Richer Than I Want To Be
by Stu Simpson

“Vulcan traffic, Cavalier Bravo Quebec Romeo is on the departure leg, runway 34, straight out northbound departure.” I made my radio call as I fire-walled the throttle to bug out after a touch and go.

I climbed steadily to the north to head back toward Kirkby’s. It was the second day of January and it was perfect. There was no wind to speak of and no clouds to block the sun. The temperature hovered just above freezing.

A few minutes later I turned slightly left toward home, leveled off and pulled back the throttle. Then my heart nearly stopped.

The engine suddenly started gurgling, spurting and stumbling. I pushed the throttle back open and the sputtering stopped. I desperately sought data from the Cav’s panel, but it revealed nothing amiss.

My first thought, my instinct, really, was that the Cav’s O-320 was running rich, but I had no solid evidence to back that up. I pulled on the carb heat and got a noticeable drop in RPM. Nothing else changed.

I turned back toward Vulcan which was a few miles behind me. The engine ran just fine for the short duration back to the airport where I made a straight-in landing on runway 16.

Back on the ramp I tried everything I could think of to get the engine to stumble again so I could pinpoint the trouble, but I couldn’t replicate the problem. Mag checks were normal, as were various mixture settings. I shut down and opened the cowling. Probing inside showed nothing amiss. Embarrassingly, though, I did forget to check the gascolator for water.

I carefully took off again and once I reached cruising altitude eased the throttle back very slowly. No further stumbling or burping occurred. In fact, the remainder of the flight was good. However, as the leg progressed I couldn’t help feeling that the engine was becoming just ever so slightly rougher. I can’t say for sure, though. It may have just been paranoia and hyper-awareness on my part. I landed safely at Kirkby’s.

I soon set about seeking other club members’ experience on what the issue might be. Wade Miller suggested an intake leak. I thought that was well worth pursuing. I removed the cowling and spent an afternoon checking and tightening

all parts of the intake system and visually inspecting everything in the engine bay.

The author’s Cavalier on a sunny Alberta day. Photo by Gary Abel

There were a few loose bolts and clamps, but nothing apparently serious. I drained and removed the gascolator, but it was clean enough to perform surgery in. I checked the plugs and was surprised to see all of them were dark and sooty. That was a surprise. I always run lean, even on the ground, and the plugs have always been nicely grey or light brown colored. This was starting to look like a too rich problem.

I made another flight a few days later. The only difference I noticed was a slightly lower RPM on takeoff until I got up to flying speed. I was maybe fifty or a hundred revs short, it seemed. I wondered if that was due to the prop trying to claw through thicker, colder air. But then wouldn’t that same increased density give the engine more power? I didn’t know which factor would take precedence, but I did know the Cav was running well.

I made my way north to Three Hills, did a touch and go, and lit out southeastbound for Drumheller. A few miles out, I leveled off, pulled the throttle back and my heart nearly stopped again!

Once more the engine grumbled and sputtered. I throttled back up and things got normal again. I immediately turned for home and set about troubleshooting. Back in cruise mode, I eased the throttle back slowly, and the engine ran fine.

I knew by now I could manage the problem so I wanted to explore the parameters within which it was happening. Twice more I did high-power climbs, still running lean, then leveled off and throttled back. Twice more the problem repeated. I checked the mags in flight and noticed an increased roughness when running on either ignition. But since I rarely check my mags in flight, I didn't have a solid baseline to know if this was normal. My instinct was that it was slighty abnormal, a little too rough.

Carb heat had no appreciable effect, and it wasn't a carb ice day anyway, not by a long shot. I decided to try something else.

I again did a high-power climb and leveled off. But this time I pulled the throttle back more slowly. No roughness this time. I felt this was an important clue, but I wasn't quite sure how.

I returned to Kirkby's without a problem and tucked the Cav away in its hangar.

At the January club meeting I talked briefly with Bob Zabolotney, a long time AME, who offered some of his valuable wisdom. He reported that sooty plugs are sometimes associated with intake leaks. Hmmm…. Maybe I missed something in the intake system.

Or maybe it's an ignition problem, Bob mused. I told him I felt that was really unlikely as I just had the magneto rebuilt a few months prior (the right side has electronic ignition), and all mag checks showed normal operation. Bob suggested I double check for an intake leak.

I soon enrolled in YouTube University and learned how to do just that. The process is sort of a reverse compression check, called a burp test. It's pretty simple, but requires two people.

You use a compressor and a spark plug hole fitting to pressure up one cylinder to 80 PSI while someone is holding the prop. The other guy sprays some sort of soapy solution, like dish soap or bubble bath, on various parts of the intake system. Then the dude on the prop rotates the prop backwards until the cylinder intake valve opens and the pressurized air rushes out, or burps. It basically bursts into the entire intake system. If there are any leaks, they show up as large soap bubbles at the point of the leak.

This check, with Wade Miller's help, showed that I'd missed a loose intake bolt on the number four cylinder. That really frustrated me because I thought I'd checked them all. I tightened down number four and we performed the test again. This time it showed just a tiny bubble. It wouldn't seriously affect engine operation and I have new intake gaskets on order for all the cylinders.

Time for another test flight to see if we'd found the smoking gun.

Bob Kirkby and I made plans to fly to Sundre on a pristine Friday. But as soon as I leveled off south of the field the problem happened again. I immediately returned to land. Kirkby escorted me around the circuit to ensure I made it safely, then at my insistence headed off to get some more air under him. No sense in both of us being grounded.

At this point, I knew an intake leak was not causing the engine roughness. So, it came down to either ignition or the carb. Ignition was unlikely, but would be the next logical step to check. I called Zabolotney again and as I offered more details he agreed that the ignition was very unlikely to be the culprit. Time to focus on the carburetor, he said. Then he happily wished me luck and headed off on a tropical vacation, the lucky bum.

I called High River Airmotive, an outfit that has done my mag twice in the past and with whom I would happily do business again. They don't do carburetor service, though. Next I talked to Harry Jaeger of Caddis Aviation in Medicine Hat. Harry is an outstanding AME.

"Don't pull the carb off just yet," he said, "Let's actually determine if that's the issue, and how so." Harry offered up a list of troubleshooting exercises that I needed to perform to see how the carb was actually behaving.

Perhaps the most important task was to see what it was doing at shut down. As the pilot shuts down the engine he or she pulls the mixture control to the rear stop called idle-cutoff. This shuts off the fuel flow at the carb and thus to the engine.

If everything is running properly the only fuel getting into the engine now is coming via the idle circuit, the part of the fuel metering process that provides the least amount of fuel to the cylinders. There should be a brief and small RPM rise just as the engine dies, only 25 to 50 RPM. That makes sense since the engine is running leaner and more efficiently for a brief instant during that process.

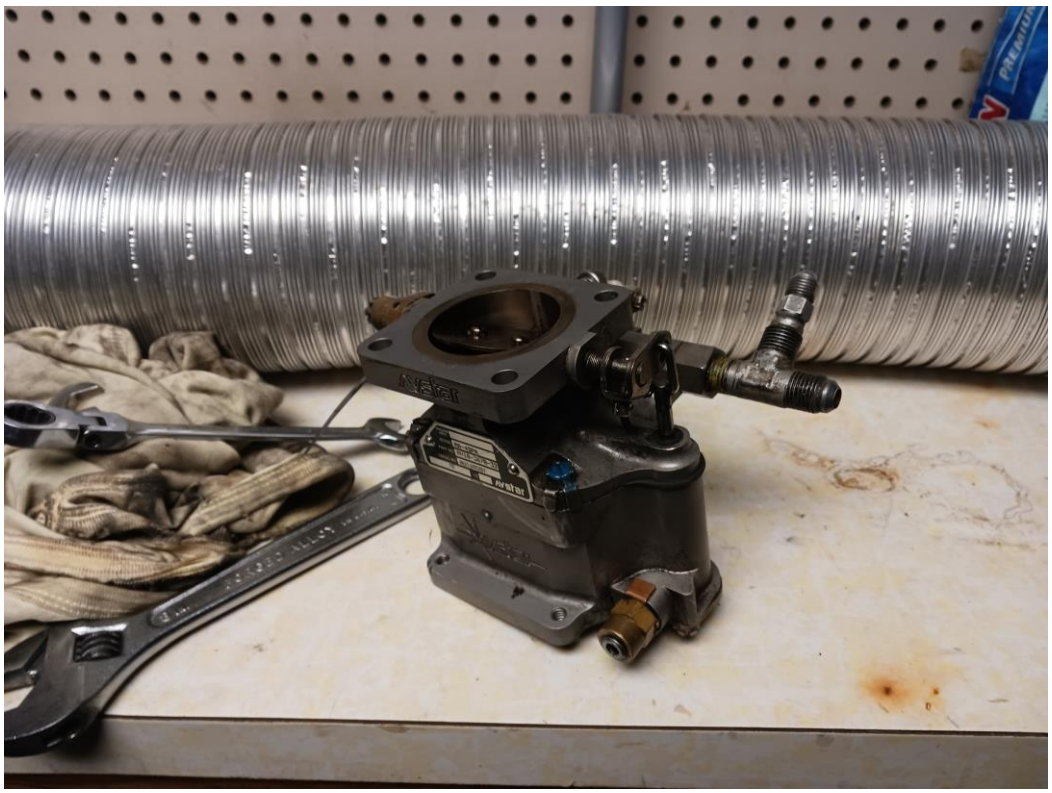
If the RPM rise is higher it means there's too much fuel remaining in the carb because it's bypassing the idle circuit, and the engine has to burn all that fuel

before it dies. In fact, over several tries performed according to Harry's instructions, I was consistently seeing a 175 to 200 RPM rise!

Harry agreed that it was now time to pull the carb for proper inspection and service. He suggested I contact Progressive Aviation in Kamloops, the certified side of Aero Sport Power. Aero Sport builds engines for homebuilt planes. Both sides of the business are very highy regarded.

Bob Kirkby suggested that I might also contact Alberta Aero Engines on the Villeneuve airport just outside of Edmonton. If possible I'd prefer to spend my money locally, or at least in Alberta so I gave them a call. I'm glad I did.

Cindy and Lance stated they absolutely service carburetors, including the Avstar brand like mine, and Lance figured he had a pretty good idea of what the problem was. Avstar carbs are essentially clones of the ubiquitous Marvel Schebler series of carbs that populate the piston engine aviation industry. I spent a couple of awkward hours removing the carb and sent it north with my fingers crossed.



The guilty party. The author's Avstar carburettor after remvoal from the Cavalier's O-320.

A few days later Lance called me back and stated he'd finally gotten the carb working perfectly. Lance said he had a difficult time actually figuring out the issue, but it came down to two problems. First, the intake needle and seat had deteriorated over the 800 hours of flying I'd done with the carb since 2015. Also,

the bottom of the needle itself had worn a divot into the contact tang on the float assembly. Just those few thousandths of an inch of wear meant that the needle was unable to properly seat in the jet to cut off the fuel flow when the float bowl was full.

The offending parts. The hollowed needle seat (left) threads into the carb body where the fuel enters the carb to fill the float bowl. The float needle seals off that entry when the floats rise with the fuel level. The float needle rides the tang on the float assembly that the arrow points to. The divot on that tang isn't supposed to be there. It's been worn in by the needle over time. That wear was enough to prevent the needle from seating properly and correctly metering the fuel going to the bowl and into the engine.

Too much fuel was leaking past the needle into the carb, and thus the engine. When I pulled the throttle back normally from high power, all that extra fuel was flooding the engine. If I pulled back more slowly from high power, there was more time for the exra fuel to burn off.

Ya, I was definitely richer than I want to be. And it's interesting to me that my initial gut reaction outside of Vulcan, that the carb was running too rich, was

correct. I sure don't regret the trouble shooting process, though, because it identified another important issue, and I learned a lot.

Lance replaced the floats, the needle and seat, some gaskets and other smaller parts, and all for a very reasonable price. I breathed a huge sigh of relief. The next steps were to get the carb back, re-install it and then test it first on the ground, then in the air.

I had the carb delivered a couple of days later, but I had to wait five more days for the weather to warm up enough to work in my unheated hangar. It took a few awkward hours to get the carb re-installed and the front of the Cav put back together. Then there was another day's delay due to higher winds than I wanted to test in.

The Avstar carburettor, essentially a clone of the Marvel-Schebler carb, in the process of re-installation in the author's Cavalier.

Finally, with a suitable day at hand, I carefully pre-heated, preflighted, and then rolled the Cav out of my hangar. Start up went just fine. Wade Miller helped by keeping a lookout for any telltale drips from the cowling, or any other obvious issues. After a few minutes of idling he gave me the thumbs up.

I taxied to a spot on the field where I could tie the plane down to do a full throttle run-up. First I did the requisite mixture and mag checks. Here I noticed immediately how much more smoothly the engine ran on each mag than before the carb repair. Definitely a good sign. When the engine was properly warmed

up I eased up to full throttle. I could only get about 2250 RPM, which I passed off to the thick winter air, but the engine defintely sounded crisper and smoother than before.

At the shut down, I noticed the mag spike at idle cutoff was about 50 RPM just before the engine died, maybe a touch higher. I can fix that by turning the idle screw in by half turns until I get the right setting.

Miller, waiting to taxi and takeoff after me, watched from his cockpit as I taxied to the threshold of Kirkby's runway 16. When all was ready to go, I firewalled the throttle and here's where I got a very nice surprise. The engine caught immediately. No delays or stumbles, just instant steady power. Acceleration and takeoff were nice and strong, and I noticed at least 100 more RPM on climbout than I saw pre-repair.

The rest of the hour long flight was a delight. I did a number of high power maneuvers and had no burping, gurgling or farting at any power or mixture settings. The only issue I had on the flight was the slippery runway I experienced on landing back home.

The Cav and I were back in the game.

In Summary

This whole exercise is another brilliant example of the value of our club, its members, and their insight and experience. I was able to lean on the expertise and advice of Wade Miller, Bob Zabolotney, Bob Kirkby and Gerry MacDonald. Without that help, this whole process would have been much more difficult and likely much more expensive. And I'm just as grateful for what I've learned on this venture. It's given me more knowledge of how the Cav runs and what to explore when it doesn't.

Finally, my many thanks to Harry Jaeger of Caddis Aviation for his crucial advice and insight; and to Cindy and Lance at Alberta Aero Engines for their excellent, timely and very responsive service. Both are businesses that I'll heartily recommend and happily do business with again!

The Cav back safe and sound in it’s hangar after a successful post-repair test flight.