

# Dual Exhaust Syst. Conversion for the Comanche 250 (Jan 2009) Mike Dolin, ICS #698

## Stage 1: Should I Buy It or Not?

Aircraft Performance Products (APP) holds the STC for the dual exhaust system on the older Comanche 180 and 250. The original single exhaust system is essentially a pretty good one, so let's discuss some advantages for the conversion.

Without getting dazzled by something new and improved, if enough parts go bad on the old single exhaust system, it makes no economical sense to keep throwing money at it. The new dual exhaust is a no-brainer at that point.



*Don Vreul's Comanche, left-side, cowl removed*

Don Vreuls did the same mod on his airplane first. Above is a picture of the Dual Exhaust mod, almost completed on his Comanche 250. For my Comanche, I had already thrown good money after bad. I bought a new muffler and exhaust pipe, and had them both ceramic coated. The ceramic coating is a wonderful improvement, but these are only two major parts of the entire system.

The critical part of the 250 single exhaust system is the right-side manifold. It has two small, but very definite, problems.

One, cracking due to flexing. Thermal flexing of the cylinders on the engine causes stress points. Yes indeed, look at the air baffles on your engine. It consists of separate interlocking panels designed to move against each other. Not very much movement, but if that baffle were one movement, but if that baffle were one piece, it would crack. The old original manifold system is all one piece. It cracks for the same reason that the baffle would (flexing), and mostly, right at the #5 cylinder joint, the hardest place to fix.

Second, the problem of cracking due to thermal stress. The other manifold stress points are the welded-on attachments for mounting the carburetor heat muff. This area is prone to cracking, due to temperature stress. You can easily see the tell-tale signs of different temperatures. The manifold pipes are darker due to high temperatures, while the cooler heat muff mount remains shiny silver colored.

Whether the manifold cracks and leaks from either cause, it's no longer airworthy. A cracked exhaust system causes major problems like severe carbon monoxide poisoning or the risk of fire.

I had given my original cracked manifold to no less than four welders, each one making it worse than the one before, but having no qualms about charging me for their time and effort. I ended up buying a used right-hand manifold pipe assembly.

Then I learned about yet another problem – there are two different manifold designs. The #5 exhaust pipe goes straight down on one of them, and tapers rearward on the other. So where's the problem? The different manifolds require different carburetor heat muffs. The temporary manifold required me to cobble up a new temporary carburetor heat muff to go with it. It was something I wouldn't want to keep on my airplane, but I knew it was going to be temporary. If I sent the original to be temporary. If I sent the original manifold to a shop up north that does it right (estimated at \$1,200, or so), then the original carburetor heat muff could go back on.

So in my case, I had to weigh the cost of the expensive fix for the old original exhaust system, against the price of the brand-new system. For a more modern, longer-lasting exhaust system, I chose the new one.

Are there a few other convincing reasons to convert your exhaust to the new system? It makes the old Comanche sound more like a Harley Hog. Does that do anything for ya? One advantage that makes ears perk up is if there's any speed gain (my crazy ICS buddies)! Sorry, no speed claims here.

I suppose the dual system may breathe easier, but I don't know enough about fluid dynamics to say so. The pipes on the original single system are bigger, but have three prominent bends. The dual system pipes are smaller in diameter and have fewer bends, but the exhaust flow must still change direction inside the heat muffs. And don't forget, only one cylinder exhales at a time on an engine, pushing the exhaust along, first from one side, then the other. It will take some real savvy engineering plus some long time measurement to see if any of that really matters.

So if there is a performance improvement, it will be difficult to prove. I don't think back pressure applies to this installation like it does on an automobile. I haven't heard folks crow about performance increases in the past, so I don't look for speed or economy improvement when I evaluate mine.

Let's count the advantages of the dual exhaust.

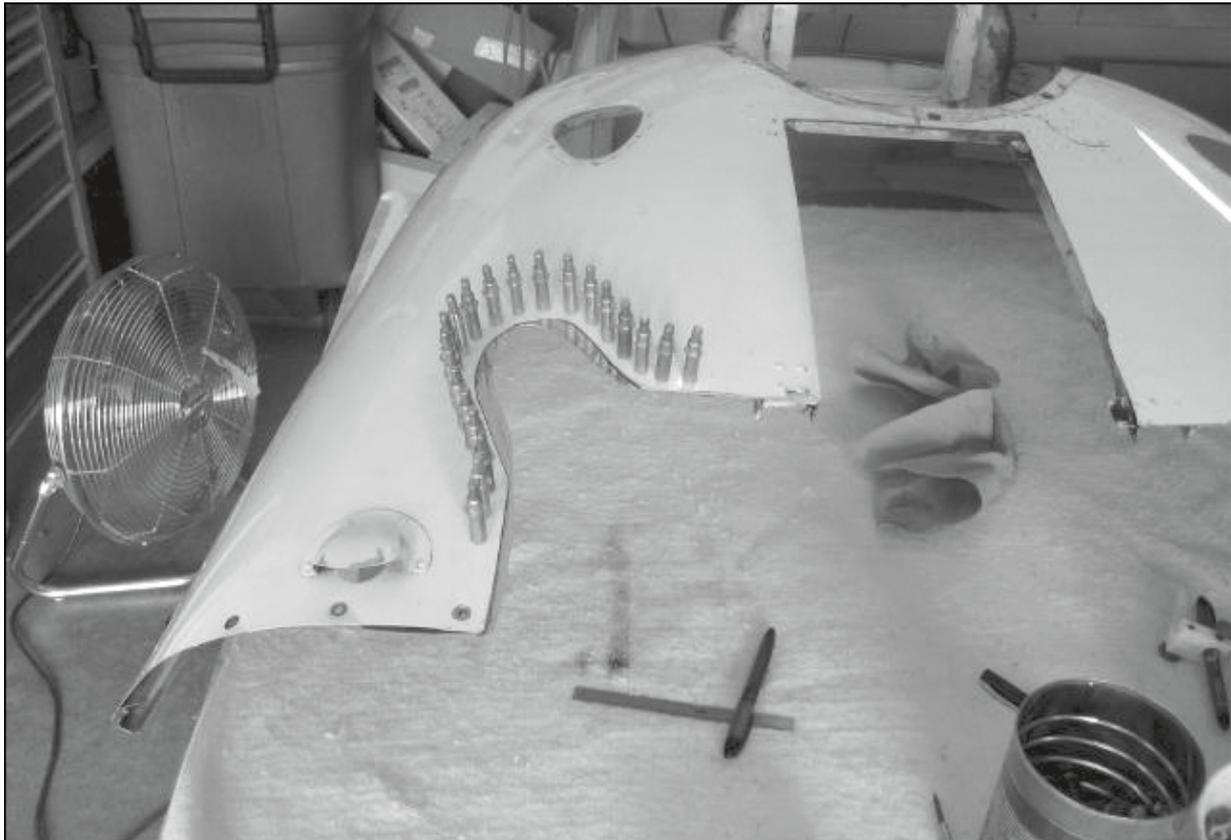
1. The dual exhaust should be less prone to cracking, which translates to a longer lasting system with less maintenance.
2. The airplane will be cooler in summer, which is probably a major consideration. In the summer, the Comanche 250 cabin is a hot box due to that large muffler between the engine and the firewall. You can feel it. On a long trip, I always climb to high altitude where it doesn't matter as much, but for local flights the cabin air wasn't cool. I'm told that cabin heat is adequate with the dual exhaust system. In the winter, my single exhaust system was always toasty warm, at 20 degrees below zero. I haven't had the chance to test the heat in the worst possible conditions yet.
3. It moves heat away from the firewall and from behind the engine. The engine accessories run cooler, especially the fuel pump, mags and vacuum pump. I've heard complaints that when the electric fuel pumps are initially turned off, fuel pressure drops to zero on the pressure gauge for a while. This is because the electric pumps block the mechanical pump fuel from flowing, and during the summer, especially at high density altitudes, the hot fuel in the engine driven pump is prone to vapor lock. This doesn't happen with the dual exhaust. With no muffler behind the engine, the mechanical pump doesn't get hot enough to cause a vapor lock.
4. The dual exhaust system is four- and-a-half pounds lighter.
5. Oil changes are easier. There is no muffler interfering with oil filter replacement. Just a simple maintenance issue.
6. AD note 68-05-01 does not apply to the new dual exhaust system. Maybe it does not apply to your old system either, or maybe it does. But it does not apply to this new one from APP.
7. Fresh air vents are cooler and just a skosh quieter, for the way I chose to install mine. The floor fresh air now comes off of the back of the engine baffle. The fresh air scoops on the bottom cowl are removed. Maybe not a measurable drag cleanup, but it sure gives the cowl a cleaner look.
8. The small stuff is beginning to add up... The nose wheel steering boot has a short life expectancy when it gets hot. The bellows last longer with the new exhaust system because there's no close-by heat cooking them anymore. I'd feel a little foolish saying the improved dual exhaust system is more

modern. The first time a dual exhaust system appeared on a Comanche was in 1965. Yep, taking off a 1962 system and stepping up to a 1965 system is going modern, you betcha! The dual exhaust and 260 engine came out one year before the six-seat B-model.

9. I must mention another area of concern on the single engine Comanche. Maybe it will find its way up to #1. I carry a CO detector in my airplane, the one mentioned on the Comanche website ([http://www.comanche-pilot.com/Tech\\_Articles/Safety/Comanche\\_Toy\\_Store/comanche\\_toy\\_store.html](http://www.comanche-pilot.com/Tech_Articles/Safety/Comanche_Toy_Store/comanche_toy_store.html)). I could never keep all the exhaust gas out of the cabin, and the CO detector ALWAYS went off on long trips. Now it doesn't. After sealing the exhaust pipe connections on my original system and the firewall as best I could, I think the path for exhaust gas flows under the airplane and up through the tailcone slot, and possibly through the main gear wheel wells. Personally, I think that getting rid of exhaust fumes is quite the most important issue.

## Stage 2: The Installation

I have to chuckle at the comment the APP prime mechanic made at Sun 'n Fun, "The exhaust conversion can be done in six to eight hours." Ha! Not the way I work, it can't. He doesn't know how slow I work. It took more than six hours just cleaning up and chasing parts. I'm told it took much more time for Don's dual exhaust installation as well. About the APP Paperwork: The instructions are all there. It doesn't spell out every step of the process as though a novice was building a kit plane, but then it shouldn't have to either. Where there is a reference to, "Make skin reinforcement doublers for the cutouts" and "rework the vent system," a good mechanic knows that AC43-13 gives examples of acceptable mechanical practices. The wording leaves room for innovation.



*Adding the reinforcements to the bottom cowl.*

All Comanches are slightly different. We must remember that Piper made rolling changes at whatever serial number happened to be on the assembly line at the time. One Comanche might have different

weldments or placement of parts located on the motor mount. So some parts fit differently from one airplane to another, as I found out when moving the starter solenoid and fuel pumps.

### **About APP Quality:**

The new pipes are exemplary in workmanship. I was pleasantly surprised when I opened the shipping box. That's pretty important, when you install something new on the airplane.

### **The Standard Work and Delays:**

Working carefully and methodically, I removed the top cowling in the first hour. It took another hour to remove the bottom cowl and hoses.

On the next visit to the hangar, I removed the nose wheel door and washed the filthy bottom cowl. Two hours later, it was still not perfectly clean. I must replace all that junky looking hardware too.

I took the bottom cowl to an RV kitplane builder's home for sheet metal help. He did the pipe outlet enlargements on the cowl, which took about six hours for the required skin doubler reinforcements (not included in the kit) and another six for closing off the air scoops. He is an absolute artist with sheet metal; it made me feel intimidated about the quality of my own work.

Another kitplane builder painted the cowling bottom half for me. Now I really do feel inadequate. These men make showpiece airplanes, one an RV-7 and the other a LongEze. Their airplanes are absolutely artistic in quality.

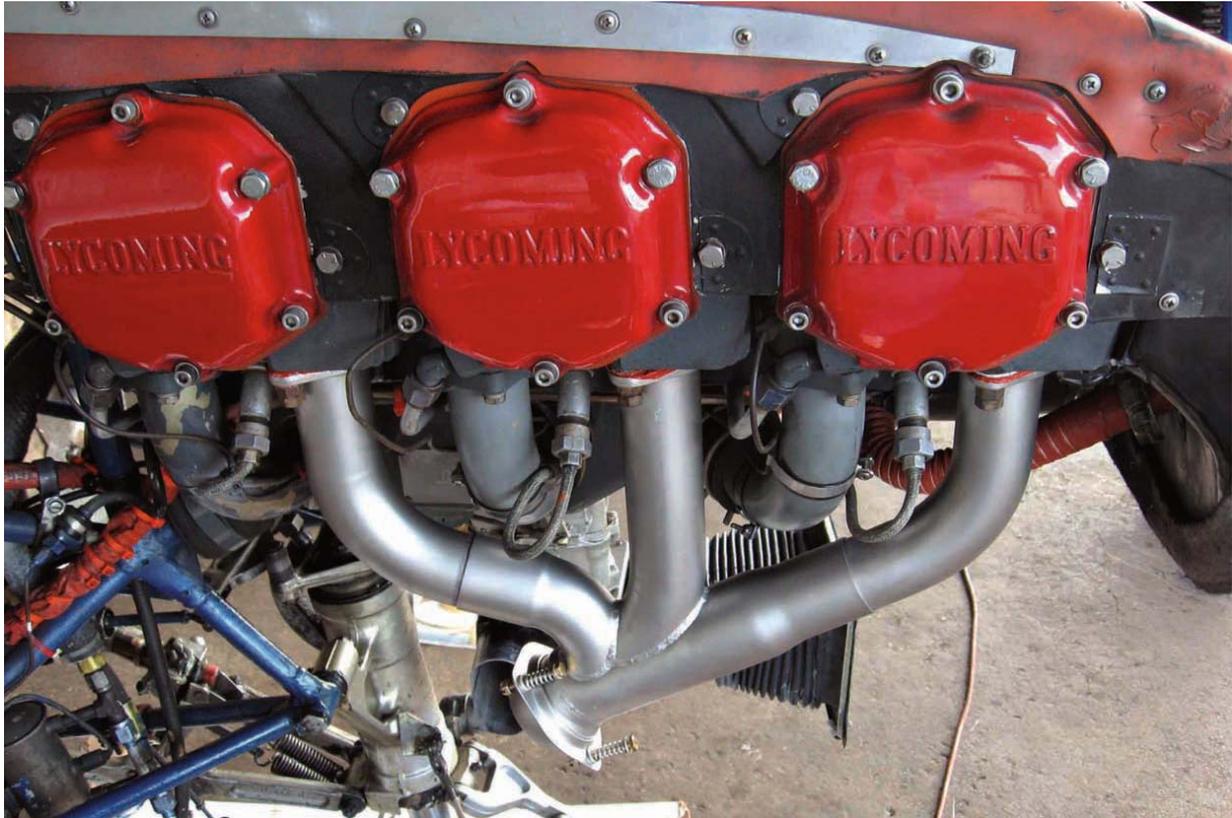
Back in the hangar, I tried to take off the old muffler brace, but couldn't get a crow's foot wrench in the area behind the engine. The oil filter must come off first. In removing the filter, the stamped steel nut on the end of my very first Kelly oil filter snapped off. It took two people to muscle off the filter with strap wrenches.

I put it in a plastic bag and sent it back to Kelly Aerospace with a nice note to the folks. The problem? This one had an early date code. The new Kelly filters have a "-1" after the number and the nut on the end is more robust.

The muffler brace came off easily, once the filter was out of the way. The pushrod bellows were hard and brittle. As expected, they peeled off in pieces. Little things like that and touching up paint on the motor mount brought hour after hour of unexpected delay. Another little item was removing the generator and sending it off for overhaul, just because it was conveniently exposed.

I replaced fuel lines, moved the oil lines, moved the starter solenoid and replaced the junky looking wires. It was also a good time to test the fuel pumps and clean the screens. Avgas squirts out of each pump at a pretty good clip.

Like any other job I do, this one would drag on for weeks to come. For quite some time, there was no light at the end of the tunnel. I had missed some good flying weather. But eventually, unlike Humpty Dumpty, it all went back together again, logbook ceremony, 337 form and all.



*Dual exhaust, right-side manifold installed.*

By following the instructions in the APP kit and directions in the maintenance manual, plus replacing hardware and hoses, the overall job came out looking pretty good. The finished job resulted in a clean, well-organized engine compartment. Personally, I like flying an airplane that looks that way.

### **Follow-Up:**

I just can't hardly remember a job without adjustment after a test flight. There's a cardinal rule that goes something like this: If at all possible, never be the first pilot to fly the plane after maintenance. But no other pilot was around, so it had to be me.

After the first flight, the pipes had to be adjusted because of rubbing on the cowl. I expected that. Even YOU expected that.

The engine wouldn't shut off when I pulled the mixture. It sure sounded like carburetor trouble, but after a closer look, I could see daylight between the mixture lever and the cutoff stop. Sure enough, the mixture cable had moved just a bit. New clamps and careful adjustment put it back to normal and it works fine again.

Later, when I showed the job to Don Vruels, he found loose clamps on some orange hoses here and there, and even saw where a nut was missing on the engine.

All in all, it was a pretty normal shakedown period.

### **Stage 3: Performance**

Let's go fly. I'm looking for a difference in any of the performance categories.

I'll break them down into separate issues. First, as always, is speed. Is there a speed improvement? I pride myself in knowing EXACTLY how to measure true air speed (TAS), which could be the topic of another article.

As for fuel consumption, I never kept good records of how much gas I purchased or the flow rate, so will never know of any small improvement. What makes me think I'll recognize a difference anyway? On a recent trip of six hours, I didn't notice any change, so not much to say about this subject.

The next issue is environmental stuff; most important, is there any CO intrusion. Then cabin heat, cabin cooling, engine sound. What are the perceived differences?

Let's start with environmental.

Carbon Monoxide (CO): The number- one premier attribute. There is not a hint of exhaust gas coming in anymore. Halleluia! I checked that issue on several long six-hour flights already, and the air smells good and fresh all the way. My CO detector has not gone off at all since the dual exhaust system went on.

I can now jump on the bandwagon that blames a suffering woozy pilot for all sorts of accidents, from gear-up landings to running out of gas.

Noise: The engine seems just a little bit louder than before, regardless that the environmental tests prove otherwise. There is a prominent low rumble sound even with E.A.R. plugs or a noise cancelling headset (some folks may put that on the plus side.). Upon landing at low power, reducing the RPM to around 2100, the rumble noise completely goes away. Then it's nicely quiet inside, but that RPM range is not for cruise.

Cabin heat and vents: Cabin heat is good, but the real test will come in the winter. The right-side cabin heat is a shadow of its former self. The hot side is now the pilot side of the cabin. The heater is very adequate so far, but I haven't tested it at 20 below, either.

The cabin vent fresh air is less of a blast with the modified cooling air divider. I like that, but this is no airplane for summer heat. I once rode in a Cessna 310 on a cloudy day in Florida. The OAT was around 60 degrees and it was actually chilly inside the cabin – sweater or jacket conditions, I'd say. You never get that cool inside a single engine Comanche. The engine affects the cabin temperature in almost every plane I have ever flown. Mostly, it's the sunshine that makes it too hot inside. Score one for high wing airplanes.

Speed: I won't even BEGIN to think that I'm getting a speed increase with the new exhaust. I checked the true air speed a few times and it's pretty much the same. Just what Piper's Pilot Operating Handbook says it should be.

So, do I recommend the dual exhaust system? The folks at APP are good friends of mine. You bet I do! Aside from the friendship, the reasons for doing this mod really speak for themselves.