AERO SUPERCHARGER SOLUTIONS INC.

FREQUENTLY ASKED QUESTIONS

Q. Can I supercharge my certified general aviation aircraft?

A. We do not know of any supplemental type certificates that allow superchargers to be installed on certified aircraft; they are usually installed on experimental aircraft only.

Q. What is the difference between a supercharger and a turbo charger?

A. Recent models of both systems use a centrifugal impeller compressor section to compress the incoming air. The turbocharger uses an exhaust turbine to drive the compressor impeller to a speed of up to 100,000 r. p. m.'s, while a supercharger is usually driven by a combination of micro v belts and step up gears to achieve the 30,000 to 50,000 r. p. m. compressor impeller speed. Turbo-charged systems usually add more weight to the engine assembly because the exhaust system, turbocharger, and the waste-gate controller are all made of heavy alloys. There is usually more complexity involved in a turbocharged system as engine oil is used to perform many different functions on the system, I can think of at least 6 additional external oil lines on a TSIO-550C. In some aircraft the turbocharged system can weigh 100 pounds more than a supercharged system. i.e. super-charging adds 40 pounds while turbo-charging adds 140 pounds.

Q. Does air heat up when it is compressed by a supercharger or turbocharger?

A. Yes, for this question both systems are about equal and the temperature increase can exceed 200 degrees F.. The air heats up even more when the piston compresses it another 7 to 8 times before combustion occurs. Supercharging has a slight edge when talking about heating up the air because the turbine side of a turbo charger is driven by hot exhaust gasses. The turbine operating temperature is often 1600 degrees F. and because the turbine and compressor shaft and bodies are so close there is some heat transference, therefore given equal situations turbo charged systems run a little hotter. There is an air density difference for either system, because the air is warmer it takes approximately 33" of manifold pressure to have the same amount of oxygen in the cylinder as a normally aspirated engine has at sea level or 29.92 m. a. p. @ 59 deg. F.. It takes another 3" m. a. p. to make up for the horsepower required to drive either system. i.e. 36" of manifold pressure on a supercharged or turbocharged engine equals approximately the same horsepower to the propeller as 29.92" of manifold pressure on a normally aspirated engine.

Example: A Continental TSIO-550C engine is rated at 350 H. P. @ 42" m. a. p. but is de-rated to 310 H. P. @ 35.5" m. a. p. when installed under an S. T. C. in an older Malibu, and can maintain that H. P. to well over 20,000' altitude.

A Continental IO-550N normally aspirated engine is rated at 310 H. P. @ 29.5" m. a. p. at sea level, and can produce just 150 H. P. at 15,000' altitude with m. a. p. of 14.5".

Q. I've been told that it doesn't take any horsepower from the engine to run a turbo charger, while it takes 15 to 25 horsepower to run a supercharger, is this true?

A. This is false; it takes horsepower to operate either. It is true that a supercharger takes 15 to 25 horsepower to operate, but a turbo charger creates 8 to 15 P. S. I. of backpressure in the exhaust manifolds. This pressure shows up as a 200 degree F. increase in exhaust gas temperature. i.e. supercharged peak e.g.t. = 1500 deg. F. vs. turbocharged peak e. g. t. = 1700 deg. F.. I would think that driving a turbocharger with exhaust gases would be much like having a high back pressure muffler on your aircraft engine which would probably cost you 15 to 25 horsepower.

Q. How does a supercharger allow an engine to create more horsepower?

A. It compresses the air before the air enters the combustion chambers in the engine allowing up to 100% more air to be mixed with a balanced amount of fuel before it combusts. The results can achieve approximately twice as much horsepower as a normally aspirated engine. This 100% increase can be accomplished easily in a liquid cooled automotive engine. But because cylinder temperatures run much hotter with air cooled engines there are strict limitations on the amount of boost that can be accomplished without detonation occurring. The primary reason for supercharging an aircraft engine is to attain sea level horsepower at higher altitudes. Our systems typically produce about 30"m. a. p. @ 15,000' altitude on a standard day.

Q. How many inches of manifold pressure could I expect to see at 17,000' to 25,000' with a supercharger system?

A. The following figures are approximate, but achievable, as the efficiency depends on the type of engine and the intake design on your particular installation: 28" @ 17,000', 26" @ 19,000', 24" @ 21,000', 22" @ 23,000', and 20" @ 25,000'. All numbers are standard day temperatures, higher than standard temperatures equal lower m.a.p..

Q. How much faster will my aircraft be with a supercharger?

A. If you own a Lancair Legacy or similar aircraft you can expect an increase of 40 to 50 m.p.h. with a comfortable cruise rate or 27" m.a.p. and fuel flow of 15 to 18 g.p.h.at altitudes of 12,500'. Even more increase at higher altitudes. If you own a Seawind seaplane you may only see an increase of 30 m.p.h., but you will be able to take off from higher altitude lakes and fly at higher altitudes in mountainous terrain.
Actual numbers for a Legacy with a 2 blade propeller at 11,500' 260 kts t.a.s. 27" m.a.p. @ 15.5 g.p.h., running 75 degrees lean of peak e.g.t.,supercharger outlet temperature of 75 degrees F. and cylinder head temperatures of 360 degrees F.. When we replaced the 2 blade prop with a 3 blade race prop and with all numbers being equal the cruise speed dropped to 245 kts t.a.s.. The race prop did well at Reno, we set a world speed record for the 3 kilometer level flight category: 347 m.p.h. @ 6,000' with 4 consecutive runs.

Q. Does a supercharged aircraft have a higher fuel burn rate?

A. Yes, about 1.5 g.p.h. at the same speed as before it was supercharged. i.e. at 6,500' A normally aspirated Legacy at 210 kts t.a.s. burns 14 g.p.h., while a supercharged Legacy would be 210 kts t.a.s. burns 15.5 g.p.h.. The additional fuel burn is caused from the horsepower it takes to turn the supercharger, and this varies with altitude. At lower altitudes it may be 2 g.p.h. and higher altitudesit may be as low as 1 g.p.h.

Q. Will a supercharger make my aircraft faster at low altitude, say 1,000' m. s. l?

A. You will need to do some work on the fuel system and be willing to operate your engine at higher manifold pressures to be faster than a normally aspirated aircraft of the same design and engine displacement. At 36" and 28 to 30 g.p.h. fuel flow you would be faster than a normally aspirated aircraft. Maximum manifold pressure recommended for an engine with 8.5 to 1 compression ratio 38", with 7.5 to 1 compression 42" with 40 to 45 g.p.h fuel flows, the limiting factor is cylinder head temperature; keep it below 400 degrees F. If you want to get serious about racing you will need to operate anti detonation sprayers on the cylinders to keep the temperature down. We raced a Lancer Legacy in the sport class at the "Reno Air Races" in 2003' with a.d.i and a supercharger producing 48" map. @ 55 g.p.h. fuel flow and cylinder head temperatures of 340 to 360 degrees F., we took 2nd place with a speed of 321 m.p.h. @ 6,000' m.s.l.. The engine was a Continental IO-550N with 8.5 to 1 compression ratio. Be warned at these pressures (38" w/o a.d.i. and 48" with a.d.i.) if anything goes amiss you could detonate a cylinder or two. i.e. a plugged a.d.i. spray nozzle, or higher than 400 degrees F. c.h.t.

Q. What type of flying could really utilize a supercharger?

A. If you fly mostly for sport or below 8,000' m.s.l. most of the time we would not recommend that you supercharge. If you fly any aerobatics we would not recommend that you supercharge. If you have a pressurized aircraft we recommend that you utilize a turbocharged engine for that application. If you use your aircraft for cross country travel and would like more speed in the 8,000' to 25,000' range, utilizing oxygen above 12,500 of course, then supercharging a normally aspirated engine is a perfect fit. If you have a normally aspirated aircraft and want to be a serious contender at any of the air races, supercharging makes sense. If you think of the supercharger kit as being about 5% to 10% of the total cost of your project, and when you are finished you own a very special high performance aircraft, for some pilots it just makes sense.

Q. Which engines do you make supercharger kits for?

A. The Continental IO-550N as well as other similar Continental engines. The Lycoming IO-540 series engines and some Lycoming IO-360 engines. We do not offer a kit for carbureted engines.

Q. What happens if the micro v belt were to unexpectedly break while in flight?

A. The engine will still run as a normally aspirated engine, you will be about 1" to 2" of manifold pressure lower than a normally aspirated engine for a given altitude. This is caused by the resistance of the air going thru a stationary impeller in the supercharger. You will need to re-set the fuel flow for optimum fuel economy as the engine may be on a much richer setting as your manifold pressure just dropped several inches of pressure. In any case you should have plenty of power to continue the flight to your destination and safely land.

Q. How often does the micro v belt need to be changed?

A. Inspect the belt at every annual and when you preflight inspect the belt if it is readily visible. We expect the belts to last between 250 to 500 hours of operation. This is generally 3 to 6 years of flying. And yes you will need to remove the prop to change the belt

Q. How often will the supercharger need to be overhauled?

A. We expect to overhaul the supercharger when the engine needs to be overhauled, or at transmission gears, bearings, and shafts is about $850.00.

Q. Is it really important to have an engine monitoring system in a supercharged aircraft?

A. As a supercharged engine can produce more horsepower and therefore more heat it becomes more critical to monitor as many aspects of it's operation as possible. A properly installed and calibrated engine monitoring system can reveal many of the challenges associated with the operation of a high performance air cooled engine. Example: it can be used to better balance exhaust gas temperatures by letting you know if injectors need to be modified and therefore result in equal fuel flow to each cylinder. It can be used to diagnose a bad magneto or timing problems, fouled spark plugs etc. it can be used to accurately measure fuel flows and manifold pressures for more precise and efficient engine operation. I recommend the J. P. I. 8000 as I have assisted in the installation of several of them and the results were outstanding. They are very accurate and reliable. You can set your own alarm set points on many parameters, and you can download all parameters to a laptop computer for analysis. We have used in flight cylinder temperature data to optimize engine cooling efficiency. By modifying engine cooling air inlets, outlets, and baffeling, we see aircraft that have all cylinders that are within 5 degrees F. and have less cooling drag.

Q. Where is the supercharger drive pulley mounted, and will I need to change my propeller or engine cowling?

A. The crankshaft drive pulley is mounted about where the prop hub meets the crankshaft flange on both the Continental and the Lycoming engines, and is mounted with a precision machined split ring mounting plate. On Lancair or Seawind aircraft, the same prop can be used in most cases as both already use longer than standard hubs. i.e. both have at least 5" from the crankshaft mount to the center of the propeller blade. On other aircraft we can supply a 4" propeller extension.
If you need to extend the prop hub, you will need to extend the engine cowling the same distance, this is best accomplished by extending the rear of the upper and lower cowl where it meets the airframe, there are usually less compound curves in that area. Sometimes other minor cowl modifications are needed for clearance of added parts in the supercharger system. The Lancair and Seawind aircraft seem to need the fewest cowing modifications. We also have a supplier of already extended engine cowls for the Glassair III.

Q. How does the pilot control the boost?

A. On the standard kit the boost is controlled with a vernier control cable, similar to a throttle. We recommend mounting this control some distance away from the throttle, mixture, and prop quadrant just to eliminate any confusion. As an option we can supply parts for a fuel control system that will control boost with the throttle control only. Caution should be taken when operating the single control system as it is much like a fixed waste-gate turbocharged system in that it is easy to over boost. We recommend a large manifold pressure gauge with a red line in front of the pilot on the single control version.