PIPER TURBO ARROW

BLOWER ON A BUDGET

The Turbo Arrow continues to mature at the hands of the aftermarket.

BY MARC E. COOK

Prepare a list of airplanes whose makers got everything right (or very nearly so) the first time, and you'll end up with a rather short list. Perhaps you'd nominate the Beech Bonanza, DC-3, or even the Boeing 707 for that roster—still, even the most hyperenthusiastic boosters

PHOTOGRAPHY BY MIKE FIZER

of those marques would admit that improvement made to the later versions brought true benefits.

And so it is with admittedly more pedestrian airplanes, like the Piper Turbo Arrow. Not to slight the feelings of Turbo owners, but the blown PA–28 represented a predictable evolution from the Cherokee's modest beginnings, and nothing about its design and execution could be considered ground-breaking. And as even content owners readily admit, the early examples were subject to considerable mechanical distress from the turbocharged six-cylinder under the cowl. Today, however, myriad modifications are available for the Turbo Arrow that address the engine's basic shortcomings and boost performance and top-end longevity.

Piper took a well-known airplane, turbocharged its engine, and charged only $5,000 more.

Introduced in 1977, the Turbo Arrow promised to bring turbocharging to everyman. The Arrow's combination of a simple, common airframe and no-frills turbo engine would be one shared by several manufacturers in the late 1970s. In 1976, Rockwell brought out the 112TC, with a turbocharged, carbureted 210-horsepower Lycoming in place of the straight 112's IO-360. Performance gains at low altitude were slight and only marginally better above 10,000 feet. Mooney followed the success of its then-new 201 with the 231, brought out in 1978, which used a slightly different version of the Turbo Arrow's TSIO-360 Continental. Though no faster than a 201 below 10,000 feet, the 231 nonetheless was a success because it could flat haul in the flight levels. The Rockwell 112TC survived to 1979 with relatively slow sales all along, and the 231 evolved into the 252, only to be supplanted in Mooney's current lineup by the fire-breathing 270-hp TLS.

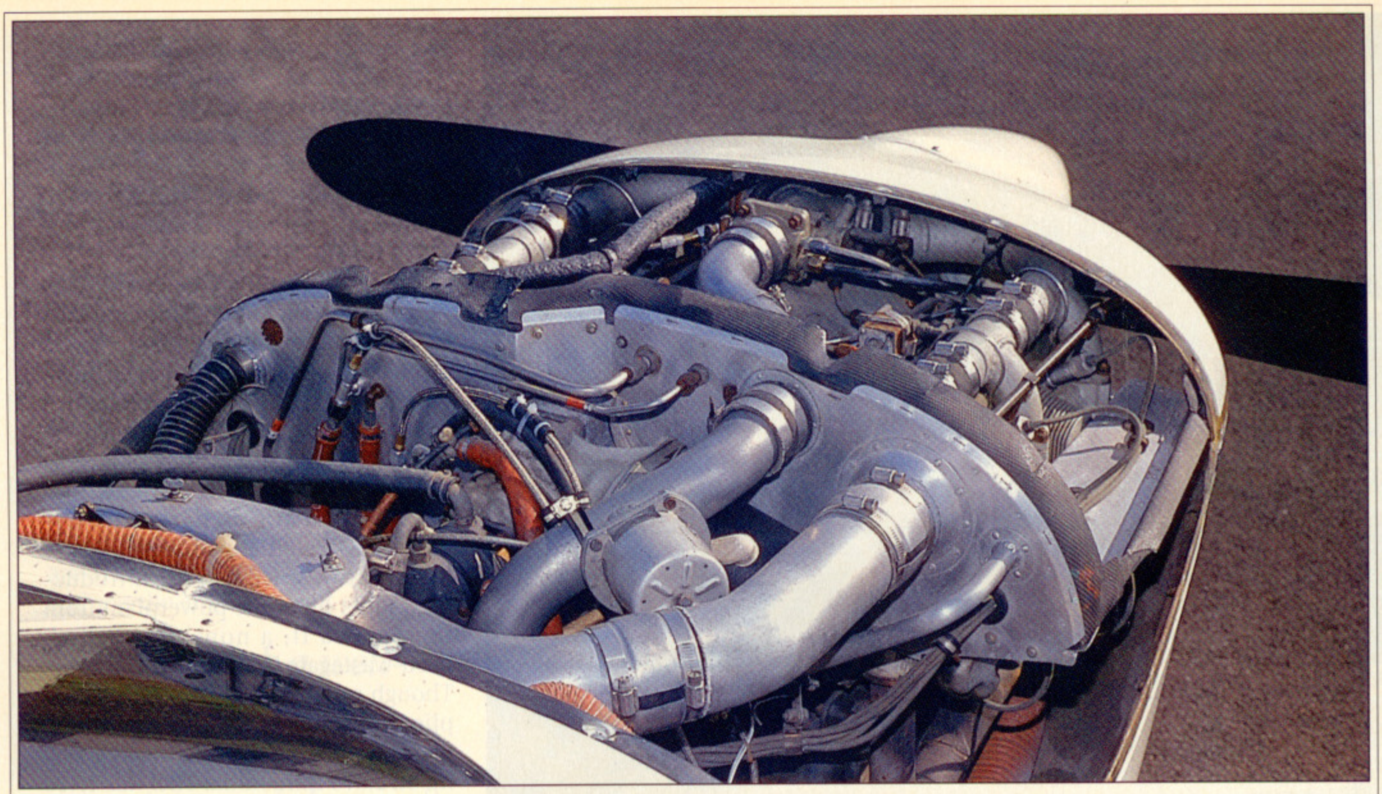
Cessna joined the fray in 1979 with the turbocharged retractable 182 and, two years later, introduced a turbo version of the fixed-gear Skylane. The Cessna would be the only of the low-

end turbos to compete with the Arrow in terms of sales volume. All told, Cessna cranked out about 1,400 turbo Skylanes, compared to approximately 1,700 Turbo Arrows; Mooney produced 890 of the 231s, and Rockwell turned out just more than 300 of the 112TCs and 112TCAs.

Part of Piper's success with the Turbo Arrow had to do with familiarity. Here was a well-known airframe given a significant performance boost with turbocharging, priced at not quite $5,000 more than a nonturbo PA–28R. What was not so familiar was the engine under the new cowling. Rather than turbocharge the Lycoming IO-360 that had been a staple of the Arrow since its 1967 introduction, Piper lifted the powerplant from the Seneca II, a non-intercooled, fixed-wastegate Continental TSIO-360. Though capable of 220 hp in some applications, the Arrow received the -F version of the six-cylinder rated at 200 hp on 2,575 rpm. Initial TBO was 1,400 hours, which was upgraded to 1,800 hours on the -FB engine, a result of stronger connecting rods. The -FB became standard in the Turbo starting in 1979, and a good percentage of the -F engines have been upgraded to -FB status at overhaul time. The TSIO-360 would prove to be the heart of the Turbo's newfound high-altitude performance and the soul of its maintenance troubles.

Field experience has shown that the odds are against hitting TBO on an absolutely stock early Turbo; early being pre-1983, when improvements like pressurized mags and better cooling came aboard the Arrow. And the blame often is placed at the feet of what some call a primitive turbo system. Several methods have been employed over the years to control turbocharger output—left unchecked, it would continue to spool up and produce ever greater amounts of boost, which would increase power and exhaust-gas output, in turn elevating boost until something blew up. The wastegate, then, redirects some of the exhaust gas around the turbo, limiting the speed of its turbine wheel and therefore boost output.

Among the best and most expensive methods of directing a wastegate's actions is an automatic controller—of which there are several types. Suffice it to say that an automatic controller maintains a manifold

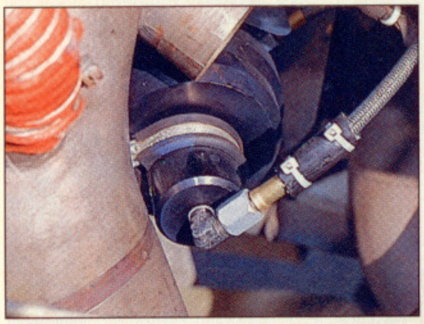


pressure the pilot asks for through throttle position. It's largely a set-and-forget system and reduces pilot work load tremendously. At the other end of the scale, there's the manual wastegate, sometimes called the "second throttle." This arrangement typifies early inexpensive turbo systems and requires the pilot to set power using both the conventional throttle (full open at altitude) and the wastegate control—this is a high-work-load system and, should the pilot forget to open the wastegate during descent, can lead to dramatic and expensive overboosting.

The advantage of the manual system is that it is cheap and reliable, and so Cessna and Rockwell employed a variation of the do-it-by-hand method for the T/TR-182 and 112TC. The wastegate is mechanically linked to the throttle; the first portion of lever travel opens the carburetor and the last closes the wastegate. Though easier to manage than a second throttle system, much pilot interaction is required to maintain manifold pressure at a given mark.

Piper and Continental chose an even simpler system for the Turbo Arrow, a fixed wastegate. The valve is partly open all the time, and manifold pressure is controlled exclusively by throttle opening. Among the disadvantages: difficulty in setting an exact

The Turbo Arrow's fixed wastegate is a simple design but very sensitive to throttle movement.



Merlyn Products' automatic wastegate replaces ground-adjustable plug and tames stock engine's throttle sensitivity.

manifold pressure, sensitivity to airspeed because of ram-air effect, and low critical altitude, or the altitude at which a certain percentage of maximum power can be maintained. Also, the throttle cannot be fully opened on the takeoff roll, or you'll severely overboost the engine; instead, you have to plant one eye on the manifold pressure gauge and the other on everything else. On the plus side, there's little to break, although there have been reports of the valve—a plug, actually, that partially blocks the passage that directs exhaust gas around the turbo—coming loose and backing out.

Dollars saved on the wastegate systems seem to have cost owners money elsewhere. A recent listing of service difficulty reports suggests that the airplane's top-end distresses—cracking cylinders, premature exhaust-valve wear, and other valve-train troubles—remain to haunt it. Fully half of the SDRs for an 18-month period reported cylinder problems, some of the malfunctions occurring in flight or immediately after takeoff.

Most of these malfunctions can be traced to heat. During the summer at a high-power climb (75 percent or greater), an unmodified Turbo Arrow shows cylinder head temperatures near the 460 degrees Fahrenheit redline. Even with full-rich mixture and a shallow climb angle, the CHT gauge often shows a needle's width or two just under the red, where it will stay until level-off. Piper did not fit the Turbo Arrow with cowl flaps—unlike in the Seneca, where the TSIO-360 has a marginally better reputation. Later, starting with the 1984 models, additional cooling louvers appeared on the bottom of the cowling, which helped keep CHTs in line; this kit is available for retrofit. Also, some pilots have resorted to running the low boost pump to force even more fuel through the engine in attempts to cool it; economy

suffers predictably.

Several modifications can be made to reduce heat. So far, the most popular seems to be the intercooler, currently offered by Turboplus, Incorporated (800/742-4202), and Airflow Systems (619/434-1889). Costs run from $3,300 for the Airflow arrangement to $4,500 for the Turboplus system, plus installation for either. The Turboplus system includes a kit to pressurize the magnetos as well; pressurized mags became standard in 1985 and helped cure often severe high-altitude misfiring. (This misfiring kept owners from using maximum cruise power at altitude.) Though the hardware differs for each system, they accomplish essentially the same thing: reducing the temperature of the air compressed by the turbocharger. This mod works well in the Turbo Arrow because the stock induction system takes its air from behind a bank of cylinders and then, because the fixed wastegate requires a greater differential of manifold pressure on either side of the throttle, heats it tremendously. This heat cuts into detonation margins and feeds very hot air to the cylinders; also, to compensate for the reduced density of this hot air, manifold pressure must be cranked up to maintain a given power output. With the cooler induction air, you use 2 inches less manifold pressure on takeoff and up to 3 inches less manifold pressure in cruise than stock for a certain percentage of power.

Another useful modification is an automatic wastegate made by Merlyn Products (509/838-7500). Replacing the fixed plug in the wastegate passage, this system is effective in taming the wild manifold pressure swings common in unmodified Turbo Arrows. Glenn Corrington, owner of the Turbo Arrow pictured here, absolutely swears by the modification, claiming that the airplane runs much cooler and has a higher critical altitude than before. The modification costs $1,995, plus installation.

We've discussed the Turbo Arrow's engine foibles, but just what do 200 turbocharged horses do for the PA–28's performance? As with other makes where a nonturbo analog exists, the blown brother is no more fleet below about 8,000 feet. Above that, though, the Turbo airplane begins to make tracks, culminating in a 75-percent cruise speed of 168 knots at 18,000 feet. (You're not likely to see that in a stock airplane, though, because to get 75-percent at Flight Level 180, you need to be spinning the engine to its 2,575-rpm redline. At more sane speeds, the TSIO-360 can produce 75 percent to about 12,000 feet, depending on temperature, where it will turn in 156 knots true.) By comparison, the smaller Mooney 231 beats the Arrow by almost 20 knots at most altitudes, and the TR–182 Cessna, using 35 more horses to pull a larger cabin through the air, is slightly faster.

Climb performance of the Turbo Arrow is good, with 1,000 feet per minute available right up to 10,000 feet or so, and with 72 gallons of fuel aboard, endurance is excellent. Count on 4.5 hours with an hour's reserve at 75 percent; though the book says fuel flow at this setting should be 12 gallons per hour, this is based upon leaning to peak turbine inlet temperature, which few unmodified engines tolerate well. More conservative leaning procedures, like limiting TIT to 1,500°F, well below the 1,650°F red-

1979 Piper Turbo Arrow IV

Typical retail selling price: $46,000

Specifications	
Powerplant	Teledyne Continental TSIO-360-FB, 200 hp
Length	27 ft 4 in
Height	8 ft 3 in
Wingspan	35 ft 5 in
Wing area	170 sq ft
Wing loading	17 lb/sq ft
Power loading	14.5 lb/hp
Seats	4
Empty weight, typical	1,900 lb
Max takeoff weight	2,900 lb
Fuel capacity, std	77 gal (72 gal usable)
Oil capacity	8 qt
Performance	
Takeoff distance, ground roll	1,800 ft
Takeoff distance over 50-ft obstacle	2,450 ft
Max demonstrated crosswind component	17 kt
Rate of climb, sea level	940 fpm
Max level speed, sea level	153 kt
Cruise speed, 75-percent power, 19,000 ft	168 kt
Fuel consumption, 75-percent power, 19,000 ft	12 gph
Landing distance over 50-ft obstacle	1,560 ft
Landing distance, ground roll	650 ft
Limiting and Recommended Airspeeds	
V_A (design maneuvering)	124 KIAS
V_{NO} (max structural cruising)	152 KIAS
V_{FE} (max flap extended)	108 KIAS
V_{LO} (max gear extension)	133 KIAS
V_{LE} (max gear extended)	133 KIAS
V_{S1} (stall, clean)	66 KIAS
V_{SO} (stall, flaps)	61 KIAS

All specifications are based on manufacturer's calculations. All performance figures are based on standard day, standard atmosphere, sea level, gross weight conditions unless otherwise noted.

line, result in about 13 gph at high cruise. Pull the power back to 65 percent, and you can lean a bit more aggressively, which will get you close to the book's estimate of 10.8 gph.

The Turbo Arrow's engine dominates most discussions of the model and for good reason; the airframe is basically the same as the venerable Arrow. Piper fitted the tapered wing to the Arrow at the Turbo's introduction, boosting slightly the nonturbo model's performance and dramatically adding to fuel supply, up from 48 gallons to 72 gallons. Two years later, in 1979, Piper added the much-maligned T-tail to all of the retractable PA–28s. In most flight regimes, you can hardly tell the difference in tails, but the T-tail versions, christened the Arrow IV and Turbo Arrow IV, come up a bit lacking in pitch authority at low airspeeds. You roll along until rotation speed and then, bang, the high-mounted stabilator takes hold, and up goes the nose. This makes the Turbo, which already is a bit awkward due to the throttle juggling required during the takeoff roll, particularly graceless on departure.

Pilots weaned on earlier Arrows will

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find the turbo an easy step up and will be pleasantly surprised that the greater weight and slightly heavier nose improves the way the airplane handles turbulence. Like most Cherokees, the Turbo Arrow is stable in cruise and very pleasant to fly on instruments.

Inside, Turbo Arrows are comfortable if not lavish, with good panel layout and ample space for avionics. Pilots through the years have bemoaned the placement of power gauges at the lower edge of the panel, above the pilot's right knee. It all depends on what you're used to because longtime Cherokee pilots seem to not even notice gauge placement.

Another way the Turbo Arrow follows in the footsteps of its Cherokee forebears is in price—getting into one will not require an armed withdrawal at your local bank. The models made in the first two years—which seem to be holding their value better than the 1979-and-later airplanes because of the conventional tail, can be had for an average of $42,000 to $44,500, according to the *Aircraft Bluebook–Price Digest*. Later models range from $46,500 for a 1979 model to $150,000 for one of the very last ones built in 1989. (Piper eventually went back to the low-tail configuration in 1989, but apparently, no Turbo models were built.) Such an increase in cost by year pretty much followed the hikes in new prices, from $54,975 with average equipment in 1977 to more than $160,000 in 1989. Piper still lists the Turbo Arrow as a current production airplane, incidentally.

So, yes, it's true the Turbo Arrow was flawed, a result largely of cost-cutting. But as time seems to heal all wounds, it is working its magic on the Turbo Arrow. Properly modified and carefully maintained, the Turbo can be a highly desirable transportation tool. What further improvement the aftermarket holds for the airplane, time will tell. □

TURBO ARROW ADs AND SDRs IN A NUTSHELL

Overall, the airworthiness directive outlook on the various Turbo Arrow models isn't bad. In our search for airframe- and engine-specific ADs, we turned up only one repetitive AD, Number 82-27-03, which calls for inspection of the turbocharger housing, clamps, and mounts for cracks every 200 hours. This AD can be obviated with an improved turbo housing, which runs about $1,000.

Otherwise, the ADs cover many systems and manufacturers: 77-23-03 called for a one-time inspection of rod-end bearings on the TSIO-360; 78-25-03 called for replacement of certain hydraulic hoses; 79-02-05 called for an inspection of the gascolator; 79-13-03 required inspection of fuel-line fittings in the wings; 79-22-02 mandated a modification of the fuel vent system; an audio-muting relay had to be removed under 80-14-03; 81-12-04 required inspection of the rudder torque-tube fittings on the T-tail airplanes; 81-13-10 spelled out inspection of the tachometer cable drive; the nose-gear drag links had to be inspected and modified under 82-06-11; 85-23-07 required modification of certain Bendix/King autopilots; and finally, 86-17-01 mandated replacement of certain ammeter shunts.

If the AD activity on the Turbo Arrow is fairly quiet, the service difficulty reports are more like a fraternity party—even taking into account that, for any airplane, the list of SDRs is usually far longer than of ADs. A handful of SDRs shows problems with the electrical system, including corroded battery terminals and defective alternator-drive couplings (the TSIO-360 uses a gear-driven alternator).

Far and away, the most common and costly problems pointed out by the SDRs have to do with top-end failures. These range from heads actually separating from the barrel to burned pistons, exhaust valves, and valve-train failures. Recently, the Federal Aviation Administration issued an emergency AD because several cylinders manufactured by Continental from June to December 1990 suffered valve failures as a result of insufficient clearance of the rocker-arm boss and rocker-box wall. A second emergency AD surfaced in February when Continental discovered that information in certain service bulletins pertaining to rocker-arm hold-down bolt torque specifications was in error. The AD called for immediate inspection for the correct hold-down bolt tension.

Landing-gear components were mentioned in several SDRs, with trouble spots ranging from broken or damaged nose-gear drag links to faulty switches. No single aspect of the landing gear system appeared more frequently than another, indicating that, by and large, the Arrow gear system has been sorted out since the original PA-28R bowed in 1967. —*MEC*