

Tips from Comanche *Flyer* magazines Feb 1973 – Sep 2012

CHAPTER TWELVE

TURBOCHARGER (INSTALLATION, MAINTENANCE & OPERATION)

Table of Contents

Turbo Waste-Gate Cracks	2
Turbo RAJAY Kits.....	2
Turbo Manifold Pressure	3
Oil Pond under the Exhaust Stack of a Turbo Engine.....	4
Avoid Compressor Damage	4
RAYJAY Turbo Systems (May 2003).....	4
Turbo Boost (Sep 2011)	5

Turbo Waste-Gate Cracks

I am the owner of a factory Rajay Turbo Twin Comanche, 1968 vintage. I would like all the other Turbo Comanche owners to be on the lookout for waste gate arm cracking and failing at the waste gate point.

It appears that on original manufacturing, the waste gate lever arm is burned away to a thinner thickness by the welding. We found the left side failed in total and upon investigation the right side was also cracked and failing. Material defect report is going into FAA on this condition. A letter was sent to Rajay in California with no reply.

The redundancy springs of the older type also fail when called upon to keep the waste gate open. The newer type spring should be put on as soon as possible. This will prevent over-boosting in the event of a vernier wire failure or a waste gate arm failure.

ED: (Nov 2006): New waste gates are available from:

- 1) Webco Aircraft Co.
1134 N.Oliver Rd.
Hgr G
Newton, KS 67114
Voice: (316)-283-7929 Fax: (316)-283-4702
<http://www.webcoaircraft.com/>
sales@webcoaircraft.com
- 2) Acorn Welding
10916 119th St.
Edmonton T5H3P4
Alberta
Canada
- 3) Gomolzig Flugzeug- und Maschinenbau GmbH
Eisenwerkstraße 9
58332 Schwelm
Germany
fon: +49 2336 4903 30
fax: +49 2336 4903 39
<http://www.gomolzig.de/>
info@gomolzig.de

For vendors 2) and 3) old waste gates need to be supplied as master.

Turbo RAJAY Kits

Q: I own a 1965 Comanche 260B with a fuel injected engine. Mr. Hellyers' article on turbocharging indicated that Rajay makes a kit for the 260 Comanche. My local PIPER dealer (Arapahoe Aviation) says there is no kit for the 260 engine in the B airframe, only the C airframe. Can you verify this please, for I'd like to turbocharge the one I have.

A: Rajay received three STC's for turbo installations on the Comanche series having TypeCertificate 1 A1 5. They read as follows:

PA-24-250 (T.C. 1A15) – Installation of turbocharged Lycoming IO-540-C158 or CC5 engine. STC #SA81 1 WE reissued 1/14/69.

PA-24-260 (T.C. 1A15) – Installation of Lycoming IO-540- RIA5 engine and Rajay Turbo superchargers, STC #SA2062WE.

PA-24-400 (T.C. 1A15) – Installation of turbo supercharged Lycoming engine IO-720-Ala STC #SA2359WE issued 6/1/71.

Suggest that you contact Rajay directly, but believe that the 260 STC applies.

Turbo Manifold Pressure

Having owned 9 Lycomings with Rajay turbos, including two Twin Comanches, I have accumulated considerable experience with their idiosyncracies and can assure Roger Sherman that his inability to maintain 29 inches of manifold pressure above 12– 13,000 feet is very common. I might say it is almost normal after a few hundred hours of operation. There are two main reasons for this and most installations suffer from both. They are

1. failure of the waste gate butterfly valve to close completely, and
2. leaks in the pressurized section of the air intake. Diagnosis and cures are given as follows:
 1. First check that the rigging of the waste gate control is correct. Before the turbo control comes to the end of its travel and "Bottoms out" on the cockpit console, it should have rotated the waste gate in the exhaust pipe as far as it will turn. Check this by pushing the cockpit control in as far as it will go, and then disconnect the actuating wire at the waste gate actuating arm and see if it can be rotated any further by hand. This is usually not the trouble, but is easy to fix by clamping the actuating wire to the actuating arm at a different place. If this doesn't help, the waste gate assembly section of the exhaust system must be taken off.
Caution: don't do this unless you have available the two high temperature gaskets you will need to put it back together. They are Rajay parts #RJ-01 14 and 0115. After removing the waste gate assembly hold it up to the light looking in the exhaust outlet end and close the waste gate by hand. You will probably find that it touches the inside of the exhaust pipe at one or two places, and there is lots of daylight showing around the rest of its perimeter. Exhaust gasses will leak around through these spaces and the turbo will not turn up to high enough speed to pressurize fully at high altitudes. One reason for the waste gate failing to close entirely could be that the exhaust pipe is no longer round, but has become oval, or elliptical.
There are three possible fixes for this problem:
 - a. Order a new assemble (\$750 current price).
 - b. Send assembly to Rajay for repair (sometimes they can, sometimes not).
 - c. Fix it yourself as follows: get some medium grit emery cloth sheets and cut up into strips (as long as possible) about one inch wide. Sit down in front of the TV with the assembly resting on a cloth on your lap and start lapping off the high spots in the butterfly valve. Pass the strip of emery cloth into the assembly between the valve and the pipe wall with the grit side against the valve. Hold the valve closed with one hand, pinching the emery cloth against the valve exhaust pipe. Then pull the strip of emery cloth out with the other hand. After eight or ten passes, hold the assembly up to the light and see if there is another place where the valve is binding and work on it. This is a slow process and expects to spend about half a football game, at least, pulling the emery cloth strip through. You will probably not get a perfect fit, but it is usually noticeably better.
 2. Even if the turbo is producing full pressure, some pressure will be lost if there are leaks in the cold air intake to the induction system. The test for this is easy. Stick a vacuum cleaner hose (blowing instead of sucking) down the air intake (stuff some rags around it to get a better seal) and feel around the intake flex ducts, hoses, fittings, doors, etc. for leaks. The most common leak is at the alternate air valve (below the air filter) which fits up loosely against a rubber gasket which may need replacing. Another similar problem may be with the flapper door in the compressor discharge box assembly. This is mounted on pivots in slots, so it seems very sloppy but that is normal. Feel around it to see if it is firmly held in place by the air pressure against its rubber gasket without leaks. A less common leak would be around the gasket on the access cover for the air filter. Incidentally, if you don't have the Rajay Owners Manual and Parts List, get it from Rajay at once.

ED: (Nov 2006): Another (mostly hidden) source for leaks is the flexible duct between the compressor discharge box and the air filter. The flex duct is squeezed on one side. Due to engine movements cracks can develop between the reinforcing steel wire of the duct.

One more source for leakage is chafing of the flex duct between the airfilter and the injector intake elbow duct.

To avoid leakage of the air filter box two further actions might be necessary:

1. replace the U-shaped seal (RJ 0605-27) with a thicker one, preferably with lesser Shore hardness, e.g. 15 (the Rajay seal has a Shore hardness of about 50).
2. Make sure that the lid of the air filter box is secured with wing nuts, a washer AND a rubber washer underneath.

Oil Pond under the Exhaust Stack of a Turbo Engine

If you find oil dripping out of the exhaust stack, the reason is likely to be a leaking O-ring in the check valve mounted between the bronze oil filter and the pressure switch. It is easy to disassemble the check valve and replace the O-ring.

Avoid Compressor Damage

Rajay Service Letter No. 19 dated 5 Sept 1972 suggests to secure the four nuts holding the composite material air intake scoop in place. If one of the nuts get loose they will be ingested into the compressor of the turbo charger and create severe damage.

My turbo charger was damaged when a broken stud (including the nut and washer) was ingested. If you safety wire the nuts according to SL No. 19 consider to applying liquid sealant to nut, washer and stud. If the stud breaks off there is a chance that the washer will stay with the broken off stud and the nut.

RAYJAY Turbo Systems (May 2003)

Karl Hipp ICS #10241

The title of this article could have simply been RayJay Turbos, because that is how everyone refers to their airplane. It's turboed or not turboed. And to most pilots (and many mechanics), when they are not getting adequate boost, they blame the turbo. I have discovered it is almost never the turbocharger that is the problem. It is likely a leak in the turbo System.

There are actually two Systems involved. The exhaust gas System, which develops the pressure that spins the RayJay compressor drive wheel, and the engine intake System where the higher than ambient pressure is developed.

Leaks in either System can cause poor Performance. When I bought my Turbo Twin Comanche, a Miller converted '67 PA-30, the right engine turbo System could produce about only 6" of boost at 12,000'. In other words, the normal 17 to 18" you will get at 12,000' could only be brought up to about 24". And the left engine turbo System was only capable of about 1" of boost.

Since I knew almost nothing about RayJay turbos (or turbo Systems), I called Gary Main at Main Turbo in Visalia, CA. Gary convinced me that if the turbos were developing any boost at all, the problem was likely leaks in the System—either System, that is. If there is a leak in the exhaust System, the turbo will not spin fast Comanche Flyer May 2003 enough. Intake System leaks will result in poor boost. Over the past few years, in a process of 'self education', I have discovered he was totally correct.

The first place to look is the wastegate. If it's not closing far enough or sealing tightly, that is a problem. Check travel first. Close the turbo vernier control and remove the exhaust tailpipe and look in from the back of the wastegate. The butterfly should seal tightly against the housing. If it's not, unhook the linkage and see if you can push it further. When the linkage is unhooked, it's a good time to check how easily the wire moves in the cable. Rust from condensation occurs on the 5" or so of cable that extends through the firewall. Put high temperature copper graphite lube (2500 degree) from Napa (North American Parts for Aviation) on the wire and work it back into the sleeve. If the butterfly isn't sealing tight against the housing, send the unit to Webco and have them rebuild it and put in the inconel butterfly. About five times superior to original equipment. The butterfly shaft should have only about .010 clearance.

Next, check all exhaust pipe joints and cylinder exhaust gaskets. Get the blo-proof gaskets from A/C Spruce if you see a problem there. Check the pipe itself for cracks. The gasket that seals the wastegate to the turbo can also be a problem. I

now make mine from .065 copper. They will never blow out. Get the heavier v-clamps from Webco with the 1/4 x 28 bolts. Coat the gasket and inside of the v- clamp with the graphite from Napa. This will help everything draw together tightly without binding. Be sure to position the clamps so you can easily access the locknuts once you rework the engine. This is not as important if you have a Single engine airplane. You will want to retighten the clamps after the first flight.

Once you get the exhaust whipped into shape, there will be plenty of pressure to spin the turbo. Now look for intake leaks. Even a tiny tear in the hose that goes from the compressor discharge box to the air cleaner will cause a big pressure drop. The compressor intake hose is not a leak issue as it is on the air intake side of the turbo, but the two red hoses need to be checked. The best way to check everything is take off the intake hose and tape a Shop vac hose on the intake side of the turbo. Turn the engine till all intake valves are closed and blow air into the System. Spray soapy water on everything. My red hoses were old but looked OK. Turns out they had a million pinhole leaks. There were bubbles everywhere. When replacing the larger hose that goes from the air cleaner to the fuel servo, be sure to check so it isn't contacting one of the turbo Support rods. You might need to trim some material off one end of the hose so you can position the bellows; portion so it doesn't contact the support rod. I wore a hole completely through a hose on a three hour flight because this was not paid attention to.

The alternate air door gasket (on the air cleaner) is also a place to look for a leak. I made a new gasket; from silicone. And check the gasket where the aluminum tube bolts to the fuel servo. The "flip-flop" door in the compressor discharge box is best checked visually. The hinge needs to be super loose. If you can see daylight around the door, you need to work on it. Webco sells the gaskets, but I worked on mine to get a good metal on metal seal without the troublesome gasket.

Most pilots think that if they can get 24" at 12 or 15,000 feet, all is working fine. Actually not. If the system is really tight, you can get a heck of a lot more boost than that!! David Buttle didn't believe me till he ran through this procedure on his turbo PA-39. He was able to get 28-1/5" on his left engine and 25-1/2" on the right engine at 23,000' at 2600 RPM.

By the way, Dave ruined a magneto distributor block while at 23,000' due to arcing over. Our Comanche mags are not pressurized, so this can be a problem.

The downside of all this good work is once you get everything up to snuff, it goes downhill from there. The constant Vibration and heat will cause joints to loosen, and hoses and gaskets to wear, till you start noticing less boost. It's a constant battle, but once you initially get it all working well, it becomes less work to keep it up.

Turbo Boost (Sep 2011)

Q Why would the turbo all of sudden quit working (no boost)? Is it usually wastegate controller linkage? When it was working, I only got about three inches of extra MP (only up to 27 inches) at 9,000 feet.

A The compressor discharge box door may not be closing correctly. It's the small rectangular door at the beginning of the air system, just behind the number three cylinder. If your turbo system hasn't been serviced by a shop that really understands the Comanche turbo system, then I would look for one. there are a lot of places for leaks in the twin turbo setup, and you have to take extra care to eliminate them all if you want top performance.

As far as the (poorly designed) linkage system, it's difficult to keep it working well. I've owned two turbo twin comanches over the last 20 years and had the wire break off at the end three different times. I did an "owner Produced Part" and got a 337 on mine and changed the connection to the other side. the reason for the low increase in MP is most likely due to air box leaks.

Dave Fitzgerald

A:the cause of total failure, if not the wastegate cable (wire), is probably the wastegate itself (having had several voluntarily leave the aircraft), or the turbo, this of course is assuming that the integrity of all of the hoses is verified. Besides the airbox leaks, the MP issue could also be any associated pressure hose, alternate air door, flapper valve, ANYTHING upstream of the turbo compressor outlet, up to and including the injector upper deck pressure lines, fuel servo, and intake runners.

Zach Grant