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**Message From Headquarters**

**Joe Norris, EAA Homebuilders Community Manager**

The Zenith and AMD CH601XL and CH650 situation continues to be a hot topic for EAA members. Perhaps a number of you have been contacted by members with questions. If you haven't already done so, I encourage you to check out all the information that's been published on the EAA web site. You can use the following link to view EAA's FAQ on the issue. The FAQ contains links to other pertinent documents as well:

[http://www.eaa.org/news/2009/Zenith601\\_FAQ.pdf](http://www.eaa.org/news/2009/Zenith601_FAQ.pdf)

To help gather data on awareness and reaction to the FAA's actions, EAA conducted a survey of Zenith owners. A report on the survey can be viewed at this link:

[http://www.eaa.org/news/2009/2009-12-30\\_ZenithSurvey.asp](http://www.eaa.org/news/2009/2009-12-30_ZenithSurvey.asp)

questions you can direct them to Sebastian's blog:

<http://www.zenith.aero/profiles/blog/list?user=00s2qtsepp2i0>

On the administrative side, make sure to get your renewal sent in (if you haven't already). We look forward to having each and every one of you continue to share your expertise with your fellow EAA members. Don't forget to report your activity! Either use the printed or web form, or just send us an email or note. The content is more important than the format, so keep us posted via the most convenient method.

As always, I will close with my usual plea for newsletter submissions from the field. This month's newsletter includes articles by Dick Koehler and Hobie Tomlinson. I appreciate their submissions and I encourage all of you to follow suit! Send your articles via "snail mail" to EAA Safety Programs, PO Box 3086, Oshkosh, WI 54903-3086. You may also submit articles via email to [safetyprograms@eaa.org](mailto:safetyprograms@eaa.org)



## Carburetor Heat

**Hobie Tomlinson, Flight Advisor #1595, EAA Member #23705**

Carburetor heat is an engine induction, anti-icing system which is designed to preheat induction system air before it reaches the carburetor. Outside air is picked up by a separate induction air intake, sometimes within the cowling. This air bypasses the engine air filter and is routed around hot exhaust pipes (where it is heated) before entering the carburetor. The purpose of carburetor heat is to prevent the formation of carburetor ice by keeping the fuel/air mixture in the carburetor venturi above freezing. It produces enough heat to also melt formed carburetor ice when necessary; although its normal use should be as a preventative measure.

[Ed. Note: As mentioned, the air intake for carburetor heat is separate from the air cleaner. This can be used as an alternate air source should the air cleaner become clogged or blocked.]

Carburetor heat should be checked during every engine run-up as well as periodically during flight whenever the conditions are conducive to carburetor ice. Anytime carburetor ice is detected, full carburetor heat should be immediately applied and left on until you are certain all ice has been removed. Applying partial heat (or leaving the heat on for an insufficient time) when icing is present can sometimes aggravate the situation. In extreme cases of icing, full carburetor heat should be left on after removing the ice in order to prevent further ice from forming.

Use of carburetor heat reduces engine power output up to 15%. This is due to the fact that the heated air entering the engine is less dense than the unheated air. This lower air density also enriches the mixture. If ice is present when carburetor heat is applied, there will be an

immediate decrease of engine r.p.m., followed by a gradual increase in rpm as the ice is melted. These symptoms can last anywhere from 30 seconds up to several minutes depending upon the severity of the carburetor icing. They may also be accompanied by engine roughness, as the melted ice is ingested by the engine. The engine should also run smoother once the ice has been removed. If the rpm decreases and remains constant, there was no ice present in the carburetor. On aircraft with constant speed propellers, the rpm will stay constant and any changes in power output will instead be observed by a change in the manifold pressure. Resist the temptation to reduce the amount of carburetor heat during the period of engine roughness; it must remain in the full-hot position until normal power returns.

Whenever the throttle is closed during flight, the engine cools very rapidly and becomes more susceptible to carburetor icing. This is the reason carburetor heat is always applied - full "On" or "Hot" position - before closing the throttle and left "On" for the duration of closed throttle (or low power) operation. The carburetor heat aids in vaporizing the fuel and helps to prevent the formation of carburetor ice. To insure the engine remains warm enough to provide adequate carburetor heat, periodically and smoothly open the throttle for a few seconds.

Carburetor heat reduces the power output of the engine and increases its operating temperature. Therefore, carburetor heat should not be used during high power operations (i.e. takeoff & climb). Even during normal operations (i.e. cruise) carburetor heat usage should be avoided except as necessary to remove carburetor ice and/or preventing its occurrence.

## Homebuilt Aircraft Council Seeks New Member

The EAA Homebuilt Aircraft Council's mission is to ensure EAA's continued focus on programs of benefit to current and future homebuilders. This council of EAA volunteer leaders represents the homebuilder, and provides a conduit for information between EAA headquarters staff and the homebuilder/craftsman community within EAA.

The EAA Homebuilt Aircraft Council (HAC) is looking for an experienced homebuilder who has a background in marketing and public relations. If that's you, and you would like to serve on the HAC, please send your resume to [hac@eaa.org](mailto:hac@eaa.org)

# Diagnosing Engine Problems

**Dick Koehler, Technical Counselor #3023, EAA Member #161427**

I had an interesting call a couple of weeks ago from a fellow EAA Chapter 186 member concerning a mag drop problem he was having. What follows is the troubleshooting process we went through to isolate the problem.

He was experiencing a drop of 225 to 250 rpm on both magnetos during the run-up at 2000 rpm. The normal limit for this engine is a 175 rpm drop. The engine also showed signs of having a rich fuel/air mixture, and the EGT probes on each cylinder had burned off! The problem showed up after about 100 hours of operation on a Lycoming IO-320 engine installed in a Lancair. If the owner tried to fly the plane, on the take-off roll the engine would sputter and run rough until about 50 to 60 knots when it would smooth out and perform normally. A respected mechanic said the engine was "normal" and safe to fly, but a pilot with a lot of Lancair experience refused to fly the plane, claiming it was unsafe!

Thinking the apparent rich fuel/air mixture was pointing to a mis-adjusted fuel injection unit, the owner had removed the metering unit, and sent it to a repair facility for a complete check. They said it was working normally. He had an A&P mechanic check the timing of the magnetos. They were found to be about 3 degrees early, but correcting the timing did not solve the mag drop problem. (Note that initial break-in wear of this amount on magnetos is fairly normal.) Thinking that the problem could be not enough air instead of too much fuel, the owner first cleaned the air filter and then removed it completely, but there was no change in the mag drop.

At this point the owner called me, and I suggested a Coke bottle test on the injectors. I'll explain the test in a bit, but first some background on how the injection system on the Lycoming engine works.

The fuel injection system on a Lycoming is the Bendix RSA unit. The fuel metering unit measures the incoming static and dynamic air pressure and uses this data to calculate the amount of fuel needed. It then adjusts the fuel pressure output accordingly. The pressurized fuel is sent to a flow-divider on the top of the engine, then through small diameter tubes to fuel injector bodies at each cylinder. The fuel injector bodies have a fixed orifice size that does not change, so more pressure produces more fuel flow, and less pressure results in less fuel flow. The fuel control unit varies the pressure into the fixed orifice size of, in this case, the four injectors. (This is why a fuel injected Lycoming can have a cockpit gauge that reads in fuel flow but is really a pressure gauge.)

The fuel control unit sends the required amount of fuel for the four cylinders, but if one of the injectors is partially or fully clogged less fuel will go to that cylinder and the excess will go to the other three cylinders. The result is three rich cylinders and one lean, but because the fuel control unit is set to be somewhat rich at take-off power, the three rich cylinders end up being very rich, and the lean cylinder may not be too bad, depending on how restricted the injector is. An overly rich cylinder will tend to show high EGT because the mixture is still burning when it comes out the exhaust

valve and down the exhaust pipe. Also, the excessive richness can cause the high mag drop.

The easiest way to trouble-shoot for this problem is to measure the flow of all the injectors at once. We do this by removing the injectors from the cylinders and reattaching them to the fuel lines. Find four equal sized bottles (name of the test comes from using old 6 ounce Coke bottles), and put them under the injectors. Set the mixture to rich, throttle about where it is for a run-up, and the boost pump on. Let the fuel flow until the bottles are about half full. After shutting everything down, place the bottles in line on a level spot and compare the level of the fuel in each. A partially blocked injector will be obvious. But on our problem engine the injectors were all putting out equal amounts, so a clogged injector body was not the problem.

At this point the owner was quite frustrated. I agreed to do some more diagnosis. I very carefully went over the engine and discussed its operating characteristics with the owner. I then performed all the operations normal to an annual inspection, including compression check, timing and run-up. We did another Coke bottle test. No Joy! The problem was still there. I was beginning to get a bit frustrated also at this point, so I just sat down and relaxed for a few moments. As I gazed absent-mindedly at the engine I began to admire the beautiful three-bladed MT propeller. I commented to the owner about the little bit of grease it was throwing from the blade shanks, and he stated that he had had it resealed at Sensenich last fall, but it was still leaking a little bit. He then idly commented that he had not been able to fly very much since the resealing because that was when the mag drop problem began!

All of a sudden the light-bulb came on. I asked more about the prop. The owner then commented that since he got it back the plane taxied faster. He thought this meant he was getting more power and it was good. I began to suspect that when the propeller was resealed, they reset the low angle pitch stops on the variable pitch blades to a higher angle than before, and at this high blade angle the propeller was providing so much drag that it was lugging the engine down and causing it to appear to be rich. The effect is somewhat like trying to go up hill from a slow start in third gear in the family car. Next day the owner called Lycoming and Sensenich. Lycoming agreed that the prop could definitely be the problem. Sensenich found their records of the reseat, which showed they had worked on a 170 propeller, but the owner has a 165!

The prop was returned to Sensenich, and they found a bad internal spring that was not allowing the prop to go to low pitch. After repairs the prop was reinstalled on the airplane and a run-up was performed. PRESTO! No more excessive mag drop, and no more symptoms of over-rich mixture. Problem solved.

The moral of the story is this: sometimes you have to look beyond the "usual suspects" to find the true cause of the problems. There can sometimes be more than one cause to a particular symptom. Don't get fixated on one possible fix and overlook other possibilities.



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## Nominations Open For Tony Bingelis, Spirit of Flight Awards

Is there an extraordinary Technical Counselor in your chapter? Or a pilot whose accomplishments and dedication to aeronautics have "flown under the radar"? Perhaps they may be appropriate recipients for two awards presented annually at EAA AirVenture Oshkosh, the Tony Bingelis Award and the Spirit of Flight award.

**The Bingelis award** honors the memory of Tony Bingelis, EAA's highly regarded homebuilding authority, author, and columnist in EAA Sport Aviation. Created in 2002, the award recognizes people who have made significant contributions to the encouragement of aircraft projects for fellow EAA members, the promotion of safety, and for maintaining the values of EAA. A nominee must have been an active and current EAA Technical Counselor for five consecutive years.

**The Spirit of Flight Award** was established in 1997 by the Society of Experimental Test Pilots and Scaled Composites to recognize an EAA member who best exemplifies the spirit of re-

search, development, or flight-testing. They promote air safety by presenting a pilot's opinion, strengthening the influence of the test pilot on aeronautical progress, and continuously evaluating the adequacy of flight equipment.

Nomination forms can be obtained on our website at: [http://members.eaa.org/home/homebuilders/awards/bingelis\\_form.pdf](http://members.eaa.org/home/homebuilders/awards/bingelis_form.pdf) and [http://members.eaa.org/home/homebuilders/awards/spirit\\_index.html](http://members.eaa.org/home/homebuilders/awards/spirit_index.html) or by calling the Safety Programs office at 888-322-4636 ext. 6864. You may also email us at [safetyprograms@eaa.org](mailto:safetyprograms@eaa.org) to receive the nomination paperwork.

To learn more about the awards or to read about the past winners go to: [http://members.eaa.org/home/homebuilders/awards/bingelis\\_index.html](http://members.eaa.org/home/homebuilders/awards/bingelis_index.html) and click on "about us" and select the award that you would like to read about.

If you have any questions, please call the EAA Safety Programs office at 888-322-4636 ext. 6864. Nominations will be accepted until March 1, 2010.