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STUDENT GUIDE

FOR

UH-60 ENGINE START

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UH-60 ENGINE START SYSTEM

TABLE OF CONTENTS

SECTION I. - INTRODUCTION

TERMINAL LEARNING OBJECTIVE:

ACTION: Identify UH-60 engine start system components and their characteristics while performing on aircraft troubleshooting.

CONDITIONS: As a UH-60 maintenance test pilot.

STANDARD: In accordance with (IAW) UH-60 technical manuals

SAFETY REQUIREMENTS:

Will be addressed as NOTES, CAUTIONS, and WARNINGS throughout the lesson outline.

RISK ASSESSMENT LEVEL: Low

ENVIRONMENTAL CONSIDERATIONS: There are no environmental concerns for this lesson.

EVALUATION: Evaluation will be accomplished with performance exam at the end of this module of instruction.

SECTION II. - PRESENTATION

A. ENABLING LEARNING OBJECTIVE ELO No. 1

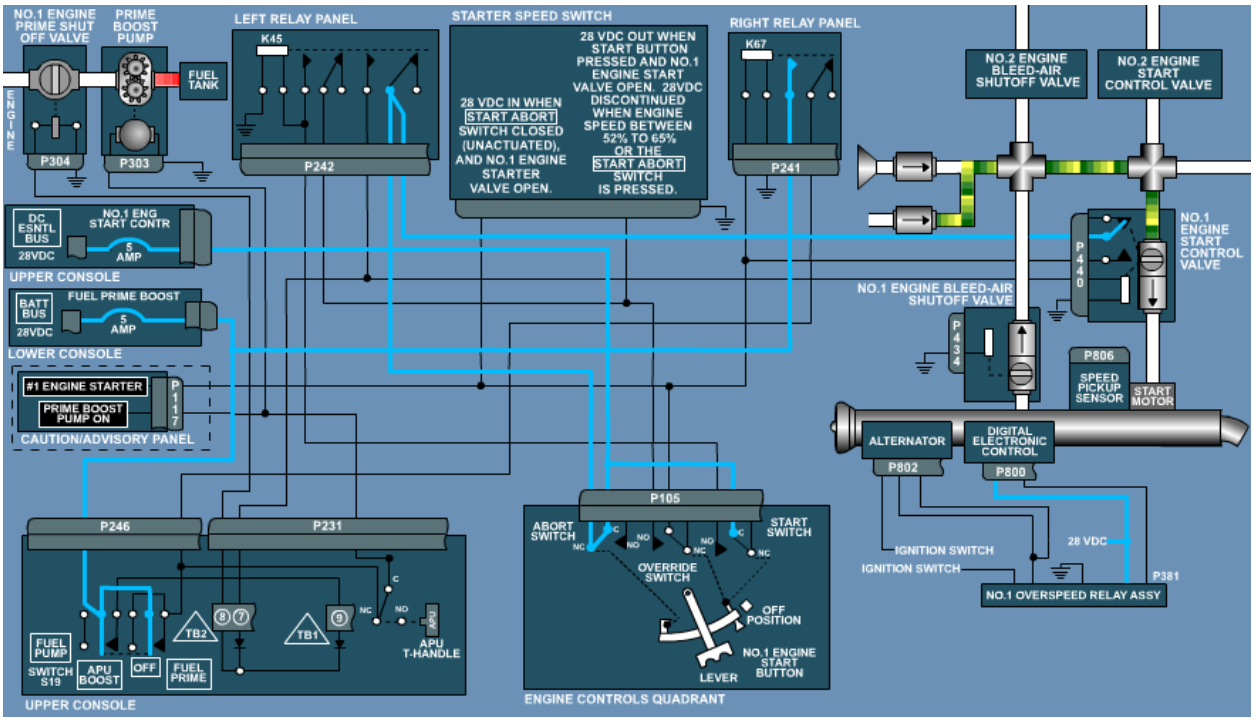
ACTION: Identify the function of the engine start system.

CONDITION: As a UH-60 test pilot.

STANDARD: IAW UH-60 Technical Manuals.

a. Engine Start System

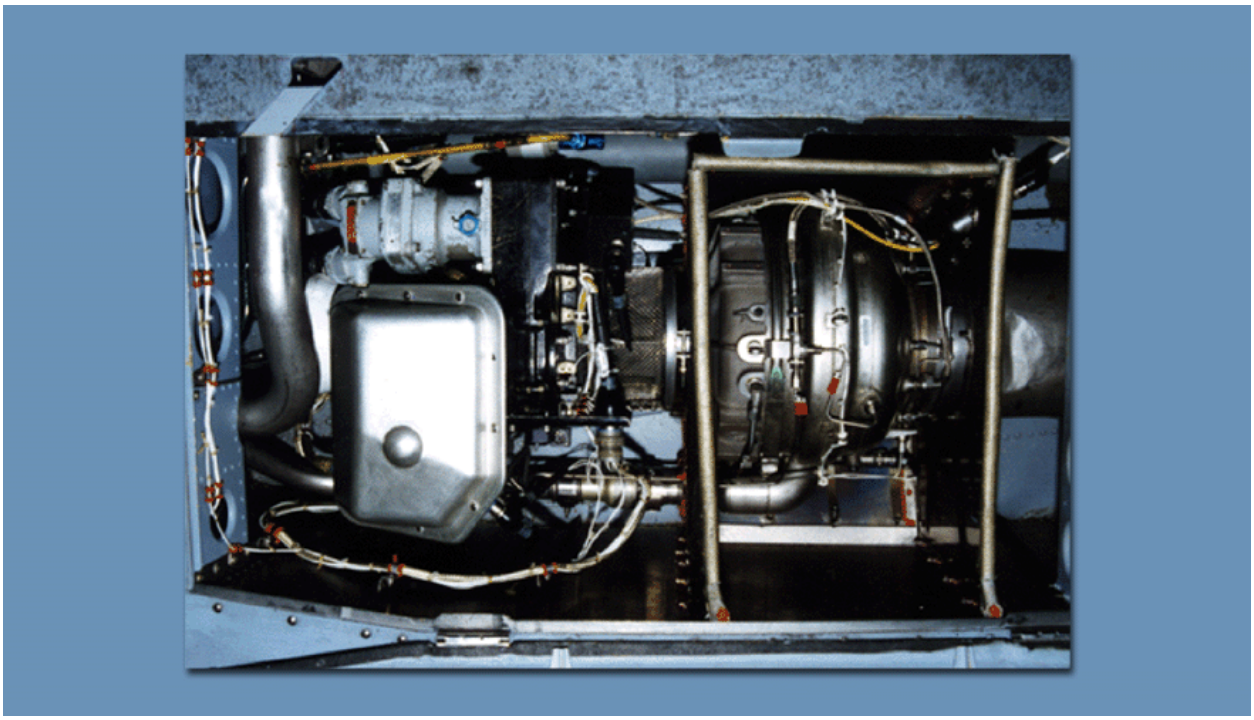
Frame #0020 (Engine Start System)



(1) The engine start system is an electro-pneumatic system used to start both engines.

b. Auxiliary Power Unit

Frame #0030 (Auxiliary Power Unit)



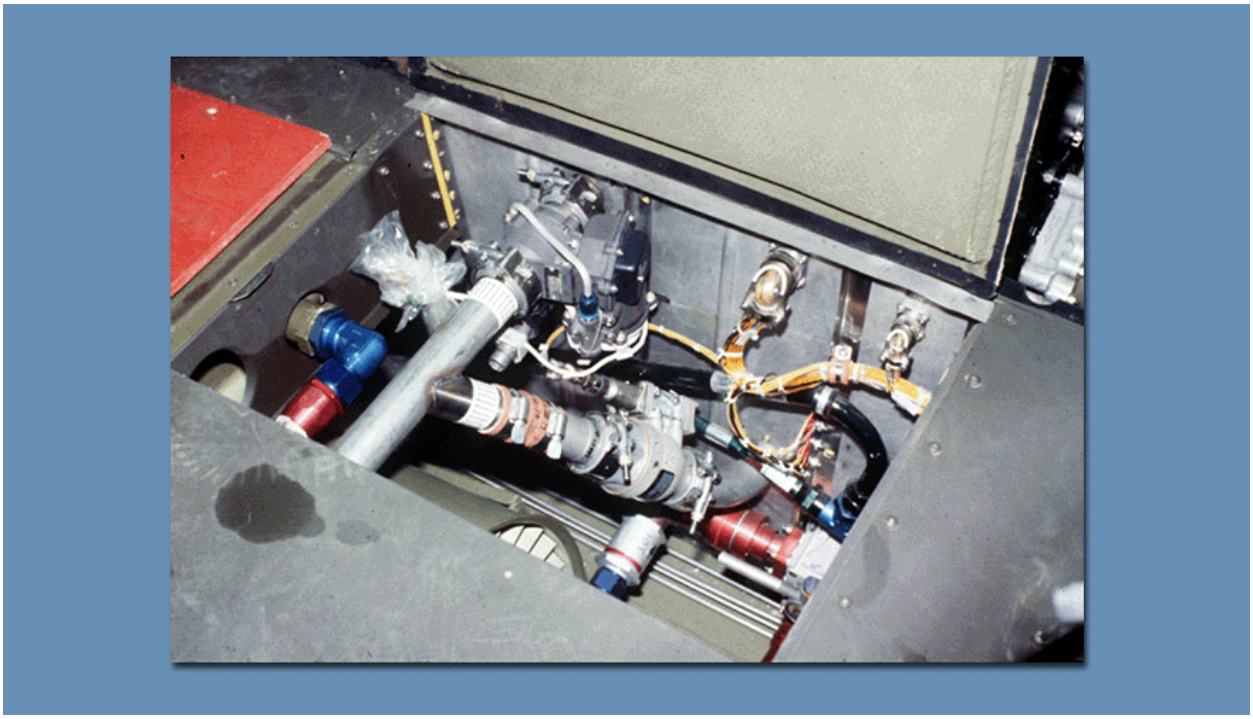
(1) There are several methods of providing air for engine starts. The first method is the Auxiliary Power Unit (APU).

(2) The APU supplies air to the engine selected for engine start.

(3) The Turbomach and Garrett are the two types of APUs.

c. Cross Bleed Starting

Frame #0035 (Cross Bleed Starting)



(1) Another method of starting the engine is cross bleed starting.

(2) Cross bleed starting utilizes the bleed-air shutoff valve to direct air from the operating engine to the opposite engine during the start sequence.

d. Ground Source

Frame #0040 (Ground Source)

(1) Another way to start the engines is with the Auxiliary Ground Power Unit (AGPU).

(2) The AGPU is an external air source used for engine starting.

e. Buddy Start

Frame #0040A (Buddy Start)

(1) The Buddy Start system (aircraft to aircraft) is another method of starting the engines.

(2) Procedures for this method are found in the TM1-1520-237-MTF.

B. ENABLING LEARNING OBJECTIVE ELO No. 2

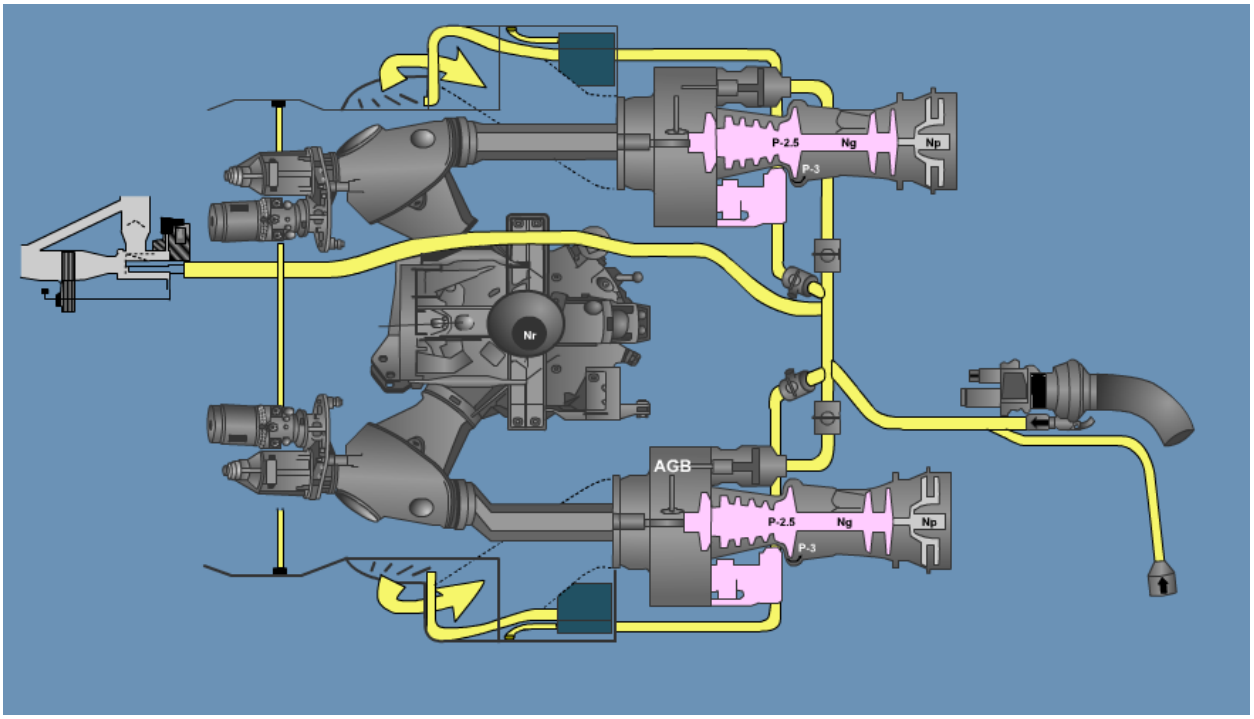
ACTION: Identify the components of the engine start system.

CONDITIONS: As a UH-60 test pilot.

STANDARD: IAW UH-60 technical manuals.

a. Pneumatic Tubing Location

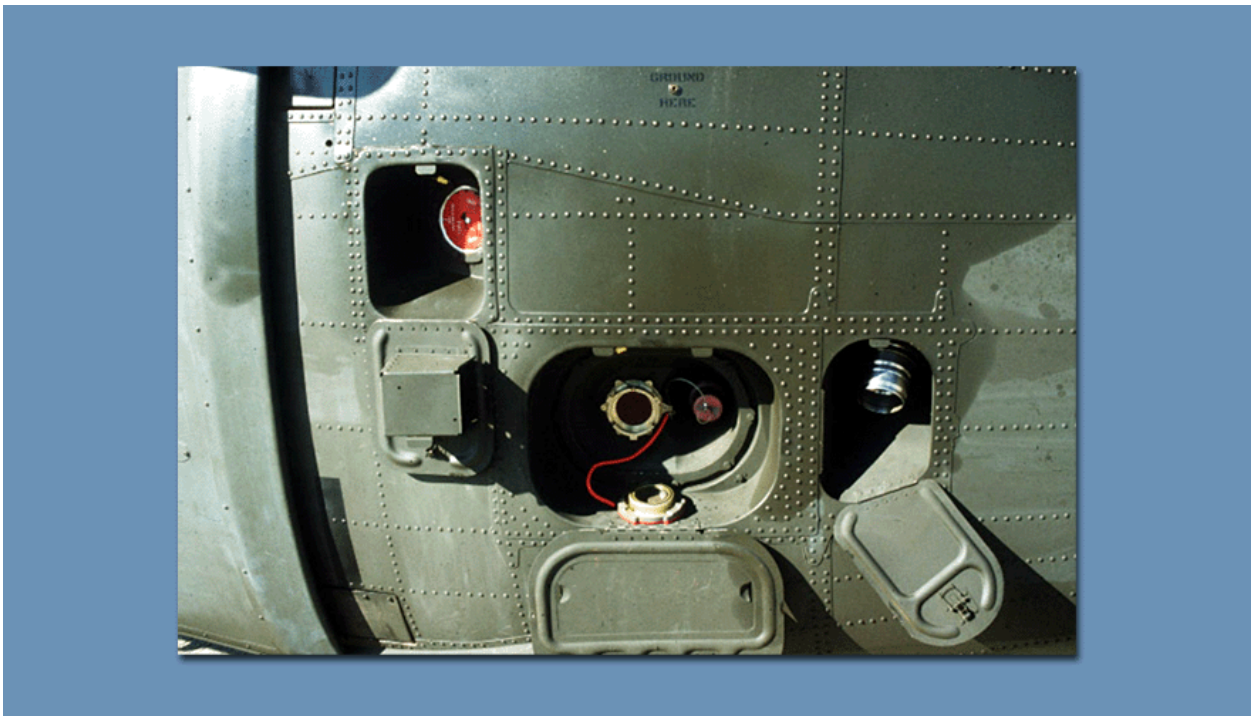
Frame #0045 (Pneumatic Tubing Location)



(1) The pneumatic tubing and manifold used during the engine start sequence, extends from the left side of the transmission section throughout the cabin section upper deck area forward to the heater.

(a) Nipple Check Valve

Frame #0045A (Nipple Check Valve)

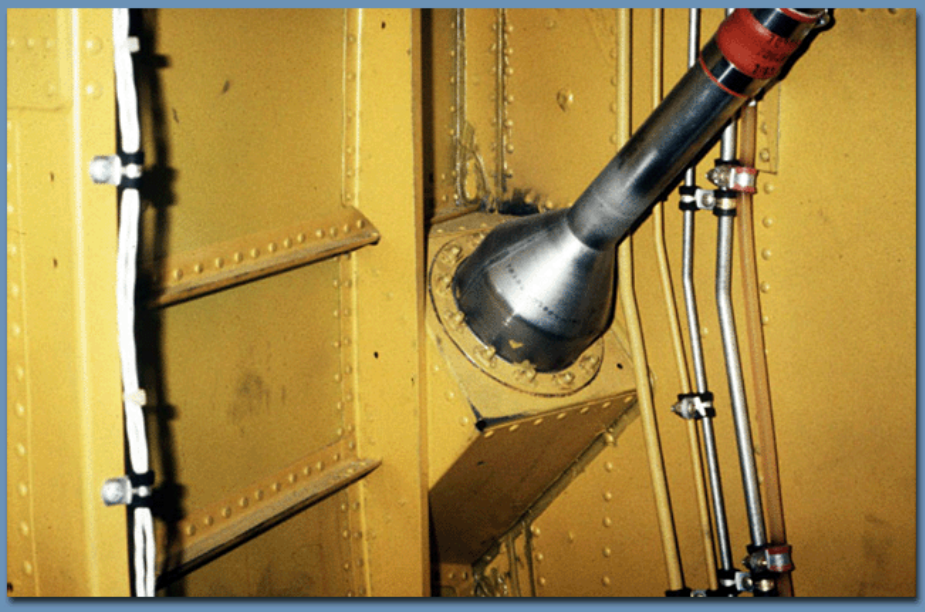


1) The first section of the tubing is the nipple check valve.

2) The nipple check valve provides a connection point for an external air source.

(b) Lower Tube

Frame #0045B (Lower Tube)

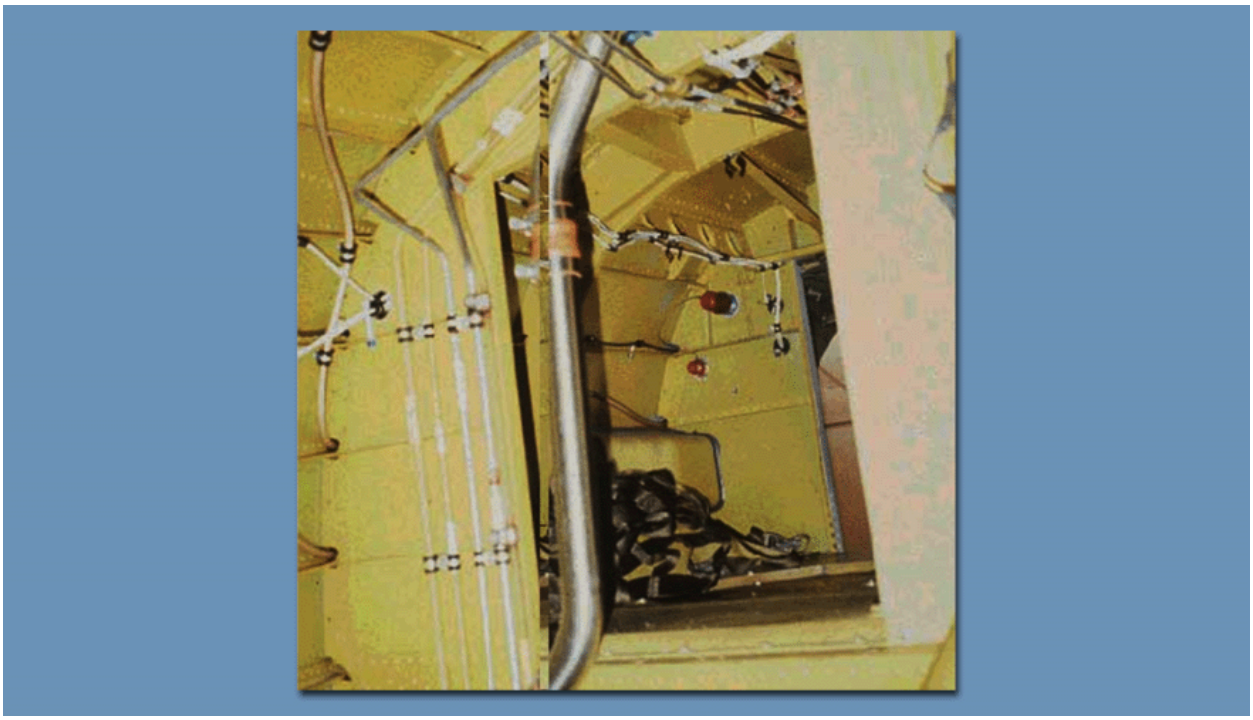


1) The next section of tubing is the lower tube.

2) The lower tube is connected between the nipple check valve and the middle tube.

(c) Middle Tube

Frame #0045C (Middle Tube)

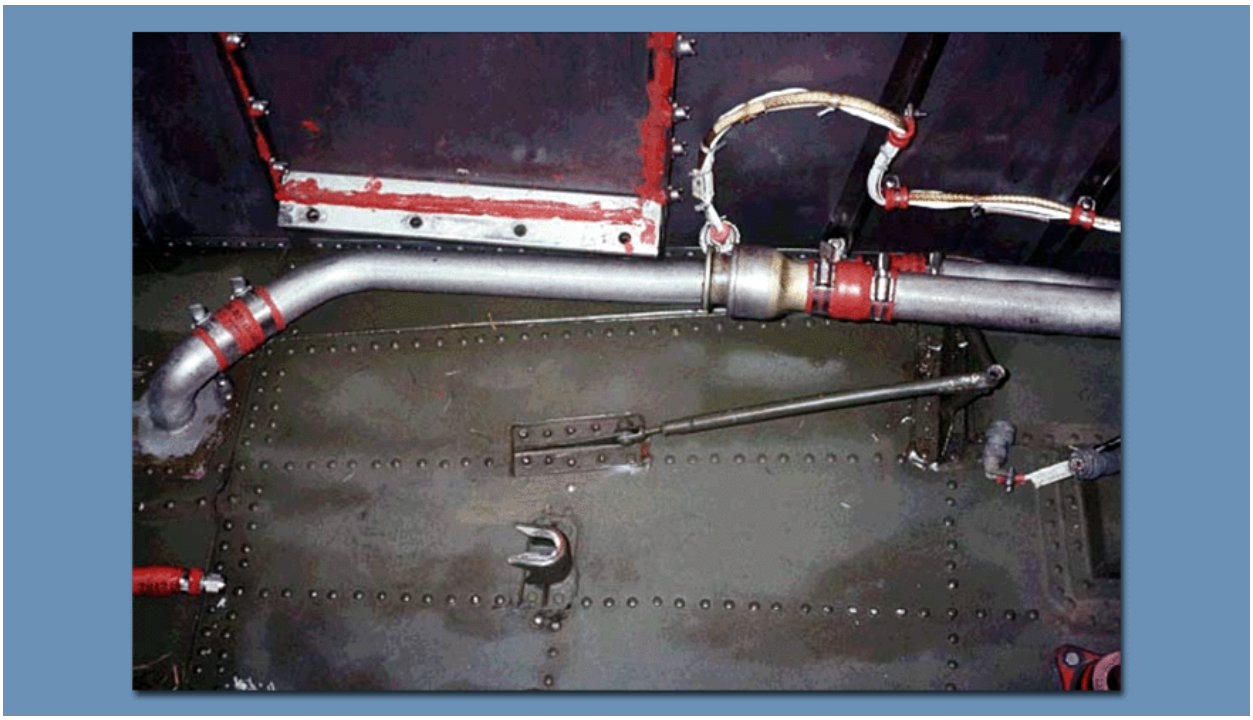


1) This is the middle tube and the upper tube.

2) The middle tube is connected between the lower tube and the upper tube.

(d) Rear Tube

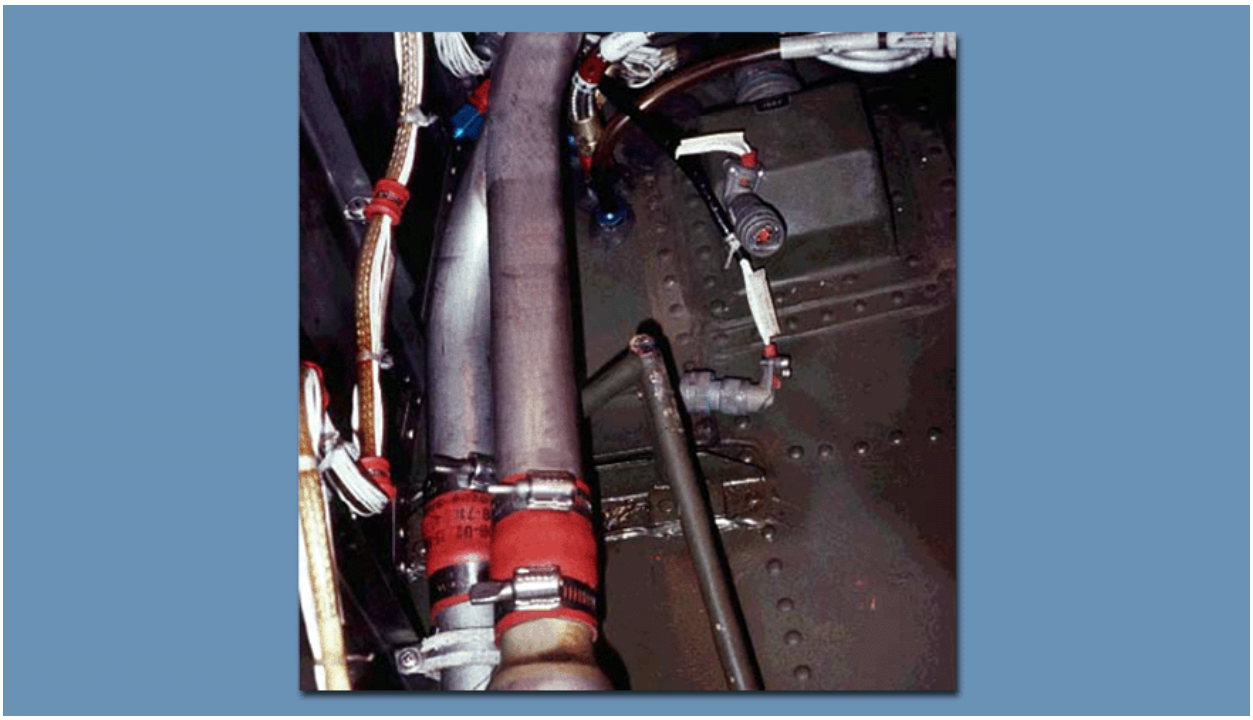
Frame #0045D (Rear Tube)



1) The rear tube is connected between the upper tube and the front tube.

(e) Front Tube

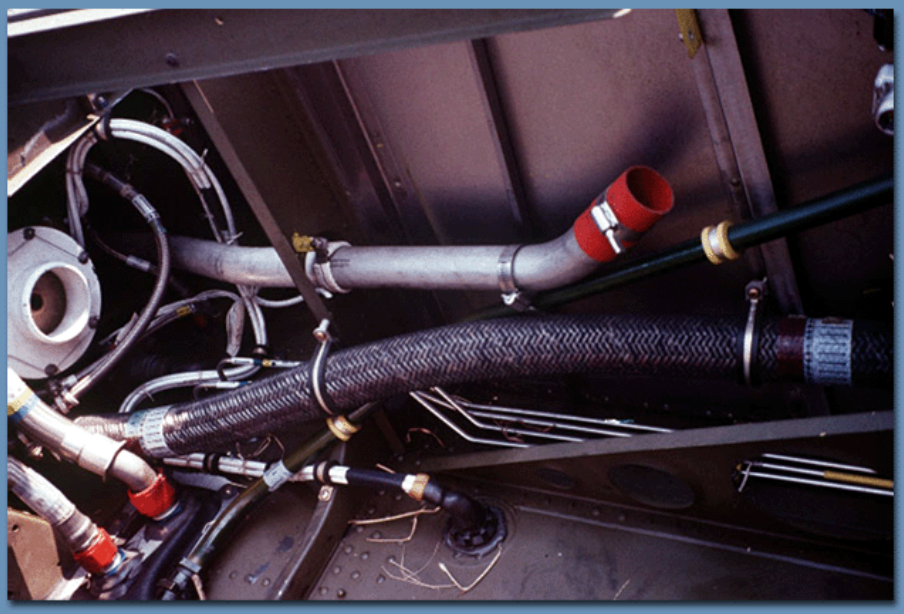
Frame #0045E (Front Tube)



1) The front tube is connected to the cross bleed tube.

(f) APU Compartment Front Tube

Frame #0045F (APU Compartment Front Tube)



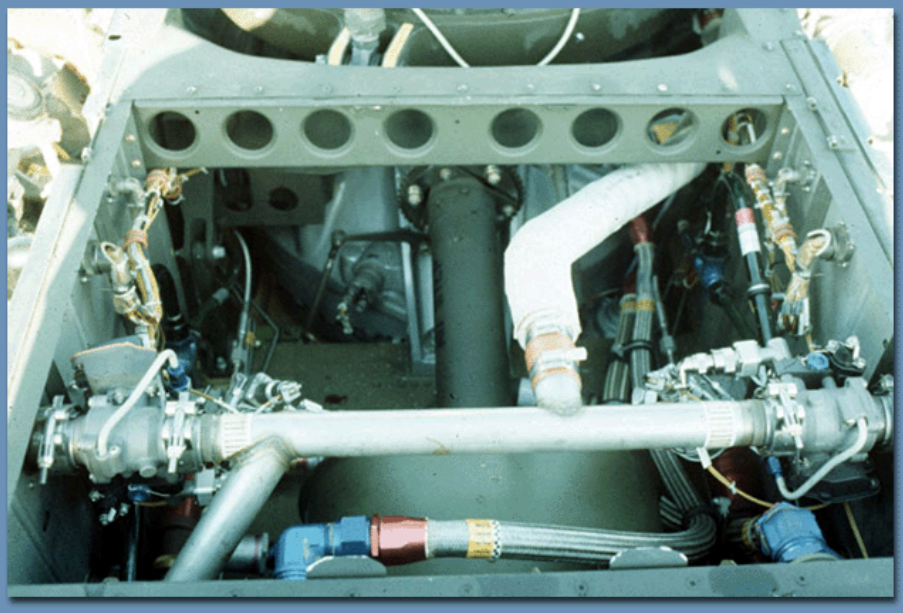
1) The APU compartment front tube connects to the cross bleed tube.

(g) Oil Cooler Compartment Tubes

Frame #0045G (Oil Cooler Compartment Tubes Uninstalled)

1) This is the cross bleed tube and the connection for the rear bleed-air tube.

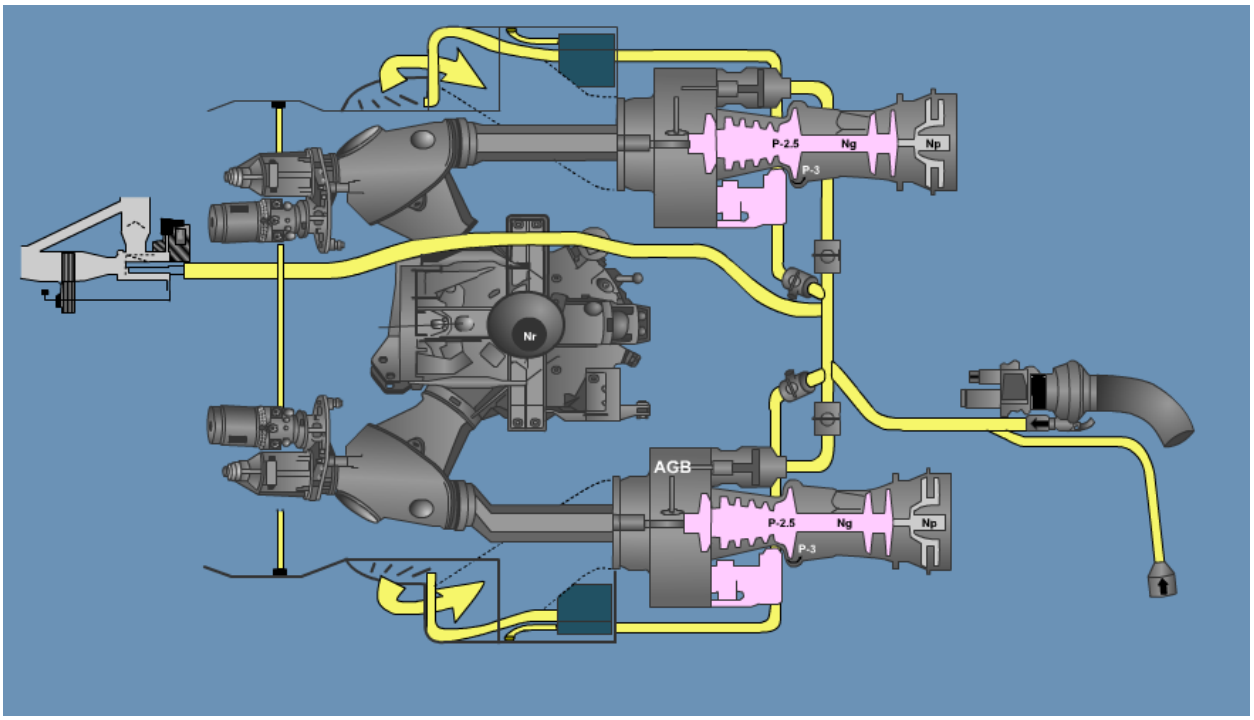
Frame #0045G (Oil Cooler Compartment Tubes Installed)



2) This is the cross bleed tube and the connection for the rear bleed air tube.

(h) Pneumatic Tubing Description

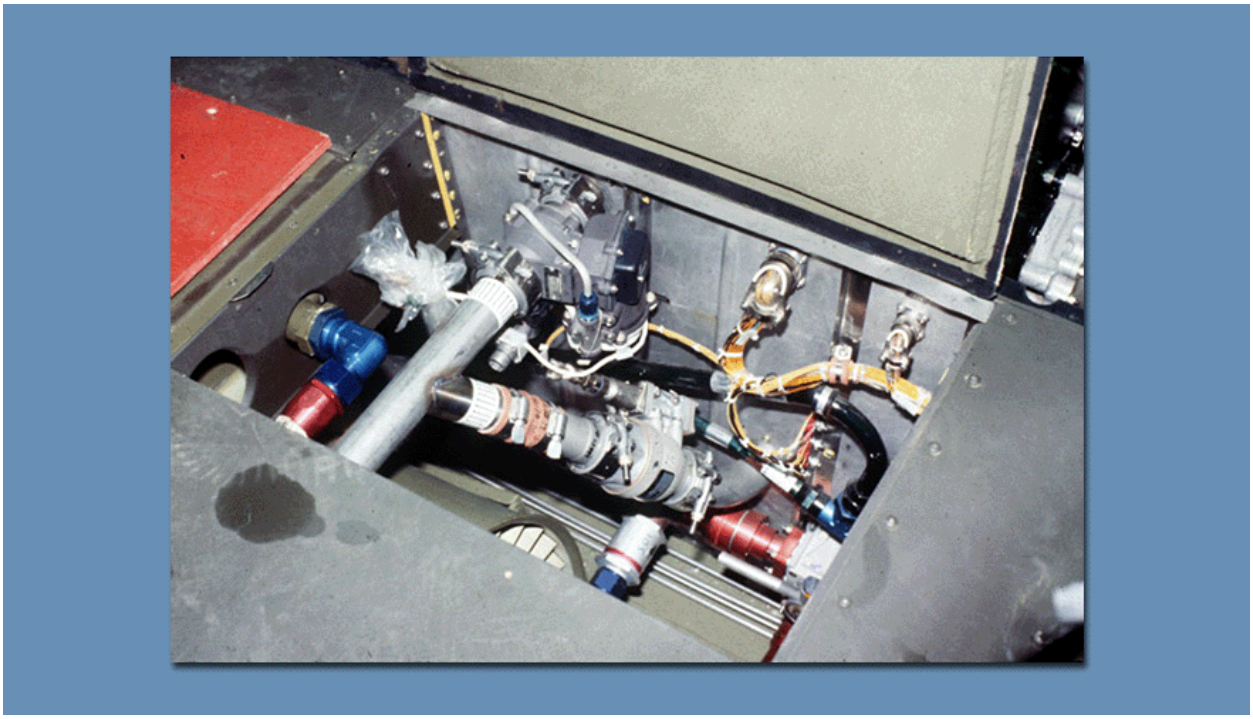
Frame #0050 (Pneumatic Tubing Description)



1) The pneumatic tubing consists of a series of coupled or welded tubes joined together so any one of the air sources may provide bleed air for whatever reason depending on demand.

(i) Tubing Maintenance Aspects

Frame #0055 (Tubing Maintenance Aspects)(0055)



1) The tubing is not allowed any dents that exceed 25% of the total diameter of the tube in question.

2) No cracks are allowed anywhere on any tube, nor are they allowed at any of the welds joining two tubes.

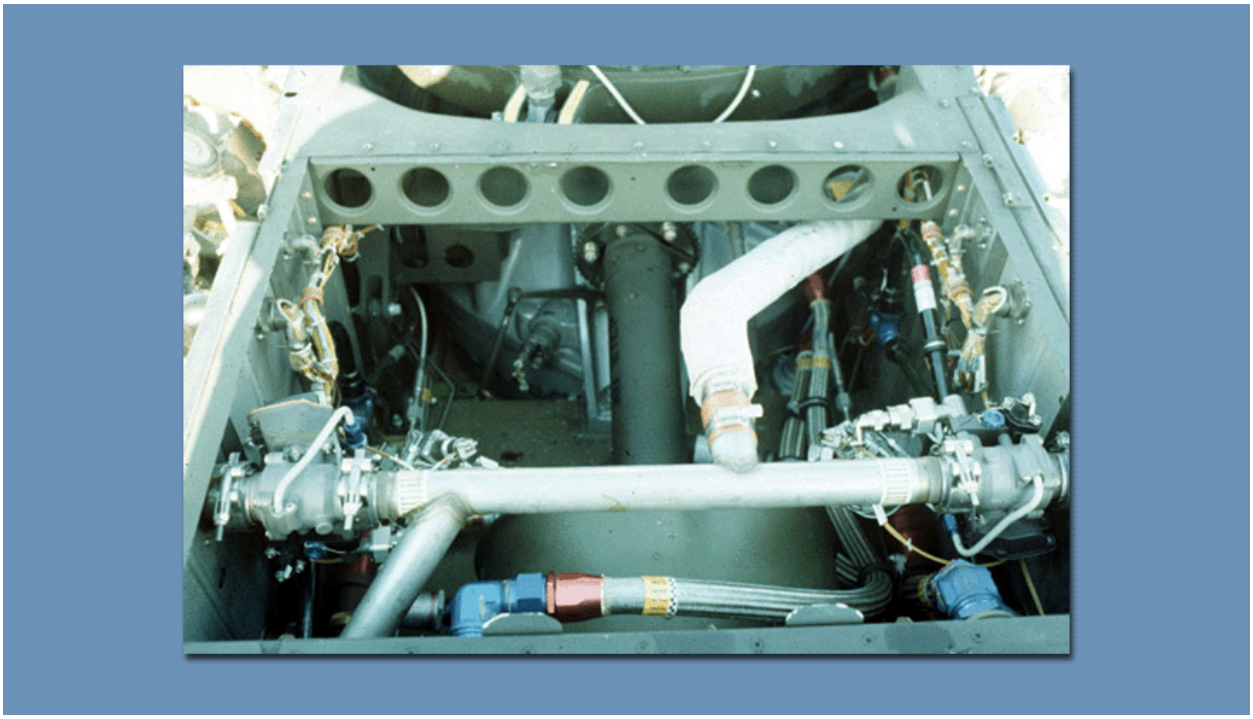
3) Where two tubes are joined, there must be at least 0.12" gap between the tubes prior to installing the rubber couplings to allow for airframe flexing.

4) The rubber couplings are to have no cuts, tears, holes or chaffing due to the inherent potential for air leaks.

5) The clamps are to be installed so that there is coupling exposed on the outboard edge of the clamp and torque applied in accordance with the TM 1-1520-237-23-4.

b. Start Control Valves

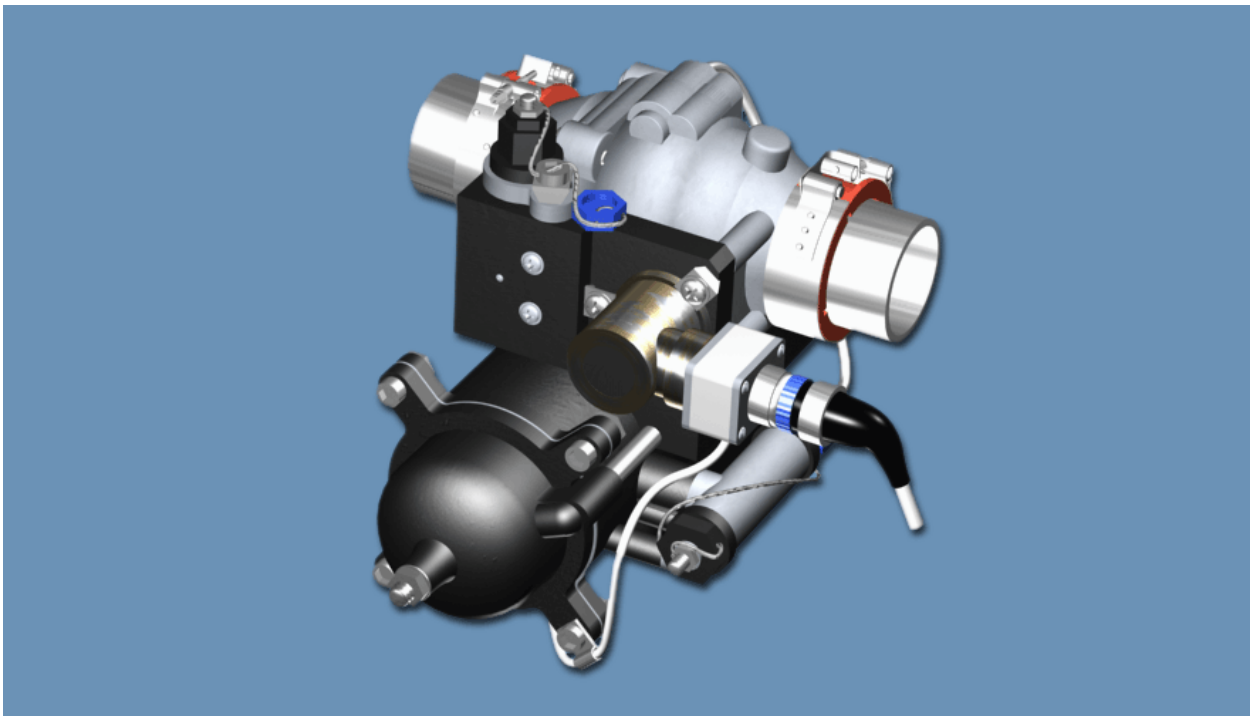
Frame #0060 (Start Control Valves Location)



(1) The start control valves are located inside the oil cooler compartment, inboard of each respective engine's firewall.

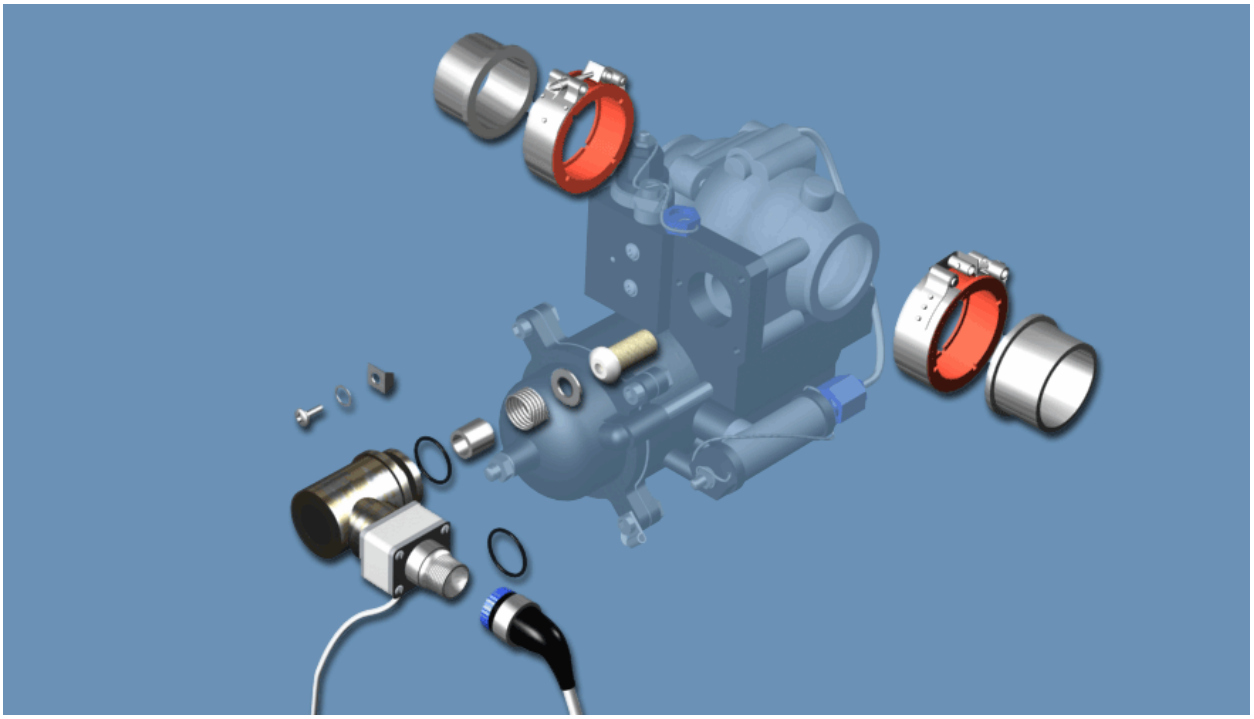
(a) Start Control Valves Description

Frame #0065 (Start Control Valves Description)



1) The start control valves are electrically controlled, and air actuated to allow bleed air to flow through to the engine starter.

Frame #0065 (Start Control Valves Description)



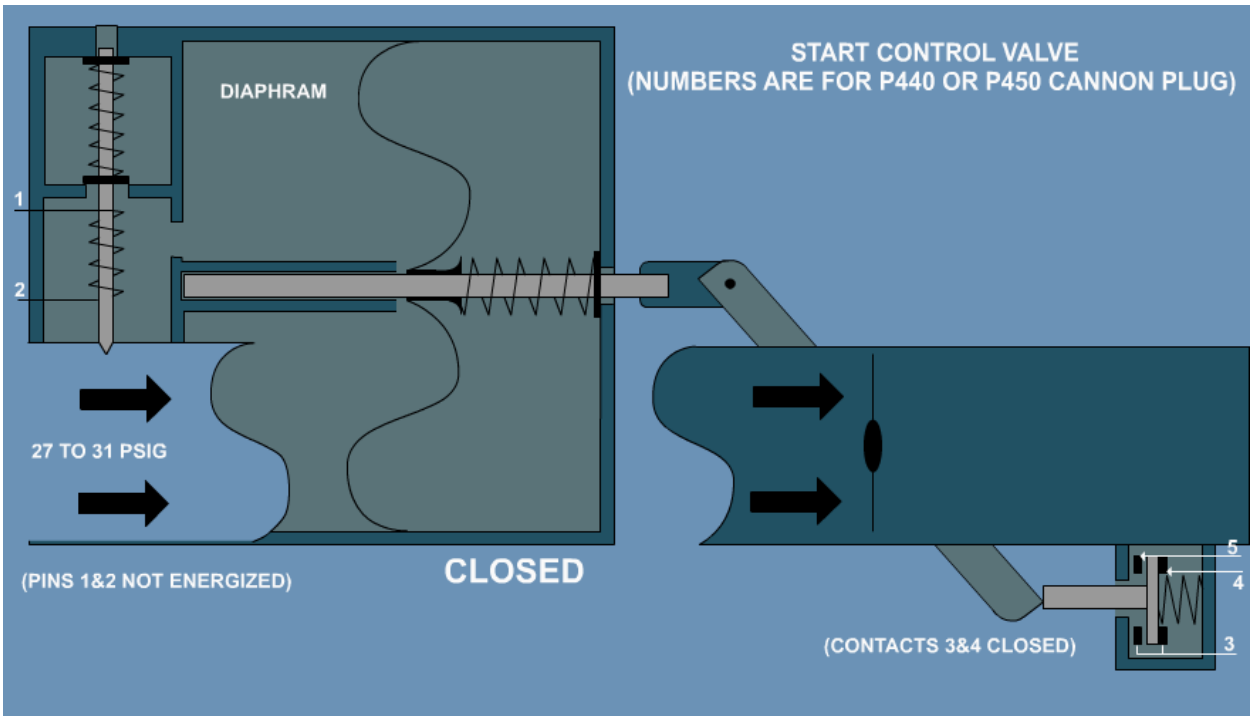
2) When the starter switch is pressed, the start control valve is electrically opened by the solenoid valve.

3) Opening the start control valve releases compressed air from the air source to the air turbine starter of the engine being started.

4) The air entering the start control valve is filtered to remove impurities from the air as it passes through the start control valve.

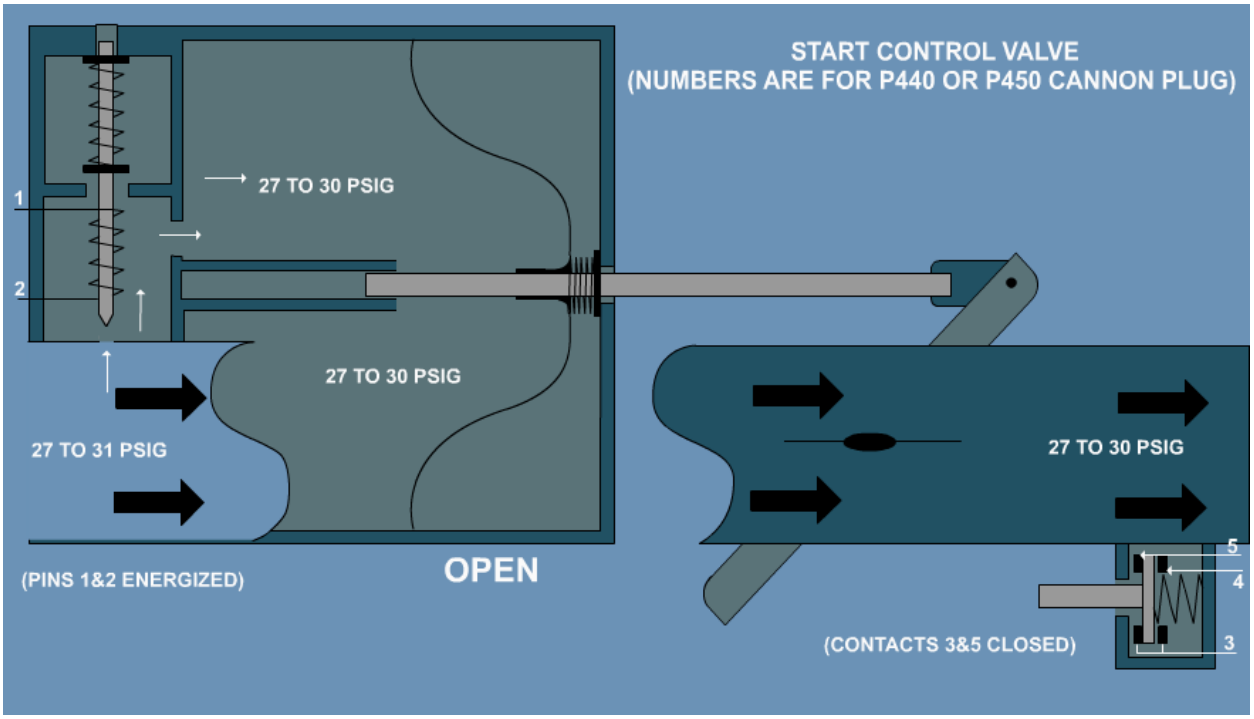
(b) Start Control Valves Operation

Frame #0070 (Start Control Valves Operation)



1) Both start control valves require 27-31psi bleed-air to actuate.

Frame #0070 (Start Control Valves Operation2)



2) An electrically controlled solenoid allows bleed-air to be routed to the air-actuator, which opens the valve and closes the switch that controls the start sequence.

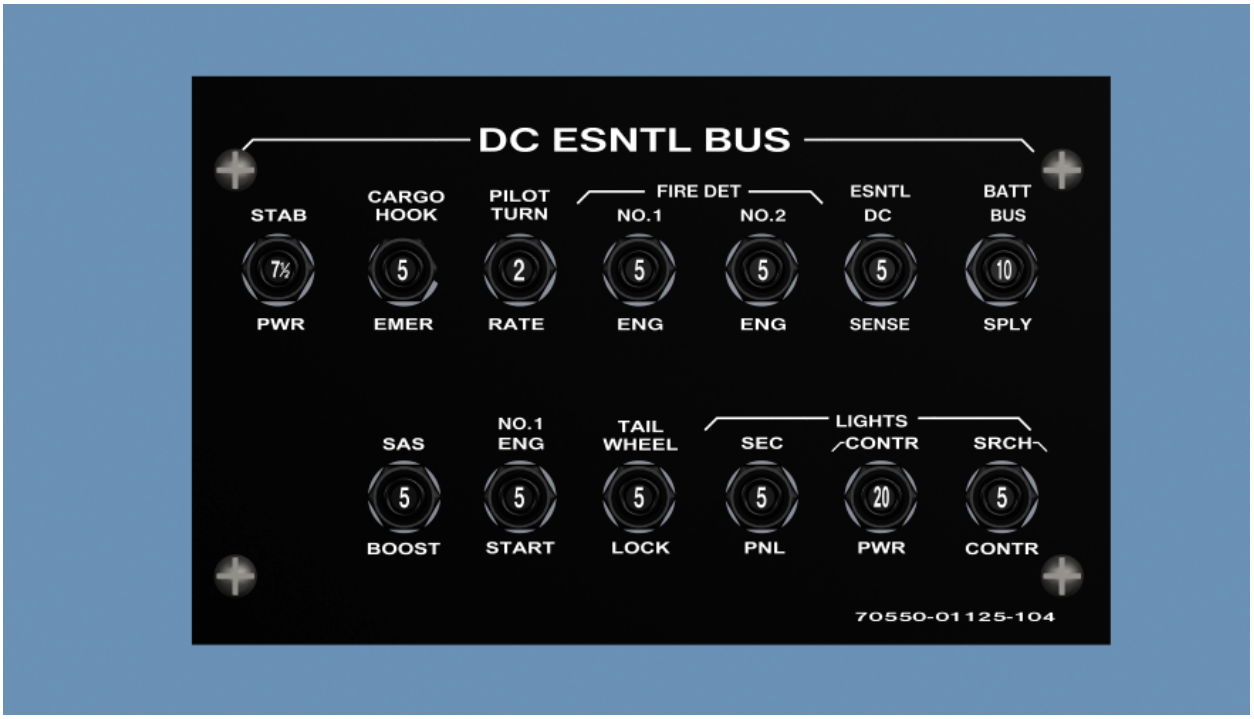
(c) Start Control Valves Power Source

Frame #0075 (Start Control Valves Power Source)

1) The DC ESNTL BUS (No. 1 Start system) provides voltage through the NO. 1 ENG START circuit breaker, to K45 relay in the left relay panel to energize the No. 1 engine start control valve.

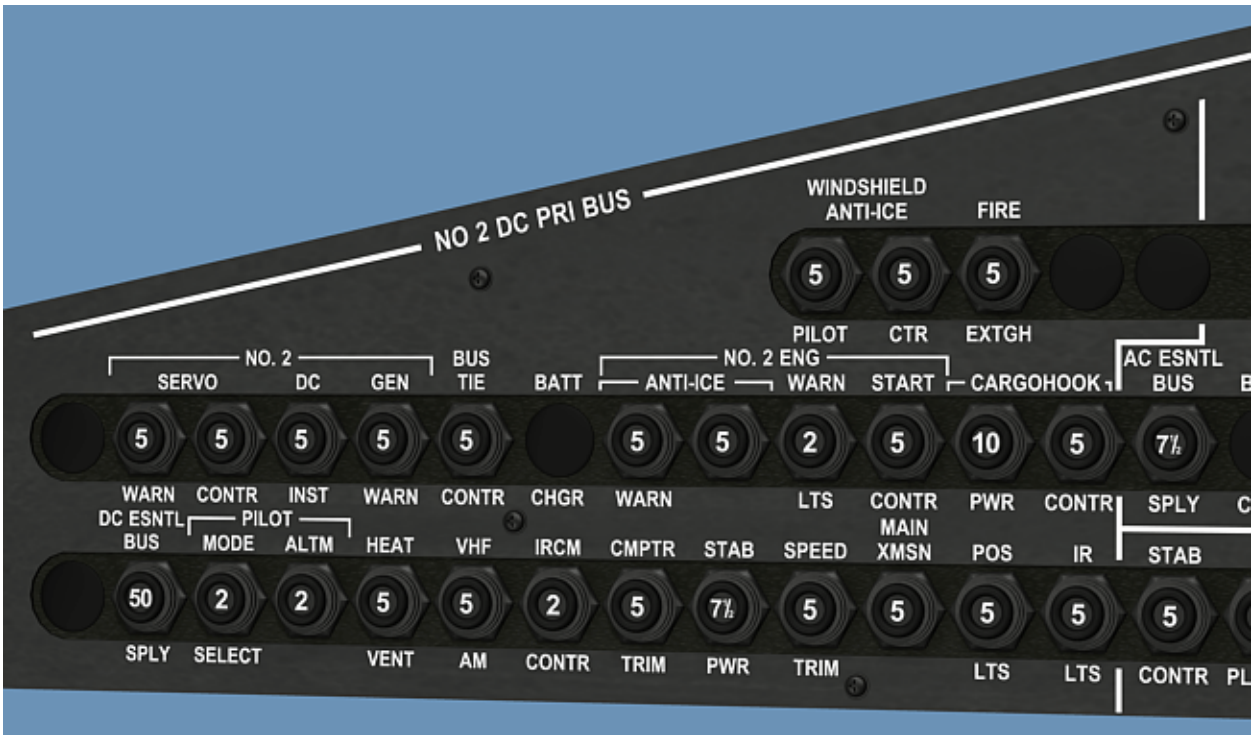
2) This voltage is removed during start sequence by pulling down on the No. 1 engine Power Control Lever (PCL).

Frame #0075 (DC ESNTL BUS)



(d) No. 2 DC PRI BUS CIRCUIT BREAKER PANEL

Frame #0075 (No. 2 DC PRI BUS)

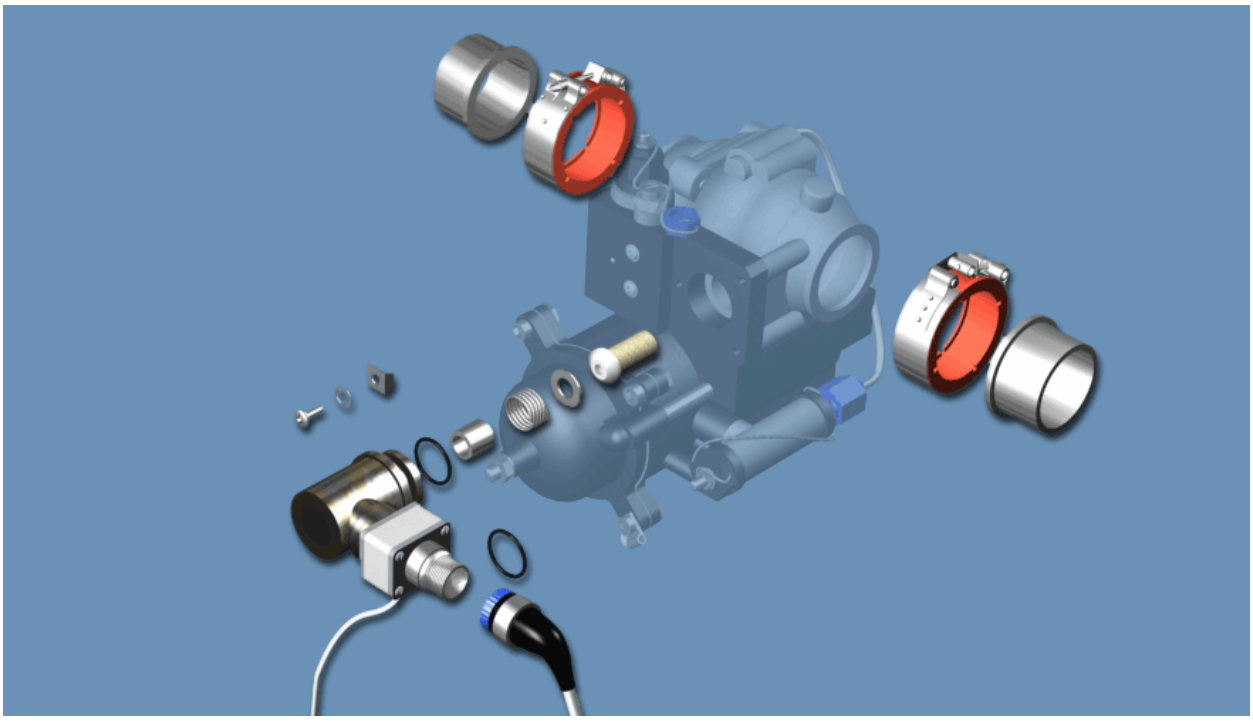


1) The No. 2 DC PRI BUS (No. 2 Start system) provides voltage through the NO. 2 ENG START CONTR circuit breaker to K26 relay in the right relay panel to energize the No. 2 engine start control valve.

2) This voltage is removed during start sequence by pulling down on the No. 2 engine Power Control Lever (PCL).

(e) Start Control Valves Maintenance Aspects

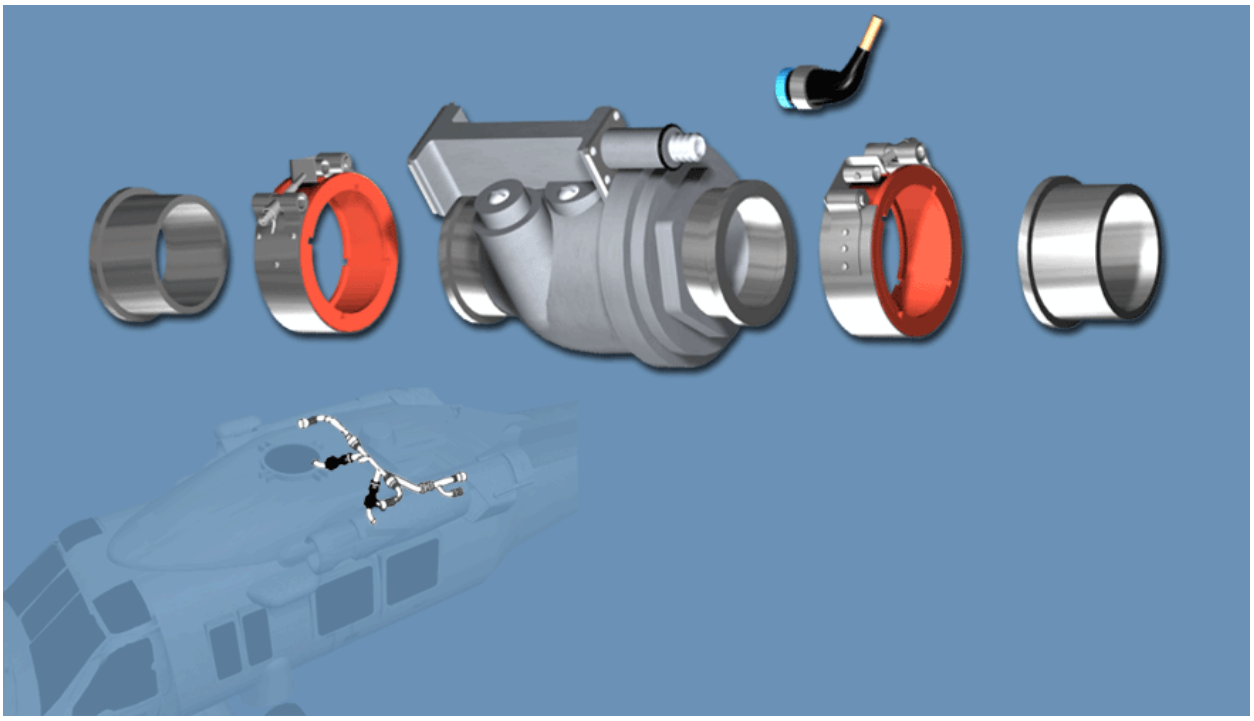
Frame #0080 (Start Control Valves Maintenance Aspects)



1) TM 1-1520-237-23-3 addresses the troubleshooting procedures and malfunctions, and the TM 1-1520-237-23-4 addresses removal, inspections, cleaning and installation procedures.

c. Bleed-Air Shutoff Valves

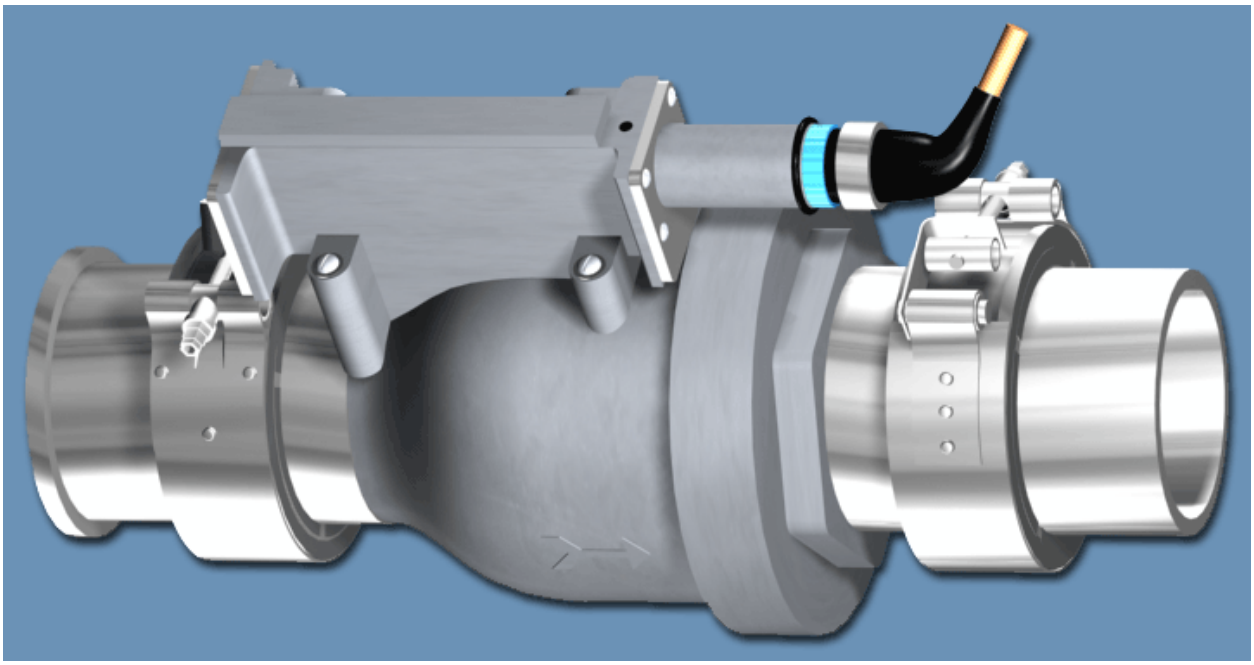
Frame #0085 (Bleed-Air Shutoff Valves Location)



(1) The bleed-air shutoff valves are located inside the oil cooler compartment below the start control valves.

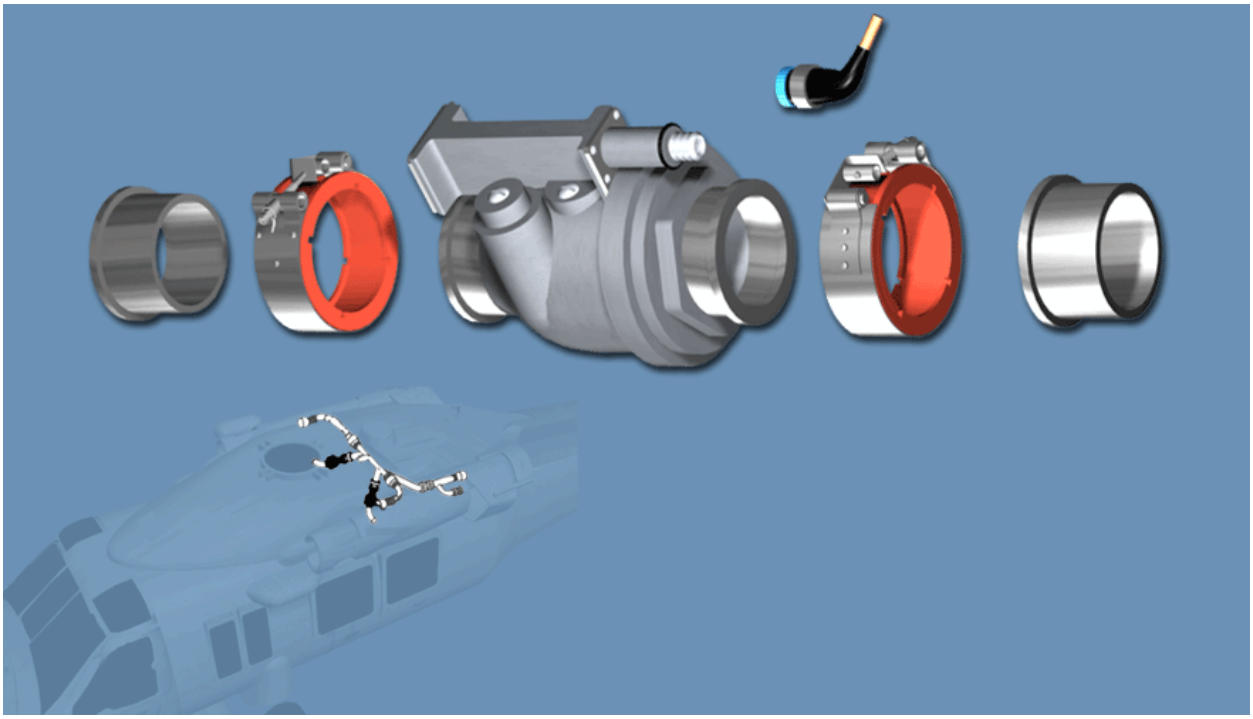
(a) Bleed-Air Shutoff Valves Description

Frame #0090 (Bleed-Air Shutoff Valves Description)



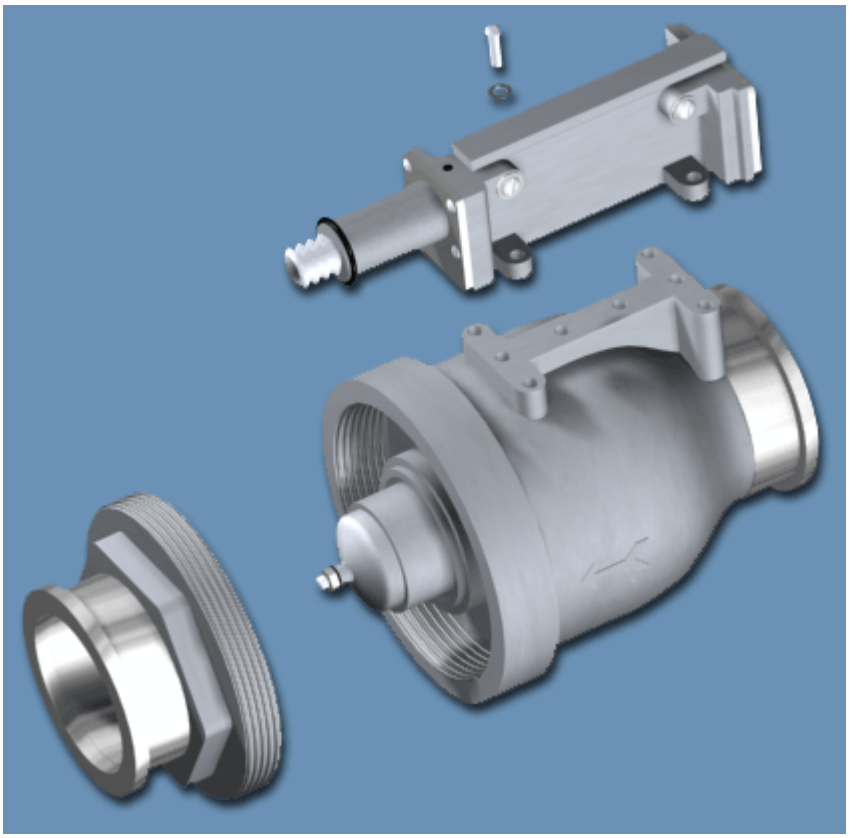
1) The bleed-air shutoff valves are electrically controlled and air actuated to allow bleed-air to flow through to pressurize the entire pneumatic manifold.

Frame #0090 (Bleed-Air Shutoff Valves)



(b) Bleed-Air Shutoff Valves Operation

Frame #0095 (Bleed-Air Shutoff Valves Operation)



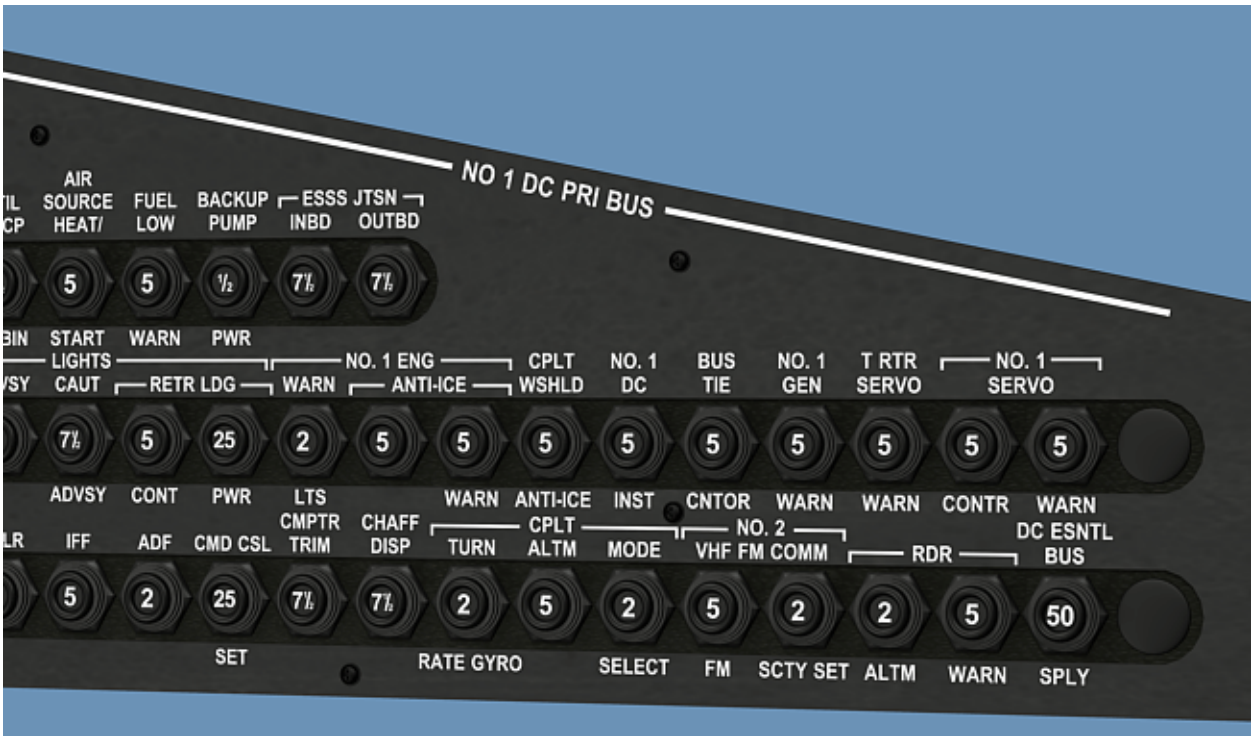
1) The bleed-air shutoff valve is electrically actuated and pneumatically opened.

2) An electric solenoid allows the bleed-air valve to open when air is being forced out.

3) The start relays prevent the bleed-air valve and start control valve from being opened at the same time.

(c) Bleed-Air Shutoff Valves Power Source

Frame #0100 (No. 1 DC PRI BUS CIRCUIT BREAKER PANEL)



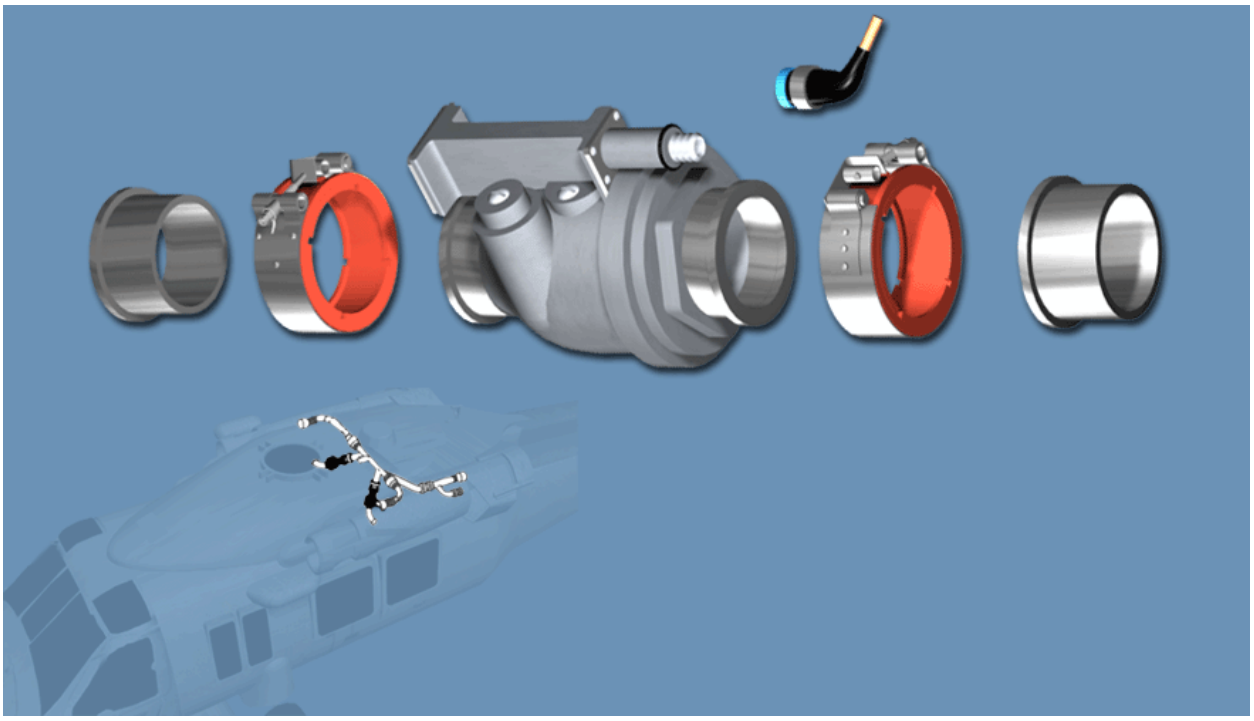
1) Power to the bleed-air shutoff valve is provided by the NO. 1 DC PRI BUS, through the AIR SOURCE HEAT/START switch and the respective start relay.

Frame #0100 (Overhead Console)

2) The AIR SOURCE HEAT/START switch is located on the overhead console.

(d) Bleed-Air Shutoff Valves Maintenance Aspects

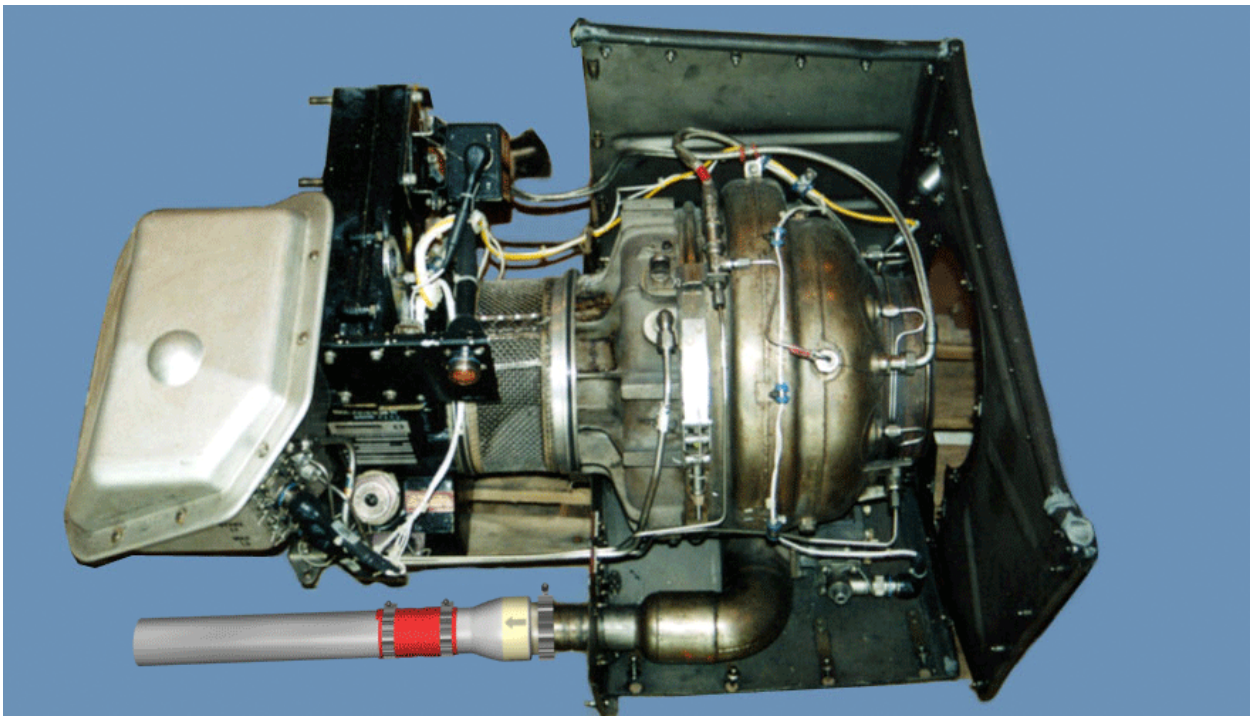
Frame #0105 (Bleed-Air Shutoff Valves Maintenance Aspects)



1) TM 1-1520-237-23-4 addresses removal, disassembly, inspection, cleaning, and installation at Aviation Unit Maintenance (AVUM) and addresses cleaning and repair at the Aviation Intermediate Maintenance (AVIM) facility.

d. APU Check Valve

Frame #0110 (APU Check Valve Location)

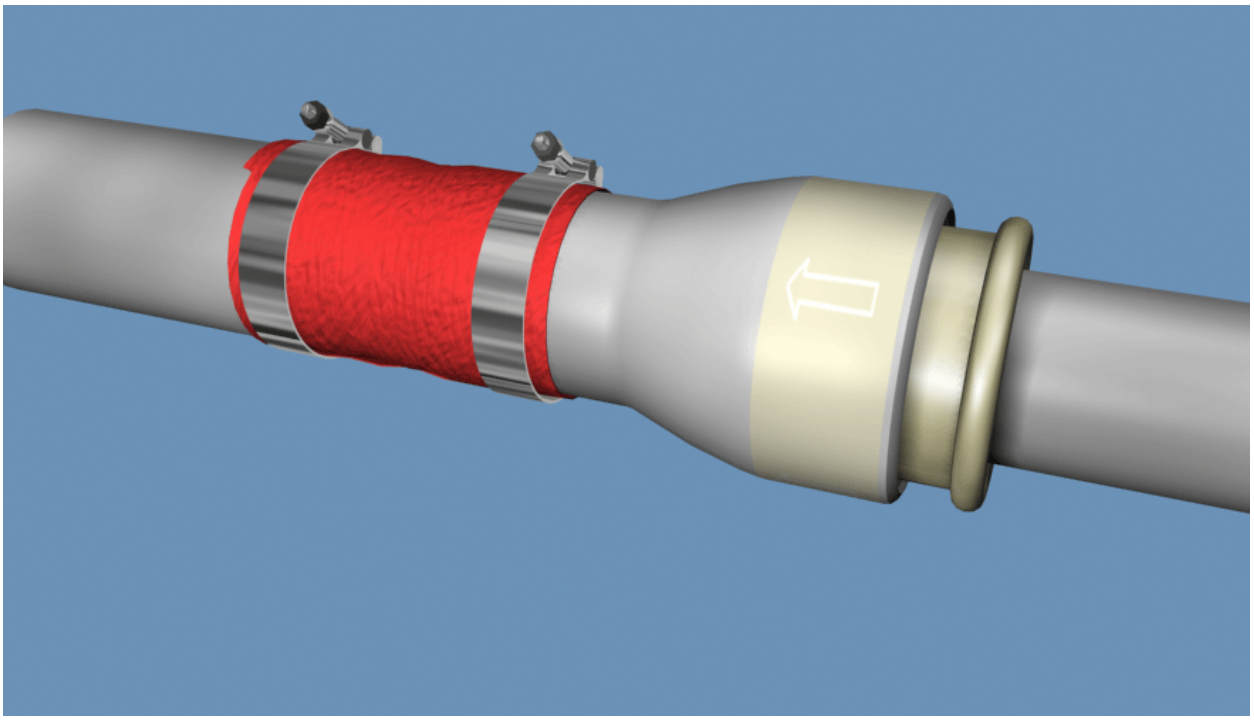


(1) The Auxiliary Power Unit (APU) check valve is located on the lower left hand side of the APU just forward of the firewall for the APU.

(2) The APU check valve is a one-way check valve that allows the APU to pressurize the pneumatic manifold, but prevents air from being forced back through the APU when it is not operating.

e. APU Check Valve Maintenance Aspects

Frame #0125 (APU Check Valve Maintenance Aspects)



(1) If the flapper valve separates from the APU check valve, the flapper valve must be located prior to replacement with a new check valve.

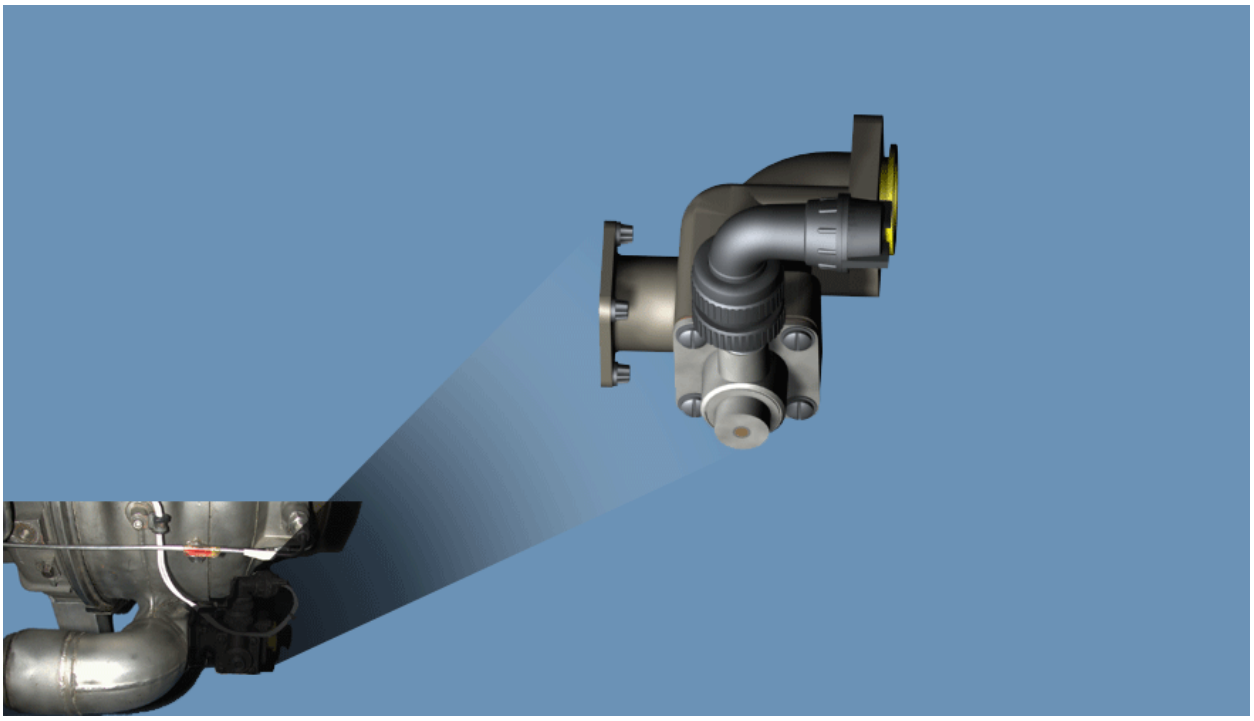
(2) TM 1-1520-237-23-4, Chapter 7, procedures for removal, inspection, cleaning, and installation.

(3) The APU check valve is a spring-loaded flapper type valve.

(4) Pressurized air opens the valve and it is spring-loaded closed.

f. APU Start Bypass Valve Location

Frame #0130 (APU Start Bypass Valve Location)

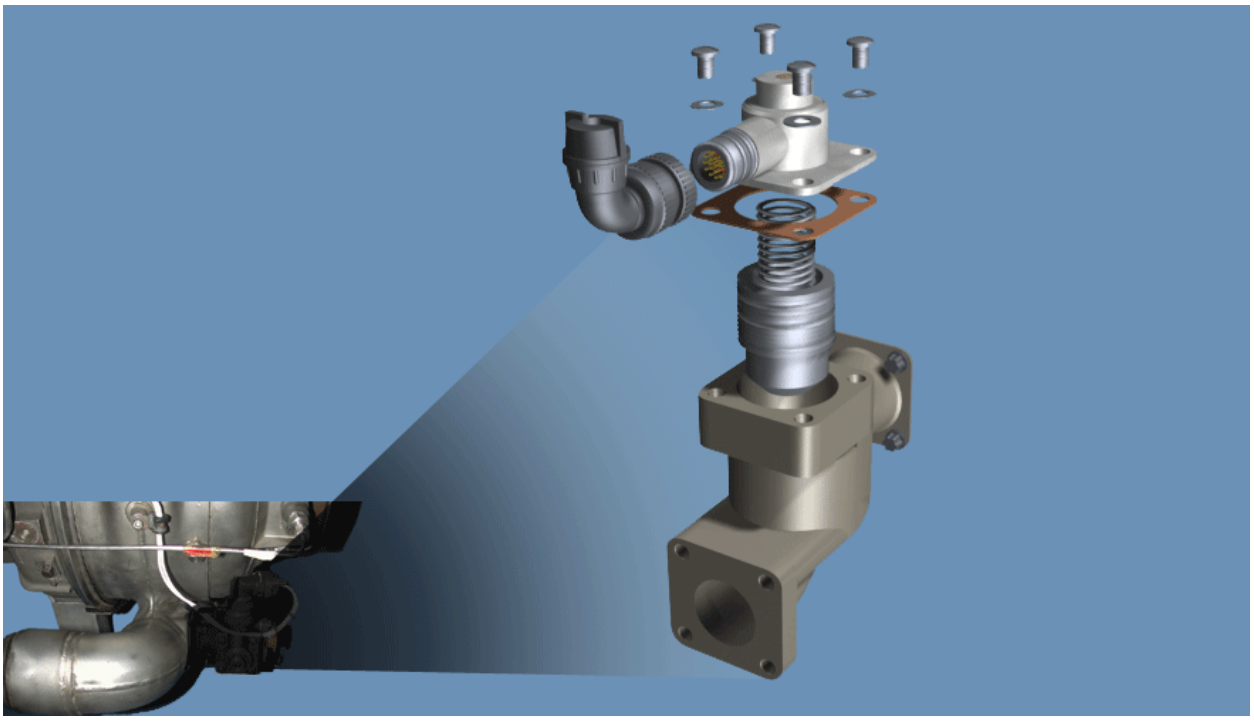


(1) The APU start bypass valve is located on the lower left hand side of the APU combustion chamber on the Turbomach APUs.

(2) They are not required on the Garret APUs due to a better fuel control on the Garret APU.

(a) APU Start Bypass Valve Description

Frame #0135 (APU Start Bypass Valve Description)

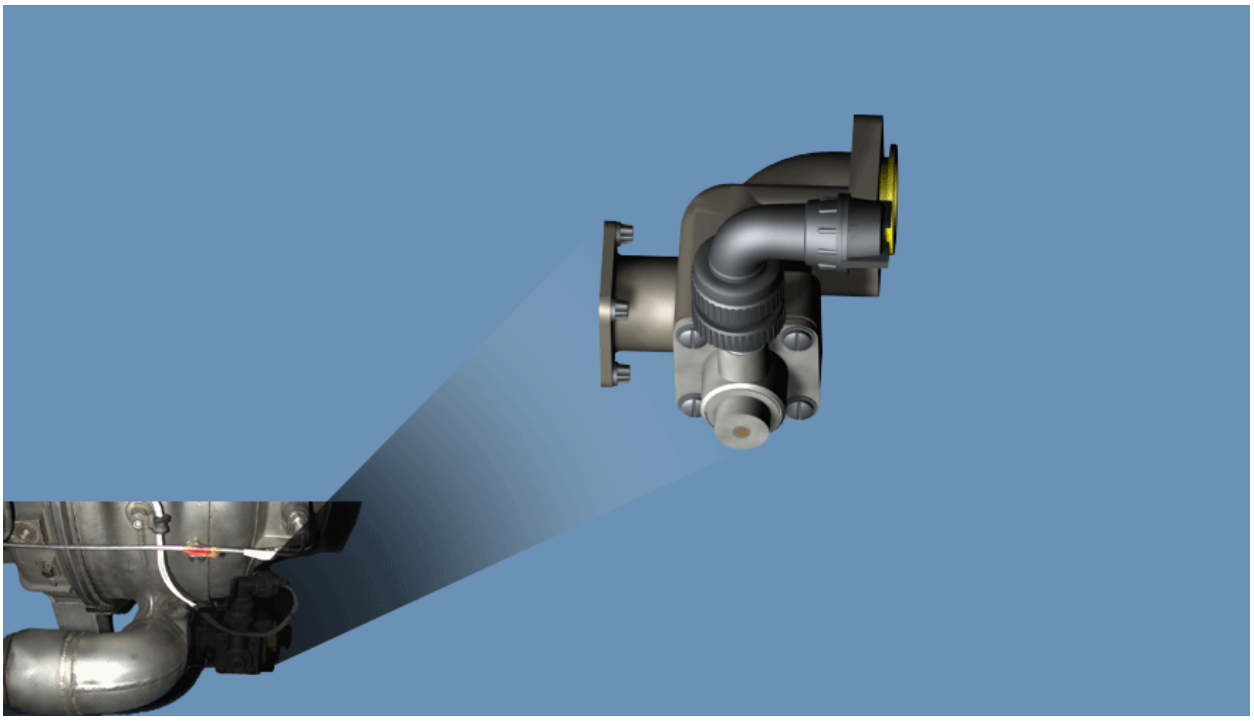


1) The APU start bypass valve is an electrically actuated valve that allows excess air to be dumped overboard until needed for engine start.

2) The valve opens to unload the compressor during the start sequence, preventing compressor stalls.

(b) APU Start Bypass Valve Operation

Frame #0140 (APU Start Bypass Valve Operation)

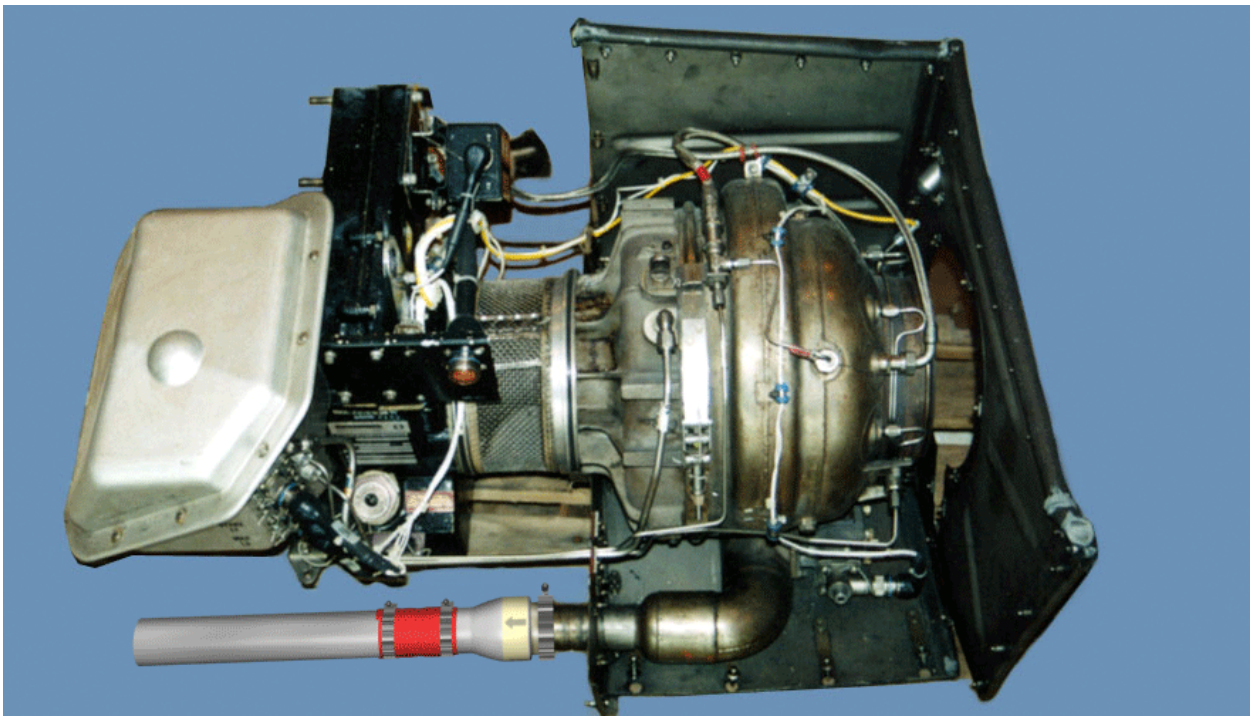


1) The APU start bypass valve is a solenoid-operated, normally open, pneumatic valve.

2) The valve is open for APU start and energized closed for engine start.

(c) APU Start Bypass Valve Power Source

Frame #0145 (APU Start Bypass Valve Power Source)



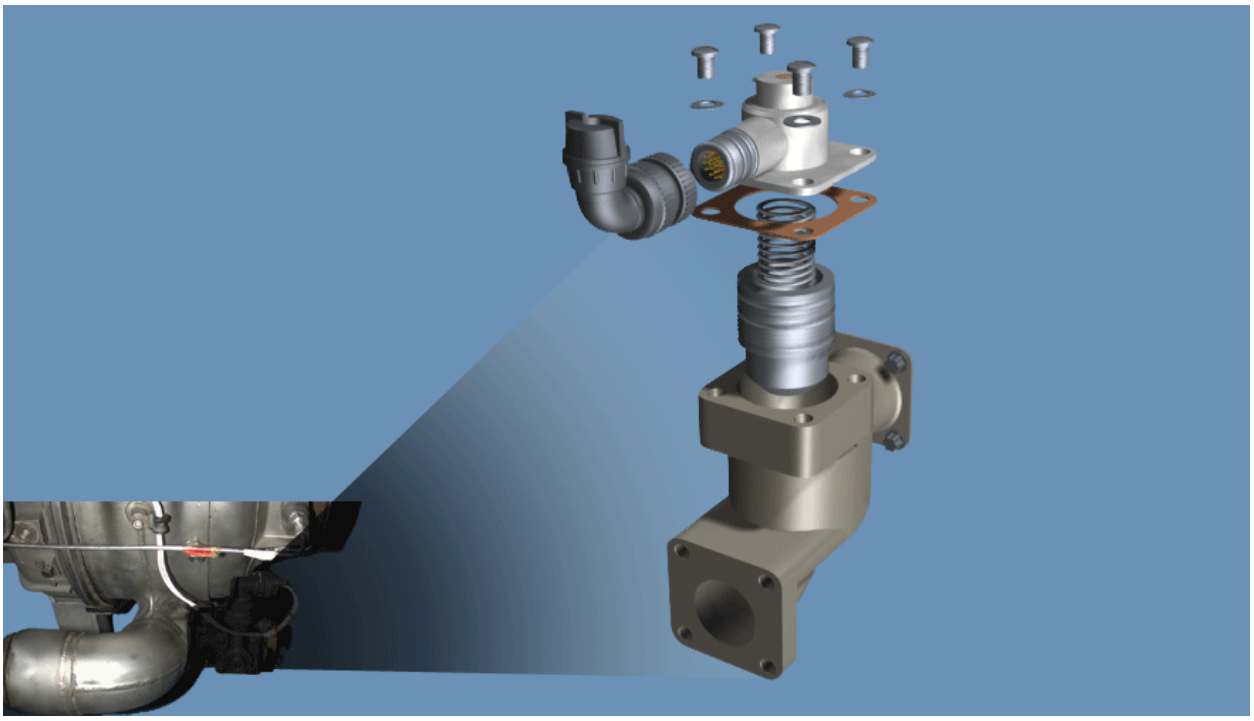
1) The APU start bypass valve is controlled by the APU Electronic Sequence Unit (ESU) and relay K22 in the right relay panel.

Frame #0145 (ESU)

2) The ESU is located in the cabin overhead and is the control element for the APU.

(d) APU Start Bypass Valve Maintenance Aspects

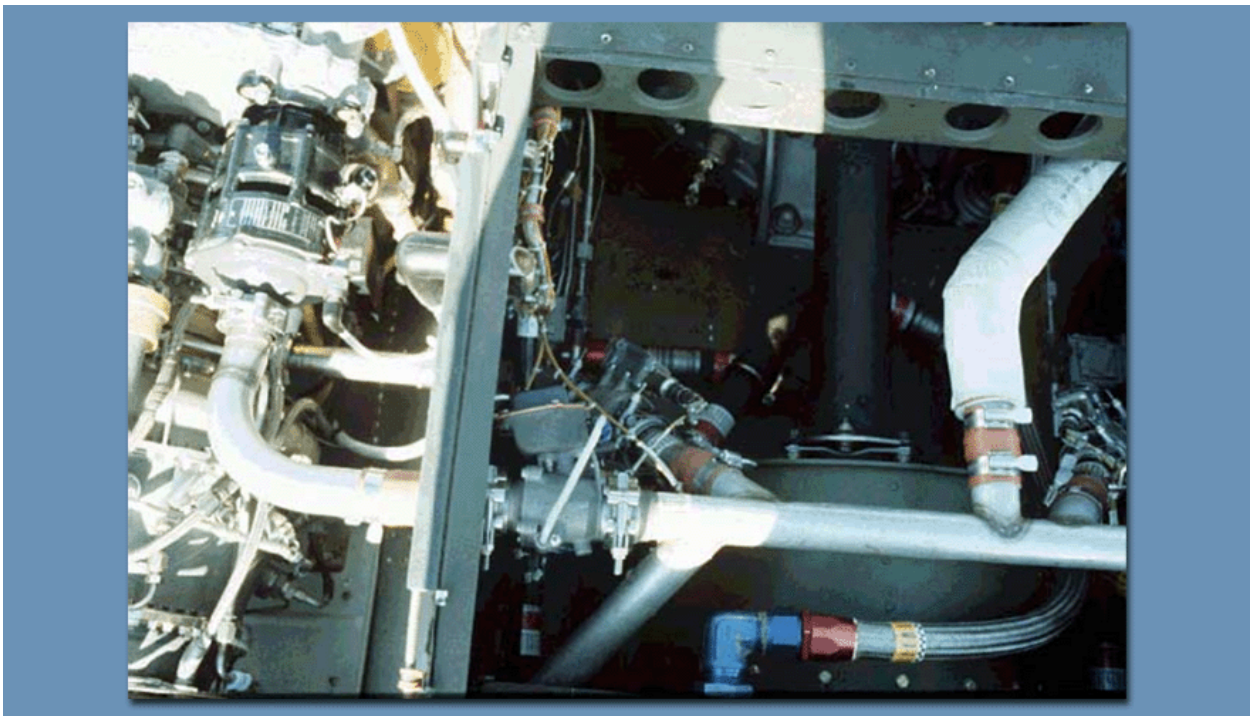
Frame #0150 (APU Start Bypass Valve Maintenance Aspects)



1) Troubleshooting procedures and maintenance tasks are located in TM 55-2835-208-23.

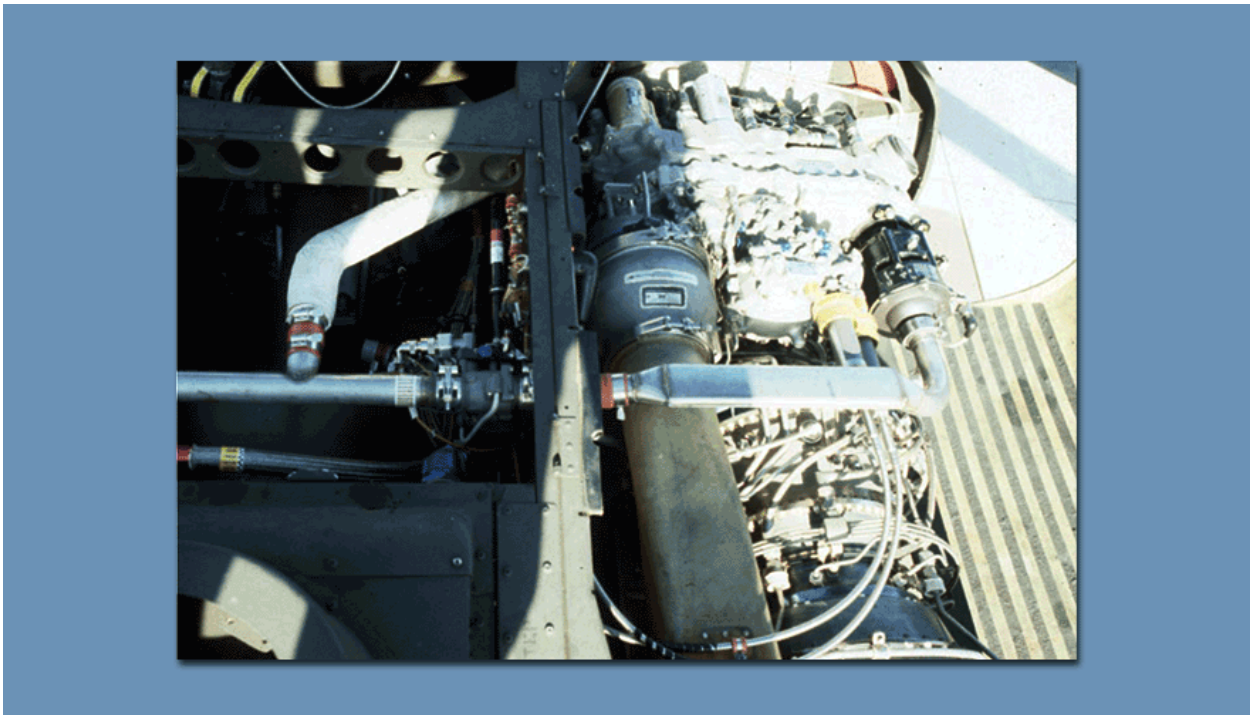
g. Air Turbine Starter

Frame #0155 (No.1 Engine Starter Location)



(1) The No. 1 engine starter is located on the accessory gearbox inner side near the firewall.

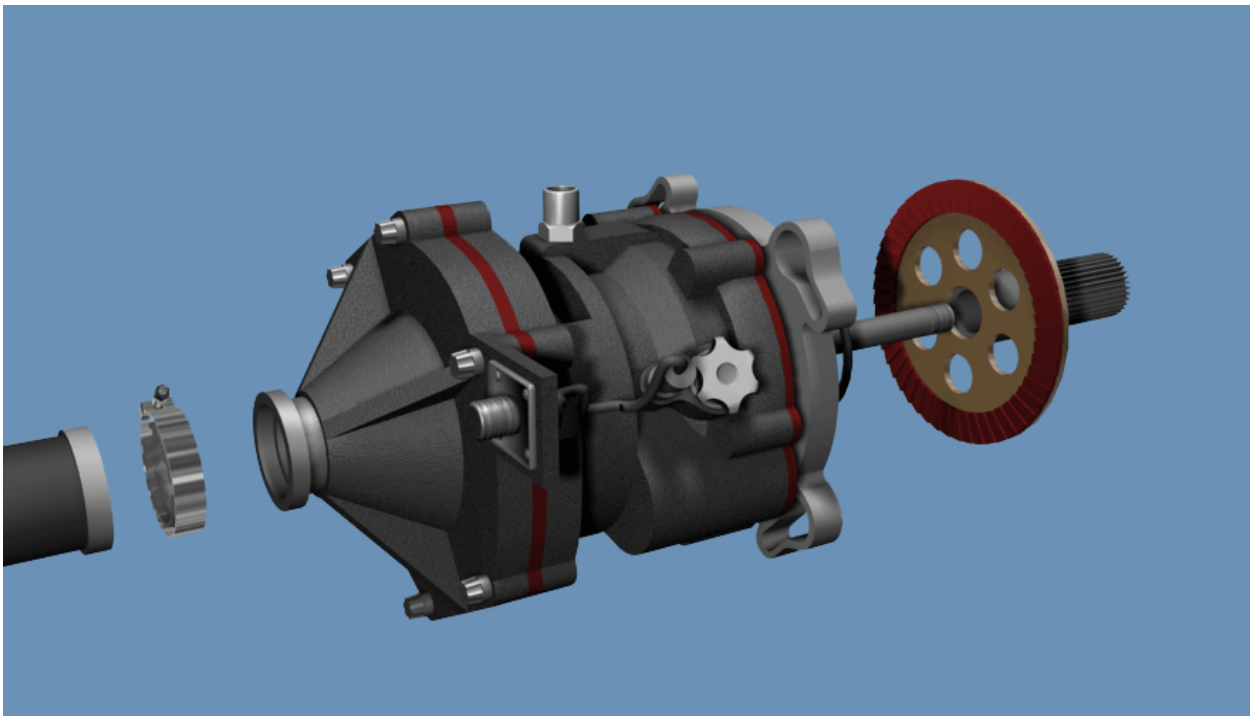
Frame #0155 (No. 2 Engine Starter Location)



(2) The No. 2 engine starter is located on the accessory gearbox outer side.

(a) Air Turbine Starter Description

Frame #0160 (Air Turbine Starter Description)



1) The air turbine starter converts pneumatic air pressure into mechanical force that turns the engine's accessory drive and Ng section.

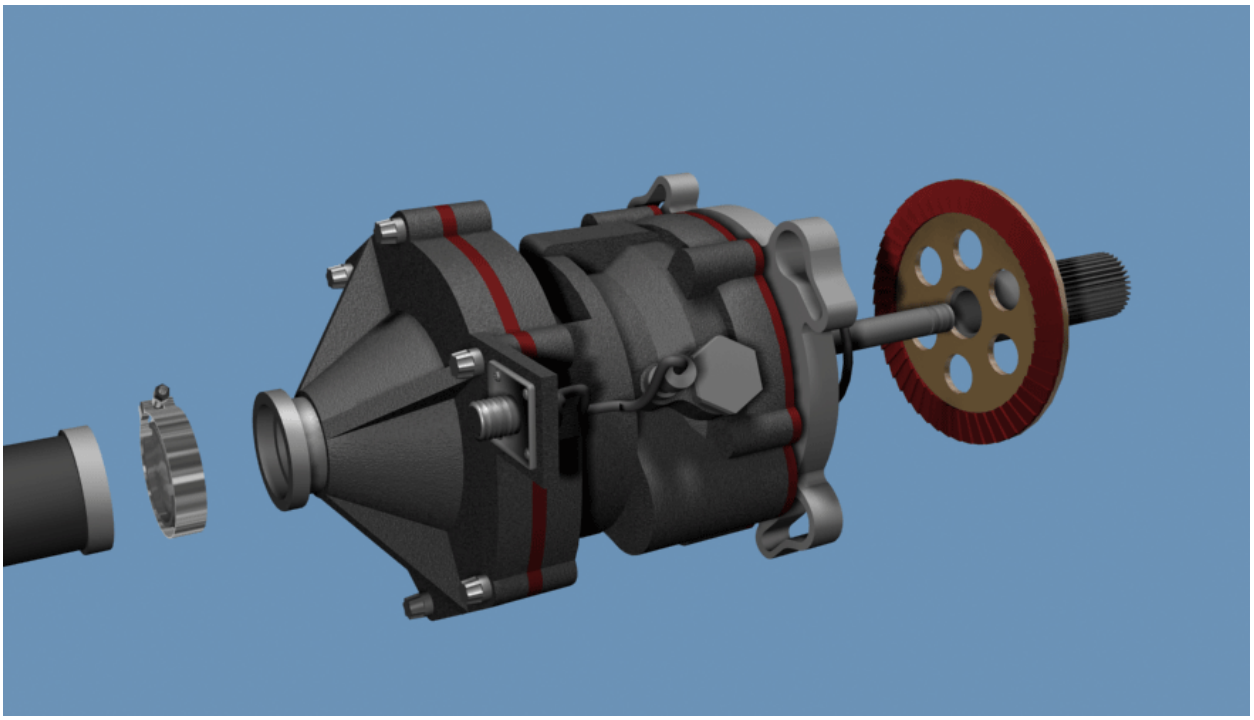
2) The starter has a small "shear" shaft, which allows the engine's accessory drive to continue to rotate in the event the starter seizes up.

3) The starter also has a magnetic "pick-up" type speed sensor on the right side, which measures the speed at which the internal gears are rotating.

4) This signal represents the speed at which the engine's Ng section is rotating and is sent to the starter speed switch.

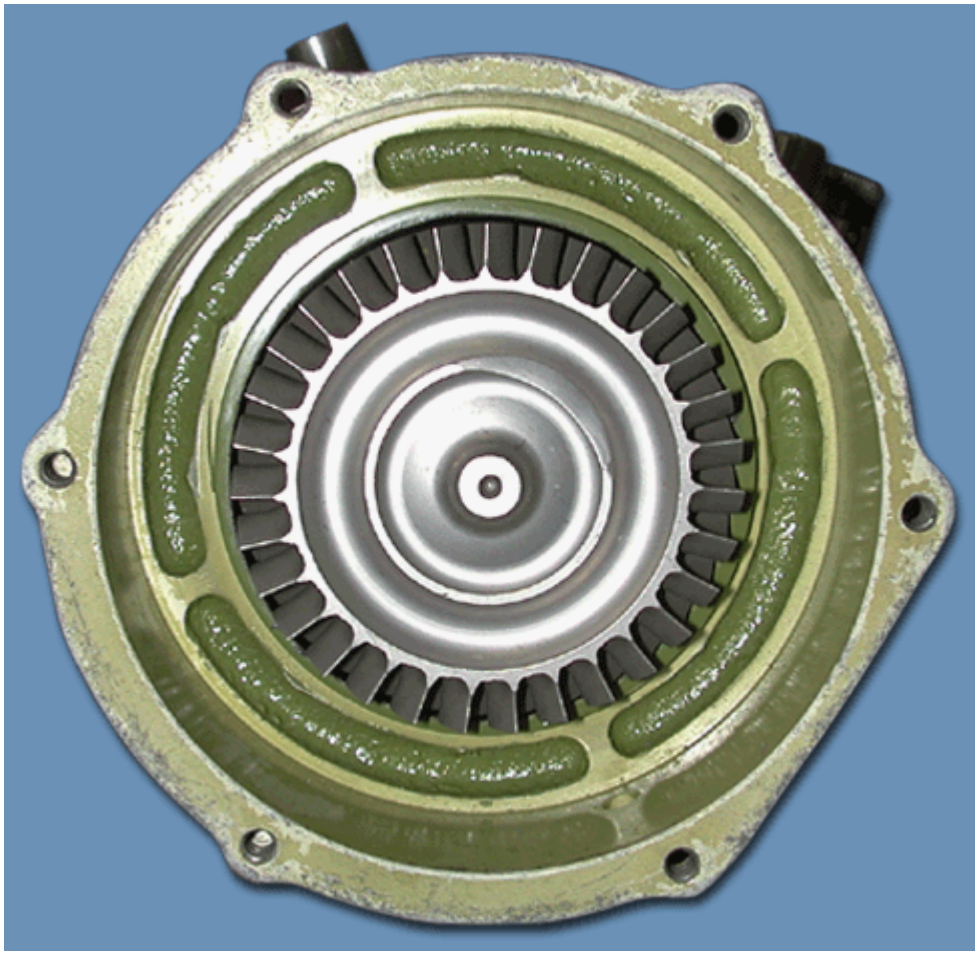
(b) Air Turbine Starter Operation

Frame #0165 (Air Turbine Starter Operation)



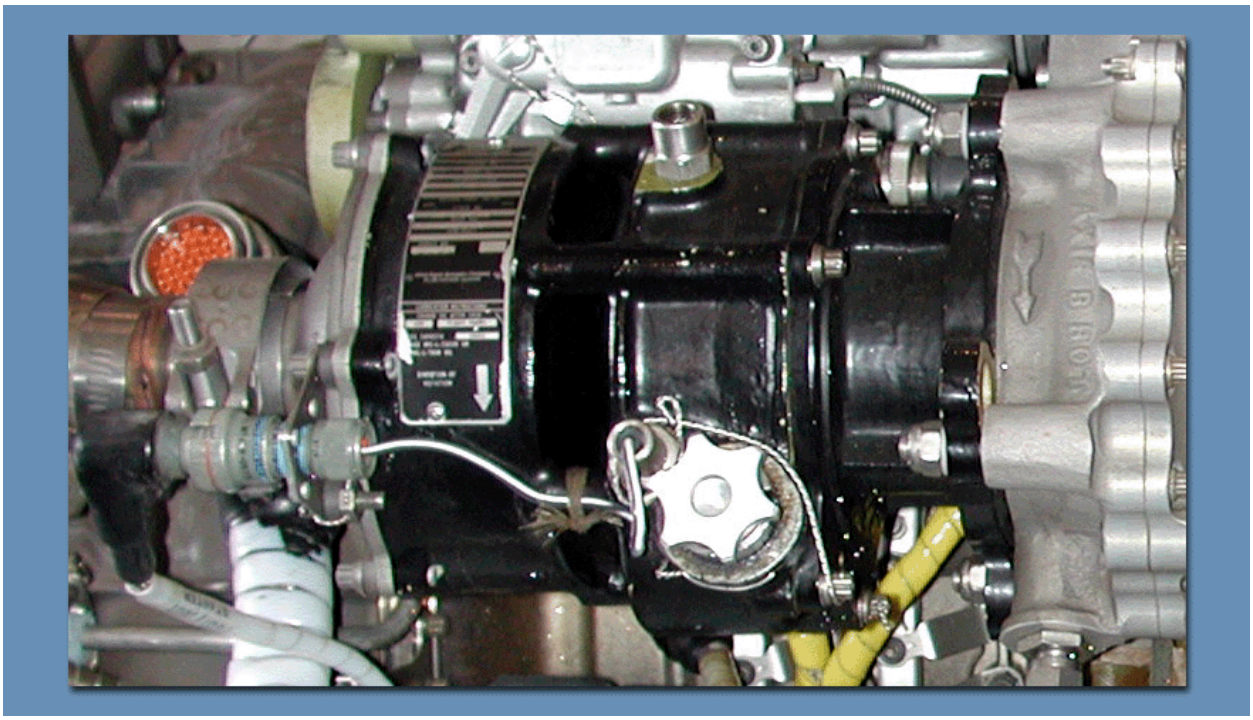
1) Air is forced across the impeller, turning the internal gear assembly and the engine.

Frame #0165 (Impeller)



(c) Air Turbine Starter Maintenance Aspects

Frame #0170 (Turbine Starter Maintenance Aspects)



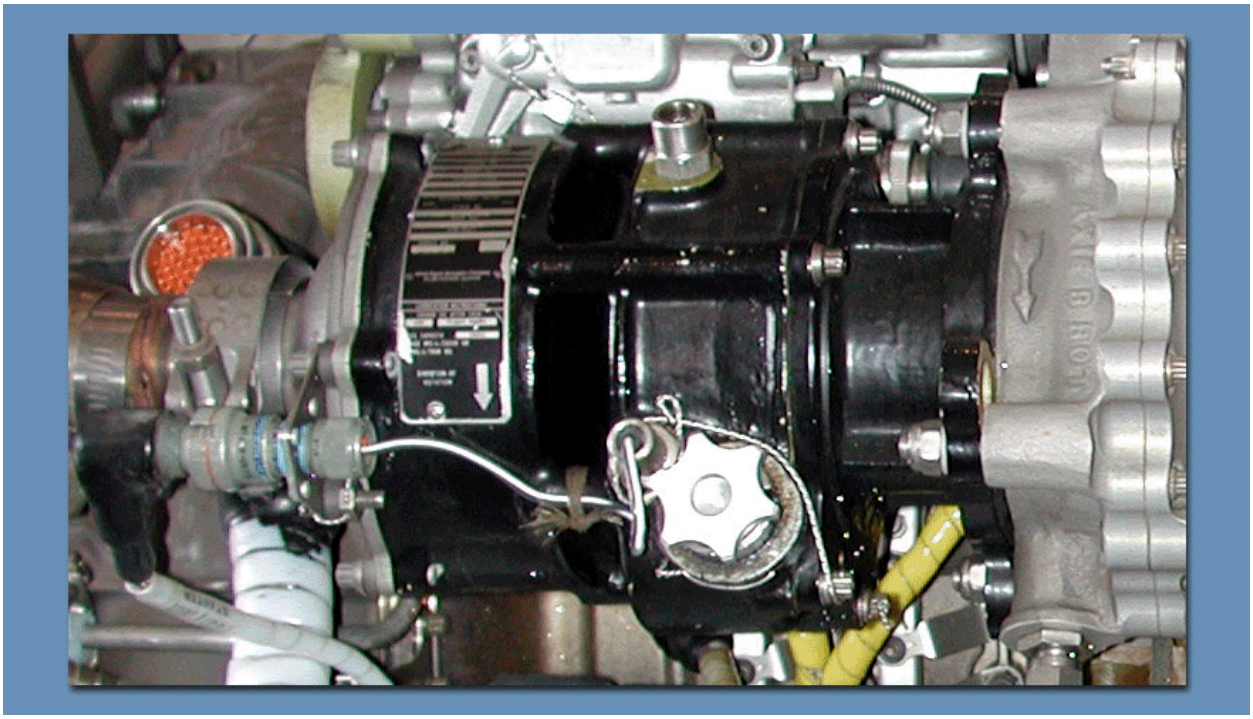
1) Special care should be taken to ensure the air turbine starter is serviced properly, otherwise damage may result to the starter.

2) The starter is serviced in accordance with TM 1-1520-237-23-1.

3) If the oil is contaminated, service IAW TM 1-2840-248-23 (T700/701/701C engine manual).

h. Speed Sensor

Frame #0157 (Speed Sensor)



(1) The speed sensor is located on the engine starter and provides an ac signal, proportional to engine speed, to the engine starter speed switch, which equates to 52%-65% Ng speed.

(2) The speed sensor switch can be replaced at the AVUM.

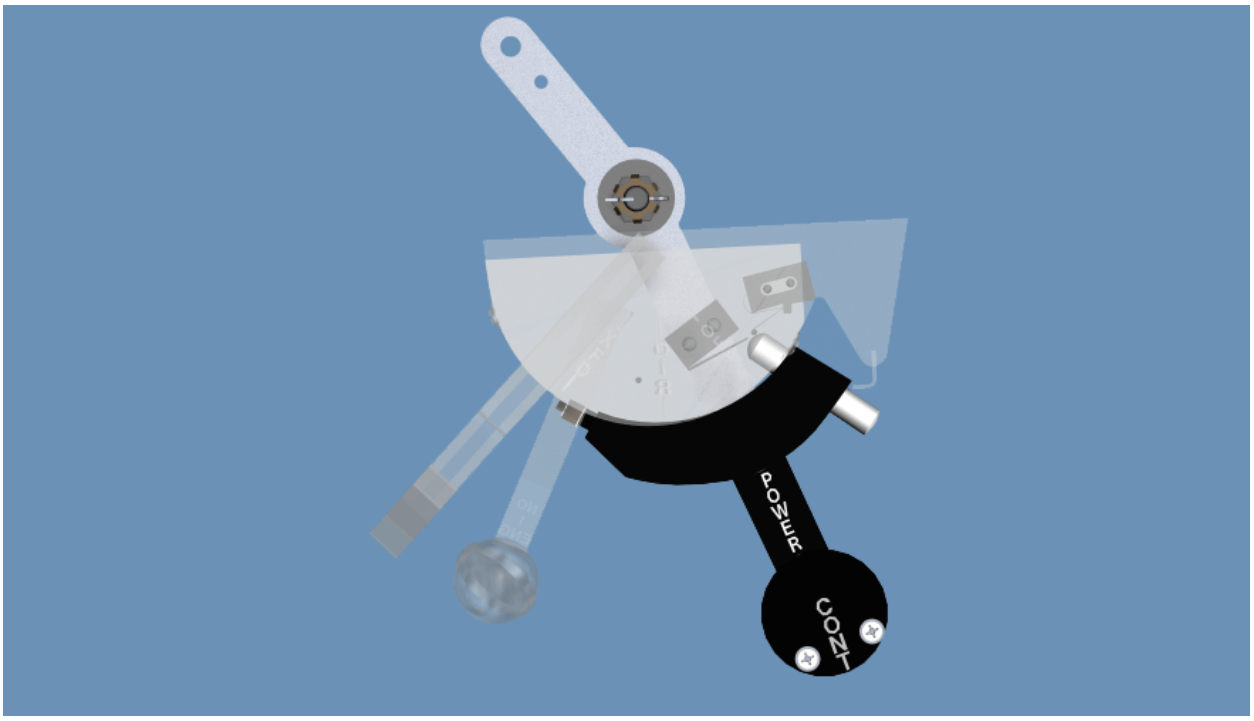
i. Engine Control Quadrant Location

Frame #0175 (Engine Control Quadrant Location)

(1) The engine control quadrant is centered on the upper console and permits either the pilot or the copilot to select engine speed, stopcock fuel, select engine fuel supply, start engine, abort start, and control the engine fire extinguisher.

(a) Engine Control Quadrant Switches

Frame #0225 (Engine Control Quadrant Switches)



1) The starter switch is located on the engine quadrant aft of the PCLs.

2) The starter switch is a micro switch that is activated by the retarded engines power control lever's start button.

3) When pressed, the starter switch allows voltage to pass through to energize the start relay.

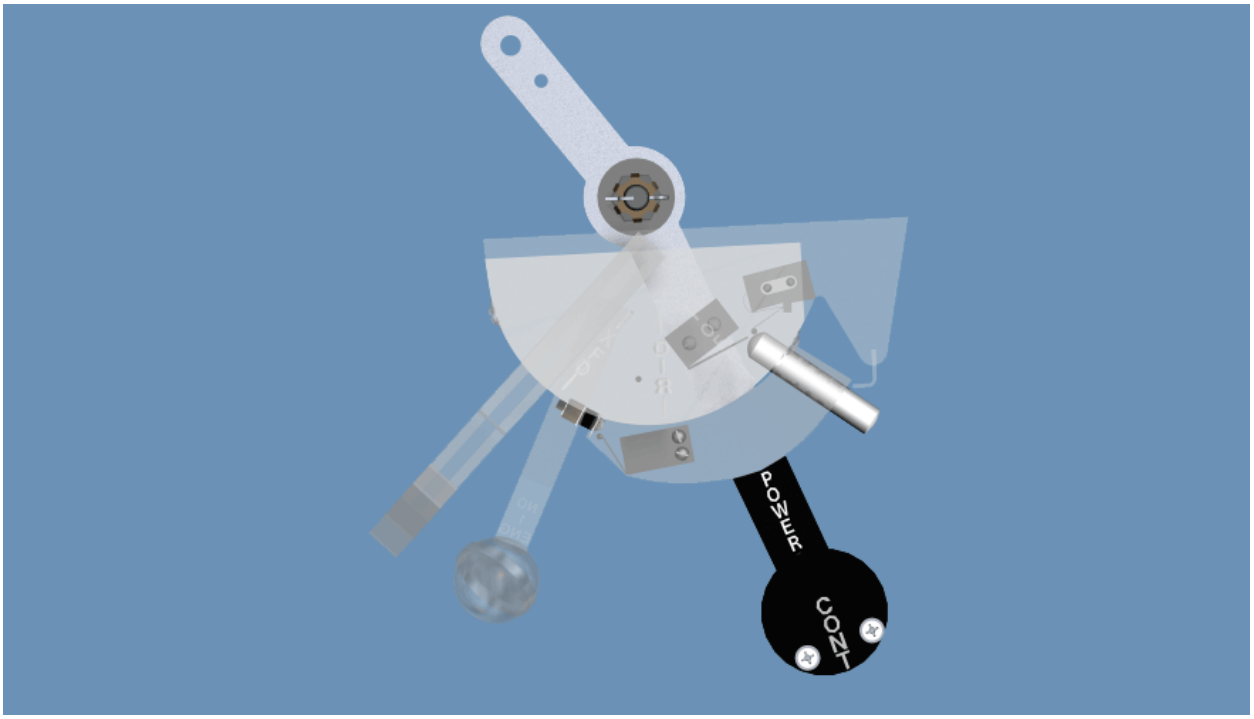
4) The override switch is located on the PCLs.

5) It is adjusted to allow activation by the start button if pressed.

6) This switch and the starter switch can be activated either together (PCL retarded) or separately (PCL idle) in the event of a starter that will not stay engaged.

7) It allows voltage to pass through to energize the start relays and also to light the starter caution light (false start light).

Frame #0225 (Abort Switch)



8) The abort switch is located on the forward side of the engine power control lever.

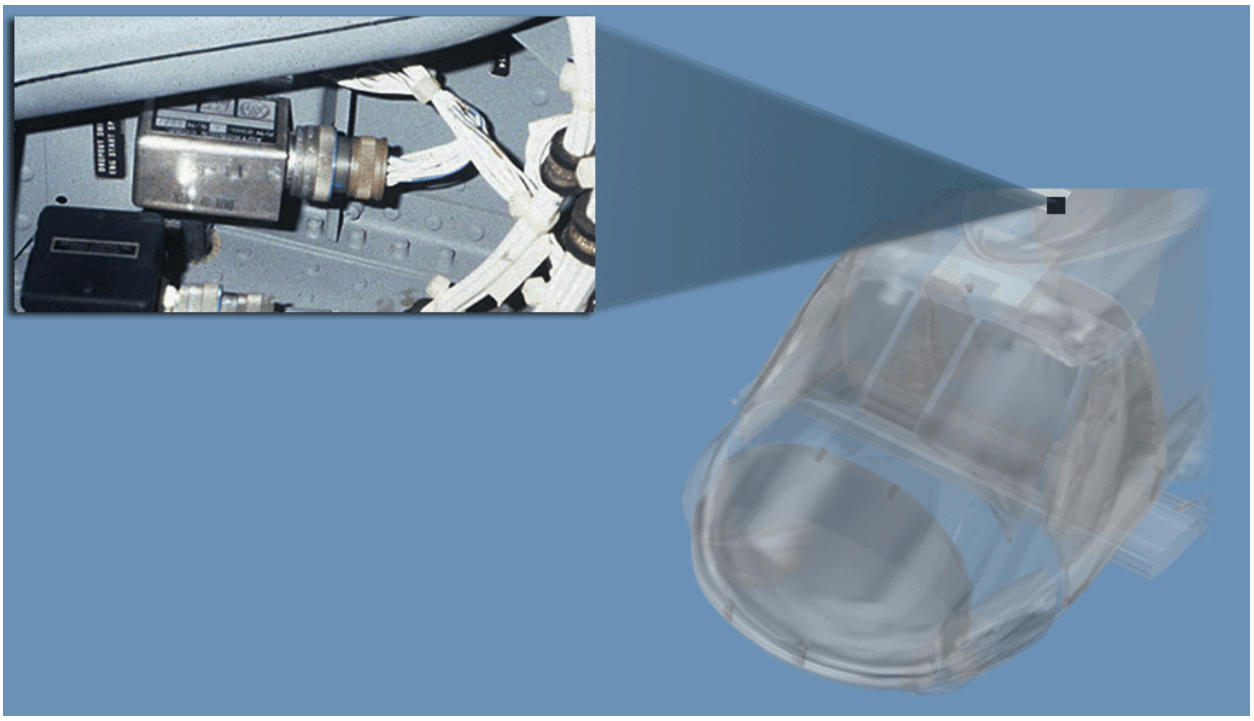
9) The abort switch is a micro switch that is adjusted to allow activation when the power control lever is pulled down.

10) Activation removes voltage from the start relays and ultimately the start control valve.

11) The abort switch will activate regardless of the position of the engine power control lever.

j. Starter Speed Switch

Frame #0230 (Starter Speed Switch)



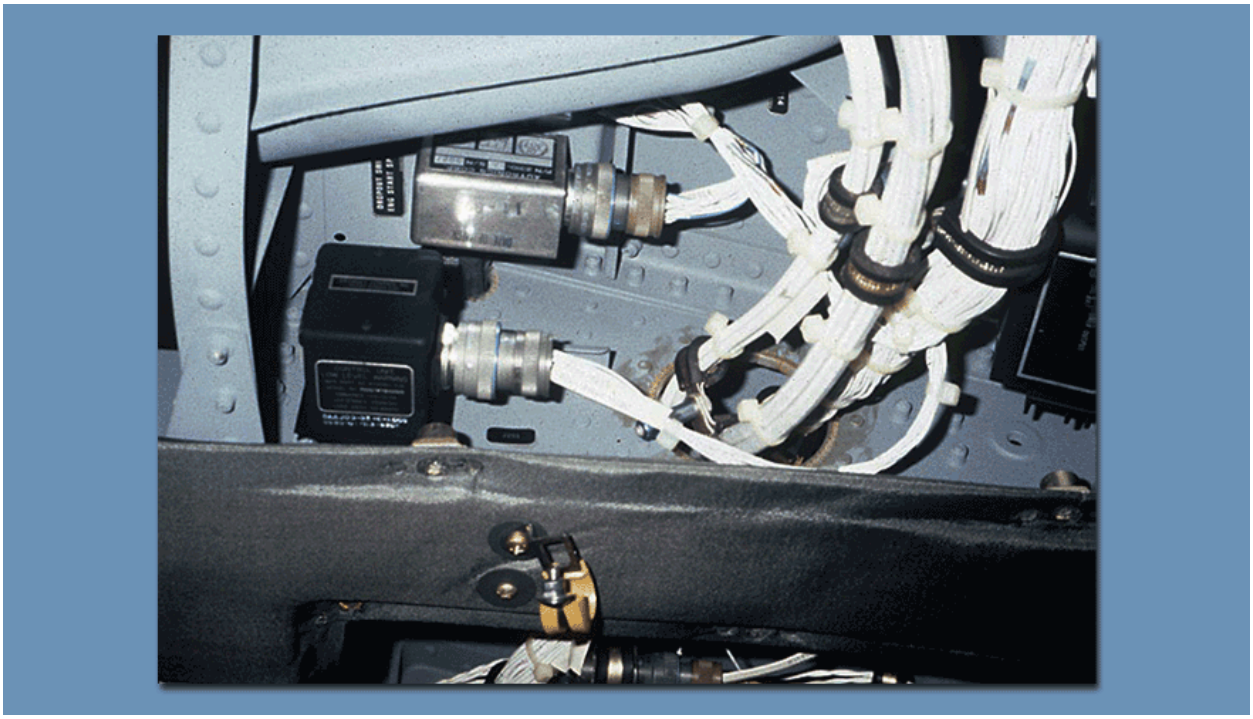
(1) The starter speed switch is located in the upper cabin area above the left-hand gunners station.

(2) As engine speed increases, the speed pickup sensor (mounted on and driven by the air turbine starter) produces an ac signal that electrically energizes the starter speed switch, holding the engine start relay in the energized position.

(3) When engine speed reaches 52%-65% Ng, the starter speed switch deactivates, closing the engine start control valve.

(a) Starter Speed Switch Operation

Frame #0240 (Starter Speed Switch Operation)



1) The starter speed switch performs the AUTO HOLD FUNCTION of the engine start system by using signals from the speed sensors and voltages from the start control valves.

2) TM 1-1520-237-23-3 addresses troubleshooting procedures and malfunctions of the starter speed switch.

3) TM 1-1520-237-23-4 addresses removal and replacement of this component.

k. Keylock Ignition Switch

Frame #0250 (Keylock Ignition Switch)

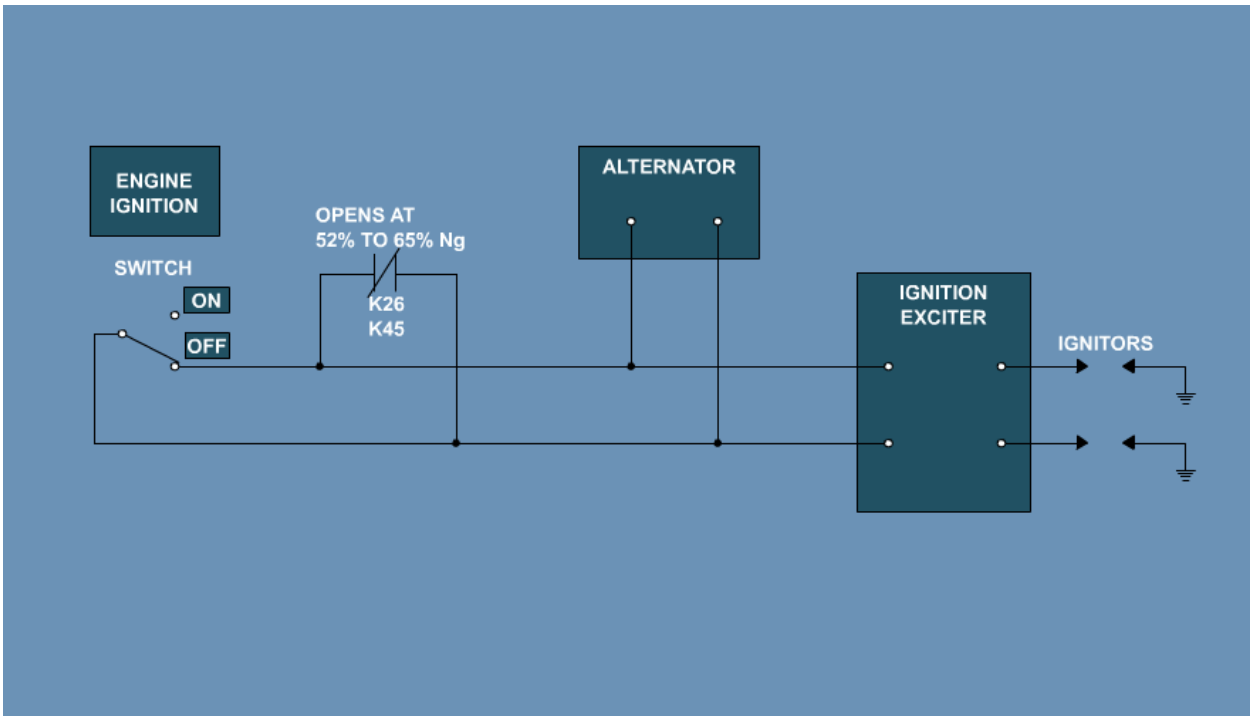
(1) The keylock ignition switch is located on the instrument panel, below the Central Display Unit (CDU).

(2) The keylock ignition switch is a two-position switch, (OFF or ON). The switch serves both engines.

(3) If the switch is in the OFF position, neither engine can be started, however, motoring capability remains.

(a) Keylock Ignition Switch Operation

Frame #0260 (Keylock Ignition Switch Operation)



1) When the ENGINE IGNITION switch is in the OFF position, a short is placed across output of both engine alternators.

2) When the ENGINE IGNITION switch is in the ON position, the short is removed from both alternators, allowing current flow to the ignition exciter and to the igniter plugs.

(b) Keylock Ignition Switch Maintenance Aspects

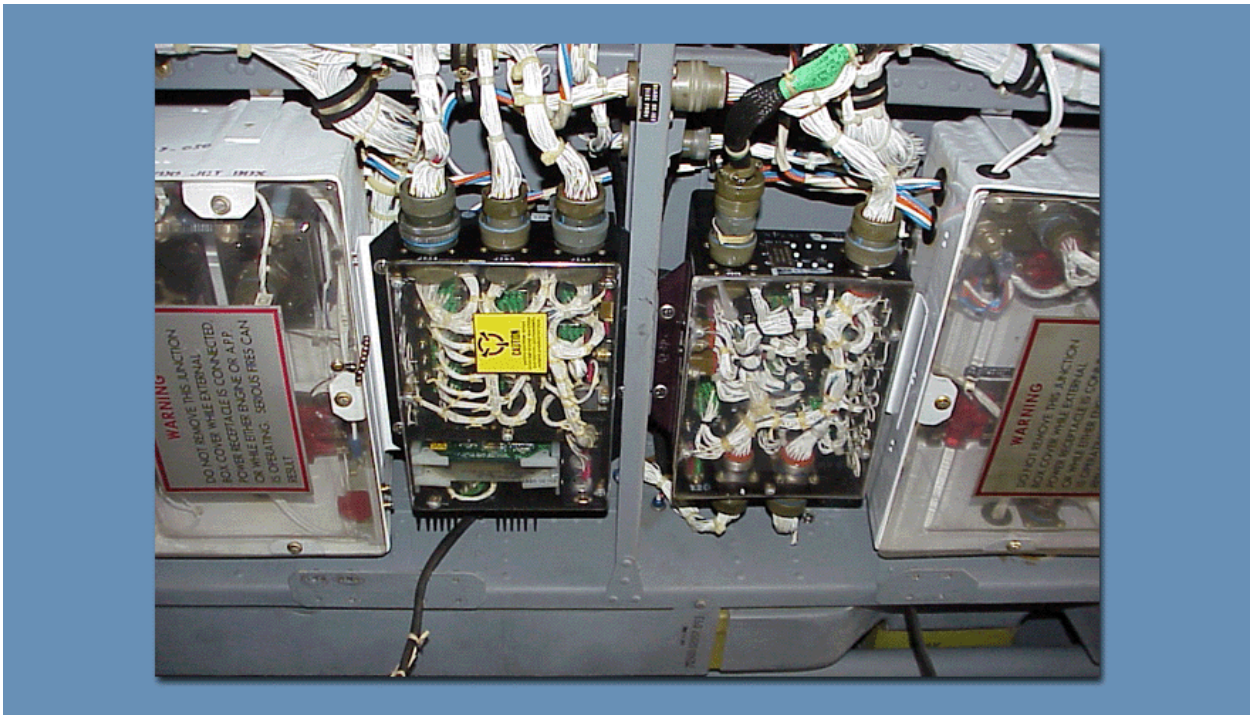
Frame #0265 (Keylock Ignition Switch Maintenance Aspects)

1) TM 1-1520-237-23-3 addresses troubleshooting procedures and malfunctions.

2) TM 1-2840-248-23 addresses removal and replacement tasks.

l. Starter Relays

Frame #0270 (Relay Panels)



(1) The No. 1 engine starter relay (K45) is located in the left relay panel.

(2) The No. 2 engine starter relay (K26) is located in the right relay panel.

m. Circuit Breaker Panels

Frame #0275 (Circuit Breaker Panels)

(1) The NO. 1 ENG START circuit breaker is located on the DC ESNTL BUS. The DC ESNTL BUS (No. 1 Start system) provides voltage through the NO. 1 ENG START circuit breaker to K45 relay in the left relay panel, to energize the No. 1 engine start control valve.

(2) The NO. 2 ENG START circuit breaker is located on the NO. 2 DC PRI BUS.

(a) The No. 2 DC PRI BUS (No. 2 Start system) provides voltage through the NO. 2 ENG START CONTR circuit breaker to K26 relay in the RIGHT RELAY PANEL to energize the No. 2 engine start control valve.

(3) The CAUTION/ADVISORY panel is located on the center instrument panel. When the start button is pressed, air from the selected source is directed through the start control valve to the engine starter.

(a) The #1 ENGINE STARTER or #2 ENGINE STARTER caution light will go on at this time and remain on until the starter drops out.

n. Prime Shutoff Valves

Frame #0271 (Prime Shutoff Valves)

(1) The prime shutoff valves are located on the top inboard center of the main fuel cells.

(2) When the starter switch is pressed, the start control valve is opened and the relay is energized.

(3) This also opens the prime shutoff valve.

(4) The engine fuel system is primed when the prime shutoff valve is opened.

o. Prime Boost Pump

Frame #0272 (Prime Boost Pump)

(1) The prime boost pump is located on top of the right main fuel cell.

(2) When the toggle switch on the upper console marked FUEL PUMP, FUEL PRIME, OFF, and APU BOOST, is in the FUEL PRIME position, the prime boost pump is energized and the prime shutoff valve to each main engine fuel supply line is opened.

(3) This mode will illuminate the PRIME BOOST PUMP ON capsule on the CAUTION/ADVISORY panel.

CHECK ON LEARNING

1. What is the purpose of the starter speed switch?

2. How much damage is allowed in the pneumatic tubing?

3. What is the purpose of the APU check valve?

SECTION III. - SUMMARY

2. REVIEW/SUMMARIZE:

You have completed the UH-60 Engine Start System components topic. The key points to remember are:

- The three methods of providing air for engine starts are:
  - APU
  - Crossbleed starting from the other engine.
  - Ground source
- The main components of the Engine Start System are:
  - Pneumatic tubing
  - Start control valves
  - Bleed-air shutoff valves
  - APU check valve
  - APU start/bypass valve
  - Air turbine starter
  - Speed sensor
  - Engine control quadrant switches
  - Starter speed switch
  - Keylock ignition switch
  - Starter relays
  - Circuit breaker panels
  - Prime shutoff valve
  - Prime boost pump

C. ENABLING LEARNING OBJECTIVE ELO No. 3

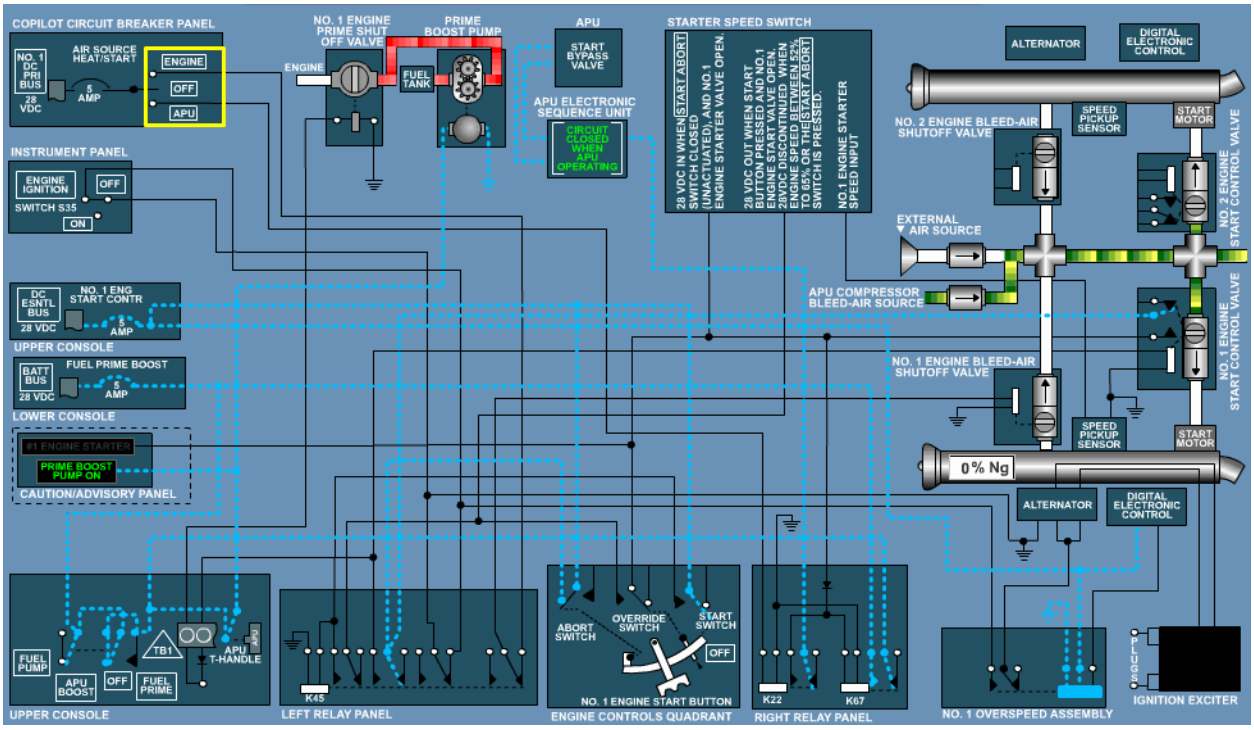
ACTION: Troubleshoot the engine start system using schematic diagrams.

CONDITION: Given electrical schematics.

STANDARD: IAW TM 1-1520-237-23-3 and class reference materials.

a. Engine Start System

Frame #0290 (Engine Start System Schematic)



(1) The following scenario is with the APU online, and the FUEL PRIME switch in the OFF position.

(2) Placing the AIR SOURCE HEAT/START switch to the APU position sends 28 V dc to energize relay K22, and causes the contacts of relay K22 to close.

(3) (K22 controls the Start/Bypass Valve).

(4) Positioning the ENGINE IGNITION switch to the ON position, removes one of the two shorting points from the alternator output.

(5) The other shorting point is removed as relay K45 is energized, after the start switch has been pressed.

(6) Pressing the ENGINE START button routes 28 V dc to the left relay panel, energizing relay K45.

(7) Simultaneously, 28 V dc is routed from the starter speed switch to relay K45, creating a holding circuit and allowing the ENGINE START button to be released.

(8) Power (28 V dc) is then routed to the No. 1 Engine Prime Shutoff Valve, opening the valve and allowing fuel flow to the engine.

(9) Power (28 V dc) is also routed to the No. 1 Engine Start Control Valve, energizing the relay and opening the valve, allowing bleed-air from the APU to flow to the engine starter.

(10) The closed contacts of the NO. 1 Engine Start Control Valve, routes 28 V dc to the starter speed switch, to the relay K67 holding circuit, and illuminates the #1 ENGINE STARTER capsule on the CAUTION/ADVISORY panel.

(11) The engine speed pickup sensor sends a signal to the starter speed switch, and as the engine spools up the alternator, produces an output to the ignition exciter which fires the igniter plugs.

(12) When the engine Ng reaches 52-65%, the starter speed switch removes power to holding circuit for relay K45, effectively closing the No. 1 Engine Start Control Valve, shorting out the alternator output, removing the ignition source.

(13) It also closes the No. 1 Prime Shutoff Valve, and the #1 ENGINE STARTER capsule goes out.

CHECK ON LEARNING

1. When does the #1 ENGINE STARTER caution light come on?

2. Which switch causes the start control valve to open?

3. During engine start, ignition will continue until the ENGINE IGNITION switch is moved to the OFF position or:_____.

SECTION IV. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the UH-60 Engine Start System troubleshooting lesson. Key points to remember are:

- Placing the AIR SOURCE HEAT/START switch to the APU position sends 28 V dc to relay K22 and causes the contacts to close.
- Positioning the ENGINE IGNITION switch to the ON position, removes one of two shorting points from the alternator output. The other shorting point is removed as relay K45 is energized.
- Pressing the ENGINE START button routes 28 V dc to the left relay panel, energizing relay K45. Simultaneously, 28 V dc is routed from the starter speed switch to relay K45, creating a holding circuit and allowing the ENGINE START button to be released.
  - Power (28 V dc) is then routed to the No. 1 engine prime shutoff valve, opening the valve and allowing fuel flow to the engine.
  - Power is also routed to the start control valves, energizing the relay and opening the valve and allowing bleed-air from the APU to flow to the engine starter.
- The closed contacts of the No. 1 Engine Start Control Valve, routes 28 V dc to the starter speed switch, to the relay K67 holding circuit, and illuminates the #1 ENGINE STARTER capsule on the CAUTION/ADVISORY panel.
- The engine speed pickup sensor sends a signal to the starter speed switch, and as the engine spools up the alternator, produces an output to the ignition exciter, which fires the igniter plugs.
- When the engine Ng reaches 52-65%, the starter speed switch removes power to holding circuit for relay K45, effectively closing the No. 1 Engine Start Control Valve, shorting out the alternator output, removing the ignition source. It also closes the No. 1 Prime Shutoff Valve, and the #1 ENGINE STARTER capsule goes out.

APPENDIX A

ILLUSTRATION LISTING

FRAME #	FRAME TITLE
0020	Engine Start System
0030	Auxiliary Power Unit
0035	Cross Bleed Starting
0040	Ground Source
0040A	Buddy Start
0045	Pneumatic Tubing Location
0045A	Nipple Check Valve
0045B	Lower Tube
0045C	Middle Tube
0045D	Rear Tube
0045E	Front Tube
0045F	APU Compartment Front Tube
0045G	Engine Compartment Tubes (Uninstalled)
0045G	Engine Compartment Tubes (Installed)
0050	Pneumatic Tube Description
0055	Tubing Maintenance Aspects
0060	Start Control Valves Location
0065	Start Control Valves Description
0065	Start Control Valves Description (Exploded)
0070	Start Control Valves Operation
0070	Start Control Valves Operation2
0075	Start Control Valves Power Source
0075	DC ESNTL BUS
0075	NO 2 DC PRI BUS
0080	Start Control Valve Maintenance Aspects
0085	Bleed-Air Shutoff Valves Location
0090	Bleed-Air Shutoff Valves Description
0090	Bleed-Air Shutoff Valves Description (Exploded)
0095	Bleed-Air Shutoff Valves Operation
0100	NO 1 DC PRI BUS
0100	Overhead Console
0105	Bleed-Air Shutoff Valves Maintenance Aspects
0110	APU Check Valve Location
0125	APU Check Valve Maintenance Aspects
0130	APU Start Bypass Valve Location
0135	APU Start Bypass Valve Description
0140	APU Start Bypass Valve Operation
0145	APU Start Bypass Valve Power Source
0145	ESU
0150	APU Start Bypass Valve Maintenance Aspects
0155	NO. 1 Engine Starter
0155	NO. 2 Engine Starter
0157	Speed Sensor
0160	Air Turbine Starter Description
0165	Air Turbine Starter Operation
0165	Impeller
0170	Air Turbine Starter Maintenance Aspects
0175	Engine Control Quadrant Location
0225	Engine Control Quadrant Switches
0230	Starter Speed Switch

APPENDIX B

TEST AND TEST SOLUTIONS

1. This appendix is only used when the test and solutions are internal to the POI file.
2. When the test and solutions are internal to the POI file, then the POI file becomes a FOR OFFICIAL USE ONLY document.