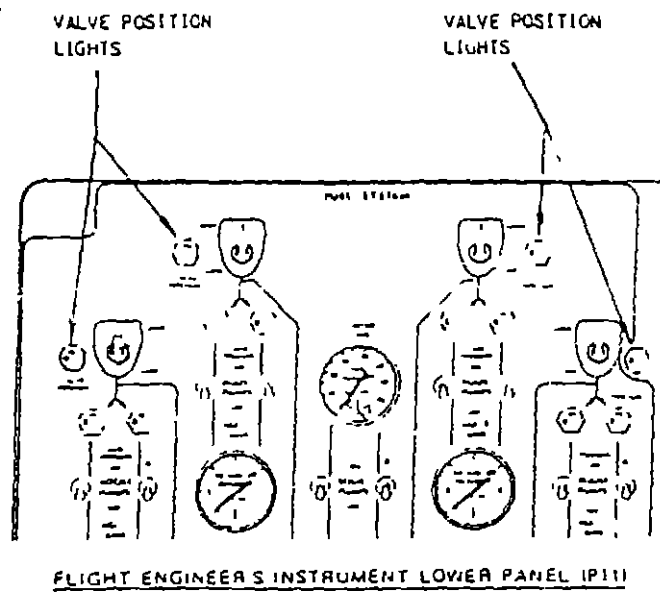
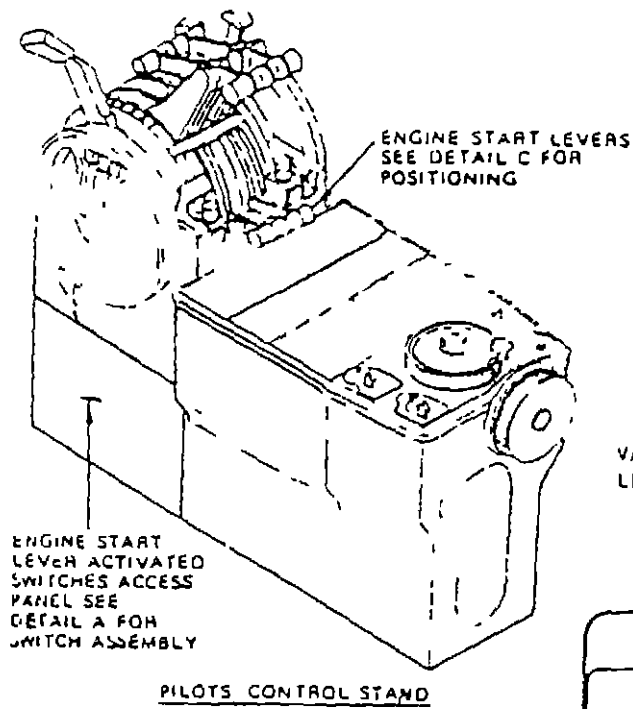
- (1) Special Spacer - F70248, or equivalent
- (2) Airplane Control Surface Protractor - F52485, or equivalent

C Prepare for Adjustment

- (1) Apply electrical power to airplane (Ref Chapter 24, Electrical Power)
- (2) Set start levers in CUTOFF detent
- (3) Close all fuel shutoff and fuel shutoff fire shutdown circuit breakers on the P6 ESSENTIAL BUS 28V BUSSES circuit breaker panel
- (4) Push in fire switches
- (5) Position fuel shutoff valve switches on flight engineer's panel to OPEN

D Adjust switches (Fig 501)

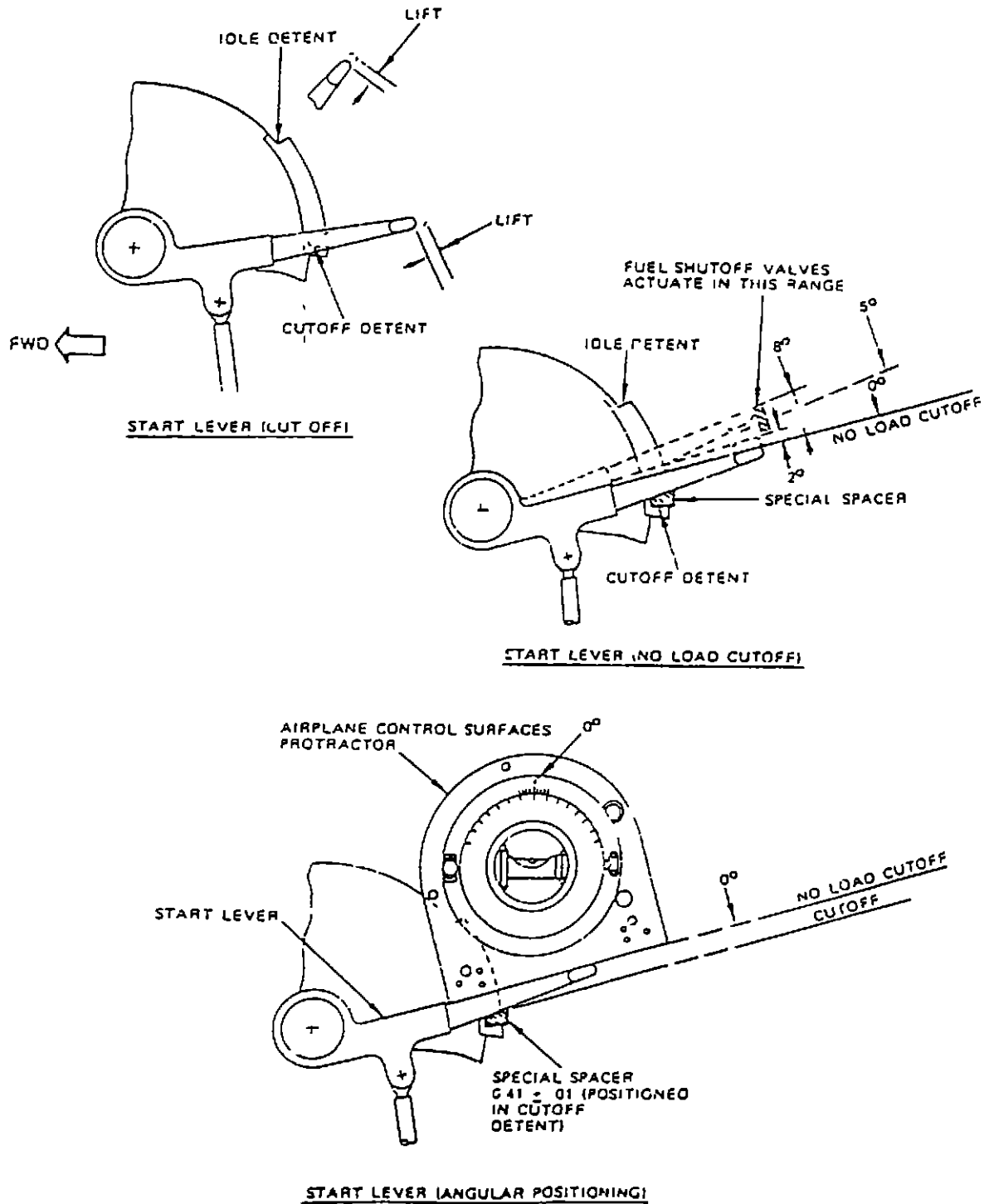
- (1) Set start lever on control stand in No Load Cutoff position (detail C)
 - (a) Position special spacer forward of the CUTOFF detent



Fuel Shutoff Valve Switch Adjustment
Figure 501 (Sheet 1)

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Start Lever Fuel Shutoff Valve Switch Adjust-
ment Figure 501 (Sheet 2)



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- (b) Position airplane control surface protractor on start lever
Set protractor to 0° (zero degrees)

NOTE 0° (zero degrees) is No Load Cutoff position

- (2) Actuate start lever to IDLE
- (3) Observe both VALVE POSITION light on flight engineer's instrument lower panel (P11) and protractor
- (4) Check that VALVE POSITION light illuminates at 5 +/- 3 degrees while retarding (IDLE toward CUTOFF) the start lever to No Load Cutoff position
- (5) If slight adjustment is required, careful bending of switch actuators' (free position) adjustment tab is permitted (detail B)

CAUTION DO NOT BEND ACTUATOR ARMS

NOTE Switch may be removed to adjust tab

- (6) Remove special spacer

2 Test - Fuel Shutoff Valve Switches

- A Move engine start lever from CUTOFF to IDLE
VALVE POSITION light will illuminate BRIGHT until valve is fully open, then OFF
- B Move engine start lever from IDLE to CUTOFF
VALVE POSITION light will illuminate BRIGHT until valve is fully closed, then DIM
- C Restore Airplane to Normal
 - (1) Remove electrical power from airplane (Ref Chapter 24, Electrical Power)

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BOOST PUMP REMOVAL VALVE, SCREW OPERATED - MAINTENANCE PRACTICES

EFFECTIVITY

TCA	LX-N20198
	LX-N20199
RTCA	LX-N19997
	LX-N20000

1. General

- A. Maintenance practices on all of the screw operated boost pump removal valves are basically the same, the only difference being one of location. The removal valve is located in the inlet to the dog house type cover on each boost pump.

2. Removal/Installation Boost Pump Removal Valve Operating Mechanism

A. Remove Boost Pump Removal Valve Operating Mechanism

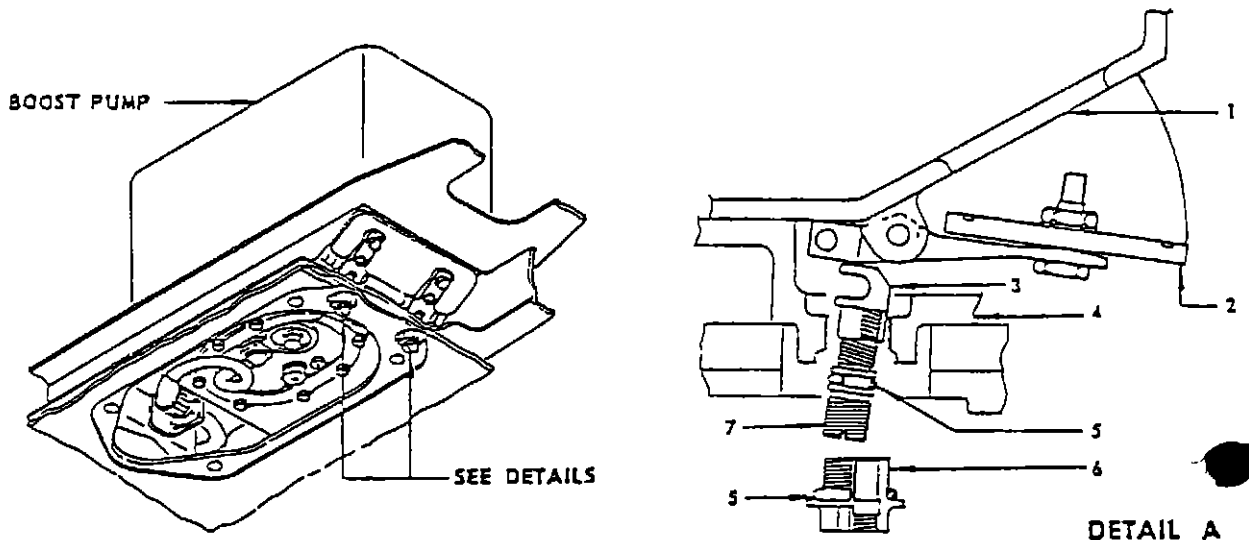
- (1) Defuel applicable fuel tank. (See 28-0.)
- (2) Remove fuel boost pump access panel. (See figure 6, 28-7-0.)
- (3) Set flapper valve to "FULL OPEN" position by turning screw clockwise into bushing until cap contacts flapper valve fitting. (See detail C, figure 201.)

CAUTION: ALWAYS OPERATE THE SCREWS ALTERNATELY WITHIN ONE TURN OF EACH OTHER TO PREVENT RACKING OF THE FLAPPER.

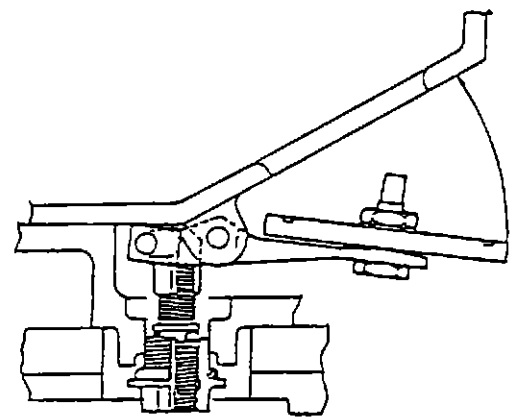
- (4) Holding each screw with a screw driver, remove the bushings in small increments, turning counterclockwise, alternating from one to the other, until removal is complete.

CAUTION: BUSHINGS MUST BE REMOVED ALTERNATELY IN SMALL INCREMENTS TO PREVENT DAMAGE TO THE FLAPPER OR BINDING OF THE FLNGE PIN.

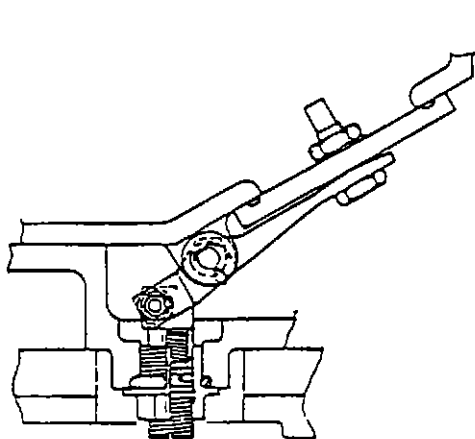
- (5) Remove cap from screw.



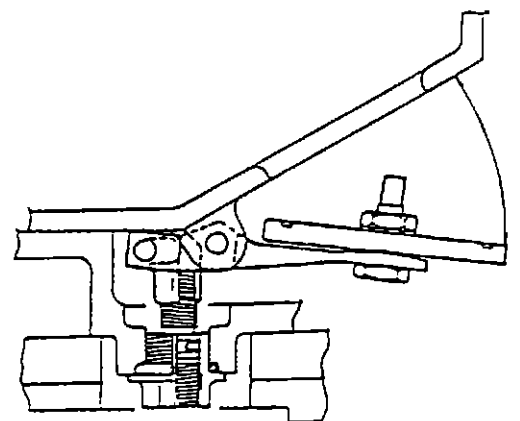
- 1 FLAPPER VALVE FITTING
- 2 FLAPPER VALVE
- 3 CAP
- 4 HOUSING
- 5 "O" RING
- 6 BUSHING
- 7 SCREW



DETAIL B



DETAIL D



DETAIL C

Assembly of Boost Pump Removal Valve Operating Mechanism
Figure 201

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B. Install Boost Pump Removal Valve Operating Mechanism

- (1) Install new O-rings, lightly lubricated with MIL-H-5606 or MIL-L-4343 lubricant, on screw and bushing. (See figure 201.)
- (2) Assemble cap onto screw.

(a) On TCA LX-N20198, LX-N201999 and RTCA LX-N19997, LX-N20000 assemble cap onto screw by 3 to 3 1/2 full turns of the LH thread to give an overall length of approximately 1.40 inches.

- (3) Set the flapper to "FULL OPEN" position and insert the cap and screw into the housing. (See detail A, figure 201.)
- (4) Insert a screw driver through the bushing. Holding the screw-cap assembly against the flapper valve fitting with the screw driver, screw the bushing into the housing until the RH threads on the screw engage in the bushing. (See detail B, figure 201.)
- (5) Continue to rotate the bushing clockwise until it locks in position but is not seated in the housing.

NOTE: Locking is the result of the different thread sizes causing the bushing to move into the housing at a faster rate than the screw moves into the bushing, thus forcing the cap against the flapper valve fitting.

- (6) To relieve the lock, rotate the screw counterclockwise, this withdraws the cap from the flapper valve fitting by reducing the overall length of the screw-cap assembly.
- (7) Holding the screw with the screw driver, continue to rotate the bushing clockwise until locking occurs again or bushing appears to be seated.

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- (8) If locking occurs again repeat steps (6) and (7).
- (9) Rotate the screw counterclockwise until approximately two full threads protrude from bushing.
- (10) Accomplish final seating of bushing.
- (11) Check for proper mechanism travel. Turn the screw clockwise to get "FULL OPEN" position and counterclockwise to get "FULL CLOSED" position.

CAUTION: AT THIS STAGE DO NOT FORCE FLAPPER AGAINST FLAPPER VALVE FITTING OR DAMAGE MAY BE CAUSED.

NOTE: In "FULL OPEN" position the end of the screw should be flush with or inside the bushing to allow installation of the fuel boost pump access panel. (See detail C, figure 201.)
In "FULL CLOSED" position the end of the screw should protrude beyond the bushing to prevent installation of the fuel boost pump access cover and the flapper should be seated against the flapper valve fitting (See detail D, figure 201.)

- (12) To install second screw mechanism set the first screw to "FULL OPEN" position and repeat steps 1 through 10.

CAUTION: ALWAYS OPERATE THE SCREWS TOGETHER WITHIN ONE TURN OF EACH OTHER TO PREVENT RACKING OF THE FLAPPER.

- (13) Using both screws recheck travel as in step 11.



FUEL BOOST PUMPS - MAINTENANCE PRACTICES

1. General

- A. Maintenance practices on all of the fuel boost pumps are basically the same, the only difference being one of location. Two fuel boost pumps are located in each of the four main tanks.

2. Removal/Installation Fuel Boost Pumps

A. Equipment and Materials

- (1) Bonding meter - Microhm Bridge, Type W Bonding Meter, Avtron Model T207, Avtron Manufacturing Inc., 10409 Much Ave, Cleveland, Ohio

B. Remove Fuel Boost Pump (Fig. 201)

- (1) Remove both fuel boost pump access panels for tank involved to close pump removal valve (Fig. 6, Ref 28-7-0). On airplanes with screw mechanism close pump removal valve by counterclockwise rotation of the screws (Ref 28-7-62).

WARNING BOTH PUMP REMOVAL VALVES MUST BE CLOSED TO PREVENT FUEL SIPHONING THROUGH VENT TUBE.

- (2) Close all fuel manifold valves and engine fuel shutoff valves and then remove external power from airplane.
- (3) Open applicable fuel boost pump circuit breaker.
- (4) Disconnect electrical plug at electrical disconnect.
- (5) Open drain valve on fuel boost pump and drain fuel into appropriate container.
- (6) Remove pump outlet connecting bolt.
- (7) Support pump, remove pump mounting bolts, and lower from dog house.

CAUTION ON AIRPLANES WITH AUTOMATIC PUMP REMOVAL VALVES, STRIKING FLAPPER VALVE PLUNGER WILL OPEN VALVE AND PERMIT FUEL TO FLOW FROM TANK.

- (8) Mop-up all residual fuel and water in boost pump cavity.



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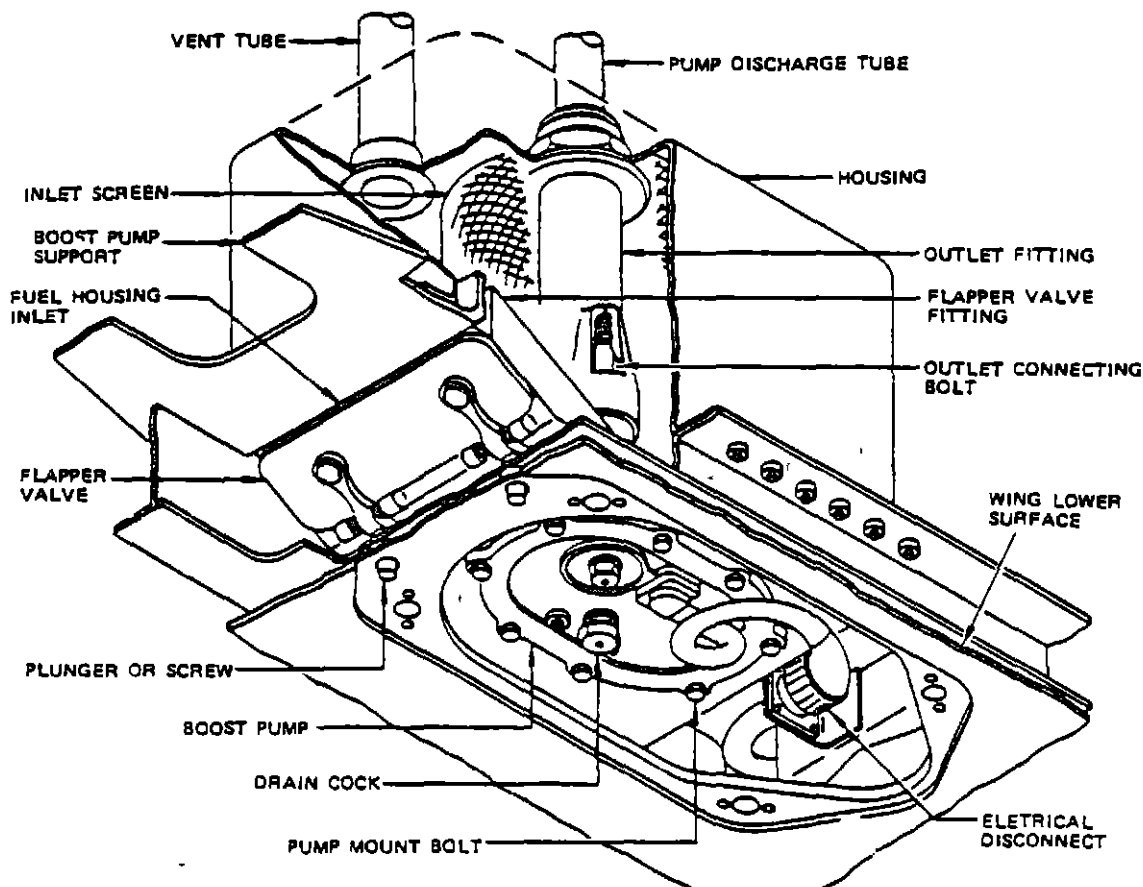
C. Install Fuel Boost Pump (Fig. 201).

- (1) Check that sleeve nut on electrical wire cover is tight.
- (2) Clean all machined surfaces on pump mounting flange and mating surfaces on wing, remove all oxidization deposits and other foreign material then clean with naphtha and wipe dry with lint-free cloth.

WARNING THOROUGH CLEANING OF THESE SURFACES IS ESSENTIAL TO ENSURE ADEQUATE ELECTRICAL BOND BETWEEN PUMP AND AIRPLANE STRUCTURE. IF THE INTEGRITY OF THE BOND IS IN DOUBT, CHECK WITH APPROVED BONDING METER. CHECK AFTER INSTALLING PUMP BUT BEFORE CLOSING PUMP CIRCUIT BREAKER. BONDING RESISTANCE BETWEEN PUMP FLANGE AND AIRPLANE STRUCTURE MUST NOT EXCEED 0.0002 OHMS.

IF THE METER USED TO VERIFY THE BOND RESISTANCE IS NOT EXPLOSION PROOF, THE HAZARDOUS GAS CONTENT OF THE ATMOSPHERE AS MEASURED BY A COMBUSTIBLE GAS DETECTOR MUST BE 25% OR LESS OF THE LOWER EXPLOSIVE LIMIT.

- (3) Fit new O-ring into groove on pump.



Fuel Boost Pump Installation

Figure 201

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- (4) Position pump in access hole so that pump discharge port aligns with outlet fitting and install outlet connecting bolt. Tighten bolt finger-tight.
- (5) Loosely install boost pump mounting bolts.
- (6) Tighten outlet connecting bolt to 120-160 pound-inches.
- (7) Tighten pump mounting bolts to 50-70 pound-inches.
- (8) Check that drain cock is closed.
- (9) Connect electrical plug at electrical disconnect.
- (10) On airplanes with screw operated pump removal valves, open valves by clockwise rotation of the screws. (Refer to 28-7-62.)
- (11) Install both fuel boost pump access panels.
- (12) Close applicable fuel boost pump circuit breaker.
- (13) Connect external power to airplane.
- (14) Check that fuel low pressure warning lights are on.
- (15) Place applicable fuel boost pump switch to ON.
- (16) Observe that fuel low pressure warning light goes out, thus indicating normal pump operation.
- (17) Return fuel boost pump switch to OFF and warning light will come on.
- (18) Remove external power from airplane.

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FUEL BOOST PUMP - INSPECTION/CHECK

1. General

- A. This procedure contains instructions to do a bonding resistance check for each fuel boost pump.

2. Fuel Boost Pump - Bonding Resistance Check

A. References

- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH
(2) Maintenance mats, commercially available

C. Procedure

- (1) Defuel all the fuel tanks (AMM 28-0/201).
(2) Do the "Purging (Air Ventilating)" procedure (AMM 28-0/201).
(3) Gain access to the fuel tank.

CAUTION PUT MAINTENANCE MATS ON THE WING SURFACES WHERE MAINTENANCE PERSONS WORK. DAMAGE TO THE WING SURFACES CAN OCCUR.

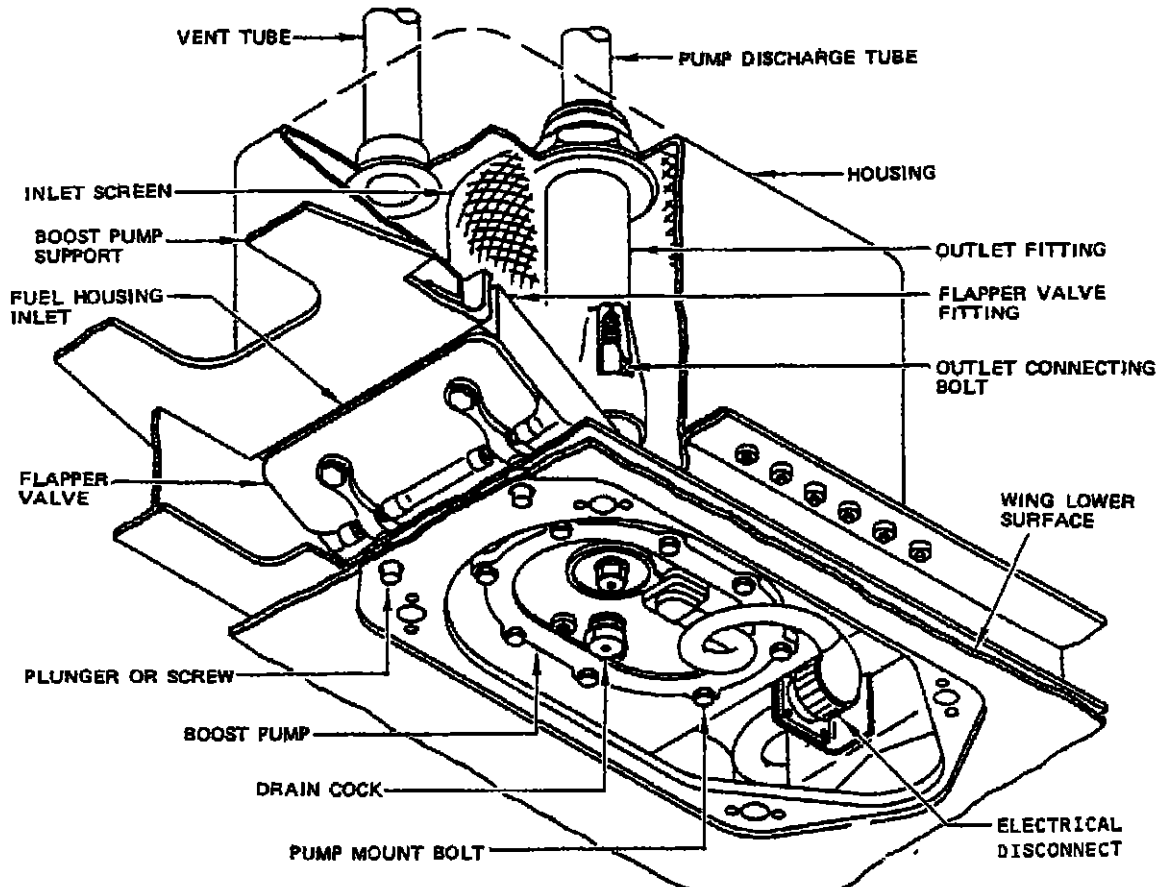
NOTE. Do the bonding resistance inspection for one fuel tank and then repeat the inspection for the other fuel tanks.

- (4) Get access to the fuel boost pump (Figure 1) from inside the fuel tank.
(5) Measure the electrical bonding resistance between the fuel boost pump wire conduit and the structure (SWPM 20-20-00).
(a) Make sure the resistance is 0.005 ohm (5 milliohm) or less.
(6) Get access to the fuel boost pump from outside the fuel tank.
(7) Measure the electrical bonding resistance between the fuel boost pump and the structure (SWPM 20-20-00).
(a) Make sure the bonding resistance between the pump motor housing and structure is 0.0004 ohm (0.4 milliohm) or less.
(b) Make sure the bonding resistance between the pump housing and structure is 0.0006 ohm (0.6 milliohm) or less.
(8) Make sure the tank is clean.
(9) Remove the maintenance mats.
(10) Install structural members at rib access openings if removed and install fuel tank access panels.
(11) Refuel all the fuel tanks (AMM 12-1-41/201).

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(12) Make sure there are no fuel leaks (AMM 28-2-0/101).

(13) Put the airplane back to a serviceable condition.



Fuel Boost Pump
Figure 1



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FUEL BOOST OVERRIDE PUMP - INSPECTION/CHECKV

1. General

- A. This procedure contains instructions to do a bonding resistance check for each fuel boost override pump.

2. Fuel Boost Override Pump - Bonding Resistance Check

A. References

- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH
(2) Maintenance mats, commercially available

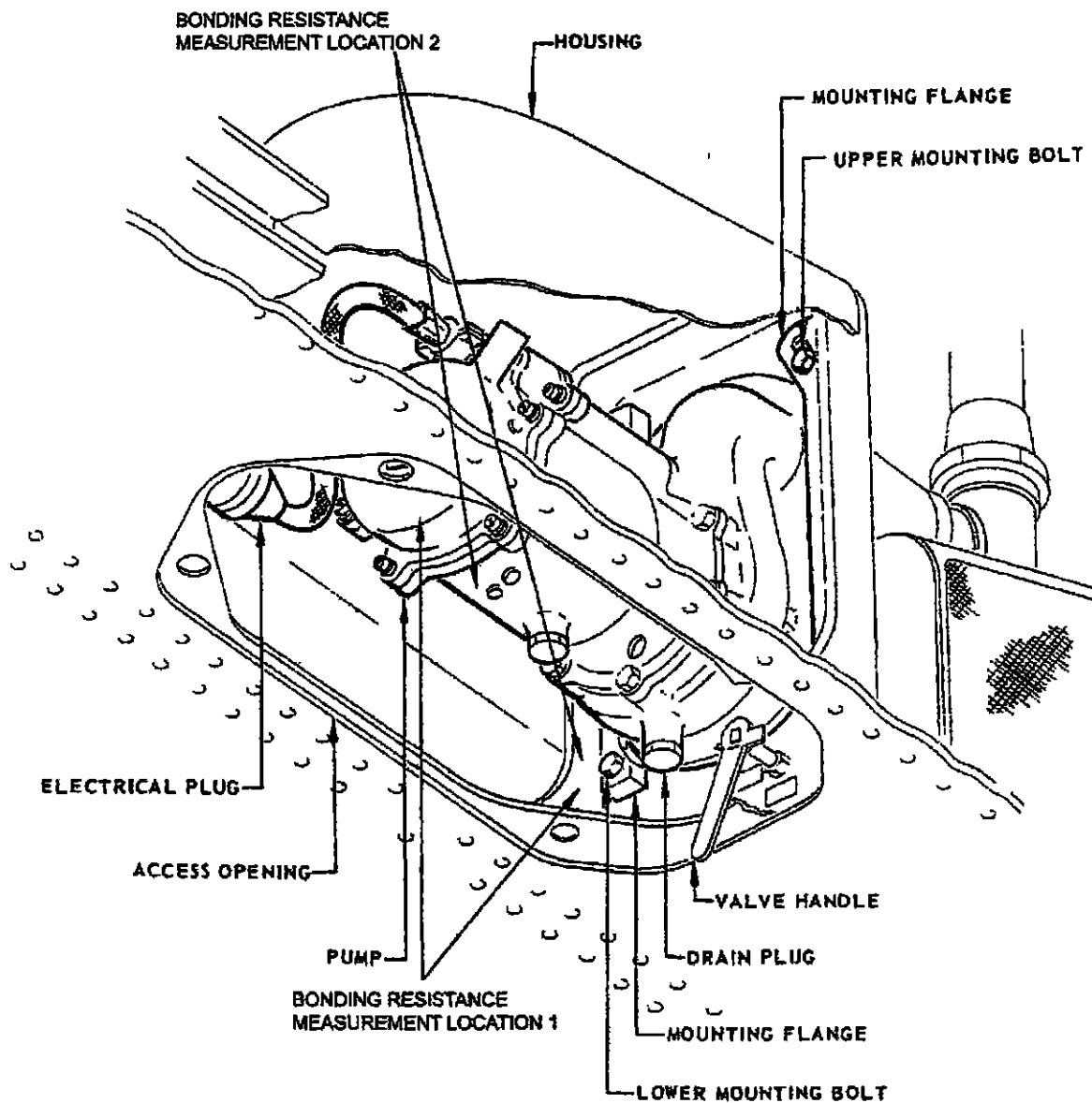
C. Procedure

- (1) Defuel all the fuel tanks (AMM 28-0/201).
(2) Do the "Purging (Air Ventilating)" procedure (AMM 28-0/201).
(3) Gain access to the fuel tank.

CAUTION PUT MAINTENANCE MATS ON THE WING SURFACES WHERE MAINTENANCE PERSONS WORK. DAMAGE TO THE WING SURFACES CAN OCCUR.

NOTE: Do the bonding resistance inspection for one fuel tank and then repeat the inspection for the other fuel tanks.

- (4) Get access to the fuel boost override pump (Figure 1) from inside the fuel tank.
(5) Measure the electrical bonding resistance between the fuel boost override pump wire conduit and the structure (SWPM 20-20-00).
(a) Make sure the resistance is 0.005 ohm (5 milliohm) or less.
(6) Get access to the fuel boost pump from outside the fuel tank.
(7) Measure the electrical bonding resistance between the fuel boost override pump and the structure (SWPM 20-20-00).
(a) Make sure the bonding resistance between the override pump motor housing and structure is 0.0004 ohm (0.4 milliohm) or less.
(b) Make sure the bonding resistance between the override pump housing and structure is 0.0006 ohm (0.6 milliohm) or less.
(8) Make sure the tank is clean.
(9) Remove the maintenance mats.
(10) Install structural members at rib access openings if removed and install fuel tank access panels.
(11) Refuel all the fuel tanks (AMM 12-1-41/201).
(12) Make sure there are no fuel leaks (AMM 28-2-0/101).
(13) Put the airplane back to a serviceable condition.



Fuel Boost Override Pump
 Figure 1

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FUEL BOOST OVERRIDE PUMPS - MAINTENANCE PRACTICES

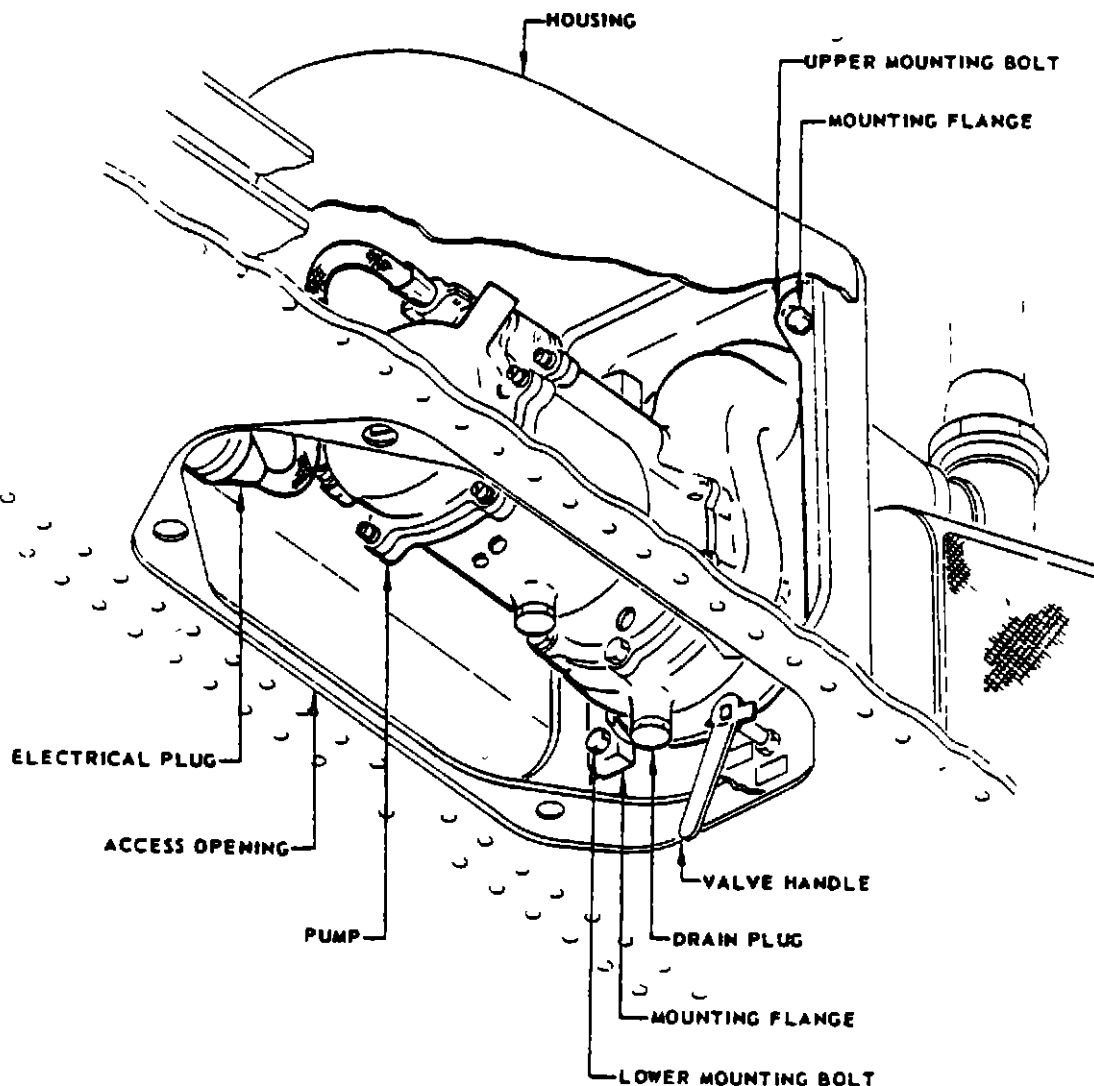
1. General

- A. Maintenance practices on both fuel boost override pumps are basically the same, the only difference being one of location. One is in the left integral section of the center wing tank and the other one is in the right integral section.

2. Removal/Installation Fuel Boost Override Pumps

A. Equipment and Materials

- (1) Bonding Meter - Microhm Bridge, Type W Bonding Meter, Avtron Model T207, Avtron Manufacturing Inc., 10409 Much Ave., Cleveland, Ohio



Fuel Bonding Override Flap Installation

Figure 201

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B. Remove Fuel Boost Override Pump (Fig. 201).

- (1) Close all fuel manifold valves and then remove external power from airplane.
- (2) Open applicable fuel boost override pump circuit breaker.
- (3) Remove applicable fuel boost override pump access panel (Fig. 6, 28-7-0).
- (4) Manually close override pump removal valve.
- (5) Disconnect electrical plug at electrical disconnecter.
- (6) Open drain valve on pump and drain fuel into appropriate container.
- (7) Support pump and remove only bottom mounting bolts.
- (8) Pump mounting flange clamps should slip down and free pump. If clamps stick, pull them down manually.
- (9) Pull pump straight back to free it from outlet fittings.

NOTE: O-rings on pump ports form sliding seals on their fittings and may make it necessary to exert extra pressure in removing pump.

- (10) Lower pump through access opening.

C. Install Fuel Boost Pump (Fig. 201).

- (1) Clean all machined surfaces on pump mounting flange and mating surfaces on wing, remove all oxidization deposits and other foreign material then clean with naphtha and wipe dry with lint-free cloth.

WARNING THOROUGH CLEANING OF THESE SURFACES IS ESSENTIAL TO ENSURE ADEQUATE ELECTRICAL BOND BETWEEN PUMP AND AIRPLANE STRUCTURE. IF THE INTEGRITY OF THE BOND IS IN DOUBT, CHECK WITH APPROVED BONDING METER. CHECK AFTER INSTALLING PUMP BUT BEFORE CLOSING PUMP CIRCUIT BREAKER. BONDING RESISTANCE BETWEEN PUMP FLANGE AND AIRPLANE STRUCTURE MUST NOT EXCEED 0.0002 OHMS.

IF THE METER USED TO VERIFY THE BOND RESISTANCE IS NOT EXPLOSION PROOF, THE HAZARDOUS GAS CONTENT OF THE ATMOSPHERE AS MEASURED BY A COMBUSTIBLE GAS DETECTOR MUST BE 25% OR LESS OF THE LOWER EXPLOSIVE LIMIT.

- (2) Fit new O-rings, lightly lubricated with fuel, into grooves on pump.

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- (3) Close drain valve on pump.
- (4) Hold pump with inlet port up and pour approximately one-half pint of fuel into pump.

NOTE: It will not be necessary to perform preceding step if center wing tank dripstick shows at least 10 inches of fuel remaining in tank with airplane at level attitude.

- (5) Allow excess fuel to run out of pump. Position pump in outboard end of override pump dry bay. Insert fittings on pump into their respective mating fittings.
- (6) Push pump straight in until pump flange is snugly against pump support surface.
- (7) Push up on one of pump retaining clamps until lower bolt can be inserted.
- (8) Install lower bolt and tighten finger tight.
- (9) Repeat steps (7) and (8) for other clamp.
- (10) Tighten both lower bolts and lockwire.
- (11) Connect electrical plug at electrical disconnect.
- (12) Deleted
- (13) Manually open override pump removal valve.
- (14) Install access panel.
- (15) Close applicable circuit breaker.
- (16) Connect external power to airplane.
- (17) Check that fuel low pressure warning lights are on.
- (18) Place applicable fuel boost override pump switch to "ON."
- (19) Observe that applicable fuel low pressure warning light goes out, thus indicating normal pump operation.
- (20) Return fuel boost override pump switch to "OFF" and warning light will come on.
- (21) Remove external power from airplane.



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DUAL CHECK VALVE - REMOVAL/INSTALLATION

1. General

- A. Dual check valves for main tanks No. 1 and 4 are connected to engine No. 1 and 4 fuel manifold valve mounting adapters through the aft walls of the inboard dry bay areas.
- B. Dual check valves for main tanks No. 2 and 3 are mounted on wing structure in main tanks No. 2 and 3.

2. Removal/Installation Dual Check Valve Main Tank No. 1 or 4

A. Prepare for Removal

- (1) Defuel and purge applicable tank. Refer to Servicing Fuel System, 28-0.
- (2) Remove tank No. 1 or 4 fuel manifold valve and the valve mounting adapter. Refer to Fuel Manifold Valve, 28-7-21.
- (3) Gain access to dual check valve through fuel tank access panel No. 4 and rib access opening No. 10. Refer to Integral Fuel Tanks, 28-2-0.

B. Remove Dual Check Valve, Main Tank No. 1 or 4 (See figure 401.)

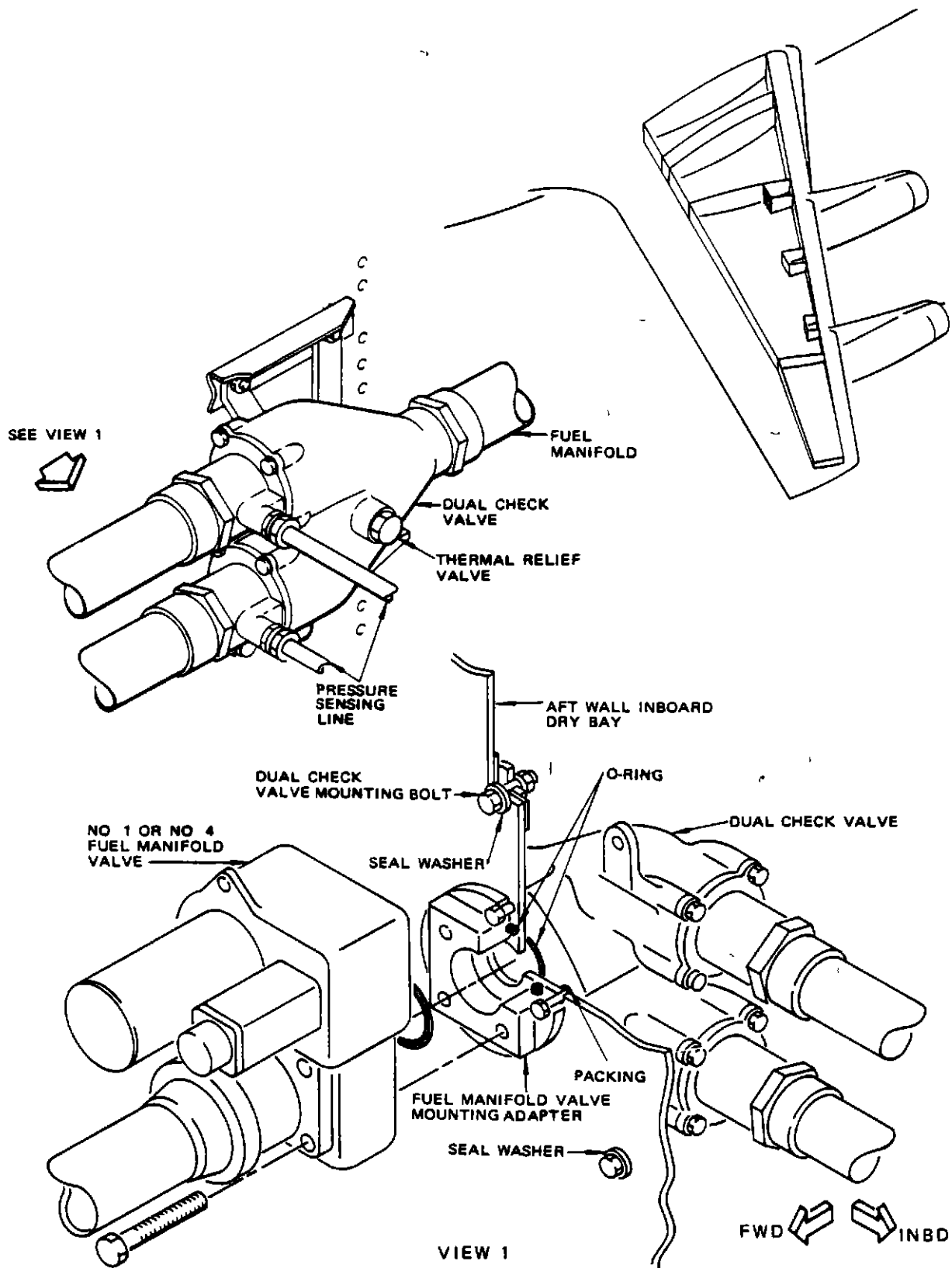
- (1) Disconnect all tube fittings.
- (2) Support dual check valve and remove mounting bolts.
- (3) Exercise care not to damage tube fittings and lower valve from mounted position.

C. Install Dual Check Valve, Main Tank No. 1 or 4 (See figure 401.)

- (1) Clean all machined surfaces of dual check valve, valve mounting adapter, and faying surfaces of dry bay wall with naphtha. Wipe dry with clean lint-free cloth.
- (2) Lubricate O-rings and bolt packings lightly with fuel. Fit O-ring into groove in valve. Fit O-ring into groove in valve mounting adapter.
- (3) Position valve mounting adapter and valve in position on structure. Check that O-rings and bolt packings are in proper position and install adapter fitting attaching bolts. Lockwire bolts.

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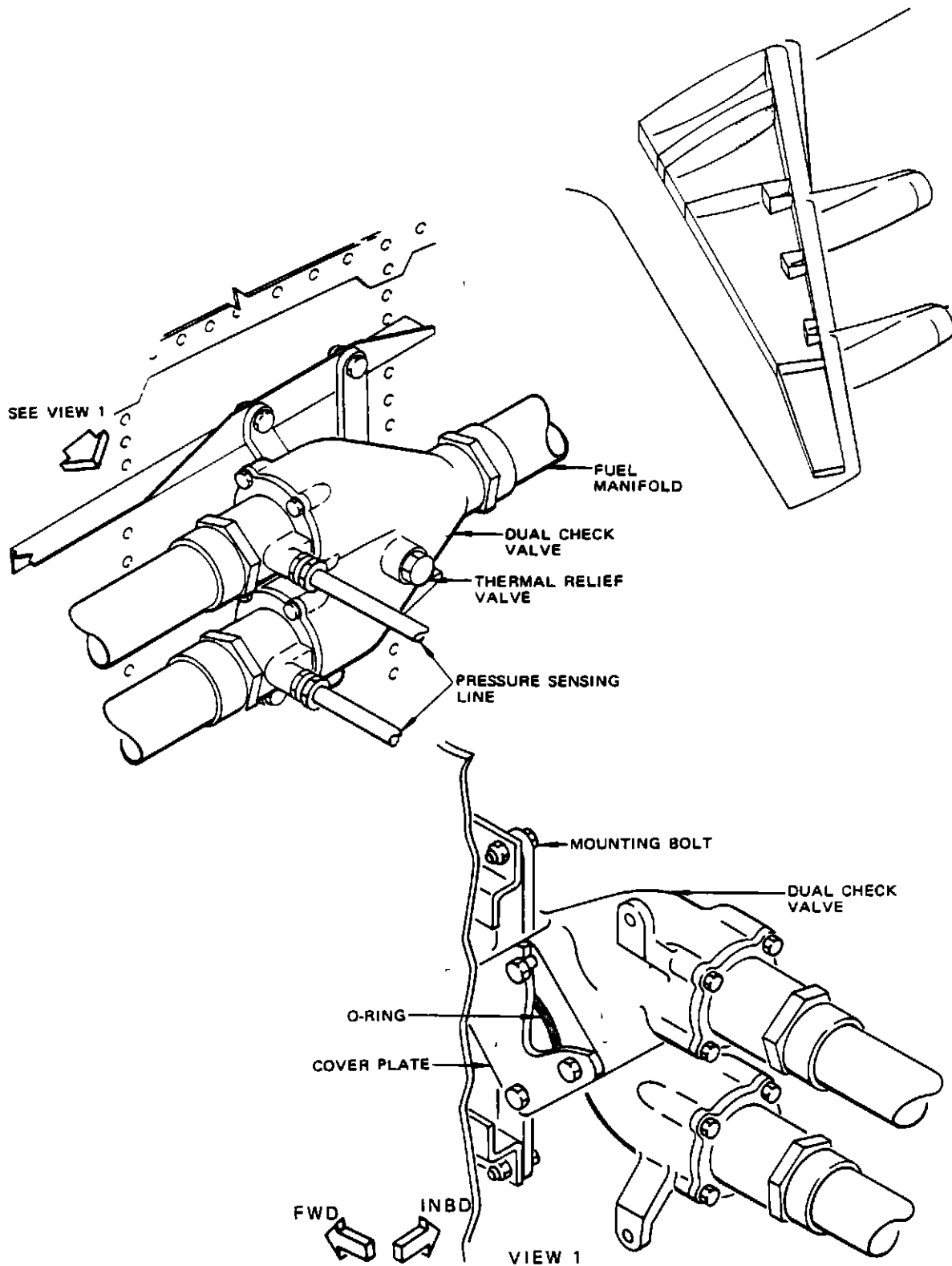
No. 1 and No. 4 Dual Check Valve Installation
Figure 401



MAINTENANCE MANUAL

- (4) Install seal washers on valve mounting bolts and install bolts with heads in dry bay area
- (5) Connect tube fittings
- D Restore Airplane to Normal
 - (1) Install fuel manifold valve Refer to Fuel Manifold Valve, 28-7-21
 - (2) Close rib access openings and install fuel tank access panel Refer to Integral Fuel Tank, 28-20
 - (3) Return all fuel system valves to normal position
- 3. Removal/Installation Dual Check Valve Main Tank No 2 or 3
 - A. Prepare for Removal
 - (1) Defuel and purge applicable tank. Refer to Servicing Fuel System, 28-0.
 - (2) Gain access to dual check valve through fuel tank access panel No. 2 and rib access openings No. 3 and 4. Refer to Integral Fuel Tanks, 28-3-0.
 - B Remove Dual Check Valve, Main Tank No 2 or 3 (See figure 402)
 - (1) Disconnect all tube fittings.
 - (2) Support dual check valve and remove mounting bolts.
 - (3) Exercise care not to damage tube fittings and lower valve from mounted position.
 - (4) Remove lockwire, coverplate attaching bolts, coverplate and O-ring from side of valve Retain coverplate and attaching bolts for installation on replacement valve.
 - C. Install Dual Check Valve, Main Tank No 2 or 3
 - (1) Clean all machined surfaces on valve and the side coverplate (removed in step.B (4)) with naphtha Wipe dry with clean lint free cloth

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Main Tank No. 2 and No. 3 Dual Check Valve Installation
 Figure 402



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- (2) Lubricate O-ring lightly with fuel. Fit O-ring into groove on side of valve.
- (3) Position side coverplate on valve over O-ring. Check that O-ring is in proper position and install coverplate attaching bolts Lockwire bolts.
- (4) Position valve on structure and install mounting bolts.
- (5) Connect tube fittings.

D. Restore Airplane to Normal

- (1) Close rib access openings and install fuel tank access panel. Refer to Integral Fuel Tanks, 28-2-0.
- (2) Return all fuel system valves to normal position.

Fuel Boost Override Pump Check Valve - Maintenance Practices

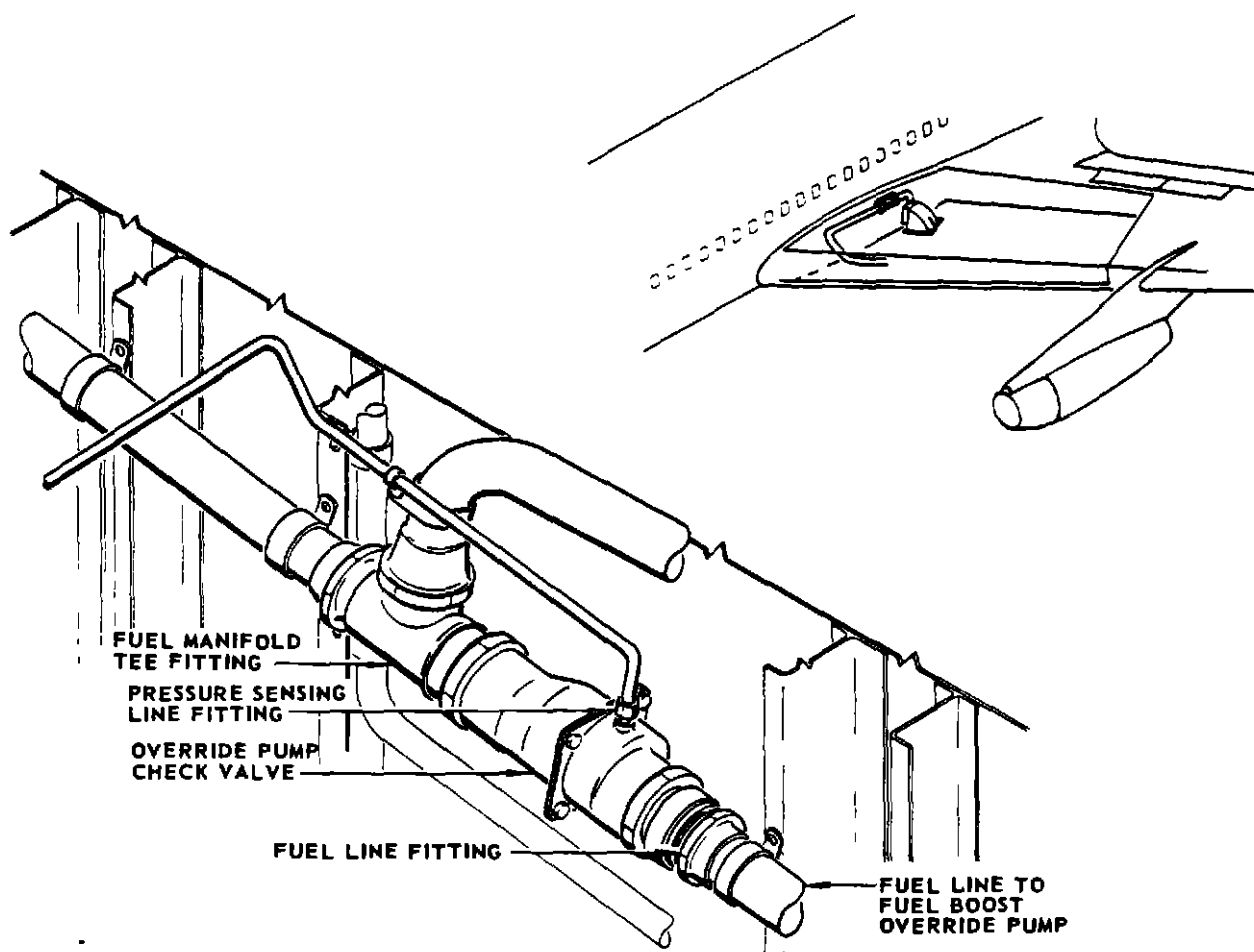
1. General

- A. Maintenance practices on both of the fuel boost override pump check valves are basically the same, the only difference being one of location. One is in the left integral section of the center wing tank and the other is in the right integral section. Access to the check valve is gained by removing fuel tank access panel no. 1 and removing structural members over rib access opening no. 1. Refer to 28-2-0, "Integral Fuel Tanks."

2. Removal/Installation Fuel Boost Override Pump Check Valve

- A Remove Fuel Boost Override Pump Check Valve (See figure 201)

- (1) Defuel center tank. See "Servicing Fuel System," 28-0.
- (2) Close all fuel manifold valves and then disconnect external power from airplane.



⑥
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Override Pump Check Valve Installation
Figure 201

- (3) Gain access to applicable valve. Refer to 28-2-0, and 28-2-11.
 - (4) Loosen tube fittings and remove the valve taking care not to damage the tube ends. Catch any fuel drip in container
- B. Install Override Pump Check Valve (See figure 201.)
- (1) Place valve in position and start tube fittings.
 - (2) Tighten tube fittings.
 - (3) Install rib access opening structural members. Refer to 28-2-11, "Rib Access Openings."
 - (4) Install fuel tank access panel.

END



FUEL LOW PRESSURE SWITCH - MAINTENANCE Practices

1. General

- A. Maintenance practices on all fuel low pressure switches are basically the same, the only difference being the location. Five switches are located in the left inboard dry bay and five switches are located in the right inboard dry bay.

2. Removal/Installation Fuel Low Pressure Switch

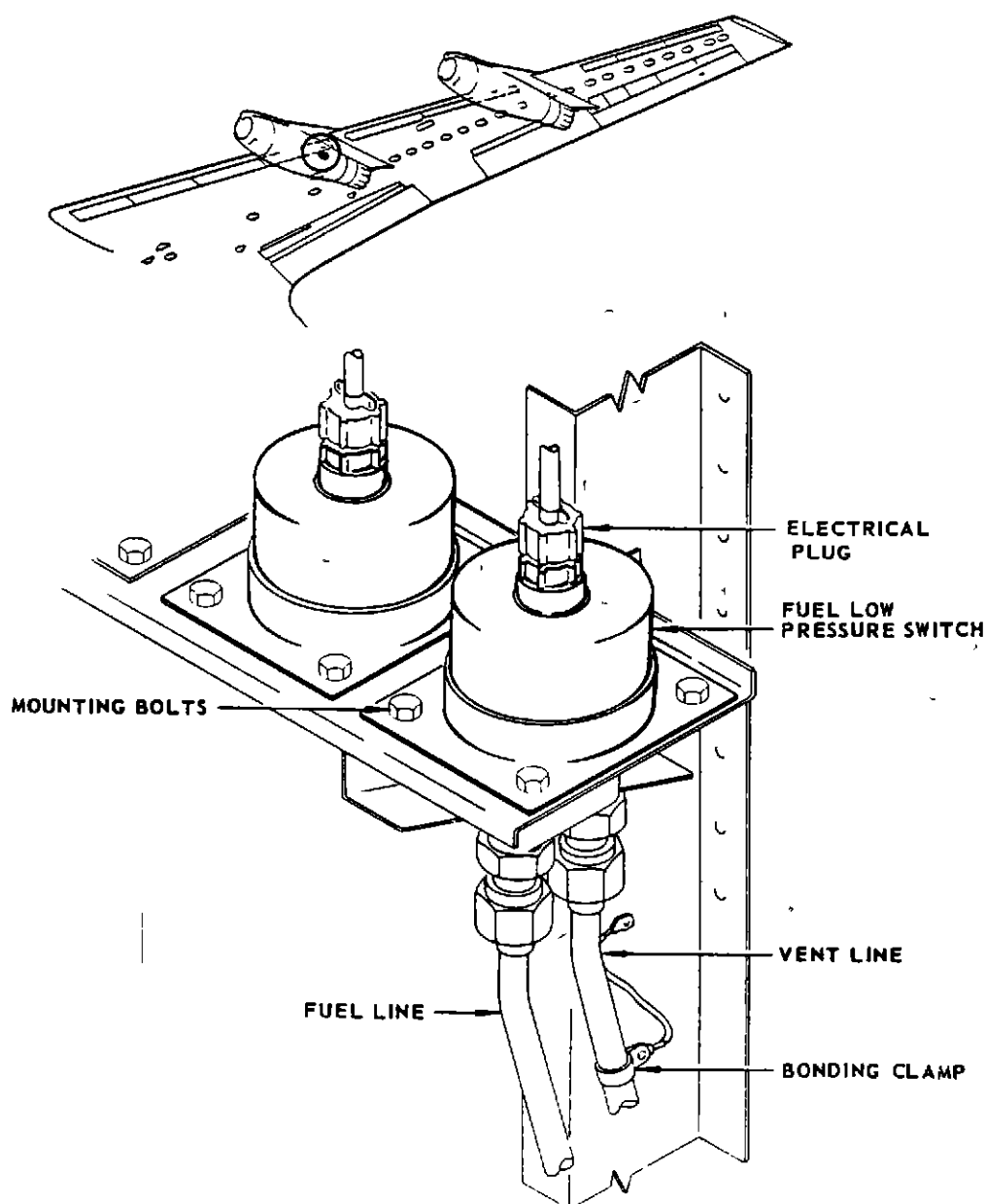
A. Remove Fuel Low Pressure Switch (See figure 201.)

- (1) Close all engine fuel feed shutoff valves and all fuel manifold valves.
- (2) Disconnect external power from airplane.
- (3) Open all pump circuit breakers and applicable fuel low pressure switches circuit breakers.
- (4) If main tank pressure switch is the one to be removed, open both fuel boost pump access panels for respective tank to close pump removal valves. On airplanes with screw operated valves, close valves by counter clockwise rotation of the screws. (Refer to 28-7-62.) If center wing tank pressure switch is one to be removed, open fuel boost override pump access panel and manually close pump removal valve.

WARNING. SIPHONING OF FUEL MAY RESULT IF PUMP REMOVAL VALVES ARE NOT CLOSED.

- (5) Drain pump housings for respective tank.
 - (6) Disconnect electrical plug at switch.
 - (7) Provide small container to catch fuel drip, and disconnect tubing fittings.
 - (8) Remove mounting bolt and lift switch free.
- B. Install Fuel Low Pressure Switch (See figure 201.)
- (1) Position fuel low pressure switch and install mounting bolts.

- (2) Connect _____, fittings.
- (3) Connect electrical plug and close inboard _____ bay access panels.
- (4) If main tank pressure switch was the one installed close both fuel boost pump access panels for applicable tank. On airplanes with screw operated pump removal valves, open valves by clockwise rotation of the screws before installing the access panels. (Refer to 28-7-62.) If center wing tank pressure switch was one installed, open override pump removal valve and install fuel boost override pump access panel.





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- (5) Connect external power to airplane.
- (6) Close applicable circuit breakers and observe that fuel low pressure warning lights come on.
- (7) Position applicable fuel boost pump or override pump switch to ON, and observe that applicable fuel low pressure warning light goes out.
- (7a) Monitor any fuel pump low pressure indication light during pump operation and immediately put the fuel pump switch to OFF when a low pressure light(s) comes on and stays on.

When operating the APU unattended for an extended period of time, follow Airplane Maintenance Manual 49-00-2 and 49-00-3 page 201 instructions regarding necessary fuel quantity based on APU fuel burn rate.

When defueling or transferring fuel with minimum backpressure to the pumps, it is possible for a pump low pressure light to illuminate before all fuel is transferred. In one pump fuel tank configurations, monitor the tank quantity and put the pump to OFF if the tank quantity does not change. In two pump fuel tank configurations, put the pump to OFF and continue, and if the remaining pump's low pressure light illuminates, then monitor tank quantity and put that pump to OFF if tank quantity does not change. If each pump's low pressure light illuminates simultaneously, put the aft pump to OFF and continue while monitoring tank quantity and put the forward pump to OFF if tank quantity does not change.

NOTE: Forward pumps can usually supply more fuel on the ground compared to aft pumps.

Only one pump per fuel tank can be operated when a low pressure light is illuminated for that tank and that pump should be put to OFF when the tank quantity does not change.

- (8) Reposition switch to OFF and warning light should come on.
- (9) Disconnect external power from airplane.

END

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FUEL

Fuel Low Pressure Switch

Maintenance Practice



- (5) Connect external power to airplane.
- (6) Close applicable circuit breakers and observe that fuel low pressure warning lights come on.
- (7) Position applicable fuel boost pump or override pump switch to "ON", and observe that applicable fuel low pressure warning light goes out.
- (8) Reposition switch to "OFF" and warning light should come on.
- (9) Disconnect external power from airplane.

END

FUEL BOOST OVERRIDE PUMP REMOVAL VALVE - MAINTENANCE PRACTICES

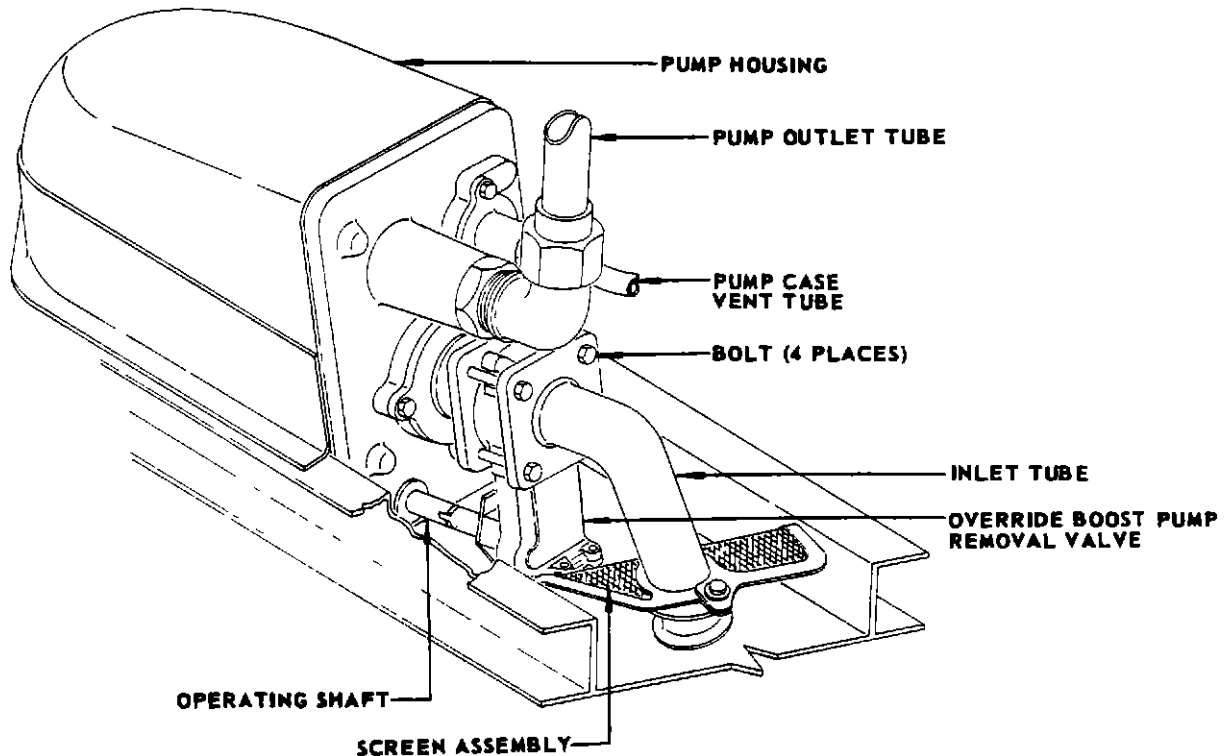
1. General

- A. Maintenance practices on both of the fuel boost override pump removal valves are basically the same, the only difference being one of location. One is in the left integral section of the center wing tank and the other is in the right integral section. Access to the valve is gained by removing fuel tank access panel No. 1 and removing structural members over rib access opening No. 1.

2. Removal/Installation Fuel Boost Override Pump Removal Valve

A. Remove Fuel Boost Override Pump Removal Valve

- (1) Connect external power to airplane.
- (2) Defuel center wing tank. See 28-0, "Servicing Fuel System."
- (3) Close all fuel manifold valves and disconnect external power from airplane
- (4) Gain access to applicable valve. Refer to 28-2-0 and 28-2-11.
- (5) Remove bolt attaching inlet tube to screen. (See figure 201.)



- (6) Remove bolts securing valve and inlet tube.

CAUTION: TO PREVENT VALVE FALLING, CAUSING DAMAGE TO VALVE OR SCREEN,
VALVE MUST BE SUPPORTED WHEN REMOVING LAST BOLT.

- (7) Rotate inlet tube until flange is clear of valve.
- (8) Move valve inboard until tongue and slot of operating shaft are clear of each other.
- (9) Lift valve clear of structure.

B. Install Fuel Boost Override Pump Removal Valve

- (1) Clean machined surfaces with naphtha and wipe dry with lint free cloth.
- (2) Place new O-rings in grooves.
- (3) Place valve in position with tongue engaged in slot of operating shaft. (See figure 201.)
- (4) Rotate inlet tube until flange lines up with valve.
- (5) Install bolts securing valve and inlet tube.
- (6) Install bolt securing inlet tube to screen.
- (7) Install rib access opening structural members. Refer to 28-2-11, "Rib Access Openings."
- (8) Install fuel tank access panel.

END



MAINTENANCE MANUAL

FUEL BOOST PUMP HOUSING - MAINTENANCE PRACTICES

1. General

- A. Maintenance practices on all of the fuel boost pump housings are basically the same, the differences are location, number of fasteners and differently shaped housings and flapper valve fittings. Access to the housings is gained by removing the applicable fuel tank access panel and rib opening structural members.

2. Removal/Installation Fuel Boost Pump Housing

A. Equipment and Materials

- (1) Bonding Meter - Michroh Bridge, Type W Bonding Meter, Avtron Model T 207, Avtron Manufacturing Inc., 10409 Much Ave, Cleveland 5, Ohio
- (2) Sealing tools (Ref 28-2-0, Integral Fuel Tanks).

B. Remove Fuel Boost Pump Housing

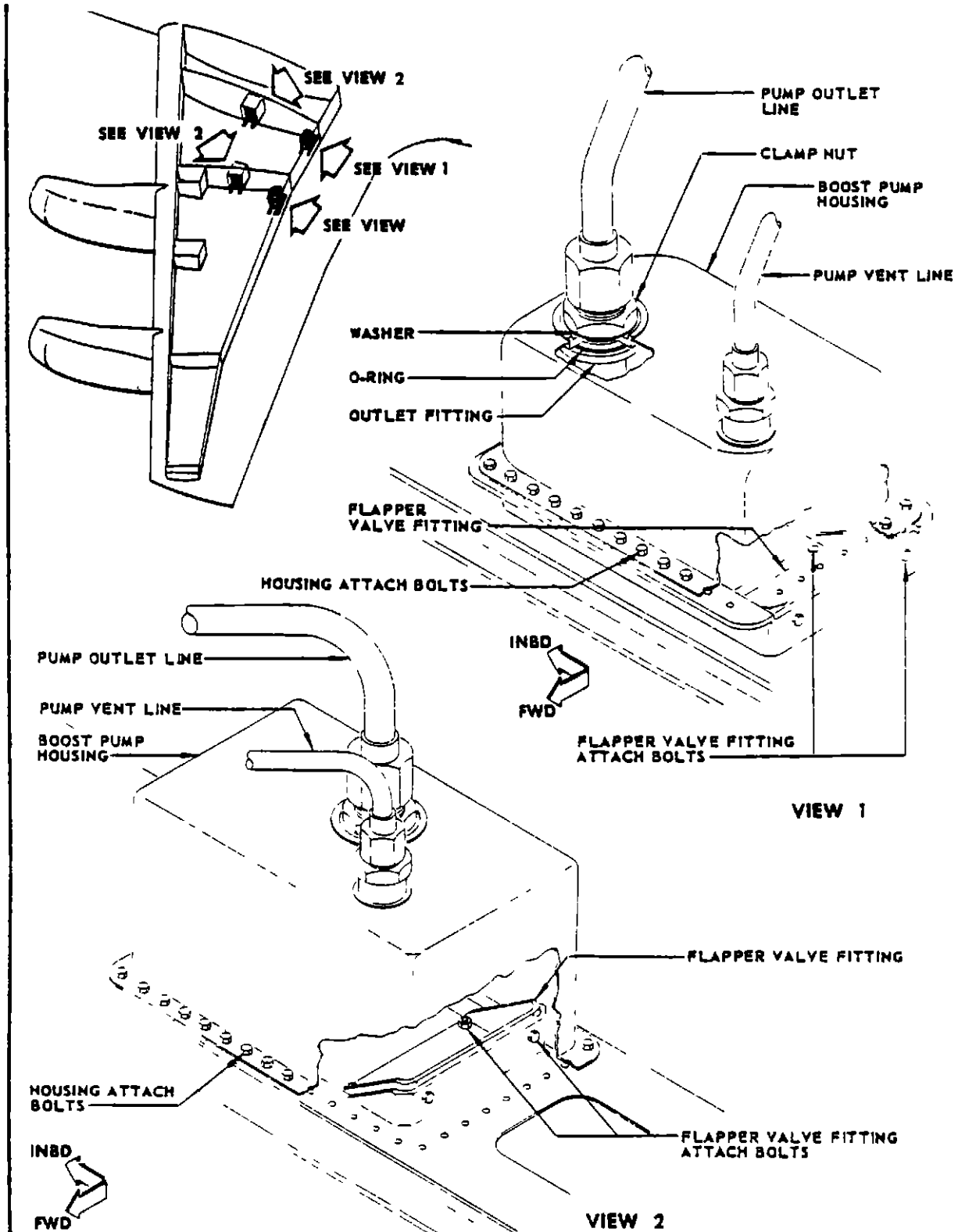
- (1) Connect external power to airplane.
- (2) Defuel and purge applicable fuel tank (Ref 28-0, Maintenance Practices).
- (3) Close all fuel manifold valves.
- (4) Disconnect external power from airplane.
- (5) Gain access to applicable fuel boost pump housing (Ref 28-2-0 and 28-2-11, Maintenance Practices).
- (6) Disconnect pump outlet line at top of housing (Fig. 201).
- (7) Slacken clamps and first coupling on pump outlet line.
- (8) Rotate pump outlet line until clear of housing.
- (9) Disconnect pump vent line at top of housing.
- (10) Slacken clamps on pump vent line.
- (11) Rotate vent line until clear of housing.
- (12) Remove outlet fitting clamp nut and washer.
- (13) Remove housing attach bolts.
- (14) Break seal and lift housing clear.
- (15) Remove flapper valve fitting attach bolts.
- (16) Break seal and lift fitting clear.

C. Install Fuel Boost Pump Housing

- (1) Remove old sealant, clean surfaces and apply new sealant to flapper valve fitting (Ref 28-2-0, Approved Repairs).
- (2) Place fitting in position taking care not to disturb sealant (Fig. 201).
- (3) Install fitting attach bolts.
- (4) Remove old sealant, clean surfaces and apply new sealant to fuel boost pump housing (Ref 28-2-0, Approved Repairs).

CAUTION APPLY NEW SEALANT ONLY TO SURFACES PREVIOUSLY SEALED, PORTIONS WITHOUT SEALANT ARE NOT ALODIZED AND ARE USED FOR BONDING.

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Fuel Boost Pump Housing Installation
Figure 201
TR 28-235

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- (5) Install new O-ring in groove of pump outlet fitting
- (6) Place housing in position taking care not to disturb sealant
- (7) Install housing attach bolts.
- (8) Using bonding meter, check that bonding resistance between flange of housing and structure does not exceed 0.0002 ohm.

WARNING FUEL BOOST PUMP HOUSINGS ARE IN FUEL VAPOR AREA. IF THE METER USED TO VERIFY THE BOND RESISTANCE IS NOT EXPLOSION PROOF, THE HAZARDOUS GAS CONTENT OF THE ATMOSPHERE AS MEASURED BY A COMBUSTIBLE GAS DETECTOR MUST BE 25% OR LESS OF THE LOWER EXPLOSIVE LIMIT.

- (9) Install outlet fitting clamp nut and washer, lockwire clamp nut.
- (10) Rotate pump vent line into position.
- (11) Connect pump vent line at top of housing.
- (12) Tighten clamps on pump vent line.
- (13) Rotate pump outlet line into position.
- (14) Connect pump outlet line at top of housing.
- (15) Tighten clamps and first coupling on pump outlet line.
- (16) Install rib access opening structural members (Ref 28-2-11, Rib Access Openings).
- (17) Install fuel tank access panel.
- (18) Perform leak test as described in par. 3, Inspection/Check Fuel Boost Pump Housing.

3. Inspection/Check Fuel Boost Pump Housing

A. Check Fuel Boost Pump Housing

- (1) Remove applicable fuel boost pump (Ref 28-7-71).
- (2) Fill tank with fuel.
- (3) Check for leaks at flapper valve and around housing flange.

NOTE Minor leaks are permissible providing they are small enough to cause no inconvenience during pump removal and installation.

- (4) Install fuel boost pump (Ref 28-7-71).

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APU FUEL SUPPLY SYSTEM - DESCRIPTION AND OPERATION

For APU Fuel Supply System - Description and Operation, refer to chapter 49-31-0, pages 1 and on

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FUEL FLOW INDICATING SYSTEM - DESCRIPTION AND OPERATION

1 General

- A Fuel flow to each engine is measured by a fuel flow indicating system consisting of four fuel flow transmitters, one fuel flow electronic package assembly and one four tape fuel flow indicator. The indicators are assembled into one instrument package. Each transmitter develops an electrical pulse signal proportionate to the rate of fuel mass (not volume) flowing to each engine. These signals are transmitted to the electronic package assembly where they are conditioned and converted to dc voltage signals for the corresponding tape of the fuel flow indicator.

CAUTION· OPERATING THE TRANSMITTERS WITHOUT FUEL CAN CAUSE SEVERE DAMAGE TO THE BEARINGS.

2 Fuel Flow Transmitter

- A A fuel flow transmitter is mounted in the fuel line on each engine strut (figure 1). Fuel entering the transmitter first passes between radial straightening vanes to remove swirl and other disturbance. The fuel then passes through the rotating measurement assembly which consists of a multi-vane impeller connected coaxially to a surrounding drum by a spiral spring. The drum is rotated at a constant speed of 100 rpm by a low speed synchronous motor. The measurement assembly is supported by two bearings that are lubricated by the fuel. The fuel passing through the measurement assembly deflects the impeller relative to the drum because of the torque required to impart angular momentum to the fuel. The deflection angle is a measurement of this torque and, therefore, a measure of the mass fuel flow. The greater the mass flow rate, the larger the deflection of the impeller relative to the drum. The deflection is measured by four small, powerful magnets (two attached 180 degrees apart on both the drum and impeller circumferences) and two pick-off coils on the outside of the nonmagnetic transmitter body (one located over the path of the drum magnet and one over the path of the impeller magnet) (See figure 1). As each magnet rotates by its respective pick-off coil, an electrical pulse is induced in the coil. The time lag of the impeller pulses relative to the drum pulses reflects the amount of torque on the impeller and is directly proportional to mass flow rate.

3 Fuel Flow Electronic Package

- A The fuel flow electronic package assembly, located on the RH Radio rack, is a solid-state electronic device that, in conjunction with fuel flow transmitters and indicators, provides instantaneous fuel flow rates and total fuel remaining indication to the pilots and the flight engineer. The electronic package (figure 2) comprises top and bottom cover assemblies and a wired chassis assembly containing four electronic printed circuit cards, one for

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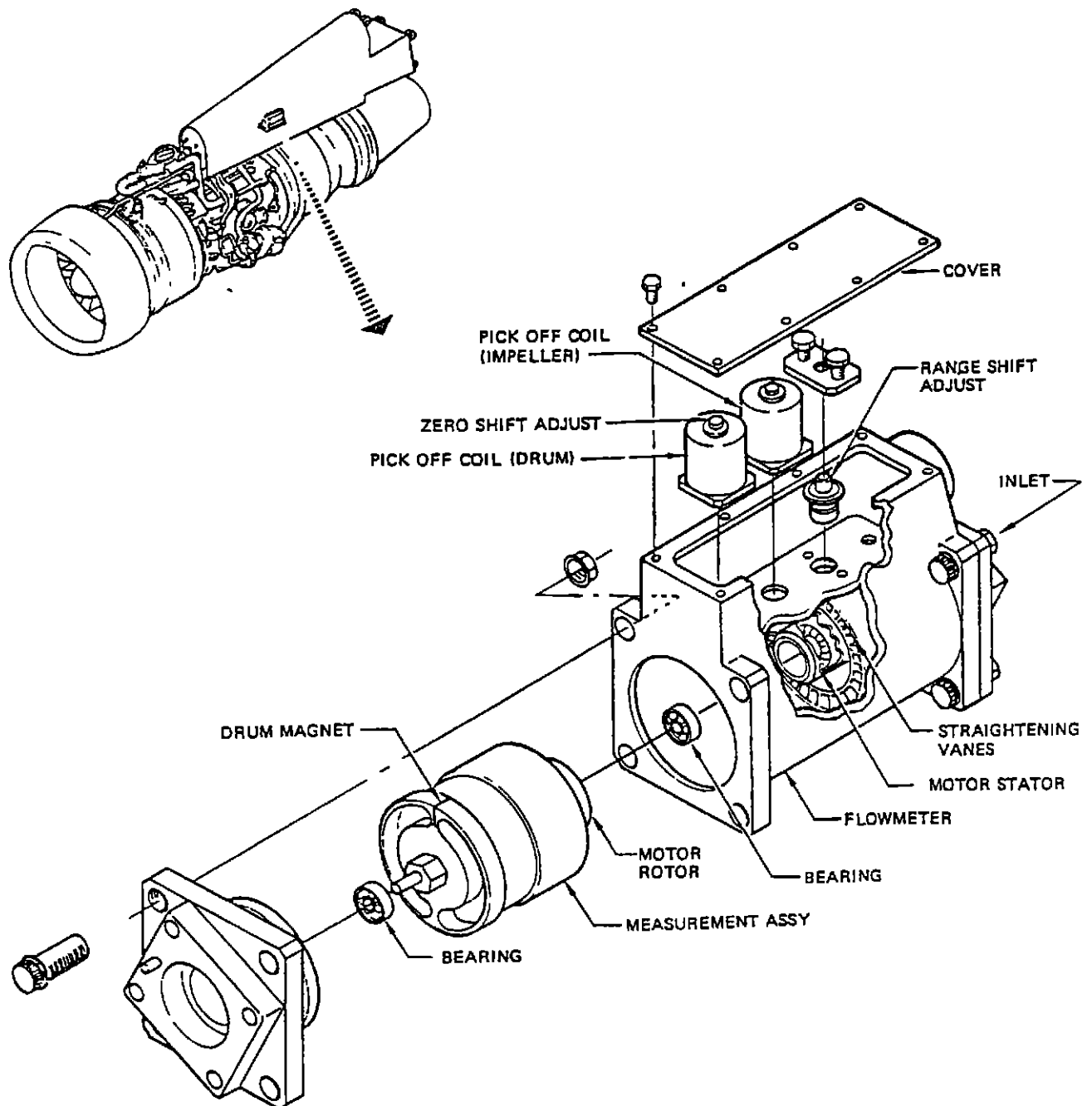
each channel. The electronic package generates low frequency power to drive the respective fuel flow transmitter motor and modifies and converts signals from the transmitter so that they are usable by the respective fuel flow indicator and total fuel remaining indicator.

4 Fuel Flow Indicator

- A A dc voltage proportional to the rate of fuel flow to each engine is applied to each indicator to drive the vertical tape to display an analog indication of the rate of fuel flow to the applicable engine. (See figure 3) The indicator, in a manner similar to the EGT indicator, employs four double-ended tapes (scales) attached at one end to precision tape drive reels that are powered by dc torque motors. The tapes are connected at the other end to low torque spring return mechanisms. The system provides a direct mechanical link between the tape and torque drive, which is coaxially mounted with a servo feedback pot to provide a simple servo mechanism. Power for the fuel flow indicator is provided by four FLOW circuit breakers on the P61-1 panel. All electronics are located in the rear portion of the instrument, included in the indicator are its own failure monitor circuits that sense the following:

- (1) Loss of primary power
- (2) Signal loss
- (3) Motor electrical failure
- (4) Amplifier failure

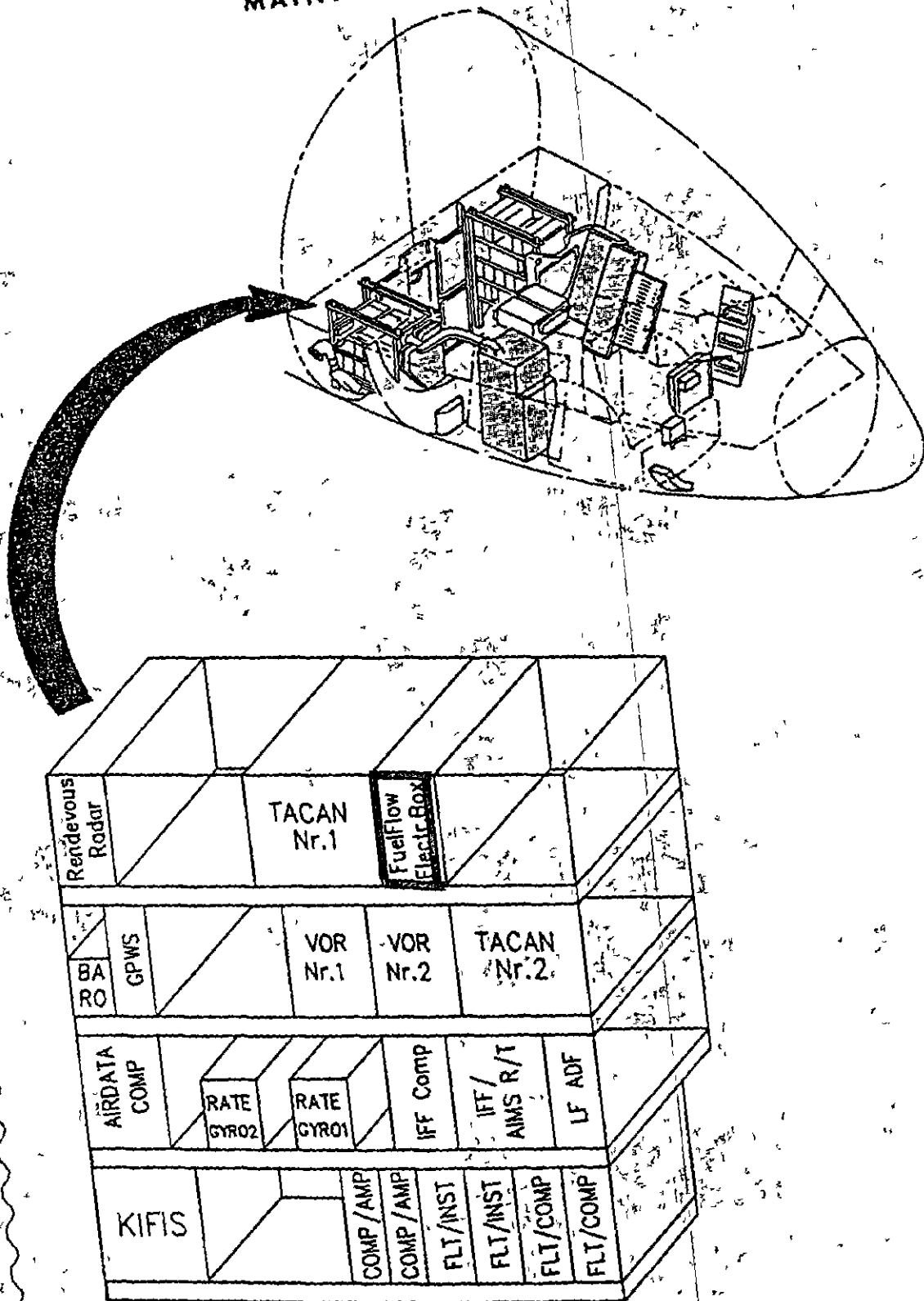
NOTE Failure of any of the items listed above will drive the indicator tape down to an off scale position and the word OFF in black letters on a red background will appear.



Fuel Flow Transmitter
Figure 1

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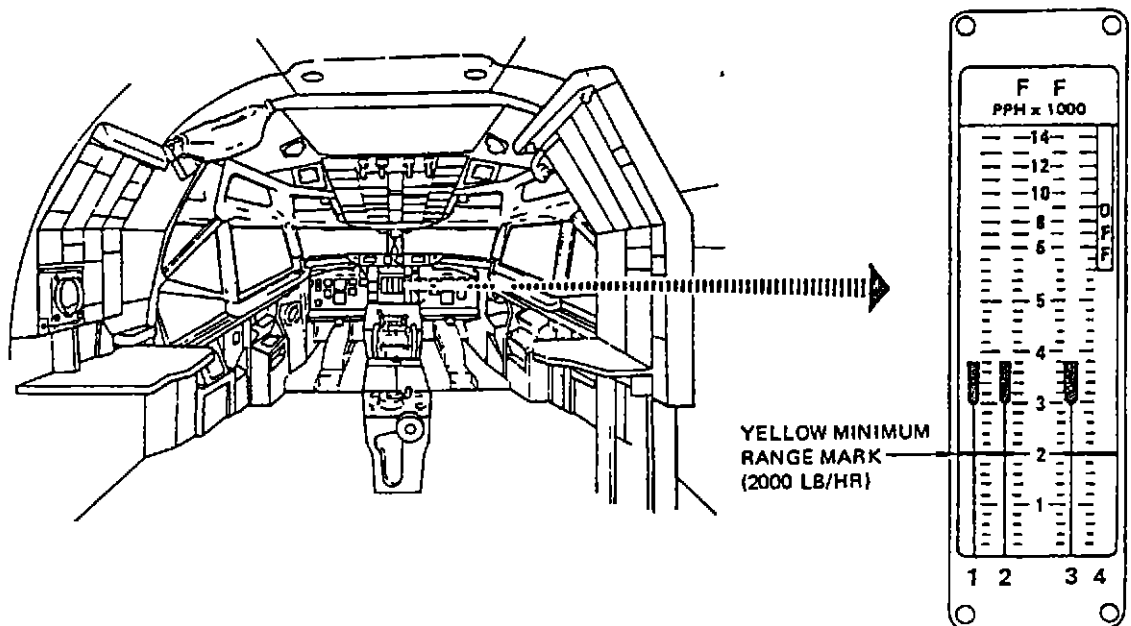


Fuel Flow Electronic Box Location
 Figure 2

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Fuel Flow Indicator
 Figure 3

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FUEL FLOW INDICATING SYSTEM - TROUBLE SHOOTING

1 General

A Table 101 lists symptoms, probable causes, isolation procedures and corrective actions as an aid in isolating causes of Fuel Flow Indicating System failures

TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
With engines running, one indicator (tape) does not move upscale	No ac power to indicator	Check that FLOW circuit breakers on P61-1 panel are closed Check aircraft wiring	Close circuit breaker or repair aircraft wiring
	Defective indicator, transmitter or electronic package.	Check system with 204-90058-1 breakout box per page 501 and on	Replace defective item.
One fuel flow indicator reads considerably more or less (approximately 10%) than others when operating conditions for all four engines are nearly the same	Defective transmitter	If indicator has been checked as satisfactory, transmitter is unsatisfactory	Replace transmitter
Fluctuating fuel flow indication	Faulty indicator	Verify correct input signals to indicator	Replace indicator
	Intermittent plug and receptacle contact	Isolate by continuity checks	Clean contacts

Fuel Flow Indicating System - Trouble Shooting
Table 101

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FUEL FLOW INDICATING SYSTEM - REMOVAL/INSTALLATION

1 Fuel Flow Transmitter Removal (See figure 401)

WARNING EXCESSIVE PHYSICAL CONTACT WLTH FUEL SUCH AS WEARING CLOTHES THAT ARE SOAKED WITH FUEL MAY PRODUCE INSOMNIA, NAUSEA, SUFFOCATION, VOMITING, VERTIGO, HEADACHE AND MUSCULAR WEAKNESS FUEL TAKEN INTERNALLY WILL PRODUCE ABDOMINAL PAIN, DISCOMFORT, PROLONGED CONSTIPATION, FATIGUE AND PALSY ANY PERSON SHOWING THESE PHYSICAL SIGNS WHILE WORKING AROUND AVIATION FUEL SHALL REPORT TO THE MEDICAL DISPENSARY IMMEDIATELY

IF FUEL CONTACTS EYES, WASH EYES AT EYE WASH FACILITY AND REPORT TO MEDICAL DISPENSARY IMMEDIATELY.

- A Provide electrical power
- B. Open applicable FIRE PROTECTION - SQUIB ENG (1, 2, 3 or 4) circuit breaker on P5 overhead panel
- C. On P13 overhead panel, pull applicable fire switch
- D. Open the following engine circuit breakers on P61-1 and P61-2 flight engineer circuit breaker panels and tag if circuit breaker panels will not be under continuous observation.
 - (1) ENGINE START & INDICATORS - CONTINUOUS IGN-ENG (1, 2, 3, or 4)
 - (2) ENGINE START & INDICATORS - START CONTROL & IGN-ENG (1, 2, 3 or 4)
 - (3) Fuel SHUTOFF VALVES - PRIMARY - ENG (1, 2, 3 or 4)
 - (4) Fuel SHUTOFF VALVES - ALTERNATE - ENG (1, 2, 3 or 4)
- E Remove electrical power
- F Place AF FORM 1492 danger tags on aircraft external power receptacle and on BATTERY switch on flight engineer's panel
- G Open applicable engine strut access panel (Eng No 1 - L10123-01, Eng No 2 - L10121-01, Eng No 3 - R10121-01, Eng No 4 - R10123-01)
 - (1) Remove left side cowling to gain access to fuel dump drain plug
- H. Disconnect electrical plug (3) from flowmeter
 - (1) Place a container to catch drain fuel under the fuel pump housing
 - (2) Remove drain plug from fuel pump, discard O-ring (figure 402), and allow

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fuel to drain from fuel pump and fuel flow transmitter

- (3) Lubricate new O-ring with petrolatum (VV-P-236) and install new O-ring on drain plug

NOTE When coupling halves are disconnected, the nut (12, figure 401) and washer (9) shall remain with fitting (14). The shell (8) shall remain with tubes (4 and 7)

- I Disconnect aft coupling nut (12) from shell (8) and move forward on fitting (14)

- J Slide shell (8) aft on tube (4).

- K Disconnect nut (12) from shell (8) on forward coupling and move nut aft towards transmitter

- L Slide shell (8) forward on tube (7)

- M Remove bolts (5) and washer (6) Retain hardware with strut for reinstallation

- N Remove transmitter from strut.

- O Remove and discard O-rings (9) from fittings (14) and O-rings (10) from tube (4 and 7) ends

CAUTION DO NOT STORE OR SHIP FUEL FLOW TRANSMITTER WITHOUT FIRST FILLING IT WITH JP4 OR CLEANING FLUID, PD-680, TYPE II FAILURE TO DO SO COULD DAMAGE TRANSMITTER

NOTE Cover, gasket, washers and screws are salvaged from replacement unit

- P Install end cover, gasket, washers and screws on outlet end of transmitter Securely tighten screws

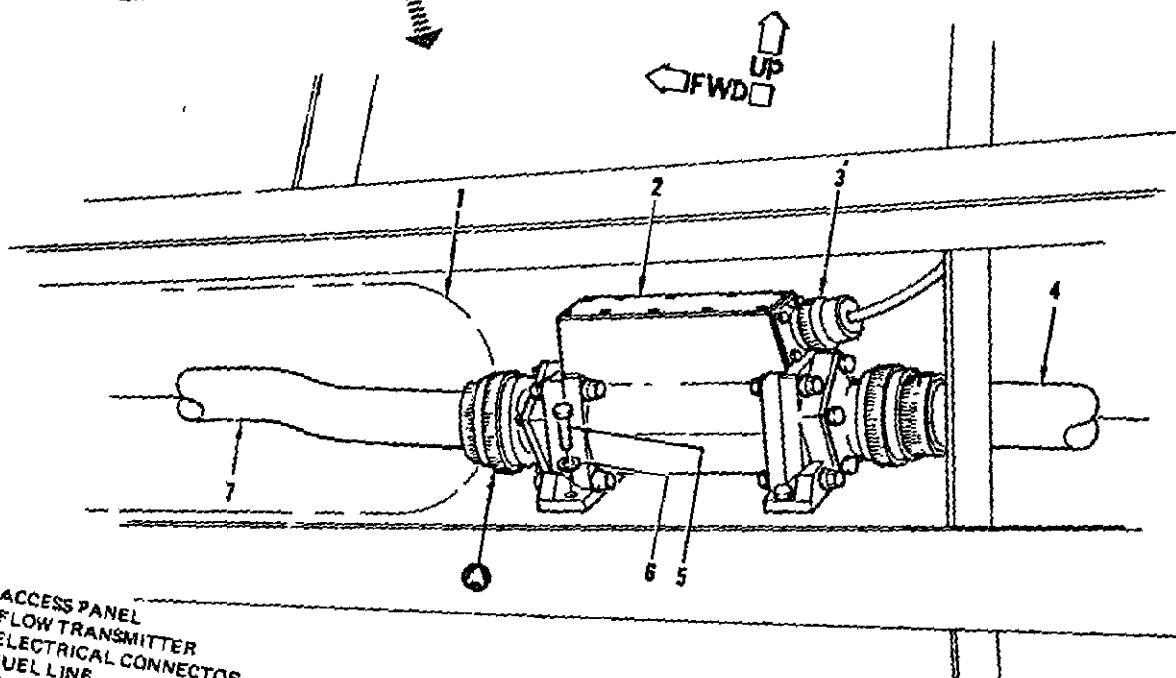
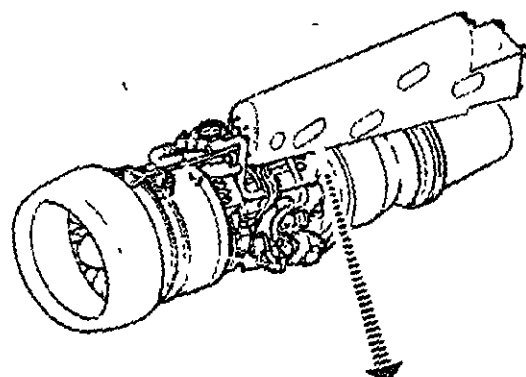
CAUTION DO NOT FILL TRANSMITTER COMPLETELY FULL OR DAMAGE MAY RESULT IN STORAGE

- Q Hold transmitter in upright position Fill it with clean, filtered fluid, JP4 or PD-680, Type II until fluid just covers dome in inlet end

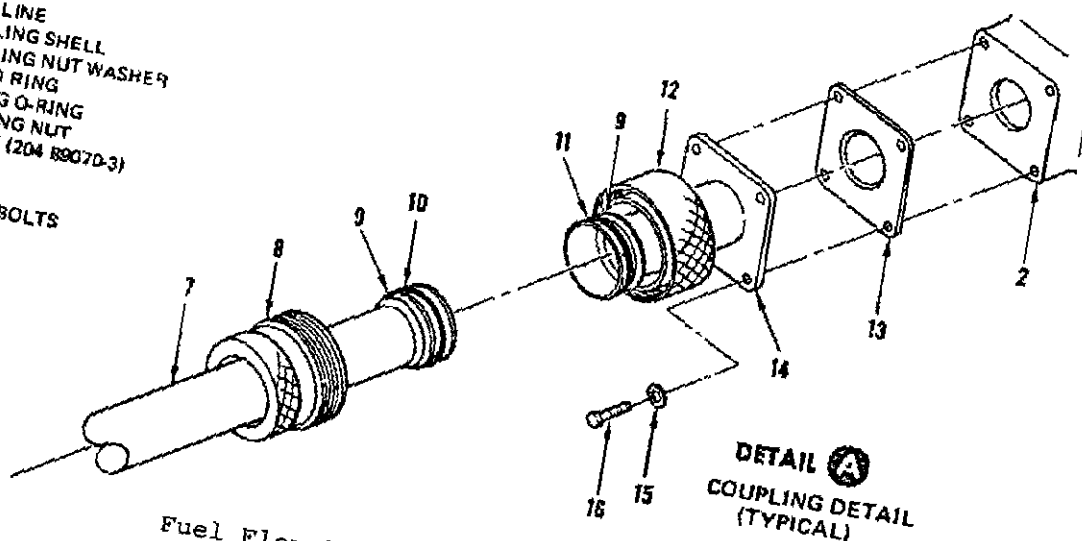
- R Install end cover, gasket, washer and screw on inlet end of transmitter Securely tighten screws

- S Install and secure fuel pump drain plug

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- 1 ACCESS PANEL
- 2 FLOW TRANSMITTER
- 3 ELECTRICAL CONNECTOR
- 4 FUEL LINE
- 5 MOUNTING BOLTS
- 6 WASHER
- 7 FUEL LINE
- 8 COUPLING SHELL
- 9 COUPLING NUT/WASHER
- 10 TUBE O-RING
- 11 FITTING O-RING
- 12 COUPLING NUT
- 13 GASKET (204 B907D-3)
- 14 FITTING
- 15 WASHER
- 16 FITTING BOLTS

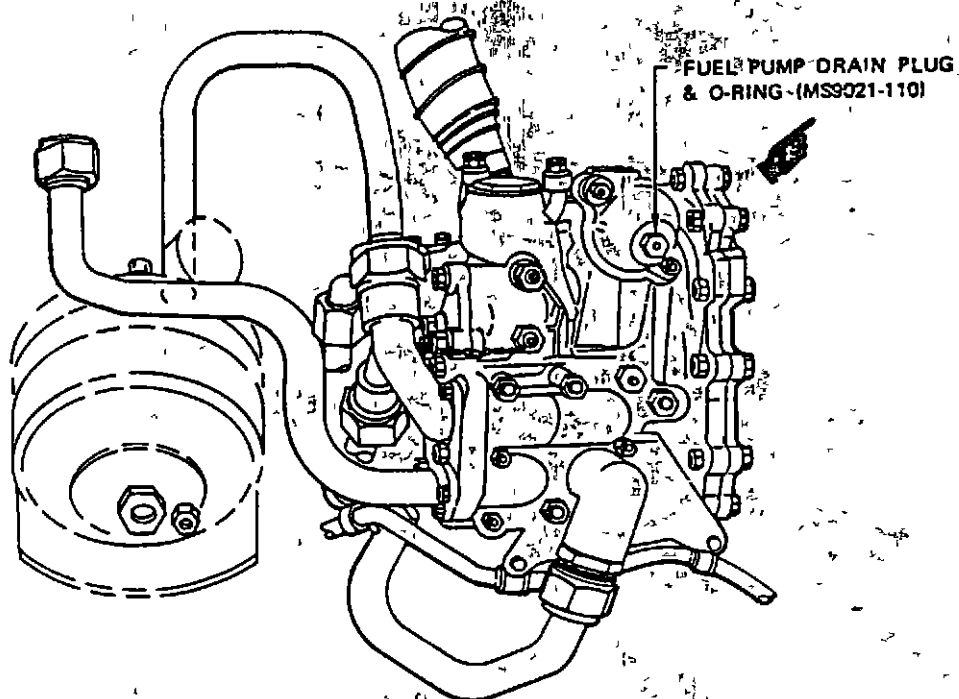


Fuel Flow Transmitter Installation
Figure 401

Ref TO 1E-3A-2-31-1
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Fuel Pump Drain
Figure 402

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2 Fuel Flow Transmitter Installation. (See figure 401)

- A If new or overhauled transmitter, as received, does not have fittings (14) installed, perform the following steps:
- (1) Lubricate new gaskets (13) with petrolatum (W-P-236) and place and align gasket with holes in transmitter
 - (2) Position fitting (14) on top of gasket (13) and align fitting with holes and start bolts (16) with washers (15)
 - (3) Tighten bolts (16) and secure with safety wire
 - (4) Lubricate new O-rings (11) with petrolatum (W-P-236) and install on fittings (14)
- B. Verify the circuit breakers called out in paragraph 1 are open.
- C. Lubricate new O-rings (10) with petrolatum (W-P-236) and install on tube ends (4 and 7)
- D. Install transmitter and align mounting holes and start bolts (5) with washer (6)
- E Slide shell (8) on aft tube (4) forward over O-rings (10 and 11) and start nut (12)
- F. Slide shell (8) on forward tube (7) aft over O-rings (10 and 11) and start nut (12)
- G Tighten bolts (5)
- H Tighten couplings so that there is no gap between nut (12) and shoulder on shell (8) and secure with safety wire

CAUTION OPERATING FUEL FLOW TRANSMITTER WITHOUT FUEL IN LINE MAY CAUSE DAMAGE TO BEARINGS WITHIN THE UNIT.

- (1) Remove AF FORM 1492 danger tags from aircraft external power receptacle and from BATTERY switch on flight engineer's panel
- (2) Provide electrical power
- (3) Provide communication between the applicable engine and flight deck
- (4) Close applicable fire switch
- (5) Close applicable FIRE PROTECTION - SQIB ENG (1, 2, 3 or 4) circuit breaker on P5 circuit breaker panel.

Ref . T O 1E-3A-2-31-1
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- (6) Close the following circuit breakers on P61-1 circuit breaker panel
 - (a) SHUTOFF VALVES - PRIMARY ENG (1, 2, 3 or 4)
 - (b) SHUTOFF VALVES - ALTERNATE ENG (1, 2, 3 or 4)
- (7) Provide suitable container to catch fuel drainage
- (8) Verify that applicable BOOST PUMPS - TANKS (1, 2, 3 or 4) circuit breakers on P61-1 circuit breaker panel are closed
- (9) Loosen fuel pump drain plug. See figure 402
- (10) Press applicable tank aft booster pump flow line switch to ON on P11 flight engineer lower panel.

NOTE The main fuel line to the fuel pump will be pressurized when applicable engine thrust lever is moved to the IDLE position. Pressurizing the fuel line should continue until all evidence of air has disappeared from fuel stream.

- (11) Move applicable engine thrust lever to IDLE position. After all indication of air has disappeared from fuel stream at drain plug, return thrust lever to STOP position and torque plug 12 (+3) inch-pound. Secure with safety wire.

I Connect electrical plug (3) to transmitter and secure with safety wire.

- (1) On aircraft incorporating TCTO 1E-3A-700, if PT2 drain line was removed, reinstall line with clamps and nut at tee of pressure sensing line.

J Close the following circuit breakers on P61-2 circuit breaker panel.

- (1) ENGINE START & INDICATORS - CONTINUOUS IGN - ENG (1, 2, 3 or 4)
- (2) ENGINE START & INDICATORS - START CONTROL & IGNITION - ENG (1, 2, 3 or 4)

K Leak check and check out fuel flow system on engine run.

L Close applicable engine strut access panel that was opened in paragraph 1.

M Replace left side cowling.

3 Fuel Flow Electronic Package Removal

A Open INDICATORS-FLOW-ENG (1, 2, 3 and 4) circuit breakers on the P61-1 panel.

Ref T O 1E-3A-2-31-1
Page 5-40A Change 24
Page 5-40B Change 17

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- B On the RH Radio Rack, release lock and rotate handle on face of the M-35 electronic package to horizontal
- C Carefully slide electronic package completely out and place protective caps on the two receptacles

4 Fuel Flow Electronic Package Installation

- A Verify that INDICATORS-FLOW-ENG (1, 2, 3 and 4) circuit breakers on the P61-1 panel are open.
- B On RH Radio Rack, uncap the electrical receptacles in the M-35 fuel flowmeter electronic package and carefully slide it into its slot with the handle in the horizontal position until the latch engages
- C Rotate handle on face of electronic package to vertical and ensure that it locks
- D Close the circuit breakers called out in paragraph 4 A
- E At the next engine runup perform the following checkout
 - (1) Provide electrical power and start all engines
 - (2) Verify that all fuel flow indicators are operating
 - (3) Verify that the total fuel remaining indicator is decreasing in 100 pound steps At idle, this indicator should step approximately once every 65 to 75 seconds
 - (4) Shut down engines and remove electrical power

5 Fuel Flow Indicator Removal (See figure 3)

- A Open INDICATORS-FLOW-ENG (1, 2, 3 and 4) circuit breakers on the P61-1 panel
- B Remove the four retaining screws on face of indicator and carefully pull out indicator until the aircraft wiring connector is accessible.
- C Disconnect the aircraft wiring connector from indicator, cap the aircraft wiring connector and ensure that it remains accessible

6 Fuel Flow Indicator Installation (See figure 3)

- A Verify that INDICATORS-FLOW-ENG 1, 2, 3 and 4 circuit breakers on the P61-1 panel are open

Ref T O 1E-3A-2-31-1
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- B Remove protective cap from aircraft wiring connector and connect to indicator
- C Insert FF indicator through front of P9-2 panel and secure with the four retaining screws
- D Reset circuit breakers called out in step A..
- E At the next engine runup, assure the fuel flows tapes are functioning

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FUEL FLOW INDICATING SYSTEM - ADJUSTMENT/TEST

1 General

A Tools and Test Equipment.

(1) See table 501 for a listing of the required tools and test equipment

PART NO OR TYPE DESIGNATOR	NOMENCLATURE	USE AND APPLICATION
204-90058-1	Test Adapter Assembly	To check fuel flow indicator and the electronic package.
AN/PSM-6 (Simpson 260)	Multimeter	To check fuel flow indicator and electronic package
Tektronix 475	Oscilloscope and Associated Test Leads and Probes	To check fuel flow indicator and the electronic package
206-0060-00 Tektronix (Local Purchase)	Probe Spring Tip	To adapt oscilloscope test lead terminations to tip plugs (Two required)
103-0051-00 Tektronix (Local Purchase)	Miniature Probe to #6-32 Adapter	To adapt oscilloscope test lead termination to accept a probe spring tip (One required)
204-92002-1	Power Supply Cable	To permit the Tektronix 475 oscilloscope to be connected to 115 vac, 400 Hz

Fuel Flow System Tools and Test Equipment
Table 501

Ref : DRW CDRL 43/44 Issue D dated May 19/89
Paragraph 7 12

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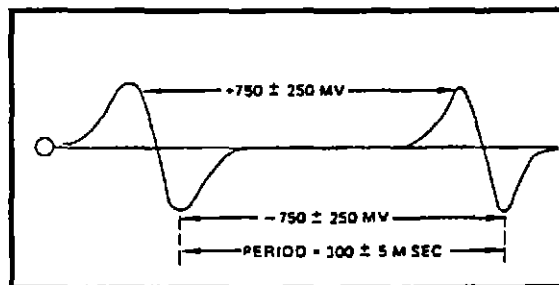
2 Operational Checkout.

A Check the fuel flow indicating system as follows:

- (1) Open fuel FLOW ENG. 1, 2, 3 and 4 circuit breaker on P4 circuit breaker panel
- (2) Place 204-90058-1 test adapter assembly (breakout box) on the floor of the electronic compartment directly below the fuel flow electronic package on rack.
- (3) Connect techtronic 475 oscilloscope to 115 vac, 400 (5) Hz outlet located directly below the electronic package.
- (4) Disconnect and remove fuel flow electronic package
- (5) Disconnect and remove black adapter box (dummy) attached to test adapter assembly.
- (6) Place adapter box where electronic package was located and connect to aircraft wiring
- (7) Place electronic package on test adapter assembly and latch in place. Verify that the nine output channel jumpers are installed in the adapter assembly
- (8) Close circuit breaker opened in step (1)
- (9) Provide electrical power
- (10) Verify that all fuel flow indicator OFF flags are out of view
- (11) Using the Simpson 260 multimeter, check applicable channel voltages at the test points on the test adapter assembly as follows
 - (a) 115 VAC 400 Hz power to CASE GND ($115V \pm 10V$)
 - (b) FUEL FLOW TRANSMITTER - MOTOR PHASE A to COMMON (29 ± 5 0 vac)
 - (c) FUEL FLOW TRANSMITTER - MOTOR PHASE B to COMMON (29 ± 5 0 vac)
- (12) Using Tektronix 475 oscilloscope and test lead adapters shown in figure 5-19, check applicable channel voltages at the test points on the test adapter assembly as follows.
 - (a) FUEL FLOW TRANSMITTER - DRUM INPUT (1) to DRUM/IMPELLER INPUT COMMON. Verify drum signal amplitude and period per limits shown in figure 501

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Paragraph 7.12

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Drum Signal Amplitude and Period per Limits
Figure 501

Ref DRW CDRL 43/44 Issue D dated May 19/89
Paragraph 7 12

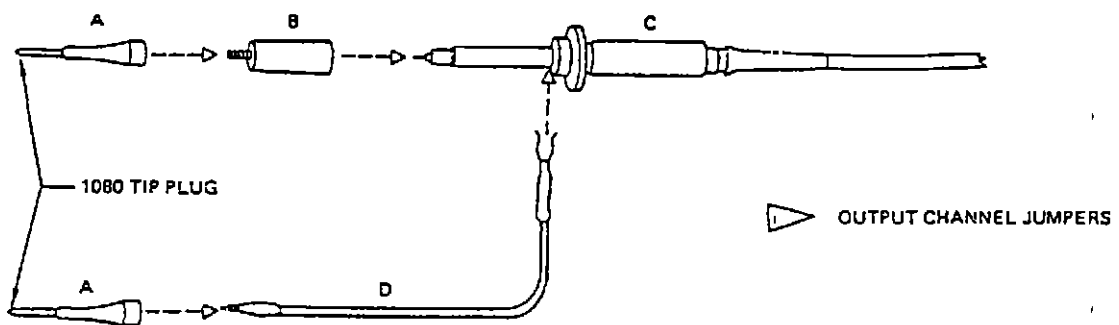
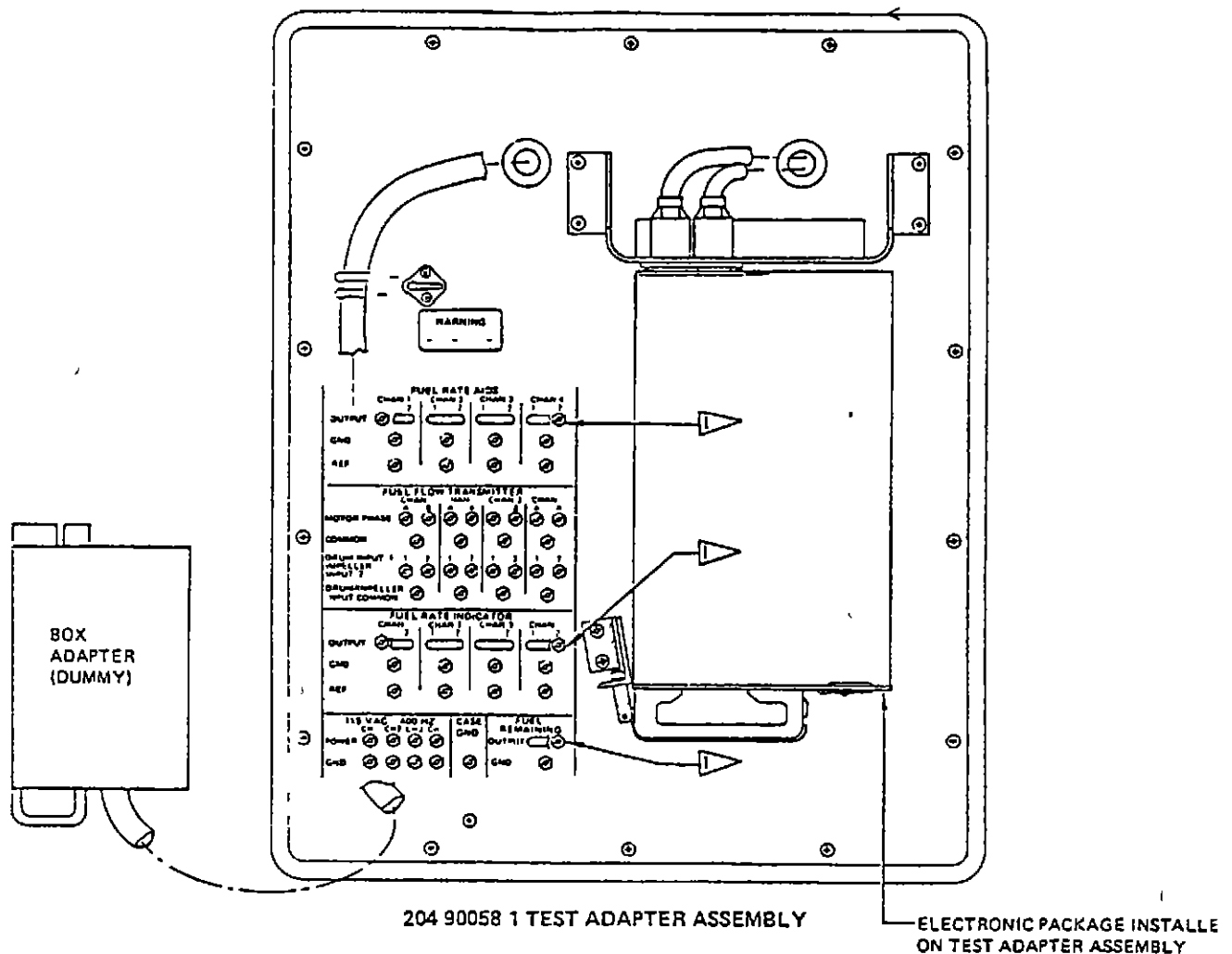
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(b) FUEL FLOW TRANSMITTER - IMPELLER INPUT (2) to DRUM/IMPELLER INPUT COMMON. Verify drum signal amplitude and period per limits shown in figure 501

- (13) Start engines
- (14) With engines at idle, verify that each fuel flow tape (scale) indicates 1100-1200 PPH. Verify that no red flag is displayed by any fuel flow tape
- (15) Using Tektronix 475 oscilloscope, check that a signal pulse can be observed at the following test point on the test adapter assembly
- (16) With all four engines operating at idle (1100 to 1200 pph).
- (17) Open the fuel FLOW circuit breaker on P4 circuit breaker panel. The OFF flags shall appear on all four aircraft fuel flow indicators.
- (18) Disconnect test equipment and reconnect fuel flow electronic package to aircraft wiring.
- (19) Close the fuel FLOW circuit breaker. The OFF flags shall disappear.
- (20) Verify that fuel flow indicators are operating normally.
- (21) Shut down engines and remove electrical power, if no longer required for other maintenance.

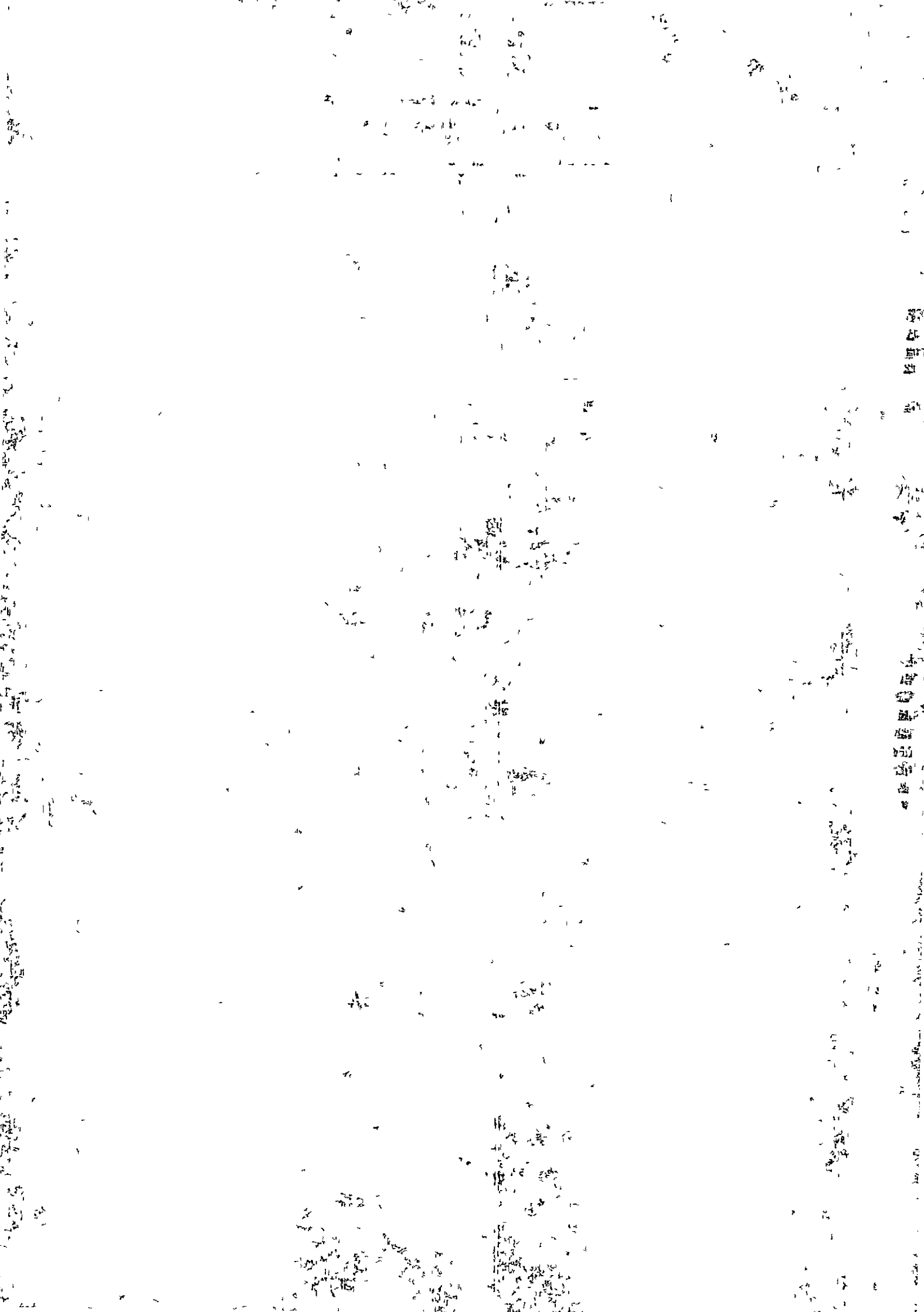
Ref. DRW CDRL 43/44 Issue D dated May 19/89
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TEKTRONIX P/N	
A	PROBE SPRING TIP 206 0060-00
B	MINIATURE PROBE TO #6 32 ADAPTER 103 0051-00
C	TEST LEAD P6075A
D	GROUND LEAD 175 0124-01 OR 175 0125 01

Fule Flow System Test Set
Figure 502
Ref - DRW CDRL 43/44 Issue D dated May 19/89
Paragraph 7 12



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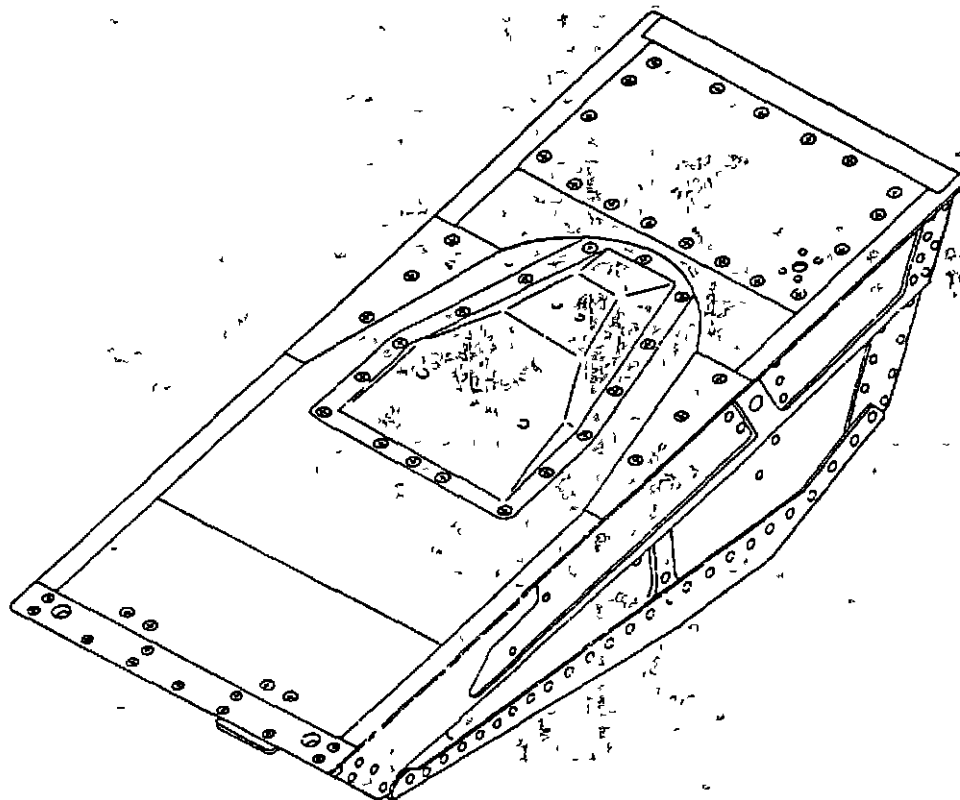
UNIVERSAL AERIAL REFUELING RECEPTACLE SLIPWAY INSTALLATION
DESCRIPTION AND OPERATION

1 GENERAL

- A The UARRSI is a hydraulically and mechanically operated assembly, which provides for refueling of an aircraft while in flight. TCA aircraft are dry refueling tanker training/cargo aircraft. Fuel flow will be prevented by blocking the UARRSI fuel outlet.
- B The UARRSI consists of a structural box (See Figure 1) enclosing the hydraulic lines, valves, cylinder, mechanical components, and receptacle. A door is closed to provide good aerodynamic characteristics while the aircraft is in flight. When refueling, the door is opened making the receptacle available to the fuel nozzle from the tanker aircraft. Normally the door is opened hydraulically but can be opened mechanically in the event that hydraulic power is lost.
- C The UARRSI door is opened and closed by a cable (See Figure 2). Switches within the UARRSI provide the receiver with door locked/unlocked, nozzle contact, and nozzle latched/unlatched indications. An induction coil and audio amplifier allow the receiver to maintain voice communications with the tanker during refueling operations.
- D The UARRSI consists of a receptacle, a door actuator assembly, an amplifier, and a box to house the components. In the closed position the slipway door is latched shut by the uplock arm on the door actuator assembly. When the control cable is actuated, a cam on the door actuator assembly moves the uplock arm out of position, unlocking the door piston. The cam also actuates the manual door valve which connects the hydraulic pressure to the door cylinder. With pressure applied to the door cylinder, the door arm is rotated down, opening the slipway door. When fully open a downlock arm locks the door cylinder in the open position. Switch S5 on the door actuator indicates that the door is open or closed. In the open position, switch S5 causes the READY lamp on the pilot's console to illuminate. Switch S1 on the door actuator indicates that the door is locked or unlocked. In the unlocked position, switch S1 causes the OPEN/UNLOCKED lamp on the pilot's console to illuminate.
- E When the READY lamp is illuminated the aerial refueling nozzle can be inserted into the receptacle. Switch S2 on the receptacle indicates that the nozzle is in contact. In the no contact position, switch S2 causes the DISCONNECT lamp on the pilot's console to illuminate. In the contact position, switch S2 causes the CONTACT lamp on the pilot's console to illuminate. In addition, switch S2, in the contact position, energizes the latch solenoid in the door actuator assembly. The solenoid valve then routes hydraulic pressure to the latch port of latch cylinder on the receptacle. The latch cylinder actuates, latching the refueling nozzle in place. An internal actuator within the door actuator assembly latches the door valve actuator in the open position.

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Page 1-1 Change 0

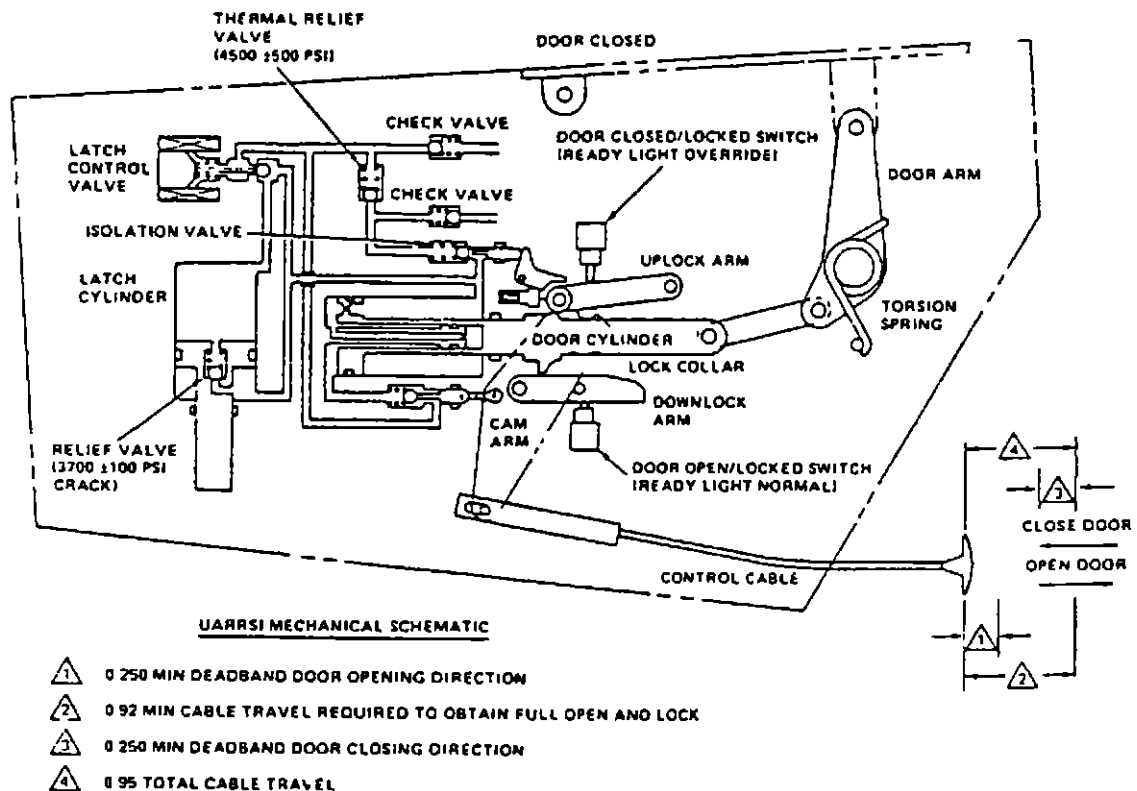
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Universal Aerial Refueling Receptacle Slipway Installation (UARRSI)
Figure 1

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Page 1v Change 0

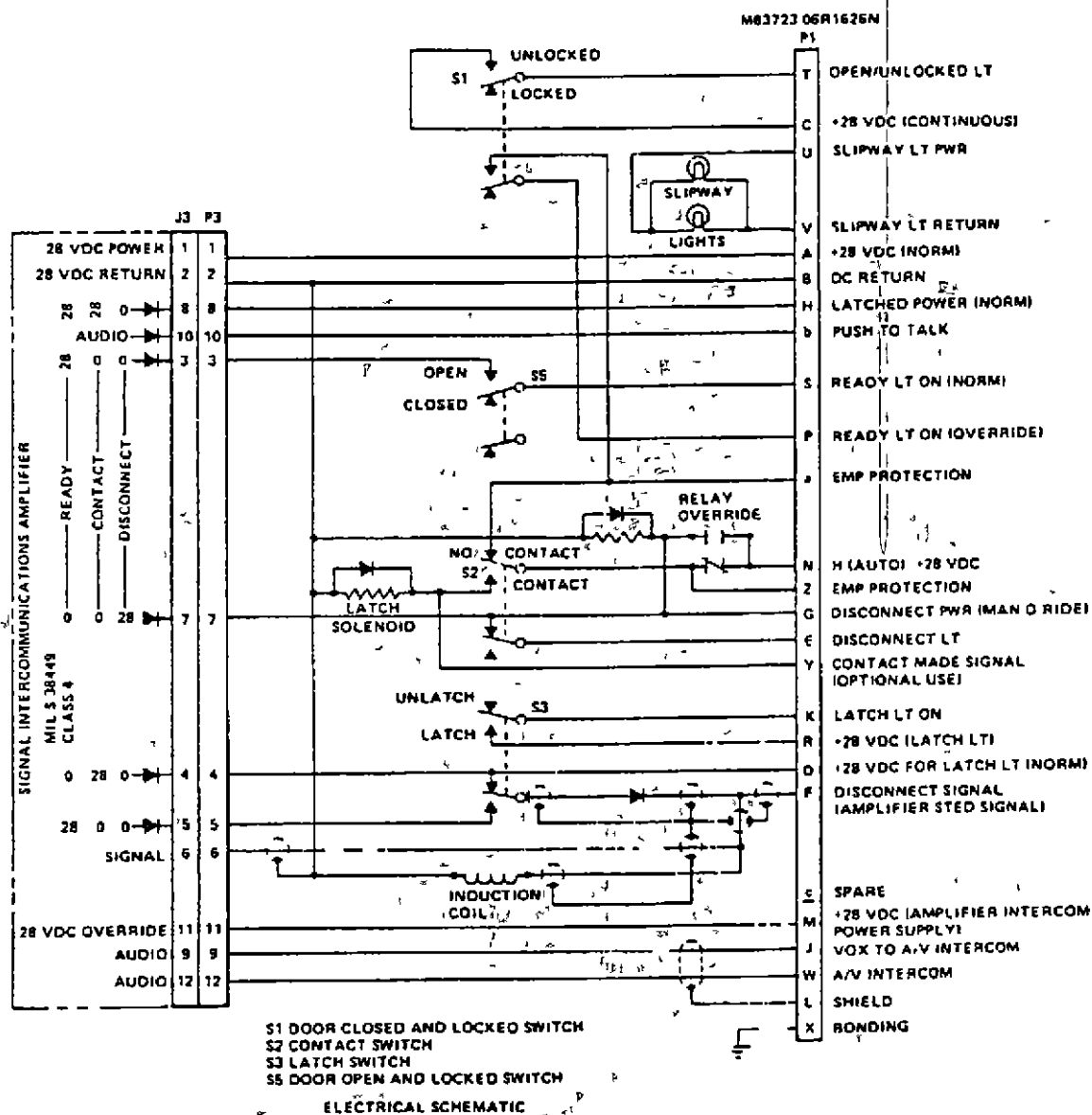
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Universal Aerial Refueling Receptacle Slipway Installation (UARRSI)
 Mechanical (Schematic)
 Figure 2

Ref T O 6A6-20-2
 Page 1-2 Change 0

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Universal Aerial Refueling, Receptacle Slipway Installation (UARRSI)
Electrical (Schematic)
Figure 3

Ref. T'O 6A6-20-2
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tion preventing accidental closing of the slipway door while the nozzle is latched in the receptacle. When the UNLATCH switch in the aircraft or tanker is pressed, the latch solenoid in the door actuator is deenergized. Hydraulic pressure is then removed from the latch port of the latch cylinder and applied to the unlatch port. The nozzle is immediately unlatched from the receptacle, allowing it to be removed by the tanker. Once the nozzle is unlatched, the door actuator control cable may be placed in the closed position. The cam on the door actuator moves the downlock arm out of position and hydraulic pressure is applied to the door close port of the door cylinder. The door mechanism closes the slipway door. When fully closed the uplock arm locks the door cylinder in the door closed position.

E. Fail Safe Features

- (1) The UARRSI has a number of fail safe features. It has a locking feature which prevents accidental shutting of the slipway door while a nozzle is latched in the receptacle. Normal control of the UARRSI such as disconnect control is controlled from the aircraft and/or the tanker through the amplifier. In an emergency, the UARRSI can be overridden, bypassing the amplifier. In override, a kickout relay is energized and the pilot's DISCONNECT switch directly controls the latch solenoid. If hydraulic power is lost to the UARRSI, the slipway door can be opened mechanically. Two large springs provide the power to open the door when hydraulic power is lost. With loss of hydraulic power, however, the door cannot be re-closed nor can the refueling nozzle be latched. If hydraulic power is lost after the nozzle is latched, the nozzle will remain latched for some time since hydraulic pressure will be retained in the latch cylinder until the pilot presses the DISCONNECT switch.

2 LEADING PARTICULARS.

A A list of leading particulars is shown in table 1.

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Dimensions (max overall)	36-1/8x 14-1/4x 12-3/4inches
Weight (max)	85 lbs
Service Fluid	Hydraulic Fluid (MIL-H-83282) or (MIL-H-5606) Fuel (JP4 or equivalent)
Hydraulic Pressure (pressure port)	
Working	3000 psig
Proof	6000 psig
Burst	10,000 psig
Hydraulic Pressure (Return port)	
Working	200 psig
Proof	3000 psig
Burst	6000 psig
Flow (Hydraulic)	1 gpm at 3000 psig
Temperature	
Ambient	-65 to +160°F (-54 to 71°C)
Fluid	-65 to +160°F (-54 to 71°C)
Leakage (fuel)	
External	0 at 240 psi
Leakage (Hydraulic)	
External	0 at 3000 psi
Electrical	
Voltage	18 to 30 vdc (28 vdc nominal)
Current	5 amperes max
Nozzle Entry Angle	
2760117-101	46°
2760117-102	41°

Leading Particulars
Table 1

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UNIVERSAL AERIAL REFUELING RECEPTACLE SLIPWAY INSTALLATION
TROUBLE SHOOTING

1 TROUBLE ANALYSIS

- A The troubleshooting data contained in tables 101 through 104 shall be used to isolate a system malfunction to a specific failed component. The system malfunction will have been observed during either checkout or normal system operation, the operational checkout procedure should be performed to verify the malfunction and simplify troubleshooting. Once the trouble is located, perform the steps of the ISOLATION PROCEDURE column. If condition is not as specified, accomplish remedy. Always open the applicable circuit breakers to cut off power prior to connecting or disconnecting any connectors for troubleshooting.

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TROUBLE	PROBABLE CAUSE	REMEDY
Excessive external leakage	Defective packings	Replace latch cylinder
Excessive internal leakage	Defective packing	Replace latch cylinder
Binding or erratic movement	Defective or damaged gland, piston or barrel	Replace latch cylinder
Relief valve does not crack and/or reseal at correct pressure	Defective relief valve in piston	Replace latch cylinder

UARRSI Latch Cylinder - Trouble Shooting
Table 101

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive external leakage (fuel)	Defective poppet, seal or packing	Replace defective part
Nozzle latches do not engage when nozzle is inserted in receptacle	Defective latch cylinder	Replace latch cylinder
Nozzle latches do not latch	Defective latch cylinder	Repair latch cylinder
Contact switch S2 does not actuate when nozzle is inserted in receptacle	Switch S2 improperly adjusted or defective.	Check switch adjustment Replace switch if defective
Latch switch S3 does not actuate when nozzle is latched	Switch S3 improperly adjusted or defective	Check switch adjustment Replace switch if defective

UARRSI Receptacle - Trouble Shooting
Table 102

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Page 4-10 Change 0

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TROUBLE	PROBABLE CAUSE	REMEDY
Excessive internal leakage, door closed	Defective door valve	Check door valve and replace defective components Replace ball, packings, pin, and spring regardless of condition
Excessive internal leakage, door open, solenoid deenergized	Defective door valve seat or solenoid pilot valve	Check door valve and solenoid pilot valve and replace defective components If solenoid valve is defective, replace packings, spring and ball regardless of condition
Excessive external leakage	Defective piston or packings	Replace defective component
Door cylinder does not operate correctly Latch cylinder okay	Defective door valve	Check door valve and replace defective components Replace ball, packings, pin and spring regardless of condition
Door cylinder okay Latch cylinder does not operate correctly	Defective solenoid pilot valve	Check solenoid pilot valve and replace defective component Replace packings, spring, and ball regardless of condition
Neither cylinder operates, significant hydraulic flow	Defective door valve	Check door valve and replace defective components Replace ball, packings, pin and spring regardless of condition
Fails insulation resistance and/or dielectric strength test	Defective wire leads, electrical connector, solenoid, or switches	Check wiring, connector, solenoid, and switches and replace defective part

UARRSI Door Actuator Assembly - Trouble Shooting
Table 103

Ref . T O 6A6-20-2
Page 4-10 Change 0

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TROUBLE	PROBABLE CAUSE	REMEDY
Excessive pull force required on cable	Defective control cable assy (84, Figure 402)	Replace control cable
	Defective door actuator assy (47, Figure 402)	Repair door actuator assy
Door does not open and door unlock light not on	Control cable assy (84) and/or door lock on door actuator assy (47) misadjusted. See Figure 402).	Check control cable and door lock adjustments and readjust as necessary
Door does not open and door unlock light illuminates	Defective door actuator assy (47, Figure 402)	Repair door actuator assy
Door opens, door unlocks, light illuminates, ready light not on (normal mode)	Control cable assy (84, Figure 402) misadjusted	Adjust as necessary
	Switch S5 defective or misadjusted.	Readjust switch as necessary or replace if defective
	Door actuator assy (47, Figure 402) piston misadjusted	Readjust as necessary
Door opens, door unlock light illuminates, ready light not on in normal mode Ready light on in override mode	Defective amplifier (98) or harness assy (104) (See Figure 402)	Replace amplifier if defective Repair harness assy if defective
Door opens and ready light is on. Receptacle does not latch nozzle when inserted (normal mode)	Contact switch S2 defective or misadjusted	Replace switch if defective or readjust as necessary
	Defective door actuator assy (47, Figure 421)	Repair door actuator assy
Door opens and ready light is on. Receptacle does not latch nozzle when inserted but latches in override mode	Defective amplifier (98) or harness assy (104) (See Figure 402)	Replace amplifier if defective Repair harness assy if defective

Universal Aerial Refueling Receptacle Slipway Installation - Trouble Shooting
Table 104 (Sheet 1 of 2)

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TROUBLE	PROBABLE CAUSE	REMEDY
Nozzle latches but latch light not on	Defective or misadjusted latch switch S3	Replace switch if defective or readjust as necessary
Latches chatter when latched	Excessive hydraulic pressure during testing	Check test setup and correct test pressure
	Defective latch cylinder	Repair latch cylinder
Receptacle releases nozzle from UARRSI command but will not release nozzle from tanker command	Induction coil defective	Replace induction coil
Receptacle will not unlatch nozzle in normal mode but okay in override mode	Defective amplifier (98 figure 402)	Replace amplifier
Poor intercom signal	Defective amplifier (98) or induction coil (37) (Figure 402)	Replace defective component
Door does not close	Defective door actuator assy (47, Figure 402)	Repair door actuator assy
	Control cable assy (84, Figure 402) misadjusted.	Adjust as necessary
Door closes but door closed light not on	Switch S1 defective or misadjusted	Replace switch if defective or readjust as necessary
	Door actuator piston misadjusted	Readjust as necessary

Universal Aerial Refueling Receptacle Slipway Installation - Trouble Shooting
Table 104 (Sheet 2 of 2)

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UNIVERSAL AERIAL REFUELING RECEPTACLE SLIPWAY INSTALLATION
REMOVAL/INSTALLATION

1 General

- A This section contains instructions for removal and installation of the various components of the UARRSI

NOTE During disassembly, cap all disconnected hydraulic lines and opened ports

2 Removal/Installation of Box Assembly (See Figure 401)

- A The box assembly is riveted and requires a special fixture to locate and match its component parts. Disassembly is limited to parts which do not require the special fixture. No disassembly of the box assembly is required unless one of these parts requires repair or replacement. If a portion of the box assembly is damaged and requires replacement, the part is removed by removing the appropriate screws, nuts, washers, and rivets.

3 Remove Access Lid Assembly (See Figure 402)

- A Remove screws (2) securing lid assembly (1) and remove lid assembly from box assembly (135).
- B If replacement of grommet (4) is required, remove rivets (5) securing retainer (3) to lid assembly and remove retainer and grommet from lid assembly.

4 Install Access Lid Assembly (See Figure 402)

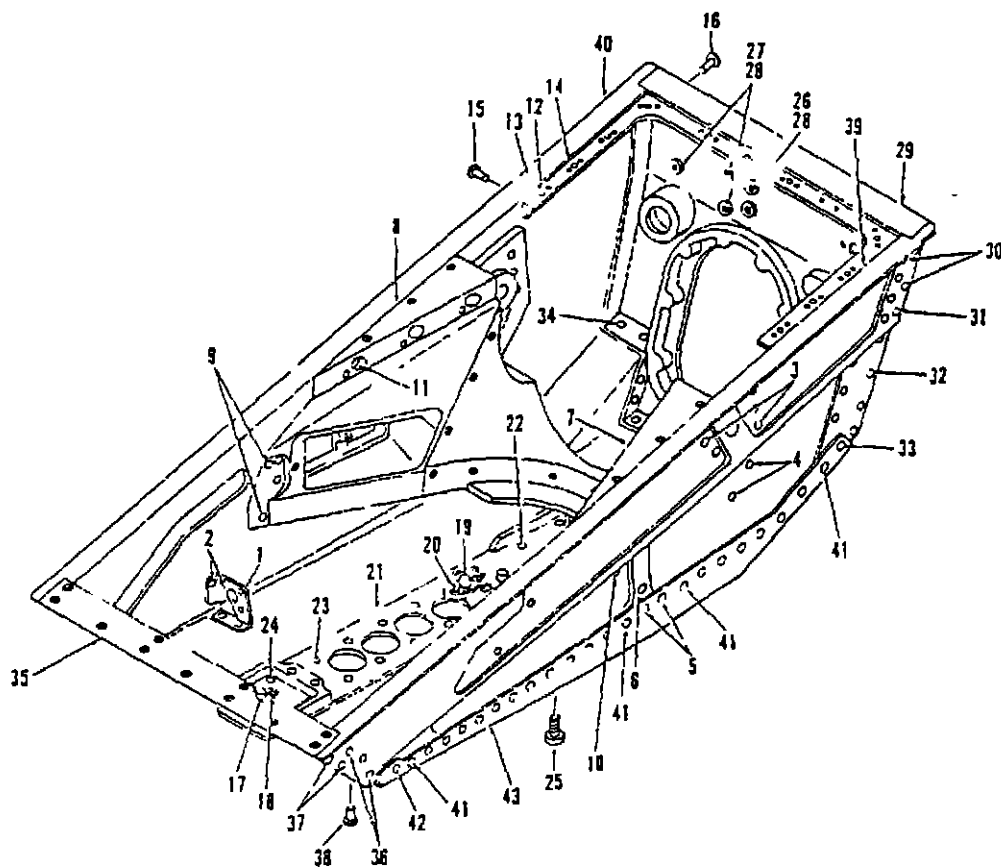
- A If required, install new grommet (4) on retainer (3), and secure retainer and grommet to lid assembly using rivets (5).
- B Attach access lid assembly (1) to box assembly (135) with screws (2).
- C Tighten screws. Note that access lid assembly may be temporarily installed on box assembly with four screws until after completion of testing.

5 Remove Impact Plate (See Figure 402)

- A Remove screws (28) and packings (29) securing impact plate assembly (27) to box assembly (135) and remove impact plate assembly.
- B Remove rivets (31) if replacement of nutplates (30) is required. Remove nutplates from impact plate (27).

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Page 5-11 Change 0
Page 5-34 Change 0

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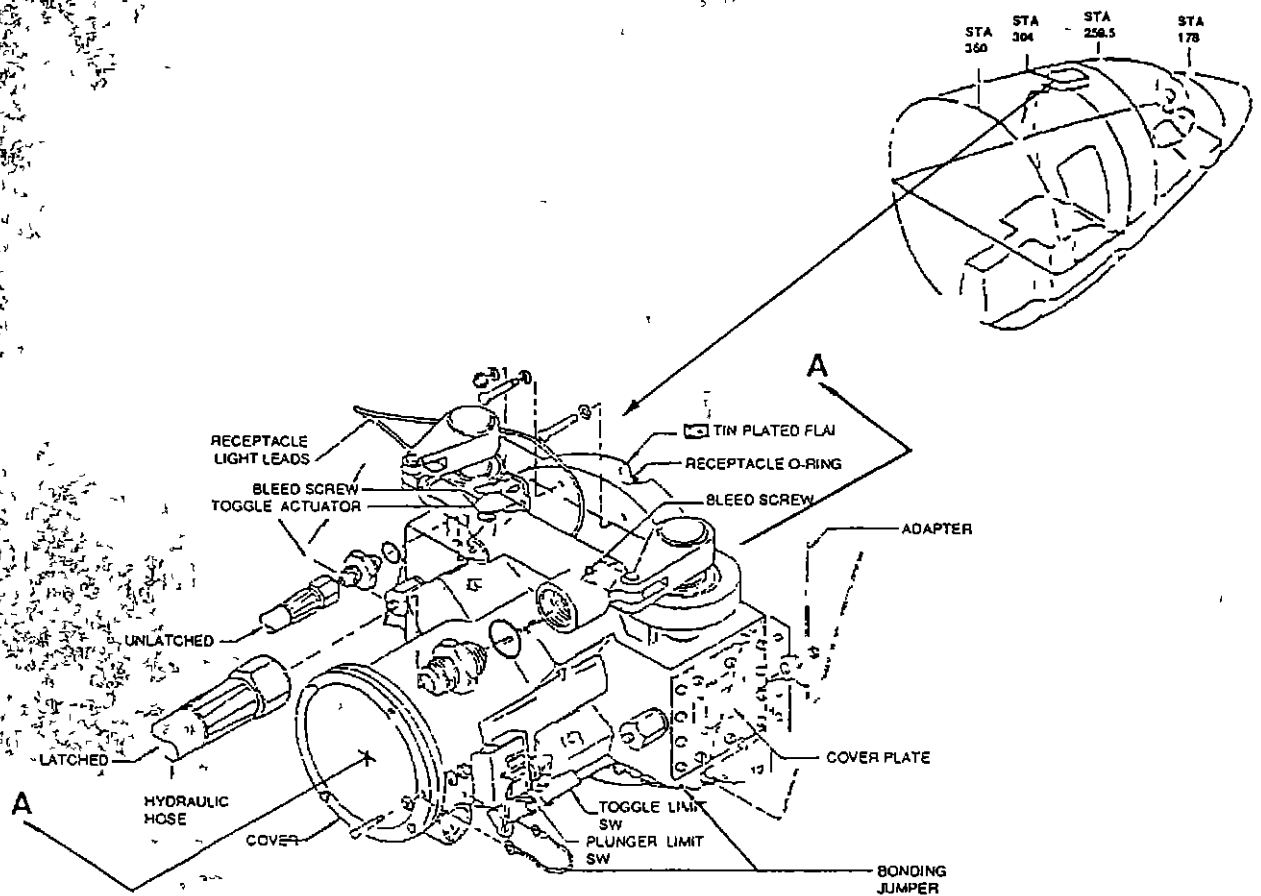


1 Harness Bracket	16. Rivet (7 reqd)	30 Rivet (6 reqd)
2 Rivet (3 reqd)	17 Nutplate (6 reqd)	31 Rivet (8 reqd)
3 Rivet (10 reqd)	18 Rivet (12 reqd)	32 Rivet (14 reqd)
4 Rivet (4 reqd)	19 Boss Assy (3 reqd)	33 Rivet (2 reqd)
5 Rivet (4 reqd)	20 Rivet (6 reqd)	34 Rivet (14 reqd)
6 Rivet (2 reqd)	21 Channel Assy	35 Bulkhead Assy
7 LH Gusset Assy	22 Rivet (8 reqd)	36 Rivet (6 reqd)
8 RH Gusset Assy	23 Rivet (8 reqd)	37 Rivet (4 reqd)
9 Rivet (4 reqd)	24 Rivet (6 reqd)	38 Rivet (6 reqd)
10 Rivet (2 reqd)	25 Screw (2 reqd)	39 LH Side Rail Assy
11 Screw (6 reqd)	26 Insert (2 reqd)	40 RH Side Rail Assy
12 Nutplate (12 reqd)	27 Insert (3 reqd)	41 Rivet (42 reqd)
13 Rivet (24 reqd)	28 Nut (5 reqd)	42. Rivet (2 reqd)
14 Gusset	29 Bulkhead Assy	43 Pan
15 Rivet (8 reqd)		
16 Rivet (7 reqd)		

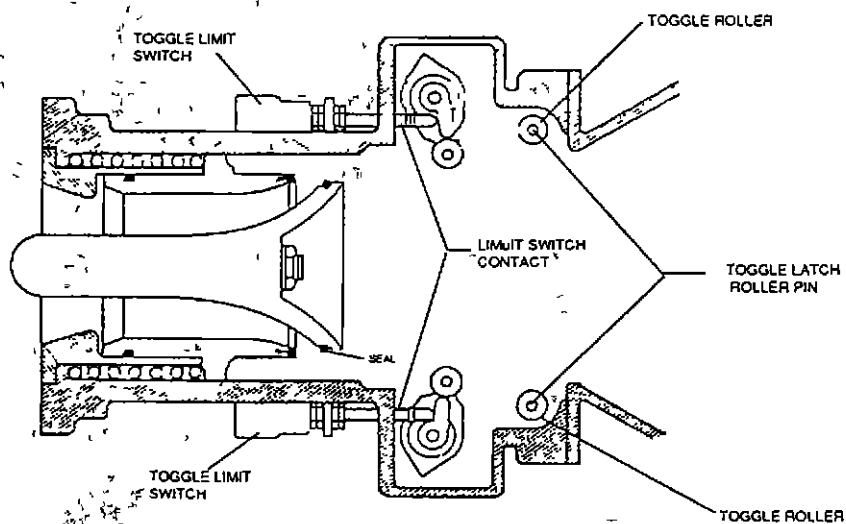
UARRSI - Box Assembly
Figure 401

Ref T O 6A6-20-2
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VIEW A - A



UARRSI - Receptacle
Figure 401A

Ref T O NN1E-3A-2-28-1

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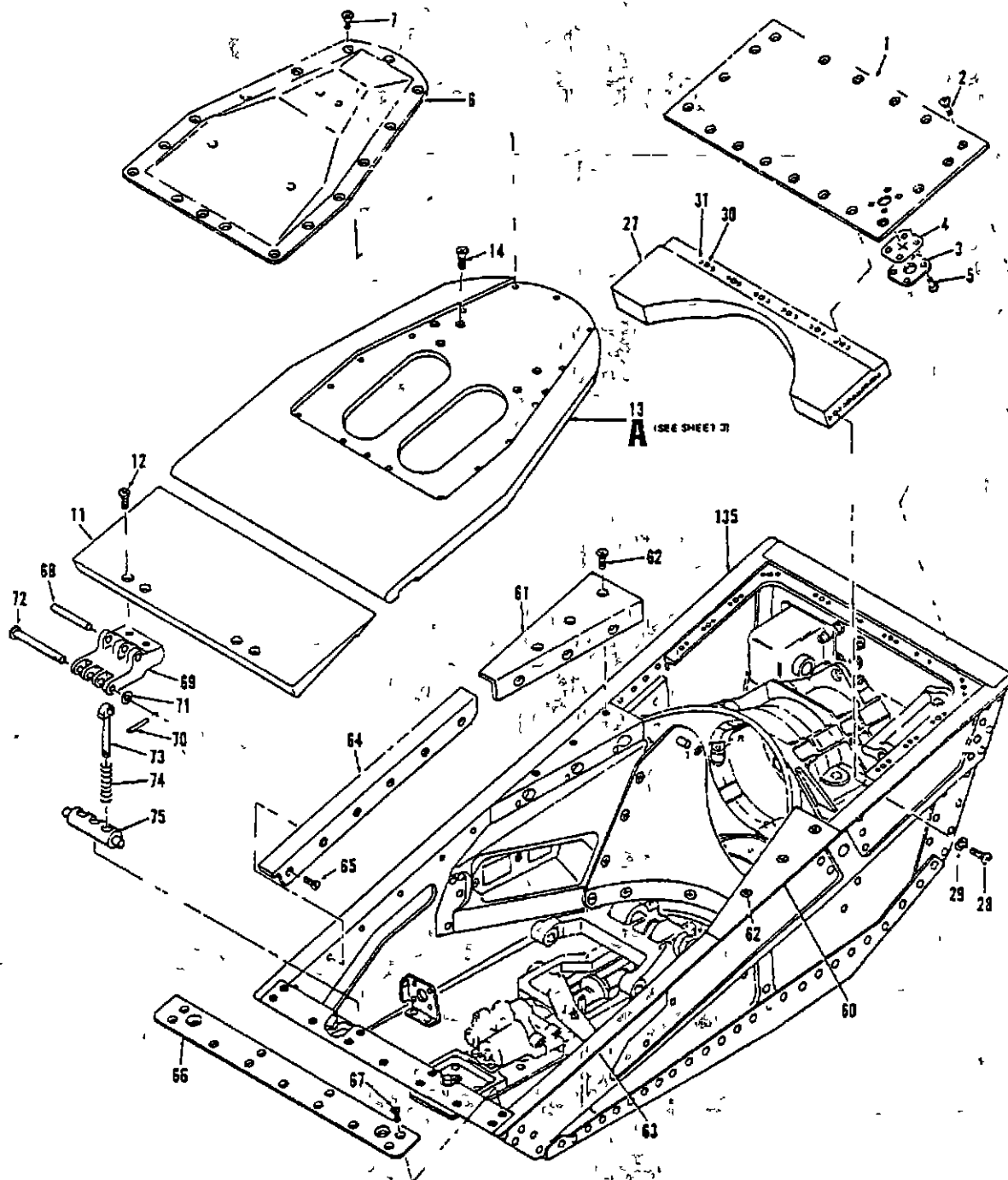
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- 6 Install Impact Plate Assembly (See Figure 402)
 - A If required, install new nutplates (30) Secure nutplates on impact plate (27) using rivets (31)
 - B Lightly coat packings (29) with petroleum VV-P-236 or equivalent.
 - C Install impact plate assembly (27) to box assembly (135) with packings (29) and screws (28) Tighten screws
- 7 Remove Flap Door (See Figure 402)
 - A Remove screws (12) securing flap door (11) and remove flap door from hinge assemblies (69)
- 8 Install Flap Door (See Figure 402)
 - A Install flap door (11) on hinge assembly (69) with screws (12) Tighten screws
 - B Check flap door for smooth operation by pulling it up There shall be no binding or rubbing
- 9 Remove Scuff Plate Assembly (See Figure 402)
 - A Remove screws (7) securing scuff plate assembly (6) and remove scuff plate assembly from door and roller assembly (13)
- 10 Install Scuff Plate Assembly (See Figure 402)
 - A Install scuff plate assembly (6) to door and roller assembly (13) with screws (7)
 - B Tighten screws
- 11 Remove Door and Roller Assembly (See Figure 402)
 - A Remove screws (14) from door and roller assembly (13) and remove door and roller assembly by lifting door to vertical position and pulling rollers in towards center of door, releasing rollers from slots in side rails of box assembly (135)
 - B Remove screws (21) and washers (22) from door roller housings (20) and remove door roller housing from door assembly (23).
 - C Remove cam bearing (15), button assembly (16), bushings (17) and springs (18) by unscrewing button assembly from cam bearing Remove bushing (19) from door roller housing (20)

Ref T O 6A6-20-2
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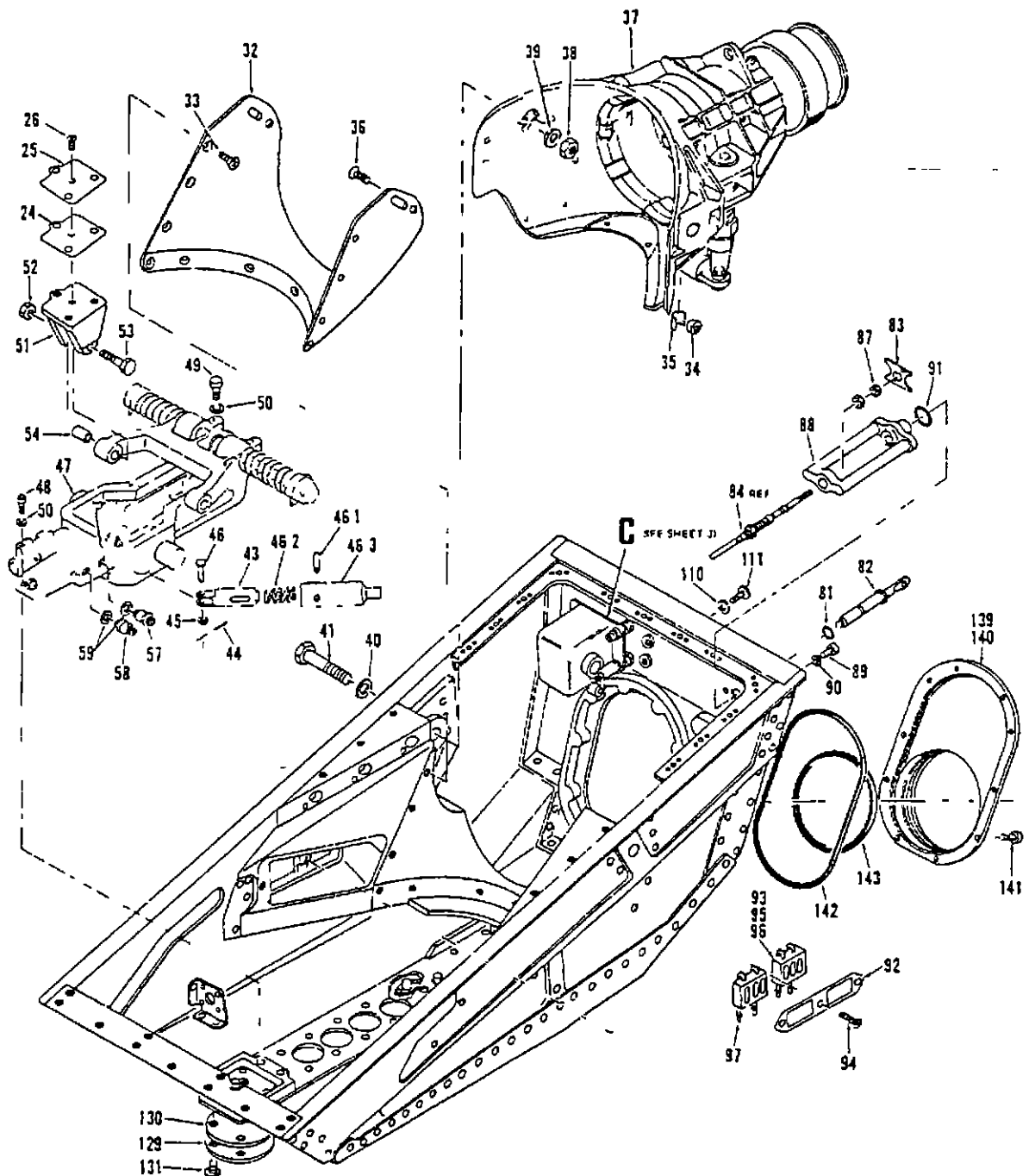
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UARRSI - Exploded view
 Figure 402 (Sheet 1)

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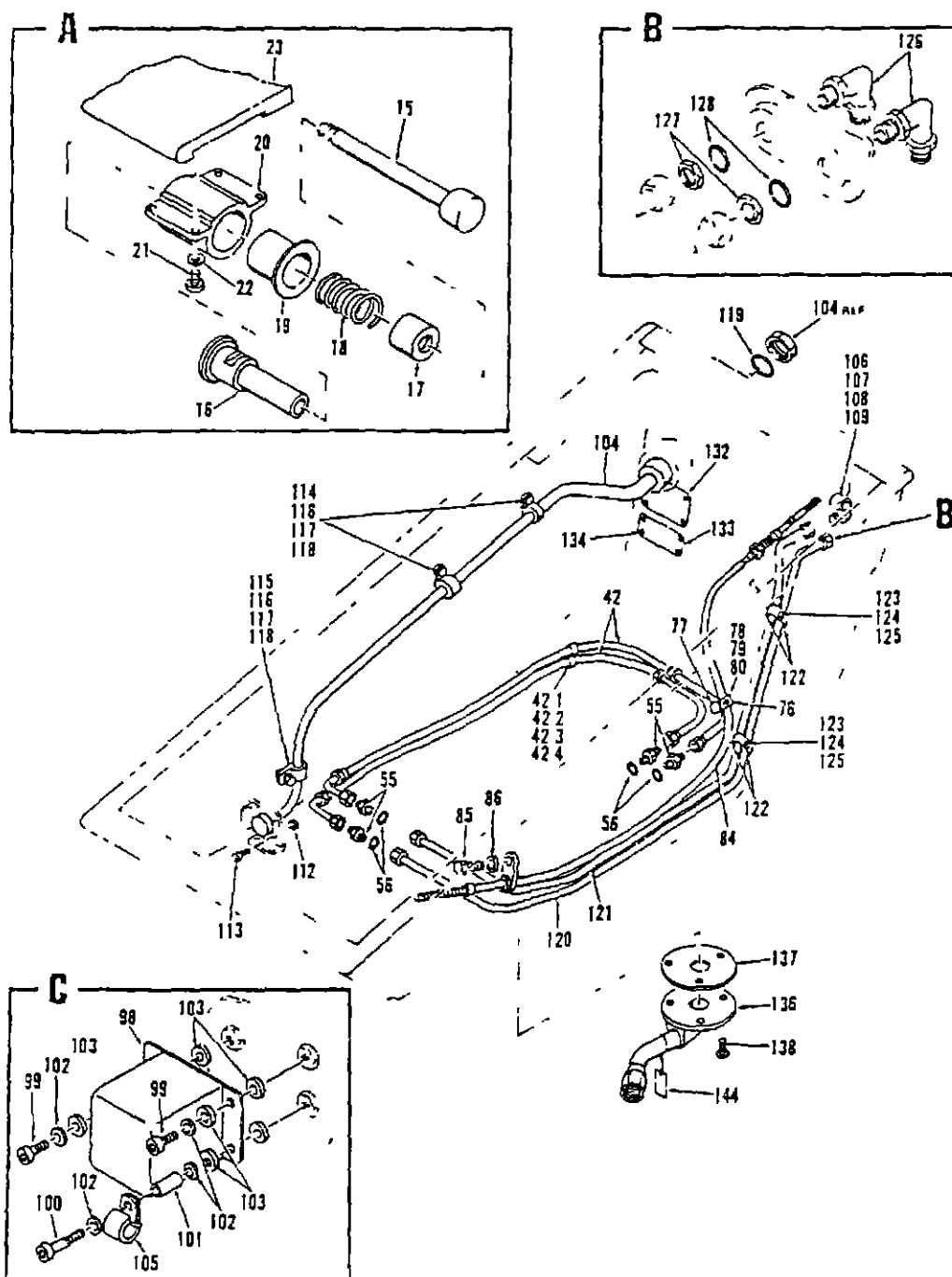
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UARRSI - Exploded view
Figure 402 (Sheet 2)

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UARRSI - Exploded view
Figure 402 (Sheet 3)

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1	Lid Assy	48	Screw (2 reqd)	102	Washer (4 reqd)
2	Screw (18 reqd)	49	Screw (2 reqd)	103	Dampener (6 reqd)
3	Retainer	50	Washer (4 reqd)	104	Harness Assy
4	Grommet	51	Bracket As / (2 reqd)	105	Clamp
5	Rivet (4 reqd)	52	Nut (2 reqd)	106	Clamp (2 reqd)
6	Scuff Plate Assy	53	Bolt (2 reqd)	107	Nut
7	Screw (16 reqd)	54	Bushing (2 reqd)	108	Washer
8	Not Assigned	55	Union (4 reqd)	109	Screw
9	Not Assigned	56	Packing (4 reqd)	110	Washer (2 reqd)
10	Not Assigned	57	Pressure Check Valve	111	Screw (2 reqd)
11	Flap Door	58	Return Check Valve	112	Nut (3 reqd)
12	Screw (4 reqd)	59	Packing (2 reqd)	113	Screw (3 reqd)
13	Door and Roller Assy	60	LH Side Gusset ScuffPlate	114	Clamp (2 reqd)
14	Screw (6 reqd)	61	RH Side Gusset ScuffPlate	115	Clamp
15	Cam Bearing	62	Screw (12 reqd)	116	Nut (3 reqd)
16	Button Assy	63	LH Side Rail Scuff Plate	117	Washer (3 reqd)
17	Bushing	64	RH Side Rail Scuff Plate	118	Screw (3 reqd)
18	Spring	65	Screw (12 reqd)	119	Packing
19	Bushing	66	FWD Bulkhead Scuff Plate	120	Return Tube Assy
20	Door Roller Housing	67	Screw (11 reqd)	121	Pressure Tube Assy
21	Screw (8 reqd)	68	Hinge Pin (2 reqd)	122	Clamp (4 reqd)
22	Washer (8 reqd)	69	Hinge Assy (2 reqd)	123	Nut (2 reqd)
23	Door Assy	70	Cotter Pin (2 reqd)	124	Washer (2 reqd)
24	Shim (4 reqd)	71	Washer (2 reqd)	125	Screw (2 reqd)
25	Shim (10 reqd)	72	Pin (2 reqd)	126	Elbow (2 reqd)
26	Screw (2 reqd)	73	Spring Guide (6 reqd)	127	Nut (2 reqd)
27	Impact Plate Assy	74	Spring (6 reqd)	128	Packing (2 reqd)
28	Screw (8 reqd)	75	Trunnion (2 reqd)	129	Cover (3 reqd)
29	Packing (8 reqd)	76	Clamp	130	Gasket (3 reqd)
30	Nutplate (14 reqd)	77	Clamp	131	Screw (9 reqd)
31	Rivet (28 reqd)	78	Nut (2 reqd)	132	Nameplate
32	Receptacle Scuff Plate	79	Washer (2 reqd)	133	Nameplate
33	Screw (12 reqd)	80	Screw (2 reqd)	134	Drive Screw (8 reqd)
34	Barrel Nut (2 reqd)	81	Seal	135	Box Assy
35	Retainer (2 reqd)	82	Eye	136	Drain Assy
36	Screw (2 reqd)	83	Lock	137	Gasket
37	Receptacle Assy	84	Control Cable Assy	138	Screw (3 reqd)
38	Nut (2 reqd)	85	Screw	139	Adapter Plate
39	Washer (2 reqd)	86	Washer	140	Adapter Plate
40	Packing (2 reqd)	87	Nut	141	Screw (10 reqd)
41	Bolt (2 reqd)	88	Cable Bracket Assy	142	Packing
42	Hose Assy	89	Screw (2 reqd)	143	Packing
42 1	Clamp (2 reqd)	90	Packing (2 reqd)	144	Warning Tag
42 2	Nut	91	Packing		
42 3	Washer	92	Light Retainer (2 reqd)		
42 4	Screw	93	Slipway Light Assy		
43	Pusher	94	Screw (6 reqd)		
44	Cotter Pin	95	Lens (12 reqd)		
45	Washer	96	Lamp (12 reqd)		
46	Pin	97	Pin (4 reqd)		
46.1	Spring Pin	98	Amplifier		
46 2	Spring	99	Screw (2 reqd)		
46 3	Cable End	100	Screw		
47	Door Actuator Assy	101	Standoff		

UARRSI - Exploded View (Key to Figure)
Figure 402 (Sheet 4)

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- D Remove screws (26) securing shims (24, 25) to bracket assemblies (51) and remove shims from bracket assemblies

12 Install Door and Roller Assembly (See Figure 402)

- A Press bushing (19) into door roller housing (20) Install spring (18) and bushing (17) through large opening in door roller housing
- B Install button assembly (16) through small opening in door roller housing (20) Insert cam bearing (15) through bushing (17) and screw it into button assembly
- C Torque button assembly (16) to 150 to 175 inch-pounds
- D Install assembled door roller housing (20) to door assembly (23) with screws (21) and washers (22) Tighten screws
- E Rotate door lift mechanism hydraulically to door closed position Note that mechanism is locked Remove rubber bands or equivalent retaining bracket assembly (51) to door actuator assembly (47)
- F Attach two shims (24) and five shims (25) to each bracket assembly (51) with screws (26) Tighten screws
- G Install door and roller assembly (13) in box assembly (135) by pulling forward on door rollers towards center of door Place door and roller assembly in box assembly and release rollers into slots in side rails of box assembly Attach door and roller assembly to bracket assembly with screws (14)
- H Measure distance between top surface of door and roller assembly (13) and top surface of impact plate assembly (27) Difference between top surfaces shall not exceed 0.015 inch. Add or remove shims (24, 25) as required
- I Tighten screws (14)
- J Actuate door lift mechanism several times. Door shall open and close smoothly without binding or rubbing Repeat step H and reshim if required Leave door in open position

13 Remove Door Actuator Assembly (See Figure 402)

- A Remove cotter pin (44) washer (45) and pin (46) from pusher (43) and actuator cam of door actuator assembly (47)
- B Disconnect connector plug P4 (19, Figure 403) from electrical receptacle
- C Cut and remove safety wire, and disconnect pressure tube assembly (121) and return tube (120) from check valves (57, 58)

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- D Cut and remove safety wire securing hose assemblies (42) to unions (55) on door actuator assembly (47) Identify latch hose with piece of tape, and disconnect hose assemblies from unions
 - E Remove screws (48, 49) and washers (50) from door actuator assembly (47) and remove actuator assembly from box assembly (135)
 - F Remove nuts (52), bolts (53) and bushings (54) from door arm of door actuator assembly (47) Remove bracket assemblies (51) from door actuator assembly (47)
 - G Remove check valves (57, 58) from door actuator assembly (47) and remove and discard packings (59) from check valves
 - H Remove unions (55) from latch and unlatch ports Remove packings (56) from unions and discard packings
- 14 Install Door Actuator Assembly (See Figure 402)
- A Lightly lubricate packings (59) with hydraulic fluid Install packings on check valves (57, 58) Install check valve (57) in pressure port of door actuator assembly (47)
 - B Install check valve (58) in return port of door actuator assembly (47). Torque check valves (57, 58) to 150 to 170 inch-pounds Install safety wire
 - C Lightly lubricate two packings (56) with hydraulic fluid Install packings on two unions (55) and install unions into latch and unlatch ports of door actuator assembly (47) Torque unions to 150 to 170 inch-pounds
 - D Install bracket assemblies (51) to door actuator assembly (47) with bushings (54), bolts (53), and nuts (52) Torque nuts to 65 to 75 inch-pounds Note that bracket assemblies should be temporarily fastened to door actuator assembly with rubber bands, or equivalent, to clear bottom of box assembly and switches during actuation
 - E Install door actuator assembly (47) into box assembly (135) and secure with screws (48, 49) and washers (50)
 - G Attach tube assemblies (120, 121) to check valves (57, 58) Torque nuts to 150 to 170 inch-pounds Install safety wire
 - H Connect receptacle connector J4 (4, Figure 403) to plug on door actuator assembly (47)
- 15 Remove Receptacle Scuff Plate (See Figure 402)
- A. Remove screws (33, 36) from receptacle scuff plate (32) and remove receptacle scuff plate from receptacle assembly (37)

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- B If replacement is required, remove retainers (35) and barrel nuts (34) from receptacle assembly (37)
- 16 Install receptacle scuff plate (See Figure 402)
- A If required, install new retainers (35) and barrel nuts (34) on receptacle assembly (37)
- B Install receptacle scuff plate (32) to receptacle assembly (37) with screws (33, 36) Tighten screws
- 17 Remove Receptacle Assembly (See Figure 402)
- A Remove screws (141) to release adapter plate (139 or 140), and remove packings (142, 143)
- B Remove screws (89) and packings (90) to release cable bracket assembly (88) Pull cable bracket assembly clear of mounting hole
- C Remove nuts (38), washers (39), seals (40) and bolts (41) from receptacle assembly (37)
- D Disconnect connector (5, Figure 403) Raise receptacle assembly (37) and disconnect connector (3, Figure 403)
- E Remove receptacle assembly from box assembly (135) Box assembly and receptacle assembly are an in-line fit and box assembly may have to be manually spread to allow receptacle assembly to be removed
- F Cut and remove safety wire securing hose assemblies (42) to latch and unlatch ports of receptacle assembly (37) Remove hose assemblies from receptacle assembly
- G Remove screw (42 4), washer (42 3), nut (42 2) securing clamps (42 1) and remove clamps
- 18 Install Receptacle Assembly (See Figure 402)
- A Lightly lubricate two packings (56) with hydraulic fluid Install packings on two unions (55) and install in latch and unlatch ports of receptacle assembly (37) Torque unions to 150 to 170 inch-pounds Install safety wire
- B Attach hoses together with clamps (42 1), screw (42 4), washer (42 3), and nut (42 2) Position clamps approximately 5 inches from tube-to-hose connectors Attach hose assemblies (42) to unions (55) Torque nuts of hose assemblies to 150 to 170 inch-pounds Install safety wire

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- C. Connect hose assemblies (42) to a 0 to 6000 psig hydraulic power supply. Test fluid shall be MIL-H-5606 or MIL-H-6083. Apply 6000 psig simultaneously to both hose assemblies. There shall be no evidence of permanent deformation or leakage. Release hydraulic pressure.
 - D. Install retainers (35) and barrel nuts (34) into receptacle assembly (37).
 - E. Install receptacle assembly (37) into box assembly (135). Feed hose assemblies (42) under cradle of box assembly as receptacle assembly is lowered into box assembly.
 - F. Connect plug connector P2 (3, Figure 403) to induction coil of receptacle assembly (37).
 - G. Attach receptacle assembly (37) to box assembly (135) with bolts (41), packings (40), washers (39) and nuts (38). Note that box assembly may have to be manually spread to allow receptacle assembly to drop into place.
 - H. Install packings (142, 143) in adapter plate (139 or 140). Install adapter plate to box assembly (135) with screws (141). Torque screws to 24 to 27 inch-pounds.
 - I. Torque nuts (38) to 90 to 100 inch-pounds.
 - J. Connect plug connector P6 (5, Figure 403) to receptacle on top of receptacle assembly (37).
 - K. Route hose assemblies (42) through notches in cradle of box assembly (135) and connect to latch and unlatch ports of door actuator assembly (47). Note that unlatch port of door actuator assembly connects to unlatch port of receptacle assembly and that latch port of door actuator assembly connects to latch port of receptacle assembly. Torque nuts on hose assemblies to 150 to 170 inch-pounds. Install safety wire.
 - L. Lightly coat packings (90) with petrolatum VV-P-236 or equivalent. Install packing (91) in groove in cable bracket assembly (84) and attach to box assembly (135) with screws (89) and packings (90). Torque screws to 65 to 75 inch-pounds.
19. Remove Scuff Plates (See Figure 402)
- A. Remove screws (62) from LH and RH side gusset scuff plates (60, 61) and remove scuff plates from box assembly (135).
 - B. Remove screws (65) from LH and RH side rail scuff plates (63, 64) and remove scuff plates from box assembly (135).
 - C. Remove screws (67) from FWD bulkhead scuff plate (66) and remove scuff plate from box assembly (135).

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20 Install Scuff Plates (See Figure 402)

- A Install FWD scuff plate (66) to box assembly (135) with screws (67) Tighten screws.
- B Install LH and RH side rail scuff plates (63, 64) to box assembly (135) with screws (65) Tighten screws
- C Install LH and RH side gusset scuff plates (60, 61) to box assembly (135) with screws (62). Tighten screws

21 Remove Hinge Assembly (See Figure 402)

- A Compress springs (74), using an adjustable wrench on hinge, to expose cross holes in spring guides (73) Insert a 3/32 dia x 1 00 inch long pin in cross hole in each spring guide to hold springs compressed
- B Remove hinge pin (68) from hinge assembly (69) and remove hinge assembly from box assembly (135)
- C Remove cotter pins (70), washers (71) and pins (72) from spring guides (73)

WARNING COMPRESSED SPRINGS ARE DANGEROUS REMOVE SPRINGS INDIVIDUALLY

- D Hold spring guide (73) in vise, manually compress spring (74), remove 3/32 dia x 1 00 inch long pin from cross hole in spring guide and remove spring guide and spring from trunnion (75) Repeat for other spring guides and springs

22 Install Hinge Assembly (See Figure 402)

- A Assemble spring guides (73) and springs (74) in trunnions (75) Compress springs and insert a 3/32 dia x 1 00 inch long pin in cross hole of each spring guide to hold springs compressed
- B Attach hinge assemblies (69) to trunnions (75) springs (74) and spring guides (73) with pins (72), washers (71) and cotter pins (70)
- C Install hinge assemblies (69) to box assembly (135) with hinge pin (68) Rotate hinge assembly to compress springs and remove pins installed in step A above

23 Remove amplifier (See Figure 402)

- A Disconnect plug connector (7, Figure 403) from amplifier (98)
- B Remove screws (99, 100), washers (102), standoff (101), and dampeners (103) Note that screw (100) also secures clamp (105) installed on harness assembly (104) Remove amplifier from box assembly (135)

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NOTE Do not remove control cable assembly (84), light assemblies (93), harness assembly (104), pressure tube assembly (121), return tube assembly (120), nameplates (132, 133), cover (129), drain assembly (136), and associated hardware unless replacement is required.

24 Install Amplifier (See Figure 402)

- A Install amplifier (98) into box assembly (135) with screws (99, 100), washers (102), standoff (101) and dampeners (103) Note that screw (100) also secures clamp (105) installed on harness assembly (104) Tighten screws until washers are snug and then tighten screws one more turn
- B Attach plug connector P3 (7, Figure 403) to amplifier (98)

25 Remove Control Cable Assembly (See Figure 402)

- A Remove screw (80), washer (79), and nut (78) securing clamp (76) to box assembly (135) and remove clamp
- B Remove screw (85) and washer (86) attaching control cable assembly (84) to box assembly (135)
- C Loosen nut (87) and unscrew eye (82) from cable assembly (84) Remove and discard packing (81) from eye
- D Remove screws (89) and packings (90) securing cable bracket assembly (88) to box assembly (135) Remove cable assembly (84) and cable bracket assembly (88) from box assembly Remove and discard packing (91)
- E Remove lock (83), nut (87) and jam nut from cable assembly (84) and remove cable assembly from cable bracket assembly (88) Replace jam nut on cable assembly

26 Install Control Cable Assembly (See Figure 402)

- A Install seal (81) in cable bracket assembly (88) Note direction of seal installation
- B Remove jam nut from control cable assembly (84) Note that rubber grommets may have to be removed to remove jam nut Install control cable assembly on cable bracket assembly (88) Note that bracket shall be approximately centered on threaded portion of control cable Install rubber grommets Install nut and tighten to 90 to 100 pound-inches Install safety wire
- C Assemble nut (87) and lock (83) on cable end Extend cable inside housing and screw eye (82) onto control cable assembly (84) end fitting until flange on eye contacts face of bracket Turn eye 1-1/2 to 2-1/2 more turns and align slots in eye with tabs in lock (83) Secure with nut (87)

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- D Pull eye (82) out of cable bracket assembly (88) Note that cable and eye slide freely If lock and flange on eye do not contact cable bracket assembly, loosen nut (87) and readjust eye Torque nut to 24 to 27 inch-pounds Install safety wire
- E Temporarily, position cable bracket assembly (88) in bracket mounting hole of box assembly (135)
- F Attach other end of control cable assembly (84) to box assembly (135) with screw (85) and washer (86) Tighten screw
- G Install clamp (76) on control cable (84). Attach clamp (76) and clamp (77) on harness assembly (104) to box assembly (135) with screw (80), washer (79), and nut (78) Tighten screw

27 Remove Light Assemblies (See Figure 402)

- A Remove screws (94) and retainers (92) securing receptacle connectors (11, Figure 403) to box assembly (135)
- B Using removal tool M83723/31-20, disconnect light assemblies (93) from receptacle connectors J8, J9, J 10, J 11 (11, Figure 403)

28 Install Light Assemblies (See Figure 402)

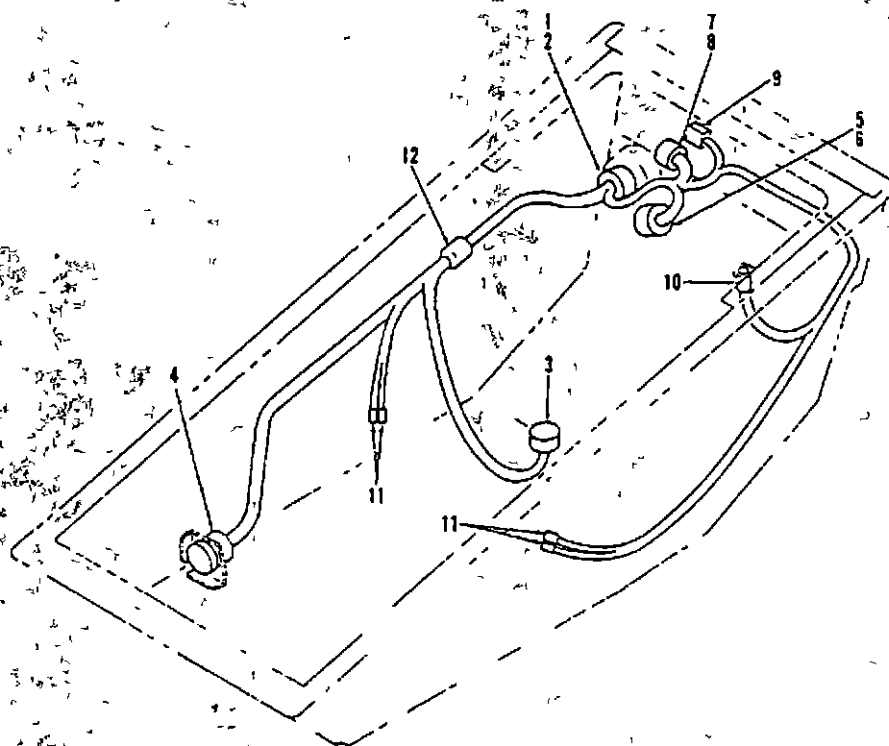
- A Connect light assemblies (93) to receptacle connectors J8, J9, J 10, J 11 (11, Figure 403) with insertion tool M83723/31-20
- B Push receptacle connectors (11) up into cavities in box assembly (135) and secure with retainers (92) and screws (94)

29 Remove Harness Assembly (See Figure 402)

- A Remove receptacle connectors (11, Figure 403) through gussets and passage in cradle of box assembly (135)
- B Remove screw (100), washers (102), stand-off (101), and dampener (103) securing clamp (105) to amplifier (98) Replace screw, washers, standoff, and dampener and hand tighten screw Remove clamp.
- C Remove screw (80), washer (79), and nut (78) securing clamp (77) to clamp (76) and remove clamp (77) Retain clamp (76) in position.
- D Remove nut securing receptacle connector J7 (10, Figure 403) and remove connector from bracket on box assembly (135)
- E Remove screw (109), washer (108), and nut (107) securing clamp (106) and remove clamp

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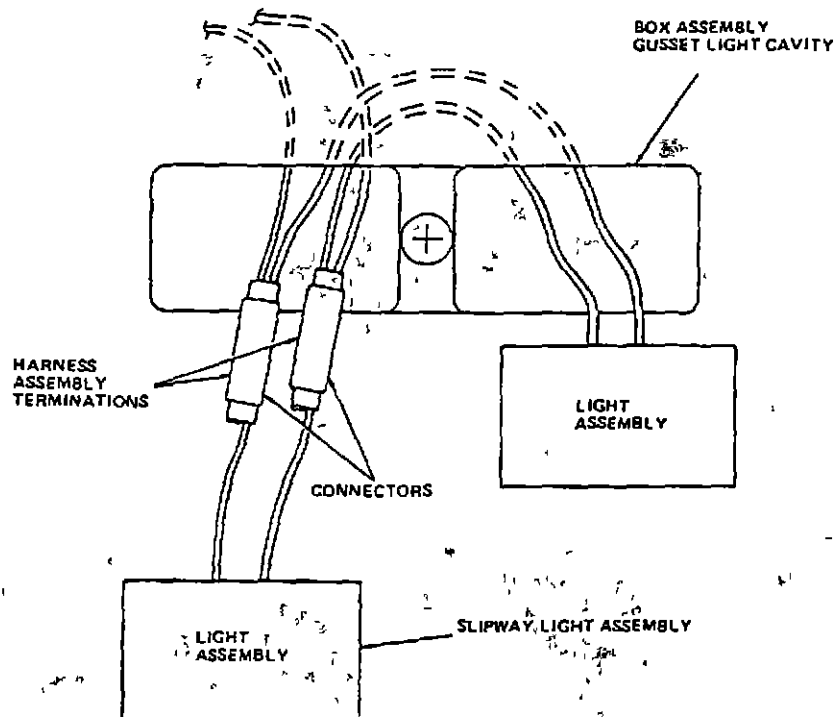
- 1 Connector P1
- 2 Backshell
- 3 Connector P2
- 4 Connector J4
- 5 Connector P6
- 6 Backshell (2 reqd)

- 7 Connector P3
- 8 Backshell
- 9 Relay Assy R1
- 10 Connector J7
- 11 Connector J8, J9, J10, J11 (4 read)
- 12 Diode CR1

Harness Assembly
Figure 403

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Light Assembly Harness Installation
Figure 404

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- F Remove screws (113) and nuts (112) securing plug connector J4 (4, Figure 402) and remove plug connector from box assembly (135) bracket
 - G Remove screws (118), washers (117), and nuts (116) securing clamps (114, 115) from box assembly (135)
 - H Remove nut securing plug connector P1 (1, Figure 403) and remove plug connector from box assembly (135) Remove and discard packing (119) Remove harness assembly (104) from box assembly (135)
- 30 Install Harness Assembly (See Figure 402)
- A. Remove nut from plug connector P1 (1, Figure 403) and install packing (110) on plug connector Install plug connector to box assembly (135), and secure with nut Torque nut to 110 to 120 inch-pounds Install safety wire
 - B. Layout harness assembly (104) as shown in figure 403 Install clamps (114, 115) to harness assembly Attach clamps to box assembly (135) with screws (118), washers (117), and nuts (116) Tighten nuts
 - C Attach plug connector J4 (4, Figure 403) to box assembly (135) with screws (113) and nuts (112) Tighten nuts
 - D Install clamp (106) to harness assembly (104) and attach to box assembly (135) with screw (109), washer (108) and nut (107)
 - E Remove nut from receptacle connector J7 (10, Figure 403) and discard washers, if any Install receptacle connector to box assembly (135) with nut Tighten nut
 - F Install clamps (105, 77) to harness assembly (104) Clamps will be attached to box assembly later
 - G Pass receptacle connectors (11, Figure 403) through passage in cradle of box assembly (135) and gusses into light assembly cavities in gussets as shown in figure 404
- 31 Remove Hydraulic Tube Assemblies (See Figure 402)
- A. Cut and remove safety wire securing nuts on tube assemblies (120, 121) and loosen nuts
 - B Remove screws (125), washers (124), and nuts (123) securing clamps (122) to box assembly (135) and remove clamps Remove tube assemblies (120, 121)
 - C Cut and remove safety wire securing nuts (127) Remove nuts and packings (128) securing elbows (126) Remove elbows from box assembly (135) Discard packings

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32 Install Hydraulic Tube Assemblies (See Figure 402)

- A Lightly lubricate new packings (128) with hydraulic fluid. Install elbows (126) in box assembly (135) with packings (128) and nuts (127). Torque nuts to 270 to 300 inch-pounds. Install safety wire.
- B Install clamps (122) to tube assemblies (120, 121). Attach tube assemblies to box assembly (135) with clamps, screws (125), washers (124), and nuts (123). Note that only nut shall be turned to tighten clamp. Molded seal under head of screw will fail if screw is turned.
- C Tighten nuts on tube assemblies (120, 121) to 150 to 170 pound-inches torque. Install safety wire.

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UARRSI - ADJUSTMENT/TEST

1 AERIAL REFUELING MODIFICATION FUNCTIONAL TEST

- A The objective of this test is to functionally test all operating portions of the newly installed aerial refueling system. The accomplishment of this test per the following step-by-step procedures will ensure proper operating capability for the refueling system. If at any point, the noted response or function does not occur when testing per this procedure - halt testing, troubleshoot system and correct discrepancy before continuing with test. Receipt of the noted response or function for each step in the test procedure should be interpreted as a success for that step. Performance of all aerial refueling system test procedures with a positive response or function should be interpreted as a successful completion of the functional test.

2 REFUEL INDICATOR TEST

- A Completion of this portion of the functional test will verify proper operation of all refuel indicators in the refuel system.
- (1) Ensure that the aircraft is properly grounded
 - (2) Verify that electrical power is provided to the aircraft
 - (3) Assure that aircraft hydraulic system is not pressurized
 - (4) Verify MASTER REFUEL switch on P11 refueling panel is in off (neither "NORM" or "OVRD" depressed)
 - (5) Close circuit breakers "ARR Control" and "ARR DIM and TEST" on P5 circuit breaker panel
 - (6) Place "ARR IND LIGHTS" switch in 'TEST'
 - a) Master Refuel "NORM" and "OVRD" indicators will be illuminated
 - b) A/R status indicators "READY", "LATCHED", and "DISC" will illuminate
 - c) "A/R" will illuminate on A/R RESET switch
 - d) Return "ARR IND LIGHTS" switch to "BRIGHT" position
 - (7) Push to test each indicator on the P15 pilots light shield "READY", "LATCHED", and "DISC" will illuminate as each is pushed and can be dimmed by rotating the lens cap

Ref DRW CDRL 43/44

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3 SLIPWAY DOOR CONTROL AND SLIPWAY ILLUMINATION LIGHTS TEST

A Completion of this portion of the functional test will verify proper operation of the slipway door, its controls and the slipway illumination devices

- (1) Pressurize the hydraulic system
- (2) Close circuit breaker "AERIAL REFUEL OVERRIDE" on P5 circuit breaker panel
- (3) Depress MASTER REFUEL "NORM" switch to ON position
- (4) Move Aerial Refueling Door Handle to "OPEN"
- (5) Verify the following
 - a) A/R Master "NORM" and A/R RESET "A/R" indicators are illuminated
 - b) Slipway doors open
 - c) A/R Status light "READY" indicator is illuminated
 - d) "READY" indication on P15 pilot's light shield is illuminated
 - e) Slipway lights are illuminated and their intensity may be controlled by slipway lights rheostat on P11 flight engineer's lower panel.
- (6) Place "ARR IND LIGHTS" switch in "DIM" position and verify A/R status lights "READY", "RESET", and master refuel "NORM" will dim
- (7) Return "ARR IND LIGHTS" to "BRIGHT" position

4 AERIAL REFUELING SYSTEM "NORMAL" FUNCTIONS TEST

A. Completion of this portion of the functional test will verify proper operation of the Aerial Refueling System in the normal mode

- (1) Assure hydraulic system is pressurized
- (2) Verify status of P11 flight engineers panel switches/indicators as
 - a) Master Refuel "NORM" illuminated
 - b) A/R Reset "A/R" illuminated
 - c) A/R Status Light "READY" illuminated
- (3) P15 pilot's light shield "READY" light illuminated

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- (4) Verify slipway doors are open.
- (5) Place "INTERPHONE SELECT" switch in "ON" position
- (6) Energize IFR test set and calibrate according to instructions provided with test set

WARNING WHEN TEST SET IS RELEASED FROM RECEPTACLE A 117 POUND SLIDING VALVE SPRING FORCE IN THE RECEPTACLE WILL EXPEL THE TEST SET OPERATING PERSONNEL MUST BE PREPARED TO RESIST THIS FORCE DUE CAUTION MUST BE EXERCISED TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO TEST EQUIPMENT

CAUTION REMOVE RETAINER AND END CLIP FROM IFR RECEIVER SYSTEM TEST SET

- (7) Insert test set into receptacle and verify that it latched in place
- (8) Verify the following
 - a) P11 flight engineer panel A/R status lights "READY" is extinguished, "LATCHED" is illuminated
 - b) P15 pilot's light shield "READY" is extinguished, "LATCHED" is illuminated

WARNING WHEN TEST SET IS RELEASED, A 117 POUND SLIDING VALVE SPRING FORCE IN THE RECEPTACLE WILL EXPEL THE TEST SET OPERATING PERSONNEL MUST BE PREPARED TO RESIST THIS FORCE DUE CAUTION MUST BE EXERCISED TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO TEST EQUIPMENT

NOTE Receptacle toggles should immediately release test set when step (9) is performed

- (9) While holding the test set firmly in position, push the test set switch to "TEST"
- (10) Verify the following
 - a) Test set is released from receptacle
 - b) P11 flight engineers panel A/R status lights "LATCHED" is extinguished, "DISC" is illuminated
 - c) P15 pilot's light shield "LATCHED" is extinguished, "DISC" is illuminated

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(11) Press P11 flight engineers panel A/R RESET switch

(12) Verify the following

- a) P11 flight engineers panel A/R status lights "DISC" is extinguished and "READY" is illuminated
- b) P15 pilot's light shield "DISC" is extinguished and "READY" is illuminated.

WARNING WHEN TEST SET IS RELEASED FROM RECEPTACLE A 117 POUND SLIDING VALVE SPRING FORCE IN THE RECEPTACLE WILL EXPEL THE TEST SET OPERATING PERSONNEL MUST BE PREPARED TO RESIST THIS FORCE DUE CAUTION MUST BE EXERCISED TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO TEST EQUIPMENT

(13) Insert test set into receptacle and verify that it latched in place

(14) Verify the following

- a) P11 flight engineer panel A/R status lights "READY" is extinguished, "LATCHED" is illuminated
- b) P15 pilot's light shield "READY" is extinguished, "LATCHED" is illuminated

WARNING WHEN TEST SET IS RELEASED, A 117 POUND SLIDING VALVE SPRING FORCE IN THE RECEPTACLE WILL EXPEL THE TEST SET OPERATING PERSONNEL MUST BE PREPARED TO RESIST THIS FORCE DUE CAUTION MUST BE EXERCISED TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO TEST EQUIPMENT.

(15) While holding the test set firmly in position, push the pilot's autopilot release switch located on the pilot's control yoke

(16) Verify the following

- a) Test set is released from receptacle
- b) P11 flight engineer panel "LATCHED" is extinguished and "DISC" is illuminated
- c) P15 pilots light shield "LATCHED" is extinguished and "DISC" is illuminated

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(17) Press P11 flight engineers panel A/R RESET switch

(18) Verify the following.

a) P11 flight engineers panel A/R status lights "DISC" is extinguished and "READY" is illuminated

b) P15 pilot's light shield "DISC" is extinguished and "READY" is illuminated

(19) Insert test set into receptacle and verify that it latched in place

(20) Verify the following:

a) P11 flight engineer panel A/R status lights "READY" is extinguished, "LATCHED" is illuminated

b) P15 pilot's light shield "READY" is extinguished, "LATCHED" is illuminated

WARNING WHEN TEST SET IS RELEASED A 117 POUND SLIDING VALVE SPRING FORCE IN THE RECEPTACLE WILL EXPEL THE TEST SET OPERATING PERSONNEL MUST BE PREPARED TO RESIST THIS FORCE DUE CAUTION MUST BE EXERCISED TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO TEST EQUIPMENT

(21) While holding the test set firmly in position, push the copilot's autopilot release switch located on the copilot's control yoke

(22) Verify the following

a) Test set is released from receptacle

b) P11 flight engineer panel "LATCHED" is extinguished and "DISC" is illuminated

c) P15 pilots light shield "LATCHED" is extinguished and "DISC" is illuminated

(23) Press P11 flight engineers panel A/R RESET switch

(24) Verify the following

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- a) P11 flight engineers panel A/R status lights "DISC" is extinguished and "READY" is illuminated
 - b) P15 pilot's light shield "DISC" is extinguished and "READY" is illuminated
- (25) Insert test set into receptacle and verify that it latched in place
- (26) Verify the following
- a) P11 flight engineer panel A/R status lights "READY" is extinguished, "LATCHED" is illuminated
 - b) P15 pilot's light shield "READY" is extinguished, "LATCHED" is illuminated
- (27) Disconnect electrical connector D5129 from A/R overpressure switch S1037 located at STA 312, BL-O
- (28) While holding the test set firmly in position, use a jumper wire to connect Pins A and B of connector D5129 together
- (29) Verify the following
- a) Test set is released from receptacle
 - b) P11 flight engineer panel "LATCHED" is extinguished and "DISC" is illuminated
 - c) P15 pilots light shield "LATCHED" is extinguished and "DISC" is illuminated
- (30) Remove jumper wire and reconnect connector D5129
- (31) Press P11 flight engineers panel A/R RESET switch
- (32) Verify the following
- a) P11 flight engineers panel A/R status lights "DISC" is extinguished and "READY" is illuminated
 - b) P15 pilot's light shield "DISC" is extinguished and "READY" is illuminated
- (33) Insert test set into receptacle and verify that it latched in place

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- (34) Perform functional check of pressure switch 10-2431-6
 - a) Disconnect tube 431-10231-4 from pressure switch
 - b) Apply pressurized air to free inlet Gradually increase pressure from 0 to 75 psi max
 - c) When 75 psi is reached, check that test set is released from receptacle (hold test set firmly during test), P11 F/E panel "LATCHED" light is extinguished and "DISC" light is illuminated and finally that P15 pilots light shield "LATCHED" light is extinguished and "DISC" light is illuminated
 - d) Reconnect tube 431-10231-4 on pressure switch
- (35) Press the P11 F/E panel A/R RESET switch
- (36) Verify the following
 - a) P11 F/E panel A/R status lights "DISC" is extinguished and "READY" is illuminated
 - b) P15 pilot's light shield "DISC" light is extinguished and "READY" light is illuminated
- (37) Move aerial refueling door handle to "CLOSED"
- (38) Place P11 Master Refuel "NORM" switch to OFF position by depressing "NORM" and releasing
- (39) Verify the following
 - a) Slipway lights are extinguished
 - b) Slipway doors will close
 - c) All A/R Status lights are extinguished
 - d) MASTER REFUEL "NORM" and "OVRD" and A/R Reset "A/R" indicators are OFF

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5 AERIAL REFUELING SYSTEM "OVERRIDE" FUNCTIONS TEST

A Completion of this portion of the functional test will verify proper operation of the Aerial Refueling System in the override mode

- (1) Depress Master Refuel "OVRD" switch to ON position
- (2) Move Aerial Refueling Door Handle to "OPEN"
- (3) Verify the following
 - a) A/R Master "OVRD" and A/R Reset "A/R" indicators are illuminated
 - b) Slipway doors will open
 - c) A/R status "READY" indicator illuminated (P11 and P15 panels)
 - d) Slipway lights are illuminated and their intensity may be controlled by slipway lights reostat on P11 flight engineer's lower panel
- (4) Press and hold P11 A/R reset switch A/R status lights "READY" indicator on P11 and P15 panels will extinguish Release A/R reset switch, "READY" indicators on P11 and P15 panels will illuminate

WARNING WHEN TEST SET IS RELEASED FROM RECEPTACLE A 117 POUND SLIDING VALVE SPRING FORCE IN THE RECEPTACLE WILL EXPEL THE TEST SET OPERATING PERSONNEL MUST BE PREPARED TO RESIST THIS FORCE DUE CAUTION MUST BE EXERCISED TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO TEST EQUIPMENT

- (5) Insert test set into receptacle and verify that it is latched in place
- (6) Verify the following
 - a) P11 panel A/R status lights "READY" is extinguished, "LATCHED" is illuminated
 - b) P15 pilot's light shield "READY" is extinguished, and "LATCHED" is illuminated

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- (7) While holding the test set firmly in position, push the test set switch to "TEST" Verify that the test set is not released from the receptacle

WARNING WHEN TEST SET IS RELEASED, A 117 POUND SLIDING VALVE SPRING FORCE IN THE RECEPTACLE WILL EXPEL THE TEST SET OPERATING PERSONNEL MUST BE PREPARED TO RESIST THIS FORCE DUE CAUTION MUST BE EXERCISED TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO TEST EQUIPMENT

- (8) While holding the test set firmly in position, push the pilot's autopilot release switch on the pilot's control yoke
- (9) Verify the following
- a) Test set is released from receptacle
 - b) P11 Panel A/R status lights "LATCHED" is extinguished, "DISC" is illuminated
 - c) P15 pilot's light shield "LATCHED" is extinguished, "DISC" is illuminated
- (10) Press and release P11 A/R reset switch
- (11) Verify the following
- a) P11 A/R status light "DISC" is extinguished, "READY" is illuminated
 - b) P15 pilot light shield "DISC" is extinguished, "READY" is illuminated
- (12) Move Aerial Refueling Door Handle to "CLOSED"
- (13) Place Master Refuel "OVRD" switch in OFF position by depressing "OVRD" and releasing
- (14) Verify the following
- a) Slipway lights will extinguish
 - b) Slipway doors will close
 - c) All A/R status lights will extinguish on P11 and P15 panels
 - d) Master Refuel "NORM" and "OVRD" and A/R Reset "A/R" will be OFF

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6 JET SUMP PUMP FUNCTIONAL TEST

A Disassembly procedure

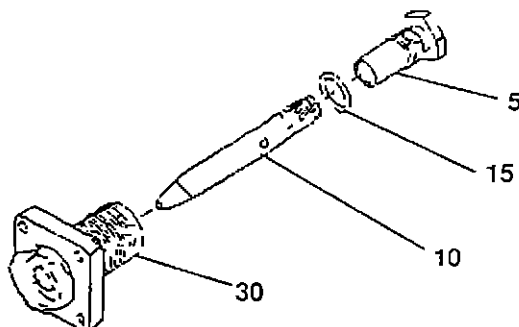
- (1) Remove pump nozzle (10), nozzle plug (5) and packing (15) by unscrewing nozzle plug (5) from pump
- (2) Unscrew pump nozzle (10) from nozzle plug (5) and remove packing (15) from nozzle plug (5)

B Check pump nozzle (10)

- (1) Check outside diameter between transverse flow holes to start of conical taper for nicks, scratches and damage
- (2) Examine orifice tip for nicks, burrs and damage
- (3) Examine threads for damage
- (4) Examine orifice for erosion

C Assembly procedure

- (1) Wet pump nozzle (10) with jet fuel and use to reform and seal glyd ring in pump housing groove
- (2) Wet packing (15) and install on nozzle plug (5)
- (3) Assemble pump nozzle (10) to nozzle plug (5) and torque to 65-75 lbs in
- (4) Wet assembly of pump nozzle (10), nozzle plug (5) and packing (15) with fuel and install into housing cap (30) Torque nozzle plug (5) to housing cap (30) to 155-165 lbs in



Jet Sump Pump Nozzle
Figure 501

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7 TERMINATE FUNCTIONAL TEST

A Accomplishment of the following steps will properly shutdown the Aerial Refueling System upon completion of the functional test

- (1) Open all circuit breakers closed in previous steps
- (2) Depressurize the hydraulic system

8 LEAK TEST REQUIREMENTS, SCAVENGE AND DRAIN INSTL

9 SYSTEM TO BE TESTED

Refueling Receptacle Scavenge and Drain System

10 GENERAL INFORMATION

A The objective of this test is to conduct a leakage test of the Scavenge and Drain System using air. The accomplishment of this test per the following requirements will ensure proper operating capability for the Scavenge and Drain System

11 TEST EQUIPMENT REQUIREMENTS

- A. Expansion plugs for drain ports located in the shroud (BL~, STA 268 & STA 298), and in the fairing (STA 261, RBL 11 ~ LBL 11, WL 285). The plug will be capable of 10 PSIG
- B. Pressure measuring device capable of measuring pressures from 0 to 10 PSIG (0 - 277.3 inches of water) within + 0.05 PSIG (+1.39 inches of water)
- C. Source of air pressure capable of 10 PSIG

12 TEST REQUIREMENTS

- A. Plug open drain fittings in the shroud and fairing per 11 A
- B. Apply 10 + 0.05 PSIG (277.3 + 1.39 inches of water) air pressure to the over-board drain port and allow to stabilize. There shall be no pressure loss in five minutes as shown on a measuring device per 11 B. Successful completion of this step should be interpreted as a successful completion of the functional test
- C. If leakage occurs apply bubble solution (BMS 10-34, system 3) to couplings and fittings as necessary to locate leakage. Repair as required. Remove test solution with water and retest per step B, above
- D. Restore system to normal configuration by removal of all test plugs and caps

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ENGINE FUEL DEICING SYSTEM - DESCRIPTION AND OPERATION

1 General

- A The engine fuel deicing system provides controlled heating of the fuel for melting ice retained in the fuel deicing filter. This ice is the result when free or suspended water in the fuel freezes. The ice, if not removed, could block the controlling orifices of the maximum speed governor of the fuel control unit. Hot air tapped from the engine compressor is used for intermittent heating of the fuel in a fuel heater. Operation of this heater is manually controlled by means of a fuel heater switch upon receiving a visual signal that ice has accumulated in the filter. Four identical systems are installed, one for each engine.
- B Each fuel deicing system includes a fuel deicing heater, a fuel deicing filter, an electrically actuated fuel heater air valve, a fuel icing pressure switch, a fuel icing indicating light and a fuel heater switch. This switch and the icing indicating light are on the flight engineer's lower panel. All other components are mounted on the engine left side, just aft of the fan outlet duct (See figures 1 and 2)

2 Fuel Deicing Heater

- A The fuel deicing heater is a multitubular heat exchanger, utilizing hot compressed air tapped from the engine diffuser. The heater consists of the heater housing and the heater core. Hot air enters at one end of the housing, flows through the core tubes and is discharged at the other end. Fuel flow between the tubes of the core is deflected by two baffles. The fuel heater is installed in the fuel line between the engine fuel boost pump and the fuel deicing filter. The heater is attached by means of brackets to the left side of the engine casing.

3 Fuel Heater Air Valve

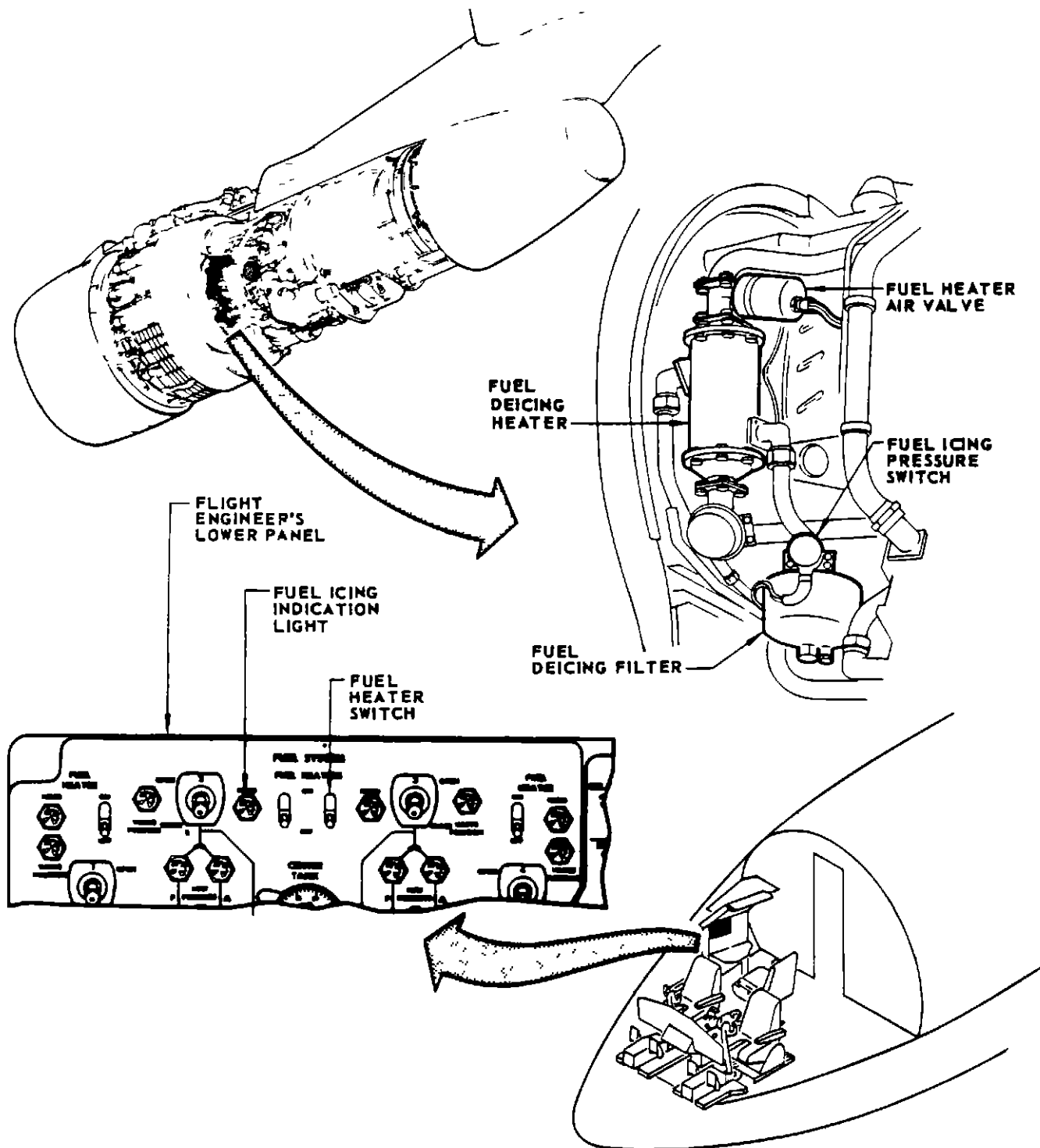
- A The fuel heater air valve is an electrically actuated valve which controls hot air flow through the fuel heater. The air valve consists of a valve housing with a butterfly valve and an actuator with a reversible electric motor, powered by 28 volts dc supplied through a circuit breaker on the radio and T-R circuit breaker panel (P5). The valve opens or closes fully in about 3 seconds. It can be stopped in any position, but its movement can be reversed in the end positions only. The valve is installed in the hot air duct just above the fuel heater on the left side of the engine casing.

4 Fuel Deicing Filter

- A The fuel deicing filter removes ice crystals from cold fuel and thus protects engine fuel controls from possible malfunctions due to ice. The filter consists of a filter head with a bypass valve, a filter casing and

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a filter element. The bypass valve opens when the filter resistance increases by 5.8 psi and permits fuel flow if the filter becomes clogged by dirt. The drain valve at the bottom of the filter permits periodical draining of accumulated water. The filter element has a large active area and retains all particles larger than 10 microns. The element is made of resin treated paper and is not reusable. The filter is attached with its head to the engine casing, aft and below the fuel heater.



Engine Fuel Deicing System Equipment Location
Figure 1

5 Fuel Icing Pressure Switch

- A The fuel icing pressure switch is a diaphragm actuated differential pressure switch which turns on the fuel icing indicating light when the flow resistance in the fuel deicing filter, due to the clogging of filter element by accumulated ice crystals, increases by 4.5 psi. The switch opens and turns the light off when the flow resistance decreases after melting the ice upon fuel heating. The switch is attached to the head of fuel deicing filter.

6 Fuel Icing Indicating Light

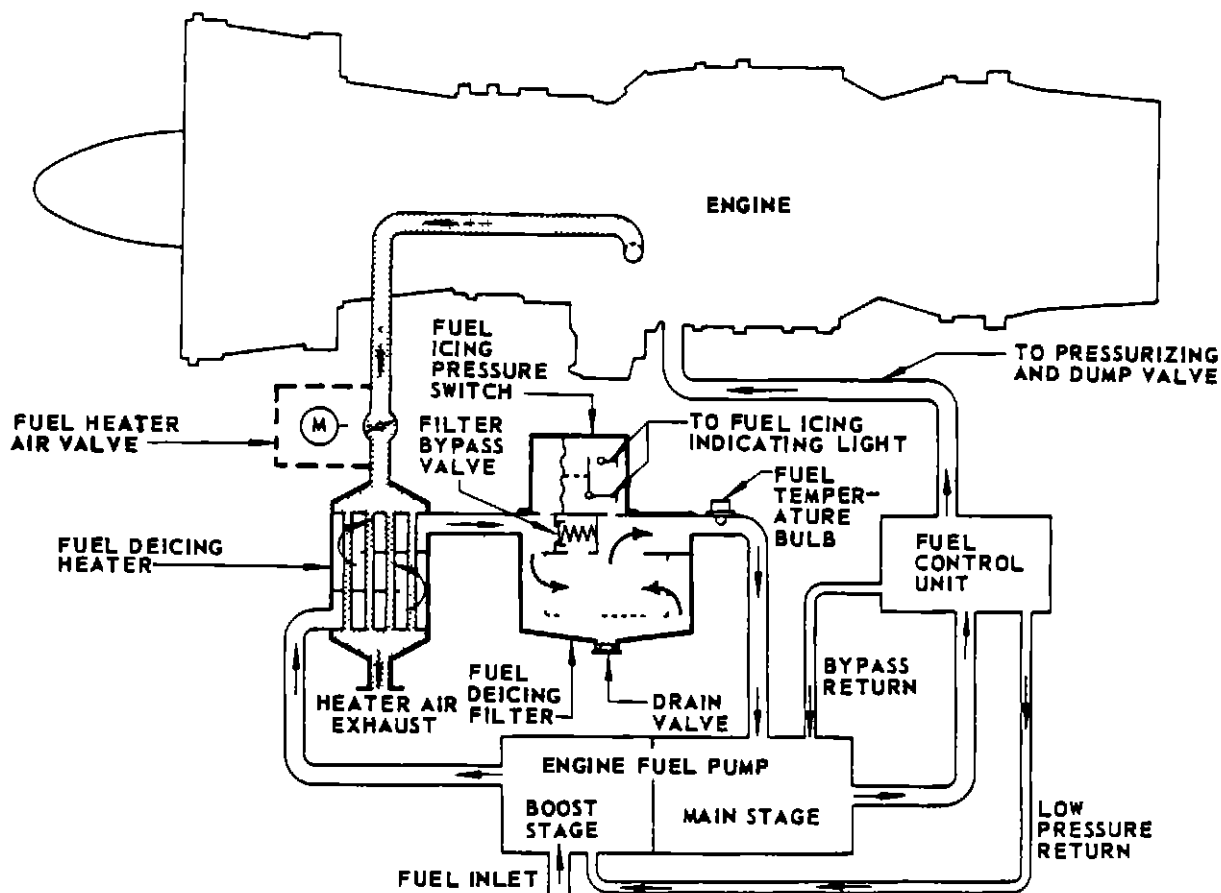
- A The fuel icing indicating light is an amber press-to-test light, controlled by the fuel icing pressure switch. The light illuminates, when fuel deicing filter becomes clogged and fuel flow resistance increase. The four indicating lights are on the flight engineer's lower panel

7 Fuel Heater Switch

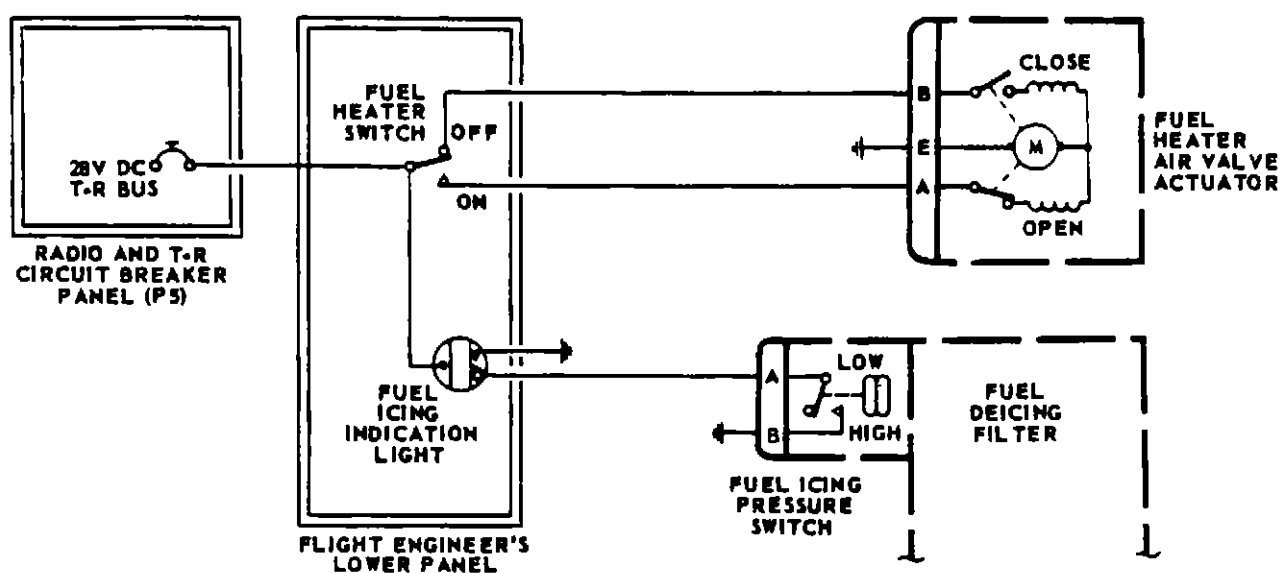
- A The fuel heater switch is a two-position toggle switch controlling the operation of the fuel heater air valve. With the switch in the "ON" position, the valve is open and the heater operates. When the switch is in the "OFF" position, the valve is closed and the heater is off. The four fuel heater switches are on the flight engineer's lower panel, adjacent to the fuel icing indicating lights.

8 Operation (See figure 2 and 3)

- A. All the engine fuel flows through the fuel deicing heater and deicing filter. With the fuel heater off, the filter retains any ice which may form. As the ice accumulates, the filter flow resistance increases. When the filter resistance increases by 4.5 psi, the fuel icing pressure switch closes to energize the indicating light, giving a signal that the fuel heater switch should be placed to "ON." With the heater switch in the "ON" position, the fuel heater air valve is opened and hot air flows through the heater. As warmed fuel melts the ice accumulated in the filter, the back pressure is relieved and the icing indicating light goes off. The temperature of fuel leaving the fuel deicing heater is measured by means of a temperature bulb and indicated on the flight engineer's lower panel. Refer to 28-20-0, "Fuel Temperature Indicating System." The heater switch should not be left in the "ON" position for more than 1 minute in every 30 minutes, even if the icing indicating light stays on. In this case, the filter may be clogged with dirt and the fuel flows through the filter bypass valve.



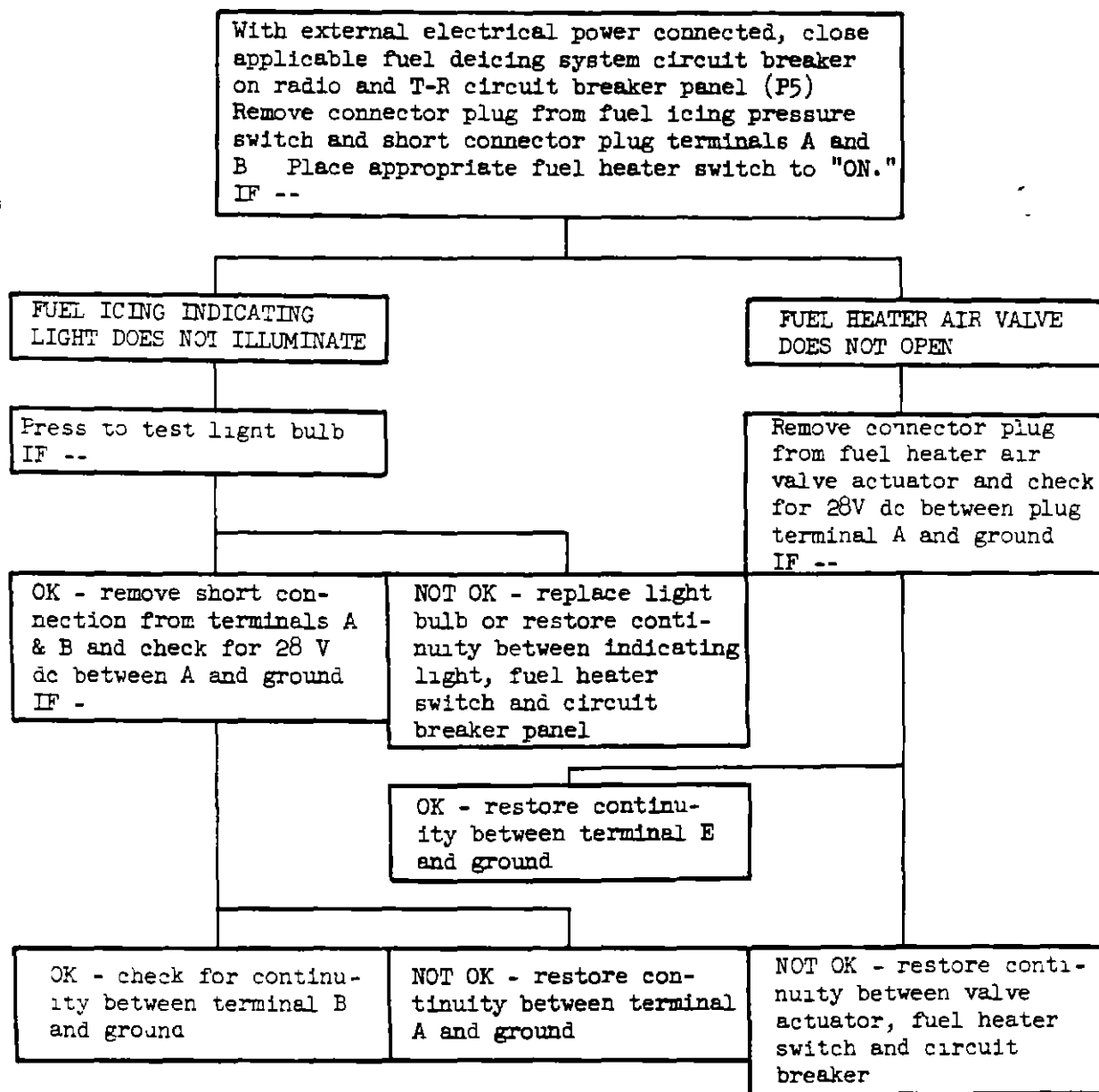
Engine Fuel Deicing System Flow Diagram
Figure 2



TYPICAL ALL FOUR ENGINES

Engine Fuel Deicing System Circuit
Figure 3

ENGINE FUEL DEICING - TROUBLE SHOOTING



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ENGINE FUEL DEICING SYSTEM - MAINTENANCE PRACTICES

1 Adjustment/Test Engine Fuel Deicing System

A. Test Fuel Deicing System

- (1) With external power connected, push in the fuel deicing system circuit breakers for all four engines
- (2) Test engine fuel deicing system.
 - (a) Place engine fuel heater switch on flight engineers lower panel in "ON" position. Verify the fuel heater air valve opens.
 - (b) Open engine cowlings and remove electrical plug from the fuel icing pressure switch at fuel deicing filter and short across the plug terminals. Verify that the applicable fuel icing indicator light comes on
 - (c) Remove the short across pressure switch plug terminals.
 - (d) Place fuel heater switch in "OFF" position. Verify that the air valve closes
 - (e) Replace electrical plug on pressure switch
- (3) Return airplane to normal configuration after completing tests
 - (a) Pull above indicated circuit breakers and disconnect electrical power
 - (b) Close engine cowlings.

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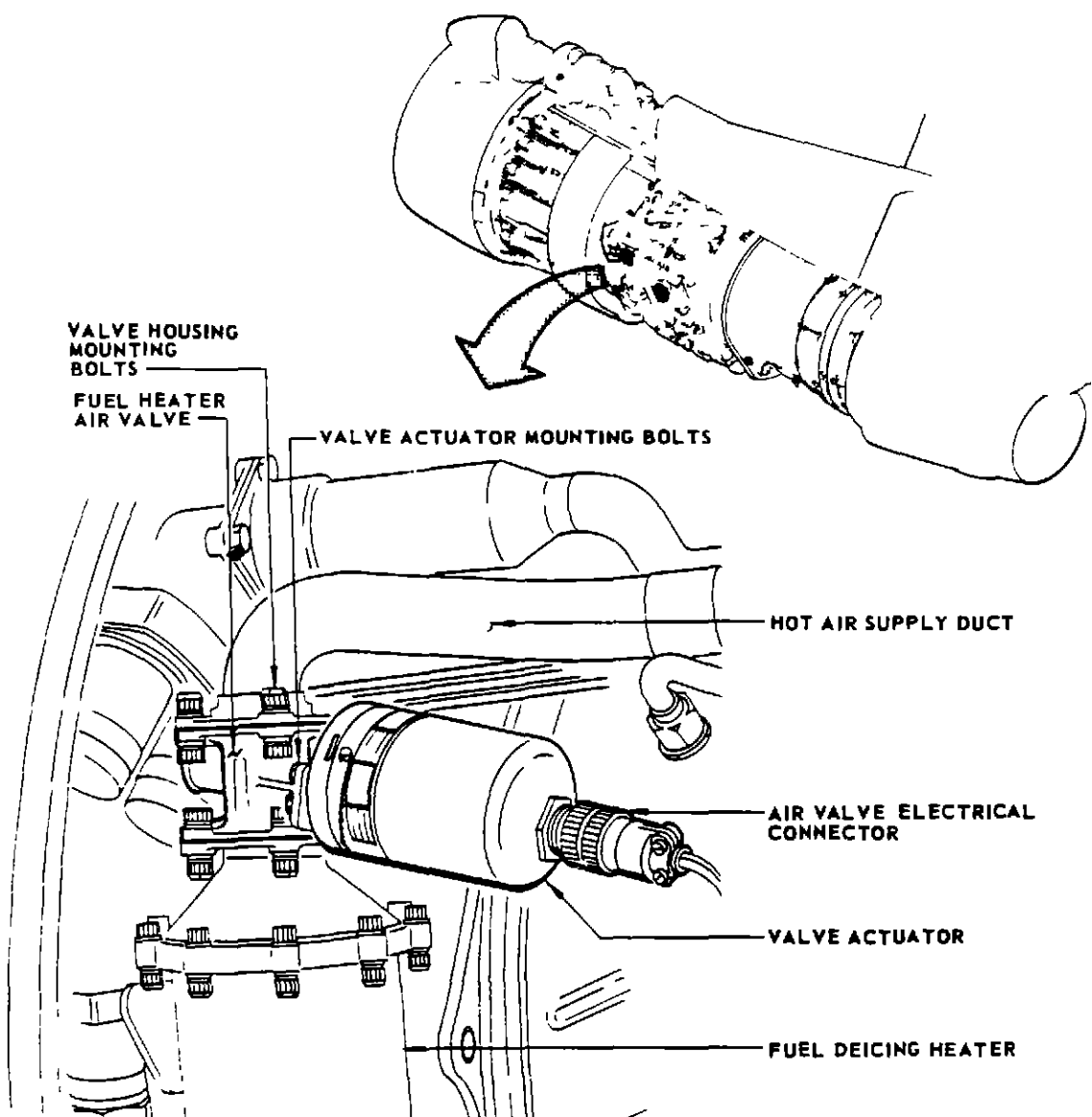
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FUEL HEATER AIR VALVE - MAINTENANCE PRACTICES

1 Removal/Installation Fuel Heater Air Valve

A Remove Fuel Heater Valve

- (1) Open applicable fuel deicing system circuit breaker on radio and T-C circuit breaker panel (P5) for applicable engine
- (2) Disconnect air valve actuator electrical plug (See figure 201)



- (3) Remove four bolts securing air supply hose elbow to air valve housing.
- (4) Remove four bolts securing valve housing to fuel heater mount.
- (5) Remove valve actuator mounting bolts to separate valve housing from valve actuator.

B. Install Air Valve (See figure 201.)

- (1) Assemble the valve housing and valve actuator and install attaching bolts.
- (2) Using a new gasket, secure valve housing to the fuel heater mount with four bolts.
- (3) Using a new gasket, secure the air supply hose to the valve housing with four bolts.
- (4) Connect air valve electrical plug. Lockwire lead nut.
- (5) Close fuel deicing system circuit breaker on panel (P5).

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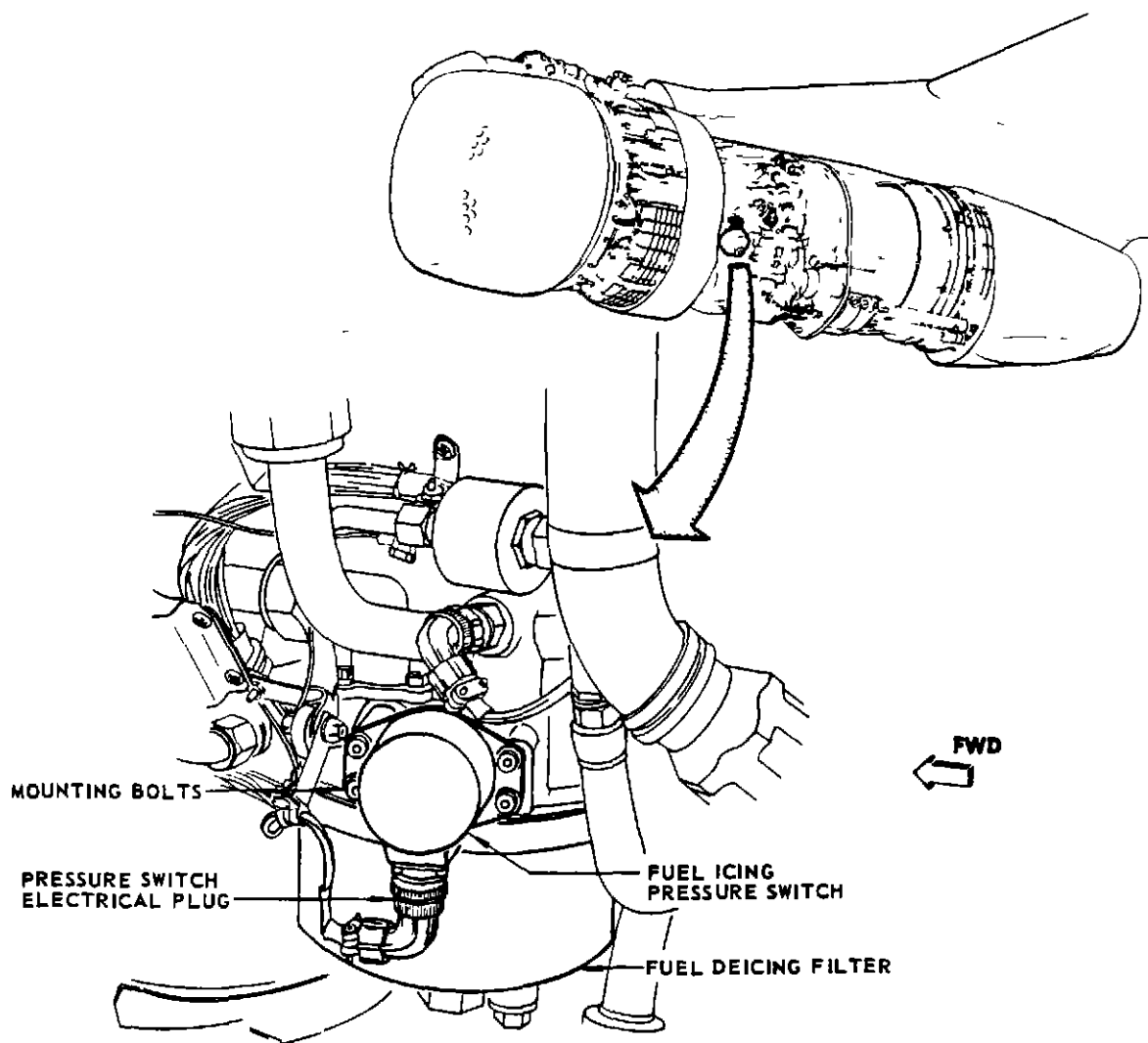
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FUEL ICING PRESSURE SWITCH - MAINTENANCE PRACTICES

1 Removal/Installation Fuel Icing Pressure Switch

A Remove Fuel Icing Pressure Switch

- (1) Open applicable fuel deicing system circuit breaker on radio and T-R circuit breaker panel (P5) for applicable engine.
- (2) Disconnect pressure switch electrical plug. (See figure 201)





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- (3) Support pressure switch and remove the four bolts which secure the switch to filter casing.

B. Install Fuel Icing Pressure Switch (See figure 201.)

- (1) Thoroughly clean mating surfaces of pressure switch and filter mount with a clean lint free cloth moistened with naphtha.
- (2) Install switch on filter mount and install four mounting bolts.
- (3) Connect pressure switch electrical plug.
- (4) Close fuel deicing system circuit breaker on panel (P5).



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FUEL TEMPERATURE INDICATING SYSTEM - DESCRIPTION AND OPERATION

1. General

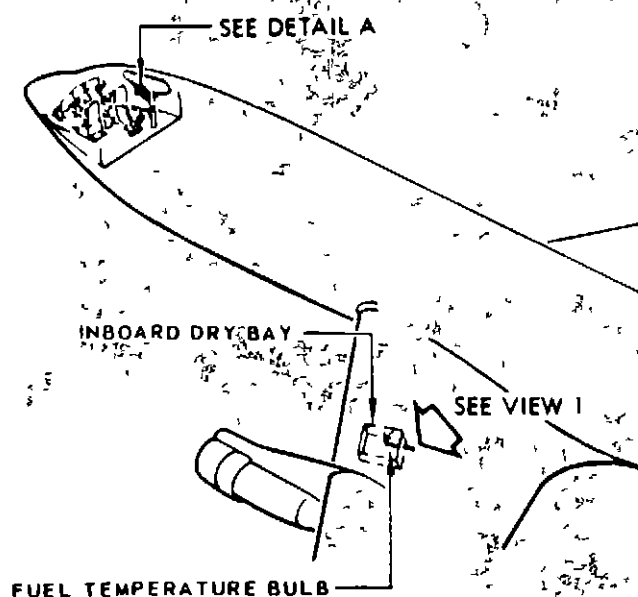
- A. The fuel temperature indicating system is used to monitor the temperature of the fuel where it leaves the fuel deicing heater on each engine and to indicate the fuel temperature of main tank No. 1. (For additional information on the fuel deicing heater refer to 28-19-0, "Engine Fuel Deicing System.") A fuel temperature indicator is located on the flight engineer's lower panel. A temperature sensing bulb is located in the fuel deicing filter outlet on each engine and one in fuel tank No. 1. A five position fuel temperature selector switch located adjacent to the indicator permits selection of fuel temperature readings from any of the five different locations.
- B. Each temperature bulb contains a resistance element whose resistance varies in proportion to changes in temperature. This element controls the current passing through the meter movement of the fuel temperature indicator. Power is supplied to the system through the 28-volt a-c circuit breaker panel (P7). (See figure 2.)

2. Fuel Temperature Bulbs

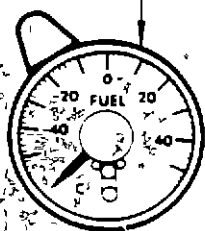
- A. In main tank No. 1 the temperature bulb is an armored, bayonet locking, type bulb. It has a temperature range of -50 to +300°C. The resistance at 0°C is 90.38 ohms. The bulb is contained in a housing which projects into main tank No. 1 through the aft wall of the inboard dry bay. (See figure 1.) The housing is integral with the tank wall, and allows the bulb to be removed without draining the tank.
- B. The temperature bulb in each of the engine fuel systems has the same electrical characteristics as that in main tank No. 1. These bulbs are screwed into a tee on the fuel filter outlet in direct contact with the fuel and when removed cause draining of fuel lines in the power plant area. (See figure 1.)

3. Fuel Temperature Indicator

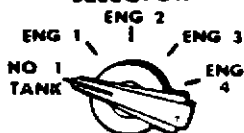
- A. The fuel temperature indicator, located on the flight engineer's lower panel, is a resistance ratio meter instrument. The indicator is operated by the ratio of the currents through two coils in the meter movement. One of these currents is determined by the resistance of the temperature bulb. The indicator dial is calibrated in degrees centigrade (See figure 1.) With power off, the pointer remains off scale at the low temperature end. Electrical connections are made to the indicator through a disconnect plug.



FUEL
TEMPERATURE
INDICATOR



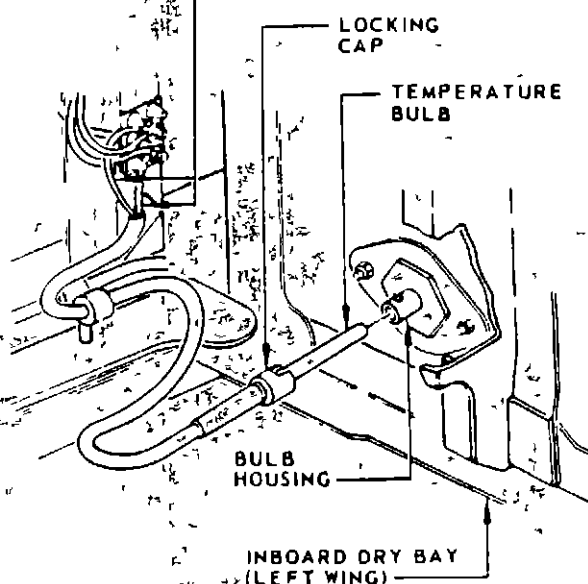
FUEL TEMP
SELECTOR



FUEL
TEMPERATURE
SELECTOR
SWITCH

DETAIL A

TEMPERATURE
BULB LEADS



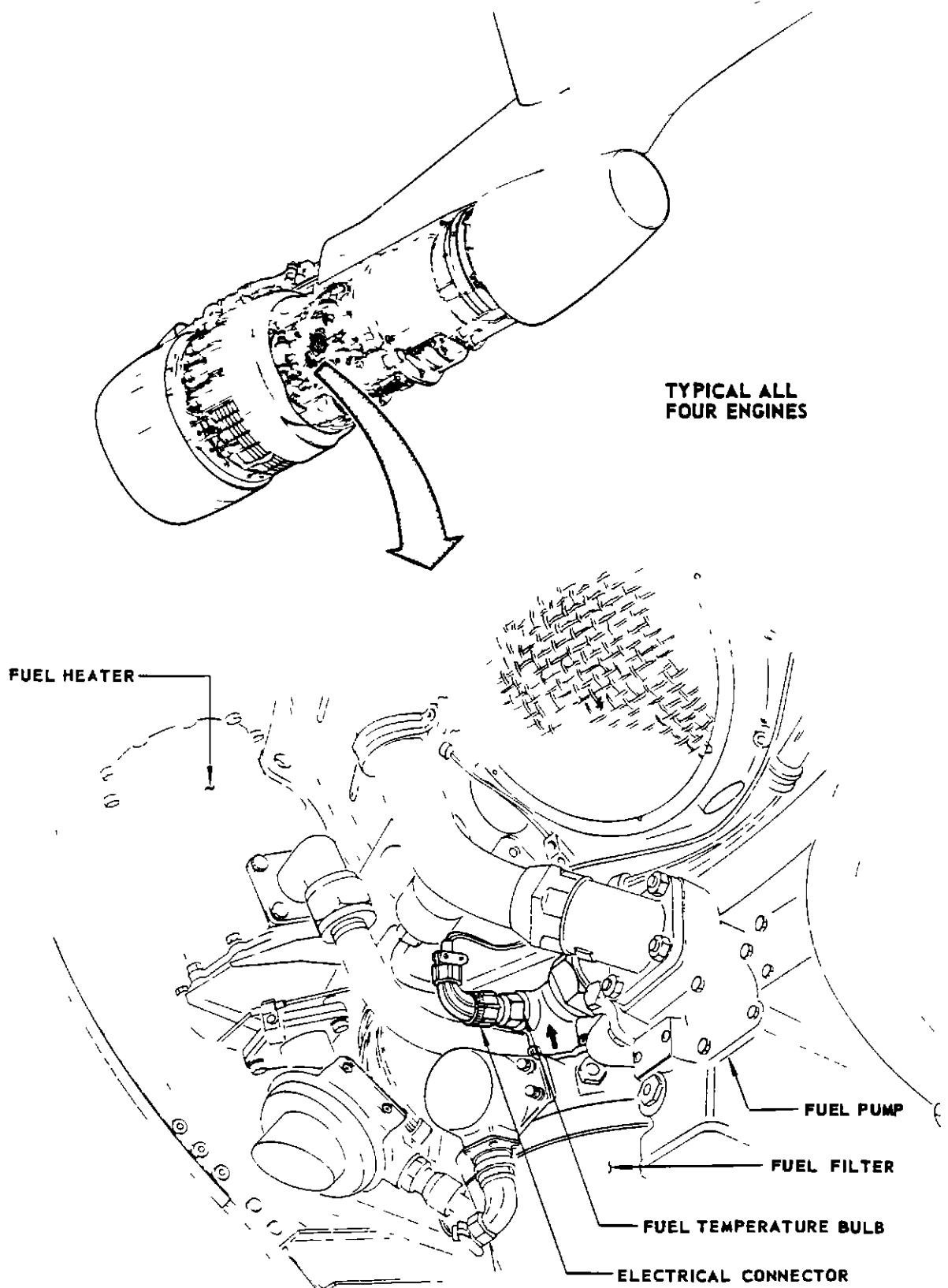
VIEW 1

Fuel Temperature Indicating System Equipment Location
Figure 1 (Sheet 1)

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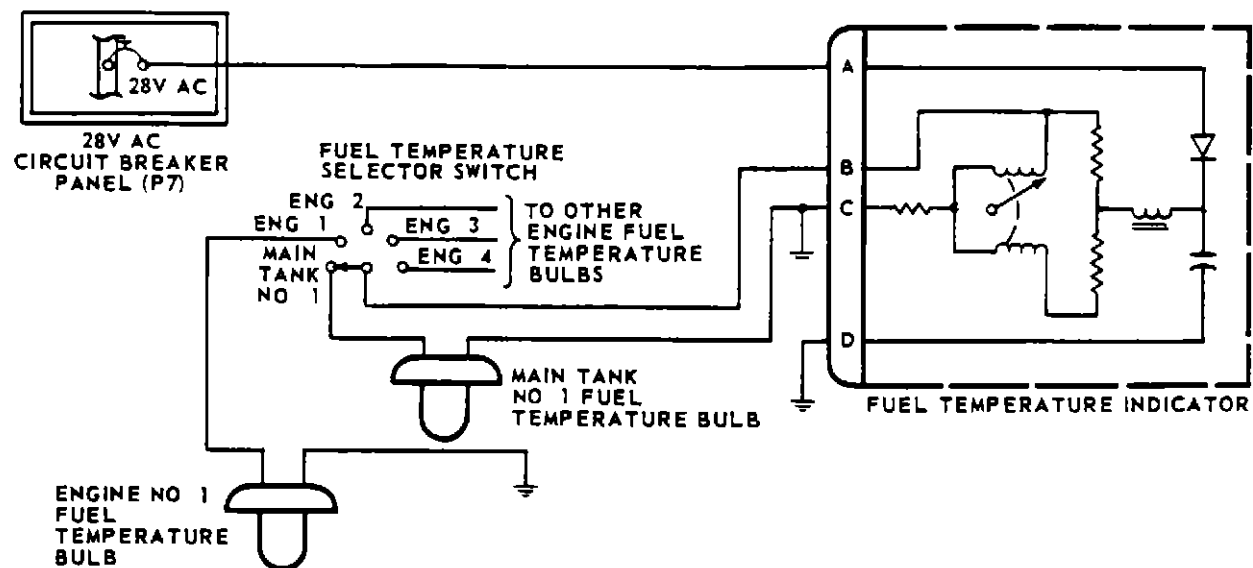
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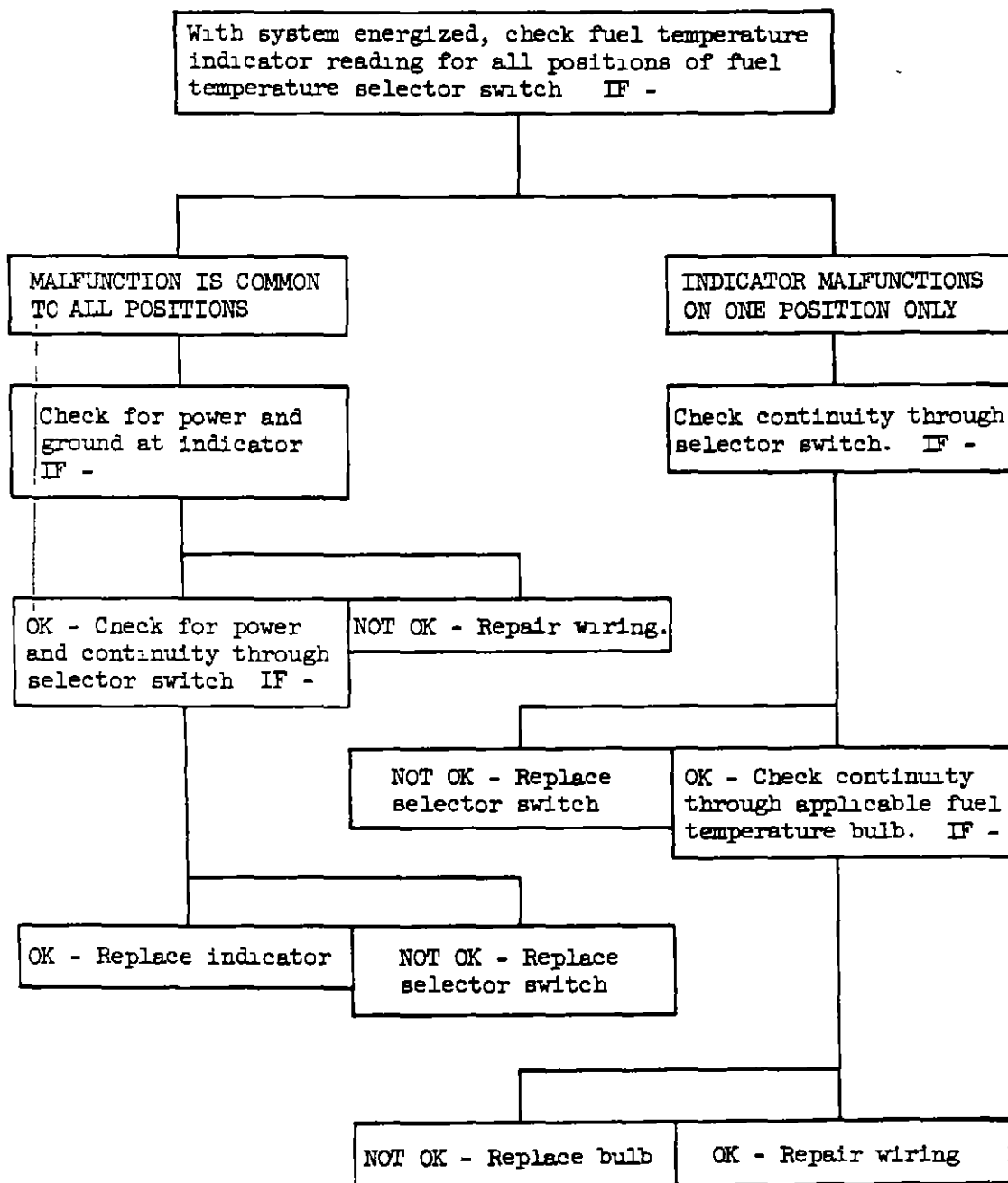
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Fuel Temperature Indicating System Equipment Location
Figure 1 (Sheet 2 of 2)



Fuel Temperature Indicating System Circuit
Figure 2

FUEL TEMPERATURE INDICATING SYSTEM - TROUBLE SHOOTING



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FUEL TEMPERATURE INDICATING SYSTEM - MAINTENANCE PRACTICES

1 Adjustment/Test Fuel Temperature Indicating System

A General

- (1) Testing the fuel temperature indicating system is done by selecting each fuel temperature bulb with the selector switch, establishing a temperature at that temperature bulb, measuring the temperature with a master thermometer and comparing the reading of the fuel temperature indicator with the master thermometer.

B Equipment and Materials

- (1) A master thermometer - mercury type, calibrated in degrees centigrade.
- (2) Oil or water bath if conditions require tests beyond ambient temperature

C. Test Fuel Temperature Indicating System

- (1) Test Main Tank No 1 Temperature Bulb
 - (a) Connect an external power source to the airplane and remove left wing inboard dry bay access panel.
 - (b) Close "FUEL TEMP IND" circuit breaker on 28-volt a-c circuit breaker panel (P7) Allow ten minutes for system to stabilize
 - (c) Set fuel temperature selector switch on flight engineer's lower panel to "NO. 1 TANK" Record fuel temperature indicator reading
 - (d) Rotate temperature bulb locking cap to free bulb from pin and pull bulb out of housing. (See 28-20-1, figure 201.)
 - (e) Place master thermometer in bulb housing and let it come to common temperature with surroundings. Record this temperature reading
 - (f) Compare readings of master thermometer and fuel temperature indicator. They should agree within $\pm 4^{\circ}\text{C}$.

(2) Test Engine Fuel Temperature Bulb

- (a) Connect an external power source to the airplane and open left side cowl panel.
- (b) Open "FUEL TEMP IND" circuit breaker on 28-volt a-c circuit breaker panel (P7).
- (c) Set fuel temperature selector switch on flight engineer's lower panel to applicable engine.
- (d) Check that engine fuel shutoff valves for applicable engine are closed.
- (e) Disconnect electrical plug and remove engine fuel temperature bulb.
- (f) Reconnect electrical plug and close "FUEL TEMP IND" circuit breaker on 28-volt a-c circuit breaker panel (P7)
- (g) Support water or oil bath close to engine and submerge fuel temperature bulb and master thermometer in bath.
- (h) Compare reading of master thermometer and fuel temperature indicator on flight engineer's panel. They should agree within $\pm 4^{\circ}\text{C}$.

FUEL TEMPERATURE BULB - MAINTENANCE PRACTICES

1. Removal/Installation Main Tank No. 1 Fuel Temperature Bulb

A Remove Main Tank No 1 Fuel Temperature Bulb (See figure 201.)

- (1) Open "FUEL TEMP IND" circuit breaker on 28-volt a-c circuit breaker panel (P7)
- (2) Remove inboard dry bay access panel on left wing

NOTE Bulb is located on aft wall of dry bay.
- (3) Disconnect temperature bulb leads from terminal strip. Remove supporting clamp
- (4) Rotate temperature bulb locking cap to free bulb from pin.
- (5) Hold locking cap and pull bulb out of bulb housing

B Install Main Tank No 1 Fuel Temperature Bulb (See figure 201)

- (1) Grasping temperature bulb by locking cap, insert it into bulb housing.
- (2) Push bulb in until it is stopped by pin
- (3) Rotate locking cap to lock around pin
- (4) Connect lead wires to terminal strip and faster support clamp

NOTE Reseal terminal strip connection with BMS-5-12D type "C" compound (Pro-Seal 606).

- (5) Replace inboard dry bay access panel
- (6) Close "FUEL TEMP IND" circuit breaker on 28-volt a-c circuit breaker panel (P7)

2 Removal/Installation Engine Fuel Temperature Bulb

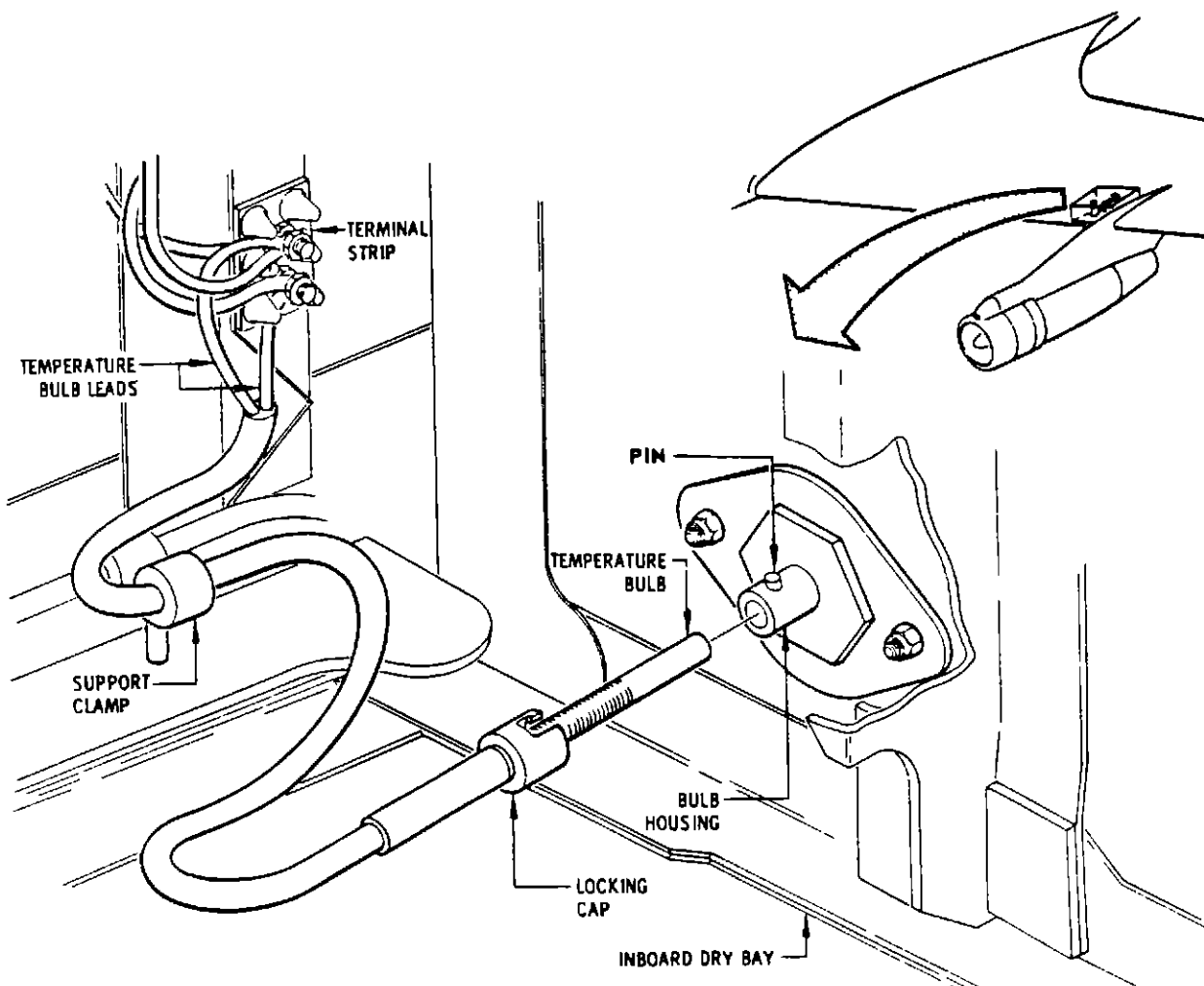
A Remove Engine Fuel Temperature Bulb (See figure 202)

- (1) Check that applicable engine fuel shutoff valve is closed
- (2) Open "FUEL TEMP IND" circuit breaker on 28-volt a-c circuit breaker panel (P7)

- (3) Open left side cowl panel.
- (4) Disconnect electrical plug and remove temperature bulb from socket on fuel filter outlet.

B. Install Engine Fuel Temperature Bulb (See figure 202.)

- (1) Replace temperature bulb in threaded socket on fuel filter using new O-ring.
- (2) Connect electrical plug.
- (3) Close left side cowl panel
- (4) Close "FUEL TEMP IND" circuit breaker on 28-volt a-c circuit breaker panel (P7).

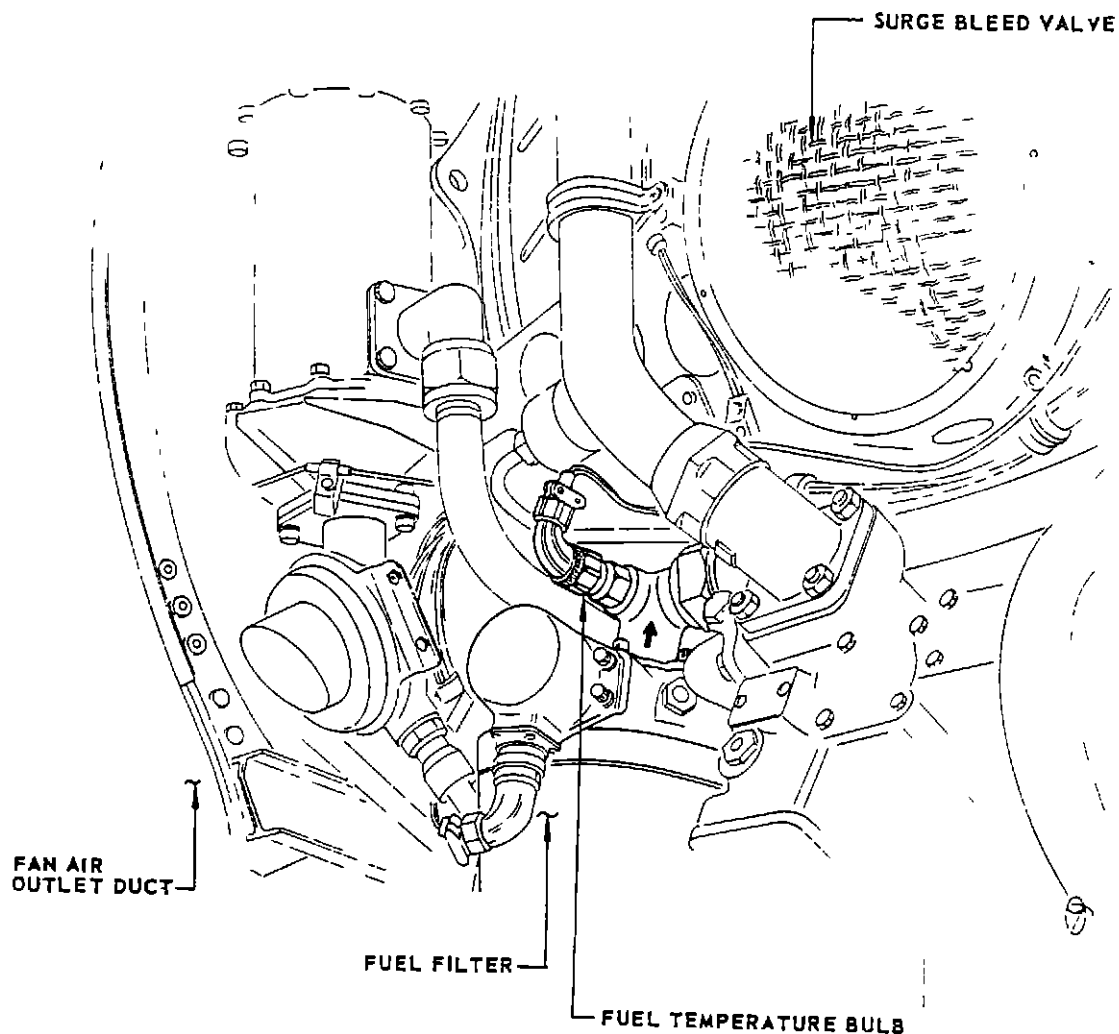
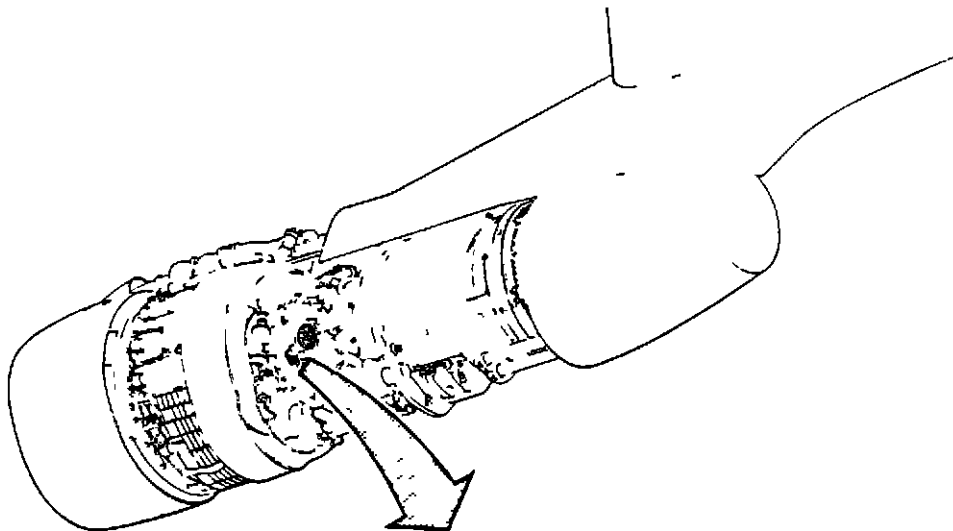


Main Tank No 1 Fuel Temperature Bulb Installation
Figure 201

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Revised

Engine Fuel Temperature Bulb Installation
Figure 202

23-20-1
Page 202

3. Adjustment/Test Main Tank No. 1 Fuel Temperature Bulb

A. General

- (1) The fuel temperature bulb has no provisions for adjustment and only a test for accuracy can be performed on it. To test the bulb, the resistance across the bulb leads is measured and compared with values found on the chart of temperature resistance values. (See figure 203.)

B. Equipment and Materials

- (1) A precision ohmmeter or bridge tester.
- (2) A master thermometer, mercury type, calibrated in °C.

C. Test Main Tank No. 1 Fuel Temperature Bulb

- (1) Open "FUEL TEMP IND" circuit breaker on 28-volt a-c circuit breaker panel (P7).
- (2) Obtain access to fuel temperature bulb by removing left wing inboard dry bay access panel.
- (3) Disconnect fuel temperature bulb leads, measure, and record the resistance across the leads using ohmmeter. (See figure 201.)
- (4) Rotate temperature bulb locking cap to free bulb from pin and pull bulb out of housing.
- (5) Place master thermometer in housing and let it come to common temperature with surroundings. Then record temperature reading.
- (6) Determine resistance value from chart (figure 203) using master thermometer reading. Compare resistance value from chart with resistance value measured across bulb leads. They should agree within ± 0.40 ohms. If they do not agree, replace with serviceable temperature bulb.

4. Adjustment/Test Engine Fuel Temperature Bulb

A. General

- (1) The fuel temperature bulb has no provisions for adjustment and only a test for accuracy can be performed on it. To test the bulb, the resistance across the bulb connections is measured and compared with values found on the chart of temperature resistance values. (See figure 203.) The bulb temperature may be measured by allowing the bulb and a master thermometer to read ambient temperature. If an extended temperature range test is required, the temperature bulb and a master thermometer should be immersed in a water or oil bath.

B Equipment and Materials

- (1) A precision ohmmeter or bridge tester.
- (2) A master thermometer, mercury type, calibrated in degrees centigrade
- (3) Water or oil bath if conditions require

C. Test Fuel Temperature Bulb (See figure 202.)

- (1) Open "FUEL TEMP IND" circuit breaker on 28-volt a-c circuit breaker panel (P7).
- (2) Obtain access to fuel temperature bulb by opening left side cowl panel on applicable engine
- (3) Disconnect electrical plug and remove temperature bulb.
- (4) Allow temperature bulb and master thermometer to reach ambient temperature, or place sensing portions of temperature bulb and thermometer in oil or water bath until a steady temperature is reached. Record temperature shown on master thermometer
- (5) Measure resistance of temperature bulb by connecting leads of ohmmeter to its A (+) and B (-) terminals. Compare resistance value from chart with resistance value measured across bulb connections. They should agree within ± 0.40 ohms. If they do not agree, replace with a serviceable temperature bulb.

TEMPERATURE		RESISTANCE (OHMS)
°C	°F	
50	122	108.39
40	104	104.60
30	86	100.91
20	68	97.31
10	50	93.80
0	32	90.38
-10	14	87.04
-20	-4	83.77
-30	-22	80.56
-40	-40	77.39
-50	-58	74.24

CONVERSION

$$^{\circ}\text{F} = 9/5^{\circ}\text{C} + 32$$

$$^{\circ}\text{C} = 5/9 (^{\circ}\text{F} - 32)$$

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MAINTENANCE MANUAL

PRESSURE FUELING SYSTEM - DESCRIPTION AND OPERATION

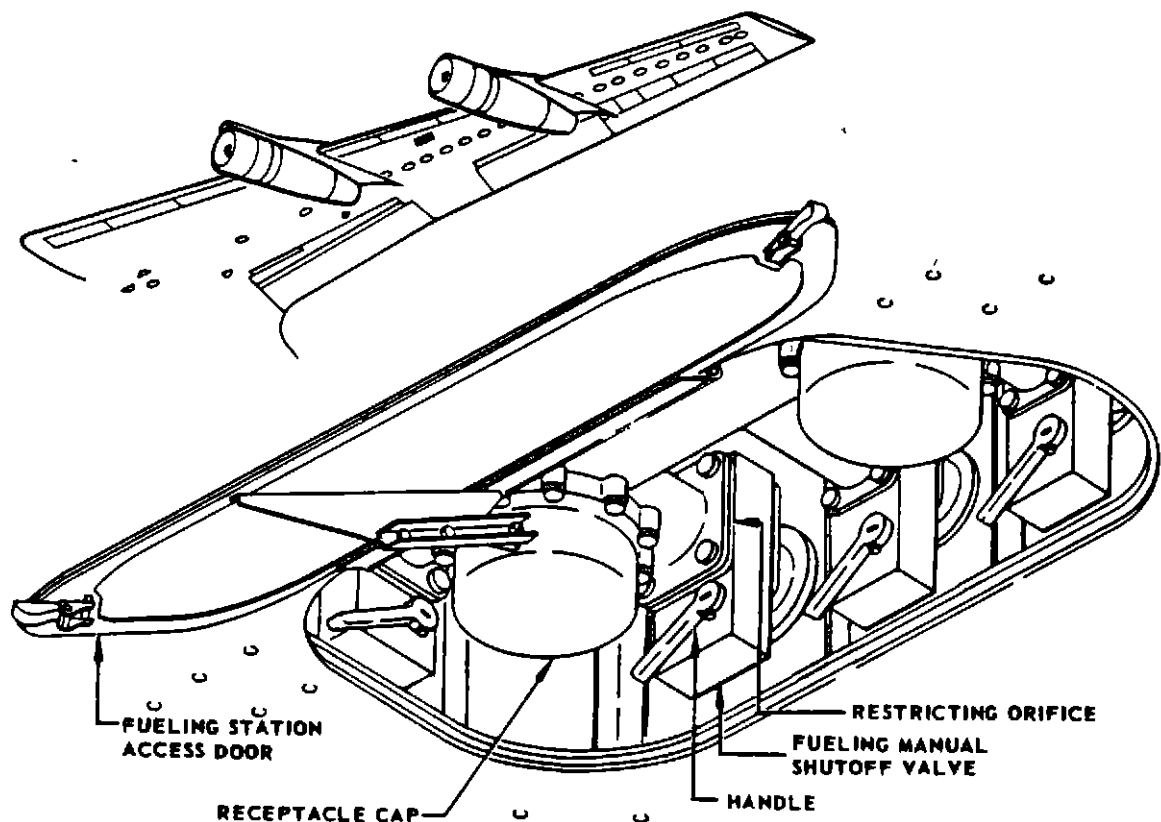
EFFECTIVITY

TURBOFAN

1 General

- A The pressure fueling system is a manually controlled system of fueling lines and valves which distributes fuel under pressure from two fueling stations to the fuel tanks at a high rate of flow. Rapid partial defueling may also be accomplished through the pressure fueling system.
- B Each fueling station (figure 1) is equipped with a fueling manifold, two fueling receptacles, four fueling manual shutoff valves, and two fueling hose nozzle grounding jacks. Each fuel tank is provided with a fueling level control shutoff valve and a fueling level control pilot valve. All major components are interconnected by fuel delivery lines to form the complete distribution system (See figures 2 and 3)

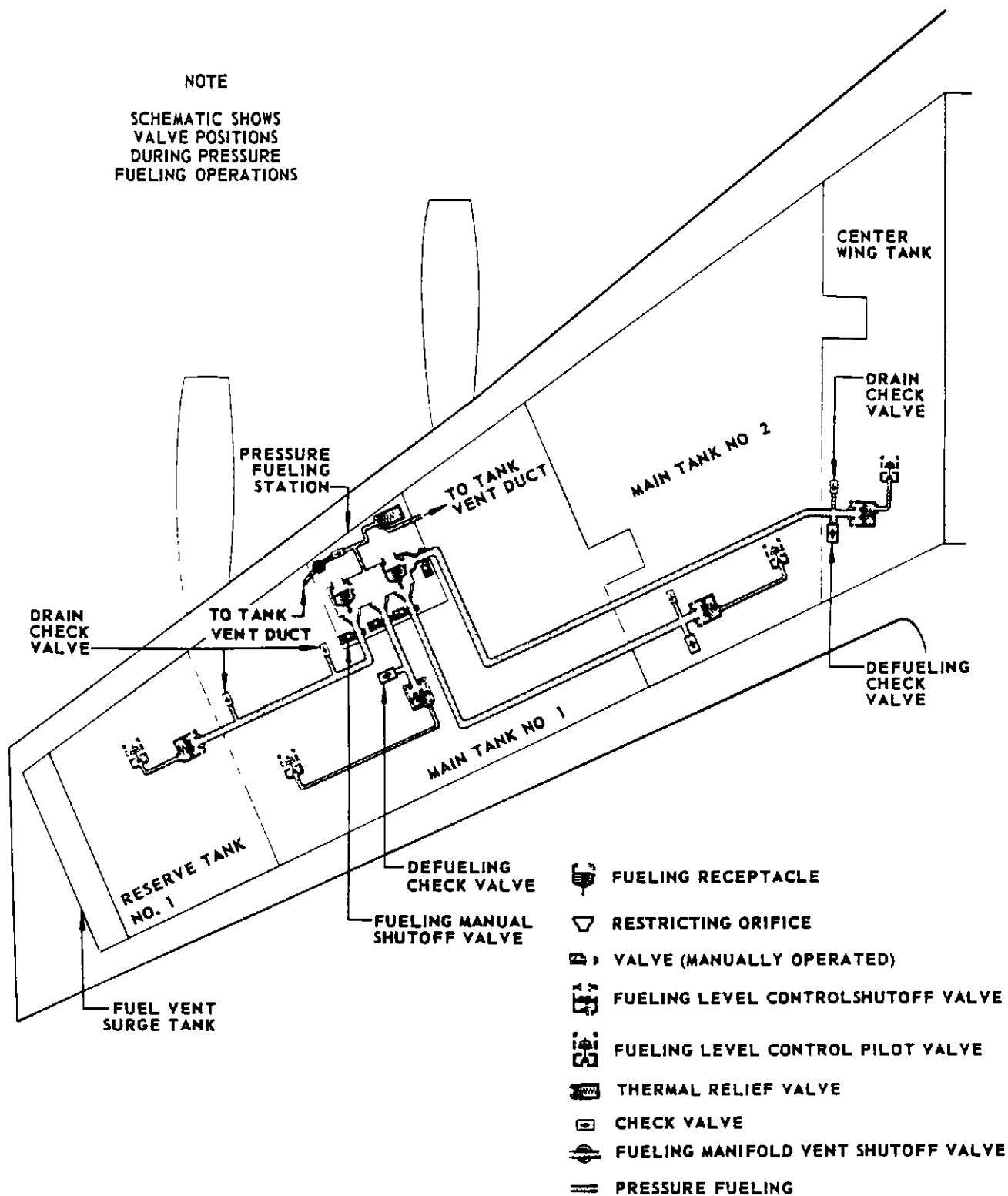
CAUTION TO PREVENT POSSIBILITY OF PRESSURE FUELING STATION ACCESS DOORS INTERFERING WITH THE WING LEADING EDGE FLAPS, THE DOORS MUST NOT BE OPENED BEYOND THEIR NORMAL DETENT POSITION.



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NOTE

SCHEMATIC SHOWS
VALVE POSITIONS
DURING PRESSURE
FUELING OPERATIONS



Pressure Fueling System Flow Diagram
Figure 2

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- C The fueling operation consists essentially of coupling the fuel hose nozzles to the receptacles, opening the fueling manual shutoff valves and pumping fuel to the tanks. An automatic shutoff feature limits the quantity of fuel that may be pumped aboard and therefore prevents overfilling the tanks.

2 Fueling Manifold

- A The fueling manifold is the distribution center of the pressure fueling system. The manifold consists of an aluminum tubing assembly with two inlet ports, four outlet ports, a vent port and two support brackets. Hangers attach to the support brackets to secure the manifold to the wing structure at the pressure fueling station. (See detail C, figure 3.) Chains that retain the receptacle caps are attached to the bottom of the manifold. A fueling receptacle is attached at each inlet port, and a fueling manual shutoff valve is attached at each outlet port. Fuel delivery to the manifold is controlled at the feed source and fuel distribution from the manifold is controlled by the fueling manual shutoff valves.

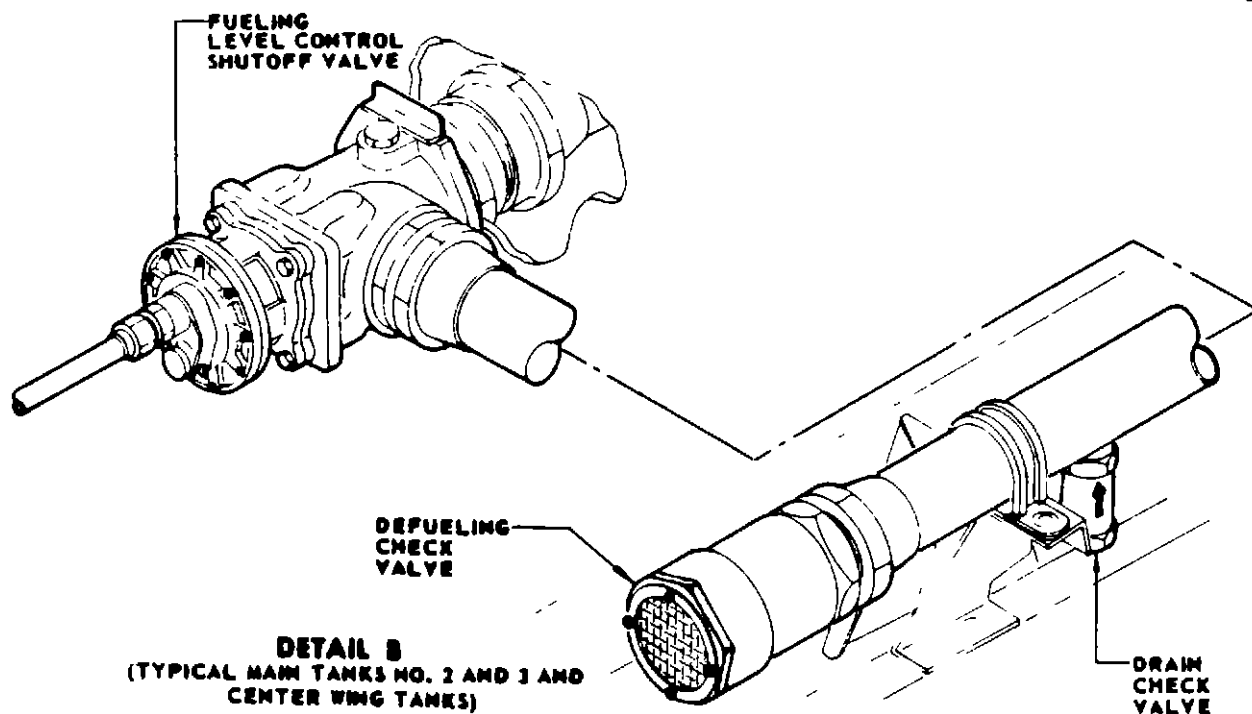
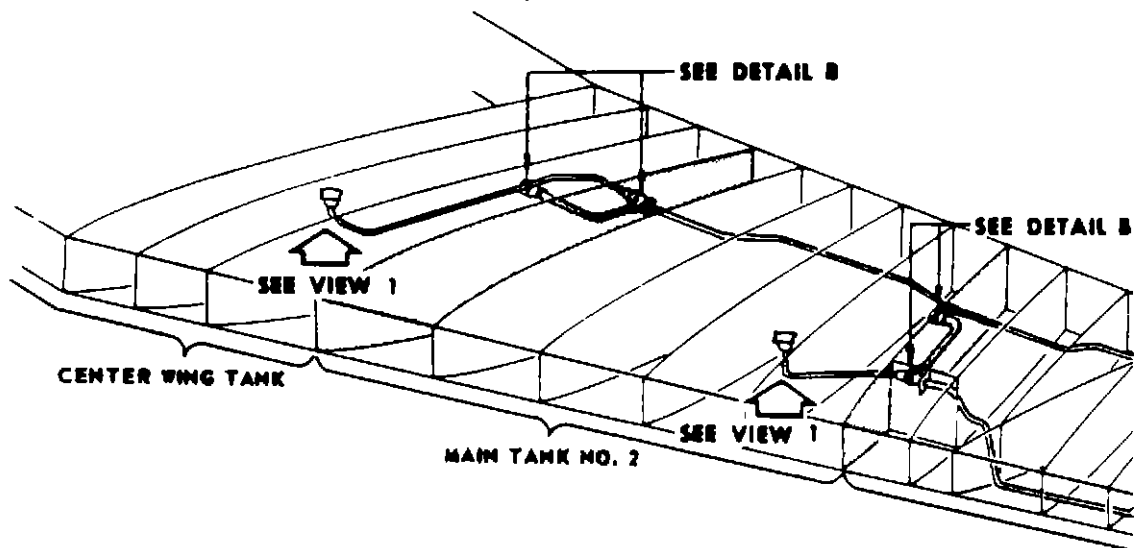
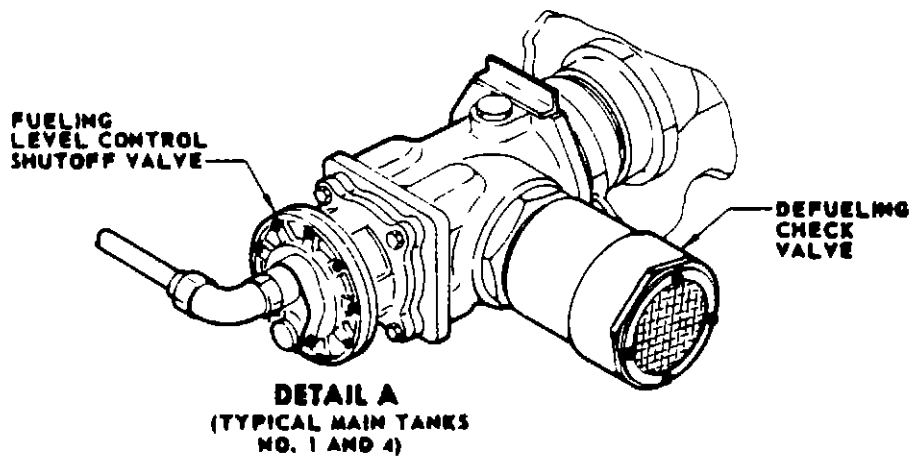
3 Fueling Receptacle

- A Two fueling receptacles adapt each fueling manifold to receive the fueling hose nozzles. Each receptacle contains a valve which seals the manifold inlet when the fuel hose is disconnected. The receptacle consists of a fueling hose adapter and a spring loaded poppet valve. (See figure 4.) The poppet valve is clamped between the manifold inlet and the fueling hose adapter flange. Each adapter has mating lugs which couple and secure the fuel hose. A plunger in the fueling hose nozzle opens the poppet valve to allow fuel to flow through the nozzle into the manifold.
- B Two fueling receptacle caps cover and seal the fueling receptacles when fueling operations are completed. Each cap consists of a housing, a locking ring and a bellows seal. (See figure 4.) The locking ring couples with the lugs on the receptacle to secure the cap. A short piece of chain attaches the cap to the manifold to prevent the cap from getting lost or damaged. The cap is manually forced up and twisted into the locked position to create a compression seal on the fueling hose adapter.

4 Fueling Manual Shutoff Valves

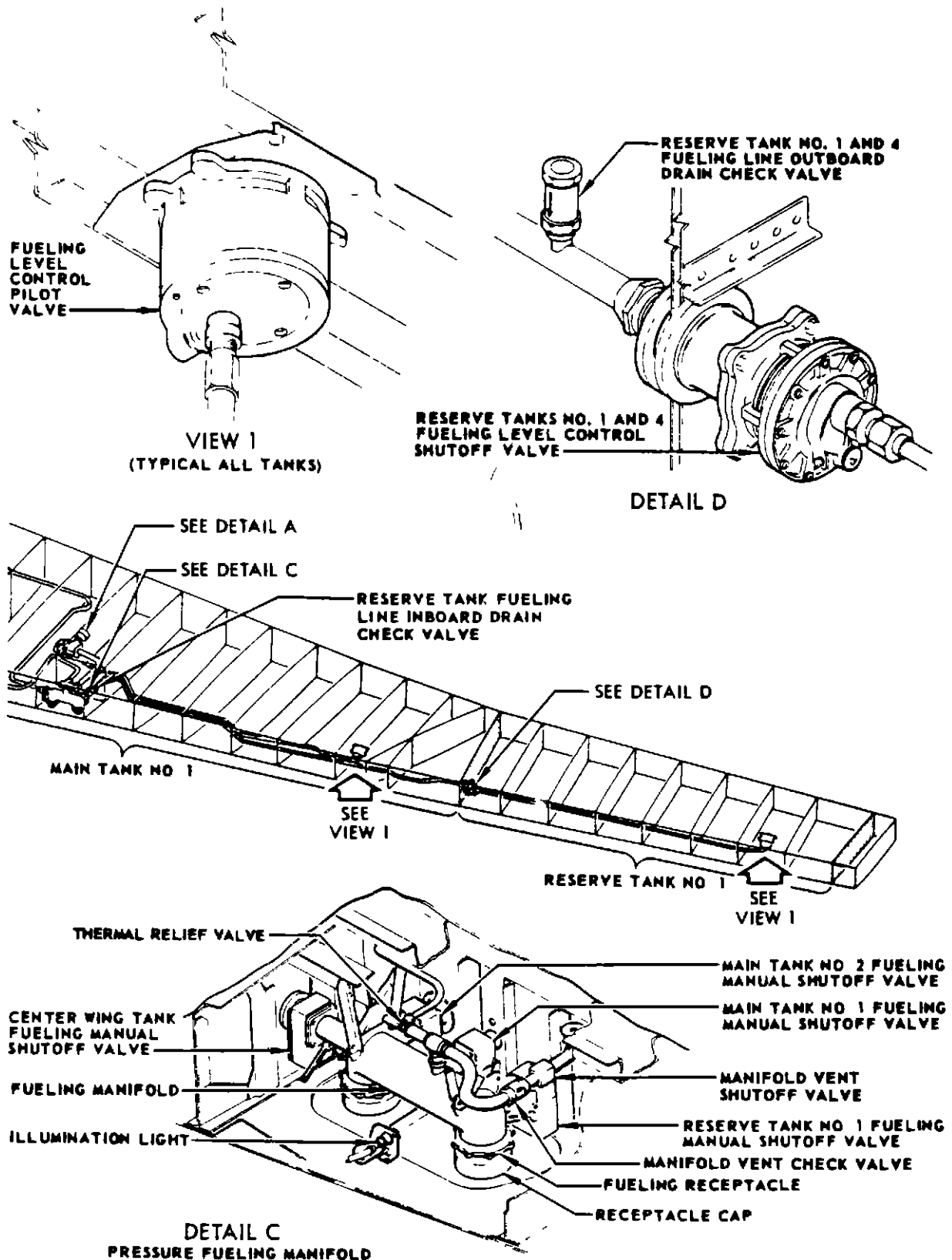
- A Eight fueling manual shutoff valves perform the function of controlling fuel distribution to all of the fuel tanks. Four of these valves are located at each fueling station (figure 1) between the manifold outlet ports and the fueling line bulkhead fittings. These valves consist of a ported housing, a sliding gate, and a manually operated handle. All valves are secured by attachment bolts which clamp them between the flanges of the manifold and the bulkhead fittings. The valve handles are manually positioned to either "OPEN" or "CLOSED" to control fueling distribution.

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Pressure Fueling System Equipment Location
Figure 3 (Sheet 1)

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5. Fueling Level Control Pilot Valve

- A The fueling level control pilot valve limits the quantity of fuel that can be pumped into a tank, by automatically controlling the closing of the fueling level control shutoff valve. Each valve assembly consists of a cylindrical valve housing, a float and a poppet. The valve (view 1, figure 3) is bolted to a bracket at the top of the tank and is connected to the fueling level control shutoff valve through a pilot line. The float actuates the poppet to close a pilot port in the base of the housing. This builds up pressure in the pilot line and closes the fueling level control shutoff valve.

6. Fueling Level Control Shutoff Valve

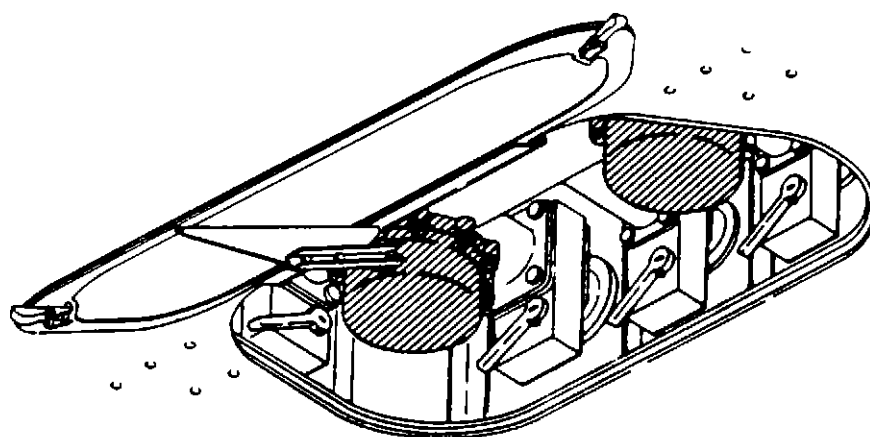
- A The fueling level control shutoff valve in each tank automatically stops fuel flow into a tank when its respective fueling level control pilot valve senses a full tank condition. The valve housing is separated into two chambers by a diaphragm. The forward chamber contains the fueling line inlet port and the fueling outlet ports. The aft chamber contains a sensing port and a spring. The two chambers are connected by a small bleed hole through a poppet in the center of the diaphragm.
- B. The valve attaches to a bulkhead fitting where the fueling line enters the inside of a tank. (See details A, B and D, figure 3.) A pilot line connects the sensing port of the aft chamber to the fueling level control pilot valve. Closing of the fueling level control pilot valve builds up pressure in the pilot line and aft chamber equal to the fueling pressure in the forward chamber. This enables the spring to close the poppet, which stops the flow of fuel into the tank. After fueling pressure is removed from the line, the spring keeps the poppet closed to prevent the fuel in the tank from re-entering the lines ahead of the shutoff valve.

7. Miscellaneous Components

A Restricting Orifice Plates

- (1) A restricting orifice plate in each pressure fueling line limits the maximum fueling rate for that tank. The orifices are holes of a specific diameter bored through flat plates which are clamped between the fueling manifold outlet flanges and the fueling manual shutoff valves. (See figure 1.)

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FUELING
MANIFOLD INLET

O-RING

POPPET VALVE

FUELING
HOSE ADAPTER

CAP

LOCKING RING

BELLOWS SEAL

CHAIN

CAP
(TOP VIEW)

VIEW 1

SEE VIEW 1

CAP
(BOTTOM VIEW)

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B. Fueling Manifold Vent Check Valve

- (1) The fueling manifold vent check valve vents the manifold to the fuel tank vent system to facilitate evacuation. The valve is located in a vent line leading from the manifold. (See detail C, figure 3.) The valve is spring loaded closed, but is set to open and vent the manifold when a negative pressure of approximately 0.5 psi exists in the manifold.

C. Drain Check Valve

- (1) Drain check valves on some pressure fueling lines permit fuel to drain from the line into the tank when fueling pressure is released. (See figure 3.) Each valve is a spring-loaded poppet valve which is kept closed by the fueling pressure in the line. The valve returns to its normally open position when the pressure in the line drops below 2.5 psi. Main tanks No. 2 and 3, and center wing tanks each have one valve fitted in a downward position. The reserve tanks each have two valves, the inboard ones being fitted in a downward position and the outboard ones in an upward position. Main tanks No. 1 and 4 pressure fueling lines are not fitted with drain check valves

D. Thermal Relief Valve

- (1) The thermal relief valve relieves the manifold from excessive pressure buildup due to thermal expansion of the fuel. The valve is a spring-loaded poppet valve fitted into a vent line from the manifold. (See detail C, figure 3) The valve is set to start opening at approximately 70 psi and reseal at approximately 60 psi.

E. Defueling Check Valve

- (1) Defueling check valves adapt the pressure fueling system for defueling. The valves are connected to the end of the branches of the fueling lines in each of the main and center wing tanks. (See details A and B, figure 3) Each valve is of the hinged flapper type, and is spring loaded closed. When fuel is being delivered into the tanks, the fuel pressure in the fueling line keeps the flapper closed. When suction is applied to the fueling lines, the flapper opens and fuel flows from the tank into the pressure fueling line. In this manner by applying pump suction to the fueling manifold, fuel is drawn from the fuel tanks. The tanks cannot be completely defueled by this method. Defueling has to be completed through the defueling valve. Refer to "Servicing Fuel System," 28-0 and "Defueling Valve," 28-1-0.

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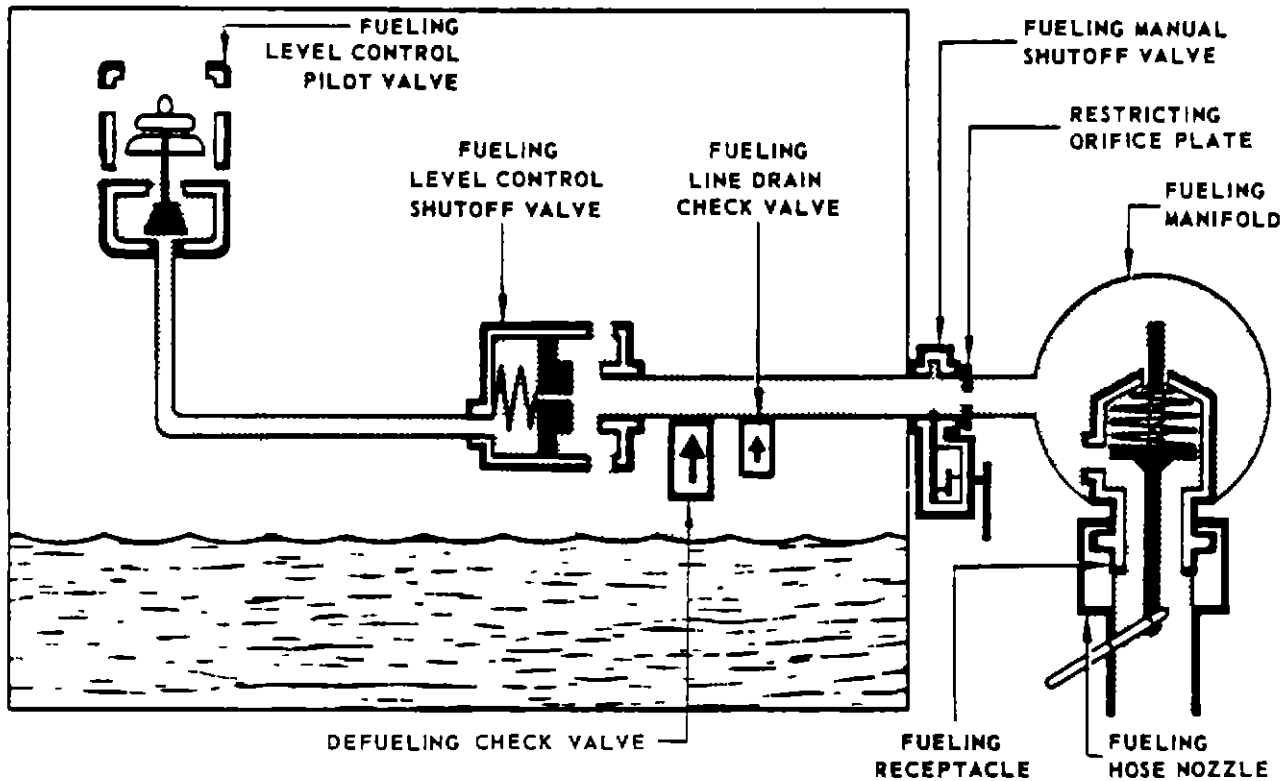
F Fueling Manifold Vent Shutoff Valve

- (1) A fueling manifold vent shutoff valve located in the vent line of each fueling manifold allows the vent line to be closed (See detail C, figure 3) The valve is a manually operated drain cock type and is normally in the open position When the valve is in the closed position, the pressure fueling system can be used to partially defuel the tanks

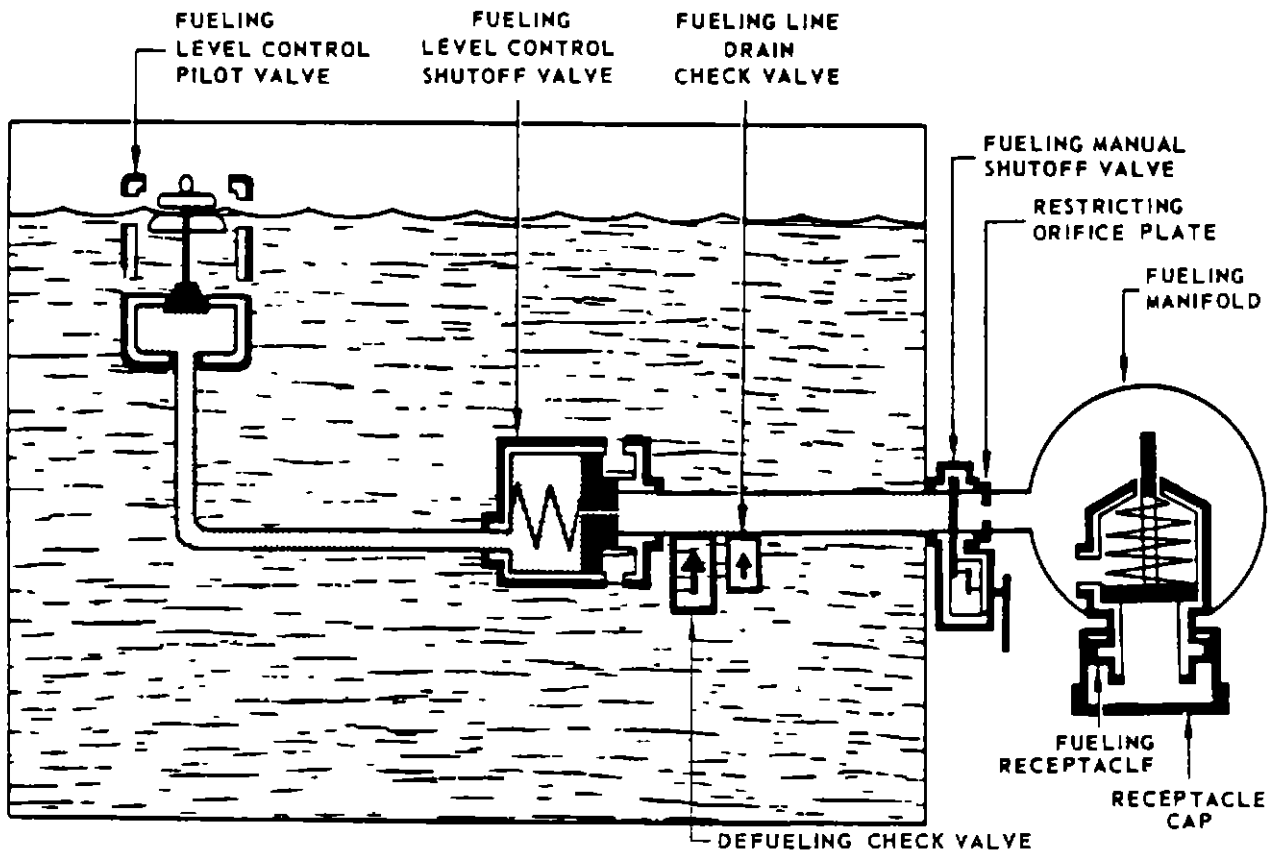
8 Operation

- A When fueling the airplane, fuel will flow into the tanks until a full fuel load is aboard, therefore if partial fueling is desired, the fuel quantity gages, on the flight engineer's panel, or the dripsticks must be monitored till the required amount of fuel is indicated, at this time the manual fueling shutoff valves should be closed. If the fuel quantity gages are being monitored, external power must be connected to the airplane and the fueling switch, adjacent to the external power receptacle, must be in the "ON" position.
- B With the fueling hoses connected to the receptacles and the manual fueling shutoff valves open, the airplane is ready to receive fuel Starting the pump operation pressurizes the fueling manifold and lines This fueling pressure forces open the fueling level control shutoff valves and fuel flows into the tanks (See figure 5.) If the manual shutoff valve is not closed fuel continues to flow until the fuel level is sufficient to actuate the fueling level control pilot valve, which in turn closes the fueling level control shutoff valve. (See figure 6)

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Fueling Level Control Flow Diagram - Fueling in Progress
Figure 5



Fueling Level Control Flow Diagram - Fueling Completed
Figure 6

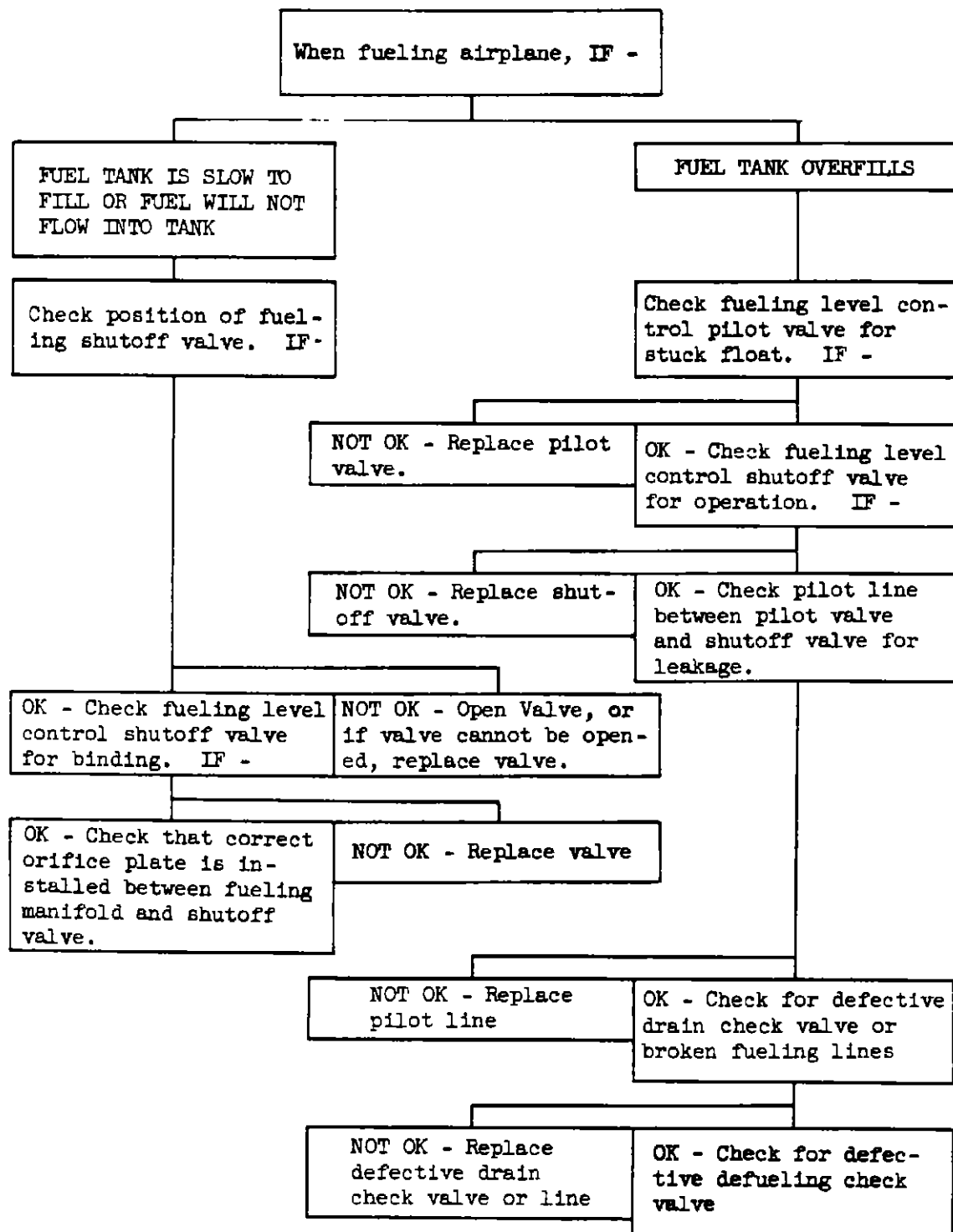


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PRESSURE FUELING SYSTEM - TROUBLE SHOOTING

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PRESSURE FUELING SYSTEM - MAINTENANCE PRACTICES

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1 Adjustment/Test Pressure Fueling System

A Test Pressure Fueling System

- (1) Connect external power to airplane.
- (2) Open fueling station access doors.
- (3) Place fueling switch on external power receptacle box (J8) to "ON," and verify that illumination light at each fueling station is on.
- (4) Remove all fueling receptacle caps, and examine receptacles for damage that may affect proper sealing of fuel hose nozzle. Check that all fueling manual shutoff valves are closed and drain fuel from manifold into suitable container.
- (5) Press poppet valve in each receptacle up with thumb and verify that there is no binding and that they reseal properly.
- (6) Install fueling hose nozzle grounding jacks and couple hose nozzle to each fueling receptacle and verify that they couple and seal properly at each receptacle.
- (7) Open and close fueling manual shutoff valves and verify that they open and close completely without binding before proceeding further.
- (8) Position fueling manual shutoff valves to "CLOSED" and start pumping fuel. The source shall not develop more than 50 psi at receptacle under any flow conditions. Verify that there is no leakage at fuel nozzle seal, receptacles, manifold line fittings or fueling manual shutoff valves.
- (9) Slowly open and close (consecutively) each fueling manual shutoff valve and verify that there is no binding under fueling conditions. Make certain that all fueling manual shutoff valves are closed before proceeding.
- (10) Open one fueling manual shutoff valve and proceed to fuel tank.
- (11) Continue fueling and observe fuel truck or hydrant system flowmeter. Verify that flow is not restricted.
- (12) Continue fueling until tank is filled. Verify flowmeter shows no flow.

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- (13) Close fueling manual shutoff valve.
- (14) Repeat steps (10) thru (13) for each tank.
- (15) Reverse fueling pump to evacuate fueling manifold and hose.
- (16) Stop fueling pump.
- (17) Disconnect fueling hose nozzles and grounding jacks, wipe up at fueling stations and replace receptacle caps.
- (18) Close fueling station access doors.

NOTE Pressure fueling station door cannot be closed if manual shutoff valves are not closed.

- (19) Place fueling switch on external power receptacle box to "OFF."

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FUELING MANUAL SHUTOFF VALVES - MAINTENANCE PRACTICES

1 Removal/Installation Fueling Manual Shutoff Valve

A. Remove Fueling Manual Shutoff Valve (See figure 201.)

- (1) Defuel center wing tank and all tanks on applicable side of airplane. See "Servicing Fuel System," 28-0.
- (2) Disconnect electrical power from airplane.
- (3) Pull circuit breakers for fueling station illumination lights.
- (4) On turbojet airplanes, pull circuit breakers for fueling preset indicator lights.
- (5) Open fueling station access door and remove fueling receptacle caps.
- (6) Drain pressure fueling lines and manifold.
- (7) Remove vent line from manifold.
- (8) Loosen manifold support bolts.
- (9) Remove bonding jumper at valve to be removed.
- (10) Remove four mounting bolts at valve to be removed
- (11) Loosen other mounting bolts as necessary and pull valve free of manifold.

CAUTION: LOOSEN MOUNTING BOLTS ONLY SUFFICIENT TO ENABLE DEFECTIVE VALVE TO SLIP OUT. EXCESSIVE LOOSENING WILL DISTURB O-RINGS ON REMAINING VALVES.

- (12) Remove orifice plate and save for installation.

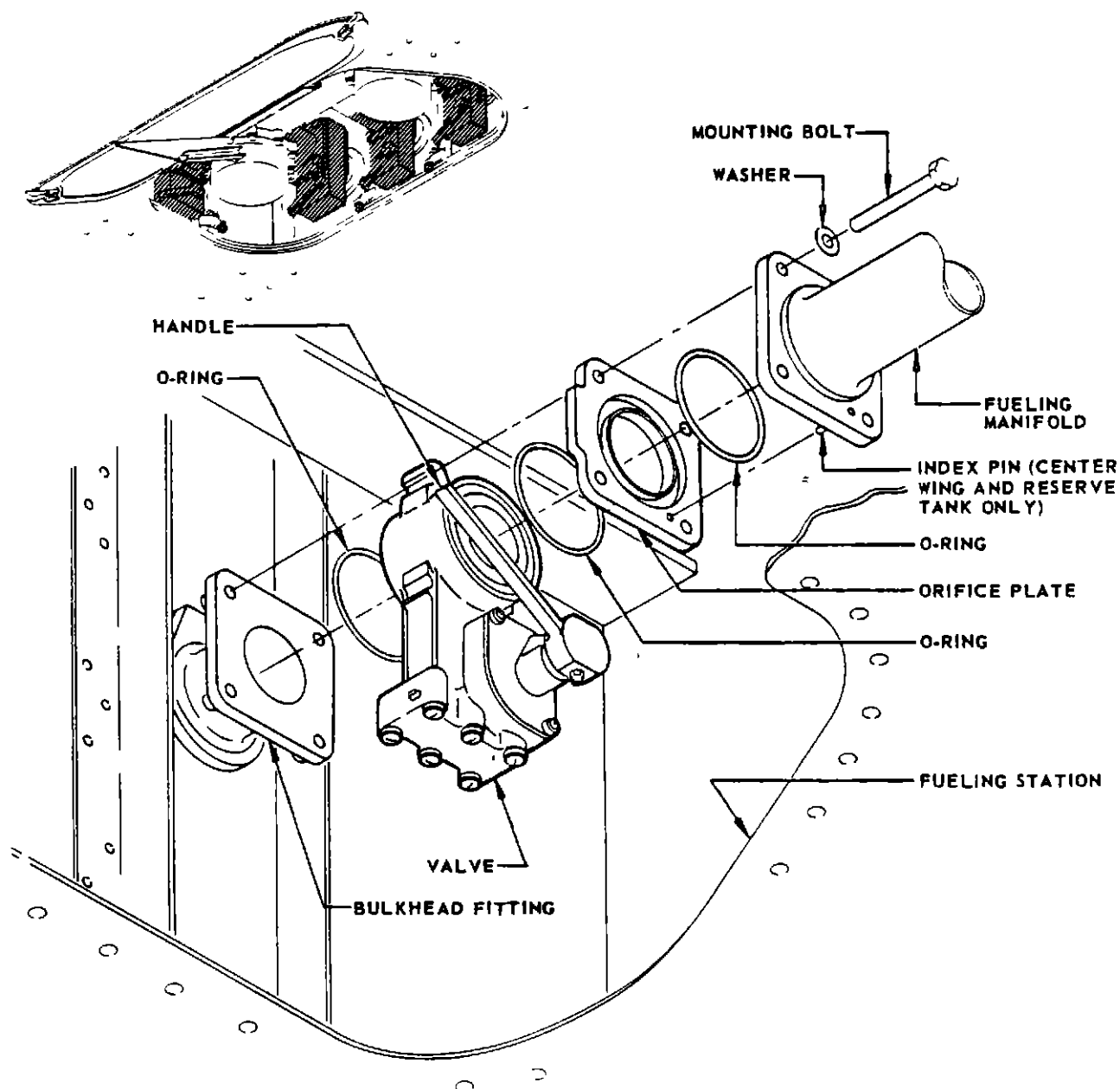
B. Install Fueling Manual Shutoff Valve (See figure 201.)

- (1) Clean machined surfaces with naphtha and wipe dry with lint free cloth, lubricate machined surfaces with fuel.
- (2) Fit O-rings, lightly lubricated with fuel, into grooves provided in valve and orifice plate.

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- (3) Position orifice plate against fueling manifold outlet and start one upper valve mounting bolt.

CAUTION: DO NOT LEAVE OUT ORIFICE PLATE. EXCESSIVE FUELING RATE WILL DAMAGE TANK.



Fueling Manual Shutoff Valve Installation
Figure 201



- (4) Slip shutoff valve in position and start remaining mounting bolts.
- (5) Tighten bolts on all valves
- (6) Connect bonding jumper on valve installed.
- (7) Tighten manifold support bolts.
- (8) Connect vent line to manifold.
- (9) Close fueling manual shutoff valves and fueling station access door.
- (10) Close circuit breakers for fueling station illumination lights.
- (11) On turbojet airplanes, close circuit breakers for preset indicator lights.

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FUELING RECEPTACLE - MAINTENANCE PRACTICES

1. Removal/Installation Fueling Receptacle

A. Remove Fueling Receptacle (See figure 201.)

- (1) Remove power from airplane, and open circuit breakers for fueling station illumination lights.
- (2) On turbojet airplanes, open circuit breakers for fueling preset indicator lights.
- (3) Open applicable fueling station access door.
- (4) Verify that fueling manual shutoff valves are closed.
- (5) Remove receptacle cap.
- (6) Drain fuel from manifold into suitable container.
- (7) Remove all receptacle mounting bolts.

WARNING: THE POPPET VALVE SPRING WILL FORCE ADAPTER DOWN WHEN MOUNTING BOLTS ARE REMOVED. HOLD RECEPTACLE FIRMLY WHILE REMOVING BOLTS.

- (8) Lower fueling hose adapter and free poppet valve.

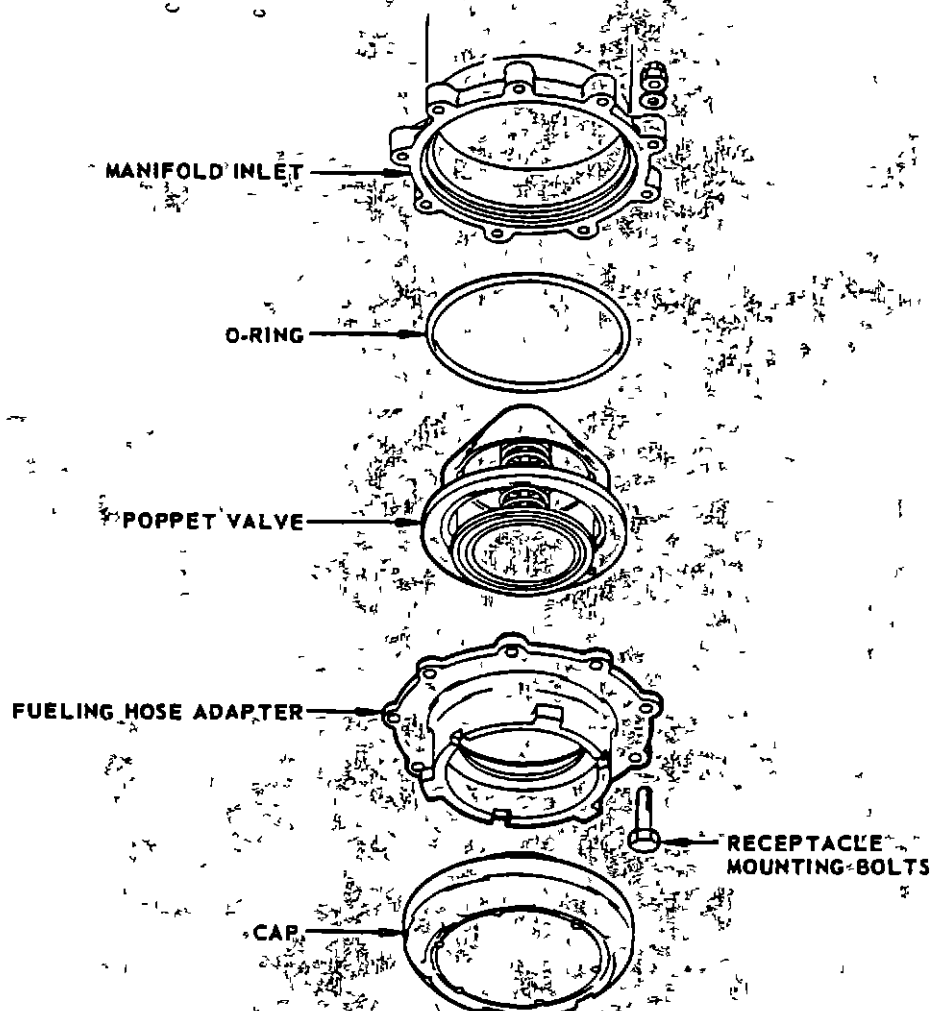
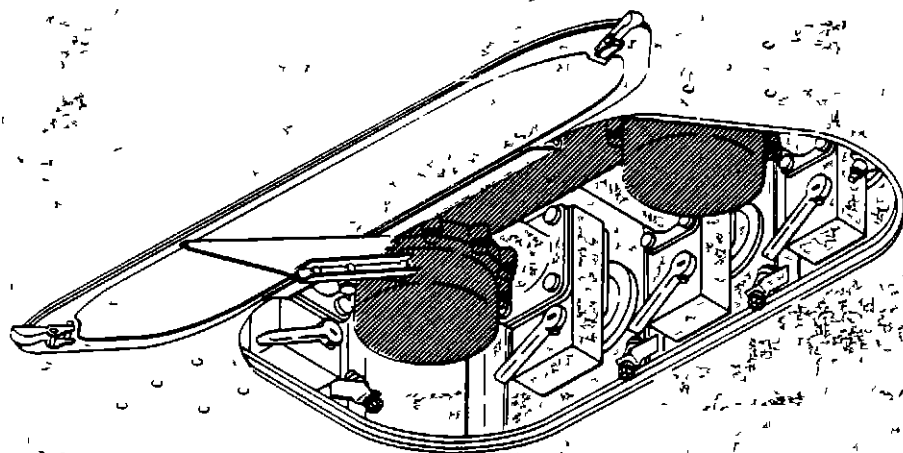
B. Install Fueling Receptacle (See figure 201.)

- (1) Clean machined surfaces with naphtha and wipe dry with lint free cloth.
- (2) Fit O-ring, lightly lubricated with fuel, into its groove.
- (3) Position poppet valve on fueling hose adapter and move them up into position.

CAUTION: DO NOT DISLODGE OR PINCH O-RING.

- (4) Force fueling hose adapter up and rotate until index pin mates.
- (5) Rotate until bolt holes are aligned and install mounting bolts.
- (6) Install receptacle cap and close fueling station access door.
- (7) Close circuit breakers for fueling station illumination lights.
- (8) On turbojet airplanes, close circuit breakers for fueling preset indicator lights.

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Fueling Receptacle Installation

Figure 201

Ref. B. 707 - M.M. 28-111-21

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FUELING RECEPTACLE - INSPECTION/CHECK

1. General

- A. This procedure contains instructions to do a bonding resistance check for each fueling receptacle.

2. Fueling Receptacle - Bonding Resistance Check

A. References

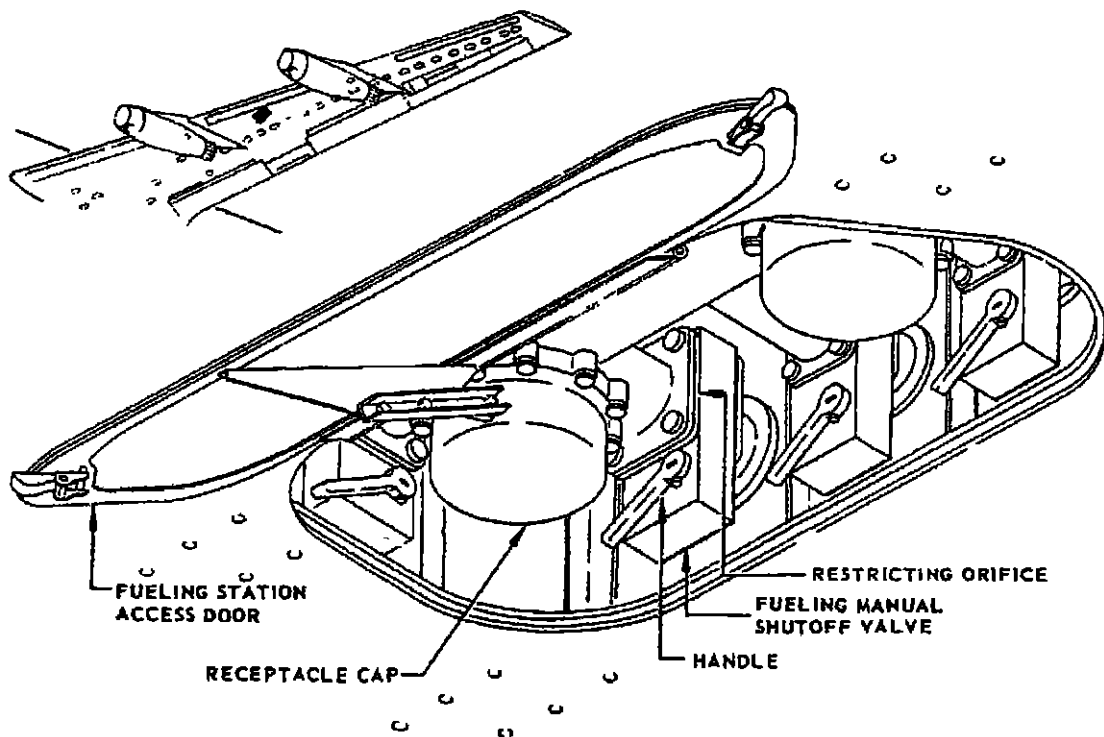
- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH

C. Procedure

- (1) Open the applicable fueling station access door (Figure 1).
- (2) Measure the electrical bonding resistance between the fueling receptacle and the structure (SWPM 20-20-00).
 - (a) Make sure the resistance is 0.010 ohm (10 milliohm) or less.
- (3) Close the fueling station access door.



Pressure Fueling Station
Figure 1

FUELING LEVEL CONTROL PILOT VALVE - MAINTENANCE PRACTICES

1 Removal/Installation Fueling Level Control Pilot Valve

A Remove Fueling Level Control Pilot Valve (See figure 201.)

- (1) Drain applicable tank See "Servicing Fuel System", 28-0.
- (2) Remove power from airplane.
- (3) Gain access to valve through panels and openings as listed below.

FUELING LEVEL CONTROL PILOT VALVE	FUEL TANK ACCESS PANELS (FIGURE 2, 28-2-0) (Figure 2, 12-02-0)	RIB ACCESS OPENINGS (FIGURE 3, 28-2-0)
Main Tanks No. 1 & 4	No 13	--
Main Tanks No 2 & 3	No 3	No. 8
Reserve Tanks No 1 & 4	No. 21	--
Center Wing Tank	No 1	--

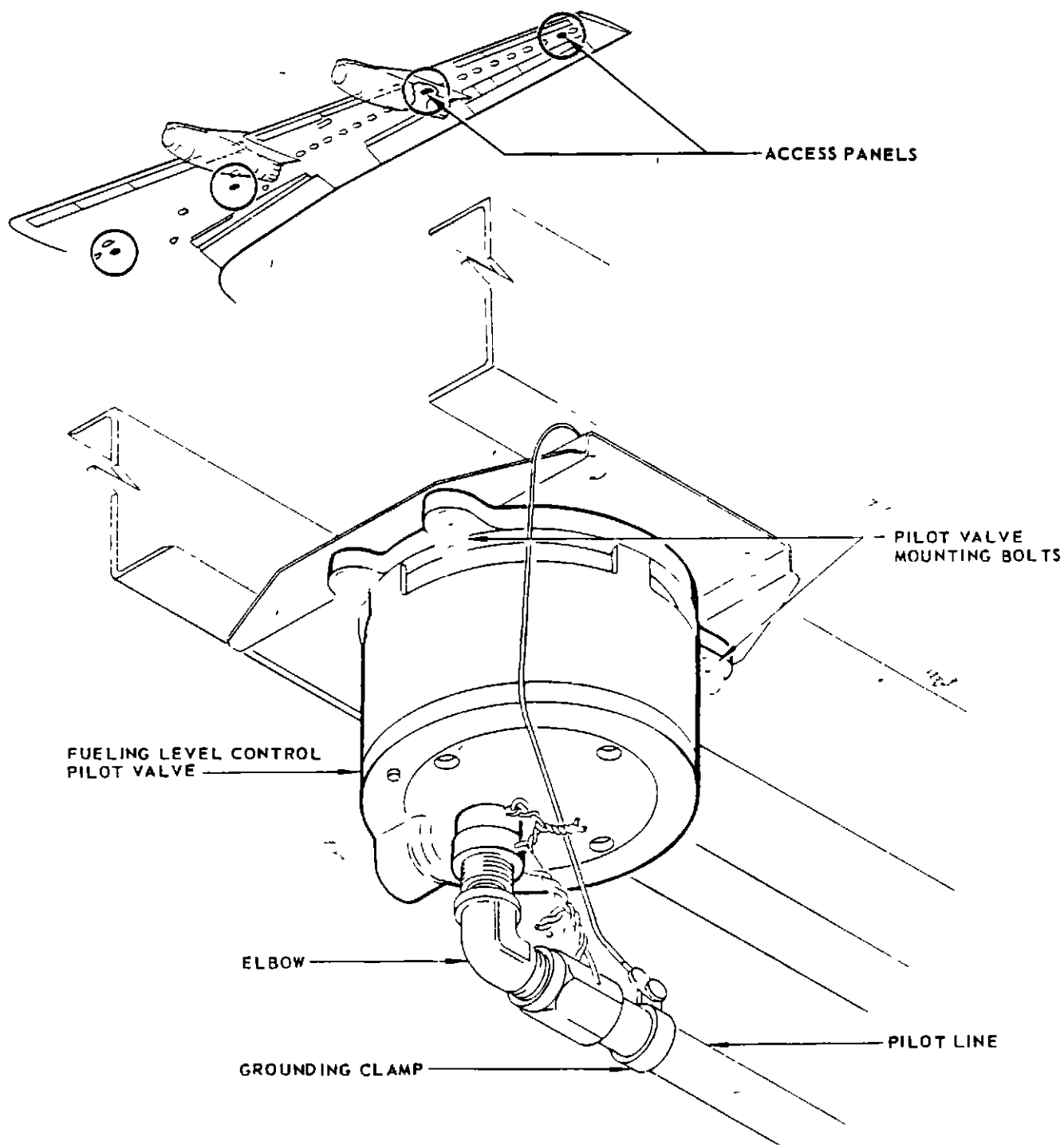
- (4) Disconnect grounding clamp at pilot line
- (5) Disconnect pilot line from elbow.

NOTE Catch fuel drip from pilot line in appropriate container.

- (6) Remove pilot valve mounting bolts and free valve from structure
- (7) Remove elbow from valve and save for installation

B Install Fueling Level Control Pilot Valve (See figure 201.)

- (1) Install elbow on pilot valve
- (2) Install pilot valve mounting bolts
- (3) Connect pilot line to elbow
- (4) Connect grounding clamp
- (5) Install fuel tank access panel



Typical Installation Fueling Level Control Pilot Valve
Figure 201

END

FUELING LEVEL CONTROL SHUTOFF VALVE - MAINTENANCE PRACTICES

1 Removal/Installation Fueling Level Control Shutoff Valve

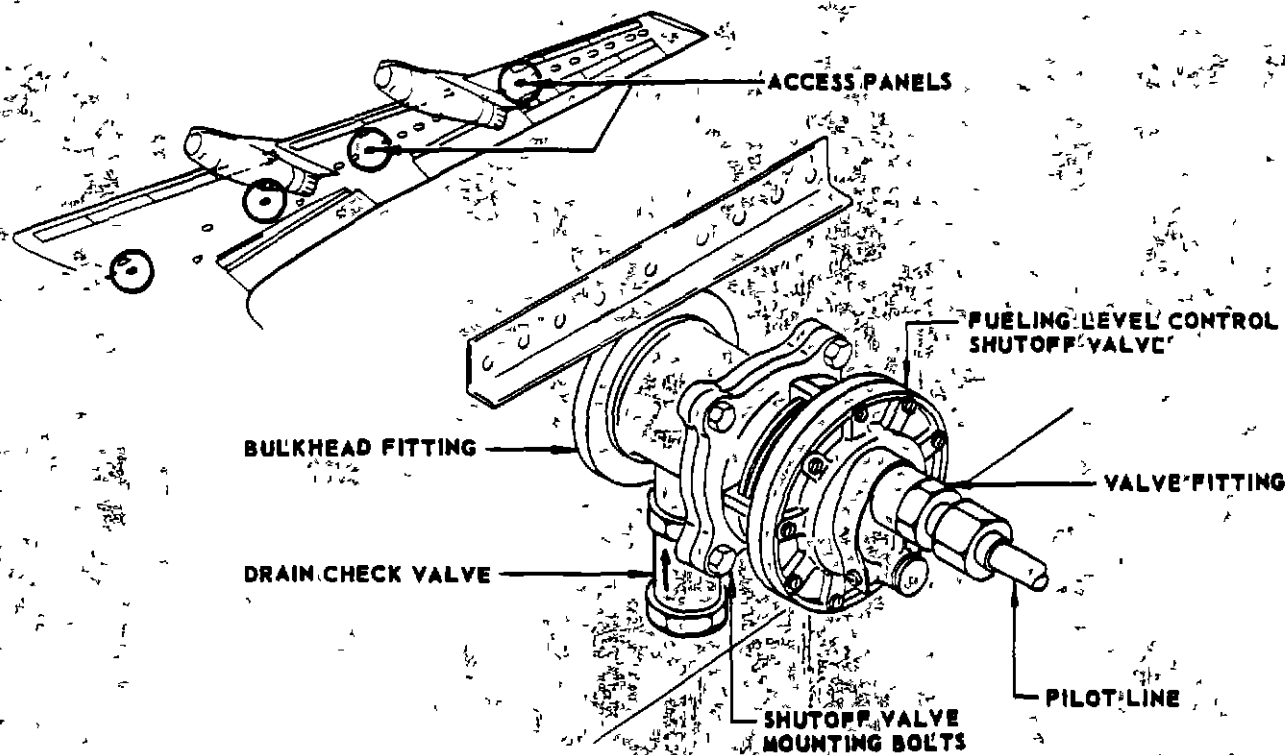
A. Remove Fueling Level Control Shutoff Valve (See figure 201.)

- (1) Drain applicable tank See 28-0, Servicing Fuel System.
- (2) Remove power from airplane
- (3) Gain access to valve through panels and openings as listed below.

FUELING LEVEL CONTROL SHUTOFF VALVE	FUEL TANK ACCESS PANEL (FIGURE 2, 28-2-0)	RIB ACCESS OPENINGS (FIGURE 3, 28-2-0)
Main Tanks No. 1 and 4	No. 6	--
Main Tanks No. 2 and 3	No. 3	No. 9
Reserve Tanks No 1 and 4	No. 15	--
Center Wing Tank	No. 1	No. 2

- (4) Disconnect pilot line at valve fitting.
 - (5) Remove shutoff valve mounting bolts and lift valve free of bulkhead fitting.
 - (6) Remove valve fitting from valve and save for installation.
- B. Install Fueling Level Control Shutoff Valve (See figure 201.)
- (1) Install valve fitting on valve.
 - (2) Clean all machined surfaces with naphtha, wipe dry with clean lint free cloth, and fit O-ring into place.
 - (3) Lift valve into place and install mounting bolts
 - (4) Connect pilot line
 - (5) Install fuel tank access panel

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Typical Installation Fueling Level Control Shutoff Valve
 Figure 201

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FUELING MANIFOLD - MAINTENANCE PRACTICES

1. Removal/Installation Fueling Manifold

A. Remove Fueling Manifold (See figure 201.)

- (1) Defuel center wing tank and all tanks on applicable side of airplane. See "Servicing, Fuel System," 28-0.
- (2) Remove power from airplane and open circuit breakers for fueling station illumination lights.
- (3) On turbojet airplanes, open circuit breakers for fueling preset indicator lights.
- (4) Open applicable fueling station access door.
- (5) Remove receptacle caps.
- (6) Drain fuel from manifold into suitable container
- (7) Remove bonding jumpers from valves.
- (8) Disconnect vent lines at A and B
- (9) Loosen manifold support bolts.
- (10) Loosen all fueling manual shutoff valve mounting bolts.
- (11) Remove one top bolt and two bottom mounting bolts at each shutoff valve.
- (12) Slide shutoff valves out and save valves for installation.
- (13) Remove remaining shutoff valve mounting bolts and orifice plates. Save plates for installation.
- (14) Support manifold, remove manifold support bolts and lower manifold through access door.
- (15) Remove vent line fitting and attached parts from manifold for use on replacement manifold.

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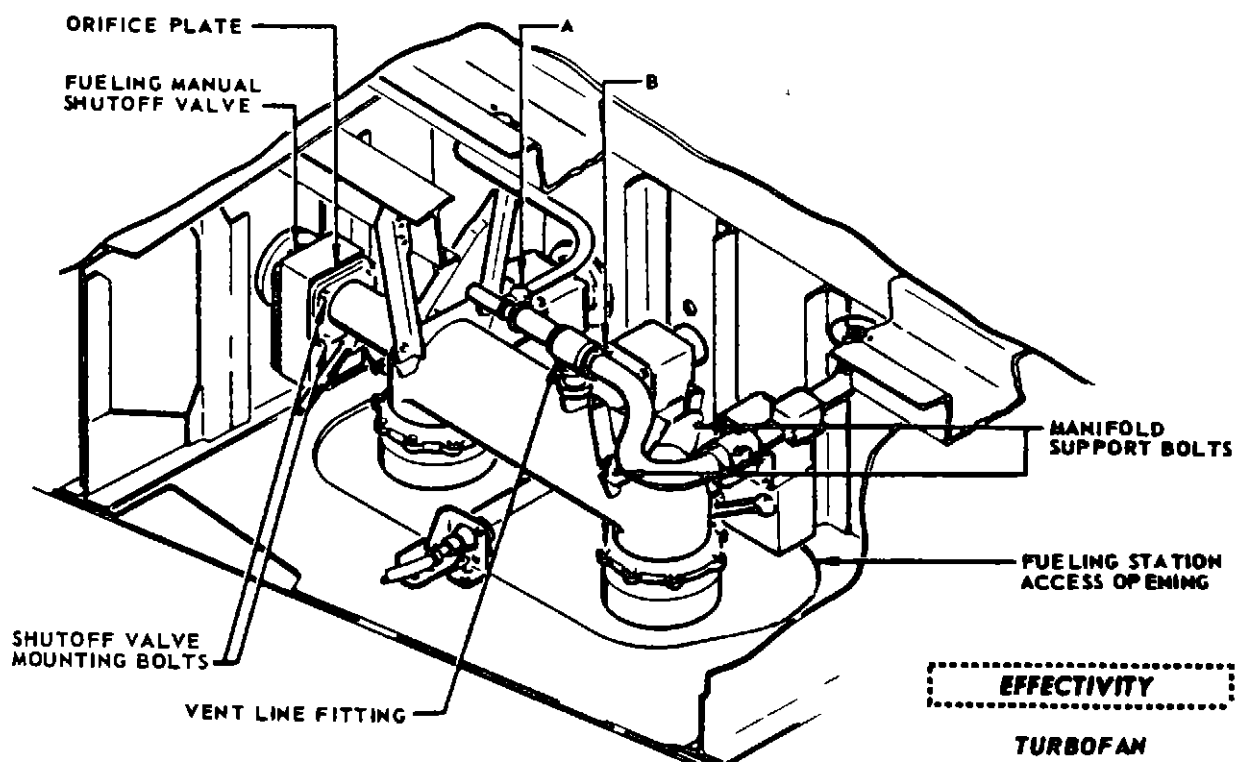
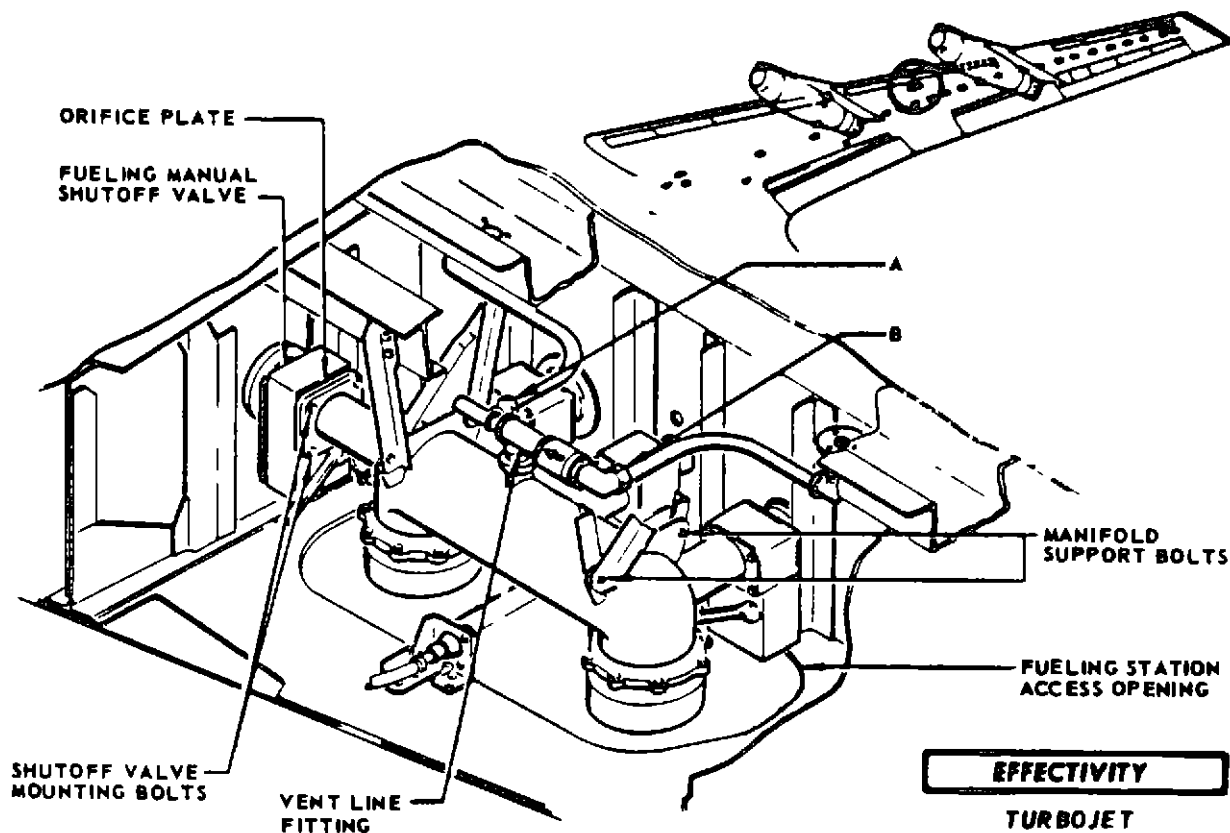
B. Install Fueling Manifold (See figure 201.)

- (1) Clean machined surfaces with aliphatic naphtha and wipe dry with lint free cloth.
- (2) Fit O-rings, lightly lubricated with fuel, into their grooves.
- (3) Install vent line fitting with attached parts.
- (4) Lift manifold into fueling station and align with support brackets.
- (5) Insert manifold support bolts.
- (6) Slip one of top shutoff valve mounting bolts through manifold flange bolt hole and orifice plate bolt hole and start with fingers.
- (7) Lubricate shutoff valve machined faces and O-rings with fuel.
- (8) Slip valve into position and start other valve mounting bolts.
- (9) Follow steps (6), (7) and (8) for installation of other shutoff valves and orifice plates.

CAUTION: DO NOT LEAVE OUT ORIFICE PLATES. EXCESSIVE FUELING RATE WILL DAMAGE TANK.

- (10) Start the vent line connections at A and B.
- (11) Tighten shutoff valve mounting bolts.
- (12) Tighten vent line connections at A and B.
- (13) Tighten manifold support bolts.
- (14) Fasten all bonding jumpers.
- (15) Close shutoff valves, fueling station access door, and circuit breakers that were opened in paragraph 1.A.

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Fueling Manifold Installation
Figure 201

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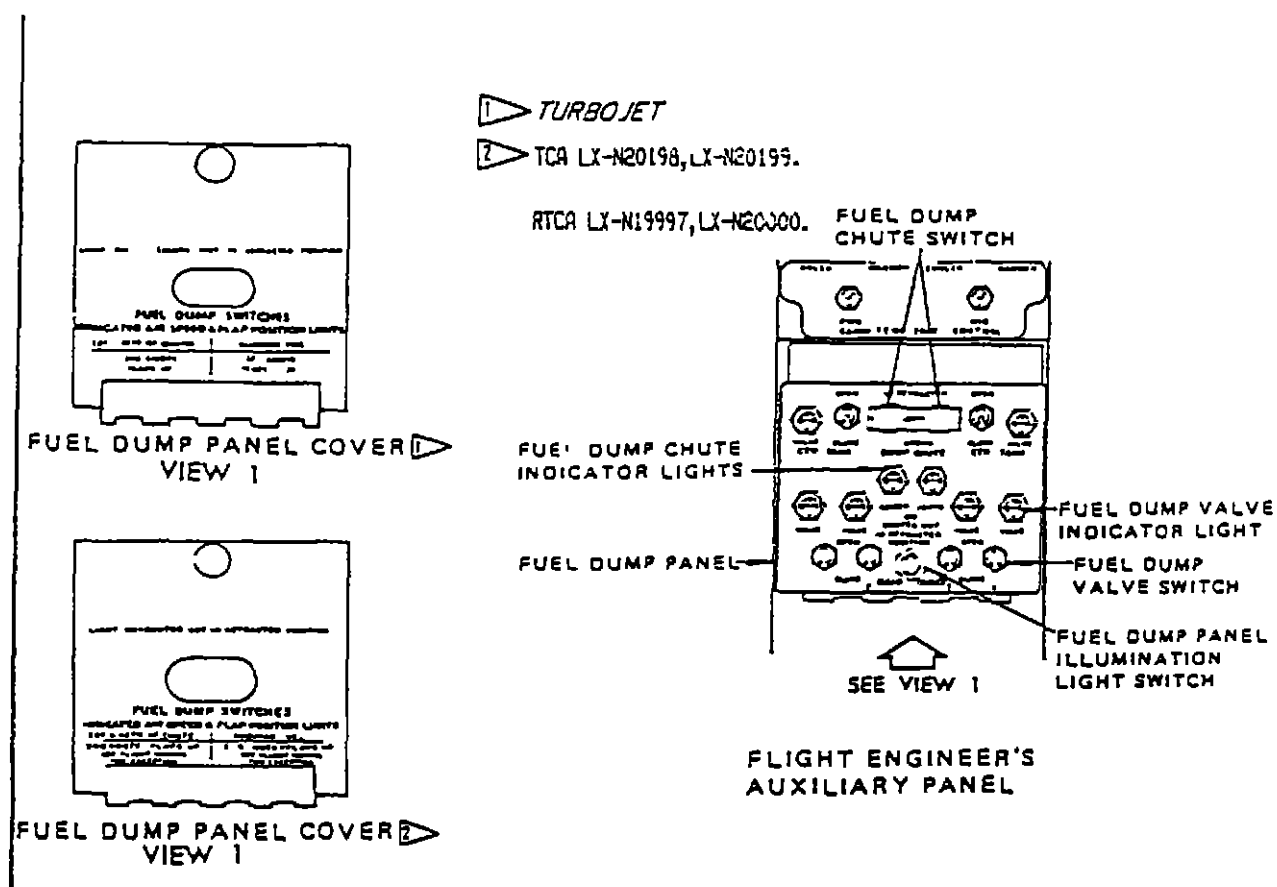


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FUEL DUMP SYSTEM - DESCRIPTION AND OPERATION

1. General

- A. The fuel dump system provides the means by which fuel can be jettisoned in flight. Each wing contains an extendable chute which must be fully extended before fuel can be dumped. The fuel in the main tanks is dumped through the chute on the same side of the airplane as the tanks. Fuel from the center wing tank is dumped through both chutes. The reserve tank fuel is transferred to and dumped with the adjacent outboard main tank fuel.



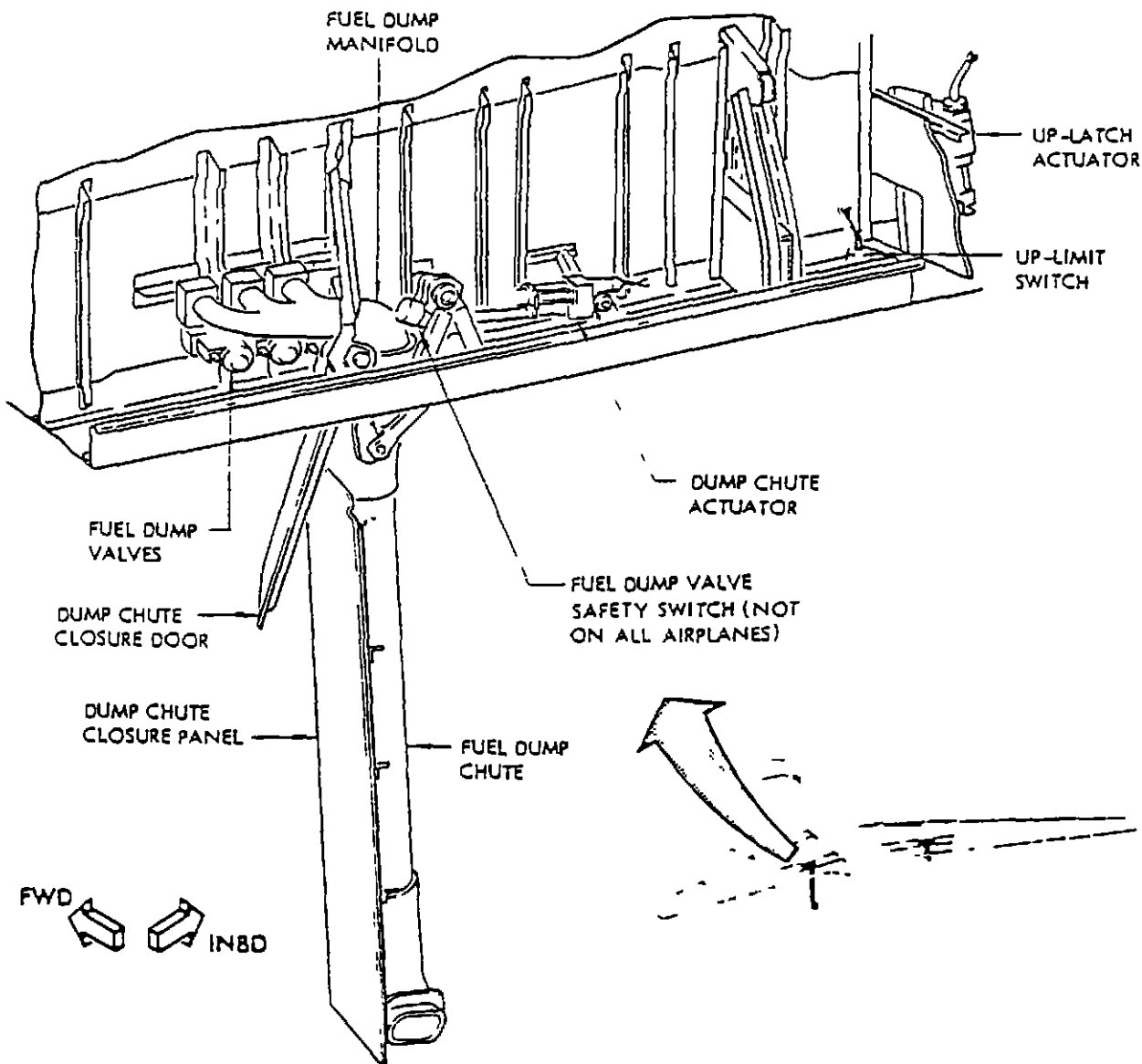
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Fuel Dump System Equipment Location
Figure 1 (Sheet 1)

28-22-0
Page 1

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- B. The overall system consists of two fuel dump manifolds, two dump chutes, two electrically operated dump chute actuators, two electrically operated latches and the corresponding mechanical and electrical controls. There are six fuel dumping lines with six fuel dump valves. The fuel dumping controls are on the flight engineer's auxiliary panel. (See figure 1)
- C. When the fuel dump switch, on the flight engineer's auxiliary panel, is placed in the "EXTEND" position, a sequence of operations is initiated to unlatch and extend the fuel dump chutes. When the dump chutes are fully extended the dump valve safety circuits are armed to permit opening the dump valves. Placing the dump valve switches on the flight engineer's panel in the "OPEN" position will now open the dump valves. With the dump valves open, all fuel in excess of an amount determined by a fixed standpipe is dumped overboard. Fuel dumping can be stopped by placing dump valve switch to "CLOSE." (See figures 8 and 9)

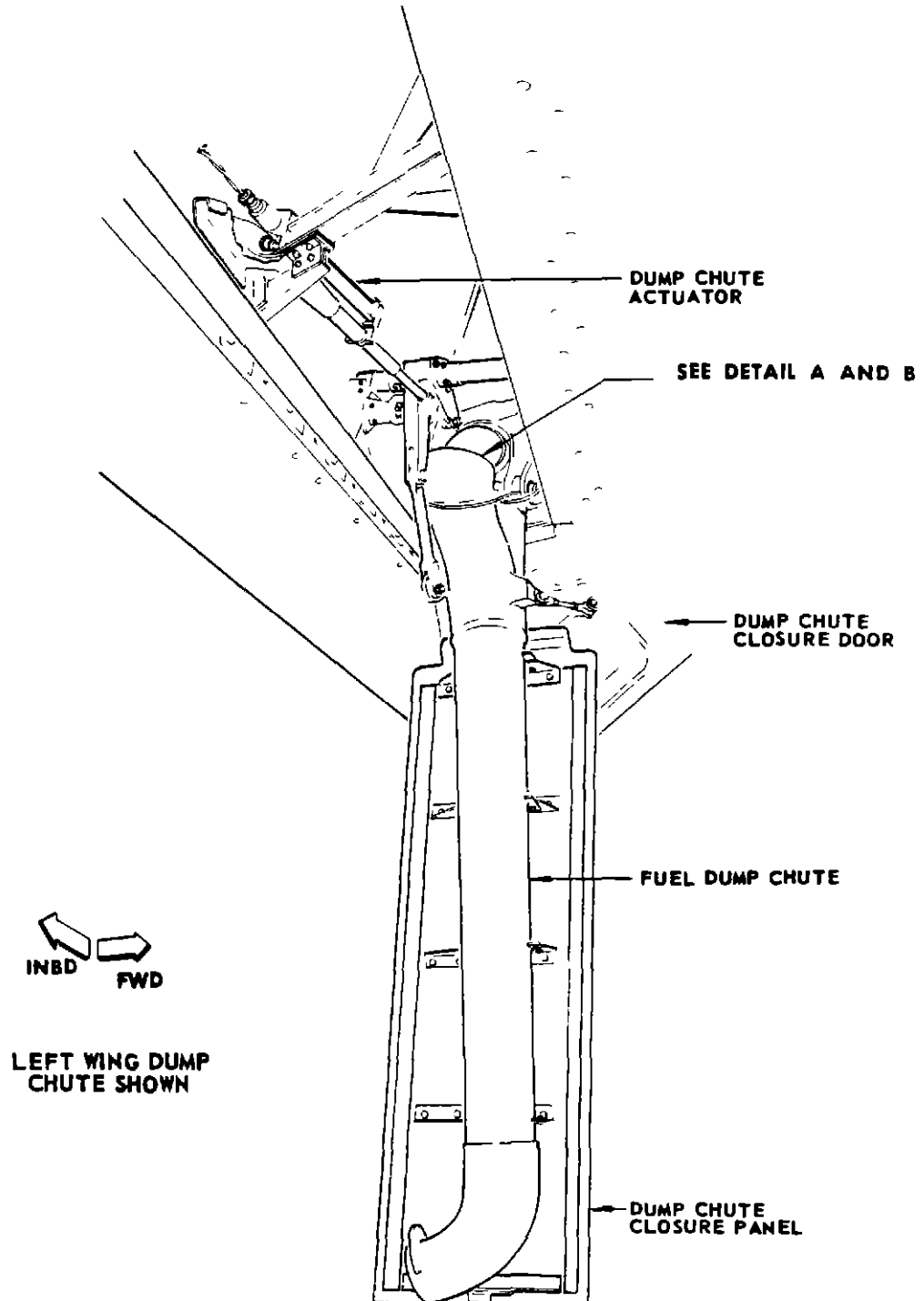


Fuel Dump System Equipment Location
Figure 1 (Sheet 2)

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2. Fuel Dump Chute

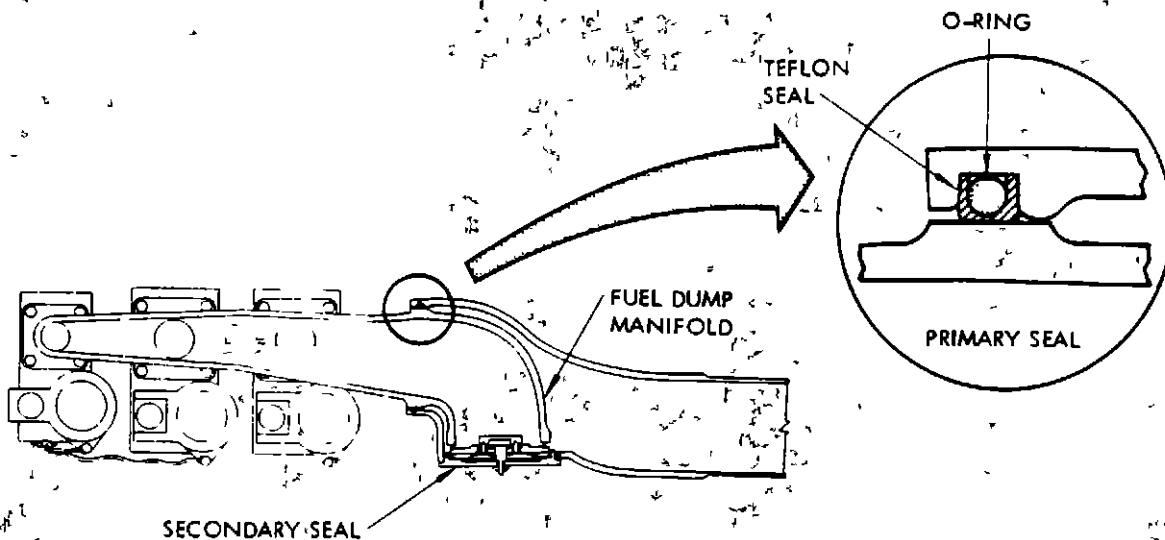
- A. Two fuel dump chutes direct fuel away from the airplane. Each chute is constructed from a straight run of tubing with an elbow at each end (See figure 2.) The inlet elbow of the chute forms a telescoping swivel



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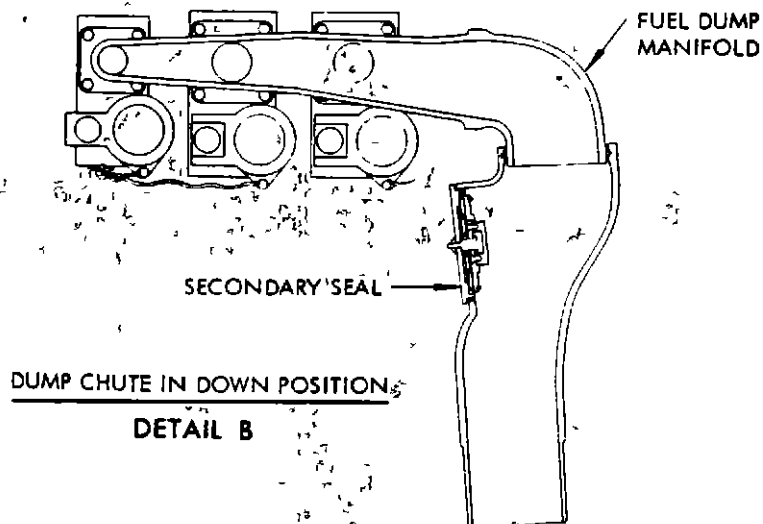
joint with the fuel dump manifold. A seal between the chute and the manifold is maintained by a concentric sliding primary O-ring seal at the chute inlet. (See figure 2.) The inlet elbow contains the pivot points of the chute and a secondary seal which covers the manifold outlet to act as a valve when the chute is in the stowed position. The outlet elbow serves as a discharge nozzle of the chute.

- B. The dump chutes are actuated by an electric motor driven actuator unit and are retractable in flight. When the fuel dump chute switch on the flight engineer's auxiliary panel is placed in the EXTEND or RETRACT position, the dump chute extends to the down position or retracts to the up, or stowed, position.
- C. Rubber seals between mating surfaces of the dump chute closure panel and the wing surface reduce air turbulence and consequent aerodynamic drag.



DUMP CHUTE IN UP POSITION

DETAIL A

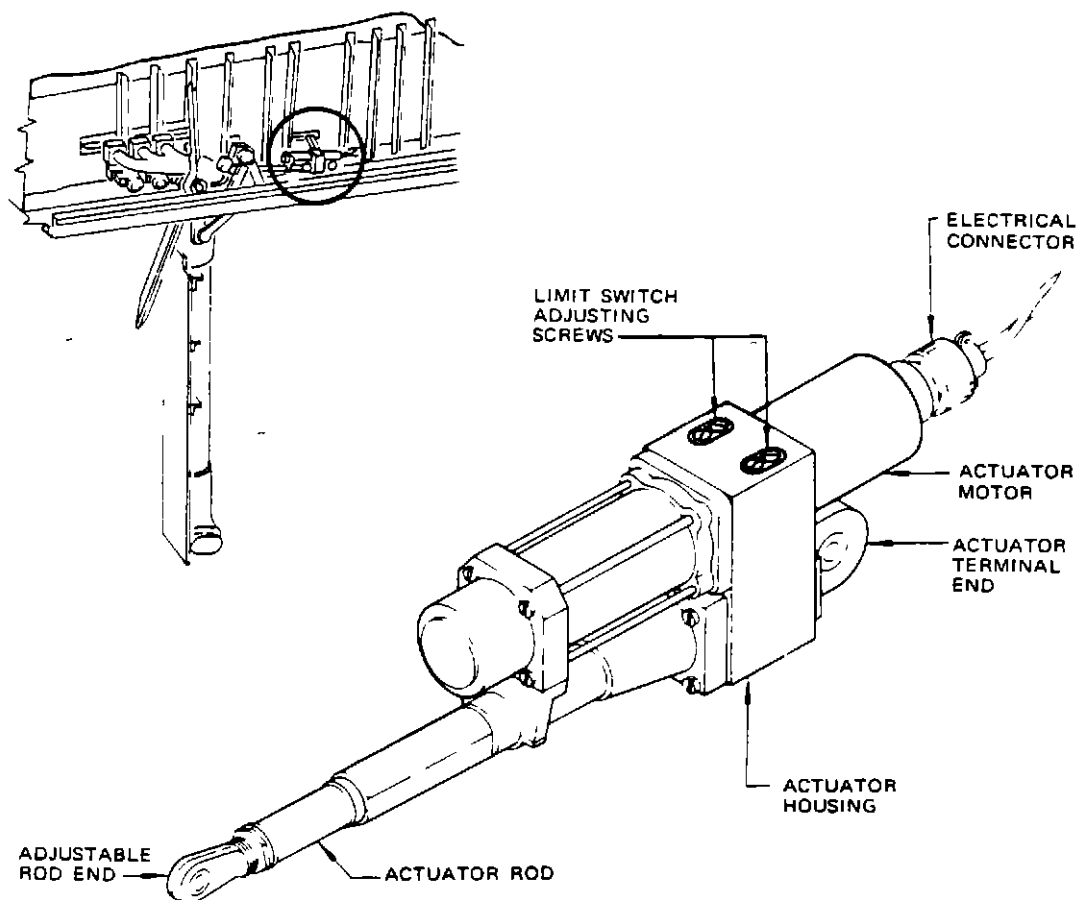


DUMP CHUTE IN DOWN POSITION

DETAIL B

3 Fuel Dump Chute Actuator

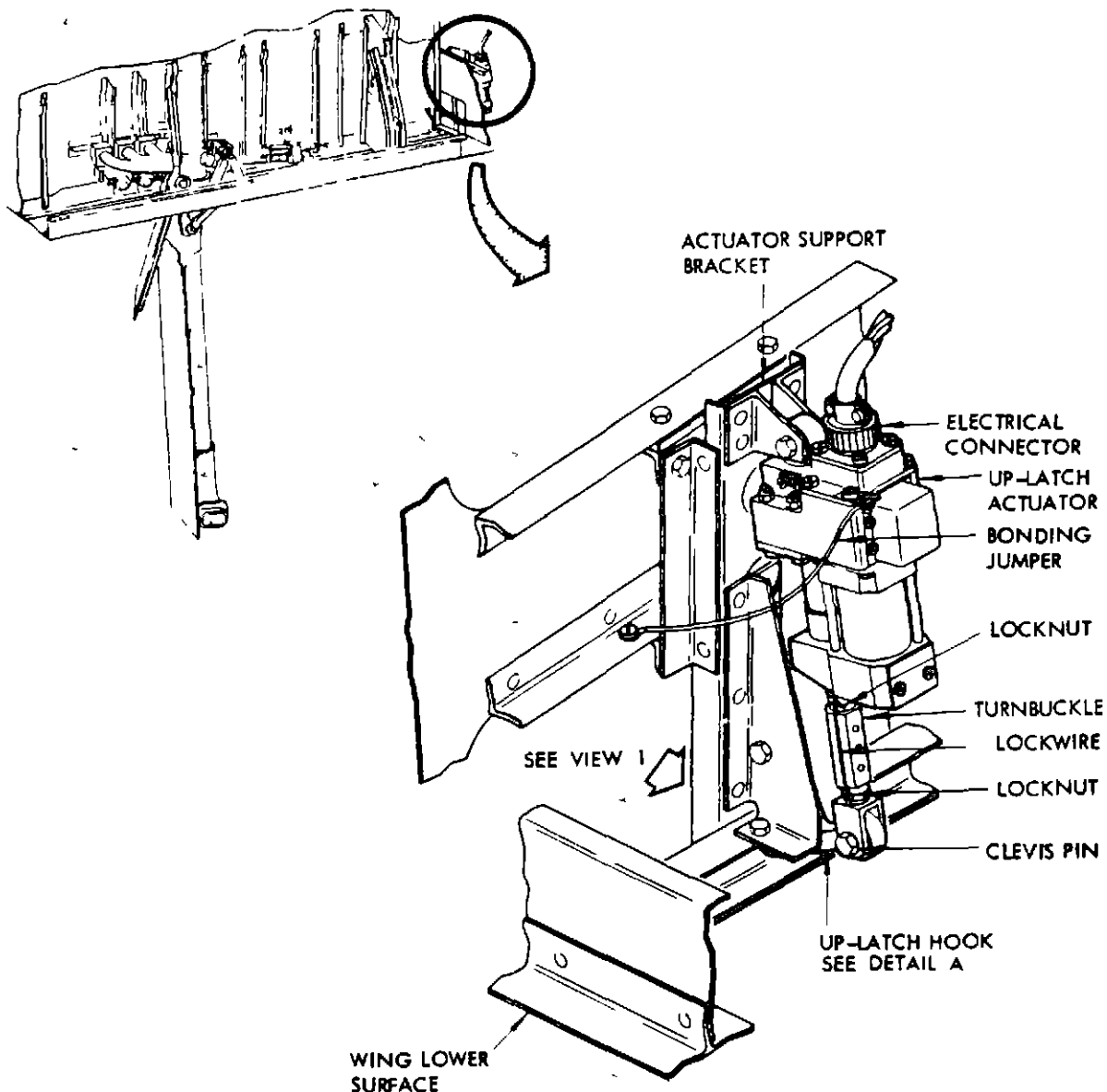
- A An electric motor-operated actuator (figure 3) controls the chute operation. The actuator controls the rate of dump chute extension and retraction. The dump chute actuator assembly consists of a housing, reduction gear, motor, actuator rod and two actuator limit switches, an extend limit switch for dump chute extension control and a retract limit switch which is bypassed. Chute retraction is terminated by a separate up-limit switch attached to wing structure.
- B When the dump chute actuator circuit is energized, the motion of the actuator rod is transferred to the quadrant assembly and dump chute drag brace. This action extends and retracts the fuel dump chute. As the actuator rod approaches full extension, the extend limit switch within the actuator terminates the extension operation of the actuator. When the dump chute is fully retracted the dump chute up-limit switch terminates the operation of the actuator. Limit switch actuation for dump chute extension is controlled by the extend limit switch adjusting screw on the actuator. The dump chute actuator is energized by 115 volts ac power.



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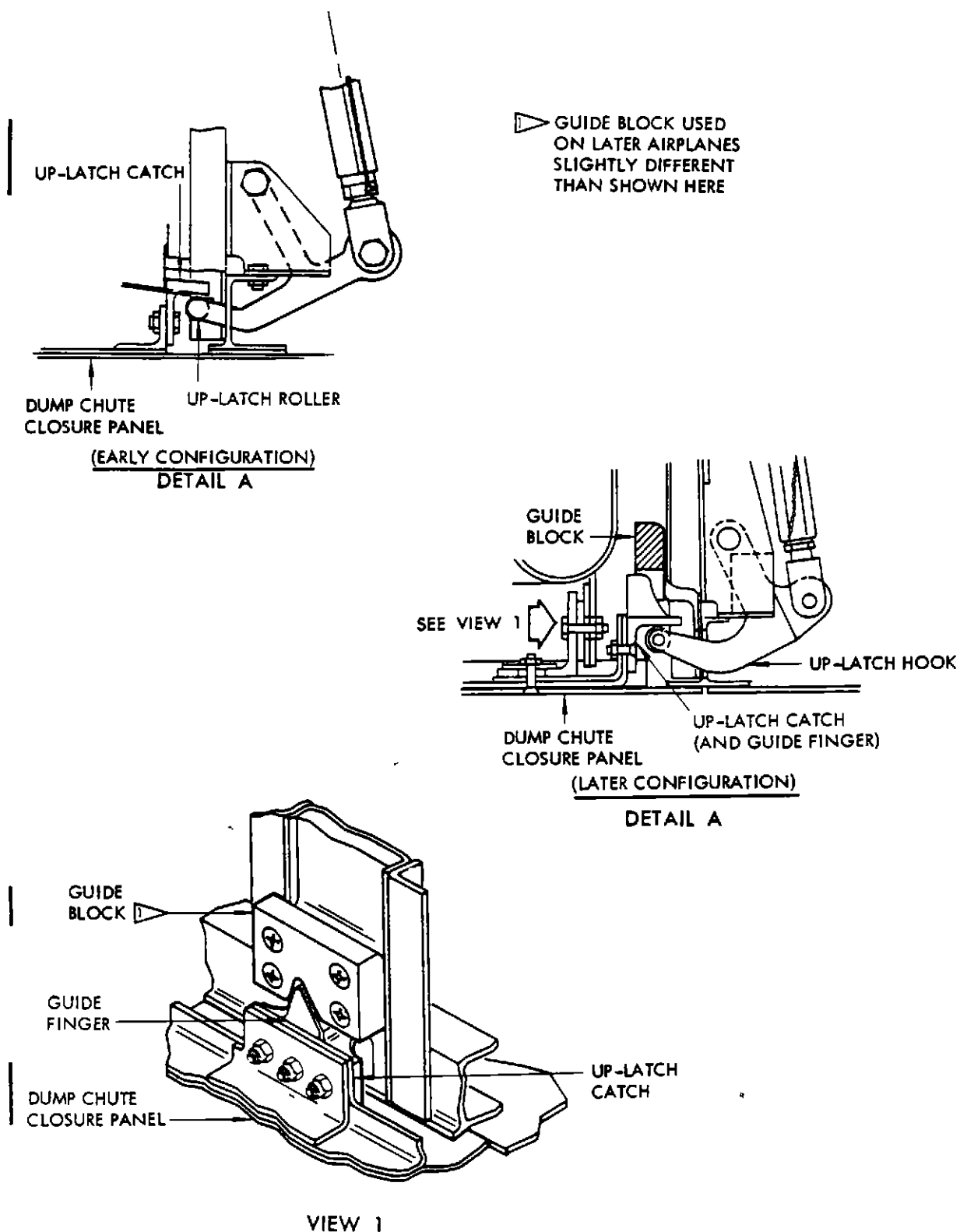
4. Fuel Dump Chute Up-Latch

- A The fuel dump chute up-latch is an electrically operated unit that locks the dump chute in the stowed position. The latch unit consists of a catch attached to the closure panel, a hook assembly and an electrical actuator attached to the wing structure. (See figure 4.)
- B When the up-latch actuator circuit is energized the extension or retraction of the actuator rod engages or disengages the hook and catch. Limit switches inside the up-latch actuator control the extension and retraction of the actuator rod, in addition, the back contacts of the retract limit switch energize the extend circuit of the dump chute actuator when the latch is unlatched. A secondary switch in the actuator is used to energize the dump chute position light when the up-latch is not in the latched position.



Fuel Dump Chute Up-Latch
Figure 4 (Sheet 1)

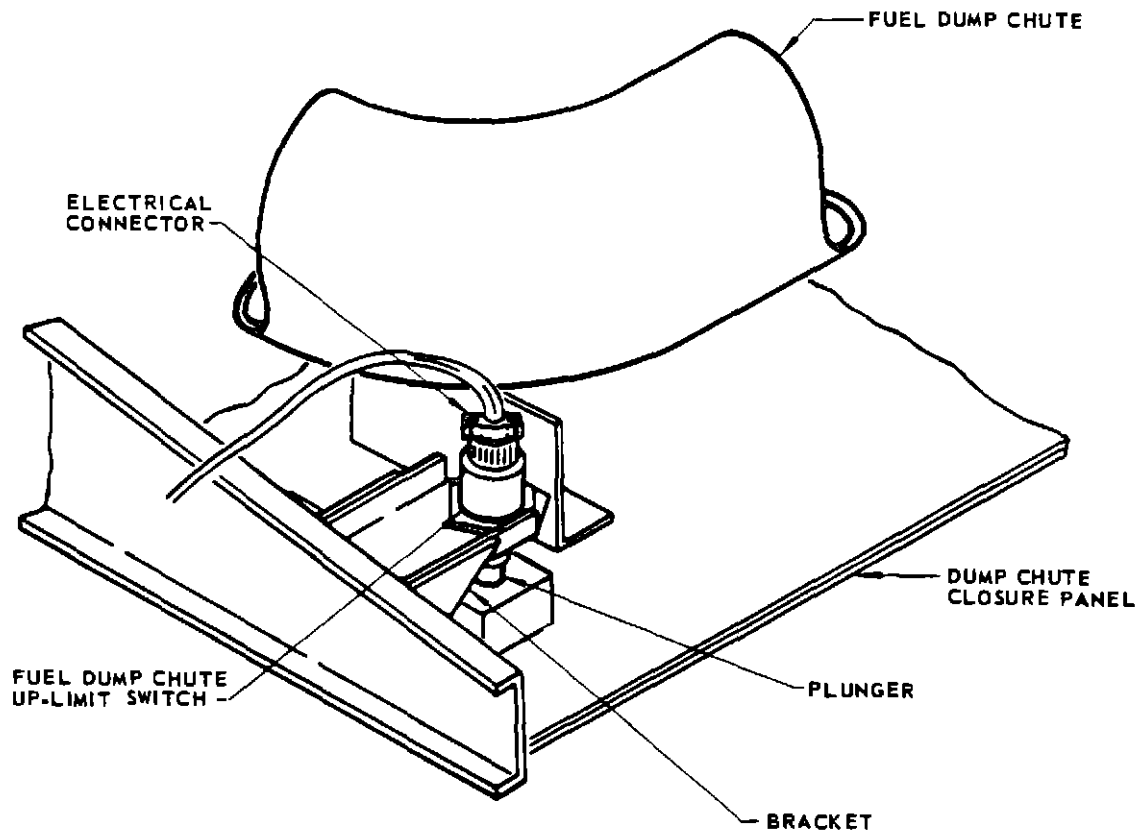
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5 Fuel Dump Chute Up-Limit Switch

- A. The fuel dump chute up-limit switch is a plunger operated microswitch. It is mounted on a bracket attached to the trailing edge structure of the wing and is actuated by the dump chute closure panel. (See figure 5.) The switch controls the dump chute indicator lights and the amount of retraction of the dump chute.
- B. When dump chute is fully retracted, the switch plunger is depressed de-energizing the dump chute indicator lights and the retract circuit of the dump chute actuator. When the dump chute leaves the stowed position, the switch energizes the dump chute indicator lights and arms the retract circuit of the dump chute actuator. The energizing and de-energizing of the dump chute position lights by this switch only occurs when the up-latch actuator is in the latched position. (See figure 9.)



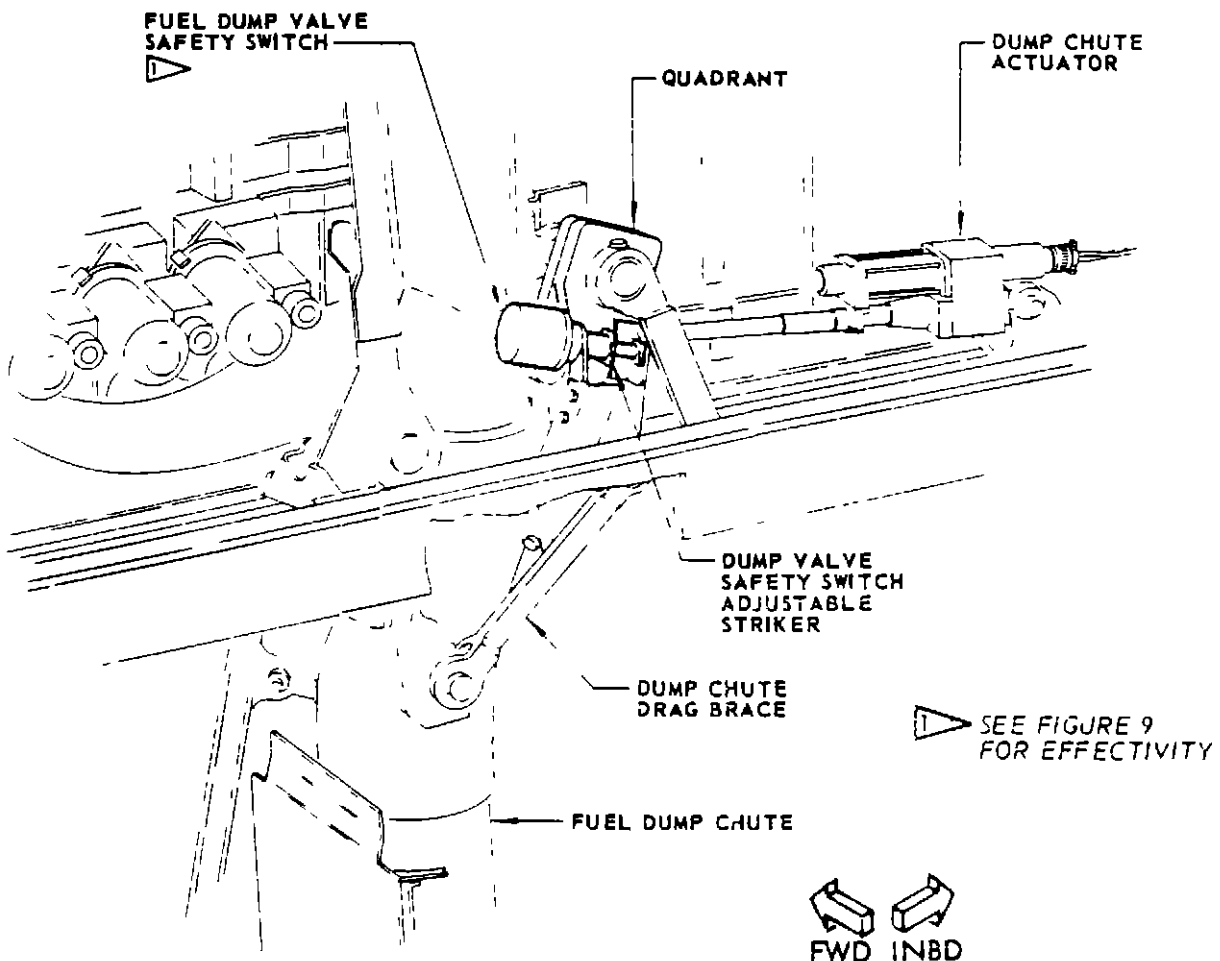
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6. Fuel Dump Valve Safety Switch (See figure 9 for effectivity)

- A. A fuel dump valve safety switch actuated by the dump chute prevents the dump valves from being opened until the dump chute is fully extended. The switch is actuated by an adjustable striker on a bracket attached to a quadrant arm. (See figure 6.) The safety switch itself is fastened to a bracket attached to the wing structure. Motion of the quadrant carries the striker into contact with the safety switch plunger. The striker is so adjusted that the safety switch is actuated when the dump chute is fully extended.

7. Fuel Dump Valve Safety Relay (See figure 9 for effectivity)

- A. The fuel dump valve safety relays, located on the J23 relay shield in the lower 41 section, prevent the dump valves being opened until the dump chutes are fully extended. The relays are energized by 28 volt d-c power and are controlled by the extend limit switch in the dump chute actuator. When the actuator is fully extended the extend limit switch completes the circuit to energize the relay and arm the dump valve circuits. (See figure 9.)



Fuel Dump Valve Safety Switch
Figure 6



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8 Fuel Dump Valves

- A Six electric motor-operated dump valves (three on each wing) control fuel jettisoning from the fuel tanks (See figure 7.) One valve is inserted in each fuel dump line at the inlets to the dump manifold. The valve assembly consists of a valve housing, a sliding gate and an electric motor. The dump valve motors are powered by 28 volt dc power and controlled by switches on the flight engineer's auxiliary panel and through the dump valve safety switches or relays which prevents opening of valves until the dump chute is fully extended.

9 Fuel Dump Chute Unlatched Relay

- A A fuel dump chute unlatched relay located on the J23 relay shield in the lower 41 section is provided for each dump chute. When the dump chutes are closed and latched, the dump chute unlatched relays are de-energized and power is removed from the dump valves, preventing the re-opening of the valves (See figure 9 for effectivity).

10 Operation

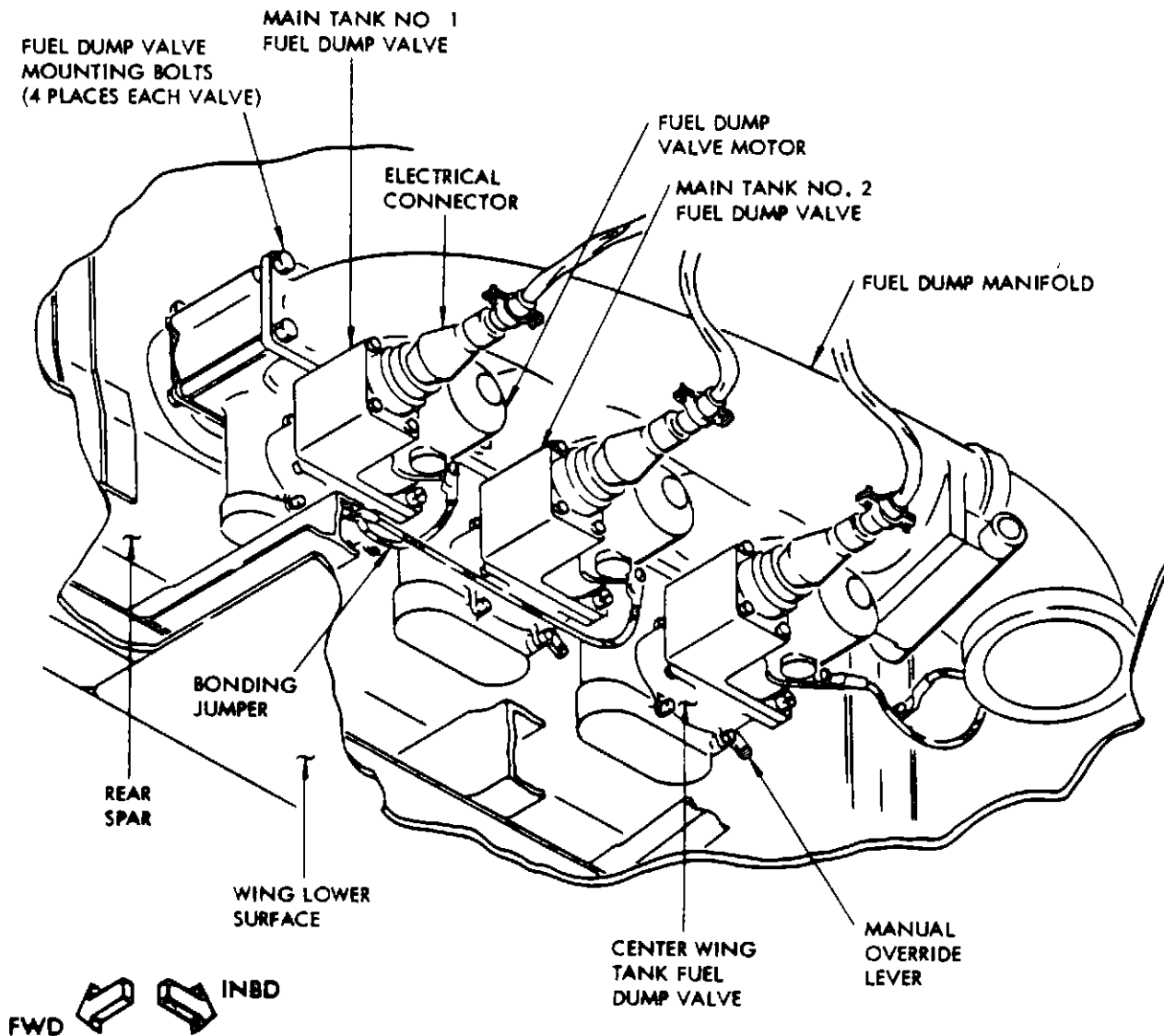
- A The fuel dump system is controlled from the flight engineer's station, all switches and indication lights being on the flight engineer's auxiliary panel. Operation of the system is initiated by placing the fuel dump chute switches in the EXTEND position, this completes the circuit to the unlatch side of the up-latch actuator (See figure 9). The actuator rod of the up-latch actuator retracts and disengages the up-latch hook assembly from the catch on the dump chute closure panel. As the up-latch reaches the full unlatched position, the secondary switch in the actuator energizes the dump chute position lights and the limit switch inside the actuator cuts the power to the up-latch actuator, this completes the circuit to the dump chute actuator and the chute starts to extend. As the chute leaves the stowed position the dump chute up-limit switch is actuated, arming the retract circuit of the dump chute actuator. The dump chute actuator continues to extend the dump chute until the EXTEND limit switch, inside the actuator, cuts the power to the actuator. As the dump chute reaches the fully extended position the dump valve safety switch is actuated or the dump valve safety relay is energized to arm the valve circuits. The valves are then opened by placing the dump valve switches in the OPEN position. The blue indicator lights adjacent to the switches will be illuminated during opening of the valves and will be de-energized when the valves are fully open. Fuel will now be dumped overboard until a predetermined amount of fuel remains in the tank, or the valves are closed by the crew.
- B. Fuel is dumped from the main and center wing tanks when the valves are opened. When a main tank dump valve circuit is energized, it overrides the adjacent reserve tank transfer valve circuit and the transfer valve opens allowing fuel to flow from the reserve tank to the adjacent main.

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tank. The predetermined amount of fuel remaining in the tanks after dumping is shown in the following chart. See figure 8 for fuel dump flow diagram.

Tanks	Pounds
Main Tank No. 1	4000
Main Tank No. 2	3650
Center Wing Tank	1633
Main Tank No. 3	3650
Main Tank No. 4	4000
Total	16,933

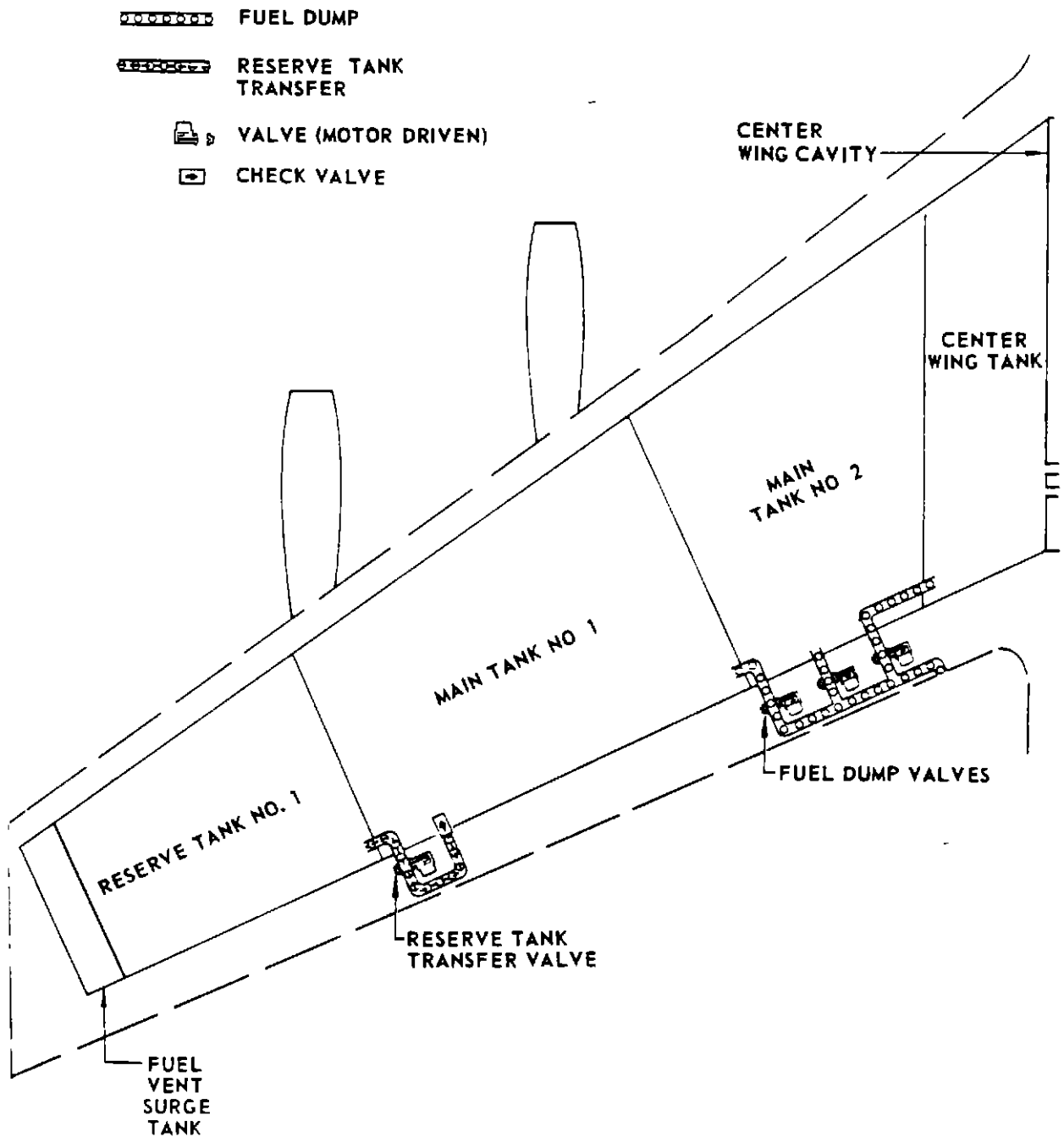
Pounds of Fuel in Tanks After Dumping



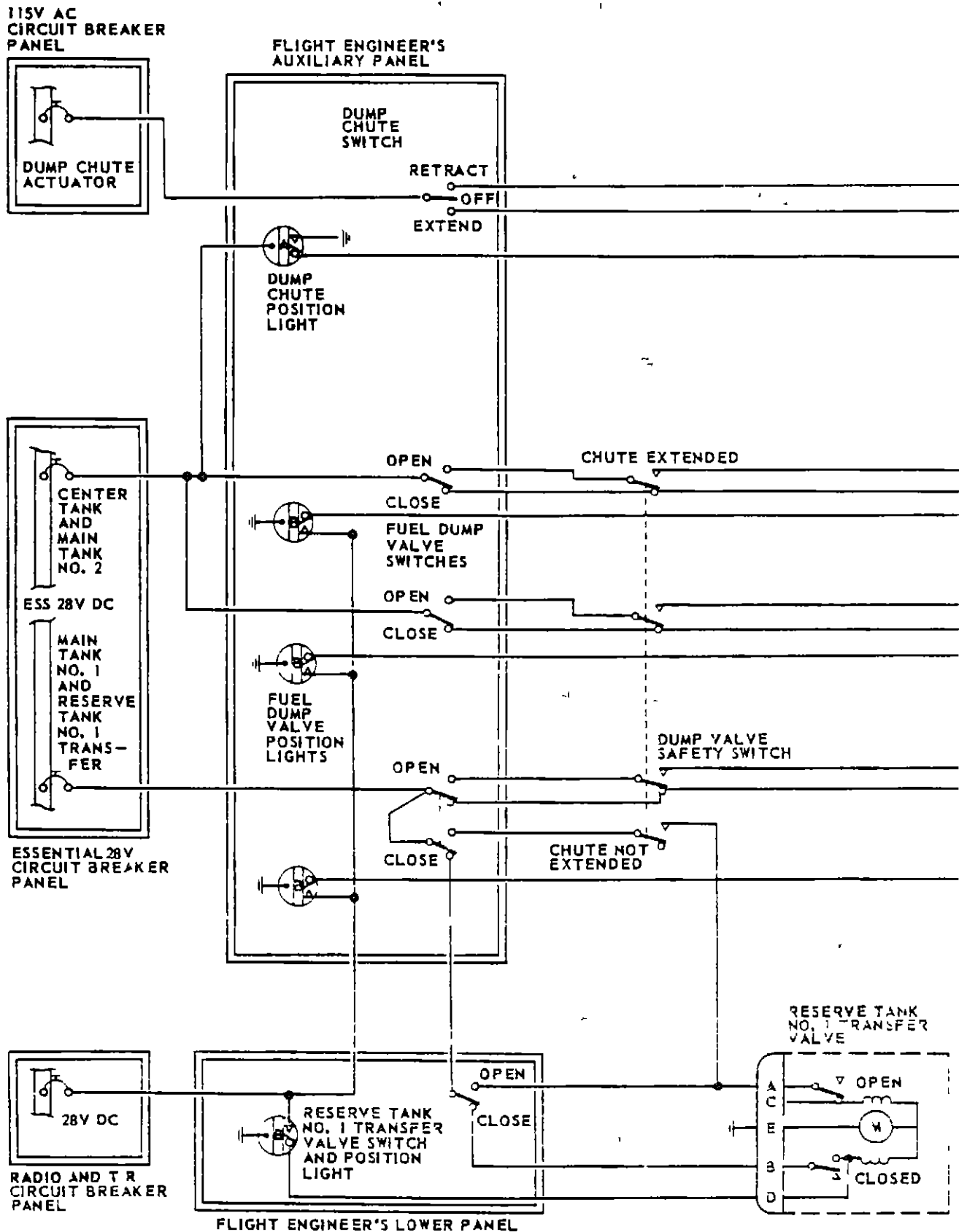
Fuel Dump Chute Manifold and Valves
Figure 7

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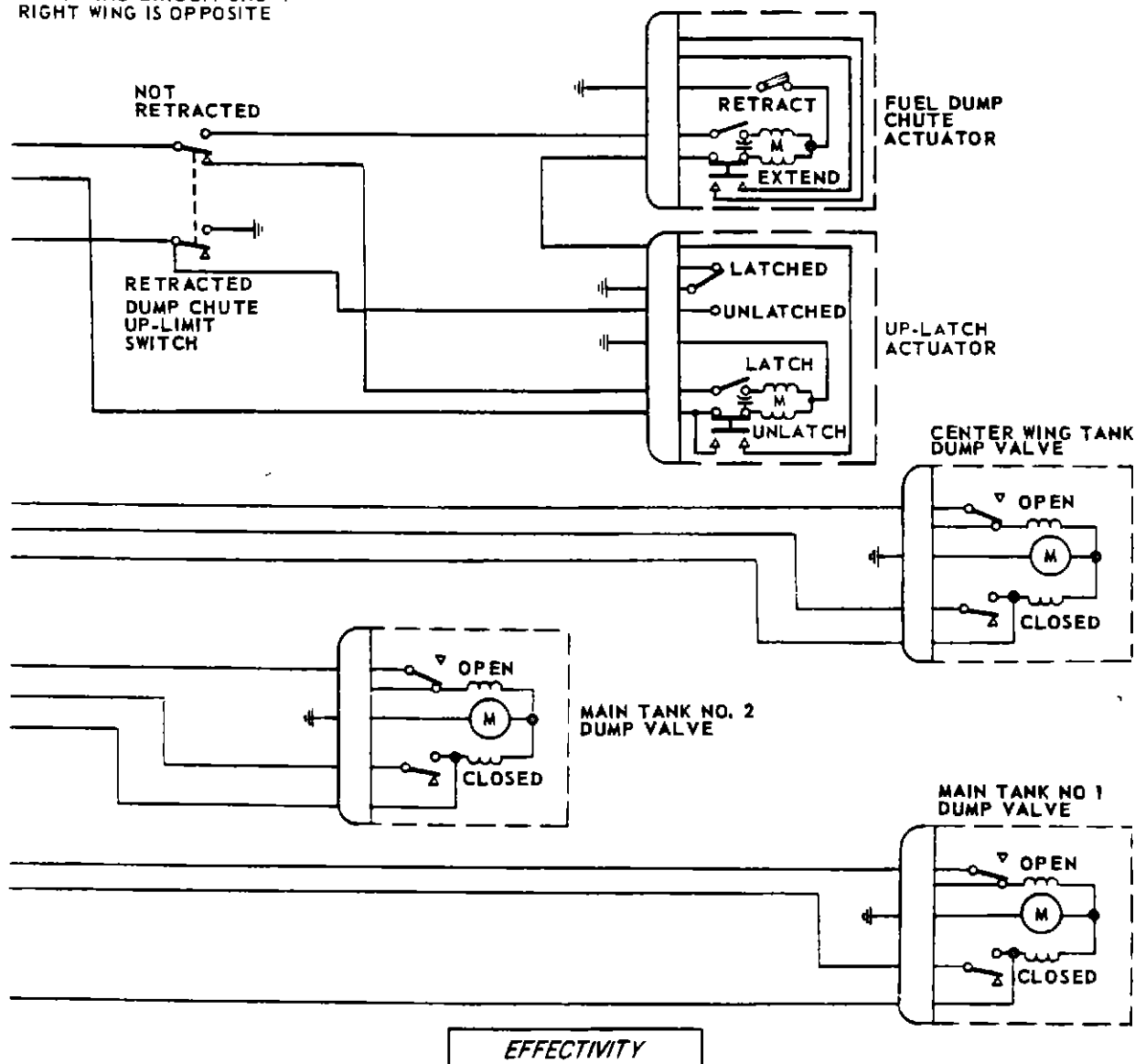
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Fuel Dump System Circuit
Figure 9 Sheet 1 of 2)

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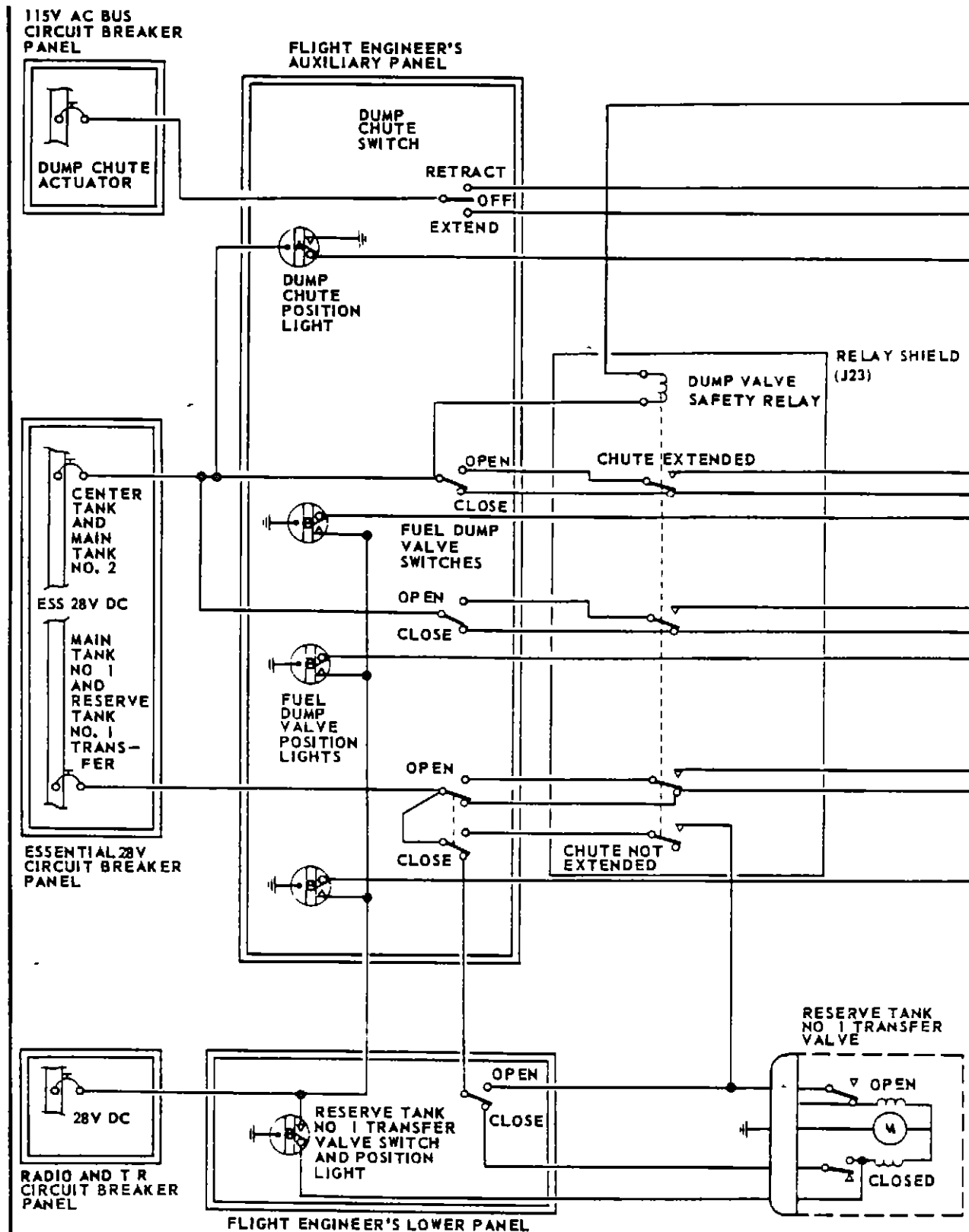
LEFT WING CIRCUIT SHOWN
RIGHT WING IS OPPOSITE



TWA N760TW, N773TW THRU N776TW, N778TW THRU N780TW, N786TW THRU N793TW
AF F-BHSR THRU F-BLCC
SAB OO-SJF THRU OO-SJH
BOAC G-ARRA THRU G-ARWE
DLH D-ABOT, D-ABOX, D-ABUB, D-ABUC
SAA ZS-DYL
EL AL 4X-ATC
TWA 707-331C
707-373C
WAI 707-373C (N373WA THRU N375WA)
NWA N351US THRU N362US
AA N7555A THRU N7561A
IIA EI-AMW, EI-ANO
QEA VH-EBN THRU VH-EBQ
CAL N17321 THRU N17324
FTL N322F
PLUS AIRPLANES INCORPORATING BOEING SERVICE BULLETIN 1200

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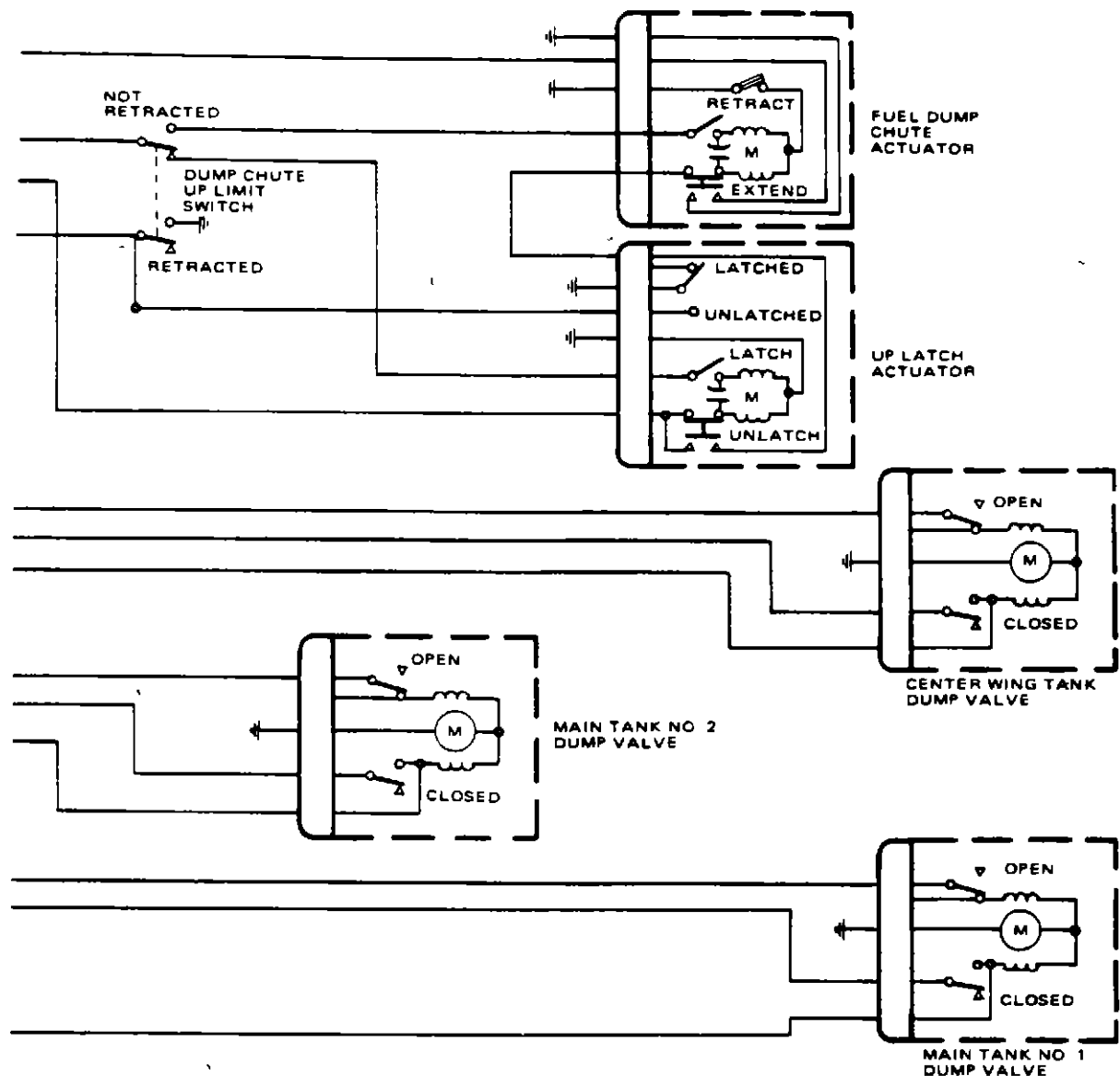
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Fuel Dump System Circuit
Figure 9 (Sheet 3)

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LEFT WING CIRCUIT SHOWN
RIGHT WING IS OPPOSITE

EFFECTIVITY

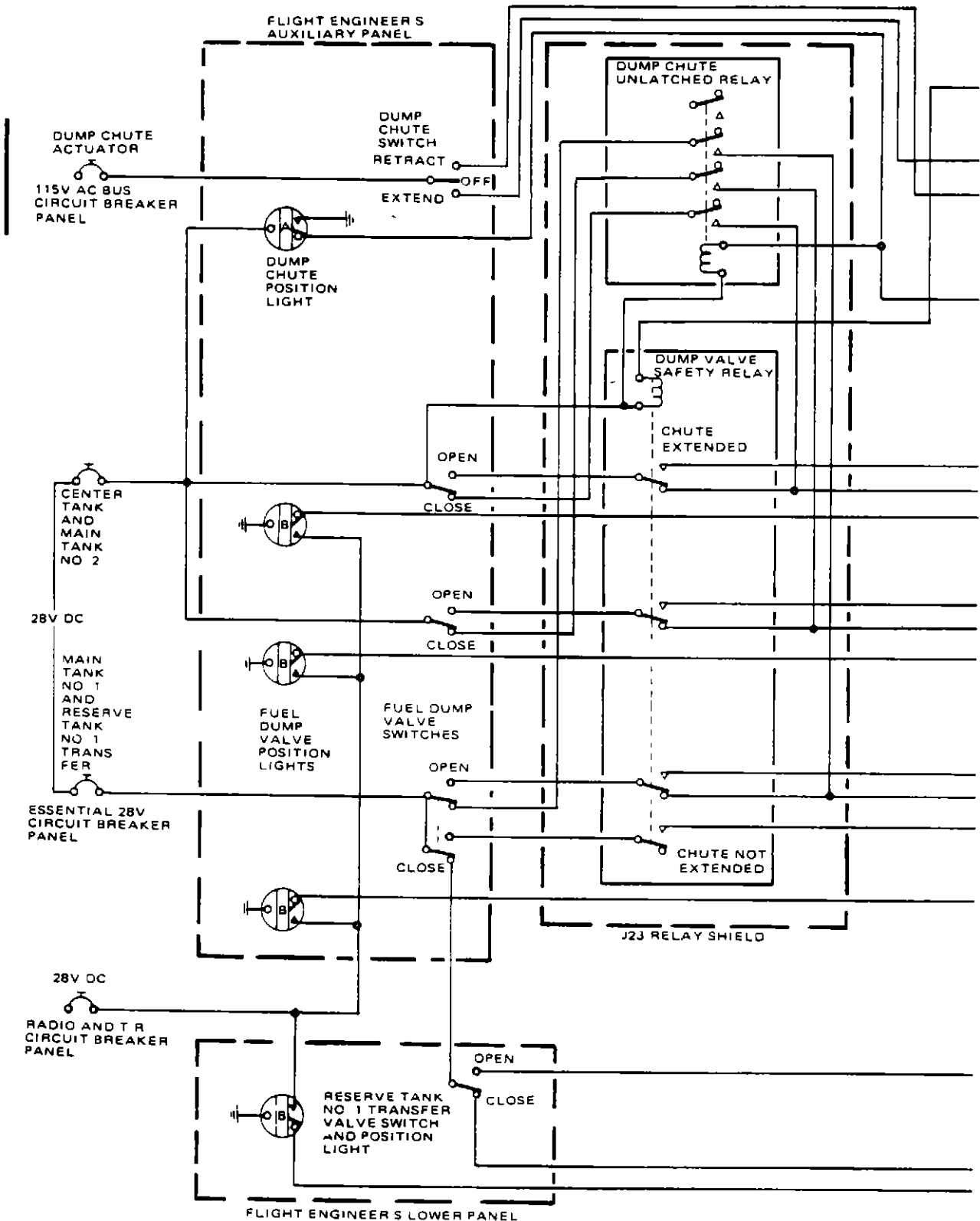
PAA	N414PA thru N799PA
TWA	N8705T, N8715T, N8725T, N18701 thru N18713 N28724 thru N28728
SABENA	00-SJJ thru 00-SJK
All	VT DPM VT-DSI, VT DVA VT-DVB
NWA	N363US thru N379US N382US thru N383US
Less airplanes incorporating Boeing Service Bulletin 2652	

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Jan 15/69

Fuel Dump System Circuit
Figure 9 (Sheet 4)

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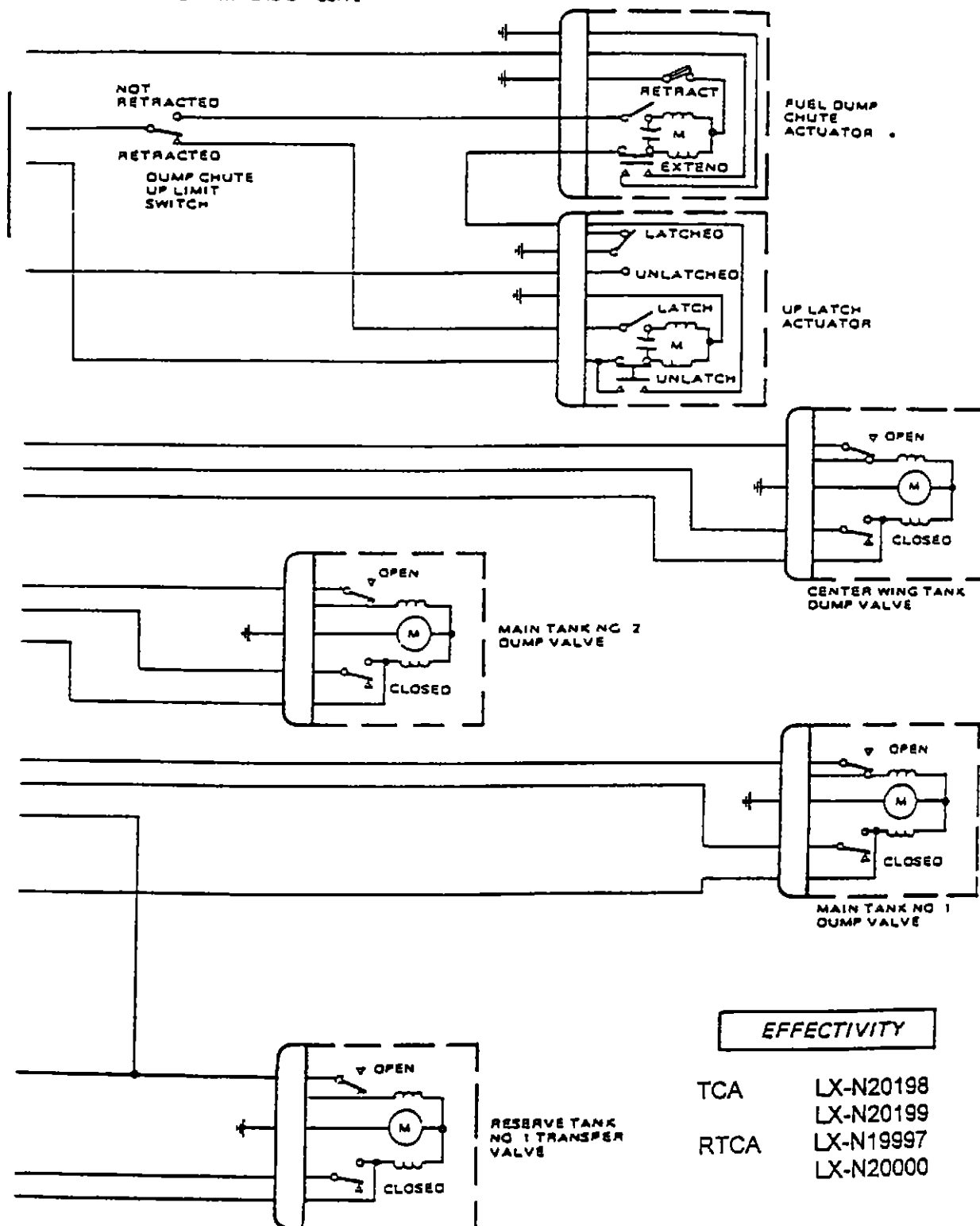
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Fuel Dump System Circuit
Figure 9 (Sheet 5)

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LEFT WING CIRCUIT SHOWN
RIGHT WING IS OPPOSITE



EFFECTIVITY

TCA	LX-N20198
	LX-N20199
RTCA	LX-N19997
	LX-N20000



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- C After dumping of fuel is completed, the dump valve switches are placed in the CLOSE position. The blue indicator lights are illuminated while the valves are closing and go out when valves are closed. After a period of 2 minutes, to allow all fuel to drain from the dump chute and manifold, the dump chute switch is placed in the RETRACT position. This energizes the dump chute actuator retract circuit and the dump chute is retracted. On airplanes fitted with a dump valve safety switch, as the dump chute leaves the fully extended position, the dump valve safety switch opens to de-energize the dump valve circuits, preventing reopening of the valves. On airplanes fitted with dump valve safety relays, as the dump chute leaves the fully extended position, the extend limit switch is opened to de-energize the safety relay. When the relay is de-energized it opens the circuit to the dump valves to prevent reopening of the valves. The dump chute continues to retract until the dump chute up-limit switch is positioned to de-energize the dump chute actuator and to energize the up-latch actuator to lock the chute in retracted position. As the actuator rod of the up-latch actuator extends, the hook assembly is engaged with the catch on the closure panel, when the hook assembly and the catch are fully engaged the limit switch inside the up-latch actuator opens to cut the power to the actuator, and the secondary switch in the actuator de-energizes the dump chute position light. On airplanes fitted with fuel dump chute unlatched relays, power is cut off from the dump valves when the dump chutes are at the closed and latched position.

WARNING CHUTE RETRACTION BEFORE CLOSING FUEL DUMP VALVES MAY RESULT IN RESIDUAL FUEL IN CHUTE SPILLING INTO WING TRAILING EDGE AREA

CAUTION WHEN OPERATING THE DUMP SYSTEM, THE DUTY CYCLE OF THE DUMP CHUTE AND UP-LATCH ACTUATORS MUST NOT BE EXCEEDED. THE DUTY CYCLE FOR THE DUMP CHUTE ACTUATORS IS 2 COMPLETE CYCLES ON, 20 MINUTES OFF AND THE DUTY CYCLE FOR THE UP-LATCH ACTUATOR IS 1 MINUTE ON 3 MINUTES OFF.

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FUEL DUMP SYSTEM - TROUBLE SHOOTING

1. General

- A. Trouble shooting the fuel dump system covers electrical systems, mechanical adjustments and physical condition of various components, most trouble shooting being accomplished with the fuel dump chute in the extended position. Malfunction of certain electrical components or circuits will prevent electrical extension of the fuel dump chute; in this case access to the dump system components is gained by removing access panel No. 1352 or 1353. Refer to 12-2-0, "Access Doors and Panels."

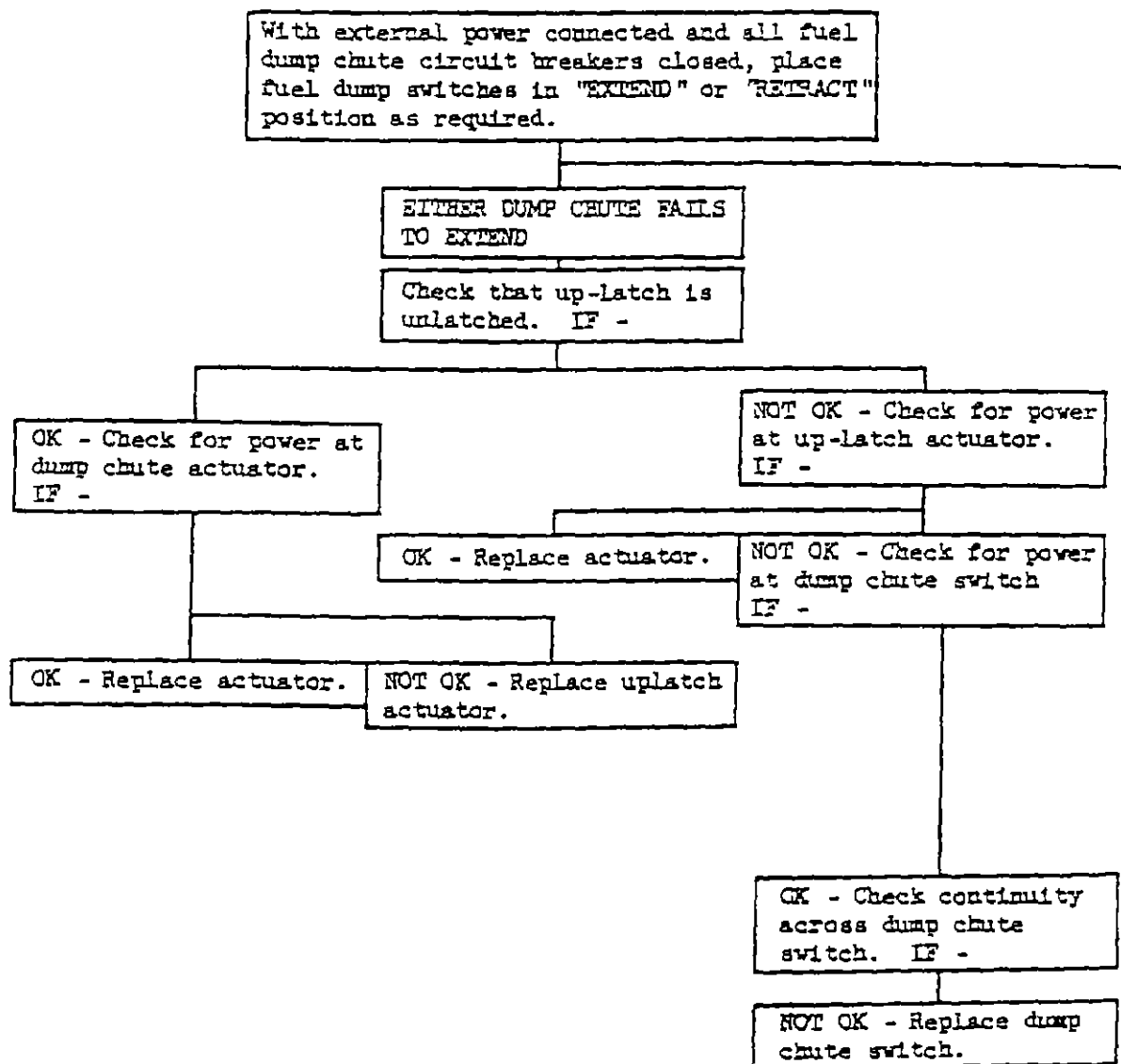
WARNING. Deleted.

CAUTION. WHEN OPERATING THE DUMP SYSTEM THE DUTY CYCLE OF THE DUMP CHUTE AND UP-LATCH ACTUATORS MUST NOT BE EXCEEDED. THE DUTY CYCLE FOR THE DUMP CHUTE ACTUATOR IS 2 COMPLETE CYCLES ON, 20 MINUTES OFF AND THE DUTY CYCLE FOR THE UP-LATCH ACTUATOR IS 1 MINUTE ON, 9 MINUTES OFF.

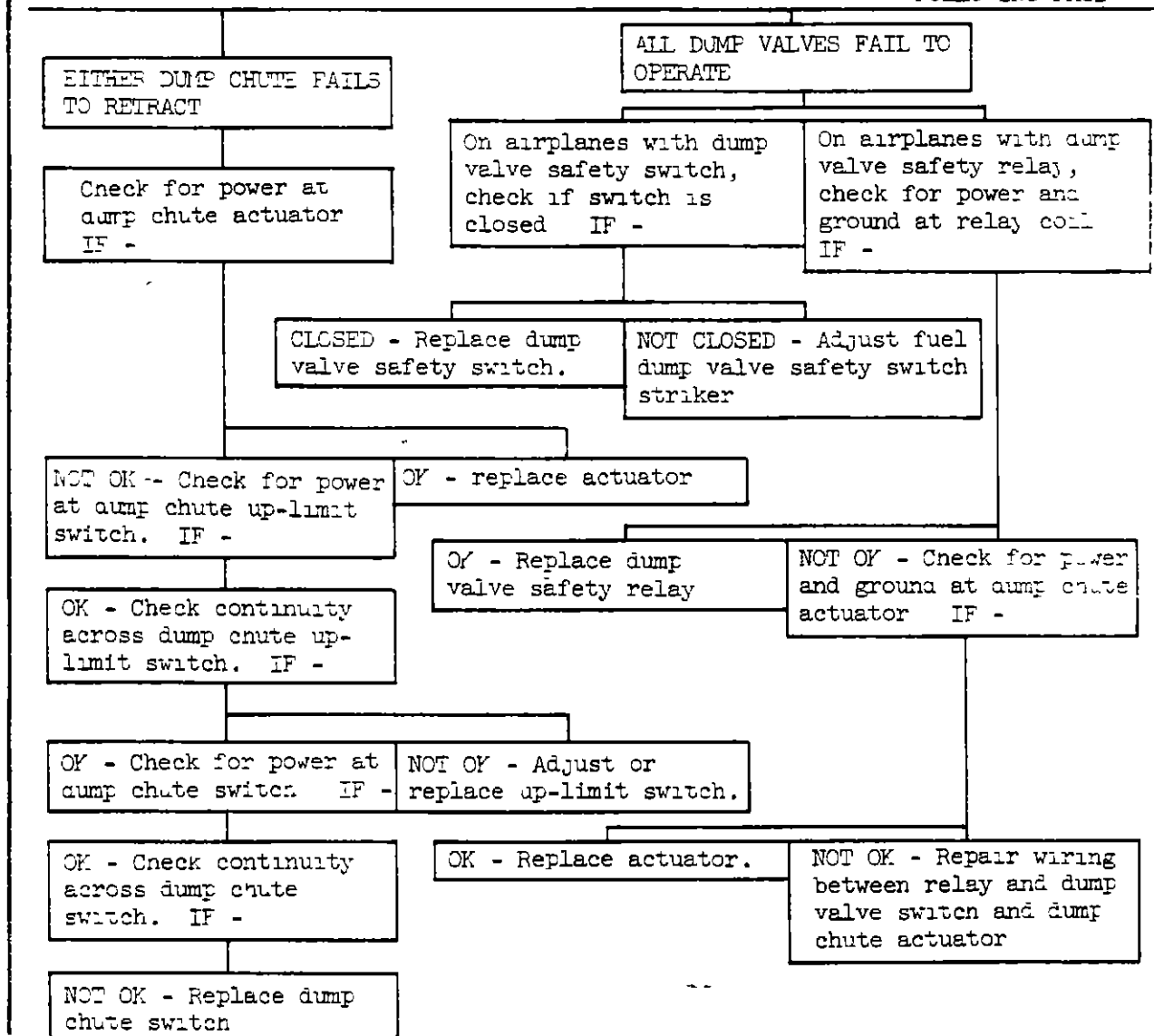
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2 Fuel Dump System Trouble Shooting Chart

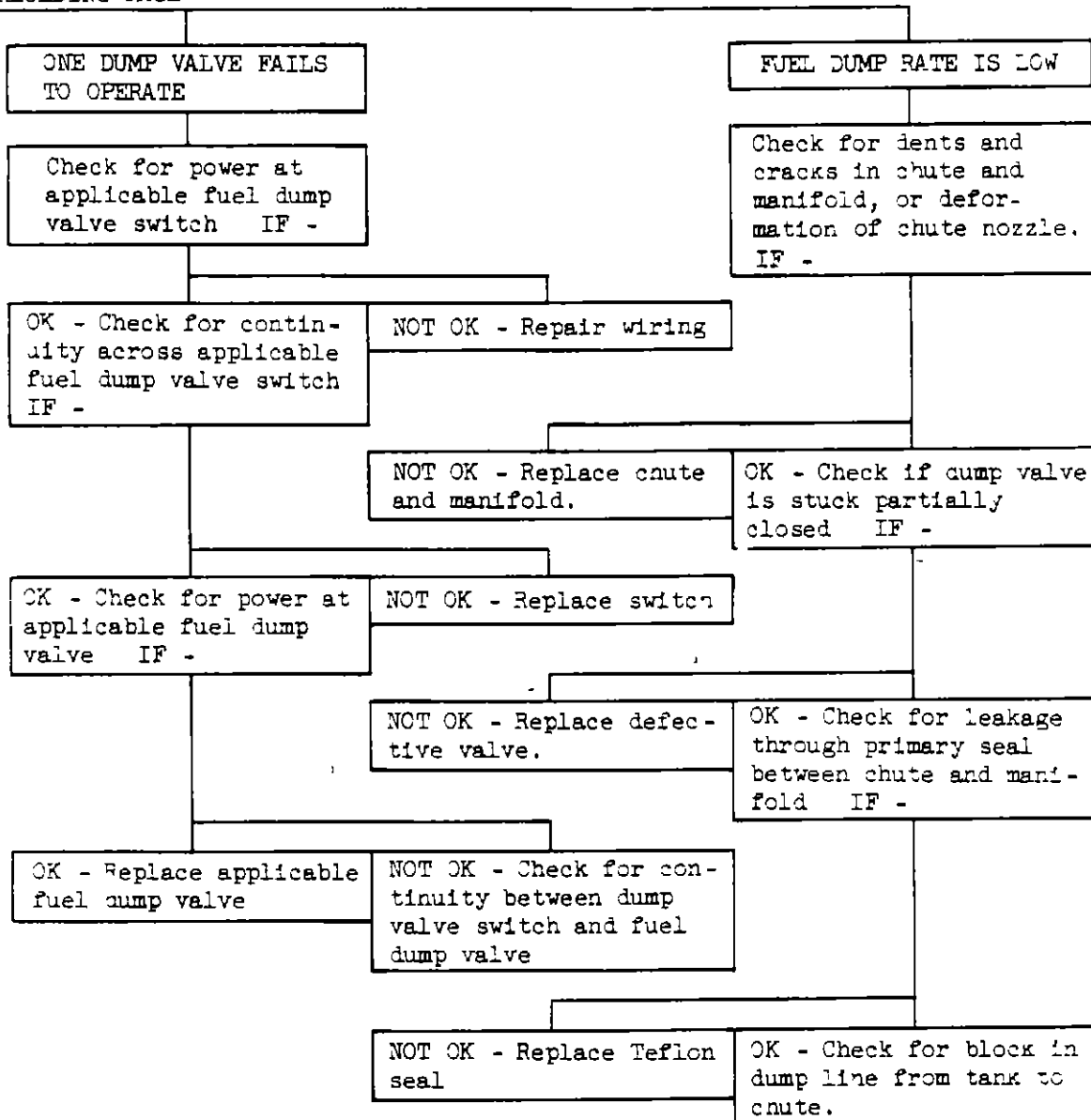


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PRECEDING PAGE





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FUEL DUMP NOZZLE - INSPECTION/CHECK

1. General

- A. This procedure contains instructions to do a bonding resistance check for each fuel dump nozzle. Access is gained by raising the inboard spoiler, lowering the flaps and lowering the inboard cove lip door on the applicable side of the airplane.

2. Fuel Dump Nozzle - Bonding Resistance Check

A. References

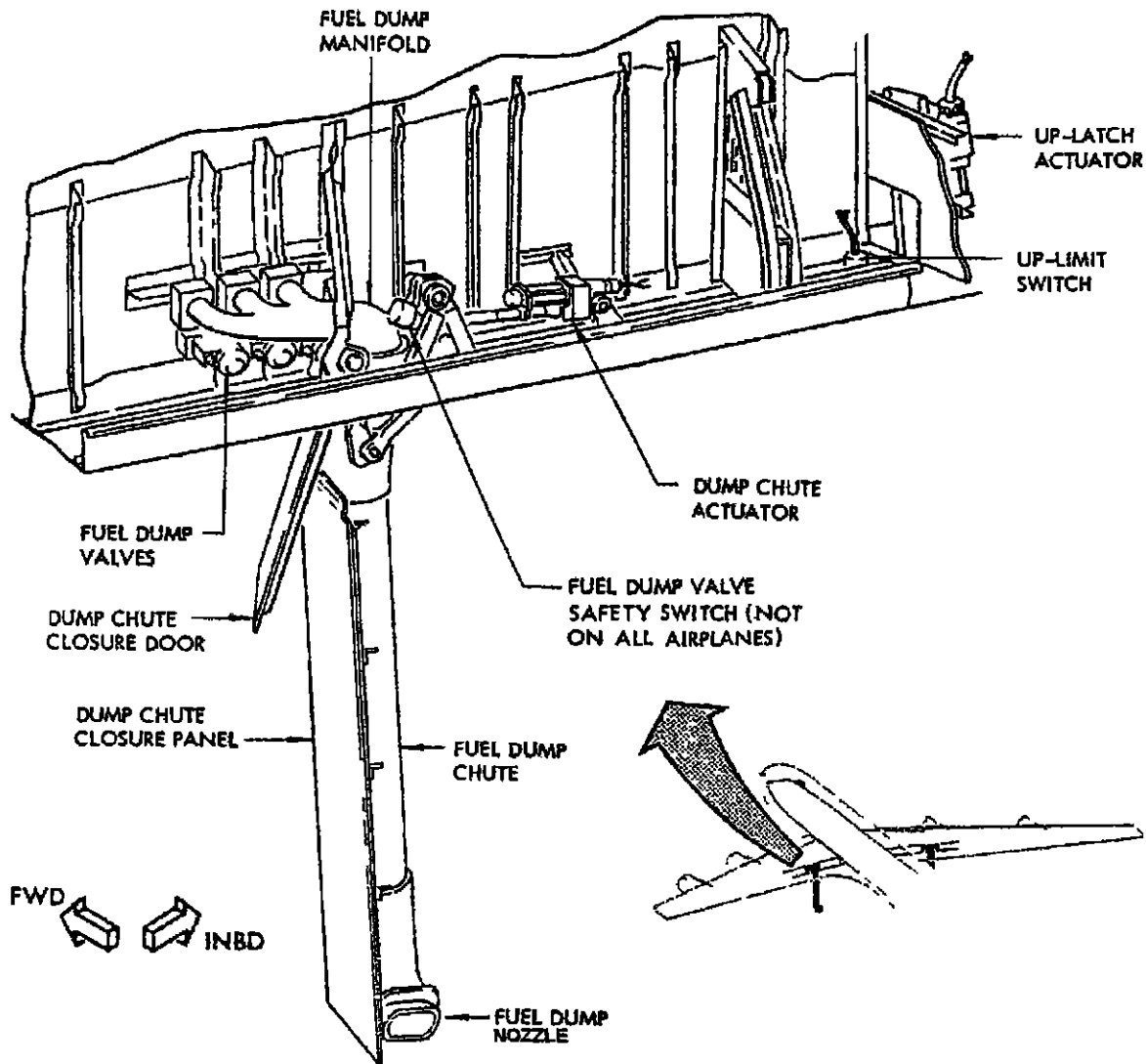
- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH

C. Procedure

- (1) Extend the fuel dump chute to the down position.
- (2) Gain access to the fuel dump chute (Figure 1) by removing access panel No.1352.
- (3) Measure the electrical bonding resistance between the fuel dump nozzle and the structure.
 - (a) Make sure the resistance is 0.005 ohm (5 milliohm) or less.
- (4) Install access panel No. 1352.
- (5) Put the airplane back to a serviceable condition.



Fuel Dump System Equipment Location
 Figure 1



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FUEL DUMP SYSTEM - MAINTENANCE PRACTICES

PLUS ALL AIRPLANES INCORPORATING BOEING SERVICE BULLETIN 1200

1. Unit Servicing Fuel Dump System

- A. Lubricate fuel dump system. (See figure 201)

2. Adjustment/Test Fuel Dump System

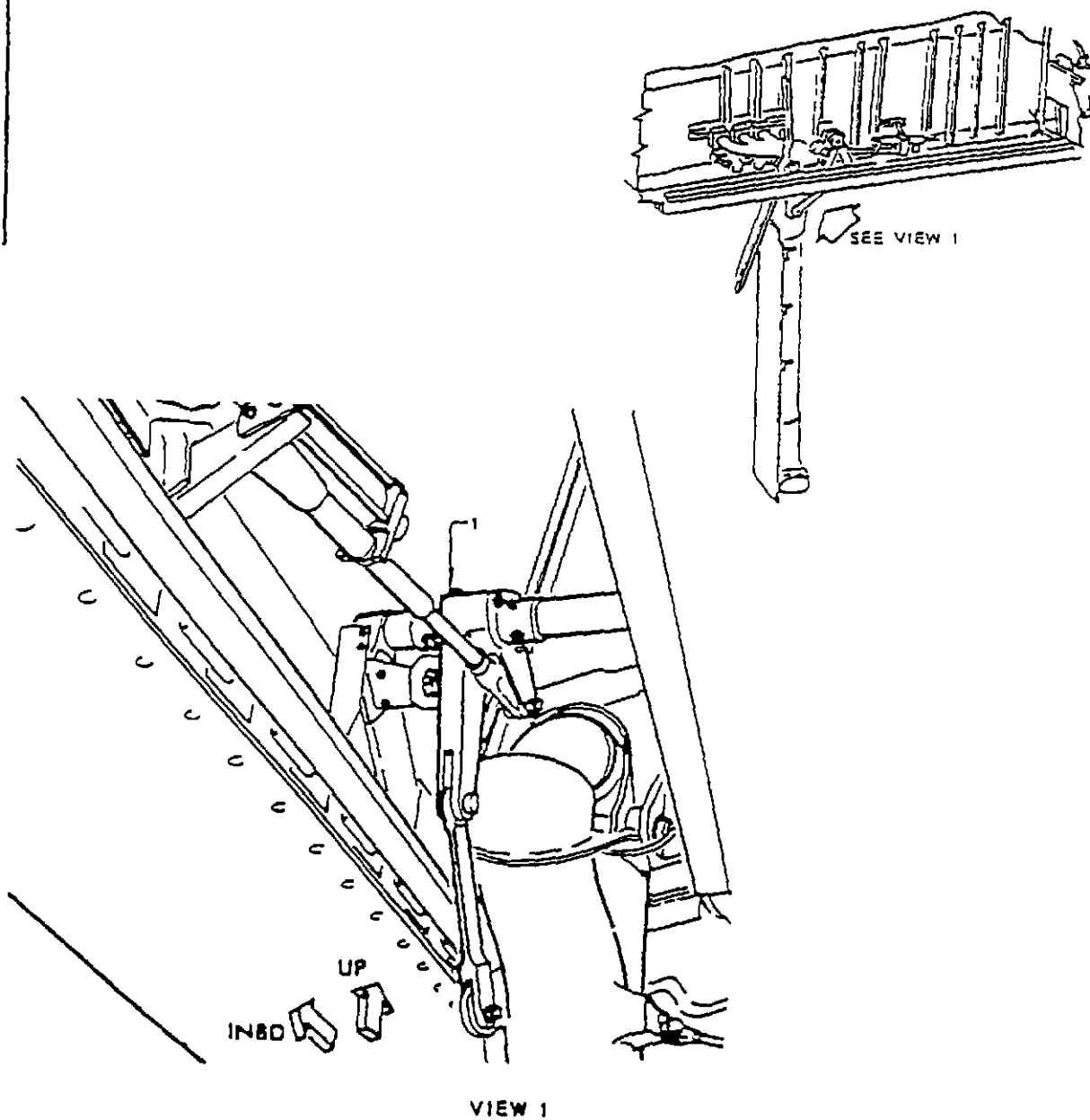
A. Equipment and Materials

- (1) Test Harness - See figure 201A
- (2) Weight - 70 ($\pm$ 10) pounds

B. Adjust Fuel Dump System

- (1) Connect external power to airplane.
- (2) Prepare for adjustment.
 - (a) Extend fuel dump chute
 - (b) Pull dump chute actuator circuit breaker
 - (c) Disconnect dump chute closure door link from dump chute. (See figure 202.) Tie or tape closure door in open position
 - (d) Disconnect electrical connector from dump chute actuator and install test harness between actuator and airplane wiring.
 - (e) Tie or tape test harness to structure to keep harness clear of retracted chute and mechanism, pass test connection through closure door opening.
- (3) Disconnect dump chute actuator rod from quadrant arm. (See figure 202.)
- (4) Tie actuator to structure to keep clear of retracted chute.

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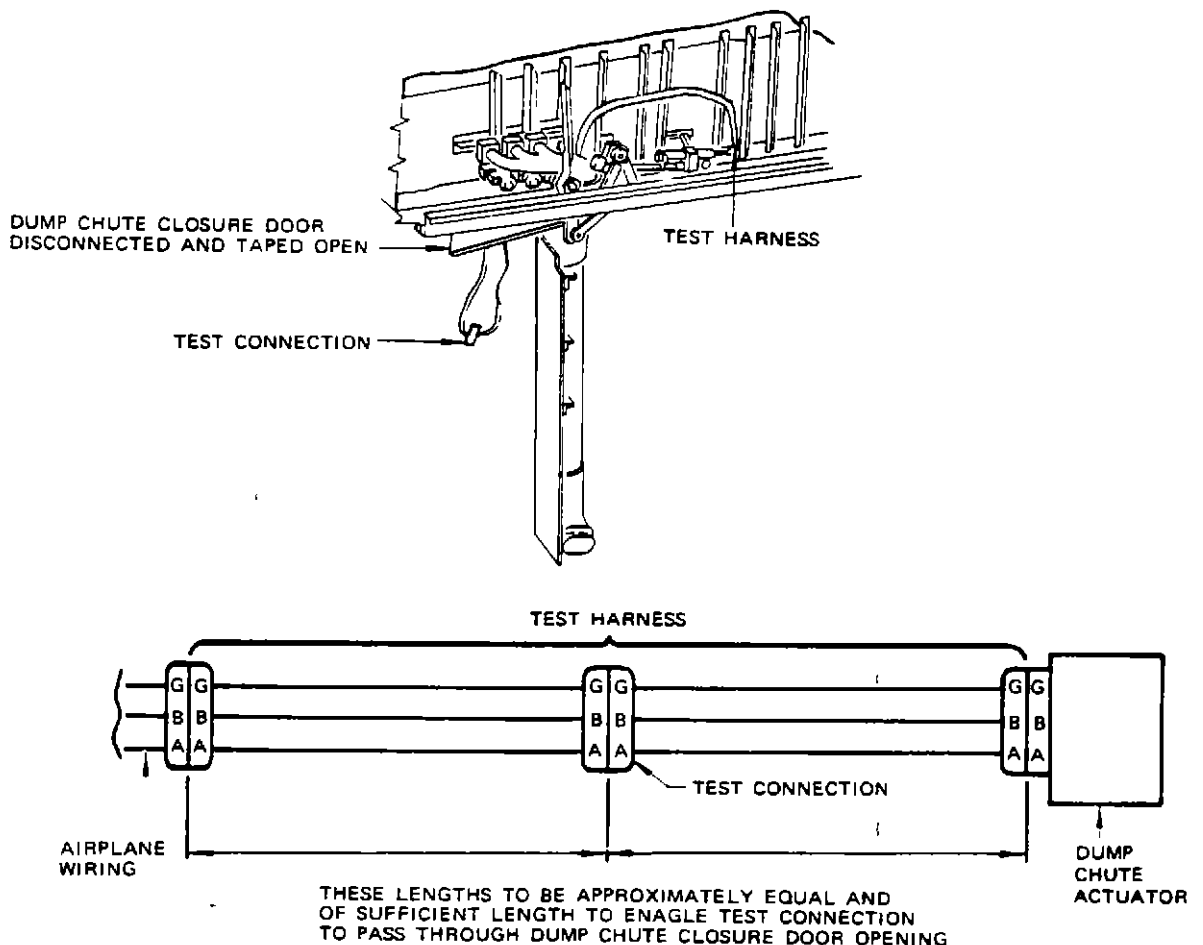


INDEX NO.	ITEM TO BE LUBRICATED	INSTRUCTIONS
1	FUEL DUMP CHUTE QUADRANT ARM	APPLY GREASE MIL-G-23827 THROUGH ZERK FITTING



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- (5) Adjust fuel dump chute up-limit switch
 - (a) Attach ball of soft putty to switch bracket so that bottom of putty extends below bottom of switch plunger in position to be contacted by switch striker attached to closure panel
 - (b) Manually raise chute to retracted position with closure panel faired with wing lower surface within 0.06 inch
 - (c) Lower chute to extended position
 - (d) Adjust up-limit switch so that bottom of plunger is 0.15 to 0.20 inch below surface of impression made in putty by switch striker.
 - (e) Remove putty from switch bracket
- (6) Untie dump chute actuator and reconnect to quadrant arm
- (7) Close dump chute actuator circuit breaker. Retract fuel dump chute and check that panel fairs with wing lower surface within 0.06 inch.



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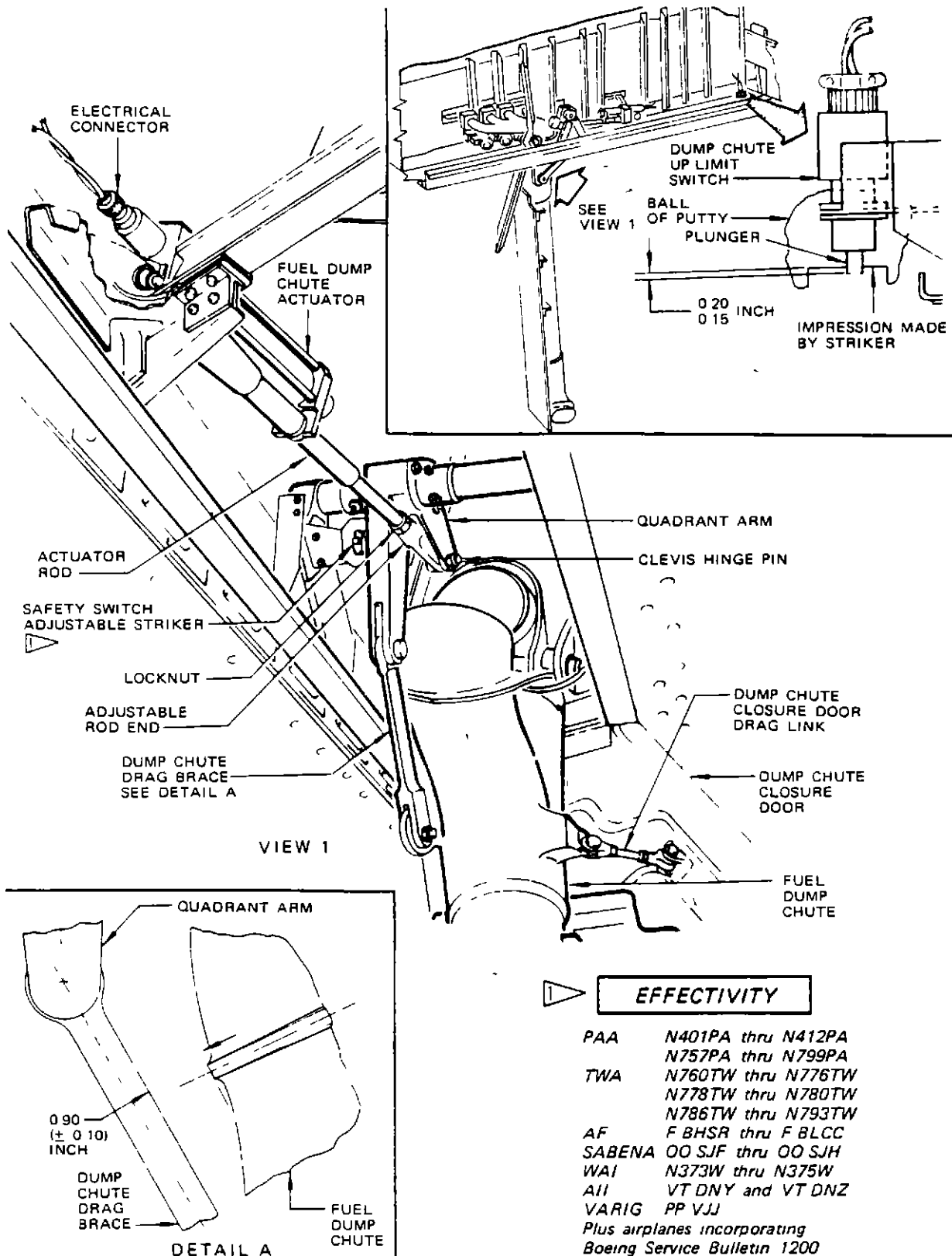


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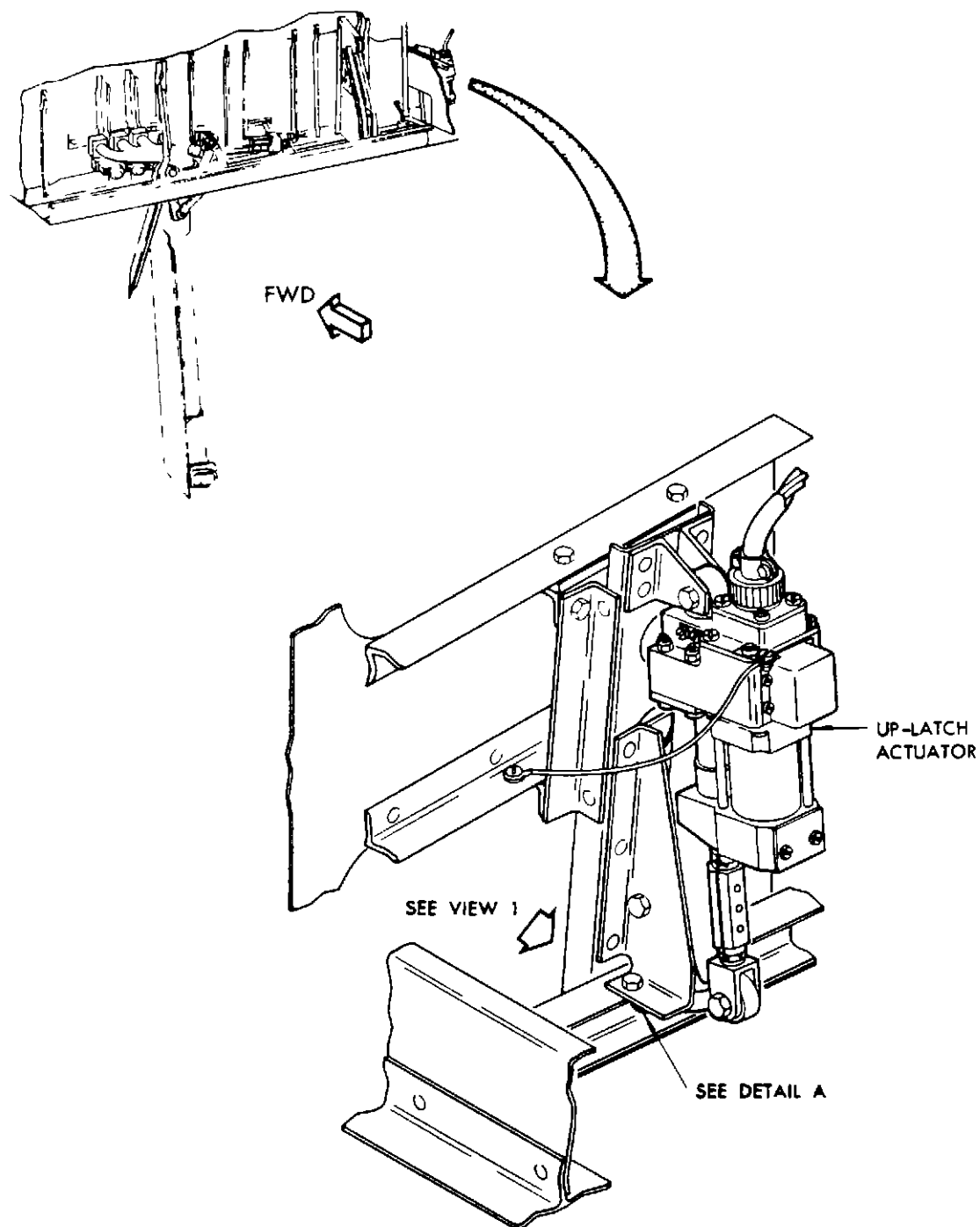
- (8) If panel does not fair proceed as follows.
 - (a) Pull dump chute actuator circuit breaker, disconnect test harness test connection then close circuit breaker.
 - (b) Check for power at pin "B" on portion of harness attached to airplane wiring.
 - (c) If power is at pin, shorten dump chute actuator rod until closure panel is faired and no power is present at pin "B."
 - (d) If power is not present at pin, readjust fuel dump chute up-limit switch until panel is faired.
 - (e) Pull dump chute actuator circuit breaker, reconnect test harness test connection then close circuit breaker.
- (9) Adjust up-latch actuator.
 - (a) Extend fuel dump chute.
 - (b) Attach ball of soft putty to inside of up-latch catch.
 - (c) Operate chute through complete retract-extend cycle.
 - (d) Using impression made in putty as a guide, adjust turnbuckle on up-latch actuator to obtain gap of 0.02 (+0.00/-0.02) inch between roller and catch. (See figure 203.)
 - (e) Using impression in putty, check 0.15 (-0.05/+0.10) inch gap between roller and catch. If gap is not correct, loosen screws attaching closure panel and move panel inboard or outboard to obtain correct gap then tighten panel attaching screws.
 - (f) Lockwire turnbuckle locknuts and remove putty from up-latch catch.
- (10) Check and adjust dump chute retraction under load.
 - (a) Attach 70 (± 10) pound weight to inboard end of dump chute closure panel.
 - (b) Retract dump chute.

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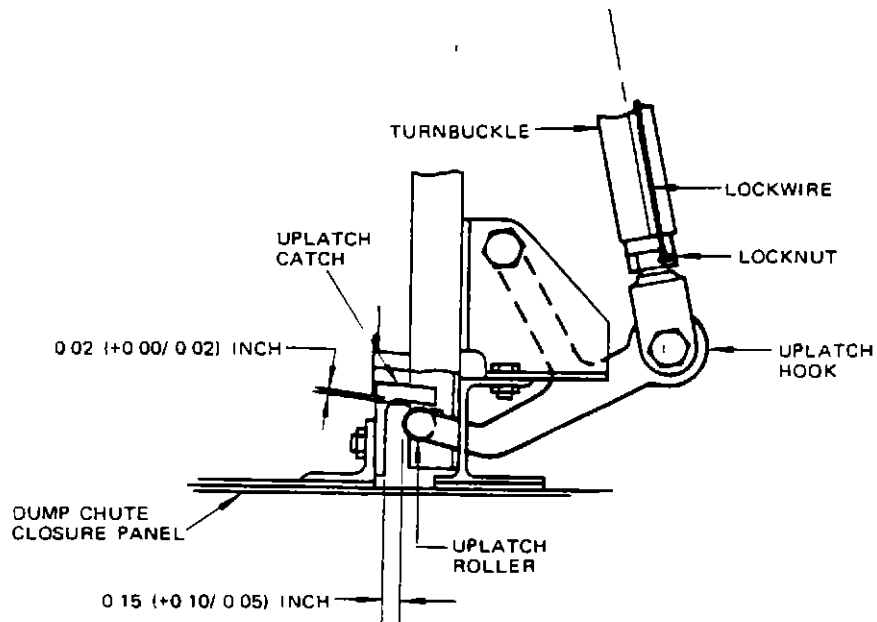
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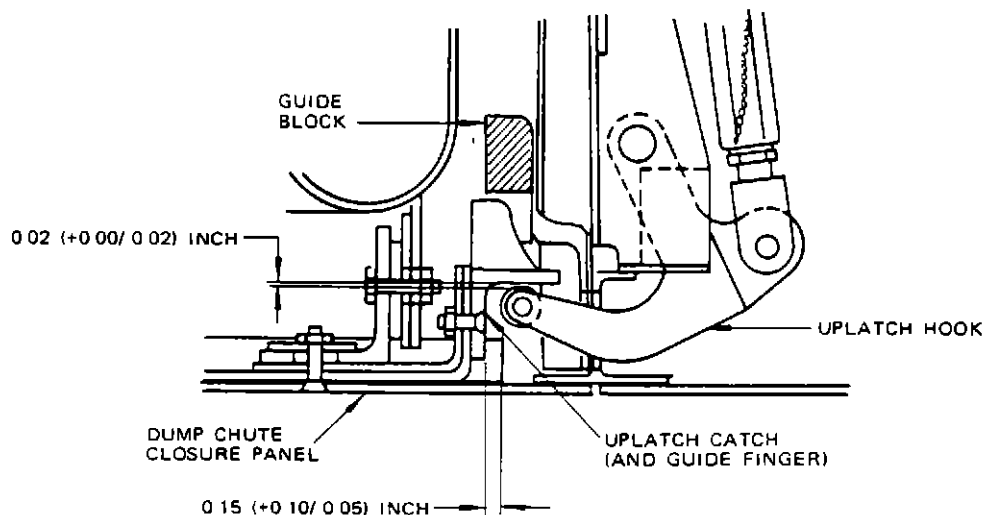
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EARLY CONFIGURATION
 DETAIL A



LATER CONFIGURATION
 DETAIL A

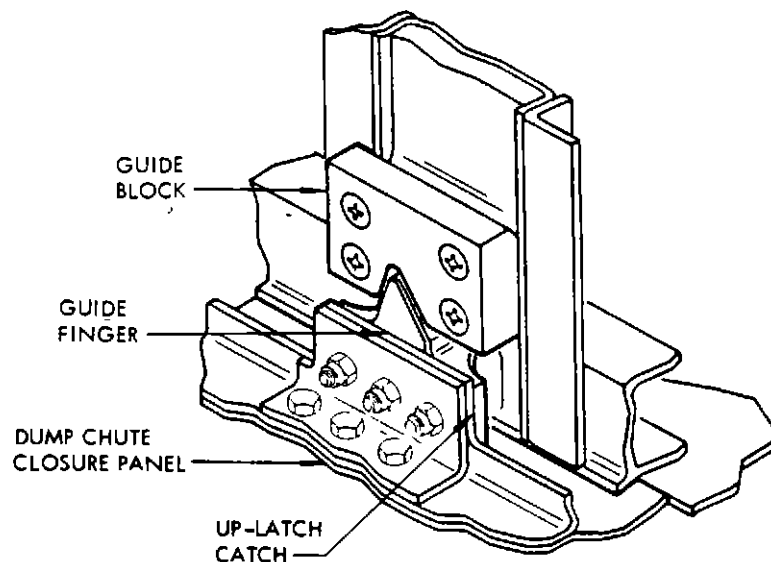


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(c) If chute does not fully retract and latch, dump chute position light will remain illuminated. If chute is not latched, perform steps (c)1) through (c)8). If chute does retract and latch, proceed to step (11).

- 1) Extend fuel dump chute.
- 2) Adjust rod end of dump chute actuator until chute will retract and latch.
- 3) If all rod end adjustment is used before retraction and latching is accomplished, retract limit switch in dump chute actuator must be adjusted as follows.

NOTE This switch must not be adjusted unless all adjustment on actuator rod is used.



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- 4) Extend fuel dump chute and remove dump chute actuator from airplane

CAUTION. TO PREVENT INTERNAL DAMAGE TO ACTUATOR, ALL ADJUSTMENTS OF LIMIT SWITCH SCREWS SHOULD BE ACCOMPLISHED ON A BENCH AND CARE EXERCISED TO ENSURE THAT ACTUATOR MECHANISM DOES NOT CONTACT INTERNAL STOPS.

- 5) Break lockwire on retract limit switch adjusting screw.
6) Turn screw counter clockwise until sufficient retraction is obtained.

NOTE: The threads on adjustment screw are extremely fine and many turns of the screw are required for a small change in actuator rod travel. After each adjustment of screw, actuator must be momentarily energized to extend before rod can be retracted to new position.

- 7) Install dump chute actuator in airplane
8) Repeat steps (10)(a), (10)(b), (10)(c)4) through (10)(c)7) until chute will fully retract and latch.

- (11) Check for simultaneous operation of dump chute up-limit switch and dump chute actuator retract limit switch. Adjust retract limit switch, if necessary, to prevent simultaneous operation.

NOTE. If these switches operate simultaneously, an unsatisfactory retract cycle could result when airplane attitude or condition is different than during adjustment.

- (a) Retract and latch fuel dump chute then pull dump chute actuator circuit breaker
(b) Disconnect test harness test connection.
(c) Check for continuity across pins "B" and "G" on portion of test harness connected to actuator
(d) If continuity exists no further action is required.



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- (e) If continuity does not exist, remove actuator from airplane and turn retract limit switch adjusting screw counterclockwise until continuity across pins "B" and "G" is obtained when actuator is reinstalled in airplane and chute is retracted.

CAUTION TO PREVENT INTERNAL DAMAGE TO ACTUATOR, ALL ADJUSTMENTS OF LIMIT SWITCH SCREWS SHOULD BE ACCOMPLISHED ON A BENCH AND CARE EXERCISED TO ENSURE THAT ACTUATOR MECHANISM DOES NOT CONTACT INTERNAL STOPS.

- (f) Install actuator in airplane and close actuator circuit breaker

- (12) Extend fuel dump chute and open dump chute actuator circuit breaker
- (13) Remove test harness and connect airplane wiring to actuator.
- (14) Close dump chute actuator circuit breaker
- (15) Connect dump chute closure door link to dump chute
- (16) Adjust extended position of fuel dump chute.

- (a) Cycle dump chute through complete retract-extend cycle.

- (b) With chute fully extended, measure distance between dump chute and drag brace. (See Detail A, figure 202)

- (c) If distance is 0.90 (± 0.10) inch, no further adjustment is required.

- (a) If distance is not within tolerance proceed as follows

- 1) Pressure check fuel dump chute and manifold. Refer to 28-22-21
- 2) If pressure check shows that primary seal is not leaking no further adjustment is required.
- 3) If primary seal leaks during pressure test, extend limit switch in dump chute actuator must be adjusted
- 4) Remove actuator from airplane and adjust extend limit switch until primary seal does not leak during pressure check ignoring distance between chute and drag brace

CAUTION TO PREVENT DAMAGE TO ACTUATOR, DO NOT ALLOW ACTUATOR MECHANISM TO CONTACT INTERNAL STOPS, MAKE ALL ADJUSTMENTS ON BENCH.



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- 5) Lockwire actuator limit switch adjusting screws.
- (17) Adjust fuel dump valve safety switch. (See figure 202 for effectivity.)
 - (a) Extend fuel dump chute.
 - (b) Adjust switch striker to depress switch plunger 0.15 to 0.20 inch.
- (18) Adjust dump chute closure door
 - (a) With fuel dump chute in retracted position verify that dump chute closure door fair with lower wing surface.
 - (b) If dump chute closure door does not fair with wing surface, extend fuel dump chute and adjust dump chute closure door link to obtain the correct position.
 - (c) Return fuel dump chute to retracted position and recheck to verify that dump chute closure door fair with lower wing surface.

C. Test Fuel Dump System (No Fuel On Board)

WARNING CHECK OF FUEL DUMP SYSTEM ON THE GROUND WITH FUEL IN TANKS IS NOT RECOMMENDED. IF DONE, DEFUELING PRECAUTIONS MUST BE EXERCISED. A CONTAINER FOR FUEL MUST BE PROVIDED AND DUMP VALVES MONITORED TO CLOSED POSITION WHEN FUEL STARTS FLOWING FROM CHUTE OUTLET.

NOTE When checking the fuel dump system with fuel on board, the tanks must contain the following minimum amounts of fuel before fuel will flow from the dump chute with valve open and airplane level. Main tanks 1 and 4, 900 gallons each. Main tanks 2 and 3, 1500 gallons each: center wing tank, 5100 gallons with 4 removable cells, 6700 gallons with 7 removable cells. If reserve tank transfer valves are opened with tanks 1 and 4 containing the above amount of fuel, all fuel will drain from reserve tanks through dump system.

- (1) Connect external power to airplane
- (2) Close all fuel dump system circuit breakers.
- (3) Place fuel dump chute switch, on flight engineer's panel, in "EXTEND" position.



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- (4) Verify that chute position lights illuminate when up-latch is unlatched.
- (5) Verify that both dump chute actuators extend chutes into down position.
- (6) Verify that power to dump chute actuator motor is cut off when dump chute is extended.
- (7) Verify that all fuel dump valves can be opened and closed when dump chute is extended.
- (8) Open and close each fuel dump valve by actuating each dump valve switch on flight engineer's auxiliary panel. Check that valve position corresponds to switch position for each dump valve.
- (9) Verify that valve position indicator lights for each dump valve illuminate during valve operating cycle and extinguish when opening and closing cycle of dump valve is completed.
- (10) Verify that each switch actuates proper valve and only that valve except as follows.
 - (a) The main tank No. 1 dump valve and reserve tank No. 1 transfer valve shall both open and close together when fuel dump switch for main tank No. 1 is actuated.
 - (b) The main tank No. 4 dump valve and reserve tank No. 4 transfer valve shall both open and close together when fuel dump switch for main tank No. 4 is actuated.
- (11) Move dump chute switches to "RETRACT" position.
- (12) Verify that uplatch actuator completely engages the hook roller with the catch.
- (13) Verify that dump chute position lights are extinguished when uplatch is fully latched.
- (14) Verify that operation of fuel dump valve switches when dump chute is retracted does not cause fuel dump valves to open.

CAUTION: WHEN OPERATING THE DUMP SYSTEM, THE DUTY CYCLE FOR THE DUMP CHUTE AND UP-LATCH ACTUATORS MUST NOT BE EXCEEDED. THE DUTY CYCLE FOR THE DUMP CHUTE ACTUATOR IS 2 COMPLETE CYCLES ON, 20 MINUTES OFF AND THE DUTY CYCLE FOR THE UP-LATCH ACTUATOR IS 1 MINUTE ON 9 MINUTES OFF.



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FUEL DUMP VALVE - REMOVAL/INSTALLATION

1. General

- A. Access to the fuel dump valves is gained by removing fuel dump valve access panel No. 1352 on applicable wing. Refer to Access Doors and Panels, 12-2-0.

2. Equipment and Materials

- A. Five gallon container

3. Prepare for Removal

- A. Connect external electrical power to airplane.
- B. Extend applicable dump chute.
- C. Disconnect external power from airplane and open fuel dump system circuit breakers.
- D. Remove fuel dump valve access panel (No. 1352).
- E. Defuel applicable fuel tank. Refer to Servicing Fuel System, 28-0.
- F. Place 5 gallon container under extended dump chute and drain applicable fuel dump line by manually opening dump valve being removed.

4. Remove Fuel Dump Valve (See figure 401.)

- A. Disconnect bonding jumper from valve being removed.

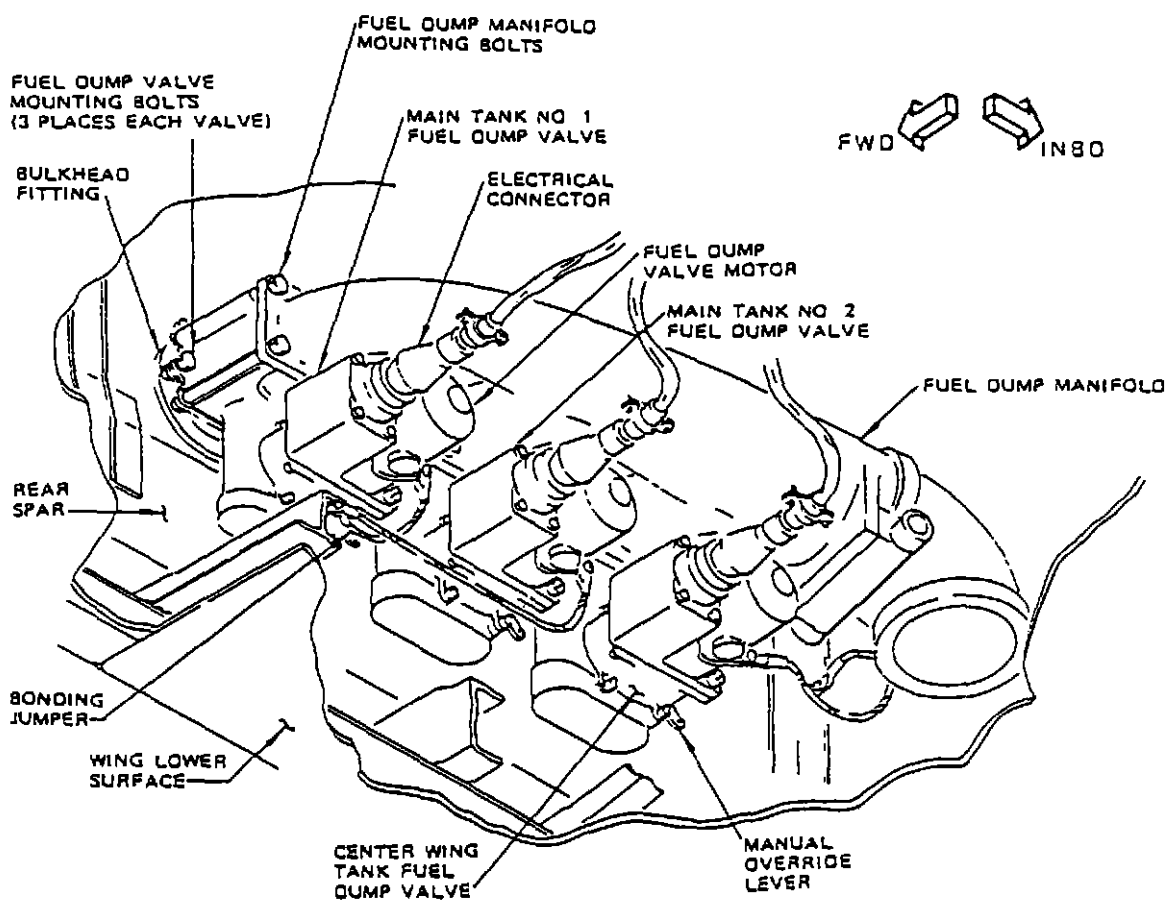


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- B Loosen all fuel dump manifold mounting bolts and remove four bolts from valve being removed. (See figure 401.)

NOTE Loosen manifold mounting bolts only enough to enable defective valve to slip out, to avoid disturbing O-rings on remaining valves.

- C Remove three valve mounting bolts from valve being removed.



Fuel Dump Valves Installation
Figure 401



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- D. Slide valve from between manifold and tank fitting and lift clear
- 5. Install Fuel Dump Valve (See figure 401)
 - A. Install new O-ring, lightly lubricated with fuel, in grooves of valve
 - B. Slide valve into position and align bolt holes
 - C. Install three valve mounting bolts.
 - D. Install four removed manifold mounting bolts
 - E. Tighten all manifold mounting bolts to 50-70 inch-pounds torque.
 - F. Connect bonding jumper and electrical connector to valve
 - G. Install fuel dump valve access panel
 - H. Close fuel system circuit breakers and connect external power to airplane
 - I. Perform system test Refer to Adjustment/Test Fuel Dump System, 28-22-0



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FUEL DUMP VALVE - INSPECTION/CHECK

1. General

- A. This procedure contains instructions to do a bonding resistance check for each fuel dump valve. Access is gained by raising the inboard spoiler, lowering the flaps and lowering the inboard cove lip door on the applicable side of the airplane.

2. Fuel Dump Valve - Bonding Resistance Check

A References

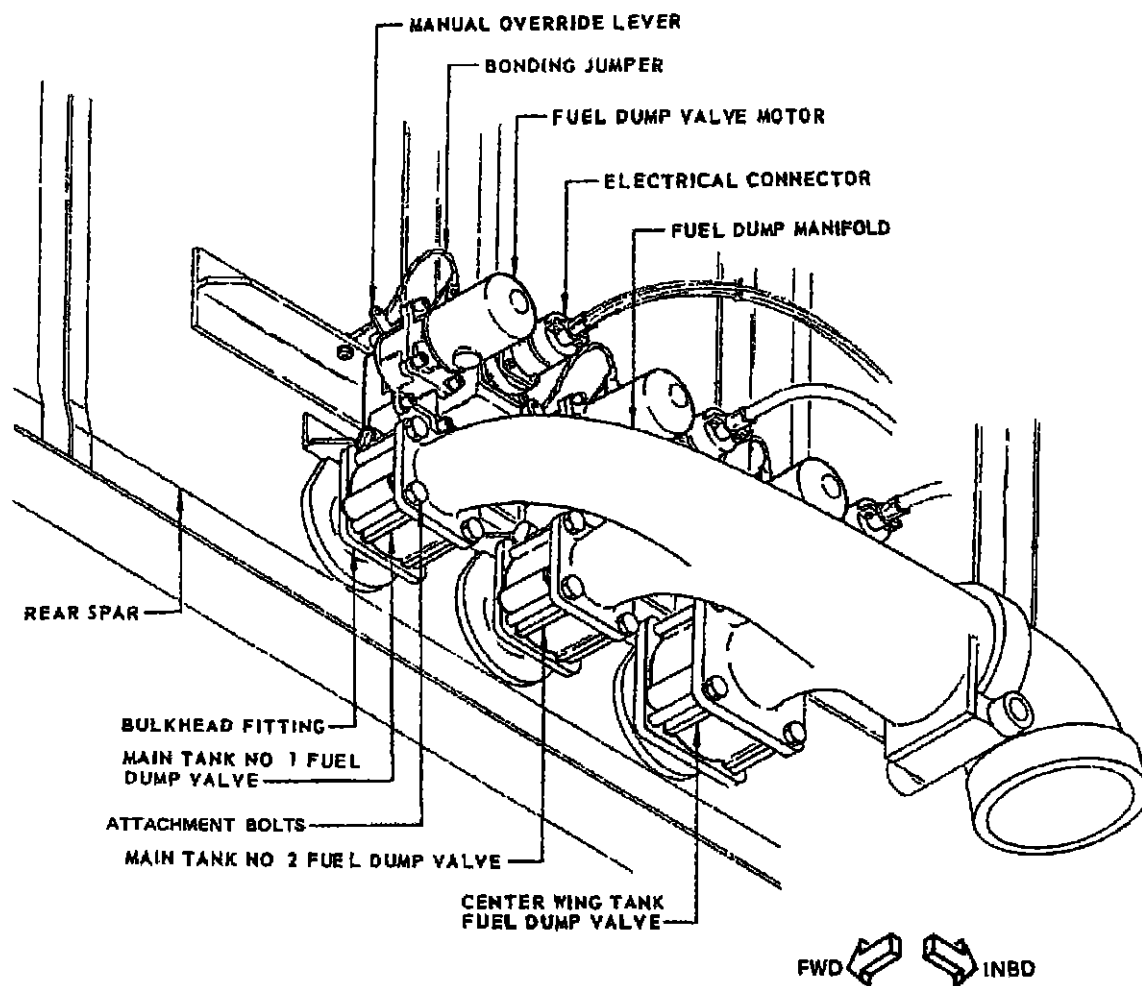
- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Bonding Meter, Model T477W, Avtron Manufacturing, Cleveland OH

C. Procedure

- (1) Get access to the fuel dump valves (Figure 1).
- (2) Measure the electrical bonding resistance between the bonding jumper terminal and the structure (SWPM 20-20-00).
 - (a) Make sure the resistance is 0.005 ohm (5 milliohm) or less.
- (3) Measure the electrical bonding resistance between the fuel dump valve housing and the structure (SWPM 20-20-00).
 - (a) Make sure the resistance is 0.002 ohm (2 milliohm) or less.
- (4) Put the airplane back to a serviceable condition.



Fuel Dump Chute Manifold and Valves
 Figure 1



FUEL DUMP CHUTE - MAINTENANCE PRACTICES

1. Removal/Installation Fuel Dump Chute

A. Equipment and Materials

- (1) Grease - MIL-G-7118, or equivalent

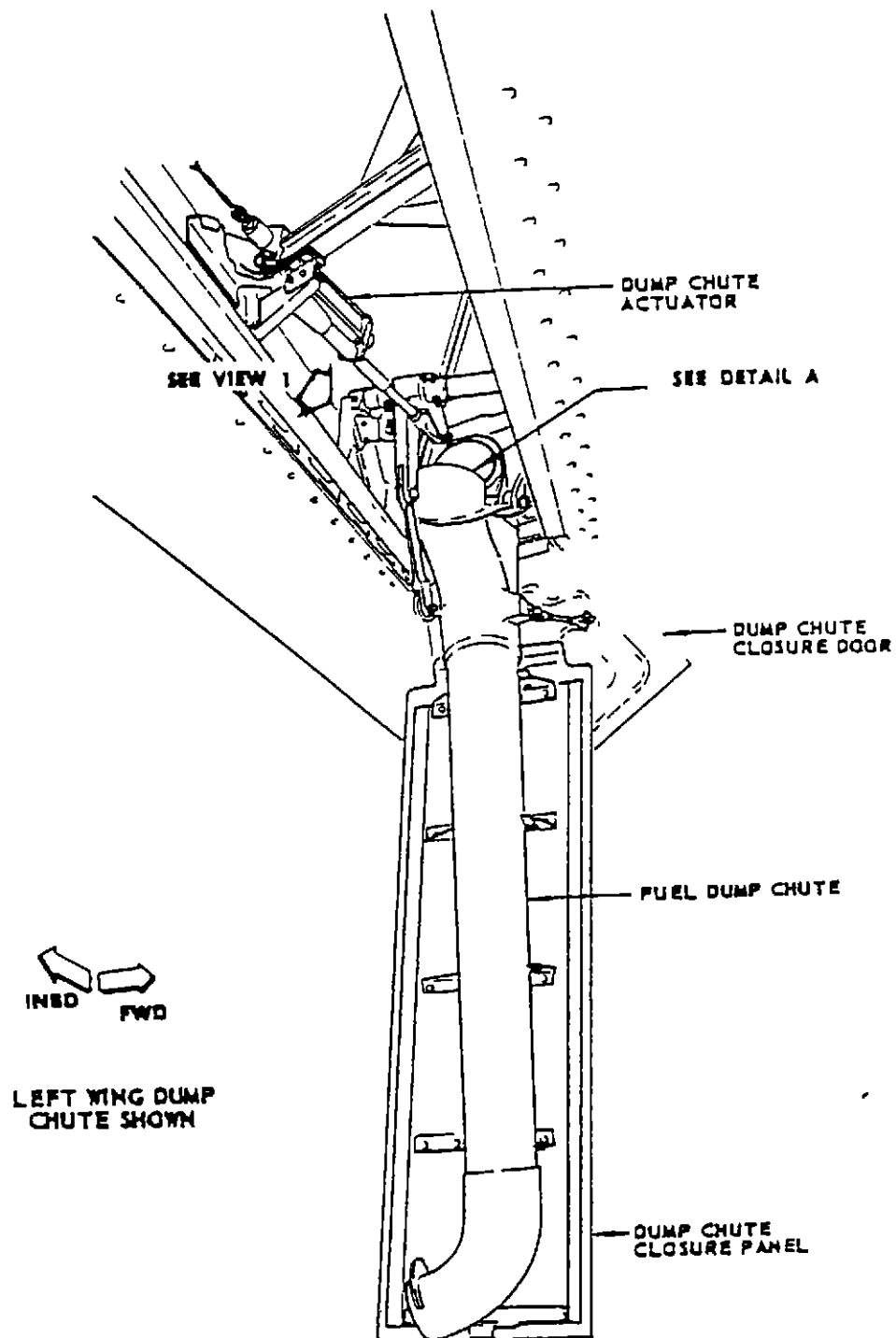
B. Remove Fuel Dump Chute (See figure 201.)

- (1) Extend dump chute to down position.
- (2) Gain access to fuel dump chute by removing access panel No. 1352. Refer to 12-2-0, "Access Doors and Panels."
- (3) Disconnect external power from airplane.
- (4) Open fuel dump system circuit breakers.
- (5) Disconnect closure door drag link.
- (6) Remove bonding jumper at chute. (See detail A.)
- (7) Remove dump chute drag brace.
- (8) Remove closure panel from dump chute.
- (9) Remove cotter pin, castle nut and washer from dump chute trunnion hinge bolt.
- (10) Remove cotter pin and extract torque pin from other end of dump chute trunnion hinge bolt. (See view 1.)
- (11) Extract dump chute trunnion hinge bolt and lower chute from dump chute cavity.

C. Install Fuel Dump Chute (See figure 201.)

- (1) Apply coat of MIL-G-7118 grease to aft faces of trunnion fitting bosses.

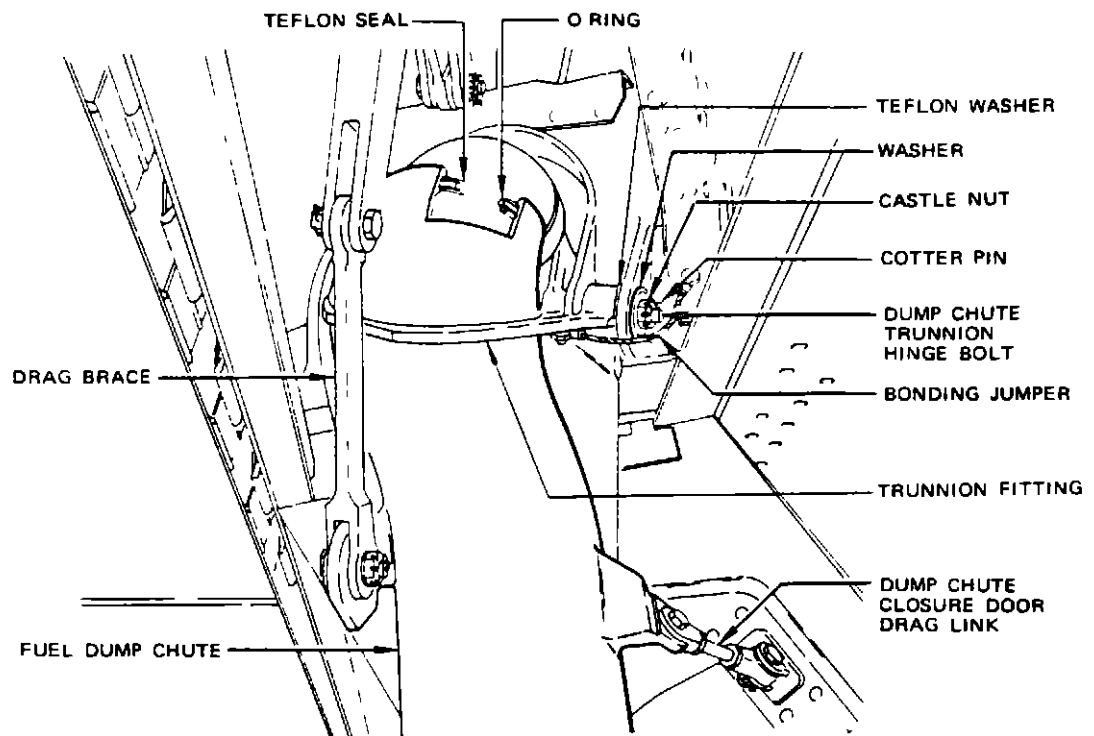
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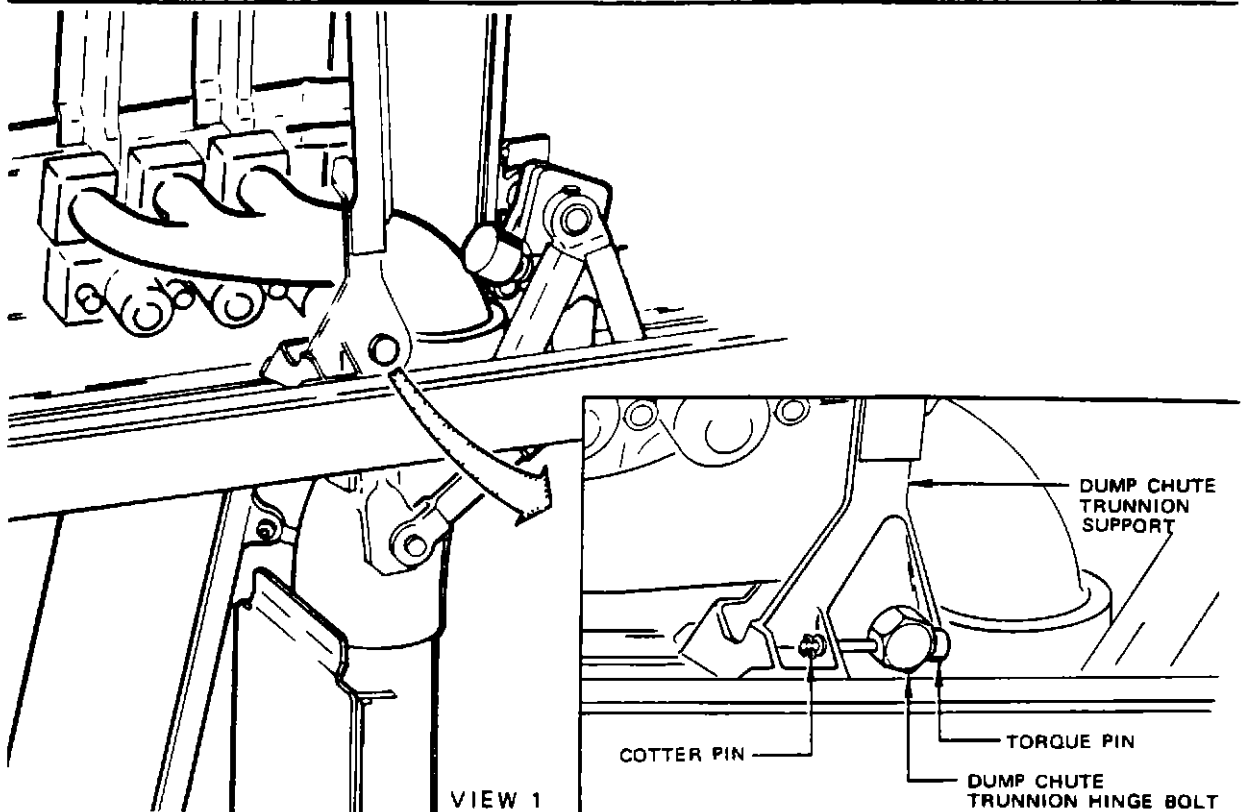
Fuel Dump Chute Installation
Figure 201 (Sheet 1 of 2)

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DETAIL A





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- (2) Lift chute into dump chute cavity and carefully fit inlet port of chute to manifold.

CAUTION: TAKE EXTRA CARE NOT TO DAMAGE SEAL.

- (3) Position Teflon washers on forward faces of trunnion fitting bosses.
- (4) Align chute and insert the dump chute trunnion hinge bolt. (See view 1.)
- (5) Insert torque pin through dump chute trunnion hinge bolt head and dump chute trunnion support and fit lock washer and cotter pin.
- (6) Install washer and castle nut on dump chute trunnion hinge bolt and tighten finger tight (See detail A.)

CAUTION: DO NOT OVERTIGHTEN CASTLE NUT OR BINDING WILL OCCUR.

- (7) Install cotter pin.
- (8) Connect drag brace at dump chute.
- (9) Attach closure panel to dump chute.
- (10) Connect closure door drag brace.
- (11) Connect bonding jumper to dump chute.
- (12) Install access panel No. 1352.
- (13) Close fuel dump system circuit breakers.
- (14) Connect external power to airplane.
- (15) Test dump chute operation. Refer to 28-22-0, "Adjustment/Test Fuel Dump System."

CAUTION: WITH DUMP CHUTE IN STOWED POSITION CLOSURE PANEL MUST COMPRESS SEAL UNIFORMLY OVER ENTIRE LENGTH.

2. Inspection/Check Fuel Dump Chute.

A. Examine dump chute and manifold for dents and cracks, check fuel dump chute nozzle for deformation.

B. Check Fuel Dump Chute

(1) Equipment and Materials

- (a) Squeeze plug (with air source connection) to fit inside dump chute nozzle.
- (b) Air cart with capacity of 10 psi and equipped with safety manometer



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- (c) Soap solution, mild (for leak check)
 - (2) Pressure Check Fuel Dump Chute and Manifold
 - (a) Extend fuel dump chute to down position.
 - (b) Verify that all fuel dump valves are closed
 - (c) Seal dump chute outlet with squeeze plug having air source connection
 - (d) Apply air pressure of 10 psig
 - (e) Check for leaks at primary seal between fuel dump chute and fuel dump manifold by brushing soap solution around joint between fuel dump manifold and fuel dump chute. (See figure 202) No leakage is allowable Maintain air pressure at 10 psig during this check
- NOTE Some pressure drop may be experienced due to possible leakage through the fuel dump valve. Each fuel dump valve has an allowable air leakage of 10 cc per minute of free air at pressure of 5 to 45 psig
- (f) Wipe residual soap solution from dump chute
 - (g) Check for leaks in wall of dump chute
 - (h) Release air pressure.
 - (i) Remove squeeze plug
 - (j) Return fuel dump chute to stowed position

3 Inspection/Check Fuel Dump Chute Secondary Seal

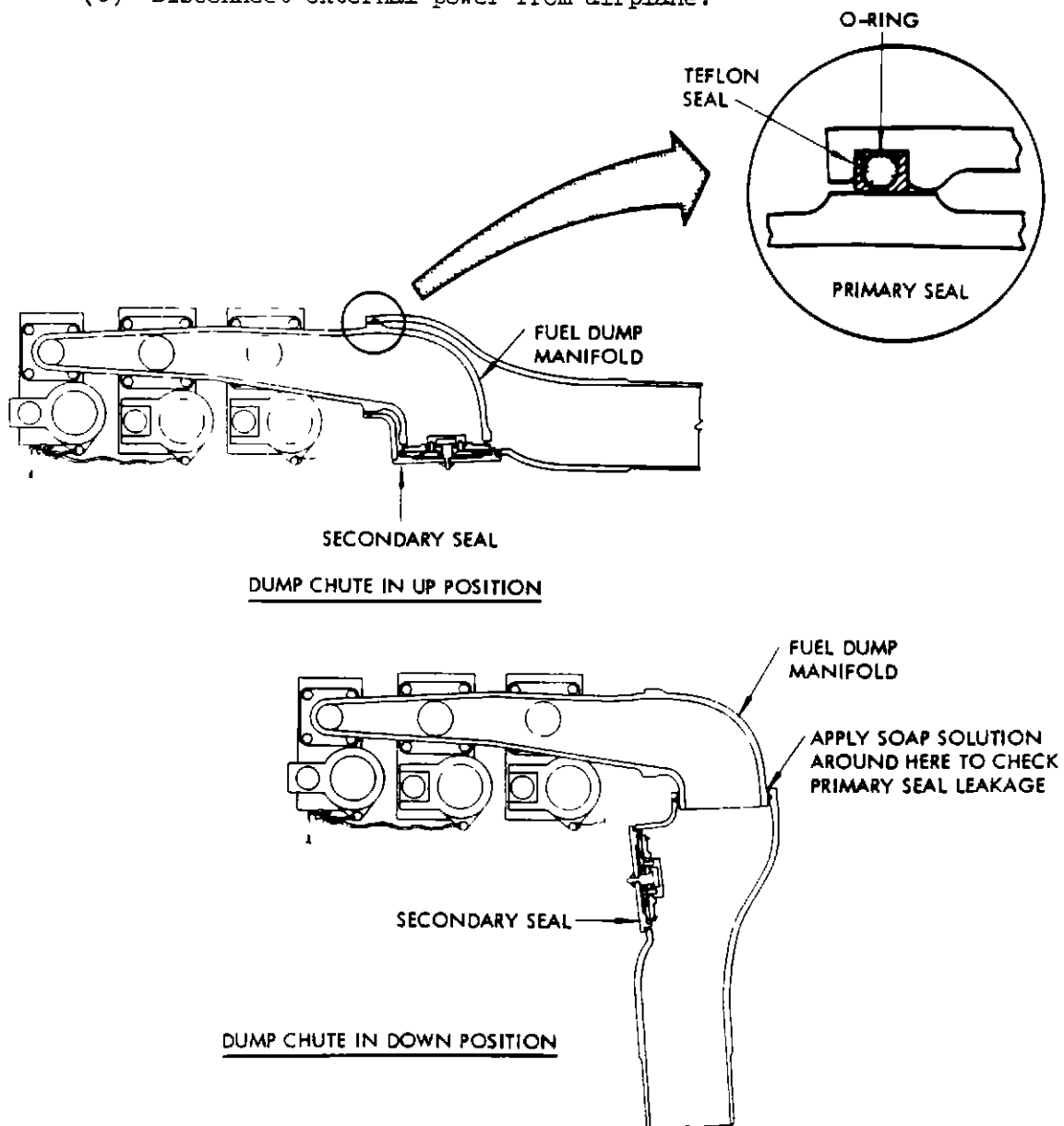
A. Equipment and Materials

- (1) Air cart - to supply air at 3 psig and with a shutoff valve in the supply line
- (2) Two squeeze plugs - 1-1/2 inch diameter
- (3) One squeeze plug - 2 inch diameter with an air connection

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B. Pressure Check Fuel Dump Chute Secondary Seal

- (1) Connect external power to airplane.
- (2) Retract fuel dump chutes.
- (3) Extend wing flaps.
- (4) Lower inboard cove lip door on applicable wing.
- (5) Check that reserve tank transfer valves are fully closed.
- (6) Disconnect external power from airplane.



Fuel Dump Chute Seals
Figure 202



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- (7) Defuel center wing tank and both main tanks in applicable wing. Refer to 28-0, Servicing Fuel System
- (8) Gain access to fuel dump system standpipes Refer to 28-2-0, Integral Fuel Tanks
- (9) Using 1-1/2 inch diameter squeeze plugs, seal top of dump system standpipes in main tanks
- (10) Using 2 inch diameter squeeze plug, seal top of dump system standpipe in center wing tank, connect air supply hose to connection on squeeze plug
- (11) Manually open all fuel dump valves for applicable wing
- (12) Open air valve and pressurize system to 3 psig, allow pressure to stabilize then close air valve
- (13) Check that there is no leakage through dump chute secondary seal by watching pressure gage for decrease in pressure.

NOTE If secondary seal leaks the seal assembly must be replaced as no leakage is allowable on this seal
- (14) Release pressure and remove air hose and all squeeze plugs

CAUTION BE SURE TO REMOVE ALL SQUEEZE PLUGS AFTER COMPLETING TEST. MALFUNCTION OF FUEL DUMP SYSTEM WILL RESULT IF ALL PLUGS ARE NOT REMOVED.
- (15) Replace all rib access opening structural members Refer to 28-2-11, Rib Access Openings

CAUTION: RIB ACCESS OPENING STRUCTURAL MEMBERS ARE PRIMARY STRUCTURE IT IS IMPORTANT THAT ANY STRUCTURE REMOVED BE CORRECTLY REINSTALLED.
- (16) Replace all fuel tank access panels Refer to 28-2-0, Integral Fuel Tanks
- (17) Connect external power to airplane
- (18) Close all fuel dump valves
- (19) Raise inboard cove lip door and retract wing flaps
- (20) Remove external power from airplane.

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FUEL DUMP CHUTE ACTUATOR - MAINTENANCE PRACTICES

1. Remove/Installation Fuel Dump Chute Actuator

A. Deleted.

B. Remove Fuel Dump Chute Actuator

- (1) Connect external power to airplane.
- (2) Place dump chute switch on flight engineer's auxiliary panel to "EXTEND" and lower chute to down position.

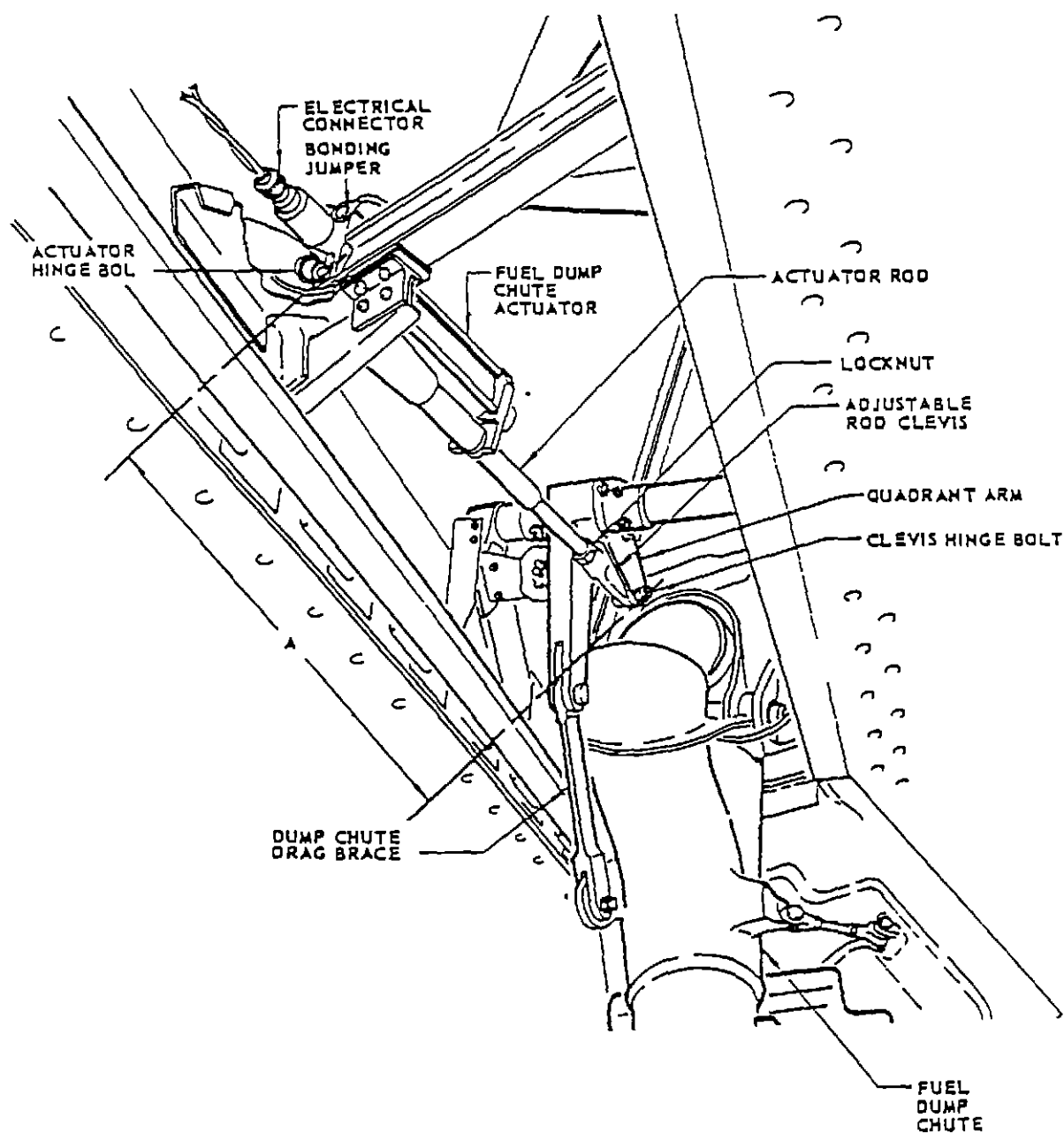
NOTE: If actuator is defective, preventing extension of chute, steps (5) through (8) must be performed from the rear of the wing; access to the actuator is gained by removing access panel No. 1353. Refer to 12-2-0, "Access Doors and Panels."

- (3) Disconnect external power from airplane.
- (4) Open fuel dump circuit breakers.
- (5) Disconnect electrical connector at actuator. (See figure 201.)
- (6) Disconnect bonding jumper at actuator.
- (7) Remove cotter pin, castle nut, washer and clevis hinge bolt at actuator rod end.
- (8) Remove cotter pin, castle nut, washer and actuator hinge bolt at terminal end of actuator assembly. Lift actuator free of structure.

C. Install Fuel Dump Chute Actuator

- (1) If new unit is being installed, adjust length of actuator rod to same length as actuator rod on removed unit.

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Fuel Dump Chute Actuator Installation
Figure 201

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- (2) If removed unit is not available the following method of rod length adjustment may be used
 - (a) Set dump chute to extended position.
 - (b) Measure distance between centers of holes for actuator hinge bolt and clevis hinge bolt, dimension A, figure 201.)
 - (c) Set "EXTEND" adjusting screw on actuator to maximum extend position then electrically extend actuator, actuator must stop just prior to engagement of internal mechanical stops.
 - (d) Adjust length of actuator rod until distance between centers of holes for actuator hinge bolt and clevis hinge bolt is same as dimension A.
- (3) Align actuator assembly to appropriate fitting and insert actuator hinge bolt and washer at terminal end of actuator assembly. (See figure 201)

- (4) Tighten castle nut finger tight and insert cotter pin.

CAUTION DO NOT OVERTIGHTEN

- (5) Connect electrical plug at actuator
- (6) Connect bonding jumper at actuator
- (7) Connect external power to airplane
- (8) Close fuel dump circuit breakers.
- (9) With actuator rod extended, attach adjustable clevis rod end to quadrant arm and insert clevis hinge bolt and washer.

NOTE If actuator rod is not extended fuel dump switch on flight engineer's auxiliary panel must be placed in "EXTEND" position to extend actuator rod

- (10) Tighten castle nut finger tight and insert cotter pin.

CAUTION DO NOT OVERTIGHTEN OR BINDING MAY RESULT.

- (11) Adjust actuator rod length Refer to 28-22-0, "Adjustment/Test Fuel Dump System."

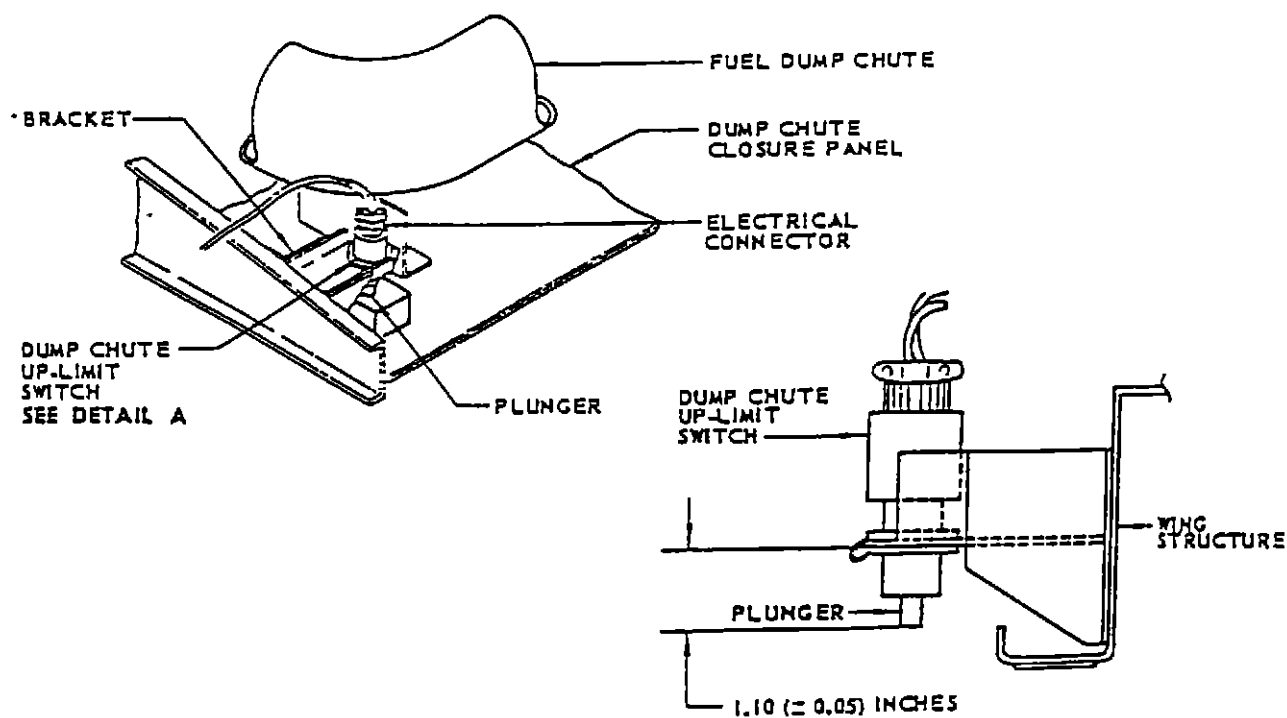
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FUEL DUMP CHUTE UP-LIMIT SWITCH - MAINTENANCE PRACTICES

1. Removal/Installation Fuel Dump Chute Up-Limit Switch

A. Remove Fuel Dump Chute Up-Limit Switch (See figure 201.)

- (1) Connect external power to airplane.
- (2) Extend fuel dump chute
- (3) Remove external power from airplane.
- (4) Disconnect electrical connector.
- (5) Remove lower lock nut and lift switch free of bracket.



DETAIL A

SN REV Jul 31/99

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Revised

Dump Chute Up-Limit Switch Installation
Figure 201

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B Install Fuel Dump Chute Up-Limit Switch

- (1) Place switch in position (See figure 201)
- (2) Set switch with plunger end 1.10 (± 0.05) inches below lower surface of support bracket (See detail A)

NOTE This is an initial setting only. Switch must be adjusted to get final setting

- (3) Tighten lock nuts.
- (4) Connect electrical connector
- (5) Connect external power to airplane
- (6) Adjust dump chute up-limit switch.
- (7) Retract fuel dump chute

2 Adjustment/Test Fuel Dump Chute Up-Limit Switch

A Equipment and Materials

- (1) Spoiler door lock - 571264, or equivalent

B Adjust Fuel Dump Chute Up-Limit Switch

- (1) Raise and lock inboard spoilers, using spoiler door lock.
- (2) Retract fuel dump chute and check that power is cut off actuator when closure panel fairs with lower wing surface
- (3) If closure panel does not fair, loosen lock nuts holding switch and move switch away from or toward closure panel as required.
- (4) Extend fuel dump chute.
- (5) Retract fuel dump chute and check closure panel fair
- (6) Unlock and lower inboard spoilers.



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FUEL DUMP CHUTE CLOSURE PANEL - MAINTENANCE PRACTICES

1 General

- A. The installation of a new fuel dump chute closure panel requires extreme care to ensure that the new panel fairs with the lower wing surface without exerting a load on any of the fuel system components.

2. Removal/Installation Fuel Dump Chute Closure Panel

- A. Deleted.

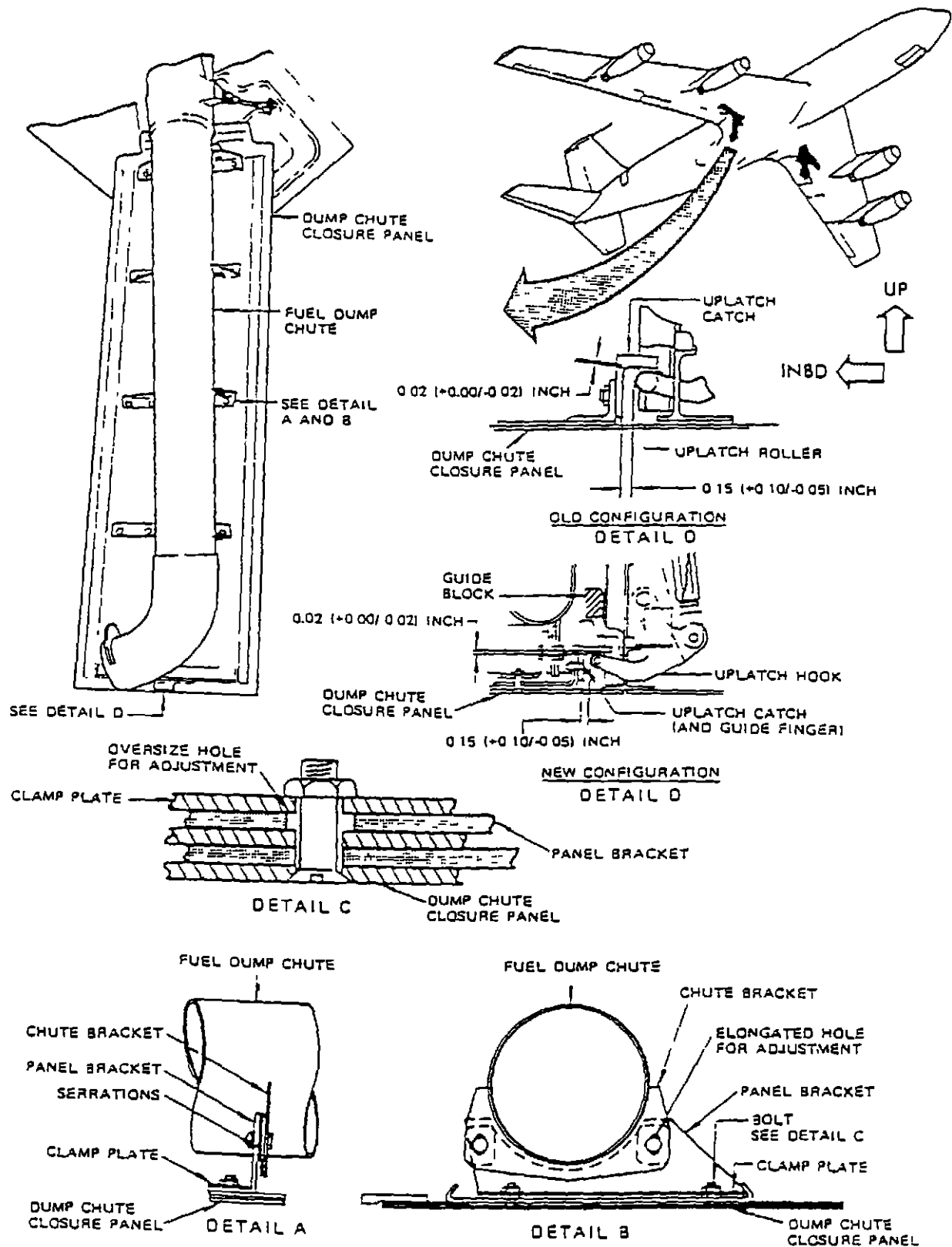
B. Remove Fuel Dump Chute Closure Panel

- (1) Connect external power to airplane.
- (2) Deleted.
- (3) Extend fuel dump chute.

NOTE: If chute cannot be extended, access to dump system components is from the rear of the wing and is gained by removing access panel No 1353. Refer to 12-2-0, "Access Doors and Panels."

- (4) Pull fuel dump system circuit breakers.
- (5) Remove bolts attaching panel brackets to chute brackets. (See figure 201.)
- (6) Lift closure panel clear of airplane.
- (7) Remove brackets from panel and save for installation.
- (8) Remove up-latch catch from panel and save for reinstallation.

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Fuel Dump Closure Panel Installation
Figure 201

C. Install Fuel Dump Chute Closure Panel

- (1) Remove access panel No. 1353. Refer to 12-2-0, "Access Doors and Panels."
- (2) Close fuel dump system circuit breakers.
- (3) Retract fuel dump chute until limit switch in dump chute actuator terminates retraction.
- (4) Pull fuel dump system circuit breakers.
- (5) Install brackets on panel, tighten nuts finger-tight only. (See figure 201.)
- (6) Place panel in position under wing, center panel in recess in lower wing surface and hold in faired position.
- (7) Install bolts attaching panel brackets to chute brackets, tighten finger-tight only.
- (8) Check fair of panel with lower wing surface.
- (9) If panel fairs with lower wing surface tighten all bolts.
- (10) If panel does not fair, loosen bolts through brackets and adjust brackets on serrations.
- (11) Tighten all bolts.
- (12) If panel cannot be faired by adjusting on serrations, adjust length of dump chute actuator rod till panel is faired.
- (13) Close fuel dump system circuit breakers.
- (14) Readjust dump chute up-limit switch. Refer to 28-22-0, "Adjustment/Test Fuel Dump System."
- (15) Extend and retract fuel dump chute.
- (16) Check fair of closure panel.
- (17) If panel does not fair repeat steps (4) and (10) through (16).
- (18) Pull fuel dump system circuit breakers.
- (19) Position up-latch catch on door to obtain dimensions shown in detail D and clamp in position with guide finger centralized in guide blocks.



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- (20) With up-latch actuator in the fully retracted position, check that up-latch catch will clear up-latch roller when chute is extended. If catch does not clear roller; loosen screws attaching dump chute closure panel to brackets and slide panel outboard until catch clears roller. Tighten panel attaching screws.
- (21) Drill up-latch catch bolt holes, install attaching bolts and remove clamps.
- (22) Close fuel dump system circuit breakers.
- (23) Extend and retract fuel dump chute.
- (24) Check that gap between top of up-latch roller and up-latch catch is $0.02 \pm 0.00 / -0.02$ inch, if not, adjust turbuckle on up-latch actuator to bring gap into tolerance.
- (25) Install access panel No. 1353.
- (26) Remove external power from airplane.



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FUEL DUMP CHUTE UP-LATCH ACTUATOR - REMOVAL/INSTALLATION

1. Prepare for Removal

- A. Connect external power to airplane
- B. Extend fuel dump chute.

NOTE: If chute cannot be extended, steps 2.A. through 2.D. must be performed from the rear of the wing. Access to the actuator is gained by removing access panel No. 1353. Refer to 12-2-0, "Access Doors and Panels."

- C. Disconnect external power from airplane
- D. Open fuel dump system circuit breakers.

2. Remove Fuel Dump Chute Up-Latch Actuator (See figure 401.)

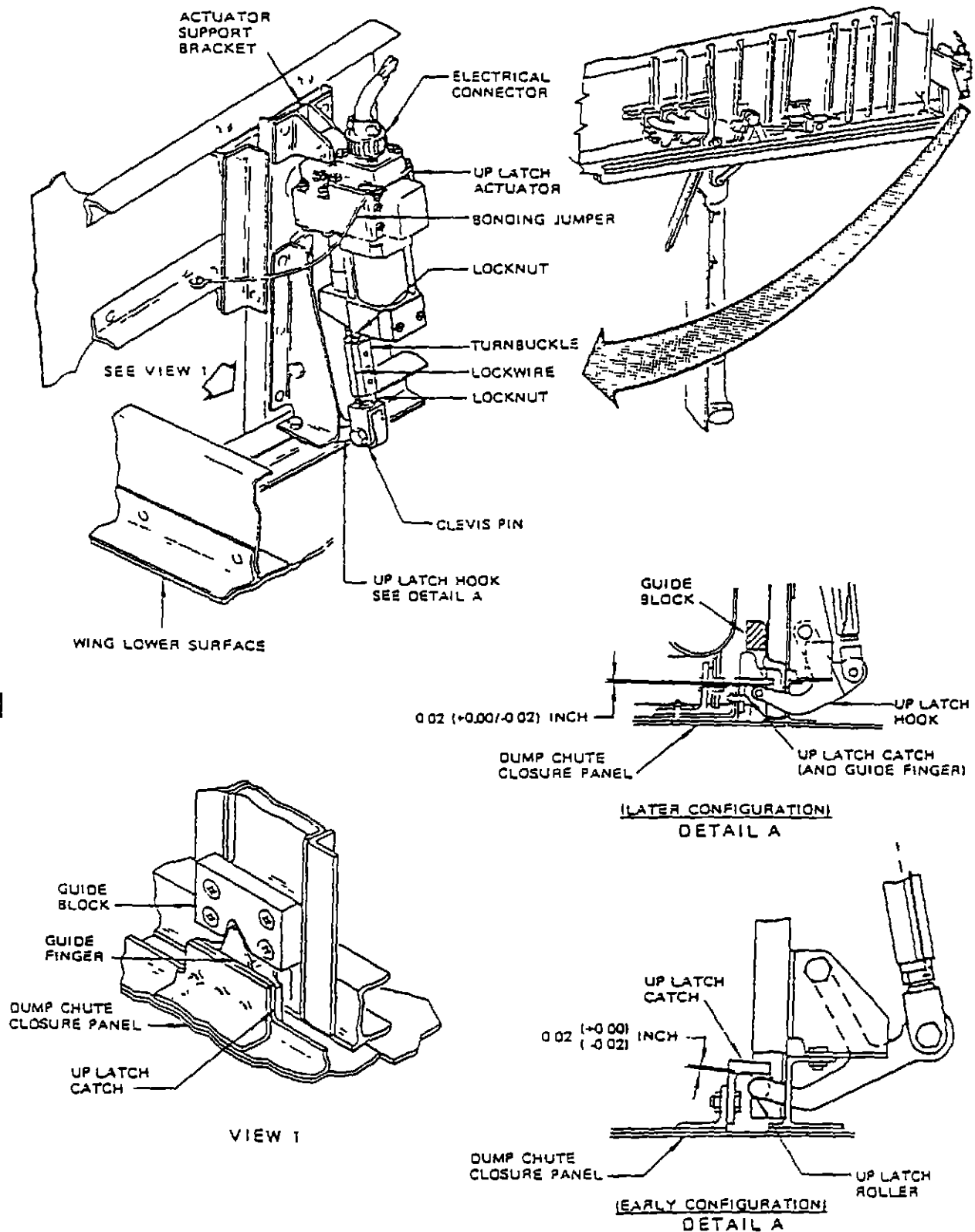
- A. Disconnect electrical connector from actuator.
- B. Disconnect bonding jumper at actuator.
- C. Remove cotter pin, washer and clevis pin at end of actuator rod.
- D. Remove cotter pin, washer and hinge pin from upper end of actuator.
Lift actuator clear of structure.

3. Install Fuel Dump Chute Up-Latch Actuator (See figure 401.)

- A. If new unit is being installed, shorten rod to minimum length by means of turnbuckle.
- B. Align actuator with support bracket and insert hinge pin, install washer and cotter pin.

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Fuel Dump Chute Up-Latch Actuator Installation
Figure 401



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- C Align rod end and up-latch hook and insert clevis pin, install washer and cotter pin
- D Connect electrical connector at actuator.
- E Connect bonding jumper at actuator
- F Connect external power to airplane.
- G Close fuel dump system circuit breakers.
- H Retract fuel dump chute.
- I Using turnbuckle adjust rod length to give a gap of 0.02 (+0.00/-0.02) inch between catch and up-latch roller.
- J Tighten locknuts and lockwire



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FUEL QUANTITY INDICATING SYSTEM - DESCRIPTION AND OPERATION

1 General

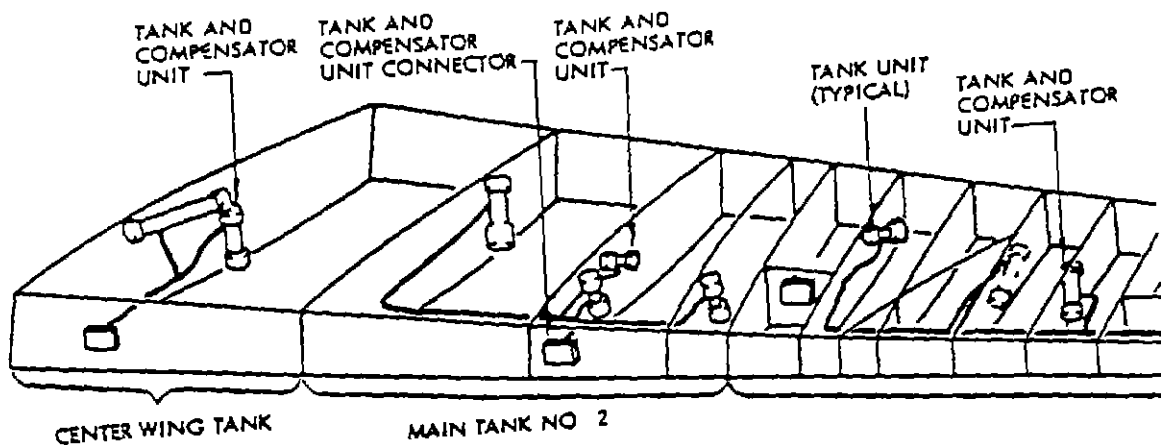
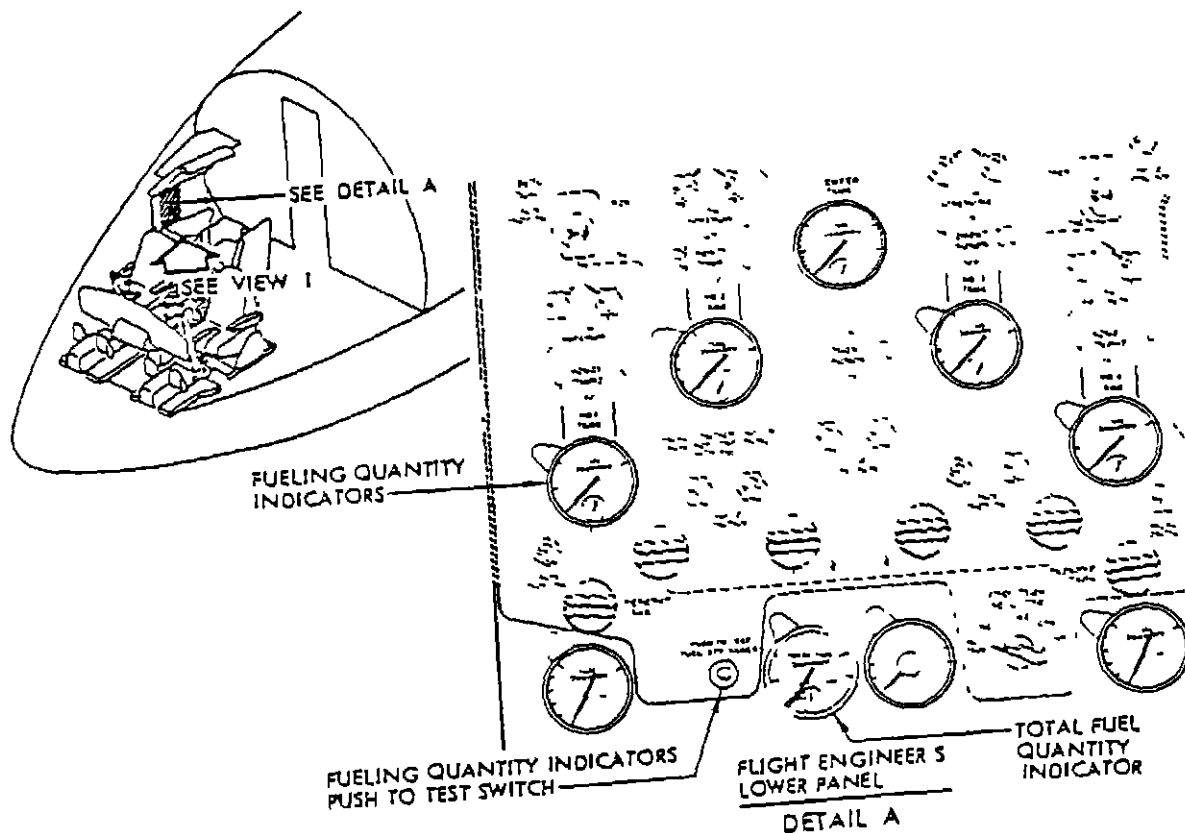
- A The fuel quantity indicating system shows the weight of the fuel aboard the airplane. The quantity in kilograms appears on indicators at the flight engineer's station. System components are located in the control cabin, fuel tanks and at the two fueling stations (See figure 1) Control cabin equipment consists of seven individual fuel quantity indicators, a signal summation unit, a total fuel quantity indicator, and a fuel quantity indicators push-to-test switch. Fuel tank components consist of tank units and compensator tank units
- B The overall system consists of seven individual systems, one for each tank. Each individual tank system consists of an indicator, a compensator tank unit, and tank units as required. Tank units for each tank are connected in parallel and positioned so that only usable fuel is measured. Fuel is the variable dielectric. Capacitance values in each tank are added to give a single capacitance value, which is transmitted to each fuel quantity indicator. The fuel quantity indicator shows continuously the weight of fuel remaining in each tank. A signal from each indicator is transmitted to the signal summation unit which gives an output signal to the total fuel quantity indicator. This shows a continuous reading of total usable fuel remaining

2 Tank Units

- A The tank units are variable capacitors located throughout each fuel tank to sense quantity of fuel in each tank. (See figure 1.) The tank unit consists of two concentric electrodes which are rigidly spaced at intervals throughout their length by insulating centering spacers. The inner electrode consists of a main body of insulating material with two separately insulated conducting surfaces around its outside face. One conducting surface is grounded, the other is connected to the amplifier input of the system bridge circuit. This conducting surface is proportionate to tank contour, so that the submerged conducting surface has a relation to fuel level in the tank. This conductive surface is profiled for accurate linear indication in the cruise flight attitude. Openings at each end of the unit permit fuel to assume the same level between the electrodes as that in the tank. Tank units are located so that errors due to airplane attitudes are kept to a minimum.

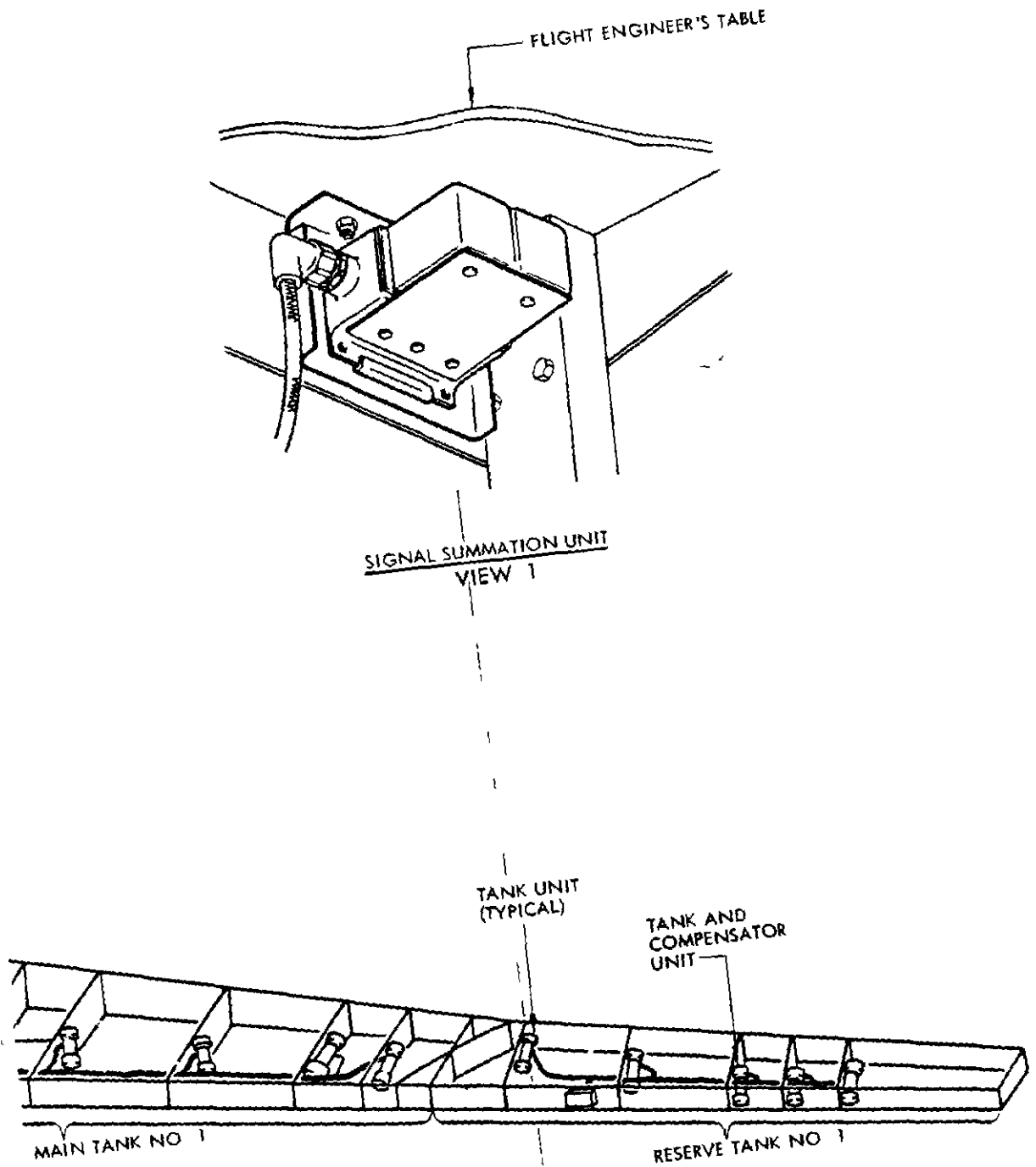
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Fuel Quantity Indicating System Equipment Location
 Figure 1 (Sheet 1)

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Fuel Quantity Indicating System Equipment Location
Figure 1 (Sheet 2)



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- B. Tank units are bolted to structure at the wing ribs. Electrical connections to tank units are made at the tank unit terminals. Tank unit leads, within a given tank, form a harness (two harnesses in wing center tank) which terminate at a connector on the front spar of the wing. There is one tank and compensator tank unit connector for each main and reserve tank; and two for the wing center tank. Access to tank units is made through fuel tanks access panel and rib access openings. Access to tank and compensator unit receptacles is made through wing leading edge access panels.
- C. Tank units in each tank are connected in parallel for sensing fuel quantity. The fuel is the variable dielectric. Capacitance of the tank units, in any one tank, add up to give a single capacitance which changes with fuel level and provides a continuous signal to the fuel quantity indicator.

3 Compensator Tank Units

- A. The compensator tank unit in each tank acts as a sensing element to maintain linear relationship between fuel dielectric properties and fuel density. (See figure 1.) Each compensator tank unit is composed of two independent capacitors, a tank unit and a compensator. The tank unit portion corresponds to the description given in the preceding paragraphs. The compensator portion consists of a group of concentric tubes spaced and insulated from each other by insulation spacers. The compensator is attached to the lower end of the tank unit and is situated at the lowest usable level of fuel. The access panels, connectors, and mountings for compensator tank units are the same as for tank units.
- B. The compensator portion of a compensator tank unit is part of the balance side of the capacitance bridge. Changes in temperature and fuel characteristics affect the capacitance of the compensator which is usually completely immersed in fuel. The compensator alters balance conditions for the bridge circuit to allow for these changes.



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4. Fuel Quantity Indicators

- A The fuel quantity indicators, located on the flight engineer's lower panel (figure 1), show weight of fuel in kilograms, in each of the seven fuel tanks. The indicator used for each individual tank indicating circuit consists of a self-balancing capacitance bridge circuit, a three-stage transistor amplifier, a reversible two-phase induction motor, gear trains, pointers, a main dial, and a vernier dial. All indicators are hermetically sealed and electrical connections are made through a plug at the rear of the indicator. Full and empty adjustment screws are located on the back of each indicator.
- B. The indicators use 115 volt ac power for the bridge and line phase of the induction motor. (See figure 2.) Indicator pointers are driven by the same shaft as the potentiometer wiper of the self-balancing bridge circuit and rotate with the wiper to provide continuous indication of fuel quantity. A signal from the balance potentiometer wiper of each individual tank system indicator is transmitted to the signal summation unit.
- C Indicator operation is tested with a fuel quantity indicators push-to-test switch located on the flight engineer's lower panel. The switch, when pressed, grounds the tank unit portion of the circuit for each fuel quantity indicator. This unbalances the bridge circuit and causes the indicator pointer to drive toward zero. When the switch is released, the dial pointers return to their original position.

5. Signal Summation Unit

- A. The signal summation unit sums balance voltage signals from each fuel quantity indicator and gives an output signal to the total fuel quantity indicator. The unit is a voltage summator consisting of two hermetically sealed ratio units. Each ratio unit contains either three or four voltage summing networks consisting of a tailored voltage divider for each individual tank system indicator. A cover plate on one side of the unit protects adjustment screws for the voltage dividers.
- B. The signal summation unit is mounted on a bracket underneath the flight engineer's table in the right rear corner. (See figure 1.)

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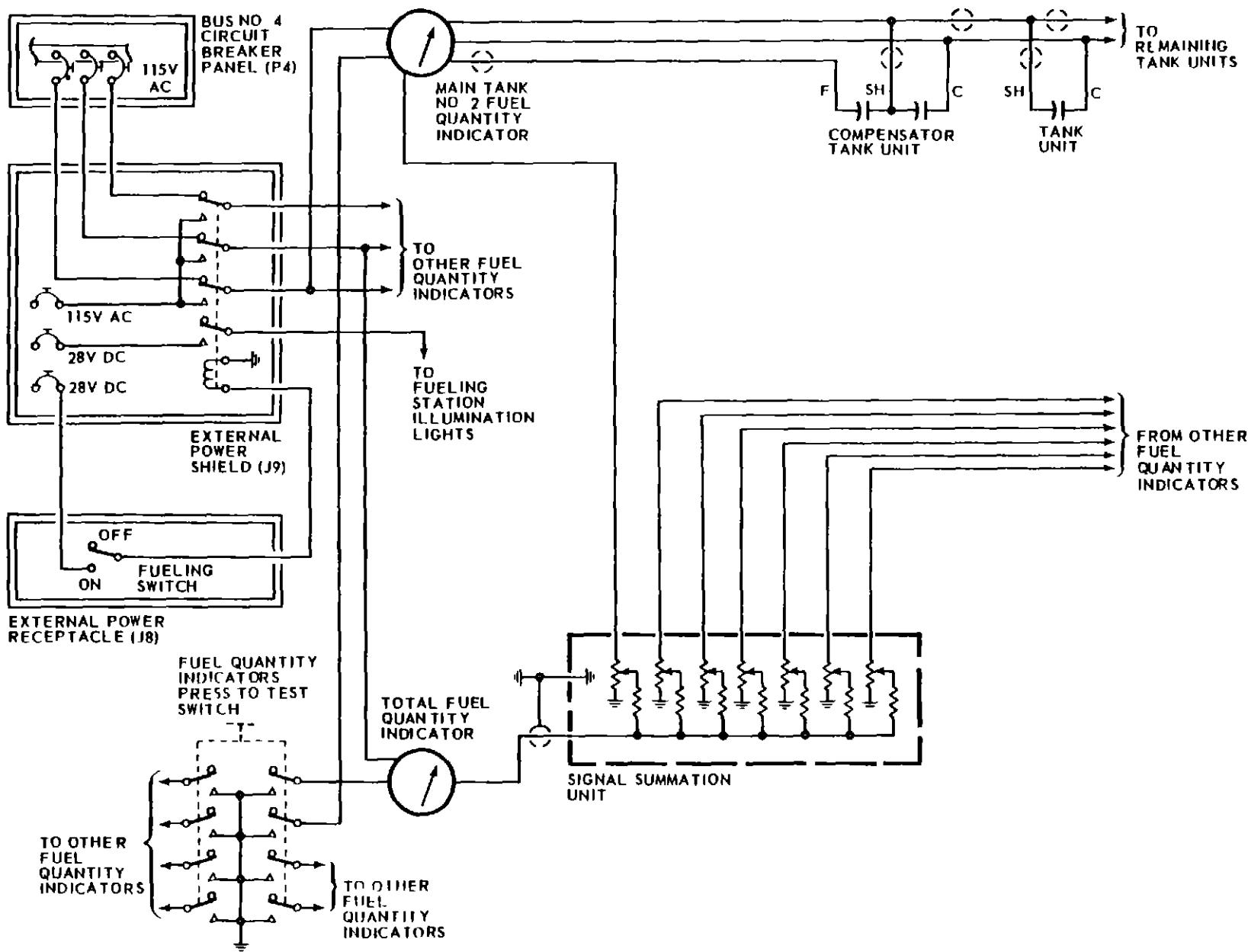
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6 Total Fuel Quantity Indicator

- A. The total fuel quantity indicator, located on the flight engineer's lower panel (figure 1) shows a total fuel quantity reading which is the sum of all individual fuel indicator readings. The indicator uses a resistance bridge circuit and balances signal summation output against a potentiometer arranged similarly to the motor-driven potentiometer in a fuel quantity indicator. (See figure 2.) The instrument has empty adjustment only.
- B. Total fuel quantity indicator operation can be tested with the fuel quantity indicators push-to-test switch on the flight engineer's lower panel. (See figure 1.) The switch, when closed, unbalances the bridge circuit in the indicator and causes the dial pointer to drive toward zero. When the switch is released, the dial pointer should return to its original position.

7. Operation

- A. Power for operation of the fuel quantity indicating system is 115 volt ac supplied through FUEL QUANTITY circuit breakers on ac bus No. 4 circuit breaker panel (P4) (See figure 2) Closing the circuit breakers delivers power to the individual tank system circuits and total fuel quantity indicator circuit through transformers in the indicators.
- B. The tank units act as variable capacitors. Their capacitance value is determined by fuel level and properties of the fuel. They are connected into a capacitance bridge so that current through the tank unit side of the bridge is compared to a current of opposite phase in the balancing side of the bridge. A change in fuel level alters capacitance value of the tank unit and causes unbalance in the bridge circuit which is detected by a phase sensitive amplifier. This amplifier controls an induction motor which moves a rebalance potentiometer wiper in the reference side of bridge until a null point is again established in the system. The indicator dial pointer is connected to the potentiometer wiper and shows a fuel quantity reading corresponding to the null balance point.



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Fuel Quantity Indicating System Circuit
 Figure 2



FUEL QUANTITY INDICATING SYSTEM - ADJUSTMENT/TEST

1 General

- A Fuel quantity indicating system adjustment/test consists of adjusting the indicators to empty and full values by means of adjustment screws on the indicators. Indicators are first adjusted to read zero, and then full adjustment is made by capacitance substitution.
- B. Adjustment of the fuel quantity indicating system can be accomplished by two methods, a preferred method or an alternate method. The preferred method requires the tanks to be empty. The alternate method allows the tanks to contain fuel.
- C. If the system adjustment values are not met, perform tank unit and compensator tank unit adjustment/test (Ref 28-41-11, Adjustment/Test) Then repeat system adjustment/test.

2 Equipment and Materials

A Testers:

- (1) Model GTF-2 P/N 361-012-001, Gull Airborne Instruments, Inc., 55 Engineer Road, Smithtown, New York, 11787

B. System Test Harness Sets

NOTE: Two complete sets are listed, but only one complete set is required for performing test.

- (1) No. UG292D-1, No. UG292D-2, and No. UG292D-3, Minneapolis Honeywell, Regulator Co., 2747 Fourth Ave., S., Minneapolis 8, Minnesota, and No. 1723, No. 1724 and No. 1725, Consolidated Airborne Systems, Inc., Carle Place, Long Island, New York.
- (2) No. 1593-1, No. 1593-2, No. 1593-3, No. UG274/U (2 required) and No. EJ114, Consolidated Airborne Systems, Inc., Carle Place, Long Island, New York.

C. Rubber stamp kit (numerals)

D. Cado pencil or Speedry type ink



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3. Adjust Fuel Quantity Indicating System - Preferred Method

A. Prepare for Adjustment

- (1) Connect external power to airplane.
- (2) Defuel airplane for adjustment of entire system or defuel applicable tank only. Refer to 28-0, Servicing Fuel System.

WARNING TO PREVENT POSSIBILITY OF EXPLOSION, DO NOT REMOVE ANY FUEL TANK ACCESS PANELS WHILE ELECTRICAL POWER IS BEING USED.

- (3) Pull fuel QTY circuit breaker on circuit breaker panel P4.
- (4) Check that fueling switch, on external power receptacle (J8), is in OFF position.
- (5) On flight engineer's lower panel, loosen fuel quantity indicator clamp screw and remove indicator from panel far enough to obtain access to indicator adjustment screws.
- (6) Remove dust caps from adjustment screws.
- (7) Install indicator on flight engineer's lower panel, but do not tighten clamp screw.
- (8) Repeat steps (5) through (7) for other fuel quantity indicators and total fuel quantity indicator.
- (9) Position fueling switch, on external power receptacle (J8), to ON.
- (10) Allow systems five minutes warmup time.

B. Adjust System to Read Zero

- (1) Adjust each fuel quantity indicator to read zero by means of empty adjustment screw at rear of indicator.

NOTE: Due to gear train backlash, adjust to zero in an increasing quantity direction.

- (2) Adjust total fuel quantity indicator to read zero.
- (3) Press fuel quantity indicator PUSH-TO-TEST switch. Observe that all fuel quantity indicator pointers move in counterclockwise direction.

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- (4) Release P.U.H-TO-TEST switch. Observe that all indicator pointers return to their original positions.
- (5) If any indicator pointer does not return to adjusted zero position after press-to-test operation, repeat steps (1) or (2) and (3) and (4).

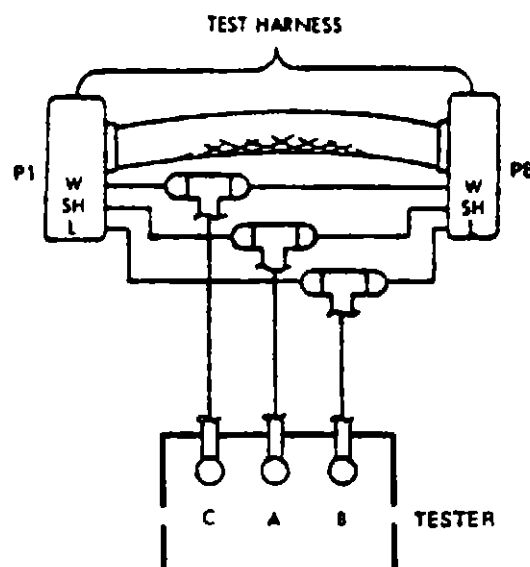
C. Determine Test Harness Stray Capacitance

- (1) Connect test harness to tester as shown in Fig. 501.

NOTE Connect BNC adapters to tester before connecting to test harness.

- (-) Determine COMP and UNSH stray capacitance of test harness. The capacitance shall measure 0.55 uuf or less.

TANK INDICATOR	TEST HARNESS	
Wing Center Tank	UG292D-2	1593-2
Main Tank No. 2 or 3	UG292D-3	1593-3
Main Tank No. 1 or 4	UG292D-2	1593-2
Reserve Tank No. 1 or 4	UG292D-1	1593-1



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Connections to Determine Test Harness Stray Capacitance
Figure 501

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D. Determine Tank Unit (UNSH) and Compensator (COMP) Capacitance

- (1) Connect test harness to tester as shown in Fig. 502.

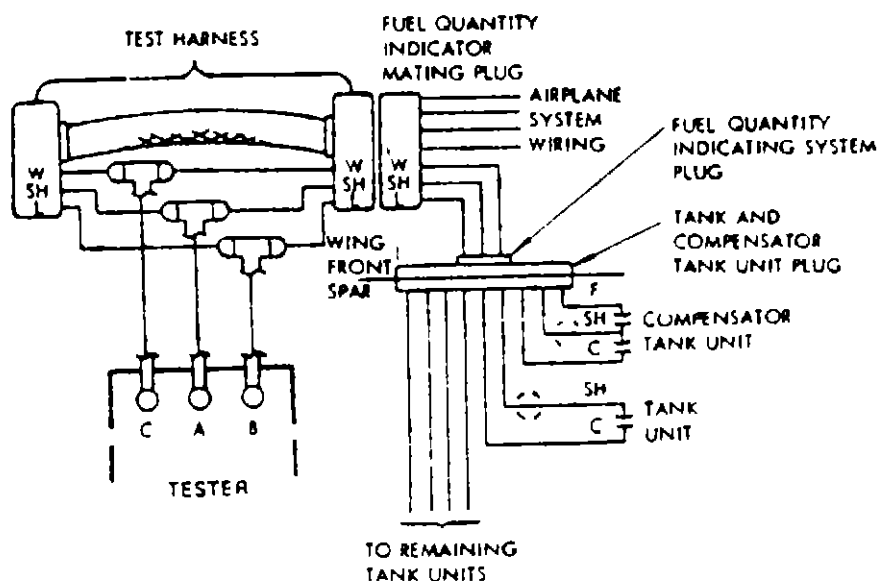
NOTE Connect adapters to tester before connecting to test harness.

- (2) Determine tank units and compensator UNSH and COMP capacitance and record values as (B1) and (C1) respectively. Values shall not be less than the following

System Minimum Empty Capacitance values (uuf)		
	Tank Units (UNSH)	Compensator (COMP)
Wing Center Tank	347.3	65.9
Main Tank No. 2 or 3	225.9	65.9
Main Tank No. 1 or 4	234.3	65.9
Reserve Tank No. 1 or 4	169.7	65.9

E. Determine Test Harness and Airplane Wiring (External to Tank) Stray Capacitance.

- (1) Disconnect applicable tank and compensator unit connector plug (two for center tank) at wing front spar.



Test Connections for Measurement of Tank Unit and Compensator Empty Capacitance

Figure 502

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- (2) Determine the test harness and airplane wiring (external to tank) UNSH and COMP stray capacitance with tester. Record these values as (B2) and (C2) respectively

F. Determine System Increased Capacitance

- (1) Subtract value (B2), recorded in step 3.E.(3), from value (B1), recorded in step 3.D.(2). Record this value (tank unit UNSH empty capacitance plus tank internal wiring stray capacitance) as (B). Value (B) shall not be less than shown in step 3.D.(2).
- (2) Subtract value (C2), recorded in step 3 E.(3), from value (C1), recorded in step 3.D.(2). Record this value (compensator COMP empty capacitance plus tank internal wiring stray capacitance) as (C). Value (C) shall not be less than 65.9.
- (3) Multiply value (B) by multiplication factor given as follows. The product is capacitance increase of the system to change indication from empty to full scale. Record as INCREASED CAPACITANCE.

Fuel Quantity Indicator	Multiplication Factor to Obtain Tank Unit Increase in Capacitance Between Empty and Full		Compensator Increased Capacitance When Immersed (uuf)		Fuel Quantity Indicator Full Scale Reading (kilograms)
	Kerosene	JP-4	Kerosene	JP-4	
Wing Center Tank	1.2175	1.2097	75.7	71.9	34,000
Main Tank No. 2 or 3	1.1753	1.1678	75.7	71.9	13,000
Main Tank No. 1 or 4	1.1179	1.1106	75.7	71.9	7,000
Reserve Tank No 1 or 4	1.2608	1.2534	75.7	71.9	1,500

- (4) Connect fuel quantity indicating system plug (two for center tank) to tank unit and compensator tank unit plug at wing front spar.

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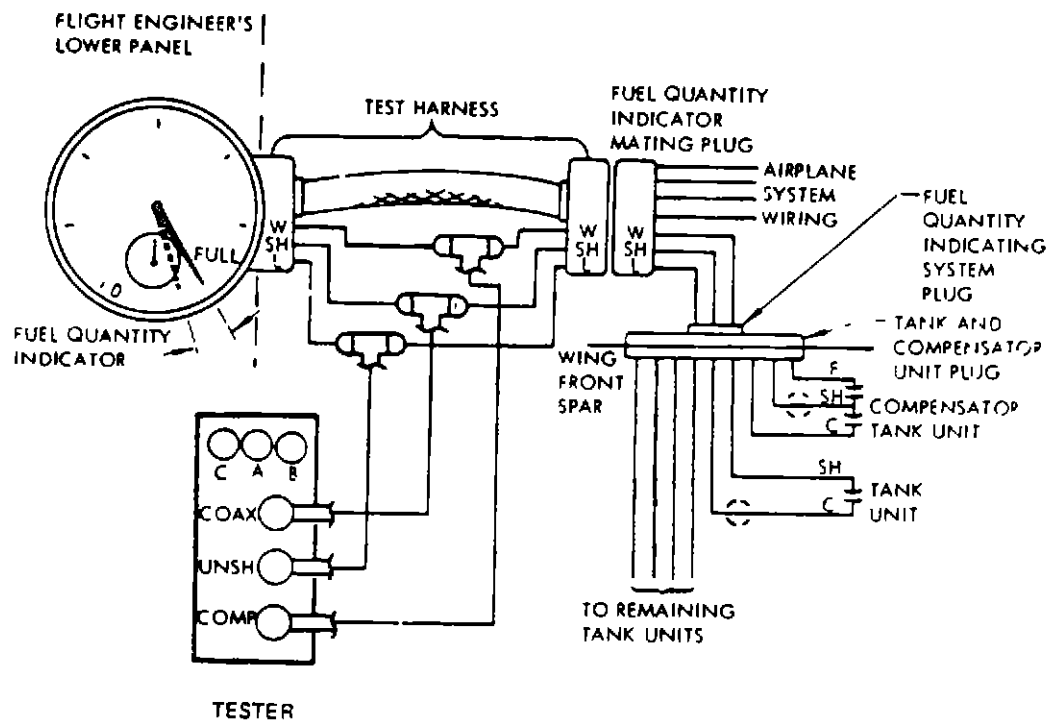
G. Adjust Indicator to Read Full

- (1) Connect test harness to tester as shown in figure 503.
- (2) Position fueling switch to ON.
- (3) Adjust tester compensator unit variable capacitor COMP to COMPENSATOR INCREASED CAPACITANCE given in step 3.F (3).
- (4) Adjust tester tank unit variable capacitor PROBE to INCREASED CAPACITANCE recorded in step 3.F (3). Adjust indicator to FULL SCALE reading given in step 3.F (3) using full adjustment screw at rear of indicator.
- (5) Position fueling switch to OFF.
- (6) Disconnect test harness and connect indicator plug to indicator.

H. Check System Adjustment

- (1) Position fueling switch to ON.
- (2) Check indicator adjustment:
 - (a) If indicator reads on zero graduation within ± 50 kilograms for wing center tank and ± 25 kilograms for all other tanks, system is adjusted properly.
 - (b) If indicator is not within limits, adjust indicator to read zero by means of empty adjustment screw and perform steps (3) through (6).
- (3) Position fueling switch to OFF.

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Test Connections for Full Scale Indication
Figure 503

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- (4) Connect test harness and tester in circuit as shown in figure 503.
- (5) Position fueling switch to ON.
- (6) Repeat steps 3.G.(3) through 3.H.(2) until empty adjustments and full adjustment do not affect one another.

I. Record Capacitance Data on Indicator

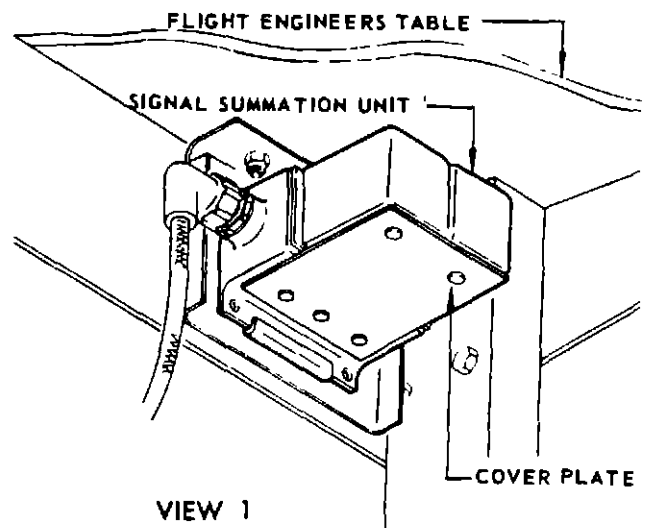
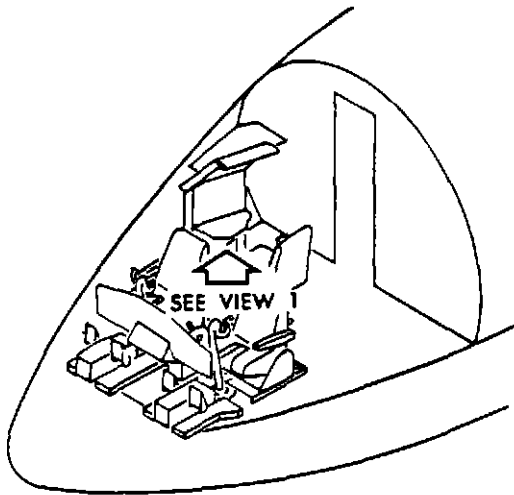
- (1) Position fueling switch to OFF.
- (2) Disconnect test harness and tester from circuit. Do not connect indicator plug to indicator.
- (3) Install dust caps on indicator adjustment screws.
- (4) Record following capacitance on metal-cls provided using rubber stamp and Cado pencil or Speedry type A ink:
 - (a) EMPTY: Empty Capacitance (B1) of step 3.D.(2)
 - (b) ADDED: Increased Capacitance of step 3.F.(3)
 - (c) FULL: Sum of EMPTY and ADDED
 - (d) COMP ADDED: Compensator Increased Capacitance of step 3.F.(3)
 - (e) COMP IN FUEL: Value (C1) of step 3.D.(2) plus COMP ADDED
- (5) Connect indicator plug to indicator.
- (6) Install indicator on flight engineer's lower panel but do not tighten clamp screw.
- (7) Repeat steps 3.C.(1) through 3.I.(6) for other fuel quantity indicators.



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J. Adjust Total Fuel Quantity Indicator

- (1) Remove total fuel quantity indicator from flight engineer's lower panel, install adjustment screw dust cap, install indicator on panel and tighten clamp screw.
- (2) Connect test harness and tester in an individual tank fuel quantity indicator circuit as shown in figure 503.
- (3) Position fueling switch to ON.
- (4) Adjust tester compensator unit variable capacitor COMP to Compensator Increased Capacitance shown in step 3.F (3).
- (5) Adjust tester tank unit variable capacitor PROBE to Increased Capacitance recorded in step 3.F.(3). Corresponding fuel quantity indicator shall show full scale reading.
- (6) Remove adjustment cover plate from signal summation unit. (See figure 504.)





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- (7) Adjust applicable channel of signal summation unit to give reading on total fuel quantity indicator equal to full scale reading on individual tank indicator.
- (8) Position fueling switch to OFF.
- (9) Remove test harness and tester from circuit and connect indicator plug to indicator.
- (10) Install indicator on flight engineer's lower panel and tighten clamp screw.
- (11) Repeat steps 3.J.(2) through 3.J.(10) for other individual tank fuel quantity indicators.

K. Perform System Final Check

- (1) Close fuel QTY circuit breaker on circuit breaker panel P-4.
- (2) Press fuel quantity indicator PUSH-TO-TEST switch. Observe that all fuel quantity indicator pointers move in counterclockwise direction.
- (3) Release PUSH-TO-TEST switch. Observe that all indicator pointers return to their original positions.
- (4) Determine whether there is any further need for electrical power on airplane, if not, remove external power.

4. Adjust Fuel Quantity Indicating System - Alternate Method

A. Prepare for Adjustment

- (1) Connect external power to airplane
- (2) Pull fuel QTY circuit breaker on circuit breaker panel P-4
- (3) Check that fueling switch, on external power receptacle (J8), is in OFF position.



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B. Adjust Fuel Quantity Indicator to Empty and Full Values

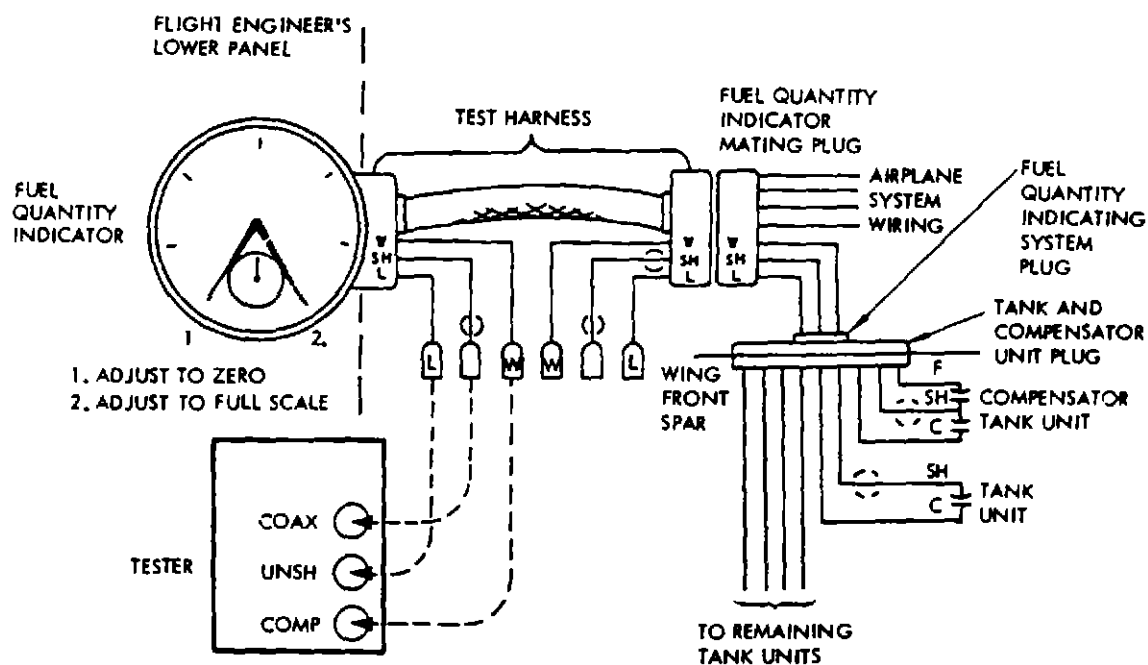
- (1) On flight engineer's lower panel, loosen fuel quantity indicator clamp screw, remove indicator from panel and disconnect indicator plug.
- (2) Remove dust caps from indicator adjustment screws.
- (3) Connect the following test harness and tester in circuit as shown in figure 505.

TANK INDICATOR	TEST HARNESS
Wing Center Tank	1593-2
Main Tank No. 2 or 3	1593-3
Main Tank No 1 or 4	1593-2
Reserve Tank No 1 or 4	1593-1

- (4) Position fueling switch to ON
- (5) Adjust tester compensator variable capacitor COMP to 67.5 uuf.
- (6) Adjust tester tank unit variable capacitor PROBE to EMPTY CAP as marked on back of indicator.
- (7) Adjust indicator to read zero
- (8) Adjust tester compensator unit variable capacitor COMP to COMP IN FUEL as marked on back of indicator.
- (9) Adjust tester tank unit variable capacitor to FULL CAP as marked on back of indicator.
- (10) Adjust indicator to FULL SCALE reading given in step 3.F (3), using full adjustment screw at rear of indicator.
- (11) Repeat steps (5) through (10) until empty adjustment and full adjustment do not affect one another.
- (12) Position fueling switch to OFF.
- (13) Disconnect test harness and tester from circuit.
- (14) Install dust caps on indicator adjustment screws.

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- (15) Connect plug to indicator, install indicator on flight engineer's panel and tighten clamp screw.
- (16) Repeat steps (1) thru (15) for other fuel quantity indicators.
- (17) Close fuel QTY circuit breaker on circuit breaker panel P-4.
- (18) Press fuel quantity indicator push-to-test switch. Observe that all fuel quantity indicator pointers move in counterclockwise direction.
- (19) Release push-to-test switch. Observe that all indicator pointers return to their original positions.
- (20) Determine whether there is any further need for electrical power on airplane, if not, remove external power.



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Test Connections - Alternate Method of System Calibration

Figure 505

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FUEL QUANTITY INDICATING SYSTEM - INSPECTION/CHECK

1. General

- A. This procedure contains instructions to do a visual inspection of the fuel quantity indicating system.

2. Fuel Quantity Indicating System - Inspection

A References

- (1) SWPM 20-20-00, Electrical Bonds and Grounds

B. Equipment

- (1) Maintenance mats, commercially available

C. Procedure

- (1) Defuel all the fuel tanks (AMM 28-0/201).
- (2) Do the "Purging (Air Ventilating)" procedure (AMM 28-0/201).
- (3) Gain access to the fuel tank.
- (4) Visually inspect the in-tank FQIS wire harness for the following:
- (a) Abraded or cracked insulation.
 - (b) Broken, loose, or missing support clamps and bonding jumpers.
 - (c) Incorrectly routed wiring.
 - (d) Loose or bent connectors.
 - (e) Corrosion at wire terminals and connectors.
 - (f) Inspect electrical connectors and seals for damage, wear or fuel leakage.
- (5) Visually inspect the in-tank FQIS tank units and compensators for the following:
- (a) Missing end caps on the tank units or compensators.
 - (b) Tank units or compensators contacting structure.
 - (c) Loose or corroded mounting brackets and hardware.
 - (d) Bent terminals
 - (e) Compensator flapper valve touching the compensator
- (6) Make sure the fuel tank is clean.



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- (7) Install structural members at rib access openings if removed and install fuel tank access panels.
- (8) Refuel all the fuel tanks (AMM 12-1-41/201).
- (9) Make sure there are no fuel leaks (AMM 28-2-0/101)
- (10) Put the airplane back to a serviceable condition.



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TANK UNIT AND COMPENSATOR TANK UNIT - REMOVAL/INSTALLATION

1. General

- A. The removal/installation of the tank units and compensator tank units are basically the same, the differences are in locations and access openings, shown in figure 401.

2. Prepare for Tank Unit or Compensator Tank Unit Removal

- A. Defuel and purge applicable fuel tank. Refer to 28-0, Servicing Fuel System.
- B. Pull fuel QTY indicating system circuit breakers on circuit breaker panel p4.
- C. Obtain access to tank or compensator tank unit through applicable fuel tank access panel opening and rib access openings. (See figure 401.) Remove access panel per 28-2-1, Fuel Tank Access Panels - Maintenance Practices.

3. Remove Tank Unit or Compensator Tank Unit

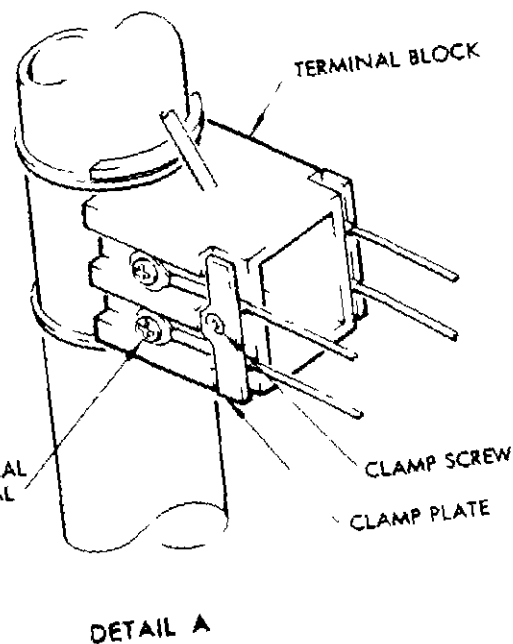
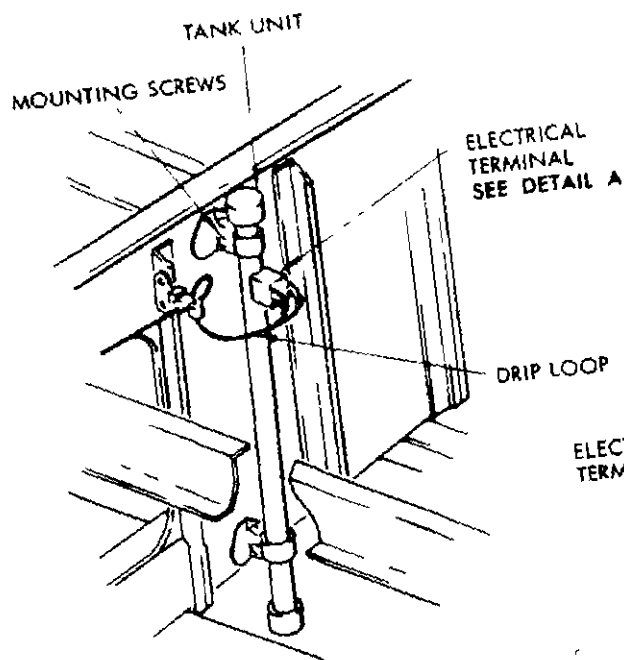
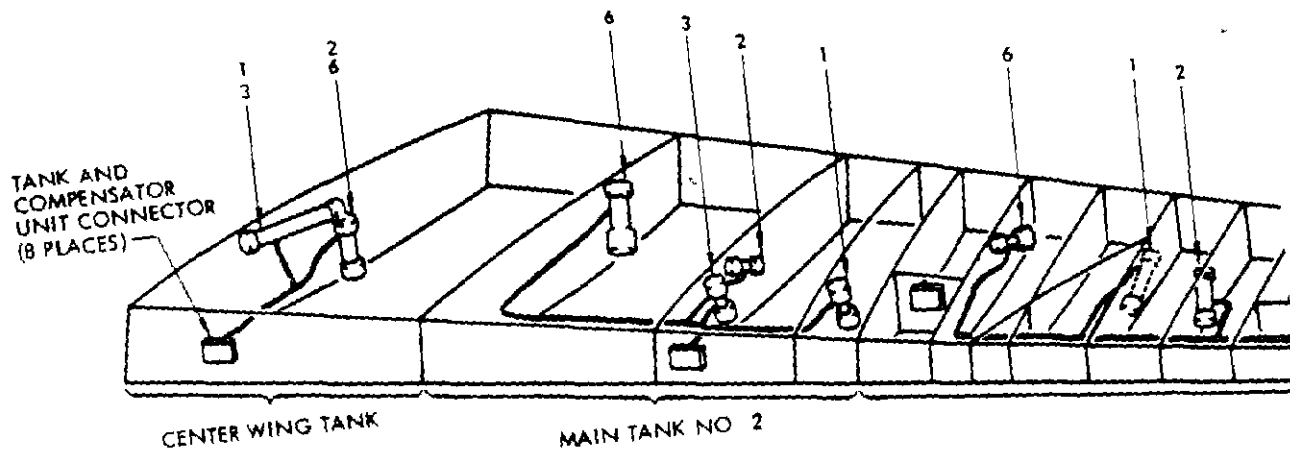
- A. Loosen clamp screw on terminal block clamp plate and rotate clamp plate 90 degrees.
- B. Disconnect leads from unit.
- C. Remove unit mounting screws and remove unit.

CAUTION: HANDLE UNITS WITH CARE. DROPPING CAN DAMAGE CAPACITANCE CHARACTERISTICS OF UNIT.

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CENTER WING TANK	
TANK UNIT NO. 1	LEFT WING
TANK UNIT NO. 2	LEFT WING
TANK UNIT NO. 3	RIGHT WING
COMPENSATOR TANK UNIT NO. 6	RIGHT WING

MAIN TANKS NO. 2 OR 3	
TANK UNIT NO. 1	
TANK UNIT NO. 2	
TANK UNIT NO. 3	
COMPENSATOR TANK UNIT NO. 6	

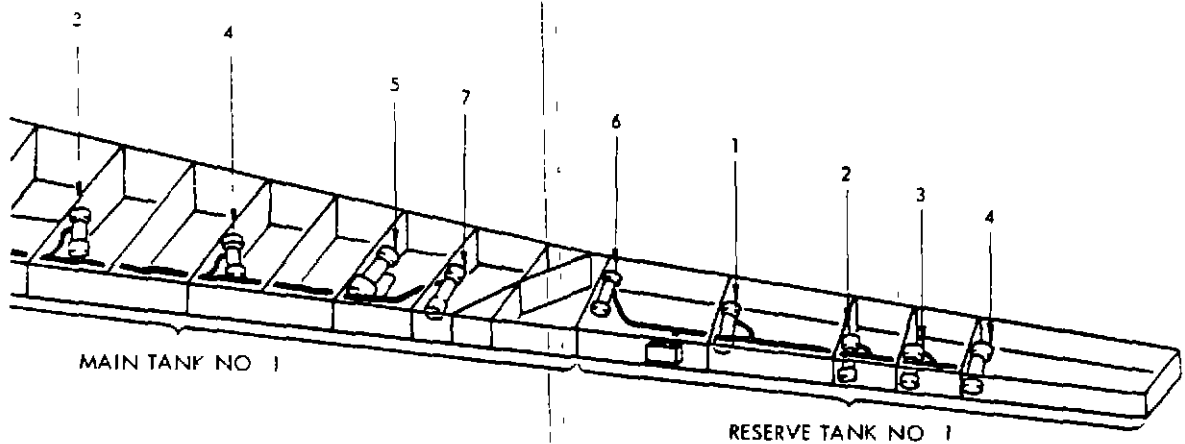


Tank Unit and Compensator Tank Unit Location and Access
Figure 401 (Sheet 1)

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MAIN TANKS NO. 1 OR 4	
TANK UNIT NO. 1	
TANK UNIT NO. 2	
TANK UNIT NO. 3	
TANK UNIT NO. 4	
TANK UNIT NO. 5	
COMPENSATOR TANK UNIT NO. 6	
TANK UNIT NO. 7	

RESERVE TANKS NO. 1 OR 4	
TANK UNIT NO. 1	
TANK UNIT NO. 2	
TANK UNIT NO. 3	
TANK UNIT NO. 4	
COMPENSATOR TANK UNIT NO. 6	



COMPONENT	FUEL TANK ACCESS PANEL (FIGURE 2 28-2-0)	RIB ACCESS OPENING (FIGURE 3 28-2-0)
RESERVE TANKS NO. 1 OR 4		
TANK UNIT NO. 1	17	--
TANK UNIT NO. 2	19	--
TANK UNIT NO. 3	20	--
TANK UNIT NO. 4	21	--
COMPENSATOR TANK UNIT NO. 6	15	--
MAIN TANKS NO. 1 OR 4		
TANK UNIT NO. 1	5	13
TANK UNIT NO. 2	5	--
TANK UNIT NO. 3	8	--
TANK UNIT NO. 4	10	--
TANK UNIT NO. 5	12	--
COMPENSATOR TANK UNIT NO. 6	4	--
TANK UNIT NO. 7	12	--
MAIN TANKS NO. 2 OR 3		
TANK UNIT NO. 1	4	--
TANK UNIT NO. 2	2	--
TANK UNIT NO. 3	4	4
COMPENSATOR TANK UNIT NO. 6	4	3 & 4
CENTER WING TANK		
TANK UNIT NO. 1 (LH)	1 (LH)	1
TANK UNIT NO. 2 (LH)	1 (LH)	1
TANK UNIT NO. 3 (RH)	1 (RH)	1
COMPENSATOR TANK UNIT NO. 6	1 (RH)	1



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4. Install Tank Unit or Compensator Tank Unit

- A. Position tank or compensator tank unit as shown in figure 401, and install mounting screws.

NOTE: It is necessary for unit to have a drip loop as shown in illustration. Water droplets tend to accumulate on lead and run down on unit terminals. Drip loop is used to prevent this.

- B Connect leads to unit using screws and washers per the following table:

NOTE. Screw size engraved on end face of terminal block. Use the torque ratings shown.

WIRE COLOR	FUNCTION AND SCREW SIZE	TORQUE (POUND INCHES)		WASHER P/N
		MAX.	MIN.	
BLUE	COMP 4-40	3	2	AN960C4
WHITE	HI-Z 6-32	8	6	AN960C6
BLACK	CRD 8-32	18	14	AN960C8
RED	LO-Z 10-32	25	20	NAS620-10L

- C. Rotate clamp plate and tighten clamp screw, making sure wire is in terminal block groove and sleeving is under clamp plate.
- D. Install fuel tank access panel. Refer to 28-2-1, Fuel Tank Access Panels - Maintenance Practices.

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TANK UNIT AND COMPENSATOR TANK UNIT - ADJUSTMENT/TEST

1 Tank Unit and Compensator Tank Unit Test

A. Equipment and Materials

- (1) Tester, Model GTF-2 P/N 361-012-001, Gull Airborne Instruments, Inc.,
Smithtown, New York, 11787
- (2) Test Harness F72731-81
- (3) Dry, warm air source (explosion proof)

B. Prepare Tank Unit and Compensator Tank Unit for Test

- (1) Defuel airplane or defuel applicable fuel tank only, and drain
sump fuel (Ref 28-0, Servicing Fuel System - Maintenance Practices).

WARNING TO PREVENT POSSIBILITY OF EXPLOSION, DO NOT REMOVE ANY
FUEL TANK ACCESS PANELS WHILE ELECTRICAL POWER IS BEING
USED.

- (2) At wing front spar, remove applicable tank and compensator tank
unit plug attaching bolts (Fig. 501).
- (3) Disconnect plug.

CAUTION. BE EXTREMELY CAREFUL WITH CONNECTOR PINS AND/OR SOCKETS.
CONNECTOR RECEPTACLE IS PART OF TANK WIRING HARNESS.
DAMAGE TO RECEPTACLE WILL NECESSITATE REMOVAL OF COMPLETE
ASSEMBLY.

C. Test Tank Unit and Compensator Tank Unit Resistance and Capacitance.



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- (1) Connect test harness plug to tank and compensator tank unit receptacle
- (2) Secure test harness plug in place using two mounting bolts.
- (3) Connect tester to test harness
- (4) Measure insulation resistance of each tank unit and compensator tank unit. Resistance shall not be less than shown in figure 502, Table A

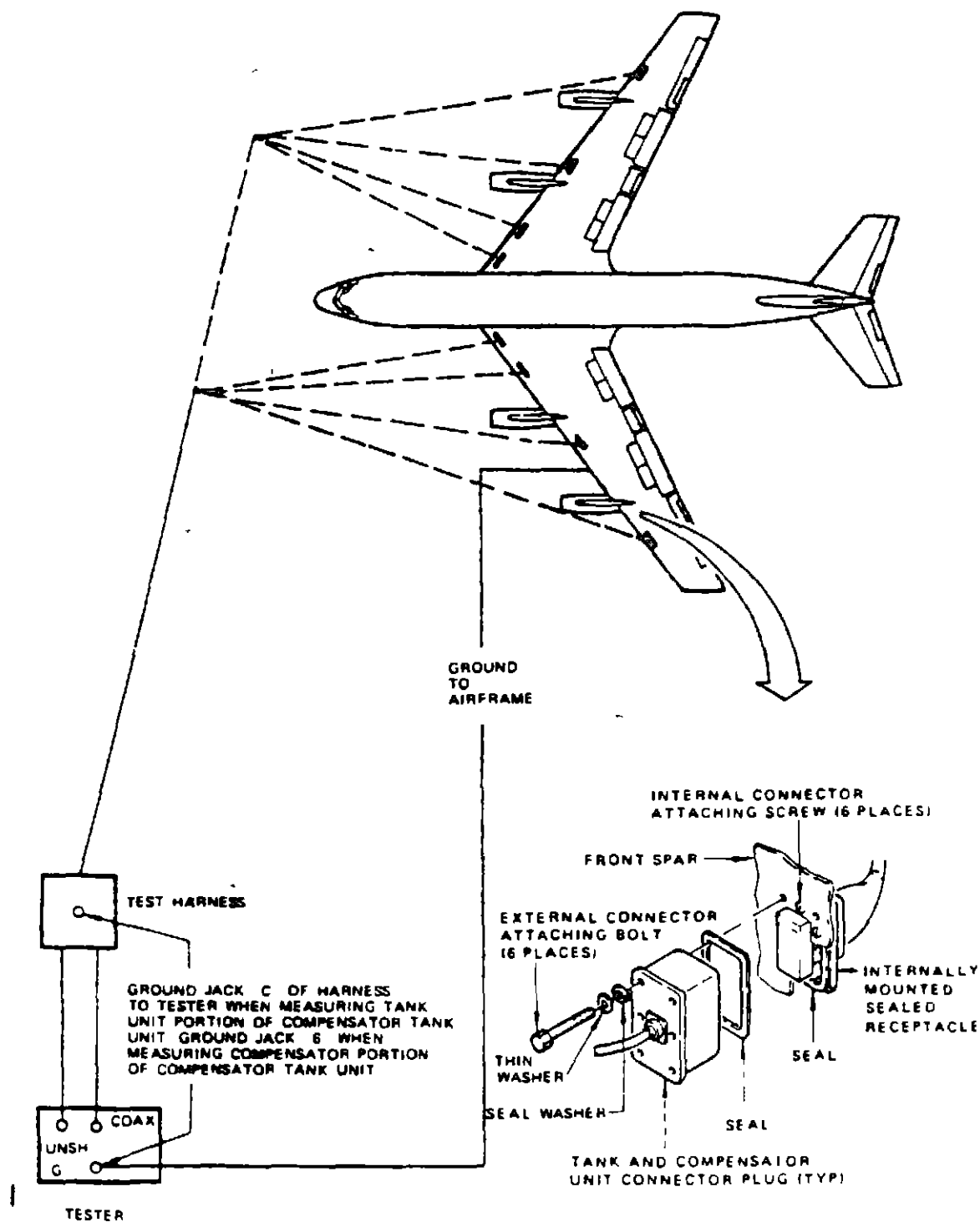
NOTE If minimum resistance values cannot be met, measure resistance with three terminal megohmmeter.

- (5) Measure capacitance of each tank unit and compensator tank unit. Capacitance should be as shown in figure 502, Table B.
- (6) Remove test harness plug securing bolts
- (7) Remove test harness plug.

CAUTION BE EXTREMELY CAREFUL WITH CONNECTOR PINS AND/OR SOCKETS. CONNECTOR RECEPTACLE IS PART OF TANK WIRING HARNESS. DAMAGE TO RECEPTACLE WILL NECESSITATE REMOVAL OF COMPLETE ASSEMBLY.

- (8) Clean front spar connector and receptacle mating surfaces. Dry with warm air
- (9) Fit new seal into groove of front spar connector and plug connector into receptacle
- (10) Install a thin washer, then a seal washer on each attaching bolt, and install attaching bolts. See figure 501.
- (11) Repeat steps 1 B (2) thru 1.C (10) for other fuel tanks

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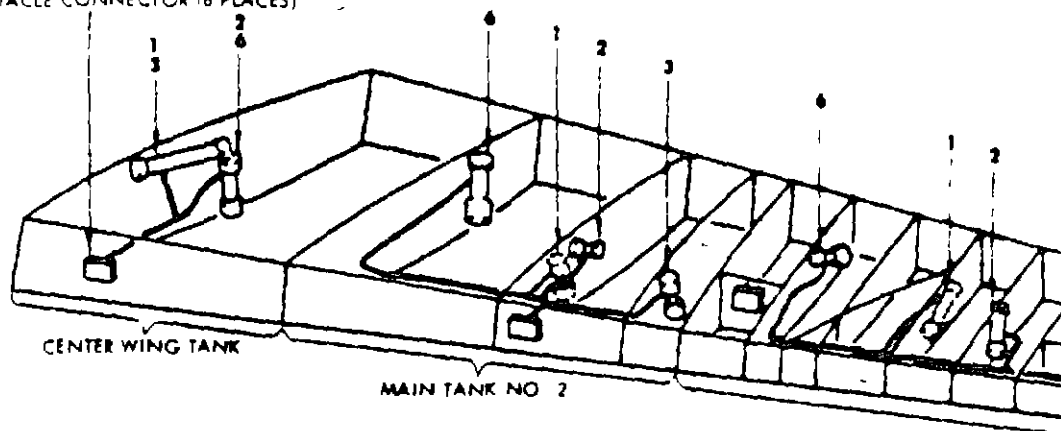




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MAIN TANKS NO. 1 OR 2
TANK UNIT NO. 1
TANK UNIT NO. 2
TANK UNIT NO. 3
COMPENSATOR TANK UNIT NO. 4

TANK AND COMPENSATOR UNIT
RECEPTACLE CONNECTOR (8 PLACES)



CENTER WING TANK
TANK UNIT NO. 1 RIGHT WING
TANK UNIT NO. 2 LEFT WING
TANK UNIT NO. 3 LEFT WING
COMPENSATOR TANK UNIT NO. 4 RIGHT WING

TABLE A				
COMPONENT	FROM	TO	WIRE POSITION/CH. TER	ALT. DIM. (INCH)
TANK UNIT	INNER ELECTRODE	ROUND	A TO F D	5
	OUTER ELECTRODE	GROUND	B TO C D	
	INNER ELECTRODE	OUTER ELECTRODE	A TO B	10
COMPENSATOR TANK UNIT	INNER ELECTRODE	INNER ELECTRODE	A TO B	
	INNER ELECTRODE	GROUND	B TO D	

TR 28-202

Tank Unit and Compensator Tank Unit

Spacelance and Resistance Values

Figure 502 (Sheet 1)

17

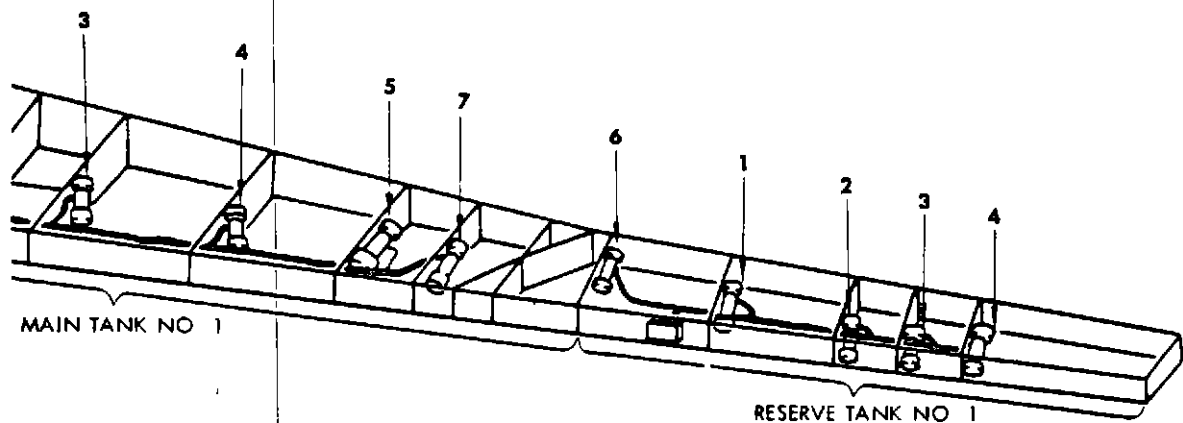
May 20/76

SN REV. December 27, 1978

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MAIN TANKS NO 1 OR 4	
TANK UNIT NO 1	
TANK UNIT NO 2	
TANK UNIT NO 3	
TANK UNIT NO 4	
TANK UNIT NO 5	
COMPENSATOR TANK UNIT NO 6	
TANK UNIT NO 7	

RESERVE TANKS NO 1 OR 4	
TANK UNIT NO 1	
TANK UNIT NO 2	
TANK UNIT NO 3	
TANK UNIT NO 4	
COMPENSATOR TANK UNIT NO 6	



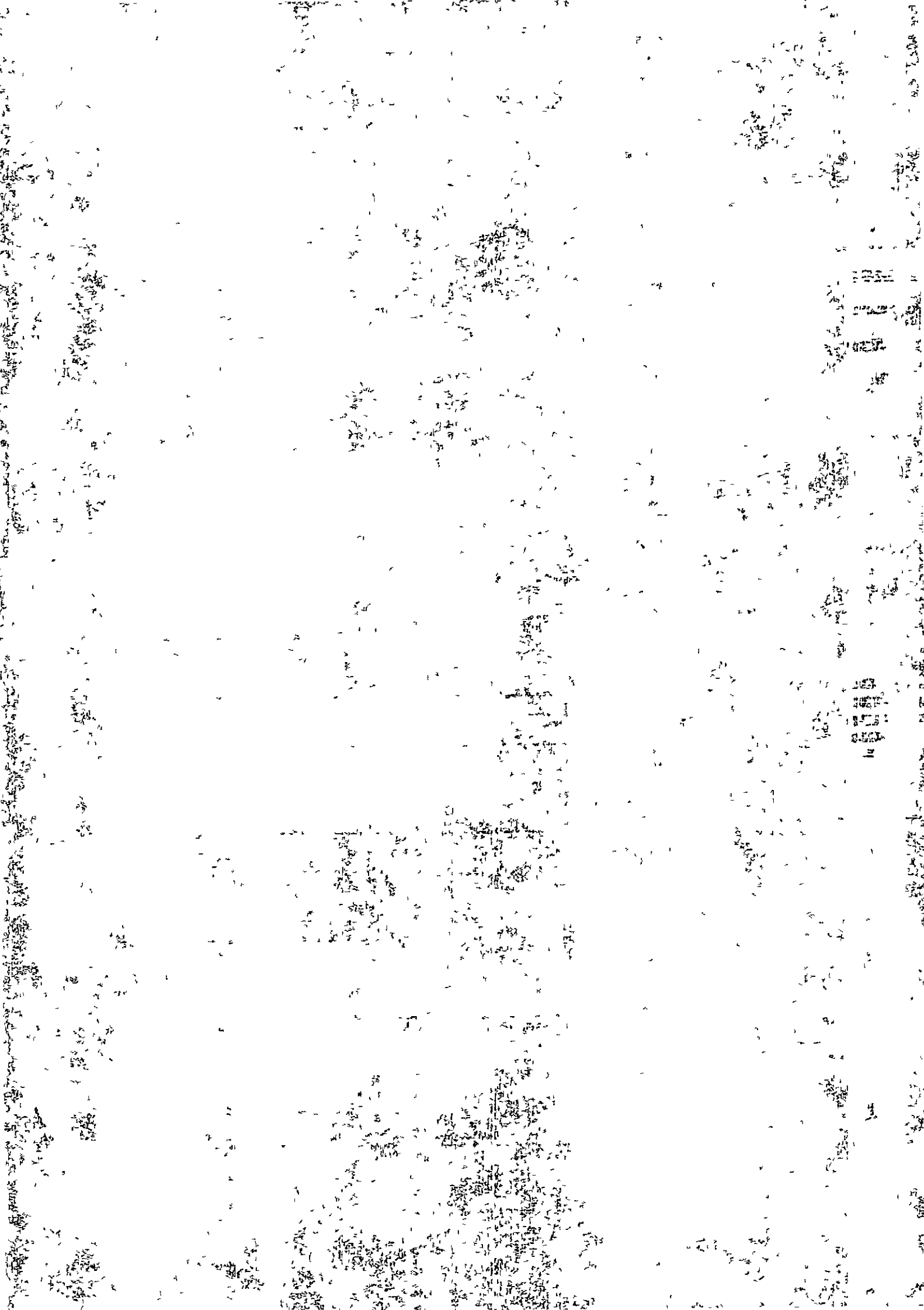
NOTE

- * GROUND JACK C OF TEST HARNESS TO TESTER
- ** GROUND JACK 6 OF TEST HARNESS TO TESTER

NOTE PIN NUMBERS CORRESPOND TO JACKS ON TEST HARNESS AND TANK RECEPTACLE PINS

TABLE B		
COMPONENT	EMPTY CAPACITANCE uu ¹	PIN NO
RESERVE TANKS NO 1 OR 4		
TANK UNIT NO 1	70 6 ± 0 9	1S AND 1
TANK UNIT NO 2	28 1 ± 0 9	2S AND 2
TANK UNIT NO 3	26 3 ± 0 9	3S AND 3
TANK UNIT NO 4	17 6 ± 0 9	4S AND 4
UNIT NO 6		
TANK PORTION	32 5 ± 0 9	6S AND 6
COMPENSATOR PORTION	67 5 ± 1 4	6S AND C
MAIN TANKS NO 1 OR 4		
TANK UNIT NO 1	60 8 ± 0 9	1S AND 1
TANK UNIT NO 2	48 6 ± 0 9	2S AND 2
TANK UNIT NO 3	36 5 ± 0 9	3S AND 3
TANK UNIT NO 4	36 5 ± 0 9	4S AND 4
TANK UNIT NO 5	19 5 ± 0 9	5S AND 5
UNIT NO 6		
TANK PORTION	22 9 ± 0 9	6S AND 6
COMPENSATOR PORTION	67 5 ± 1 4	6S AND C
TANK UNIT NO 7	17 0 ± 0 9	7S AND 7
MAIN TANKS NO 2 OR 3		
TANK UNIT NO 1	55 4 ± 0 9	1S AND 1
TANK UNIT NO 2	88 1 ± 2 5	2S AND 2
TANK UNIT NO 3	76 7 ± 0 9	3S AND 3
UNIT NO 6		
TANK PORTION	12 9 ± 0 9	6S AND 6
COMPENSATOR PORTION	67 5 ± 1 4	6S AND C
CENTER WING TANK		
TANK UNIT NO 1 (RIGHT WING)	26 8 ± 0 9	1S AND 1
TANK UNIT NO 2 (LEFT WING)	26 8 ± 0 9	2S AND 2
TANK UNIT NO 3 (LEFT WING)	151 7 ± 2 76	3S AND 3
UNIT NO 6 (RIGHT WING)		
TANK PORTION	151 4 ± 2 76	6S AND 6 *
COMPENSATOR PORTION	67 5 ± 1 4	6S AND C *

Tank Unit and Compensator Tank Unit
Capacitance and Resistance Values
Figure 502 (Sheet 2)





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AIRWORTHINESS LIMITATION PRECAUTIONS - MAINTENANCE PRACTICES

1. Airworthiness Limitation Precautions

A. General

(1) Critical Design Configuration Control Limitations (CDCCLs)

- (a) All occurrences of CDCCLs found in this chapter of the AMM are identified by this note after each applicable CDCCL design feature:

NOTE: CDCCL - Refer to the task: Airworthiness Limitation Precautions (AMM 28-99/201), for important information on Critical Design Configuration Control Limitations (CDCCLs).

- (b) Design features that are CDCCLs are defined and controlled by Special Federal Aviation Regulation (SFAR) 88, and can be found in the 707/720 Airworthiness Limitations document, D6-7552-AWL. CDCCLs are a means of identifying certain design configuration features intended to preclude a fuel tank ignition source for the operational life of the airplane. CDCCLs are mandatory and cannot be changed or deleted without the approval of the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency. A critical fuel tank ignition source prevention feature may exist in the fuel system and its related installation or in systems that, if a failure condition were to develop, could interact with the fuel system in such a way that an unsafe conditions would develop without this limitation. Strict adherence to configuration, methods, techniques, and practices as prescribed is required to ensure the CDCCL is complied with. Any use of parts, methods, techniques or practices not contained in the applicable CDCCL must be approved by the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency.

(2) Airworthiness Limitations Instructions (ALIs)

- (a) All occurrences of fuel tank system ALIs found in this chapter of the AMM are identified by this step after the General section in the applicable ALI inspection task:

NOTE: ALI - Refer to the task: Airworthiness Limitation Precautions (AMM 28-99/201), for important information on Airworthiness Limitation Instructions (ALIs).

- (b) Inspection tasks that are ALIs are defined and controlled by Special Federal Aviation Regulation (SFAR) 88, and can be found in the 707/720 Airworthiness Limitations document, D6-7552-AWL. These ALIs identify inspection tasks related to fuel tank ignition source prevention which must be done to maintain the design level of safety for the operational life of the airplane. These ALIs are mandatory and cannot



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be changed or deleted without the approval of the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency. Strict adherence to methods, techniques and practices as prescribed is required to ensure the ALI is complied with. Any use of methods, techniques or practices not contained in these ALIs must be approved by the FAA office that is responsible for the airplane model Type Certificate, or applicable regulatory agency.

B. Critical Design Configuration Control Limitations (CDCCLs)

- (1) Make sure you follow the procedures for items identified as CDCCLs.

WARNING OBEY THE MANUFACTURER'S PROCEDURES WHEN YOU DO ANY MAINTENANCE THAT MAY AFFECT A CDCCL. IF YOU DO NOT FOLLOW THE PROCEDURES, IT CAN INCREASE THE RISK OF A FUEL TANK IGNITION SOURCE.

C. Airworthiness Limitation Instructions (ALIs)

- (1) Make sure you follow the procedures for tasks identified as ALIs.

WARNING OBEY THE MANUFACTURER'S PROCEDURES WHEN YOU DO ANY MAINTENANCE THAT MAY AFFECT AN ALI. IF YOU DO NOT FOLLOW THE PROCEDURES, IT CAN INCREASE THE RISK OF A FUEL TANK IGNITION SOURCE.

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FUEL QUANTITY INDICATING SYSTEM WIRING AND CONNECTORS -
APPROVED REPAIRS

1 Equipment and Materials

A Sealer; one of the following or equivalent.

(1) Nycote 21, Nycote Laboratories, Los Angeles, California.

(2) E C 776SR, Minnesota Mining and Manufacturing Co , St. Paul, Minnesota.

B Fiberglass Tape, 0 003 to 0.007 inches thick.

C. Nylon or Dacron Cord.

D Aliphatic Naphtha.

2 Repair Tank Unit or Compensator Tank Unit Integral Wiring

A Clean area of wire to be repaired by using aliphatic naphtha. Remove all traces of fuel.

B. If outer jacket of wire has minor scuffing, such that the inner individual wire insulation is not exposed, apply one coat of sealer.

C If outer jacket of wire is scuffed such that inner individual wire insulation is exposed, apply one coat of sealer. After applied sealer has dried for approximately five minutes, wrap area with fiberglass tape, tie ends with nylon or dacron cord and cover repair with another coat of sealer