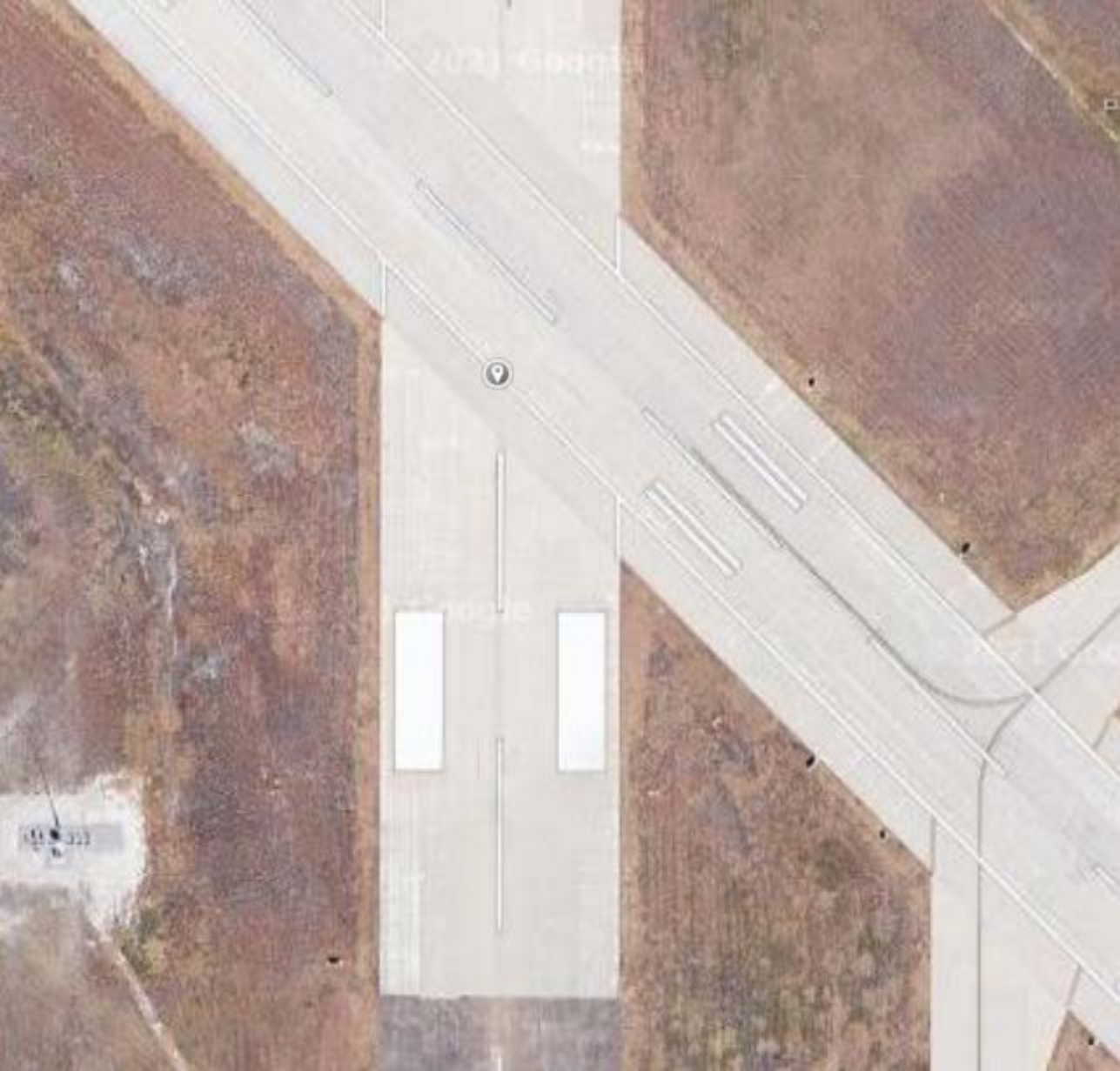




Measure distance

Click on the map to add to your path

Total distance: 1,415.01 ft (431.29 m)





35



Doug Hodge
[REDACTED]
Austin Tx 78730
[REDACTED]

November 10, 2021

Mr. Jim Staggs
Aviation Safety Inspector
FAA

[REDACTED]
Inving TX 75063

Dear Mr. Staggs:

This letter serves as an addendum to my statement for the accident on October 20, 2021 at Dallas Executive airport.

When I notified my partner of the accident he commented that the engine had never worked correctly since it was rebuilt by Christopher Albrecht, A&P [REDACTED] IA. I was told that after this event he lost his A&P but I have not confirmed this. After the rebuild the engine would not run and we hired Dale Faulkner to disassemble the engine and rebuild it once again. He also made a list of all the items that Chris had done incorrectly. A reoccurring event was fuel fluctuation. We would also see a very fine sand like material in the fuels samples. I had assumed it was due to contamination at Spicewood airport where I got most of my fuel but now I believe it could be a residue from the sealant used when Chris resealed the fuel tanks. Dale Faulkner, A&P [REDACTED] helped us trouble shoot these problem items and we though we had them resolved. I have the highest respect for Dale's work and do not think anything he did contributed to the problem. The fuel flow fluctuation would always happen on the second flight of the day on take off when I was on my way home.

Sincerely,

[REDACTED]
Lew Douglas Hodge

From: [REDACTED]
To: [REDACTED]
Cc: [REDACTED]
Subject: Re: CEN22LA018 (N1235U - Cessna 210N) - Additional Questions
Date: Tuesday, November 30, 2021 11:55:21 AM
Attachments: [Letter from Dale Faulkner.pdf](#)

[CAUTION] This email originated from outside of the organization. Do not click any links or open attachments unless you recognize the sender and know the content is safe.

Dear Michael:

Here is the Letter from Dale Faulkner listing the discrepancies found after Christopher Albrecht, A&P [REDACTED] IA installed the new engine which would not run after installation.

We do not have any additional information on the sealant used in the tanks. Please let me know if I can help with anything else.

Thank you

Douglas Hodge, CCIM
President
Republic Commercial Properties
[REDACTED]
Austin TX 78703
[REDACTED]

On Nov 22, 2021, at 5:30 PM, Hodges Michael [REDACTED]
wrote:

Sounds good – thank you so much sir for the help. I am sorry about the passing of your friend.

Mike

Mike J. Hodges, MS, CHP
Air Safety Investigator
National Transportation Safety Board

4760 Oakland Street, Suite 500
Denver, Colorado 80239-2793

Cellular/SMS: [REDACTED]
Facsimile: [REDACTED]
Response Operations Center (24/7): 1-844-373-9922
Work Hours: Monday-Friday, 0900-1730 Mountain Time

"We always need to prepare ourselves for handling the unexpected." – Neil A. Armstrong

From: [REDACTED]
Sent: Monday, November 22, 2021 4:28 PM
To: Hodges Michael [REDACTED]
Subject: Re: CEN22LA018 (N1235U - Cessna 210N) - Additional Questions

[CAUTION] This email originated from outside of the organization. Do not click any links or open attachments unless you recognize the sender and know the content is safe.

I have asked my partner if he has a copy of the list and if he recalls any details about the sealant. At this point my third partner Stan Graham was handling these details and he was given the list by Dale. Stan did express concern about sealant to me. It was know that Chris had used the wrong sealant on the tank access panels in the wing and Stan said "I hope he did not use the wrong sealant inside the wing."

Stan has since passed away at age of 72 due to pancreatic cancer.

I have reached out to Rich Schaffer my other partner and I will reach out to Dale Faulkner to see if he kept a copy of the lease and know any more details on the sealant.

Thank you

Douglas Hodge, CCIM
President
Republic Commercial Properties
[REDACTED]
Austin TX 78703
[REDACTED]

On Nov 22, 2021, at 3:54 PM, Hodges Michael
[REDACTED] wrote:

Hi Lew,

I hope you are doing well sir.

Thank you again for submitting that additional statement to the NTSB and FAA. We are also working with Textron Aviation on this case.

We are trying to schedule a future date at ASOD in Lancaster to examine the airframe and engine. Thank you also for shipping all the airframe/engine/propeller maintenance records to ASOD.

I did want to ask please – you mentioned about Chris Albrecht, who previously resealed the fuel tanks, and the possibility of sealant residue being a potential issue.

Do you happen to have any work orders or other documentation showing what type of sealant that Chris used on the fuel tanks, that you could please send to me?

Can you also please send me a copy of the list that Dale Faulkner made, of the various incorrect items from Chris?

Thank you again sir. Have a Happy Thanksgiving.

Mike

Mike J. Hodges, MS, CHP
Air Safety Investigator
National Transportation Safety Board

4760 Oakland Street, Suite 500
Denver, Colorado 80239-2793

Cellular/SMS [REDACTED]
Facsimile [REDACTED]
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“We always need to prepare ourselves for handling the unexpected.” –
Neil A. Armstrong

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Following is a list of discrepancies found on N1235U on December 3, 2018 during a limited inspection requested by Spicewood Centurion Partnership in their hangar at the Spicewood Airport:

Magneto timing: left magneto was timed at 60 degrees BTDC: right magneto was timed at 59 degrees BTDC. Engine data plate specifies timing should be 22 degrees BTDC.

Compression checked as follows: #1 - 72, #2 - 72, #3 - 73, #4 - 68, #5 - 72, #6 - 70/80 (cold)

Ran starter to confirm operation. Removed starter from adapter.

Removed starter adapter from the engine and confirmed unit had failed.

Both the #3 cylinder CHT probe and the #4 cylinder CHT probe are loose. Installation of each was not completed.

#1 cylinder fuel injection line and #5 cylinder fuel injection line are both loose at the injectors. Injectors are tight but the fuel line B nuts on the nozzles are not tightened. Fuel stains were noted under the engine oil pan.

#4 cylinder spark plug is not torqued.

#6 cylinder spark plug lead is not tight.

Right muffler is missing the heat shield.

Left muffler is missing the heat shield.

Left muffler is missing the duct from the heat shield to the firewall that supplies heat to the cabin.

Left muffler is missing the scat hose from the forward engine baffling to the heat shield.

The alternator tensioning bolt is not properly safety wired.

The push rod tube seals are not installed correctly at the cylinder head on #1, #2, and #6 cylinders.

The owner was invoiced for new spark plugs. The spark plugs installed had not been cleaned or gapped. They are a mix of approved and unapproved spark plugs for the engine.

The left aileron tip has sustained impact from the rear. The skin is cracked and requires repair.

The left elevator top skin has corrosion that has penetrated through the skin. Requires repair.

Aft engine baffling rear upper section is not completely installed. It is 6 missing screws.

All 4 newly installed seat rails have improperly driven rivets and loose-pulled rivets. Without replacing the rivets, the installation is deemed unairworthy.

ELT was found to be in the "off" position. After inspecting the ELT's battery, it was confirmed that the battery date is expired and the label placed on the ELT for a new battery expiration date is incorrect.

Inspection of the upper wing fuel tank access plates shows that improper sealant was used in their installation. Internal fuel tank sealant was used which will not allow ease of access plate removal at a later date.

Dale R. Faulkner

A&P [REDACTED] IA

[REDACTED]

SERVICE BULLETIN

Contains Important Information Pertaining to Your Aircraft Engine
Compliance Will Enhance Safety

SB08-4A

Supersedes SB08-4
TECHNICAL PORTIONS
FAA APPROVED

SUBJECT: FUEL INJECTION SYSTEM CONTAMINATION

PURPOSE: To provide guidelines to prevent contamination of Continental Motors (CM) fuel injection systems during installation and maintenance.

COMPLIANCE: Anytime a CM continuous flow fuel injection system component is removed for replacement or repair.

MODELS

AFFECTED: All with CM Continuous Flow Fuel Injection Systems

Continental Motors has continued to receive fuel injection system components from the field which have been contaminated with foreign material during installation or maintenance procedures. It is imperative that fuel injection system components be kept free from contamination during all installation and maintenance procedures. The following guidelines must be followed during fuel injection system maintenance:

- All caution must be exercised during reassembly of the fuel system to NOT allow any contaminants to enter the components, lines and fittings during installation.
- All surfaces surrounding the area where components are to be installed must be clean and free of all forms of contaminant before and during installation.
- All hose assemblies must be flushed and verified to be free of contamination prior to installation.
- All fuel system component and lines must be capped and remain capped until flushed and ready for installation.
- The engine, tools and environment must be clean to minimize any potential for fuel system contamination.
- All fuel system components, regardless of their source, must be purged at time of installation.

WARNING

Fuel system contamination may lead to fuel system component damage, erratic engine operation, loss of power, or engine shutdown.

ISSUED			REVISED			 P.O. Box 90 Mobile Alabama 36601 251-436-8299	PAGE NO	REVISION
MO	DAY	YEAR	MO	DAY	YEAR		1 of 4 SB08-4	A
03	14	2008	07	27	16			

FUEL SYSTEM PURGING PROCEDURES

1. Fuel Pump Installation

- a. Install fuel pump using the latest revision of the applicable engine Maintenance and Overhaul Manual.
- b. Remove the protective cap from the fuel inlet line. Direct the fuel inlet line into a clean bucket. Utilizing the airframe boost pump, flush a minimum of 1 quart of fuel from the fuel pump inlet hose into a clean, dry container.
- c. Inspect the flushed fuel. If free from contamination, proceed to the next step. If contamination is found, locate the source and correct the issue before proceeding further.
- d. Remove the fuel pump inlet fitting cap and install the inlet fuel line using the installation instructions contained in the latest revision of the applicable engine Maintenance and Overhaul Manual.
- e. Remove the cap from the fuel outlet line and install the line using the applicable engine Maintenance and Overhaul Manual. (If line is installed or partially installed, the line will have to be removed to facilitate the flush process.)
- f. Utilizing the airframe boost pump, flush a minimum of 1 quart of fuel through the fuel pump into a clean, dry container. If the fuel pump is equipped with a mixture control, operate the mixture control slowly through its full range of motion several times during the flushing procedure.
- g. Inspect the flushed fuel. If free from contamination, proceed to the next step. If contamination is found, locate the source and correct the issue before proceeding further.
- h. If the fuel pump and associated lines are verified to be free from contamination, complete the fuel pump installation and setup procedures in accordance with the latest revision of the applicable Maintenance and Overhaul Manual, and the latest revision of M-0, Standard Practice Maintenance Manual.

2. Fuel Control Unit

- a. Install the fuel control unit using the latest revision of the applicable engine Maintenance and Overhaul Manual.
- b. Remove the protective cap from the fuel control inlet line. Direct the fuel control inlet line into a clean bucket. Utilizing the airframe boost pump, flush a minimum of 1 quart of fuel from the fuel control inlet hose into a clean, dry container.
- c. Inspect the flushed fuel. If free from contamination, proceed to the next step. If contamination is found, locate the source and correct the issue before proceeding further.
- d. Remove the cap from the fuel control inlet line and install the line using the applicable engine Maintenance and Overhaul Manual.
- e. Remove the cap from the fuel control outlet. Install the fuel control outlet line using the applicable engine Maintenance and Overhaul Manual. (If line is installed or partially installed, the line will have to be removed to facilitate the flush process.)

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- f. Utilizing the airframe boost pump, flush a minimum of 1 quart of fuel from the fuel control inlet hose into a clean, dry container. If the fuel control is equipped with a mixture control, operate the mixture control slowly through its full range of motion several times during the flushing procedure.
- g. Inspect the flushed fuel. If free from contamination, proceed to the next step. If contamination is found, locate the source and correct the issue before proceeding further.
- h. If the fuel control unit and associated lines are verified to be free from contamination, complete the fuel control unit installation, additional fuel system component installation if required, and setup procedures in accordance with the latest revision of the applicable Maintenance and Overhaul Manual, and the latest revision of M-0, Standard Practice Maintenance Manual.

3. Fuel Manifold Valve

- a. Install the fuel manifold valve using the latest revision of the applicable engine Maintenance and Overhaul Manual.
- b. Remove the protective cap from the fuel manifold valve inlet line. Direct the fuel manifold valve inlet line into a clean bucket. Utilizing the airframe boost pump, flush a minimum of 1 quart of fuel from the fuel control inlet hose into a clean, dry container.
- c. Inspect the flushed fuel. If free from contamination, proceed to the next step. If contamination is found, locate the source and correct the issue before proceeding further.
- d. Remove the cap from the fuel manifold valve inlet and install the line using the applicable engine Maintenance and Overhaul Manual.
- e. Install the fuel injector lines. Torque each fitting at the manifold valve to 55-60 in-lbs.
- f. Utilizing the airframe boost pump, flush fuel from the fuel injector lines into appropriate, clean, and dry containers.
- g. Inspect the flushed fuel. If free from contamination, proceed to the next step. If contamination is found, locate the source and correct the issue before proceeding further.
- h. If the fuel manifold valve and associated lines are verified to be free from contamination, complete the fuel manifold valve installation, additional fuel system component installation if required, and setup procedures in accordance with the latest revision of the applicable Maintenance and Overhaul Manual, and the latest revision of M-0, Standard Practice Maintenance Manual.

4. Bypass Fuel Filter (Where Installed)

- a. Install the bypass fuel filter assembly using the latest revision of the applicable engine Maintenance and Overhaul Manual
- b. Remove the protective cap from the bypass fuel filter inlet line. Direct the fuel inlet line into a clean bucket. Utilizing the airframe boost pump, flush a minimum of 1 quart of fuel from the bypass fuel filter inlet hose into a clean, dry container
- c. Inspect the flushed fuel. If free from contamination, proceed to the next step. If contamination is found, locate the source and correct the issue before proceeding further.

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- d. Remove the cap from the bypass fuel filter inlet line and install the line using the applicable engine Maintenance and Overhaul Manual.
- e. Utilizing the airframe boost pump, flush a minimum of 1 quart of fuel from the bypass fuel filter inlet hose into a clean, dry container.
- f. Inspect the flushed fuel. If free from contamination, proceed to the next step. If contamination is found, locate the source and correct the issue before proceeding further.
- g. If the bypass fuel filter and associated lines are verified to be free from contamination, complete the bypass fuel filter installation, additional fuel system component installation if required, and setup procedures in accordance with the latest revision of the applicable Maintenance and Overhaul Manual, and the latest revision of M-0, Standard Practice Maintenance Manual.

NOTE: Operational verification of the engine fuel system in accordance with the latest revision of M-0, Standard Practice Maintenance Manual is required any time one of the following circumstances occurs: (1) at engine installation, (2) during 100 hour and annual inspections, (3) whenever a fuel system component is replaced or adjusted, (4) when changes occur in the operating environment.

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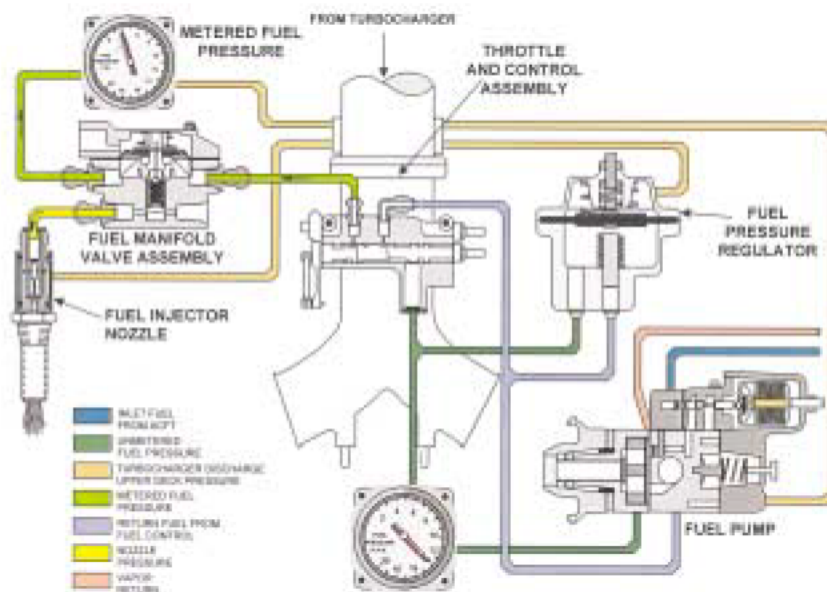
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RECIP TECHNOLOGY

Continuous Flow Fuel Injection Systems

By Randy Knuteson



Typical Turbo-Charged Fuel System Schematic (With Regulator)

Continental Motors calls it their "Continuous Flow Fuel Injection System." Some technicians refer to it in less dignified terms, replete with colorful expletives. The proclivity of human nature has always been to focus on the negative. But regardless of an occasional negative encounter, the positive attributes of these systems are easy to identify. You need not look far to appreciate the commendable features of the TCM Fuel Injection System.

For many years, the factory has pointed to "simplicity" as being the "single most significant feature" of their systems. Some would agree. Others would strongly disagree. The

goal of this article is to provide some information to clear up any misunderstandings that may have landed you in the "disagree" camp.

GENERAL OPERATION

As the name suggests, this system provides for a "continuous" (un interrupted) flow of fuel to the intake port of each cylinder. To reach the cylinder, fuel follows a circuitous path from the engine driven pump, through a metering device (controller), then to a manifold valve that serves to evenly distribute an equal flow through the lines and finally to the injection nozzles.

The TCM System varies greatly from its

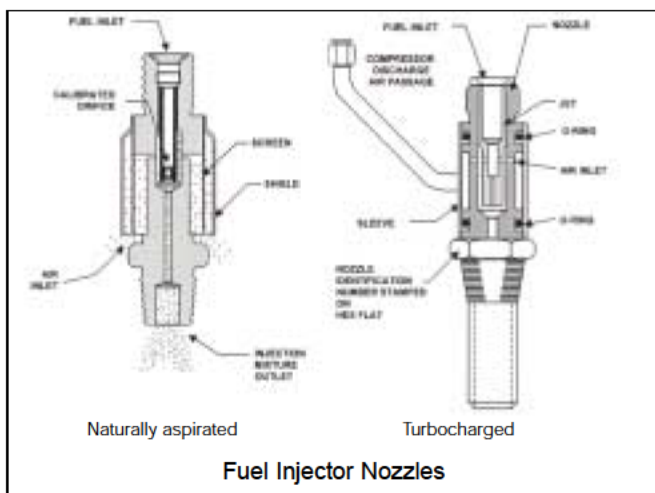
Lycoming counterpart, the Bendix Fuel Servo. Perhaps most noticeable is the absence of a venturi to schedule fuel flow proportionate to air flow. The Bendix system regulates fuel flow by means of a delta pressure across an air diaphragm. Comparatively, the Continental System has no way to sense airflow. It does not compensate for altitude or density changes, nor does it correct for MAP unless turbocharged.

FUEL PUMPS

The only continuously moving part of this system is a positive displacement rotary vane pump. Pump output and pressure will vary in accordance with engine rpms. At all rpm settings, these pumps are capable of producing fuel pressures well in excess of demand. Surplus fuel is internally re circulated through the pump, and vapors are purged from the pump by means of the centrifuge action of the pump's "swirl chamber." These vapors exit through the vapor return on the top of the pump, and are routed to the fuel tank or head or tank of the airframe.

TCM installed an adjustable orifice in their pumps to maintain adequate pressures at lower rpms. TCM provides a good analogy when they compare this orifice to "placing one's thumb over the end of a garden hose to increase pressure." Once set, this adjustable orifice becomes fixed during actual operation.

All TCM pumps rely on a "by pass valve" which serves to purge vapors from the lines when the boost pump is engaged prior to engine start up. Also, in the unlikely event of a sheared fuel pump shaft, this by pass enables the boost pump to provide enough fuel for the plane to maintain 75 percent power.



METERING UNITS

Metering units remain relatively problem free besides an occasional leaking "O" ring or an ICO problem due to scored valve faces (again, the result of fuel borne contamination). Sometimes, "lean" conditions caused by induction leaks, are mistakenly blamed on this unit. Induction leaks usually reveal themselves in higher MAPs at lower rpms. Rich conditions on 360 style throttle bodies can often be traced to a

leaking throttle shaft "O" ring that allows fuel to seep past the throttle bushing and into the induction.

MANIFOLDS

TCM manifolds are calibrated in conjunction with the nozzles making them a "married" system. Herein lies an ongoing problem. Well meaning mechanics occasionally swap nozzles engine to engine. If little or no consideration is given to the letter designation on the wrenching flats of the nozzle, or to the "M" or "P" stamped on the manifold data tag, this action could result in a split in mixture levers and fuel flow indications.

NOZZLES

Plugged or even partially plugged nozzles are notorious for creating rich and rough running engines. If these symptoms occur, look here first. Plugged jets create back pressures that route that nozzle's fuel to the other cylinders, creating a rich indication, and are often the cause for in flight roughness. Nozzles with plugged air bleeds will allow the engine to suck excessive fuel from the lines, causing the flow divider to respond erratically. A simple "bottle test" may isolate the problem at the nozzle and save you pulling other components. Look for indications of fuel staining, loose shrouds, or dirty screens. Immerse nozzles in an ultrasonic cleaner if they require cleaning.

JETS

TCM no longer sells jets for these nozzles. This poses a problem. Between overhaul, these jets may experience a slight fluid erosion of the brass, resulting in an enlarged jet diameter. In the past, shops would insert new jets into the existing nozzle bodies in order to properly set up the manifold since nozzles and manifolds are a "matched" set.

According to Kelly Aerospace Power Systems these jets can once again be procured. Kelly Aerospace Power Systems began manufacturing FAA PMA replacement jets. Nozzle bodies, shrouds, and screens are also available. This should result in substantial savings since the only alternative is to purchase entire nozzle assemblies from the TCM factory.

Fuel borne contaminants can wreak havoc in any fuel system and often are the cause for the poor performance of many an aircraft engine. It may seem that the TCM fuel system is more susceptible than other systems. We'll leave that judgment to the experts. Suffice it to say, regular maintenance is in order. Keep the finger strainer in the brass metering unit free of debris and clean the injection nozzles at regular intervals (some suggest every 100 hours). Close attention should also be given to leaking fuel lines, seals, fittings, diaphragms, and reference lines. Any of these can be the cause for erratic fuel indications.

SETTING UP THE SYSTEM

Is "Fine-Tuning" Required?

Some shops make the erroneous assumption that a freshly overhauled fuel system need only to be bolted to the engine and flown away. They say "after all, wasn't the system overhauled and calibrated to factory specs?" Yes however, variations in induction systems, supply systems, and operating environments mandate a final "tweaking" of the installed components. Still, some tenaciously hold to the mind set that "it should be set up for my airplane out of the box."

For this reason, many Repair Stations have difficulty persuading technicians to use calibrated hand held gauges while setting up their Continental systems on the airframe. While TCM strongly recommends the usage of externally plumbed gauges, some technicians still consider this procedure nothing more than a mere suggestion. Failure to follow this "suggestion" often results in lackluster performance, frustration, and dissatisfied customers. Always use these gauges if you expect to appreciate the system's full performance capabilities. Teledyne's Service Information Directive 97 3 provides clear instructions for final adjustments once fuel components are installed on the airplane.

BEFORE ADJUSTING

Verify the accuracy of the following gauges before making adjustments to the fuel system: Tach, MAP, Fuel Flow, Oil Temp, Oil Press, CHT, EGT. Don't rely solely on the ship's gauges when setting pressures and flows. Rectify any discrepancy if found. Errant gauge readings, if significant, can result in annealed rings, com



Turbocharged engines reference upper-deck pressure to the injection nozzles. Always replace o-rings and packings when cleaning or replacing these nozzles.

THROTTLE/CONTROL ASSEMBLY (METERING UNIT)

The pump feeds fuel under pressure to the controller. The controller's chief purpose is to meter this fuel proportionate to the air being ingested at the cylinder. Depending on the configuration of the unit, this is accomplished by adjusting either a linkage rod or a fuel adjustment screw. Either adjustment serves to change the position of a cam faced valve in relation to a metering jet, enabling the unit to schedule adequate fuel on demand.

MANIFOLD/LINES/NOZZLES

The primary task of the manifold valve is to provide an even distribution of fuel to each cylinder. It serves a dual purpose by providing a secondary idle cut off (ICO) when mixtures are pulled. The resulting decrease in fuel pressure allows its plunger to seat, disrupting fuel flow to the nozzles.

IDENTIFYING POTENTIAL PROBLEMS

Many TCM fuel system failures can be attributed to contaminants that have entered the system. These contaminants range from shaved "O" rings to fuel bladder material. "Foreign objects" always seem to migrate to the worst possible spots.

FUEL PUMP

In the fuel pump, debris lodged under the seat of the relief valve results in a loss of pump pressure. This loss of pressure is especially apparent below 1,500 rpm and may require boost pressure to keep the engine running at idle. If contaminants obstruct the adjustable orifice, the opposite occurs an increase in output pressure at higher RPMs (above 1700 rpm). Contaminants can also hinder the free floating movement of the variable metering rod connected to the aneroid in turbocharged applications. And, any small obstructions lodged in the vapor ejector may result in a rich and rough running engine due to the excess fuel (and vapors) now being pumped into the metering unit. This rich characteristic can also occur if the vapor return check valve is installed backwards.



This is a typical 470 and 520 mixture style adjustment. It requires a 3/8 wrench with a clockwise rotation to enrich the mixture.

pression loss, and cylinder detonation. Tee in the calibrated gauges. Pressurize the system with the boost pump and inspect for leaks. Chock the wheels, set the brakes. Finally, before attempting any adjustments, allow CHTs and oil temps to reach their normal operating values as spelled out in the POH.

CAUTIONARY NOTES

Be sure to limit the duration of full rated power run ups, and cowl the engine to direct prop blast across the cooling fins of the cylinders. Carefully monitor CHT readings during all ground runs. Allow the engine to stabilize for 10 to 15 seconds, and take your readings, but always hold high rpm runs to a minimum especially with newly installed cylinders. Never exceed 420°F CHT or 210°F oil temps. Failure to take these precautions could dramatically shorten the life of your cylinders. After full powered runs, it is also imperative that the engine be allowed to run at 800 to 1000 rpm for a few minutes. This practice allows the engine temperatures to stabilize prior to engine shut down.

SETTING PUMP PRESSURES

Don't be alarmed if it takes several

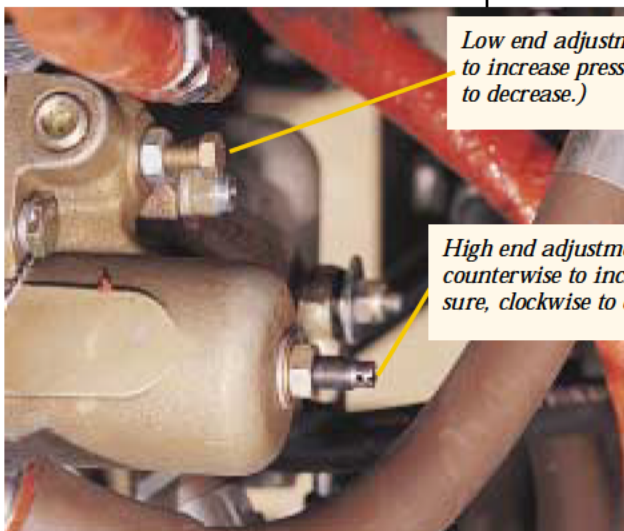
attempts to set pump pressures. Both low and high end settings tend to chase each other. Fine tuning these pressures requires a little patience.

When adjusting the pump idle pressure it is important to recognize that the fuel system's idle mixture is established by the combination of the pump idle pressure and metering unit mixture setting. A high idle pump pressure setting will require a lean metering unit mixture setting in order to maintain the OE's specified mixture rise.

Conversely, a low idle pressure setting will require a rich metering unit mixture setting in order to maintain the same mixture rise. The metering unit mixture setting establishes a bias in the fuel system that affects fuel flow over the entire range of throttle operation. However, the authority of the fuel pump's idle control setting progressively decays as the engine speed increases. By 1,500 rpm the idle pump pressure setting has little affect of the fuel system's mixture control.

With these relationships in view, its difficult to be emphatic about where the pump idle pressure should be set, at the upper or lower end of the limit. The predominant school of thought is that setting the idle pump pressure to the lower limit is preferred as it yields a rich part throttle mixture condition. Rich mixtures may lead to cool heads at taxi and idle setting but may also lead to stumbling on acceleration, increased rates of valve seat deposits, fowled spark plugs, back firing and afterburning. Rich mixtures are also known to have a detrimental affect on the cylinder's ability to hold a sufficient oil film. End gases from an overly rich combustion event may "wash" oil from the cylinder walls during the power stroke.

When setting the pump idle pressure consideration should be given to the home field elevation for the aircraft, the condition of the



Low end adjustment. (Turn clockwise to increase pressure, counterclockwise to decrease.)

High end adjustment. (Turn counterclockwise to increase pressure, clockwise to decrease.)

Typical turbocharged fuel pump w/aneroid adjustment (high-end fuel pressure) and relief-valve adjustment for low-end pressures.

SOME ANOMALIES TO CONSIDER

This system's inability to sense changes in air density and temperature creates a challenge when dealing with aftermarket intercooler installations. The denser air coming from the intercooler requires more fuel to keep the fuel/air ratios in the cooler burning ranges required by the engine. The easiest way to tell if fuel flow is adjusted correctly is to set full rich on takeoff and climb and check the TIT. If adjusted correctly (TSIO-360,470, and 520 engines) the temperature on a calibrated TIT system would read in the high 1300's to low 1400 degrees fahrenheit.

Another after-market change that requires attention when dealing with the fuel system is the "Merlin" wastegate system for the TSIO-360. This engine, more so than others (due to fixed wastegates from the factory), is very sensitive to upper deck pressure adjustments for proper fuel flow when the turbo is in operation. Careful attention to installation instructions and set-up procedures will help to head off cylinder problems in the future.

baffles, the specific engine model being serviced, general engine health, and the operational habits of the operator. Evaluating these factors will help determine at what point within the allowable idle pressure range the pump's idle pressure should be set.

When setting up the top end of naturally aspirated systems, be sure to fly the airplane, rather than rely on ground runs. Most naturally aspirated engines will not achieve redline rpm in static runs at any field elevation, but will do so on takeoff roll as air gets moving through the prop. It's just a fixed pitched prop until the engine turns up to on speed governor rpm. Make certain the governor is adjusted to redline rpm also. Use a tach checker, as most older mechanical tachs seem to deviate as much as 100 rpm. Remember, this system is rpm dependent and will require actual redline rpm and full rich mixture (regardless of altitude) to check redline/takeoff fuel flow. Turbo systems can be tuned by using static runs but pay close attention to those temps.

Turbo charged engines that incorporate a pressure regulator require this unit to be deactivated when setting pump pressures. Remove the center hose to the regulator and cap the fitting. Also plug the detached hose. TCM recommends setting these systems so full power metered fuel pressure and fuel flow are "5 percent higher than the maximum specified limit." Upon successfully setting pump pressures, plumb the pressure regulator back into the system. Pressure regulators, (sometimes referred to as pressure controllers), serve to "regulate" or limit full power fuel pressures without compromising maximum fuel pressures at lower rpms.



ADJUSTING THE THROTTLE/CONTROL ASSEMBLY

The pilot's sole control over the fuel system lies in the throttle and control (metering unit) assemblies. The metering unit houses both the mixture and the main metering valves. Adjustments to these units are rather straightforward. Idle speed is increased by a clockwise rotation of the adjustment screw and conversely, a CCW

360s and some 520s incorporate a mixture boss. Adjustments are made with a straight bladed screwdriver or allen wrench. Turning it counter-clockwise (out), enriches the mixture.

rotation decreases idle speed. Mixture set up is accomplished by adjusting the length of a linkage rod joining the throttle plate to the metering valve. Once set, this arrangement then schedules fuel in relation to airflow. A 3/8 in. elastic stop nut serves to make this adjustment. A C/W rotation of this nut enriches the mixture and turning it, CCW leans the mixture. Mixture adjustments made to the GTSIO system on the Cessna 421 are the exact opposite and are an exception to this rule. Throttle bodies that include an appendage like Seneca's 360 system requires the usage of a straight bladed screwdriver or allen wrench to adjust mixtures. On these control assemblies, a C/W rotation leans the mixture. When leaning to ICO, an rpm increase of 25 to 50 rpm (75rpm+ at 5,000 ft. field elevations) should

be observed on the tach. A reading in excess of 50 rpm indicates an overly rich setting whereas, no increase in rpm reveals a lean condition. Between mixture adjustments advance the throttle to approximately 1,500 rpm for a short period of time to clear the engine in order to prevent it from loading up and giving false rich indications.

MANIFOLD VALVE ASSEMBLY

The next component in line is the manifold valve. It sits astride the backbone of the engine and, as mentioned earlier, serves several practical purposes. Although there are no field adjustments that can be made to this simple device, a few suggestions may help when faced with the grim task of troubleshooting.

If an engine continues to lope on at ICO, it can usually be attributed to either scored mixture valves in the metering unit or a manifold plunger that refuses to seat. Typically, if the engine runs on indefinitely, the problem can be attributed to scored mixture valves. However, if it continues to run for a short period, then the problem lies somewhere between the manifold valve and the cylinders. To further isolate the cause, remove the hose feeding the manifold valve at the metering unit outlet fitting. With the mixture valve against the ICO stop, engage the boost pump and look for any indication of fuel flow from this fitting. Be certain to capture any leaking fuel in a suitable container and use caution if the engine or exhaust is heat soaked. Leakage in excess of 20 drops per minute at 10 psi of pressure is unacceptable. The metering unit should be sent in for repair. If you're still uncertain as to the cause, interrupt the hose feeding the manifold inlet and plumb a ball valve between it and the metering unit. Then, with the engine running at idle speed, use the ball valve to manually cut off fuel flow to the divider. If the engine



Paul Cramer of Kelly Aerospace is using a Porta Test unit manufactured by Aero Test, Inc. to set fuel pressures on a Cessna 340.

continues to run, the problem most likely rests at the manifold valve. Other contributing causes of poor idle cut off may stem from a leaking primer system plugged or partially plugged injection nozzles, allowing the engine to run on residual fuel pooled in the induction, or in the case of a turbo charged engine, a leaking fuel pump aneroid seal that dumps fuel back into the upper deck.

A fuel system that has been fine tuned for a specific engine/airframe may require a periodic re trimming. As the engine breaks in, and operating parameters change, and cockpit gauges lose their accuracy, it becomes necessary to perform a "check up."

Continental encourages an "operational verification" any time an engine is installed, a 100 hr. or annual is performed, or whenever a fuel component is replaced or adjusted. This may seem "excessive," but it assures of a smooth running engine to TBO.

AMT

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AUTO-LEANING

Some mechanics remain mystified by the auto-leaning capabilities of the IO-550 fuel pumps installed in some Bonanzas and Barons. This pump has what appears to be an aneroid configured much like a typical TSIO-520. However, unlike the turboed 520 that is referenced to upper deck pressure, this application has an aneroid that senses changes in ambient pressures. Ambient pressures are routed to the aneroid through the drain fitting via a bolt hole channel in the pump body. High rpm pressures are set by means of a tapered needle (like those seen on naturally aspirated models) housed in a brass boss on the side of the pump. Field elevations and pressure altitudes are to be compensated for when adjusting the aneroid. Normally, this auto-leaning aneroid is factory set and requires no adjustment. A tenuous balance must be achieved when setting up these pumps especially if the aneroid requires adjustment. When properly set these pumps achieve the desired results. When misunderstood or haphazardly adjusted they may cause fuel flows to drop well out of acceptable limits. Needless to say, this pump continues to baffle a fair share of mechanics.

This ongoing confusion was the impetus for Raytheon issuing SB28-3052 in February of this year. This optional bulletin allows for the replacement of the auto-leaning pump with the manual leaning. Many pilots prefer the manual leaning capabilities as it puts the control back in their hands and eliminates the occurrence of improperly adjusted pumps. On twin applications both pumps must be replaced. It is advisable to specify which pumps are desired (by spec. #) when purchasing OH'd or factory new 550 engines.

The 550 style pump incorporates three adjustments. The aneroid adjustment is factory preset to compensate for altitude changes. The brass boss on the side of the pump is an adjustable orifice that once set, determines high-end fuel pressures output. Turning it clockwise (in) increases pressure. The 5/16-inch bolt with 3/8 jamnut is the relief valve adjustment that determines low-end pump pressure. A clockwise movement increases pump pressure.

