

AVOIDING FUEL RELATED PROBLEMS

Fuel problems take many forms and they can - and do - occur in sophisticated certificated aircraft as well as in the more modestly priced personal aircraft variety. Needless to say, homebuilts are not immune to this indiscriminate affliction.

I certainly would not classify fuel related problems as being epidemic in frequency, they are not. They simply happen every now and then, and when you least expect them.

Most fuel problems occur because of:

1. A poorly planned and poorly installed fuel system.
2. A malfunction, or failure, of a fuel system component or accessory.
3. A poor preventative maintenance regime fails to detect a deteriorating condition.
4. A pilot induced problem . . . yes, amigo, it is otherwise known as "Pilot Error."

Fuel Problems Can Start With The Initial Installation

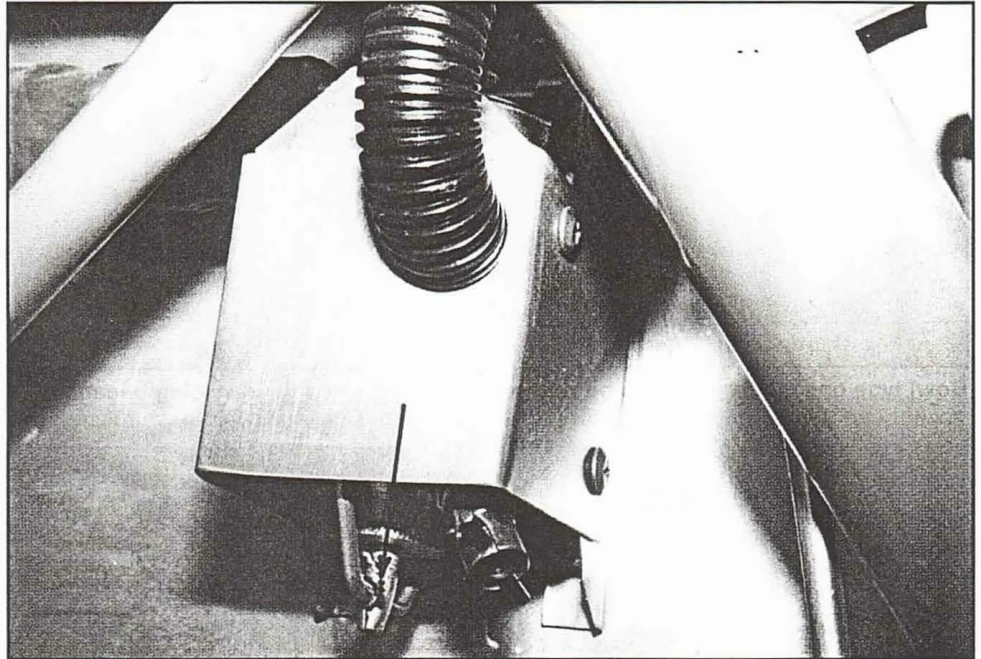
The initial fuel system installation in a homebuilt is of particular importance because a fuel system, properly installed, is generally reliable right from the start.

Nevertheless, unanticipated fuel related problems can crop up even in well executed installations. For example, fuel leaks can develop for any of a number of reasons. It is, therefore, important that you use the best materials and equipment you can obtain and muster your best workmanship for the job.

This doesn't necessarily mean you shouldn't install surplus materials or used accessories. After all, it is the quality that counts, and reconditioned accessories are just about as good as new.

For that matter, even new parts may be flawed so they, too, should be subjected to careful scrutiny and testing before you install them.

Understandably, every fuel system installation will differ in some way because of differences in the materials and equipment used. For that matter where you locate the equipment and how you route the fuel hoses and lines will also affect the



If you forget to safety the gascolator, engine vibrations can ultimately cause the nut to loosen and you can lose all your fuel later . . . probably much later.

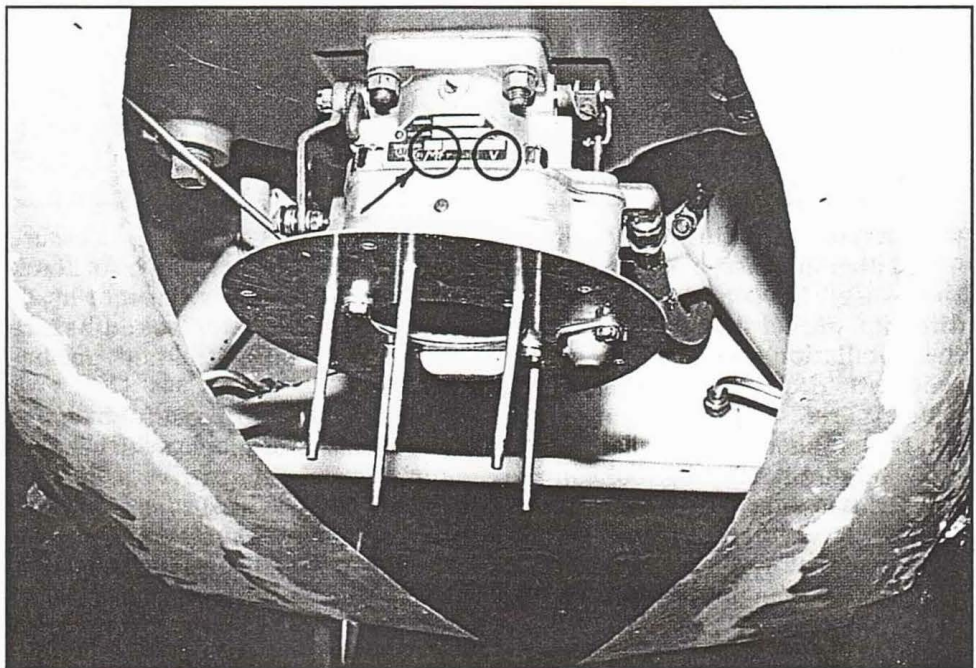
operation of your fuel system in some manner.

Where To Begin?

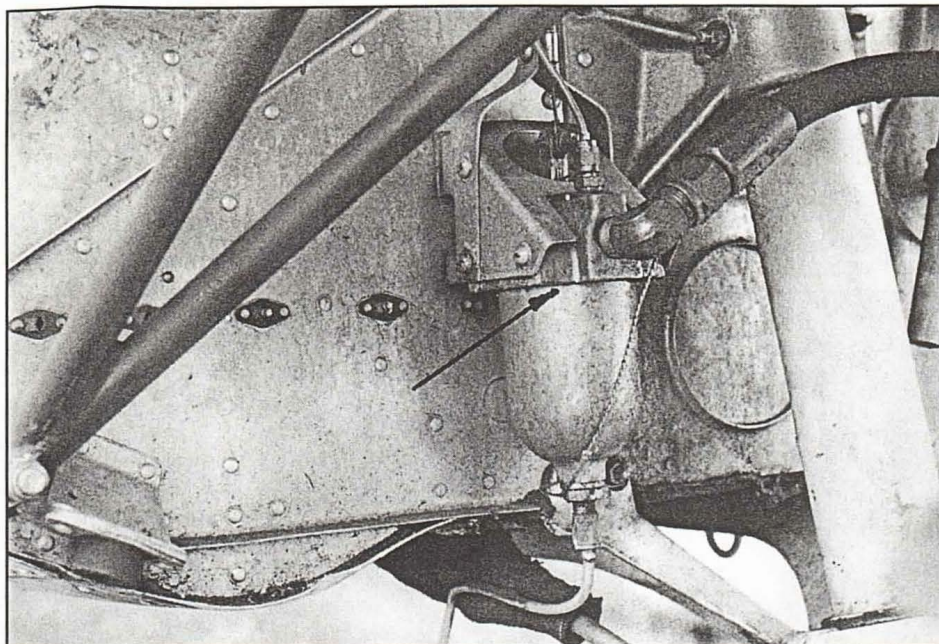
Here are a few practical suggestions:

1. First, obtain a schematic drawing of a simple well proven aircraft fuel system that would be suitable for your aircraft - then, duplicate that installation.

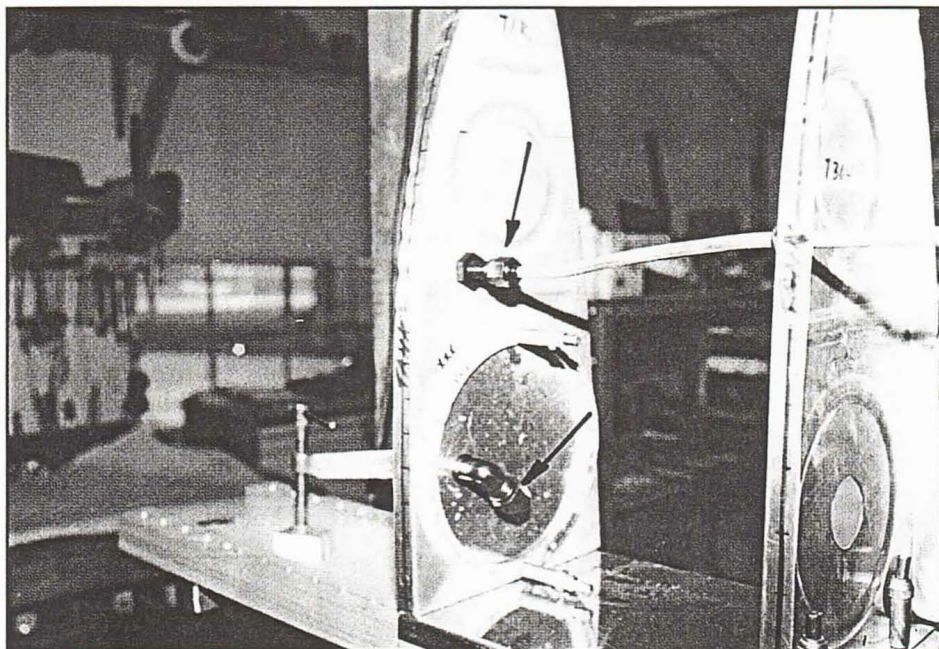
If you prefer to develop your own fuel system, keep in mind the fact



If the lower portion of your Marvel Schebler carburetor has the letters "MF" stamped, etched, or scratched thereon - you're O.K. It has the new metal float. That "V" means it also has the Venturi modification.



Bowl type gascolators have to be reassembled carefully after servicing because the gasket can become cocked, allowing fuel to leak out when the system is pressurized.



Internal fuel tank fittings must be positively torqued before you assemble and seal the tank. Double check this before the tank is closed. You may have trouble getting to the fittings, later, without pulling the tank.

that simplicity equates to reliability.

In either instance, a detailed sketch showing all the components and the direction of fuel flow will help make the installation easier. Besides, that schematic drawing will be handy to have as a reference for maintenance and trouble shooting guidance.

2. Be sure the flaring tool you use to fabricate your aluminum lines is the correct 37 degree aircraft tool. Don't use that auto parts flaring tool - its 45 degree angle is wrong for fabricating flared AN aircraft connections! Make uniform bends and avoid sloppy routing of lines.

3. Leave nothing to chance. Check and check again. For example, make

one more "final" inspection to assure yourself that the inside of a fuel tank is clean, and no tools, rags, or hardware have been overlooked before closing and sealing the tank permanently.

You can't be too careful because there seems to be ample evidence that debris (metal filings, rivets, sealant particles and the like) somehow finds its way into fuel systems, clogging screens and raising havoc with normal fuel flow in new installations and, especially, after maintenance has been performed.

4. Never forget to look into and blow through each fuel hose and line before connecting it. Then, before

you forget, plug or tape over its open end to keep out debris.

This precaution is very important because your fuel and vent line connections will often remain open for quite some time before the final assemblies can be completed.

5. When installing a three or four-way fuel selector valve, the risk is great that you will lose track of which port feeds which tank.

Before connecting the fuel lines, reassure yourself that the selector handle does indeed point to the correct tank position.

Confirm this by blowing through the selector valve's outlet port for each selector handle setting. This is no idle concern.

6. Don't install the wrong type of auxiliary fuel pump. Here's why. A loss of engine power was experienced because of insufficient fuel flow after a new aux fuel boost pump had been installed. Later, it was learned that the newly installed fuel pump was the wrong type. It did not have an internal bypass provision.

If your fuel system requires a back-up fuel pump, be absolutely sure it has an internal bypass capability. A bypass valve permits the engine driven fuel pump to continue to draw fuel through the aux pump even though the auxiliary pump is OFF (not operating).

The mistake is easy to make because both types look alike and you can't distinguish one type of pump from the other without verifying its part number.

You could, of course, confirm a bypass presence by blowing through the inlet port of the new pump before installing it.

7. Don't fail to check the existing Airworthiness Directives for the accessories you have. A good case in point is the Marvel Schebler carburetor. It has had its problems.

The carburetor is the heart of your fuel system and if a piece of equipment must work right, this is it.

Anyone who has been flying behind a Marvel Schebler (now Facet) carburetor during the past few years must certainly be familiar with the float controversy and confusion regarding the correct float for that carburetor. Even now, some say the plastic float is O.K., and others say it must have a metal float to be legal.

Well, here is the way it is for now, at any rate.

The original Airworthiness Directive mandating the installation of composite material floats has been revoked.

It is back to the metal floats for the

Marvel Schebler carburetors. For that matter, the plastic floats are no longer being manufactured by the new owners (Facet Aerospace).

Actually, neither the old metal floats nor the plastic floats can be used legally for replacement any more.

If you plan to acquire a used engine for your project, you can assume the carburetor will have been around for a long time, and probably will have the wrong type of float.

If the lower portion of your Marvel Schebler nameplate has the letters "MF" stamped, etched or scratched thereon, you're O.K. The same is true if it has a Facet Aerospace nameplate - that is, it being a later production carburetor will already contain the correct type of float.

The original carburetor problems stemmed from the tendency of the floats to leak and start sinking. One clue to the problem was an excessively rich running engine.

Incidentally, there is another AD. It is on the carburetor venturi. Better check that one out with your favorite mechanic also.

Things Like This Really Happen

- More than one homebuilder (actually, I'd guess about one per EAA Chapter) has been surprised to find he had somehow overlooked tightening one of his fuel line connections. The embarrassing consequence has usually been a fuel sopped cockpit floorboard during the first engine start attempt.

Every inch of a newly installed fuel system should be rechecked after you have completed the installation. Check each connection with a wrench to assure yourself it is properly torqued.

- Those fancy steel braided fuel lines have been known to leak through their braided sidewalls.

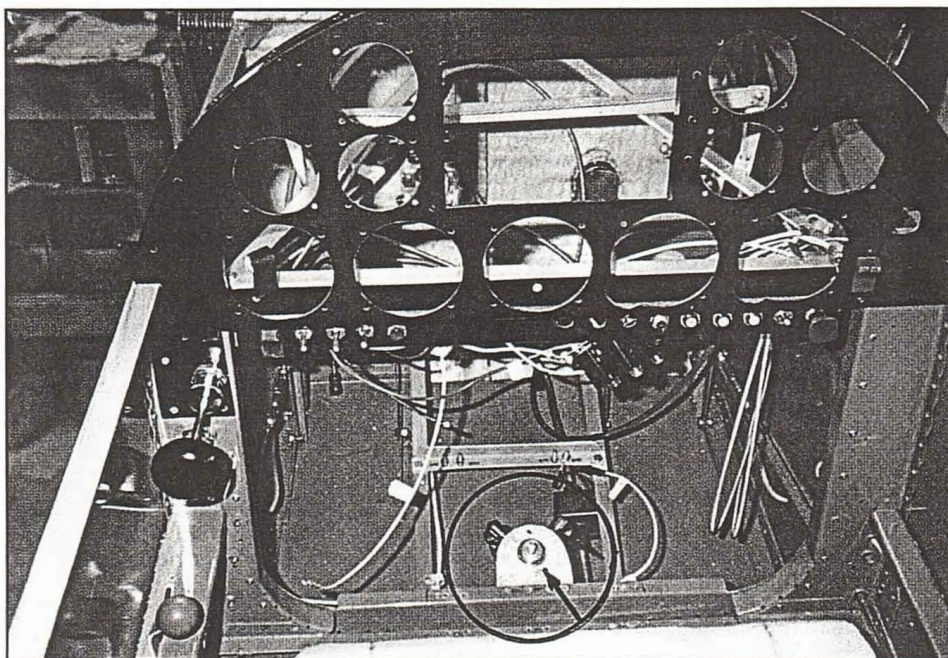
The problem may first be noticed when fumes or a fuel seepage is detected (on the ground hopefully) when the boost pump is turned on. A very good reason to pressurize the fuel system (if you are equipped with an auxiliary fuel pump) before going operational.

- Seepage around the gascolator gasket may be noticed after servicing the bowl and the system is pressurized. Sometimes the gasket is not aligned properly or the screw head (nut) is insufficiently torqued.

Oh yes. If you forget to safety wire the gascolator, engine vibration can ultimately cause you to lose all your fuel later. Probably much later.



Fuel tanks filled to the top with cool fuel during low morning temperatures will overflow through the vents as the fuel and the temperatures warm up on a hot sunny ramp.



This guy is going to connect the fuel lines from his wing tanks to the selector valve. Unfortunately, since he removed the selector handle he has forgotten which way the fuel selector handle was pointing when he took it off. Could this happen to you?

- That new fuel tank checked out O.K. did it? The presence of a fuel stain could be the only indication of a seepage problem which will not cure itself . . . it should be corrected as soon as possible.

- The fuel selector valve turned but would not operate the valve resulting in a "landing" short of the runway. The plastic insert inside the fuel selector valve broke and pieces wedged in the valve preventing its activation.

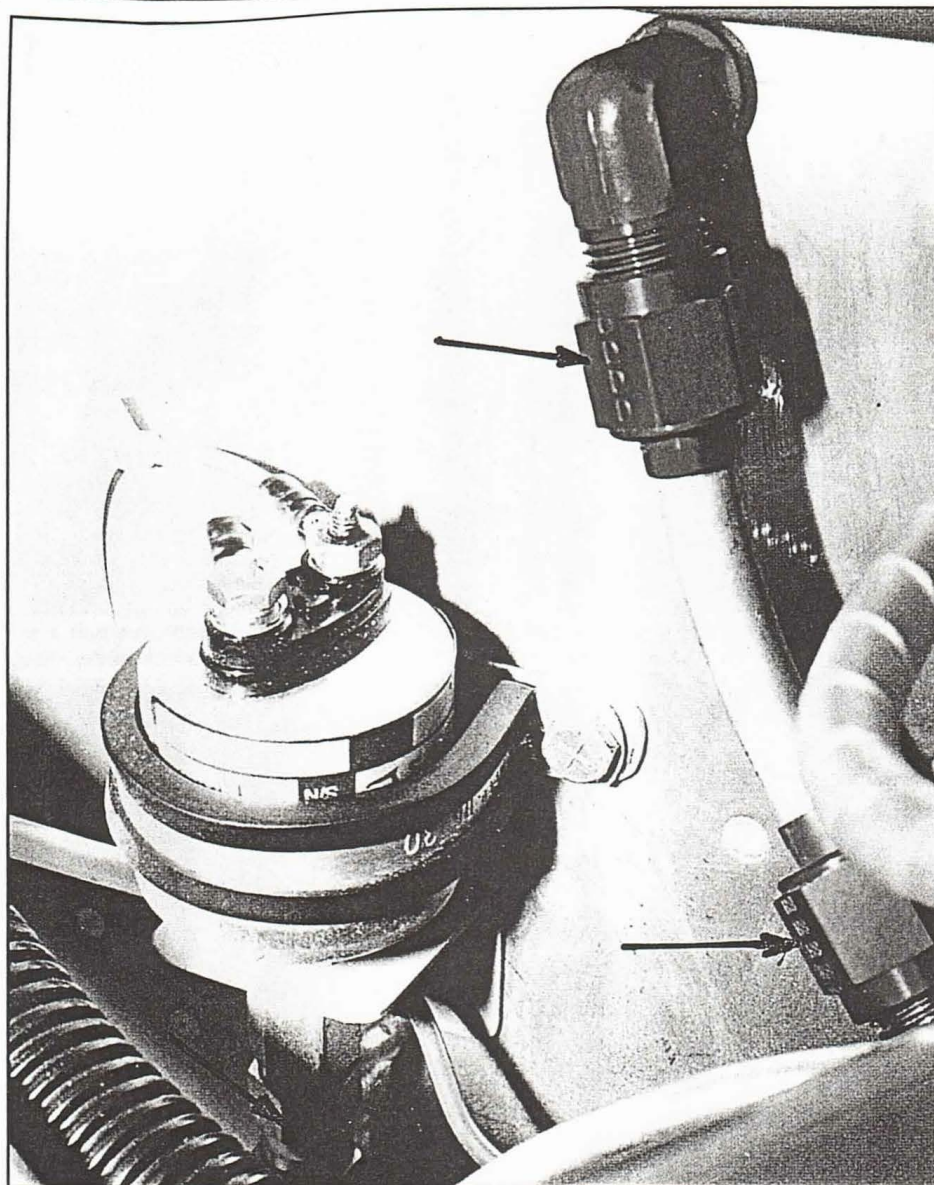
- The fuel selector valve was hard to operate. During an attempt to switch from the left to the right tank the selector handle broke. The plastic handle had wallowed out and was turning on the shaft. After a forced landing on a highway, pliers had to be

used to turn the valve stem.

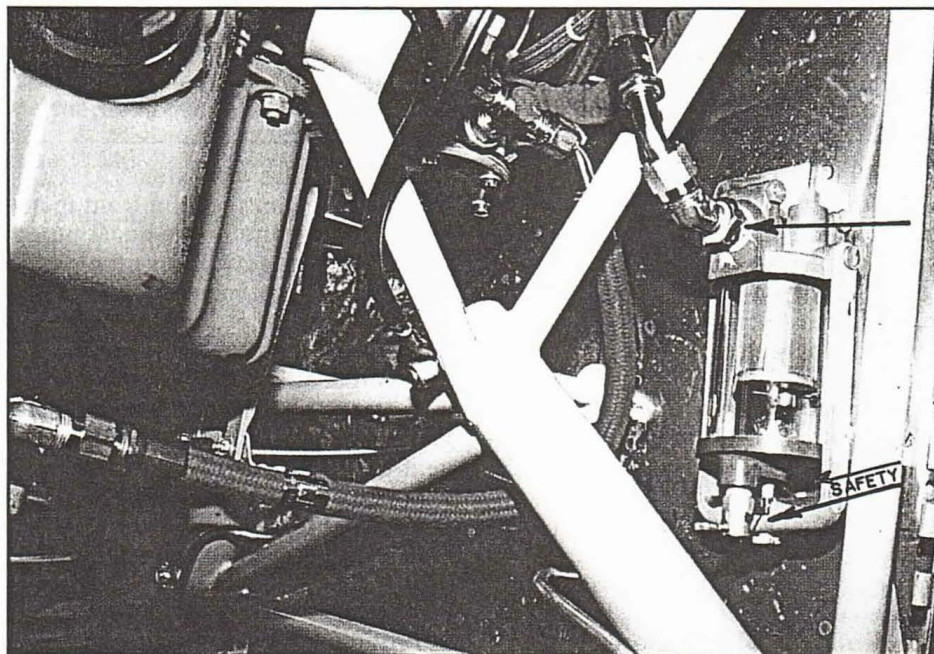
- Tank sealant peeling from inside caused the failure of the boost pump. A careful inspection found clogged screens and small pieces in the carburetor screen.

- Twenty minutes after take off, the wing leading edge skin buckled - and the fuel tank collapsed. Fuel gushed out of the damaged tank. The vent tube opening inside the fuel tank was inadvertently plugged during a tank resealing operation.

- "Explosafe," an expanded aluminum mesh used in fuel tanks to reduce the risk of fire and explosion in ruptured tanks, was breaking down and shedding aluminum flakes. These can block the flow of fuel. The rec-



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Don't use Teflon tape on any fuel line pipe threads as particles of the tape sometimes find their way into the fuel system and show up on the screens.

ommendation is to remove the "Explosafe."

- He took his fuel selector apart because it was hard to turn and he couldn't feel the click of the index detents. Did he improve the condition? No, because the valve was incorrectly assembled. The brass washer under the compression spring may have been installed with the recess up toward the spring . . . should have been turned over so recess fits over shoulder on the shaft of the rotating valve plug.

- Fuel tanks filled to the top with cool fuel during low morning temperatures will overflow through the vents as the fuel and the temperatures warm up on a hot sunny day.

- You can expect carburetor icing to occur in less time and at higher ambient temperatures with autogas than with avgas. Therefore, if you plan to use autogas - be sure your carburetor heat is effective and you are familiar with induction system icing prevention procedures.

- In the good ol' summer time, if you allow your aircraft to heat soak on the ramp, or idle on the ground for long, be sure you can develop full power before commencing the take off run.

- Fuel vents can get plugged by insects. Do you check your fuel vent openings during the preflight? Especially after the airplane has been idle for a few weeks?

Chafing of Fuel Lines

This is the most common hazard to which fuel lines are subjected. Unfortunately, in many instances the chafing will not be detected until the line is severely abraded and the unmistakable odor of fuel is detected.

Oddly enough, chafing can occur long after a good initial chafe-free fuel system was installed. No matter how carefully fuel lines are routed they seem to be vulnerable to chafing.

Chafing most frequently takes place where a fuel line passes through a bulkhead, or some metal structure.

Don't run fuel hoses and lines across electrical wiring, engine controls or close to exhaust pipes.

Even when sufficient clearance is provided it seems that, in time, unless the line is adequately supported it will ultimately start rubbing on something.

Where hoses and aluminum lines pass through a bulkhead, protect them with rubber grommets.

Actually, when two aluminum lines are in contact with each other,

chafing can take place on both of them if the lines are not properly secured or supported.

During every annual, carefully check the fuel lines between connectors by passing your fingers over their length to assure yourself the lines are not rubbing against anything anywhere.

Chafing, if caught in time, is of no consequence and is actually a testimonial to good inspection and maintenance.

Fuel Exhaustion

Fuel exhaustion means you just ran out of fuel. Your engine has stopped and your immediate prospects are, (1) a successful forced landing, or (2) a crash landing.

Precautions you can take to avoid such a situation:

Know your fuel system.

Know how much fuel you have on board.

Know your fuel consumption.

Be sure your refueling destination will have fuel and will be open for business (check your Airport/Facility Directory - issued every 8 weeks).

Don't trust fuel gauges.

Some pilots run a fuel tank dry as

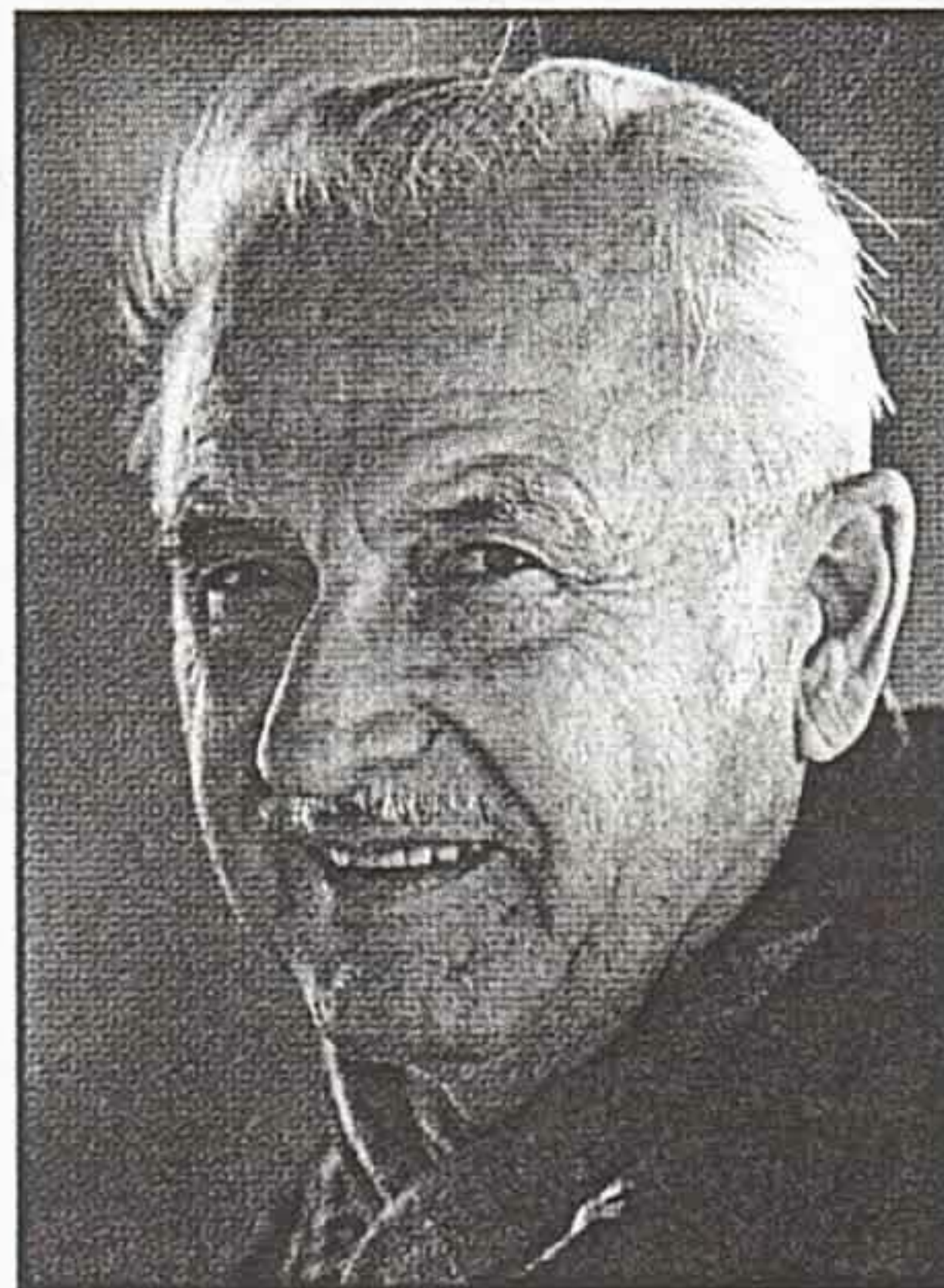
a routine practice. This technique should be avoided as the engine will stop. A fuel injected engine requires a longer restart effort than does a carbureted one. Meanwhile, loss of precious altitude and an undesirable

sudden cooling may result in potential engine damage . . . or even a forced landing.

Fuel exhaustion, whatever the cause, invariably has serious consequences.

BOOKS BY TONY

The following books by Tony Bingelis are available from the EAA Aviation Foundation, EAA Aviation Center, Box 3086, Oshkosh, WI 54903-3086, 1-800/843-3612. Major credit cards accepted.



If you wish to contact the author of this column for additional information, please send a SASE to:

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-Sportplane Builders (Aircraft Construction Methods, 320 pages) - \$19.95

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