

GULFSTREAM G550
OPERATING MANUAL
ENGINE FUEL AND CONTROL

2A-73-10: Engine Fuel System

1. General:

A. Description:

Fuel stored in the aircraft tanks is pressurized by the tank boost pumps and supplied to the engines after passing through the tank shutoff valves. Upon reaching the engine, fuel is further pressurized by a low pressure pump element, warmed in a heat exchanger containing engine oil, filtered and pressure monitored and supplied to a high pressure pump element that raises fuel pressure to the level required for engine operation. From the high pressure pump element fuel is routed to the metering unit that regulates fuel volume in response to commands from the Full Authority Digital Electronic Control (FADEC). Modulated fuel volume passes through a high pressure filter that houses a fuel flow transmitter and then to combined unit containing a shutoff valve and fuel flow splitter that divides the fuel into a lines supplying the upper and lower fuel injector nozzles in the combustion chamber. (See Figure 1.)

2. Description Of Subsystems, Units And Components:

A. Low Pressure Pump:

The low pressure pump receives the fuel supplied by the main and/or alternate boost pumps. The pump, driven by a shaft mounted in the accessory gearbox, uses centrifugal motion to increase fuel pressure to one hundred fifty (150) psi. If the pump fails, fuel can still pass through the inoperative centrifugal element. After pressurization fuel is routed to the fuel / oil heat exchanger.

B. Fuel Cooled Oil Cooler (FCOC):

A heat exchanger, termed the Fuel Cooled Oil Cooler (FCOC), warms engine fuel and cools engine oil. The unit acts as a radiator with the fuel passing between vanes warmed internally by engine oil. After fuel temperature has been increased, the fuel is filtered.

C. Low Pressure Fuel Filter:

The low pressure fuel filter is attached to the FCOC outlet and removes any debris in fuel that might damage the high pressure pump. A filter bypass line is provided to circumvent the filter if it becomes blocked or clogged. In the event of blockage, a pressure differential switch will open a relief valve allowing fuel to enter the bypass if fuel pressure entering the filter exceeds the pressure exiting the filter by twenty-five (25) psi. The pressure differential switch will supply a signal to the FADEC when the entering and exiting fuel pressures differ by five (5) psi to warn of an impending filter bypass. The FADEC communicates the condition to the Modular Avionics Units (MAUs) that in turn prompt the Monitor and Warning System (MWS) to display a blue "L - R Fuel Filter" Crew Alerting System advisory (CAS) message to inform the flight crew of the condition.

D. Low Fuel Pressure Switch:

A low fuel pressure switch is installed adjacent to the filter assembly to monitor the fuel pressure prior to fuel entering the high pressure fuel pump. If sensed fuel pressure drops below fifty-five (55) psi, the FADEC

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communicates with the MWS through the MAUs to prompt the display of a blue "L - R Engine Fuel Pressure" advisory CAS message.

E. High Pressure Pump:

After filtration, fuel is directed into the high pressure pump. Unlike the centrifugal low pressure pump, the high pressure pump is a positive displacement gear pump. The pump shares the drive shaft on the engine accessory gearbox with the low pressure pump. The high pressure pump boosts fuel pressure to twelve hundred (1,200) psi. then routes the pressurized fuel to the Fuel Metering Unit (FMU) for modulation by the FADEC.

F. Fuel Metering Unit (FMU):

The fuel metering unit modulates fuel flow to the engine in response to commands from the FADEC. Since the high pressure fuel pump always delivers fuel volume in excess of engine demands (in order to provide immediate engine response to power lever movements), the FMU routes excess fuel to return to the high pressure pump inlet at high power settings or to the FCOC at low power settings.

Outlets at the FMU also provide the means to deliver warm engine system fuel to the wing fuel tanks to maintain the tank temperature at satisfactory limits. The FUEL RETURN switch, located on the fuel system panel on the cockpit overhead controls the outlet at the FMU. If the switch is positioned to the normal AUTO position, the FMU will return warmed fuel to the wing fuel tanks whenever fuel tank temperature drops below five degrees centigrade (5°C). For a description of the Heated Fuel Return System (HFRS), see Section 2A-28-30: Fuel Distribution.

The pressurized fuel within the FMU is used as a hydraulic force to control the position of the variable inlet guide vanes and variable stator vanes that separate the first three stages of the high pressure compressor. Vane position is determined by the FADEC adjusting the angle of attack of the vanes to optimize airflow generated by the rotating compressor stages. The FADEC electrically signals the FMU to port pressurized fuel to the increase or decrease angle side of the hydraulic actuator controlling variable vane position.

The FMU also houses the high pressure shutoff valve that is controlled by a direct electrical connection to the FUEL CONTROL switches on the cockpit center console. The shutoff valve is also controlled by the engine FADEC. When the cockpit FUEL CONTROL switches are on, the shutoff valve provides a means to shutdown the engine in the event of an overspeed of either the low pressure or high pressure turbine. The speed of each turbine section is monitored by two independent overspeed protection circuits. If both circuits detect an overspeed, the FADEC will signal the high pressure shutoff valve to close, interrupting fuel flow and shutting down the engine. The overspeed shutdown trip points are set at one hundred eleven percent (111%) LP rpm and one hundred nine point six percent (109.6%) HP rpm.

Whenever the engine is shutdown, excess pressurized fuel must be drained from the engine fuel system to avoid waste and leakage. At shutdown the FMU opens a drain valve to deliver the excess fuel to a drain tank on the engine. The drain tank is large enough to accommodate the fuel from two (2) engine shutdowns. Fuel in the tank is returned to the low

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pressure fuel pump at the next engine is start.

G. Fuel Flow Transmitter:

After the FADEC has regulated the fuel supplied to the engine, fuel flow is measured by a transmitter downstream of the FMU. The fuel mass flowmeter reports fuel usage to the FADEC that in turn transmits the data to the MAUs. The MAUs subsequently supply fuel flow information to the MWS for display on the Fuel synoptic page and the Engine system page.

H. High Pressure Fuel Filter:

A high pressure fuel filter, attached to the rear of the fuel flow transmitter, provides final filtration of the fuel supplied to the engine.

I. Fuel Temperature Transducers:

The fuel temperature transducers are mounted within the housing of the high pressure fuel filter. The transducers report fuel temperature to the FADEC that share the data with the MAUs and MWS in order to display engine fuel temperature on the Fuel and Summary synoptic windows.

J. Overspeed and Splitter Unit (OSU):

High pressure filtered fuel is distributed to the engine fuel spray nozzles in the combustion chamber of the engine through an upper and lower fuel manifold. The overspeed and splitter unit divides the incoming fuel flow equally to both manifolds to ensure uniform distribution. A safety feature providing overspeed protection is incorporated into the fuel splitter function. The function will interrupt the distribution of fuel to the engine combustion chambers if a failure is detected in the engine low pressure shaft connecting the fan and turbine stages. If a difference in fan and turbine stage rotational speed is detected, a spring actuator on the splitter unit will close to prevent fuel flow to the engine.

K. Fuel Spray Nozzles:

Twenty (20) fuel spray nozzles are arranged symmetrically around the engine combustion chamber. The nozzles are positioned within the air flow generated by the high pressure compressor stages and mix a fine spray of fuel with the airflow to provide an optimal combustion medium.

3. Controls and Indications:

See the cockpit overhead switch panel fuel controls shown in Figure 2.

Engine fuel indications are incorporated into the following display window presentations:

NOTE:

If selected by the customer, fuel flow indications may be shown in kilograms per hour (kph).

- Fuel synoptic 2/3 window contains digital readings of engine fuel flow and two pointer arrows to indicate the difference in fuel flow between the two engines. The arrows are shown on either side of a central vertical line, with the vertical line length representing a three hundred (300) pounds per hour flow rate. The arrows on either side of the line will be displaced up or down to indicate flow rate difference. The rate difference is calculated by subtracting the right engine fuel flow from the left engine fuel flow.

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The window also contains an indication of fuel temperature at the engine.

- Summary synoptic 2/3 window includes a digital indication of fuel temperature at the engine.
- Engine system 1/6 window display contains a digital display of fuel flow in pounds per hour with a resolution of ten (10) pounds.
- Secondary (Alternate) Engine system 1/6 window illustrates engine fuel flow with the displaced arrows and central vertical line format used on the Fuel synoptic window. The arrows and line will be shown in amber if the fuel flow difference exceeds one thousand (1,000) pounds per hour.
- Compacted Engine system 1/6 window contains digital indications of fuel flow.
- Engine Start system 1/6 window provides a red "L - R Fuel Pressure Low" text message if the fuel boost pumps are off or if fuel boost pumps are on and no fuel pressure is detected.

NOTE:

Descriptions of the Engine system windows, the Fuel and Summary synoptic windows appear in Section 2B-07-00

A. Circuit Breakers (CBs):

The following CBs power the engine fuel system:

Circuit Breaker Name:	CB Panel:	Location:	Power Source:
FUEL RETURN	LEER	C-2	L MAIN DC BUS
L HPSOV	LEER	A-12	L ESS DC BUS
R HPSOV	REER	A-12	R ESS DC BUS

B. Crew Alerting System (CAS) Messages:

The following CAS messages are associated with the engine fuel system:

Area Monitored:	CAS Message:	Message Color:
EEC / Low Fuel Pressure Switch senses less than 55 psi	L-R Engine Fuel Pressure	Blue
EEC / LP Filter Pressure Differential Switch senses 5 psi difference across the filter	L-R Fuel Filter	Blue
EEC / Heated Fuel Return System	L-R Fuel Return Fail	Blue

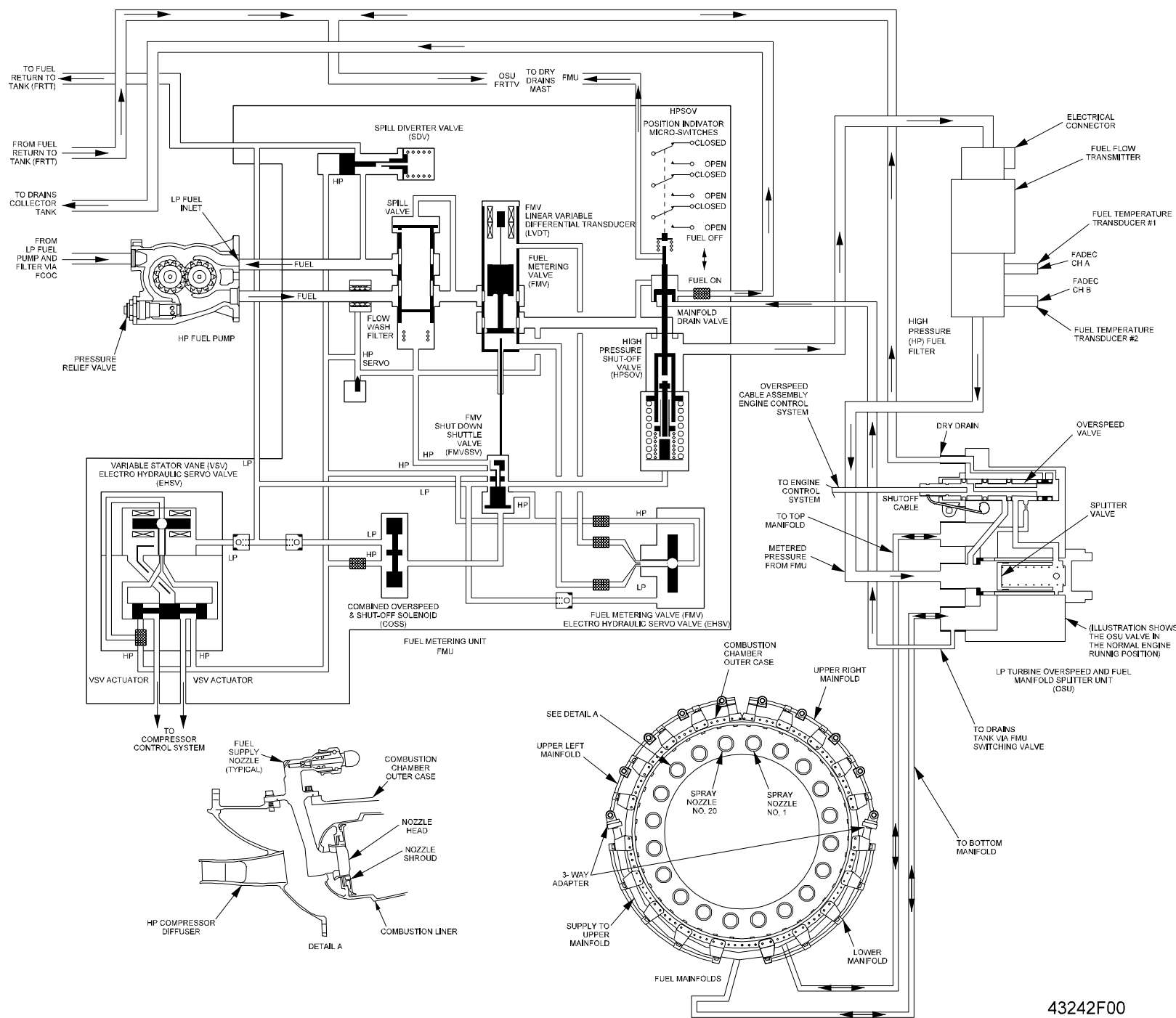
4. Limitations:

A. Engine Fuel Temperature:

- (1) **Minimum:** -40°C
- (2) **Maximum Unrestricted:** +140°C
- (3) **Maximum (15 Minute) Transient:** +165°C

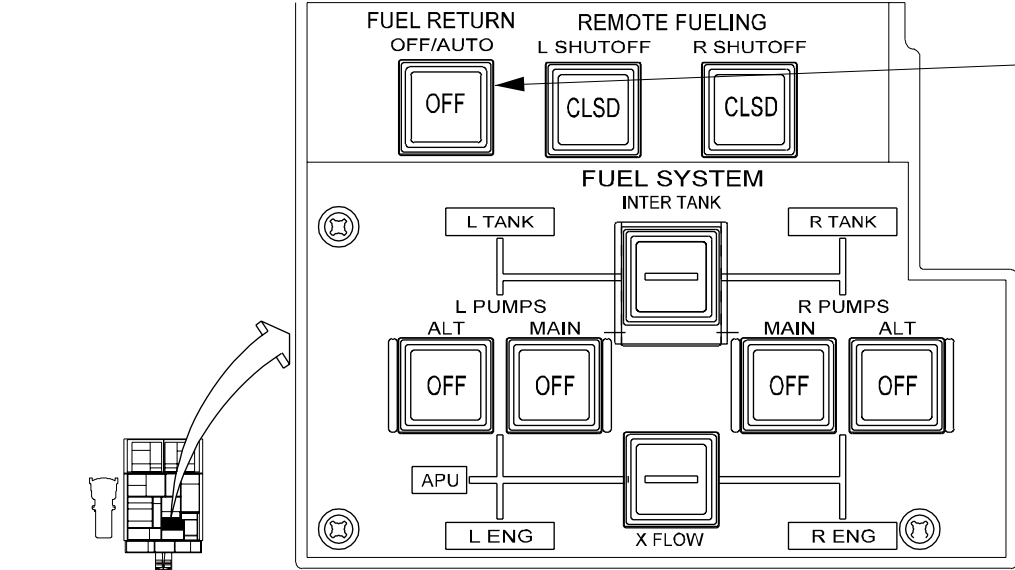
B. Maximum Fuel Tank Temperature:

The maximum allowable fuel tank temperature is +54°C.



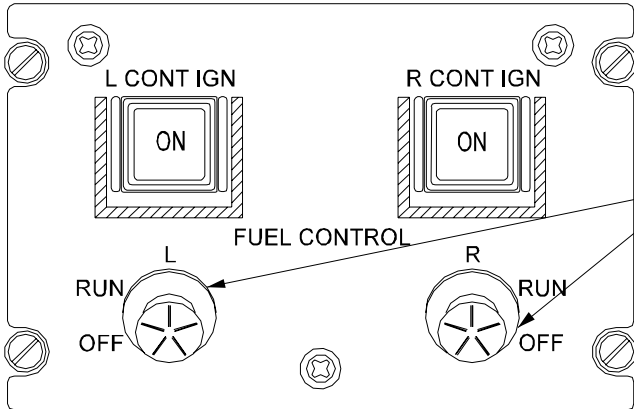
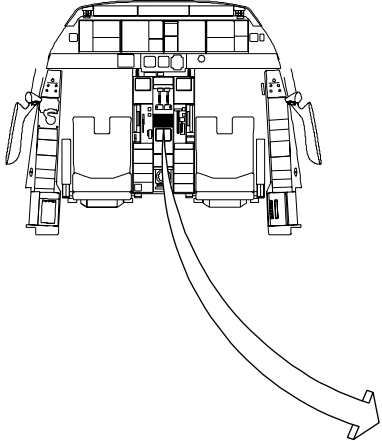
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Engine Fuel System
Diagram
Figure 1



FUEL RETURN OFF/AUTO
OFF:
 Fuel Return To Tank (FRTT) system is inhibited.
AUTO:

- FRTT system is armed and will function provided:
 - Fuel Management Unit (FMU) spill diverter valve is open.
 - Hopper fuel temperature is 0 °C or less.
- Will cease operation when:
 - Hopper fuel temperature is +10 °C or greater.
 - Either FIRE handle is pulled.
 - Low fuel pressure is detected.
 - Low fuel quantity is detected.
 - Impending blockage of the LP fuel filter is detected.
 - HP speed lower than minimum IDG on-line speed.
 - Crossflow (XFLOW) valve is detected OPEN.
 - FUEL CONTROL switch selection to OFF.



FUEL CONTROL
OFF:

- High Pressure Shutoff Valve (HPSOV) is closed.
- Electronic Engine Controller (EEC) is notified and signals fuel metering valve to close.
- EEC also resets FADEC.

RUN:

- HPSOV is opened.
- Fuel is allowed when HP RPM is 8% or greater.

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Engine Fuel System
Controls
Figure 2

