*View/reply* [*online*](http://VOBA.clubexpress.com/content.aspx?page_id=2161&club_id=495146&item_id=718721&message_id=1785797)*Reply to forum at* *forum@velocityowners.com**Reply directly to William E Hunter at* *billhuntersemail@gmail.com*

>> If you do not want to role your own solution, talk to the factory about the cooling modifications (duct, plenum and cowl if I recall everything correctly). For the actual turbo charging system: buy the system from Tornado Alley…

Knowing that the fate of 100 LL AVGAS is in question and also knowing how expensive this stuff is…why would you prefer a “turbo-normalized” system over a “turbocharged” system?

A “turbo-normalized” system takes the usual high compression (like 9.5:1 or 10.5:1) piston aircraft engine and then adds a turbocharger to the exhaust system.  The “cold side” of the turbo charger is a turbine that  creates a positive pressure of 30.00 inches of mercury and this pressure is available upstream of the Bendix all the way up to the service ceiling of the engine (like in the flight levels).

Standard sea level pressure is 29.92 inches of mercury and about 14.7 PSI so the turbo-normalized system makes the engine think it is still at sea level even though it is really high in the sky.

A true “turbocharged” system takes a LOW compression (like 7.3:1) piston aircraft engine and also adds a turbocharger to the exhaust system.  The “cold side” of the turbo charger is the same kind of turbine but in this system it will create a positive pressure of 42 plus inches of mercury (some can pump it up to 49 inches of mercury) and this pressure is available upstream of the Bendix all the way up to the service ceiling of the engine and the pressurized air can pump more air and fuel into the cylinders so therefore with this system in increased pressure can effectively increase the “Effective Compression Ratio” back up to 10.5:1 (or more).

Since the pistons are low compression there is a lot of volume in the cylinder and the increased pressure will cram more air and fuel into the cylinder and therefore the engine will make more horsepower (and heat).

Here are some numbers to bang around:

49 inches of mercury equals 24.25 PSI - 14.7 PSI = 9.55 PSI of boost

At 7.5:1 Compression Ratio, 9.55 PSI boost makes an Effective Compression Ratio of 12.5:1 ECR

45 inches of mercury equals 22.10 PSI - 14.7 PSI = 7.40 PSI of boost

At 7.5:1 Compression Ratio, 7.40 PSI boost makes an Effective Compression Ratio of 11.9:1 ECR

42 inches of mercury equals 20.75 PSI – 14.7 PSI = 6.05 PSI  of boost

At 7.5:1 Compression Ratio, 6.05 PSI boost makes an Effective Compression Ratio of 11.2:1 ECR

Top fuel dragsters have engines with very low static compression ratios down in the neighborhood of 6.5:1 and with such extra volume in the cylinders they are near 70 PSI so they get way more bang but it also costs a lot more bucks but hey they run fuel that is nitromethane and methanol.

12:1 is considered to be the max safe limit with aluminum heads on pump gas in car engines.  I would not run an air-cooled airplane engine more than 10.5:1 on 93 octane MOGAS.  There are lots of STCs out there to run the Lycosaurus IO-540 on MOGAS.

My dad’s 1949 Packard straight flat head 8 has 7.5:1 compression pistons and it runs on whatever gas is available.  If the pilot of a true “turbocharged” 7.3:1 compression engine manually adjusts the engine Manifold Pressure to 30.0 inches then the internal pressure the pistons sees is only 7.3:1 and you can run the airplane on 80 octane AVGAS.  Of course the HP available would be really low like 200 HP but you can still fly.

If 93 octane MOGAS is available, then the pilot could manually set the MP to “only” 40 inches of MP then the Effective Compression Ratio is more reasonable 10:1…sure the engine will only be putting out 260 HP at sea level however that same 260 HP will be available all the way to altitude whereas normally aspirated engines running 25 MP/2500 RPM taper off above 8500 MSL

Cheers!!!

Bill  Hunter

Further:

## Matt Bucko responded:

## And yes, the io540 can be TNed.  Example here... <http://www.piperads.com/ads/turbo-normalized-lycoming-io-540j4a5-complete-firewall-forward-piper-aztec-video-2/>

## Turbonormalizing Vs Turbocharging.

<http://www.taturbo.com/tnvtc.html>

Tim Spear: Turbo charging will help with your first couple of points. Except for the additional heat, turbo normalizing should not place additional strain on the engine.

Do not use a car based turbo charger solution, they are not designed for this application.

If you want minimal boost, a straight electric super charger would be the easiest. But you are rather limited for what critical altitude would be.

Otherwise the complexity mostly comes from trying to fit everything and provide adequate cooling.

If you do not want to role your own solution, talk to the factory about the cooling modifications (duct, plenum and cowl if I recall everything correctly). For the actual turbo charging system: buy the system from Tornado Alley (often mentioned as having the most efficient system, but I have seen no data to back this up), or any Lycoming, Continental engine shop. Depending on case you currently have, will drive a lot of the cost decisions.

Here is a hybrid one from Eaton:
<http://www.eaton.com/Eaton/ProductsServices/Vehicle/Superchargers/EAVS-supercharger/index.htm>

A old fashioned super charger:
<http://www.forcedaeromotive.com/products/homebuilt-aircraft/>

And an electric kit:
<http://www.ebay.com/itm/Electric-Turbo-Supercharger-Thrust-Motorcycle-Turbocharge-Air-Filter-for-all-car-/252692253670?_trksid=p2385738.m2548.l4275>

Be aware, a lot of these you rob Peter to pay Paul.

Tim

Brian Michalk:

I turbo normalized my Franklin, 10.5:1 CR engine.  I removed the turbo due to heat issues that were not necessarily attributable to the turbo, but certainly did not help the situation.  In the future, I may reinstall the system and give it another go.

You'll really need to research the issue.  I read several books on engine theory, and turbos in particular.  For the me takeaway is that for engine longevity, thou shalt not exceed any published parameter.  Not only is this a MP limit, but also a inlet temperature limit, which is going to affect you more than anything else.

Do you need an aviation turbo?  Not necessarily.  However, pull down the turbo maps, and plug in the numbers for your operating specifications, and find the turbine and compressor maps that work for you.  You can mix and match turbines and compressors, and have your shop build a turbo to your specifications.  That's just the applied theory part.  Now, you need to look at bearing requirements.  Does your bearing require oil?  Will it then need a scavenge pump?  How will you throttle the turbo?  How will you address over boost?  How will you spec out your exhaust system?  Intake manifold?  Will it require modifications to your injection system?

Or, you can buy an off the shelf system where someone's already engineered all of these questions.  If you roll your own, it's a lot of fun, adding years to your build.  Frustrating, but doable.  You won't save yourself any money by doing it yourself, and you will find there is very little assistance to be had from others who have done this before you.

So, ask yourself how much of an experimenter you want to be.  This is really not a performance issue.