

A Whole New Airplane
By
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Please understand, I am not a mechanic nor am I an engineer. I'm a pilot, a user of airplanes, not a designer or fixer. My area of expertise has nothing to do with how or why things work. I am totally ignorant regarding things mechanical, but I'm not stupid, and I think I can tell a good thing when I see one.

The Turbo Arrow and the Seneca II, III and IV, as well as the Turbo Dakota and the Mooney, all of which use the Continental TSIO 360 powerplant(s), come with an absolutely terrible turbocharging system. They use a fixed wastegate system which adds to the pilot's pucker factor and with which he must be constantly aware and cautious not to overboost the engines. The throttles are so sensitive that if one merely breathes on 'em the manifold pressure jumps four or five inches, and extreme care must be exercised to avoid an overboost situation. This problem is particularly pronounced on take-off. Just at the time when a pilot is extremely busy dividing his attention among several important tasks, he must add substantially to his workload by carefully monitoring the manifold pressure gauges to insure that he doesn't overboost the engines, which, as I pointed out, is very easy to do with those hypersensitive throttles. For several years I lived with this condition as I operated a Seneca II, and believe me, it was a constant worry. As power is added on the take-off run, one must be especially careful, for as take-off power is approached (if one is using full recommended take-off power) one must learn the correct amount of lead to give the manifold pressure gauges, and stop advancing the throttles well before reaching full travel.

Now comes Merlyn Products, Inc. to the rescue with their "Black Magic" automatic variable wastegate controller. This Upper Deck Pressure Controller (UDPC) which Merlyn calls "Black Magic" absolutely revolutionizes the performance of the airplanes in which it is installed. They turn the Seneca II into a whole new airplane, just like magic! I've had them on a Seneca II for about eight months and something over four hundred hours of service so I think I've seen enough experience to be able to properly evaluate them from the owner/operator viewpoint.

However, in order to compare the Black Magic wastegate controllers of Merlyn Products with the "fixed wastegate" system that is original equipment on the Turbo Arrow, Turbo Dakota, Mooney, and Seneca II, III and IV, we must first understand how the original ones work and what they do. You'll find no technical description of exactly how the fixed wastegate system works (with a bolt through the exhaust bypass elbow) as compared to just how the automatic upper deck controller work (through differential pressure sensed between the two sides of the throttle butterfly), but rather a simple description of what each system does, along with the disadvantages of the fixed system compared to the automatic variable (Black Magic) system.

As we all know, turbocharging is a technique by which intake air is compressed so that the engine(s) can deliver more power and continue to do so at a higher altitude where the air is less dense. In other words, by means of turbocharging an engine we can get sea level performance to a substantially higher altitude. This is accomplished by a turbine compressor usually driven by exhaust gasses, and these gasses are, of course, extremely hot. In order to avoid forcing more compressed air into the cylinders and overstressing them the amount of compressed air that is being put out by the compressor must be controlled by some means or other. The amount of hot exhaust gas that turns the turbine ideally will be only what is needed to produce the power called for by the pilot. Any excess exhaust is dumped or allowed to escape by means of a "wastegate", which simply allows it to bypass the turbine. Some wastegates are

controlled by the pilot by means of a knob or set of knobs on or adjacent to the power quadrant, others are controlled automatically by means of pressure sensitive devices upstream of the butterfly valve (controlled by the throttle), and still others are "fixed", or only controlled by adjustment on the ground.

This last kind is what comes on the TSIO 360 engines mounted on the Seneca II, III and IV series aircraft and those others mentioned above. And there are several pronounced drawbacks to this kind of installation. This system involves having the turbine turning at full allowable capacity all the time. It must be fixed at a compromised position which can only be efficient at a specific ambient pressure, which means that on any given day, depending on temperature and pressure there is only one precise altitude at which it will deliver the correct amount of pressure for a given power setting. At lower altitudes throttle application must be very restricted or the engine will be overstressed, and at higher altitudes it is impossible to get utilization of all the horsepower the engine has to offer. Meanwhile an enormous amount of excess heat is being generated, a factor which tends to shorten both engine and turbine life.

The critical altitude of a turbocharged engine is that altitude above which any increase in altitude results in a decrease in manifold pressure, just as a climb does in a normally aspirated (unturbocharged) engine. With a fixed wastegate, since some of the compressed air is being dumped all the time, when the critical altitude is reached there is still some compressed air being wasted, therefore some of the horsepower of which the engine (and the turbine) is capable of producing cannot be used. With an adjustable wastegate (whether manual or automatic) all the pressure offered by the turbocharger is available, and thus the critical altitude is raised. In the Seneca II the critical altitude is raised from 14000 feet to 18000, which means that the engines will develop full rated horsepower for an additional four thousand feet before it starts to fall off with an increase in altitude. On a long trip leg this means that you can get into the high altitude structure where the air is less dense and you can go faster without having to sacrifice any of the rated power of your engine(s) And maybe even get above the weather.

The act of compression itself generates a lot of heat, and the intake manifold of a turbocharged engine is a great deal hotter than that of a normally aspirated engine. This extreme heat itself creates an additional problem for the operator. One solution to this problem is the installation of an expensive intercooler system. Another is the Black Magic wastegate controllers. Since the turbine is only compressing and delivering the amount of compressed air demanded by the pilot to deliver the desired power at any given time, it is not running as hot as that which is running at full capacity at all times, as is the fixed wastegate system. This results in a cylinder head temperature thirty-five degrees Fahrenheit lower with the Black Magic automatic wastegate controllers than that which is experienced with the fixed wastegate. This cooler operation is another factor that reduces both turbine and engine wear, and results in longer periods between both engine and turbine overhaul, a substantial savings for the operator. Of course, the turbine will last longer anyway since it is working only as hard as needed, rather than at the maximum all the time. The fixed wastegate system is certainly cheaper to build, but the owner/operator pays for it many times over as a result of the increased wear and tear on the engine and components. In others words, while the manufacturer saves, the user pays.

From the pilot's standpoint, an airplane with turbocharged engines using the automatic wastegate controllers can flow just like any other airplane as far as the power controls (throttles and props) are concerned, except, of course, at a substantially higher manifold pressure. The surge experienced when the throttles are advanced in an airplane equipped with the fixed wastegate system is absent. The power responds in a more normal fashion.

There are several advantages to the Merlyn Black Magic wastegate controllers in addition to the increase in critical altitude and the reduction in cylinder head temperature. The company claims an increase of four knots indicated airspeed at the same power setting, an increase of six per cent rate in cruise climb, a reduction of eight degrees Fahrenheit in maximum cylinder head temperature in climb, a reduction of seven degrees Fahrenheit in maximum oil temperature in climb, a reduction of fifteen degrees Fahrenheit oil temperature in cruise, a reduction of four tenths of a gallon per engine in cruise at a given power setting, and equivalent performance with on to on and a half inches less manifold pressure.

My experience, as well as that of others, has been that not only are the company's claims not exaggerated, but they are consistently conservative. Not having taken my airplane to and above eighteen thousand feet, I can't say anything about the claimed increase in critical altitude, but with respect out of all the other claims, in my experience the actual performance has exceeded the claims made by Merlyn for their product. This kind of understatement sure makes the consumer happy when he discovers the product to be better than advertised! Cruise speed at the same power setting has increased by six, not the four knots claimed, and all the other statement of Merlyn regarding temperatures have been bettered in the real world. It sure beats paying a ton of money for intercoolers and still having to live with the fixed wastegates. Of course, if you have unlimited funds, the ideal would be to add both intercoolers and automatic wastegates to your airplane since the two systems compliment one another, but if you can only go with one, Black Magic is definitely the way to go!

If you want to know what I think of the Merlyn Products Upper Deck Pressure Controller system, get a load of this; a couple of weeks ago I added another (second) Seneca II to our fleet. After a more or less cursory pre-purchase inspection, I took possession of the airplane. It was due for an annual inspection in about six weeks, but since there were a few minor squawks needing attention, I gave it to Kitze Aviation to have it annualized prior to putting it on the line. Before anything else, I ordered a pair of Black Magic wastegate controllers to be installed by Doug Kitze as he annualized the airplane. In other words, I wouldn't put it in service without them. This is the first thing I did when I committed to buy the airplane, and the only change I plan to make. That should say something about my personal opinion of the product, and others with whom I've talked are just as enthusiastic.

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