

6-4.7.4. Fuel System Operational Check

CAUTION: Fuel system operational check instructions in this section and the adjustments in Section 6-4.10.2 apply only to Continental continuous flow fuel injection systems. For engines equipped with carburetors or servo controlled fuel systems, refer to aircraft and/or equipment manufacturer's instructions.

A fuel system operational check is required after replacement of fuel injection system components, such as the fuel pump, fuel manifold valve, or fuel injectors. The fuel system setup is a critical component of proper engine operation.

Follow the test equipment setup instructions in Section 6-4.7.4.1. When the test equipment is set up properly, proceed with the "Fuel System Operational Checkout Procedure" in Section 6-4.7.4.3.

NOTE: Fuel system adjustments are interactive. Once begun, perform the entire procedure for proper fuel injection system operation.

Required Test Equipment

- Portable Tachometer
 - Calibrated pressure gauges (Section 2-1)
- OR, if available
- Model 20 ATM-C Porta Test Unit (Section 2-1)

NOTE: Pressure gauges must be accurate within +/- 1%. The calibration period should not exceed one year.

- A calibrated 0-60 psi gauge, graduated in 1 psi increments, to measure unmetered pressure.
- *On naturally aspirated engines*, a calibrated 0-30 psi gauge graduated in 0.2 psi increments, to measure metered pressure, or
- *On turbocharged engines*, a calibrated differential pressure gauge, 0-30 psid maximum, graduated in 0.2 psi increments.
- Two Part No. MS51523-B4 swivel tees, used to insert gauges in line with fuel lines, for metered and unmetered pressure references.
- Hoses of sufficient length to allow personnel and equipment to perform the test at a safe distance from the propeller arc and blast area.
- A digital hand-held tachometer, capable of verifying aircraft tachometer accuracy prior to fuel system adjustment.

6-4.7.4.1. Fuel System Operational Checkout Setup Instructions

Important Setup Notes

CAUTION: For L/TSIO-360 and TSIO-520 engine models equipped with a fixed (ground adjustable) exhaust bypass, verify the wastegate is adjusted according to the aircraft manufacturer's instructions. Failure to do so can result in an improperly adjusted fuel system and possible engine damage.

1. Test gauge readings must be taken with the gauges held at the same height above the ground as the fuel system component being measured.
2. Engine driven fuel pump output pressures vary with engine RPM. During ground operation, full power RPM may not be obtained. Use the "Static RPM Compensation" instructions found in Section 6-4.7.1.1 to correct the specified metered pressures if full power RPM cannot be achieved.
3. *On turbocharged engines*, ensure manifold pressure is adjusted according to the aircraft manufacturer's instructions. Engine driven fuel pumps installed on turbocharged engines are referenced to turbocharger compressor discharge pressure (upper deck pressure) to achieve full power fuel pump pressure.
4. Turbocharged engines equipped with fuel pressure regulators must indicate a full power metered pressure and fuel flow five (5) percent higher than the maximum specified limit **when the regulator is disconnected**. This is required to ensure adequate part-throttle fuel flow.

WARNING

Failure to properly support and stabilize component fittings can result in fitting and/or component damage and loss of system pressure.

Procedure

1. Perform a Maintenance Preflight Inspection according to Section 6-4.7.2.
2. Loosen and remove the unmetered fuel supply hose from either the fuel pump outlet fitting, the fuel control assembly inlet fitting, or the throttle and metering assembly inlet tee (whichever is most accessible). Some engine models have a fuel pressure connection fitting in the control assembly inlet screen that may be utilized for unmetered pressure gauge attachment.

NOTE: Some installations may require multiple fittings to adapt the metered and unmetered test equipment to the fuel injection system. Connect the unmetered fuel supply hose to the straight end of the tee connector.

3. For engine models with throttle and metering assemblies (see Figure 6-38), remove and set aside the cap fitting (P/N 639494) from the inlet tee. This cap will be reinstalled after setup is complete.

4. Connect a tee fitting (P/N MS51523-B4) directly to the fuel connection loosened in step 2 (see Figure 6-3 through Figure 6-6, as applicable). Torque the tee fitting to the value specified in Appendix B.

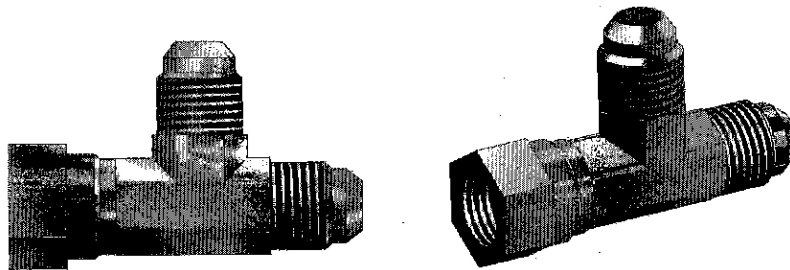


Figure 6-1. Part No. MS51523-B4 Swivel Tee

5. Attach the unmetered fuel supply hose to the straight end of the tee fitting (P/N MS51523-B4) and torque to the value specified in Appendix B.
6. GAUGE METHOD: If using the 0 to 60 PSI gauge, connect the gauge to the tee fitting using a length of hose which will provide proper clearance from the engine cowling and propeller arc. Torque connections to the value specified in Appendix B. PORTA-TEST METHOD: Connect the unmetered test hose from the Porta-Test unit to the tee fitting and torque to the value specified in Appendix B.
7. Loosen and remove the metered fuel supply hose from the fuel manifold valve inlet fitting.
8. Install and torque the second tee fitting directly to the fuel manifold valve inlet fitting.
9. Attach the metered fuel supply hose to the straight end of the second tee fitting and torque to the value specified in Appendix B. On certain models there is an optional capped fitting on the fuel manifold valve in lieu of second tee fitting.
10. GAUGE METHOD: If using the 0 to 30 PSI gauge, connect to the swivel end of the tee fitting using a hose long enough to provide proper clearance from the engine cowling and propeller arc. PORTA-TEST METHOD: Connect the metered pressure test hose from the Porta-Test unit to the second tee fitting and torque to the value specified in Appendix B.
11. Torque all connections to the value specified in Appendix B.
12. *On turbocharged engine models:*
GAUGE METHOD: If using the 0 to 30 PSID differential gauge pressure fitting, connect to the metered pressure tee fitting using a hose of sufficient length to provide clearance from the aircraft and propeller arc. Connect an equal length of hose to the "suction" side of the gauge and connect the other end to a location to reference turbocharger compressor discharge (upper deck) pressure (see Figure 6-5 and Figure 6-6).
PORTA-TEST METHOD: connect the Porta-Test manifold pressure hose and the upper deck pressure hose to the engine following the instructions provided with the Porta-Test unit.

13. Turbocharged engine models (incorporating a fuel pressure regulator) must have the regulator deactivated during the initial fuel system adjustment. (see Figure 6-45).
 - a. To deactivate the fuel pressure regulator, loosen and remove the fuel line or hose from the “center” (outlet) port fitting at the pressure regulator.
 - b. Install a cap on the “center” (outlet) port fitting.
 - c. Install a plug in the removed line (or hose).
 - d. Torque the cap and plug to the values specified in Appendix B.
 - e. Perform a pressurized leak test on the connections prior to proceeding with fuel system adjustments.
14. GAUGE METHOD: If using the alternative calibrated test gauges, loosen the test connections at each gauge to bleed the lines of any air. Hold the gauge at or slightly above the height of the fuel system component during the bleeding operation. Operate the boost pump only long enough to allow purging of air from the installed test equipment. Verify that all fuel lines, hoses and fittings are securely torqued and that no fuel leaks exist before proceeding. Ensure test hoses have been routed clear of the exhaust system and are securely supported over their entire length to avoid inaccurate gauge readings.

PORTA-TEST METHOD: Position the throttle control to the FULL OPEN position and the mixture control to FULL RICH. Operate the aircraft boost pump in accordance with the aircraft manufacturer’s instructions. Bleed the air from the test unit and hoses according to the Porta-Test unit instructions.

WARNING

Drain all fuel from the induction system prior to attempting engine start. Failure to comply may result in hydraulic lock and subsequent engine failure.

15. Install the engine cowlings or cooling shroud during ground operation.
16. Proceed to Section 6-4.7.4.3.

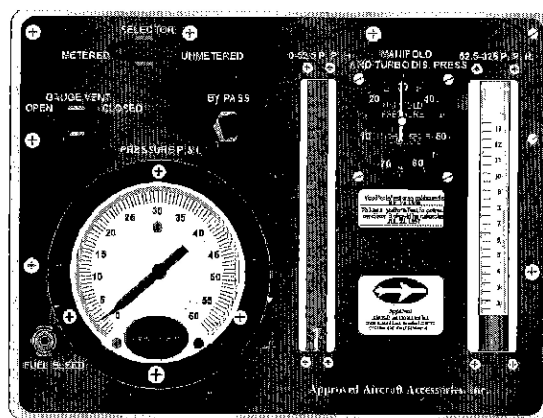


Figure 6-2. Porta-Test Model 20 ATM-C

6-4.7.4.2. Test Equipment Connection Schematics

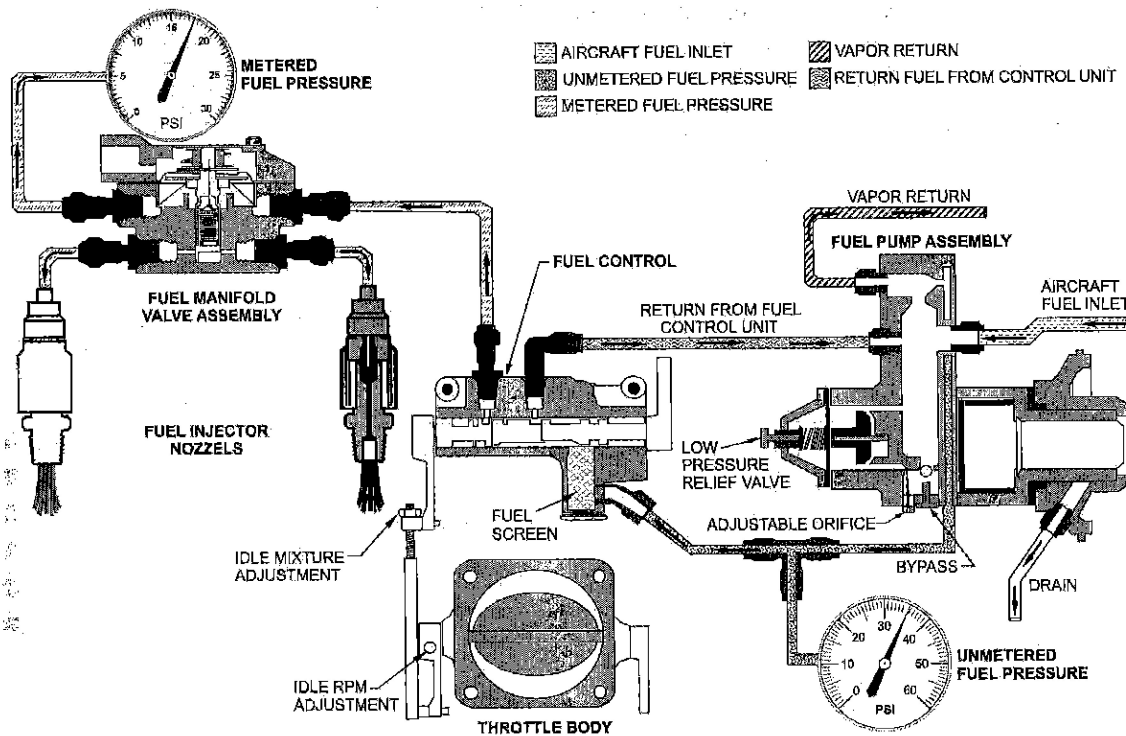


Figure 6-3. Typical Naturally Aspirated Fuel System Schematic (with Fuel Control Assembly)

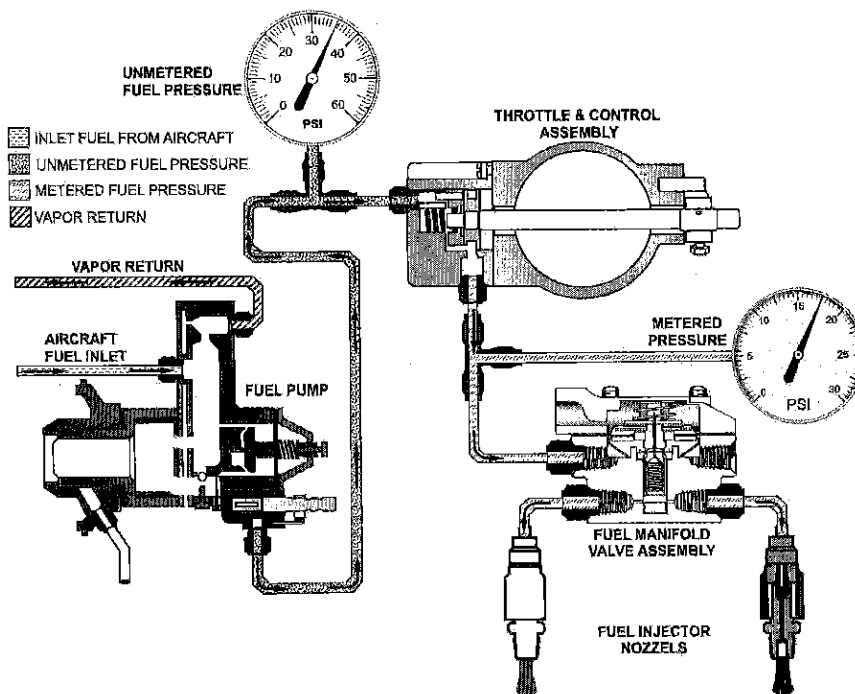
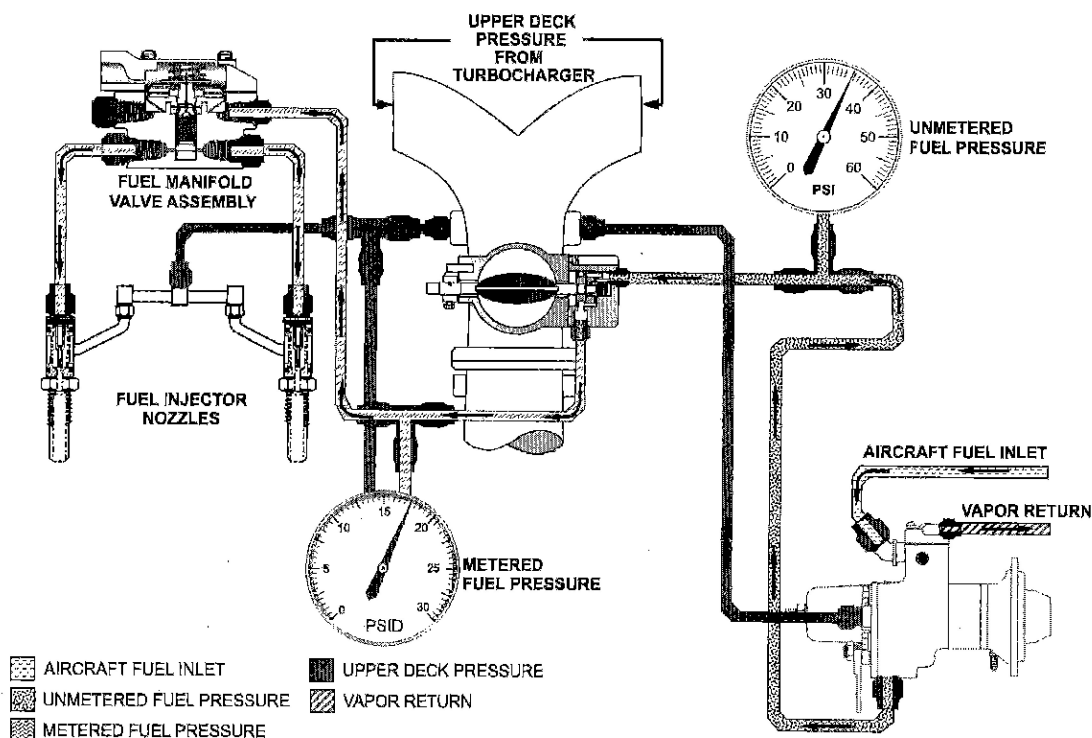
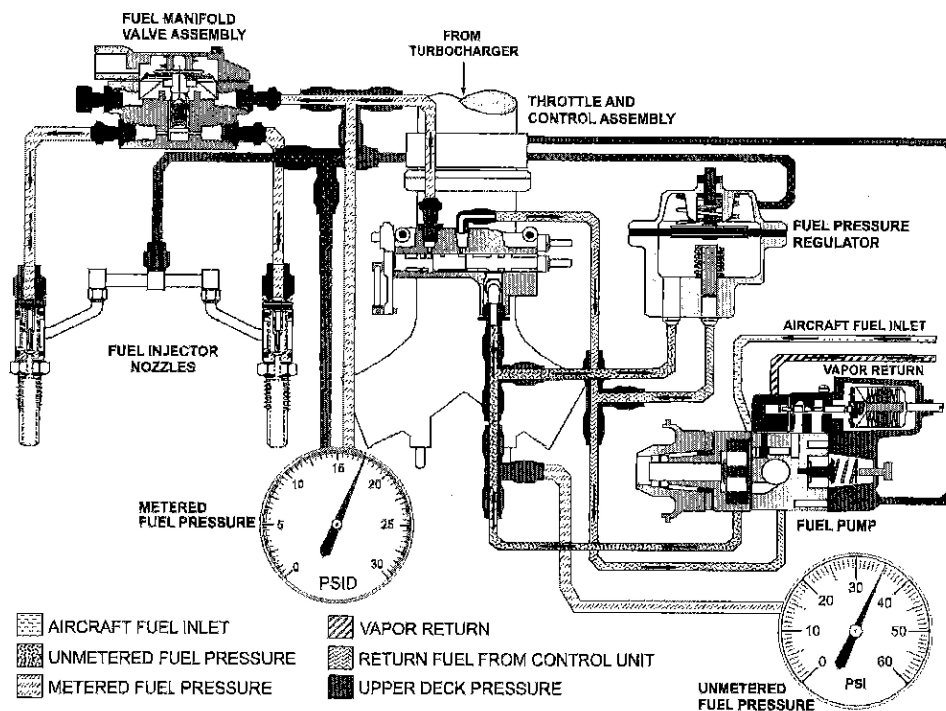


Figure 6-4. Typical Naturally Aspirated Fuel System Schematic (Fuel Pump with Integral Mixture Control)



6-4.7.4.3. Fuel System Operational Checkout Procedure**Procedure**

1. Set the aircraft brakes and block the aircraft main landing gear tires.
2. Verify the accuracy of the tachometer, manifold pressure gauge, and fuel flow gauges prior to making any adjustments; replace faulty gauges.
3. Locate the IDLE speed stop screw (Figure 6-38 or Figure 6-40) on the throttle assembly and turn it counter-clockwise two complete turns. During the operational check, IDLE RPM will be controlled manually using the cockpit throttle control.

WARNING

Ensure the propeller area is clear before starting the engine.

4. Fuel Selector Valve ON
5. Mixture Control FULL RICH
6. Boost Pump (if equipped) AFM/POH
7. Perform a normal "Engine Start" according to instructions in Section 7-3.2 and "Ground Run-up" according to Section 7-3.3 to allow the engine to warm to normal operating temperatures.

NOTE: A puff of white smoke from a new or rebuilt engine, or an engine returned from storage is normal. The source of the smoke is the remaining preservation oil in the burning off in the combustion chamber. The smoke should dissipate quickly; if smoke persists, shut down the engine and investigate the cause.

CAUTION: Operating the engine without oil pressure will result in engine malfunction or failure.

8. Throttle..... 600-1000 RPM (One minute)
RESULT: Operate the engine for one minute, gradually increasing the speed to 1000 RPM in 3 minutes.

9. Oil Temperature Check

NOTE: Allow the engine oil to reach normal operating temperature (100°F (38°C) for turbocharged engines or 75°F (24°C) for naturally aspirated engines) before proceeding to the next step.

10. Boost Pump OFF
11. Mixture Control FULL RICH
12. Throttle..... Set to IDLE RPM (Table 6-4)
13. Unmetered Fuel Pressure Gauge..... Check

RESULT: Unmetered fuel pressure is within the range specified in Section 6-4.7.1. Maintain engine speed until CHT is 250°F to 350°F (121°C to 177°C) and engine oil temperature is 160°-180°F. Record the unmetered fuel pressure, regardless of setting. If the unmetered fuel pressure is not within the limits specified in Section 6-4.7.1, adjust the fuel pressure according to the instructions in Section 6-4.10.2.

WARNING

Do not operate the engine at speeds above 1700 RPM until the oil temperature reaches minimum takeoff temperature (100°F (38°C) for turbocharged engines or 75°F (24°C) for naturally aspirated engines) and oil pressure is within the normal operating range. Operating at speeds above 1700 RPM before reaching the minimum oil temperature may result in engine malfunction or engine failure.

NOTE: To eliminate rough idling after mixture rise check, set engine RPM to 1500-1800 RPM for 15 seconds before returning to IDLE RPM.

14. Mixture Control Retard *slowly* to IDLE CUT-OFF
 RESULT: Monitor engine RPM as mixture is leaned; stop leaning when maximum RPM is achieved and record engine RPM. IDLE mixture rise should be 25 to 50 RPM (50-75 RPM for **IO-240-B** only) before beginning to drop toward zero. If mixture rise is less than 25 RPM (50 for **IO-240-B**), the mixture is too lean. If the mixture rise is more than 50 RPM (75 for **IO-240-B**), the mixture is too rich. Adjust the idle mixture rise according to instructions in Section 6-4.10.2.
 NOTE: The IDLE MIXTURE RISE is the difference (or RISE) between the IDLE RPM at FULL RICH and the maximum achievable IDLE RPM.
15. Mixture Control FULL RICH
16. Propeller Governor WIDE OPEN
17. Throttle..... WIDE OPEN
 RESULT: Check the engine RPM with a portable tachometer. Record the engine speed on the checklist. If the engine does not reach the rated, full power RPM, calculate the corrected metered fuel pressure (Table 6-5 or Table 6-6).
 NOTE: If no Manifold Pressure is provided for the engine model in Table 6-4, skip step 18.
18. Manifold Pressure Check
 RESULT: Manifold pressure should equal the value specified for the engine model in Section 6-4.7.1. If manifold pressure is not within the specified limits, adjust the Wastegate Controller according to instructions in Section 6-4.10.3.
19. Metered Fuel Pressure Gauge Check
 RESULT: The full power, metered fuel pressure should equal the value in Section 6-4.7.1, with Table 6-5 or Table 6-6 correction factor, if applicable. Record the metered fuel pressure, regardless of setting. If the full power, metered fuel pressure is not within the specified limits, adjust the metered fuel pressure according to Section 6-4.10.2.
20. Throttle..... Position to desired IDLE RPM
 RESULT: adjust IDLE RPM according to instructions in Section 6-4.10.2.
21. Perform a "Flight Check", if required, according to the instructions in Section 7-2.4.2.
22. If no further checks are required, proceed to "Engine Shutdown" instructions in Section 6-4.7.6.

6-4.7.6. Engine Shutdown

Procedure

1. Perform a normal engine shutdown according to the “Engine Shutdown” instructions in Section 7-3.4.
2. Remove installed test equipment.
 - a. Disconnect the metered fuel pressure test hose from the aircraft fittings.
 - b. Disconnect the unmetered fuel pressure test hose from between the fuel pump and the fuel control assembly.
 - c. Remove any fittings added to adapt the plumbing to the test equipment.
3. Reconnect and torque the fuel system hoses to Appendix B specifications.
 - a. Connect the unmetered pressure hose between the fuel pump and the fuel control assembly.

WARNING

Failure to connect and torque fuel system fittings to the proper specification will result in a fuel leak and potential fire hazard.

CAUTION: Upon completion of fuel system testing or adjustment, install and torque P/N 639494 cap, if equipped, at the metered pressure test connection. Use only P/N 639494 cap on the metered pressure fitting; installation of a pipe thread cap on the flared fitting may damage the fitting.

- b. Install the protective cap (P/N 639494) (or airframe-installed fitting to cockpit metered pressure gauge) on the fuel manifold valve (metered pressure) or throttle and metering assembly (metered pressure) fitting, if equipped, and torque the cap to standard torque for a #4 steel fitting in Table B-8.
4. Leak Check
 - a. Master Power Switch ON
 - b. Mixture..... FULL RICH
 - c. Boost Pump Switch (if equipped)..... ON
 - d. Throttle..... WIDE OPEN
 - e. Check for leaks in the following areas and correct any discrepancies before releasing the engine for flight:
 - 1) Induction System
 - 2) Exhaust System
 - 3) Fuel System
 - 4) Lubrication System
 - f. Boost Pump..... OFF
 - g. Throttle..... IDLE
 - h. Mixture..... IDLE CUT-OFF
 - i. Master Power Switch OFF