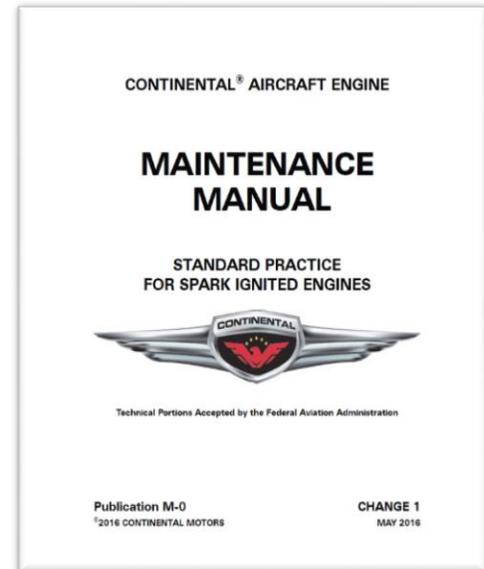


Continental Engine Fuel System Adjustment

LOBO has assembled two kits for use in adjusting Continental continuous flow fuel injection systems. Continental's instructions to complete these adjustments may be found in several different documents floating around the world-wide web, but the latest, greatest "official" guidance is *Standard Practice For Spark Ignited Engines*, Publication M-0, Change 1 (May 2016).



PURPOSE:

The instructions found in Continental's Publication M-0 are thorough but convoluted, requiring reference to sub-steps and data in different sections of the document as you advance through the procedure. This article is intended to provide an overview which can serve as a preparatory guide for the DIYer.

*CAUTION: This article is not to be used in lieu of Continental Publication M-0 while adjusting your fuel injection system. To ensure your fuel injection system is properly adjusted you **MUST FOLLOW THE INSTRUCTIONS PUBLISHED BY CONTINENTAL.***

You may obtain a copy of this publication directly from Continental's website. If you haven't already done so, [click here](#) to create an "Aviator Membership" account with Continental; you'll need the serial number from your engine. Once you've registered and received a confirmation email you will have unrestricted access to [Continental's electronic publication library](#), where you may download copies of all applicable maintenance documents.

RELEVANT SECTIONS

The relevant sections of Continental Publication M-0 are **6-4.7.4, Fuel System Operational Check**, and **6-4.10.2, Fuel System Adjustment**. Section 6-4.7.4 describes the procedure to measure the appropriate fuel injection system parameters and 6-4.10.2 describes how to make adjustments (if required).

NOTE: At the end of this document you can find a list of reference material found in Publication M-0. You may find it useful to print out all of the sections, figures and tables listed for reference as you complete the procedure.

NOTES, CAUTIONS AND WARNINGS

Publication M-0 includes three types of *Advisories*, which are meant to highlight particularly important information (a convention I've applied to this article). Advisories include:

WARNING

A warning emphasizes information which, if disregarded, could result in severe injury to personnel or equipment failure.

CAUTION: Emphasizes certain information or instructions, which if disregarded, may result in damage to the engine or accessories.

NOTE: Provides special interest information, which may facilitate performance of a procedure or operation of equipment.

OVERVIEW:

To complete the fuel system operational check and adjustment procedure you will do the following:

- 1) Read and thoroughly understand the entire procedure, including measurement/adjustment of idle and full-throttle fuel pressure and idle mixture. In addition, beg, wheedle or cajole the services of an assistant, who should as well be fully familiar with the procedure.
- 2) Secure the aircraft to a solid tie down using the straps provided in the kit.
- 3) Record test conditions (field elevation, barometric pressure, temperature, etc.).
- 4) Remove the top cowling and connect calibrated gauges to the fuel injection system.
- 5) Bleed air from the hoses connected to the gauge cluster and check for leaks in connections.
- 6) Replace top cowl (if practicable) and start the engine.
- 7) Monitor oil pressure and check magnetos while engine reaches normal operating temperature.
- 8) Confirm accuracy of tachometer.
- 9) Confirm the WOT RPM (and Manifold Pressure for turbocharged engines) are EXACTLY on spec; adjust if necessary.
- 10) Check/adjust unmetered fuel pressure (at idle):
 - a) If unmetered fuel pressure meets specifications record calibrated gauge AND engine instrument readings and proceed to Step 9.
 - b) If unmetered fuel pressure does not meet specifications, shut down the engine and make an adjustment.
 - c) Repeat Steps 8a-8b until unmetered idle fuel pressure meets specifications.
- 11) Check/adjust engine idle mixture:
 - a) If engine idle mixture meets specifications, record idle RPM rise and proceed to Step 10.

- b) If engine idle mixture does not meet specifications, shut down the engine and make an adjustment.
 - c) Repeat Steps 9a-9b until idle mixture meets specifications.
- 12) Check/adjust metered fuel pressure (at full-throttle):
- a) If metered fuel pressure meets specifications, record calibrated gauge AND engine instrument readings and proceed to the Step 13.
 - b) If metered fuel pressure does not meet specifications, shut down the engine and make an adjustment.
 - c) Repeat Steps 10a-10b until metered full-throttle fuel pressure meets specifications.
- 13) If you made an adjustment to metered fuel pressure (adjustable orifice adjustment screw), repeat steps 8 – 10 until calibrated gauge readings fall within specifications.
- 14) If you made an adjustment to unmetered fuel pressure (low-pressure relief valve adjustment screw), torque the jam nut on the low pressure relief valve adjustment screw and repeat Steps 8 – 10.

WARNING

Do not attempt fuel system adjustments with the engine running!

WHAT YOU WILL NEED:

Before starting you'll need to assemble the following:

- An assistant fully briefed on the procedure (HIGHLY RECOMMENDED).
- The appropriate reference material from Continental Publication M-0.
- Gear straps (in LOBO kit) and two cargo straps.
- Printed copy of Table 6-26, *Engine Operational Checklist*, to record data on.
- Calibrated gauge cluster (in LOBO kit).
- Long, steel-braided fuel lines (in LOBO kit).
- The appropriate fittings to connect fuel lines to your fuel system (in LOBO kit).
- Electronic tachometer.
- A recently tested fire extinguisher.
- Tools to remove/replace top cowling.
- Tools to make fuel system adjustments (in LOBO kit).

LET'S DO IT!

Each of the following sections corresponds to one of the tasks in the overview above. Except for securing the aircraft and recording the test conditions, the tasks listed are covered in detail in Continental Publication M-0. What you'll find below are a few tips, tricks and clarifications that will aid you in following through Continental's publication.

READ AND UNDERSTAND THE PROCEDURE

I can't emphasize this enough; you and your assistant must fully understand the procedure as published by Continental, AND you must follow the sequence of events as given. There are several critical steps that must be followed to the letter to minimize the danger of personal injury, as well as damage to your engine and/or aircraft. Further, if your engine is new or freshly overhauled you want to keep ground runs to a minimum to facilitate proper engine break in. A thorough understanding of the procedure can prevent the need for do overs (ask me how I know).

SECURE THE AIRCRAFT

WARNING

Full-thrust, static engine runs on the ground are dangerous; you cannot rely on brakes and/or chocks alone to prevent movement. Properly securing your aircraft is crucial.

LOBO's test kit includes two straps with loops and sturdy metal D-rings. Attach the straps to the main gear leg close to the bottom of the aircraft and use a cargo strap to connect the D-ring to a ground tie down point. Consider cargo straps with spring guards.

CAUTION: Attach straps to gear legs as close to the bottom of the aircraft (as far away from the wheel) as possible to minimize stress on the gear attach points and gear actuation mechanism. Additionally, power up the hydraulic system to guard against gear collapse (particularly the nose gear).



RECORD TEST CONDITIONS

If this is the first time you've ever started your engine and/or adjusted a fuel injection system it will take some time. I would plan on at least 1.5 – 2 hours, so check the weather before you begin; you don't want to get rushed while doing this. Print out Table 6-26, *Engine Operational Checklist* and record the test conditions.

CONNECT THE CALIBRATED GAUGES

NOTE: You will likely need to taxi/tow your aircraft to a tie down spot to complete this procedure. You may not want to tow you aircraft—and you definitely don't want to taxi it—with the gauges connected. Determine and assemble the fittings you'll need to connect the lines to your system, and put them in the aircraft before you taxi to the tie down area. Include some zip ties to secure the fuel lines in the engine compartment.

Figure 6-4, *Typical Naturally Aspirated Fuel System Schematic (Fuel Pump with Integral Mixture Control)* (reproduced in reference section at the end of this document) depicts connection of the calibrated gauges to your fuel system. Typically, you will disconnect a fuel hose at the appropriate location and install a swivel tee fitting between the fuel hose and the fitting it was connected to, thus creating a connection point for the fuel line to the calibrated gauges. There are fittings of several different sizes in the kit, but you may have to purchase one to fit if your system is non-standard. The "unmetered" gauge connects to the system after the engine-driven fuel pump, but before the throttle and control assembly. The "metered" gauge connects to the system after the throttle and control assembly, but before the fuel manifold valve (sometimes called the fuel distribution valve, or spider). You may also connect to the AN2 port on the "back" side of the spider.



TO UNMETERED GAUGE

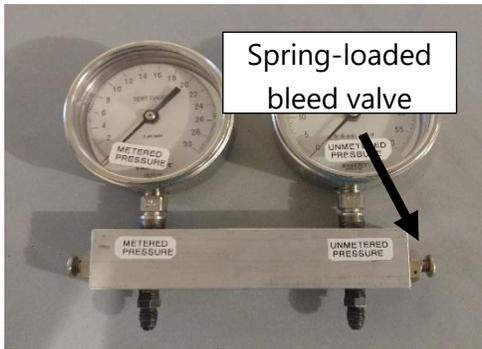


TO METERED GAUGE

WARNING

You will be disconnecting fuel lines on a warm engine. Take care to manage fuel spills, and have a recently tested fire extinguisher available!

BLEED LINES AND CHECK FOR LEAKS



You must bleed all the air out of the fuel lines.

The calibrated gauge cluster supplied in the kit includes spring-loaded bleed valves on the ends of the cluster housing. Hold the hoses and gauge cluster higher than the connection points on your engine (because air bubbles rise), turn on the boost pump and press the bleed valve until the air is purged.

CAUTION: Be prepared for fuel spray from the valve; mind the wind!

REPLACE THE TOP COWL AND START ENGINE

Continental recommends keeping the top cowl on while the engine is running. This will add time to the procedure (because you have to remove/replace the cowl between adjustments), but will ensure your engine gets the maximum cooling air. To do this you'll need to safely route the fuel lines connected to the calibrated gauge cluster out of the engine compartment. I left several screws off the left-aft corner of the top cowl, and routed the fuel lines to exit there. You can also run them out the oil check door--with some caution and effort--or out the exhaust exit under the engine--again with some caution to protect the lines from the hot exhaust.



If your cowl is painted you can wrap the fuel lines in a shop towel to protect the paint (attach it securely; it will need to withstand the prop blast). If your cowl is attached with hinges you may not be able to route the fuel lines as I did. If you cannot find a way to safely route the lines out of the engine compartment you may have to complete the procedure with the top cowl off. In this case it's imperative that you keep the engine running to an absolute minimum.

If you have never started your engine before the procedure can be found in Section 7-3.2, *Engine Start*.

CAUTION: If this is the first engine start following installation/ overhaul you must follow all required prerequisite procedures described in Publication M-0. As a minimum, you must complete the procedures in Section 6-4.7.2, Maintenance Preflight Inspection and 7-3.1, Pre-operational Requirements.

NOTE: This procedure requires several engine starts, so don't forget to turn on your alternator when the engine is running to recharge the battery.

MONITOR OIL PRESSURE AND CHECK MAGNETOS

The very first thing you must do after the engine starts is ensure you have oil pressure. Minimum oil pressure at idle is 10 psi. If after starting you don't get an indication of minimum oil pressure immediately shut down the engine and investigate the cause.

WARNING

**Do not operate the engine without an indication of oil pressure!
Do not operate the engine at speeds above 1700 RPM until the oil temperature is at least 75°F (24°C) and oil pressure is within the normal operating range (30-60 psi). Operating at speeds above 1700 RPM before reaching the minimum oil temperature may result in engine malfunction or engine failure.**

You'll have to wait for the engine to reach normal operating temperature (CHTs between 250°F to 350°F) and ensure the ignition system is properly functioning before checking the fuel injection system. You can kill two birds with one stone by checking the magnetos while waiting for the engine to warm up. The procedure to check the magnetos is in Section 6-4.7.5, *Magneto RPM Drop Check*.

CHECK/ADJUST UNMETERED FUEL PRESSURE (AT IDLE POWER)

Section 6-4.7.4.3, *Fuel System Operational Checkout Procedure* is your guide for the next few steps. Your assistant should stand outside the aircraft holding the calibrated gauges so you can see them. Be sure he/she holds them higher than the connection point on your engine, or the readings may be inaccurate.

CAUTION: Your assistant should stand behind the wing and far enough outboard to get out of the prop blast; properly routed fuel lines are long enough to allow for this. Ear and eye protection is an absolute



must! Brief them to monitor the engine nacelle and to warn you immediately if they see a fuel/oil leak, excessive smoke, fire or any other abnormal condition.

Observe the reading on the unmetred gauge. If it is within the specification listed in Table 6-4, *Fuel System Adjustment Values* record cockpit engine indications and fuel pressure indicated on the calibrated gauge using the *Engine Operational Checklist*. You printed one out and brought it with you, right?

NOTE: Don't forget to observe/record the fuel pressure/flow indications of your cockpit engine monitor. Cockpit gauges are not accurate enough for the adjustment procedure, but you can use them for trend monitoring. A change in the baseline cockpit fuel pressure/flow indications you record during this procedure would be grounds to perform a system operational test using calibrated gauges to determine if your system is out of adjustment or your gauge is going bad.

If the unmetred idle fuel pressure is not within specifications shut down the engine and make an adjustment. The adjustment procedure is in Section 6-4.10.2, *Fuel System Adjustment*. This is an iterative process; you'll have to shut down the engine, make an adjustment and then restart and check the results.

CHECK/ADJUST IDLE MIXTURE

Continuing in Section 6-4.7.4.3, you'll now check the idle mixture. If adjustments are required refer to Section 6-4.10.2. This is also an iterative process: Check, shut down and make adjustment, restart/recheck, etc. Once idle mixture meets specifications record the relevant data.

CHECK/ADJUST METERED FUEL PRESSURE (AT FULL POWER)

The last check in Section 6-4.7.4.2 is metered fuel pressure at full throttle. As in the previous two steps, this is an iterative process, with the adjustment procedure in Section 6-4.10.2. Be sure to record relevant data.

NOTE: Fuel pressure closely correlates with RPM. If your engine cannot attain full RPM (2700) you can still check the metered fuel pressure by applying a correction factor. Refer to Table 6-5, *Static Ground Setup Compensation Table*.

LATHER, RINSE, REPEAT

Changes in fuel pressure at idle can affect the fuel pressure at full throttle, and vice versa. If you make an adjustment to the metered fuel pressure you must recheck and adjust (if required) all fuel system parameters. You'll continue repeating the full procedure (idle fuel pressure, idle mixture, full throttle fuel pressure, in that order) until all parameters fall within specification.

CAUTION: If you make adjustments to the unmetered fuel pump pressure you must properly torque the jam nut on the adjustment screw. You must then recheck all fuel injection system parameters (unmetered fuel pressure, idle mixture and metered fuel pressure, in that order) to ensure you didn't move the adjustment screw while torquing the jam nut.

FINAL RECOMMENDATION

And that's it; you're done! Once you have the engine fuel pressure properly adjusted to the calibrated gauges you should adjust your engine gauges/monitor settings such that cockpit indications are accurate.

PUBLICATION M-O REFERENCES

- 6-4.7.2, *Maintenance Preflight Inspection*
- 6-4.7.4, *Fuel System Operational Check*
- 6-4.7.5, *Magneto RPM Drop Check*
- 6-4.10.2, *Fuel System Adjustment*
- 7-3.1, *Pre-operational Requirements*
- 7-3.2, *Engine Start*
- Table 6-4, *Fuel System Adjustment Values*
- Table 6-5, *Static Ground Setup Compensation Table*
- Table 6-26, *Engine Operational Checklist*

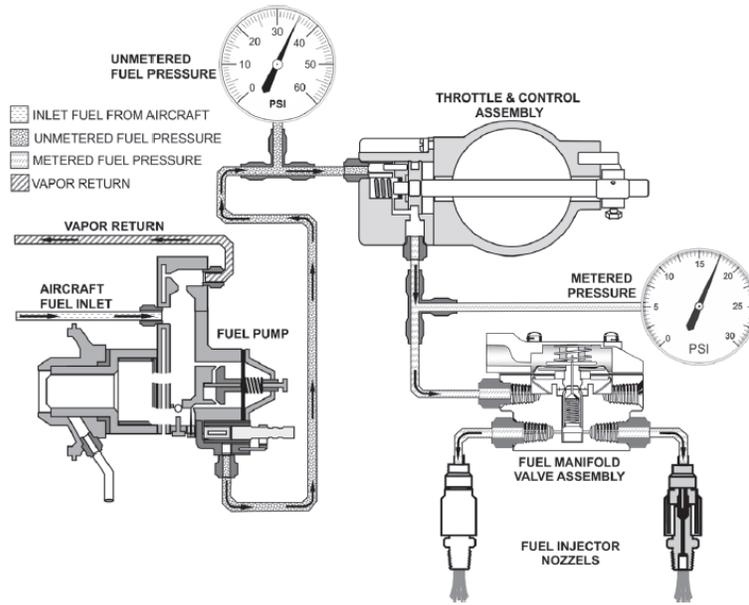


Figure 6-4. Typical Naturally Aspirated Fuel System Schematic (Fuel Pump with Integral Mixture Control)

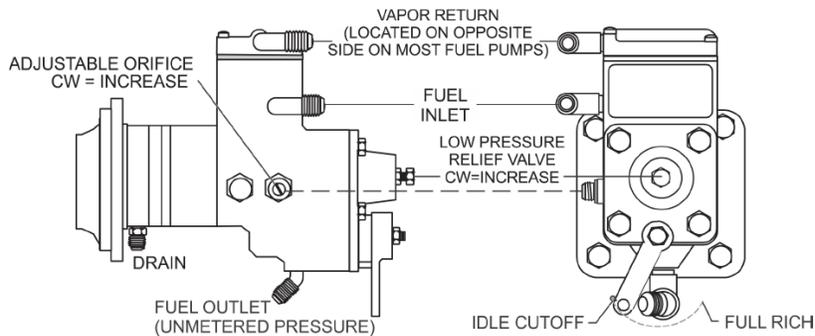


Figure 6-36. Fuel Pump, Naturally Aspirated Engine with integral Mixture Control

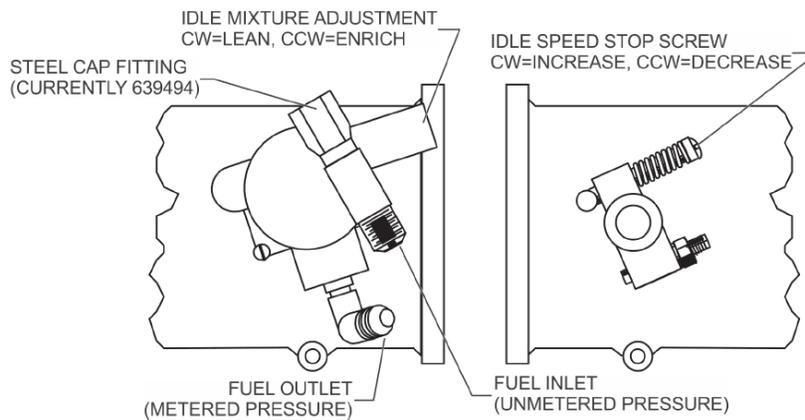


Figure 6-37. Throttle and Metering Assembly

Table 6-26. Engine Operational Checklist																
Aircraft Make & Model:								Aircraft Registration #:								
Engine Model:								Engine Position:	Left	Right	Front	Rear				
Engine Serial Number:								Engine Total Time:NewOverhaul								
Date	Location:							Elevation:	Outside Air Temp.:			Altitude:				
Operational Check																
RPM		Magneto Drop Check			MAP		Cylinder Head Temp. - °F						EGT	TIT		
Spec	Actual	L	R	Drop/Spread	Spec	Actual	1	2	3	4	5	6	°F	°F		
Adjustments																
IDLE Fuel Pressure (psi)				Full Power Fuel Pressure (psi)				Oil								
Spec	Actual	Adjustments		Spec	Actual	Adjustments		Pressure PSI	Temp. °F	Adjustments						
		CW	CCW			CW	CCW			CW	CCW					
Check Flight Data																
RPM	MAP	Pressure Altitude		EGT °F		TIT °F		CHT °F								
		Set altimeter to 29.92"		Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual					
Fuel Flow				Oil PSI		Oil Temp. °F		Indicated Airspeed								
Spec		Actual		Spec	Actual	Spec	Actual									
Remarks:																
Signature:																