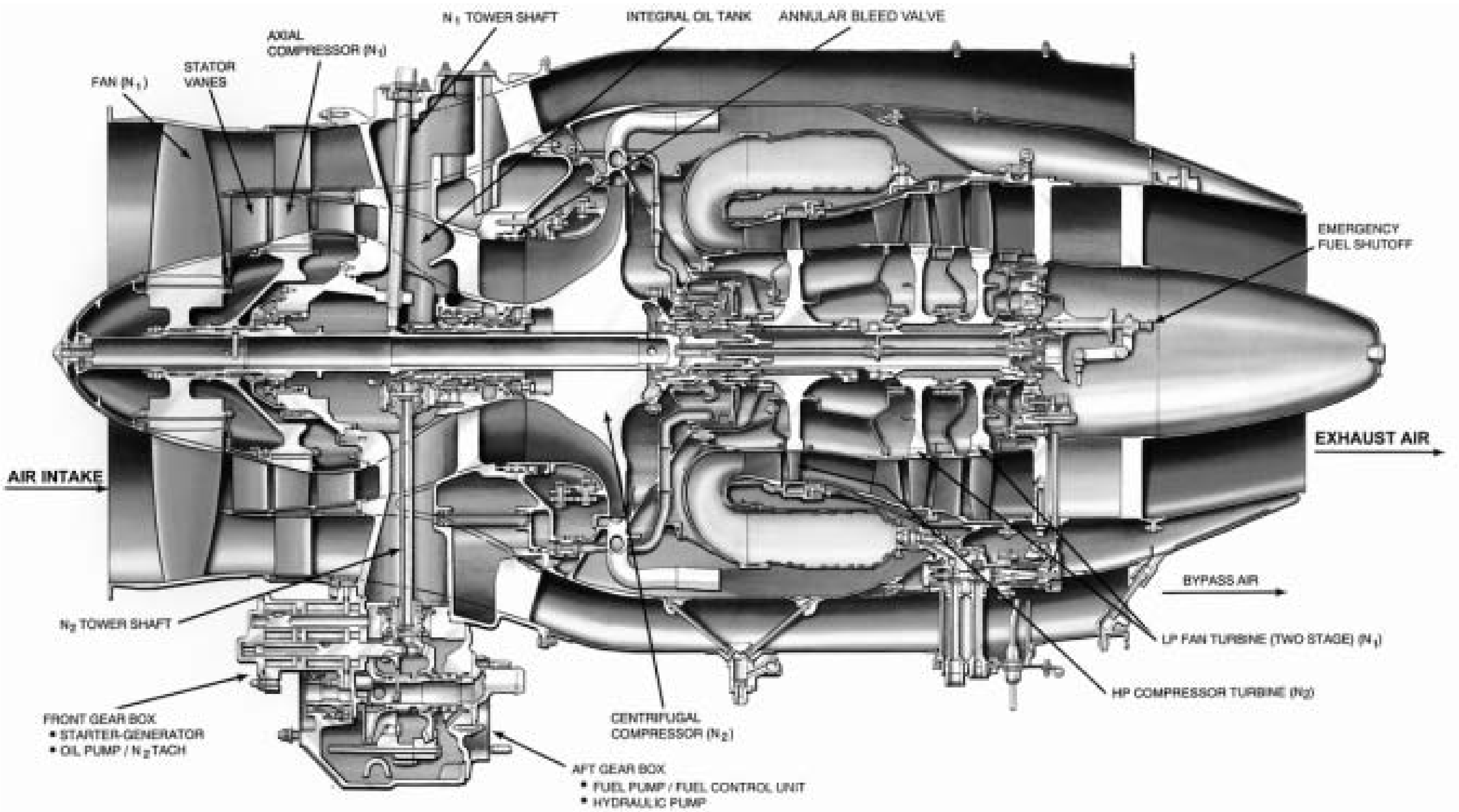
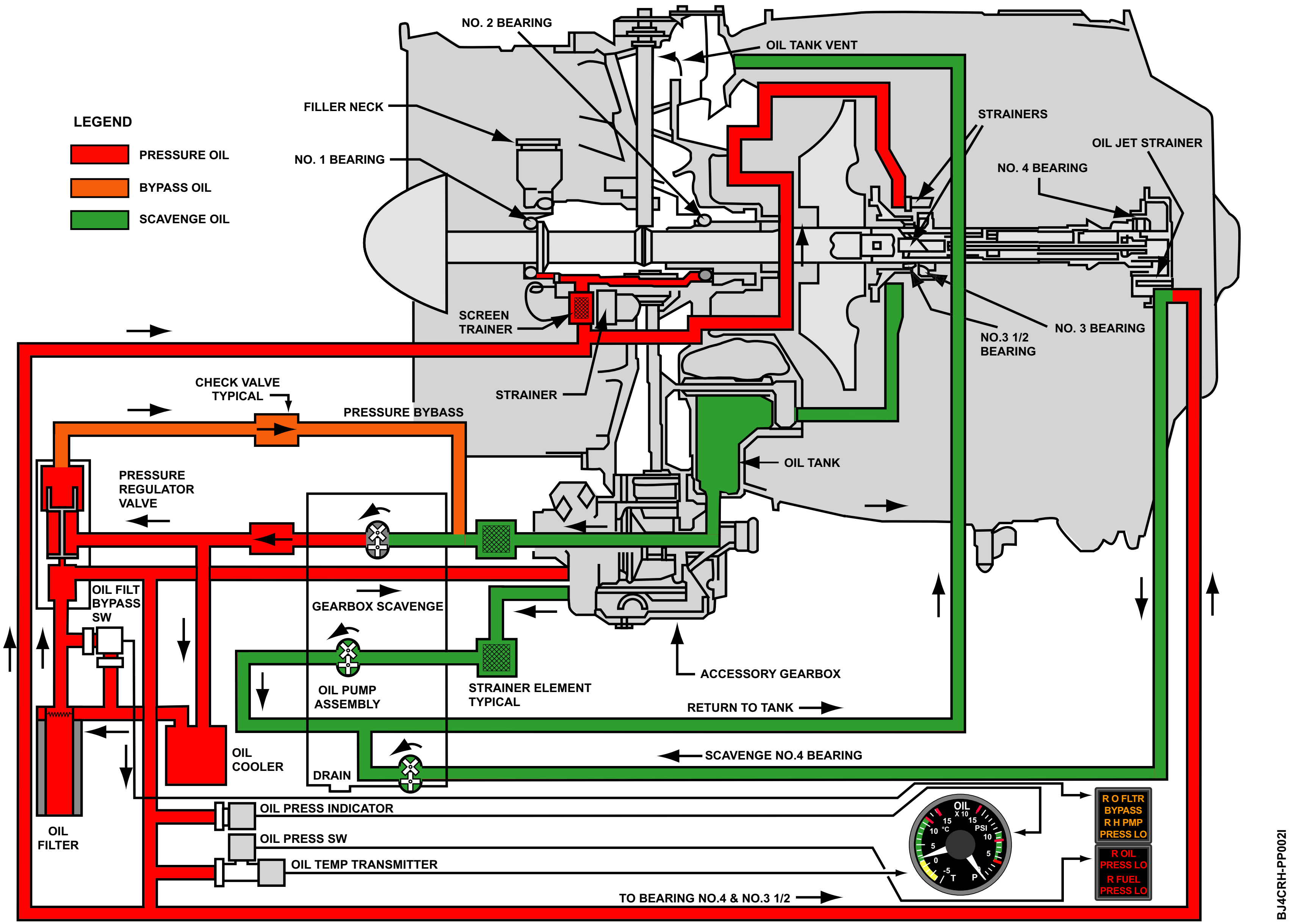
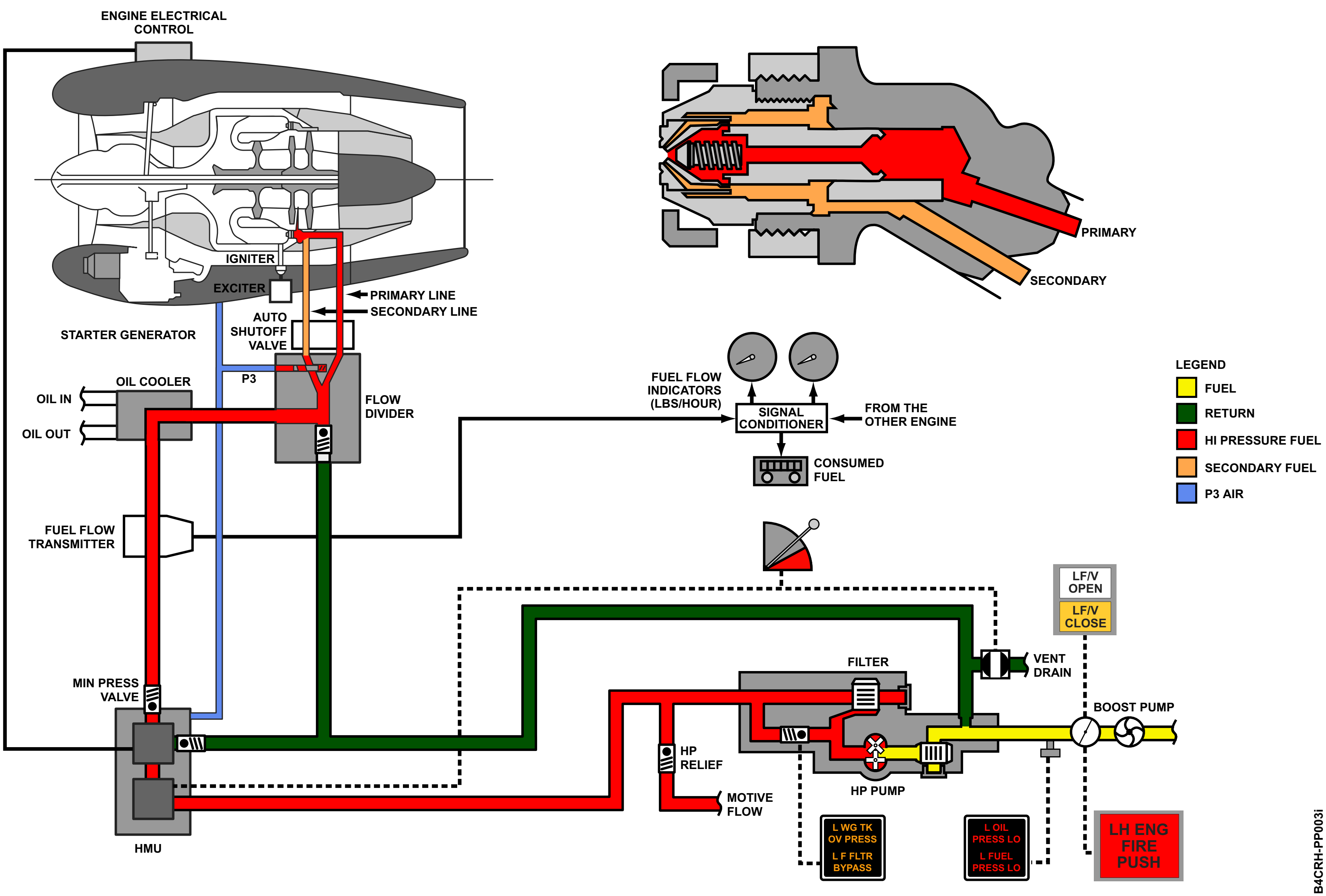
JT15D-5 Turbofan Engine



Engine Oil Lubrication

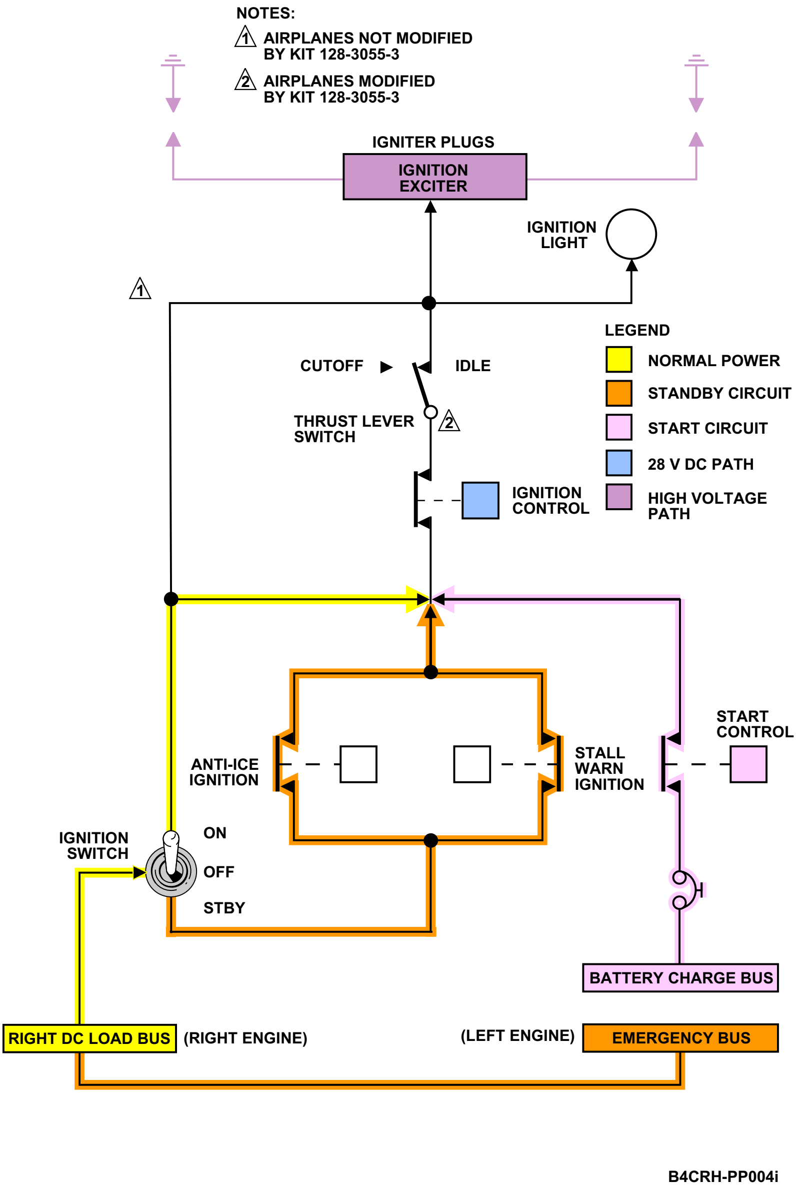


Fuel System

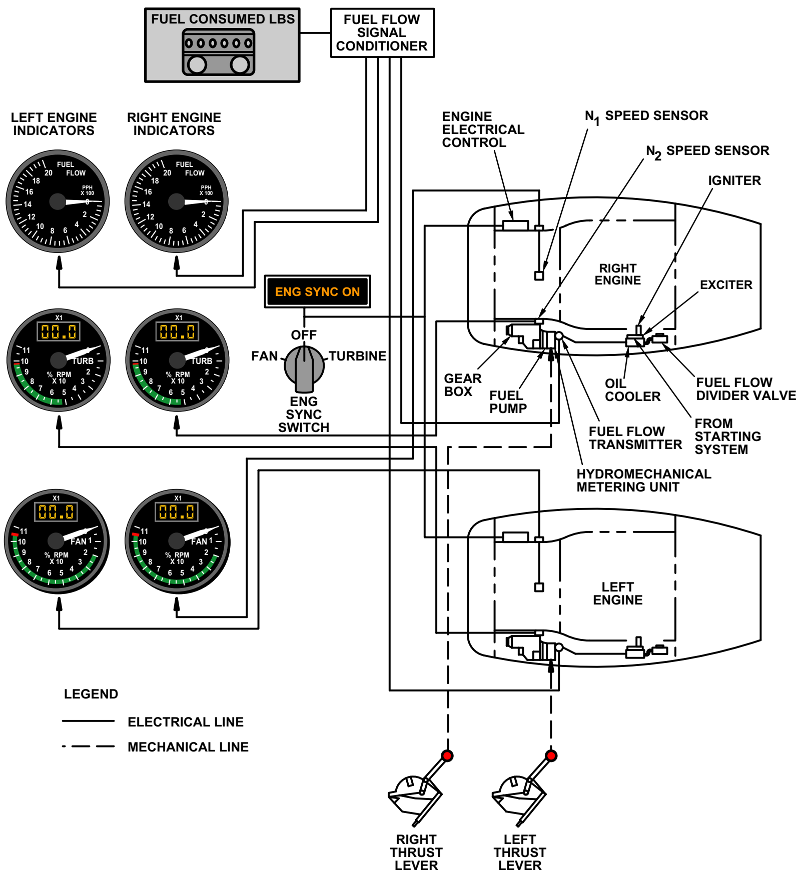


ENGINE ELECTRICAL CONTROL
IGNITER
EXCITER
PRIMARY LINE
SECONDARY LINE
AUTO SHUTOFF VALVE
STARTER GENERATOR
OIL COOLER
OIL IN
OIL OUT
P3
FLOW DIVIDER
FUEL FLOW TRANSMITTER
MIN PRESS VALVE
HMU
PRIMARY
SECONDARY
FUEL FLOW INDICATORS (LBS/HOUR)
SIGNAL CONDITIONER
FROM THE OTHER ENGINE
CONSUMED FUEL
LEGEND
FUEL
RETURN
HI PRESSURE FUEL
SECONDARY FUEL
P3 AIR
LF/V OPEN
LF/V CLOSE
VENT DRAIN
FILTER
BOOST PUMP
HP RELIEF
HP PUMP
MOTIVE FLOW
L WG TK OV PRESS
L F FLTR BYPASS
L OIL PRESS LO
L FUEL PRESS LO
LH ENG FIRE PUSH
B4CRH-PP003i

Ignition System



Engine Synchronization



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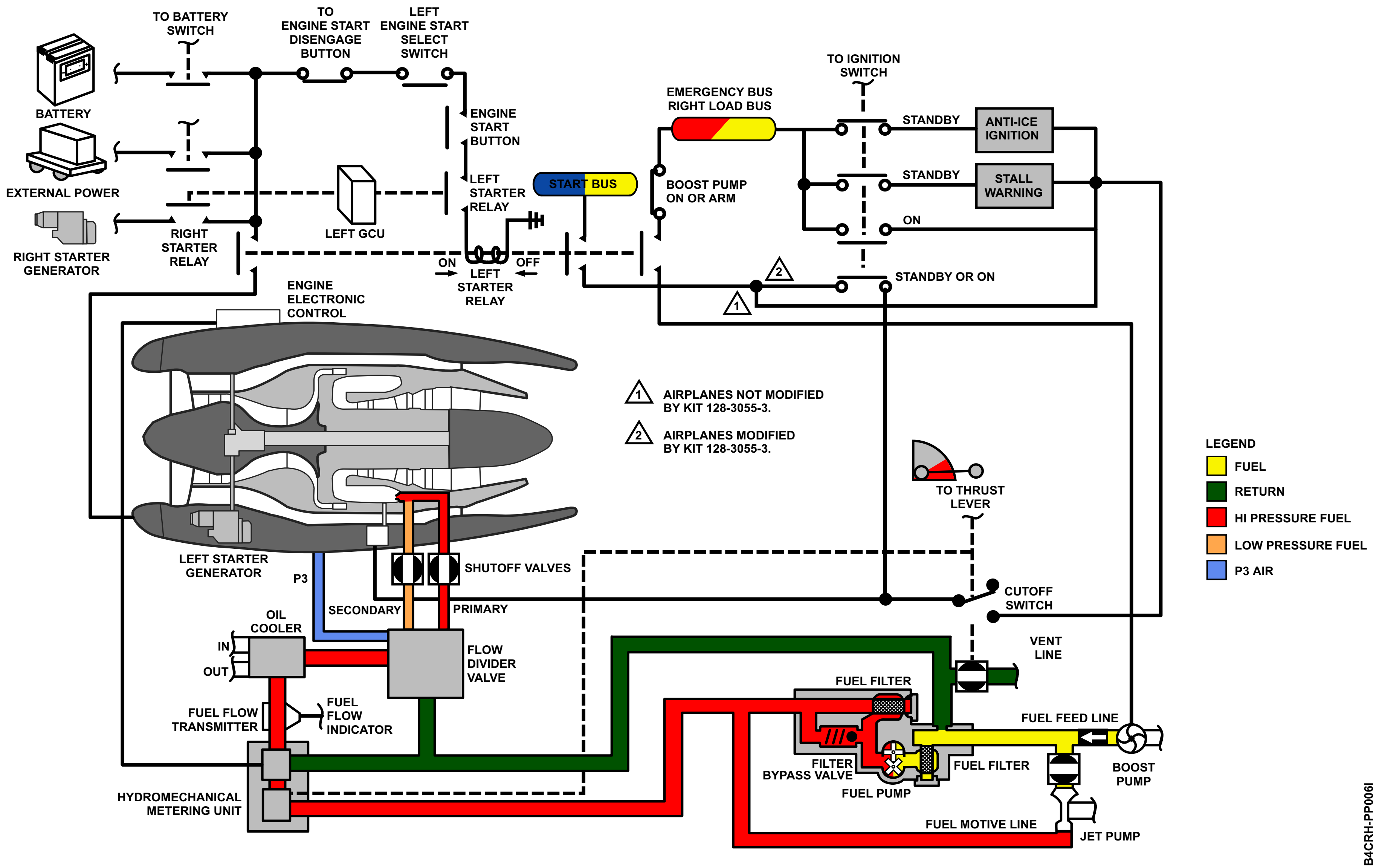
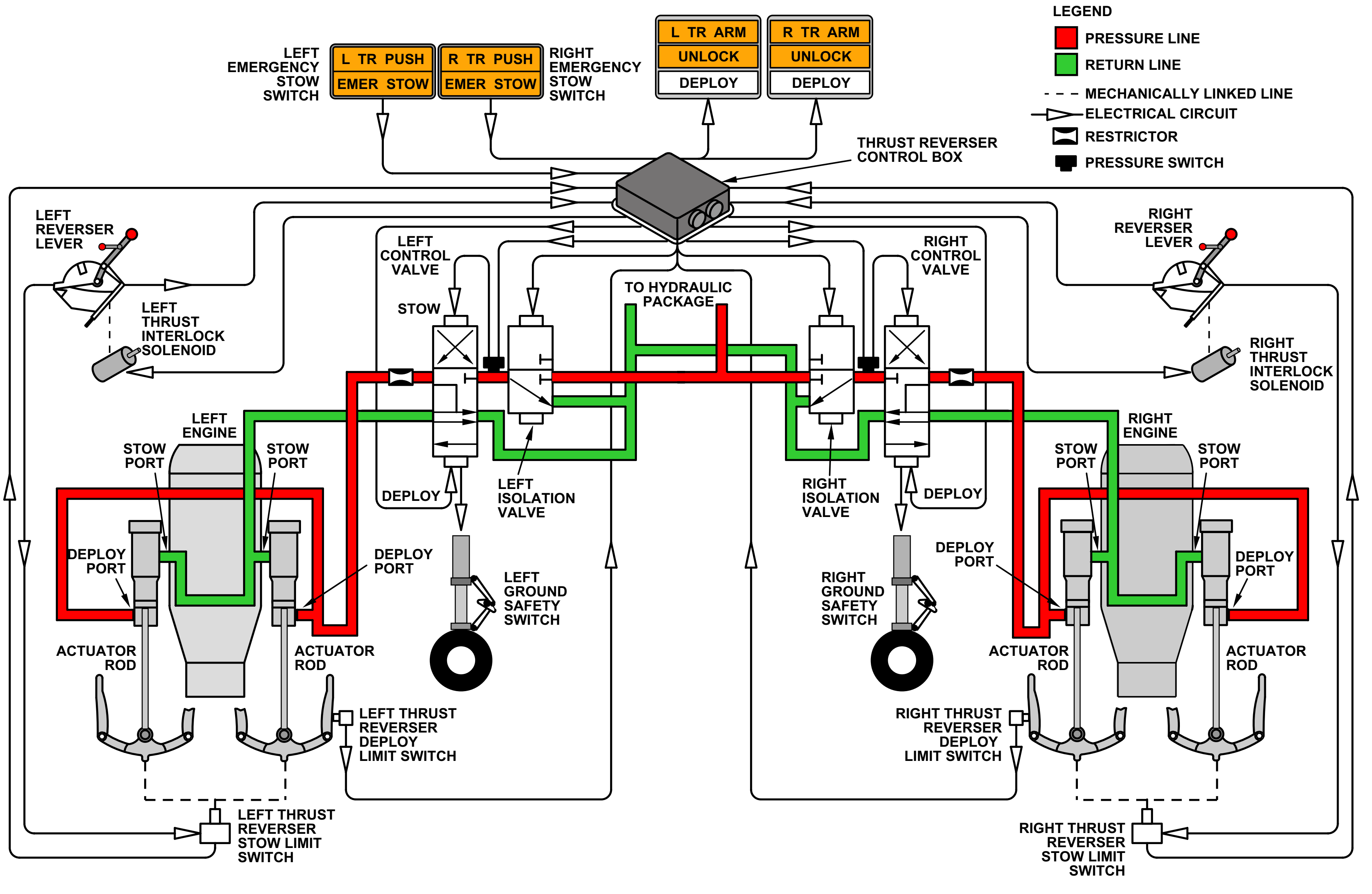
Engine Start



Thrust Reverser



Engines

The Beechjet 400A is powered by two aft pod-mounted JT15D-5 turbofan engines manufactured by Pratt & Whitney Aircraft of Canada, Limited. The engines are lightweight, twin spool, front turbofan jets having a full-length annular bypass duct.

The low compressor consists of a low compressor fan followed by a primary gas path booster stage. A concentric shaft system supports the high and low rotors. The inner shaft supports the low compressor fan and booster stage and is driven by a two-stage turbine supported at the rear. The speed of this assembly is designated as N_1 RPM. The outer shaft supports the high-pressure centrifugal compressor impeller and is driven by a single-stage high-pressure turbine. This speed is designated as N_2 RPM.

The JT15D-5 will produce 2,965 pounds of static thrust on a standard day at sea level and a maximum continuous thrust of 2,900 pounds. All intake air passes through the low compressor fan. Immediately aft of the fan, the airflow is divided by concentric ducts. Most of the total airflow is bypassed around the engine through the outer annular bypass duct and is exhausted at the rear. Air entering the inner duct passes through a booster stage and is compressed by the impeller. The high-pressure air then passes through a diffuser assembly and moves back to the combustion section. The combustion chamber is a reverse flow design to save space and reduce engine size. Most of the air entering the chamber is mixed with fuel and ignited while the remainder streams down the chamber liner for cooling. Fuel is introduced by twelve dual orifice nozzles supplied by a dual manifold. Spark igniters that extend into the combustion chamber at the 5 and 7 o'clock positions initially ignite the mixture and after start, the combustion becomes self-sustaining. The hot gases expand in the reverse direction and pass through a set of turbine guide vanes to the high-pressure turbine. As the expanding gases move rearward, they pass through another set of guide vanes and enter the two-stage low-pressure turbine. The greater portion of the remaining energy is extracted there and transmitted by the inner shaft to the forward mounted fan. The hot gases are then exhausted into the atmosphere.

An accessory gearbox is mounted on the lower side of the engine's intermediate case and is driven by a tower shaft from the bevel gear to the N_2 shaft. Its function is to turn the engine during starting, and to drive the accessories for the engine and airplane systems. The accessory gearbox drives the following components:

- DC Starter-Generator
- N_2 Speed Sensors
- Oil Pump
- Fuel Pump
- Hydromechanical Metering Unit (HMU)
- Hydraulic Pump.

Engine Indicators

The engine monitoring system consists of the fan RPM (N_1) inter-turbine temperature (ITT), turbine RPM (N_2), fuel flow, oil pressure and temperature, fuel consumed totalizer, and engine vibration indicators.

The fan RPM (N_1) indicator displays engine fan speed RPM in percentage. A fan speed of 15,900 RPM equals 100% RPM. The indicator receives a signal from its respective N_1 speed sensor.

The turbine RPM (N_2) indicating system operates on the same principle as the fan RPM indicator. A turbine speed of 32,760 RPM equals 100% RPM. Turbine RPM red line is 96%.

The scale range on the ITT indicator is from 0 to 10 with readings multiplied by 100 in degrees centigrade (100°C). The ITT (T_5) receives voltage from thermocouples that measure fan inlet air temperature (T_1) and turbine exhaust temperature (T_6).

The engine vibration monitoring system consists of two piezoelectric accelerometers, a signal conditioner and an indicator. The accelerometers, mounted on the top of each engine, convert the vibratory acceleration into an electric charge. The signal conditioner, mounted on the baggage compartment wall, receives the electric charge from the accelerometers. A single indicator with dual pointers is mounted on the instrument panel. The scale range on the indicator is from 0 to 10 and corresponds to engine vibration velocity. The engine vibration indicator is used as a trend instrument. A significant change in the engine vibration level over a period of time may indicate a problem.

Separate oil and pressure indicators for each engine are located on the instrument panel. Their functions are described under the Oil System section.

Two engine fuel flow indicators are located on the main instrument panel. Their functions are described under the Fuel Control System section.

Oil System

The system supplies cooled, pressurized oil for lubrication and cooling of engine bearings and accessory drive gears and bearings. An integral oil tank on each engine has a capacity of 2.03 U.S. gallons of which 1.34 US gallons are drainable. Recommended oils are listed in Pratt & Whitney Service Bulletin 7001.

Oil drawn from the oil tank by the pressure oil pump is ducted through a check valve to the pressure relief valve for oil pressure regulation. The oil is also passed through the oil cooler and oil filter. Excess oil pressure at the oil filter outlet opens the pressure-regulating valve and some of the oil is bypassed and ducted externally through a second check valve to the oil pressure pump inlet. From the filter, oil is routed to the engine bearings and accessory gearbox. If the filter becomes clogged, a bypass valve opens allowing lubrication to continue and the L or R O FLTR BYPASS annunciator will illuminate. Circulated oil from the No. 4 bearing area and accessory gearbox is returned to the tank by two scavenge pump elements in the oil pump assembly.

Oil pressure is sensed by a transmitter and is displayed on two AC powered indicators with dual pointers (pressure and temperature) on the instrument panel. The scale ranges on the dual indicators are 0 to 150 PSI for oil pressure and -50 to 150°C for oil temperature. The minimum oil pressure at idle RPM is 40 PSI. The L or R OIL PRESS LO annunciator will illuminate when the system pressure decreases below 40 PSI. The acceptable operating pressure range is 40 to 60 PSI when the power is below 60% N_2. The normal operating range is 60 to 83 PSI when the power is over 60% N_2. Oil pressure below 60 PSI is undesirable and should be tolerated only for the completion of the flight, preferably at reduced power settings. In cold starting conditions, oil pressure may exceed 83 PSI, but may not exceed 150 PSI. Oil temperature is sensed by a resistance bulb and transmitted to the dual DC powered indicators. Minimum oil temperature for engine start is -40°C and normal operating range is 10 to 121°C.

Fuel Control System

Fuel flow to the engine is mechanically controlled by thrust lever movement and regulated by the engine fuel control system. This system consists of an engine-driven fuel pump, a hydromechanical unit (HMU), an oil cooler (heat exchanger), a flow divider valve (FDV), and a dual fuel manifold with 12 dual-orifice fuel nozzles. The engine-driven fuel pump is mounted on and driven by the engine accessory gearbox and ensures a positive fuel pressure to the HMU. The fuel control unit is an HMU, supervised by an engine electronic control (EEC) separately mounted on the low compressor case, which provides fuel scheduling for engine operations at all altitudes. The FDV receives fuel from the HMU and provides proper fuel distribution to the combustion chamber by dividing the flow into the primary and secondary fuel manifolds. The HMU also acts as a fuel shutoff valve, bypassing fuel back to the pump during windmilling operation. When the throttle is closed, fuel flow is terminated at the HMU and the fuel is returned by ram air pressure from the manifold through the dump valve to the aft fuselage tank via the drain box and the surge tank (refer to Fuel System section, this manual).

With the electronic fuel control (EFC) switches off, N_2 idle RPM will vary with pressure altitude, indicating higher values as pressure altitude increases. In normal operation, the HMU meters fuel to the engine in proportion to the thrust lever angle selected by the pilot and the engine electronic control (EEC) schedules an additional amount of fuel. The HMU and EEC schedules are defined so that the sum of their fuel flows will produce maximum rated thrust at a thrust lever angle near 80 degrees. EEC failure will result in the loss of its scheduled fuel flow. The maximum thrust loss due to EEC failure would be within 20 to 40% depending on ambient conditions and thrust lever angle. The pilot is able to recover EEC thrust loss by advancing the thrust lever, thus causing the HMU to deliver the required fuel flow.

The engine fuel flow indicating systems for both engines consist of transmitters, DC-powered fuel flow indicators, a fuel flow signal conditioner, and a fuel consumed totalizer indicator. The fuel flow transmitter is on the outlet side of the HMU and measures the frequency signals proportional to the fuel flow rate that passes through it. The flow rate is converted into an electrical current by the signal conditioner and is sent to the fuel flow indicator. The fuel flow indicators on the instrument panel display engine fuel consumption in pounds per hour. The scale range of the indicator is 0 to 2,000 pounds per hour. The fuel-consumed totalizer receives the current from the signal conditioner and provides a digital display of the fuel consumed.

Engine Ignition System

The engine ignition system provides the engine with a quick light-up capability over a wide range of temperatures. The engine ignition system is controlled by an IGNITION switch, thrust lever cutoff switch, ENG ANTI-ICE switch, engine start control relay and stall warning control relay.

Engine Start Mode

RK-118, RK-140 Thru RK-220 Not Modified by Kit 128-3055-3

The ignition is sequentially operated during engine starting. Depressing the respective ENG START button energizes the engine start control relay. Moving the thrust lever to IDLE during start directs voltage from the battery charge bus through the engine start control relay, thrust lever switch, and start ignition fuse to the exciter. The L or R IGNITION operation light illuminates, indicating that the exciter is receiving low voltage power, until the ENG START DISENGAGE switch is depressed or the ENG START SELECT switch is turned OFF at the completion of the start.

RK-221 and After or RK-118, RK-140 Thru RK-220 Modified by Kit 128-3055-3

The ignition is continuously operated during engine starting. Depressing the respective ENG START button energizes the engine start control relay. This action directs voltage from the battery charge bus through the engine start control relay, and start ignition fuse to the exciter. The L or R IGNITION operation light illuminates, indicating that the exciter is receiving low voltage power, until the ENG START DISENGAGE switch is depressed or the ENG START SELECT switch is turned OFF at the completion of the start.

Manual Mode

When the ignition switch is placed to the ON position, ignition low voltage is supplied through the engine thrust lever switch and the ignition circuit breaker to the exciter. The respective L or R IGNITION operation light illuminates any time the ignition is on and the thrust lever is not in cutoff. Power source is the emergency bus in the left system or right load bus in the right system.

Standby Mode

The IGNITION switch should normally remain in the STBY position. Ignition low voltage power is supplied to the exciter when the ENG ANTI-ICE switch is actuated or when the stall warning ignition relay is energized.

Engine Control

Power Controls

During normal operation, the engine power may be adjusted to any setting between idle and Takeoff Rated Thrust (TRT). TRT can be used for a maximum of 5 minutes. The ITT should not exceed 700°C; the N_1 should not exceed 104%; N_2 should not exceed 96%; and oil temperature and pressure should be in the normal operating range of 10 to 121°C and 60 to 83 PSI, respectively. Maximum continuous thrust has no time limit, but the ITT is limited to 680°C. Oil temperature should be within 10 to 121°C. All other limits are the same as TRT. The minimum idle speed with engine EFC ON is 52% N_2; with engine EFC OFF, it is 46% N_2. In either case the CABIN PRESS switch is in the BOTH position with the generator load below 50 amps. The ITT should not exceed 580°C. During any acceleration, the ITT should not exceed 700°C.

The thrust levers control engine thrust. Angular displacement of the thrust lever is transformed into stroke displacement of the cable connected to the engine fuel control. The thrust lever has four detent positions: CUT OFF, IDLE, NORM TAKE OFF (NORM T.O.) and TAKE OFF (T.O.). To move the thrust lever from CUT OFF to IDLE or from IDLE back into CUT OFF, it is necessary to pull up and move the levers over the detent on airplanes without thrust reversers; or to pull up the detent release lever and move the thrust levers over the detents on airplanes with thrust reversers.

A friction lever is mounted on the left side of the pedestal adjacent to the thrust levers. The thrust levers may be fixed in any position by moving the friction lever forward.

Engine Synchronizer

CAUTION: The engine synchronizer must be off during takeoff, landing, and single-engine operation.

The engine synchronizer automatically synchronizes either fan or turbine speed of the slave engine to that of the master engine. The speed of the slave (right) engine will follow changes in the speed of the master (left) engine over a predetermined limited RPM range. This limited range prevents the slave engine from losing more than a fixed amount of RPM in case the master engine is shut down while the ENG SYNC switch is in the FAN or TURBINE position. The engines should be manually synchronized using the thrust lever and sound (harmonic deviation) before turning the system on.

The three position ENG SYNC rotary switch is mounted on the center pedestal and is marked FAN-OFF-TURBINE. This selects the fan or turbine speed signal of each EFC, which will cause the right engine RPM to slave to the left engine. When the switch is turned ON, the ENG SYNC ON annunciator on the right shroud panel will illuminate.

Engine Starting

Engine starts may be made using the airplane battery, external power, generator assist, or by air starting. The starter-generator operates as a starter until engine speed (N_2) reaches approximately 35 to 40% RPM. At this time, the starter ceases to turn the engine and the solenoid held ENG START button is automatically released. As engine RPM increases, the starter-generator begins to function as a generator. The generator output is automatically connected to the DC bus system when the ENG START SELECT switch, located on the pedestal, is placed to the OFF position.

Battery Start

RK-118, RK-140 Thru RK-220 Not Modified by Kit 128-3055-3

During a battery start, the BATTERY switch must be ON with the battery supplying a minimum of 22 volts. Turn the ENG EFC switch ON and select the engine (left or right) to be started with the ENG START SELECT switch. Momentarily press the respective ENG START button, then release. Verify illumination of the ENG START button and the BOOST PUMP light and monitor N_2 RPM. At 8% N_2 RPM, move the thrust lever to IDLE and check that the IGNITION operation light illuminates. Monitor N_1, N_2, ITT, and oil pressure during start.

RK-221 and After or RK-118, RK-140 Thru RK-220 Modified by Kit 128-3055-3

The battery start for airplanes RK-221 and After or RK-118, RK-140 Thru RK-220 Modified By Kit 128-3055-3 is identical to airplanes RK-118, RK-140 Thru RK-220 Not Modified By Kit 128-3055-3. The only difference is the illumination of the IGNITION operation light when the ENG START button is pressed.

External Power Start

An external power start may be accomplished by plugging in an external power source capable of supplying 28V DC, 1,000-1,500 amperes output. If both engines are to be started with external power, the GEN RESET switches must be OFF during start.

Generator Assisted Start

Because the external power unit is automatically taken off-line when a generator comes on-line, the second engine start is normally powered by the battery with the operating generator assisting even though external power is connected. The only difference between a generator assisted start and a battery only start is that the operating engine must have the MASTER GEN switch in the NORM position, GEN RESET switch in the NORM position and the engine N_2 set at 52 to 54%.

CAUTION: During generator assisted starts do not start the second engine until the operating generator's load is below 150 amps.

Air Start

CAUTION: An air start should not be attempted if the engine shutdown was due to obvious mechanical difficulties.

Air starts can be accomplished by either a windmilling air start or a starter assisted air start. Refer to Abnormal Procedures Section in the FAA Approved Airplane Flight Manual for Air Start procedures.

Engine Shutdown

Prior to engine shutdown, retard the thrust lever to IDLE and observe the ITT indicator. Allow the engine to idle for a minimum of 1 minute at the lowest stabilized, observed temperature, then place the thrust lever in the CUT OFF position. If the engine is being shut down due to an emergency, the ITT need not be stabilized.

Thrust Reverser System

The thrust reverser is a hydraulically operated, four-bar linkage, external target type system. It is mounted on the aft end of each engine, forming the exhaust nozzle and the aft portion of the nacelle when stowed. When deployed, the reverser doors join behind the exhaust nozzle and direct the exhaust gas forward over and under the nacelle. This provides a deceleration force for ground braking. The thrust reverser system is intended for ground operation only.

Normal Operation

The thrust reversers have two positions: stow and deploy. They are stowed during takeoff and flight and may be deployed during the landing ground roll.

Deployment is initiated by pulling the reverser levers, mounted on the thrust levers, up and back when the thrust levers are in the IDLE position. This action supplies hydraulic pressure (1,500 PSI) to the deploy ports of the reverser actuators which are mounted on the support casting on each side of the engine. The hydraulic pressure retracts the actuator pistons and the reverser carriage is pulled forward. This unlocks the linkage mechanism, actuates the driver links, and moves the reverser doors to their deployed position.

The hydraulic pressure supplied to the actuator deploy ports also actuates a pressure switch in the system which closes at 200 PSI and opens at 100 PSI. The pressure switch transmits a signal that illuminates the TR ARM annunciator located on the shroud panel. The reverser carriage's forward movement releases a normally closed thrust reverser stow limit switch (L or R). This action transmits a signal to illuminate the UNLOCK annunciator on the shroud panel. Upon full deployment of the reverser doors, a deploy limit switch (L or R) actuates to illuminate the DEPLOY annunciator on the shroud panel.

When the deployment cycle is completed, 28V DC is supplied through the deploy limit switch to the thrust interlock solenoid (L or R) which releases the reverser lever interlock. The pilot may then move the reverser lever(s) further upward, driving the thrust linkage from IDLE to any desired reverse thrust setting.

NOTE: Maximum deploy cycle time after actuation of the reverser lever is 1.6 seconds at 110 KCAS. An erroneous sequence or a delay in the deploy cycle time denotes a thrust reverser system failure. An inspection and maintenance check should be conducted prior to further use of the system.

Should a system failure actuate the deploy cycle with the thrust levers set above the IDLE position, a thrust reverser feedback subsystem will force the thrust linkage to the IDLE position. In such a failure condition, the reverser lever is restrained in the IDLE position by the thrust interlock.

To initiate the stow cycle, the reverser levers are pushed back to their stow positions. This reverses the mechanism actuation, returning the reverser doors to their stowed and locked position. The DEPLOY, UNLOCK, and TR ARM annunciators will sequentially extinguish during the stow cycle.

NOTE: Maximum stow cycle time after actuation of the reverser lever is 5.0 seconds at 130 KCAS. Refer to Limitations Section in the Approved Airplane Flight Manual for stow limitations during flight.

Emergency Stow Operation

Emergency stow switches are located on the shroud annunciator panel. They are used to stow the reversers in the event of a failure in the primary thrust reverser control system. When an EMER STOW switch is depressed, an isolation valve and control valve are energized to the stow position. Hydraulic pressure is supplied to the actuator stow ports, causing the actuator pistons to extend and drive the reverser doors to their stowed position.

Should a thrust reverser door unlock condition occur in flight, the entire affected emergency stow switch will illuminate providing a TR PUSH EMER STOW annunciation. When the EMER STOW switch is pushed, the TR PUSH portion of the annunciator will extinguish, indicating the thrust reversers' doors are stowed. The EMER STOW annunciator will remain illuminated as a reminder that the thrust reverser was stowed using the emergency mode. If pushed again and the reverser remains locked and stowed, the EMER STOW annunciator will extinguish to show normal system operation.