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p. 28

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HORSEPOWER OR ECONOMY

Which is Best? p. 34

Process, Procedures, Discipline

Benefits and Purposes of Two
Types of Checklists **p. 20**

Destination

Lakeland, Florida **p. 44**





Jim Hoddenbach

HORSEPOWER

[Which is Best?]

Does more horsepower really produce better climb and cruise performance? How about load hauling? Is there a “sweet spot” for economy? KRISTIN WINTER examines the Piper PA-24 Comanche series for examples.



OR ECONOMY

The pros and cons of bigger engines with more horsepower is a favorite hangar flying topic. Pilots are fond of relating tales of both underpowered aircraft and the overpowered beasts that they have had fun flying. In these discussions, the dragon of cost always rears its head.

So, what is the balance between performance and cost? It varies with the mission, but there are some considerations when trying to decide for oneself.

The Piper PA-24 Comanche variants offer an interesting opportunity to examine the pros and cons of more horsepower. The Comanche

was produced in essentially three flavors: the 180 hp version (which was the original), the 250/260 hp version, and the 400 hp version. Obviously, this progression of increasing horsepower is not unique to the Comanche. Piper PA-28 Cherokees range from 140 hp to 235 hp, without significant airframe changes.



Horsepower and aircraft performance

To generally understand the effects of increased horsepower, we must consider some basic aerodynamics.

In steady-state flight, drag is equal to thrust. For every airframe and atmo-

spheric condition, when drag increases to the point that thrust is counteracted, the aircraft remains at that speed, in level flight.

Drag increases roughly at the square of the speed. Thus, for every knot increase in speed, a plane that already flies

fast will need more additional thrust for each additional knot of speed than will a slower aircraft.

A reduction in drag is usually the most effective way to see improved cruise performance. Where extra horsepower has more effect is when the

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PA-24-400 Comanche 400



Ken Stoltzfus

PA-24-400 Comanche 400



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PA-24-400 Comanche 400

aircraft is slow, such as during takeoff and climb. Acceleration to flying speed is purely a function of excess thrust over the drag of the wheels and the aerodynamic drag. Likewise, rate of climb is a result of thrust in excess of the amount needed to overcome some of the weight and the aerodynamic drag resulting in an upward flight path.

Increased horsepower on a particular airframe is more likely to result in shortened takeoff rolls and an increased rate of climb than it is to result in a significant increase in speed. Likewise, reducing

aerodynamic drag pays dividends in cruise speed, but does little to decrease the takeoff roll or the rate of climb.

One potential factor limiting the performance increase of additional horsepower is the tendency for either the additional horsepower to come with additional weight and/or the tendency for the manufacturer to raise the gross weight of the aircraft.

For example, a PA-24-180 Comanche 180 has a gross weight of 2,550 pounds. The PA-24-250 Comanche 250, which was produced at the same time as the

180, started with a gross weight of 2,800 pounds and went to 2,900 starting with the 1962 model year.

In 1962, Piper changed the flaps from an essentially plain flap to a Fowler flap that increased the area of the wing and provided a slot for better flow control over the flap. This lowered the stall speed and allowed Piper to increase the gross weight.

As mentioned above, the Comanche has perhaps the largest range of horsepower options provided by an airframe manufacturer. The first Comanches had

...reducing aerodynamic drag pays dividends in cruise speed but does little to decrease the takeoff roll or the rate of climb.

180 hp. At the other end of the spectrum, Piper produced 145 Comanches with an 8-cylinder, 400 hp engine. In between is the 250/260 hp version, which was by far the most produced model. The 75% cruise speed of the Comanche models ranges from 140 knots to 185 knots.

A real-world comparison

The 180 hp Comanche was the original Comanche, though the 250 hp engine was offered as an option after the first 102 airframes were produced. It is interesting to compare the performance of each. In other words, what did one get for an extra 70 hp, other than an increased gross weight?

The key metrics for the Comanche 180 are approximately 140 ktas at 75% power at the optimum altitude with a fuel burn of 9.5 to 10 gph, a sea-level climb rate of 900 fpm, and a takeoff over a 50-foot obstacle of 2,250 feet. The Comanche 250 compares at 155 ktas at 75% power at the optimum altitude with a fuel burn of 13.5-14 gph, a sea-level climb rate of 1,350 fpm, and a takeoff over a 50-foot obstacle of 1,600 feet.

The 250 does all of this at an extra 250 pounds of gross weight. However, the Comanche 250's empty weight is higher as well, only yielding around 150 pounds of additional useful load in practice.

As one can see from these comparisons between the 180 and the 250 hp versions, for the 39% increase in horsepower, one gets a 50% increase in the rate of climb, an 11% increase in cruise speed, and a 40% increase in fuel burn.

One also gets enough additional useful load to either carry an extra person or to fill the aux tanks (30 gallons) which



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provides for longer range. Also, you will have about a 36% increase in the cost of overhauling the engine.

So, how about a comparison at the same weight? A Comanche 250, at the same takeoff weight as a 180, will give a rate of climb of about 1,500 fpm and a very short takeoff roll. The cruise speed, however, would only be a knot or two better at the lighter weight.

The Piper PA-24-260 Comanche 260 is for all practical purposes the same as

the 250. The 260 gets its extra 10 hp from turning the prop faster. The Comanche 250 redlines the prop at 2,575 rpm, and the 260's redline is 2,700 rpm.

Piper does not claim much difference in performance until you get to the 260 C model. This is partially due to the fact that the gross weight keeps increasing. With the 1966 Comanche 260 B, the gross weight is increased to 3,100 pounds. With the C model, it goes up to 3,200 pounds.

The speed increase that is typically

seen in the C model Comanche is due to the reduction in cooling drag brought about by the new "shark nose" cowlings.

Should you opt for more horsepower?

Whether the trade-off for more horsepower at a higher cost is worth it depends more on the mission than the aircraft, unless one wants to admit to the pure emotional pleasure of going faster and climbing faster.

PA-24-260 Comanche 260



The strength of the Comanche 180 is its economy, and it is the nicest flying and nicest landing of all the Comanches.

The strength of the Comanche 250/260 is the additional useful load and the better ability to top the mountains in the west. The Comanche 180 struggles a bit above 10,000 feet msl, and the Comanche 250 doesn't see the similar struggles until about 14,000 feet msl. Which horsepower version is better depends on the individual.

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Jim Hoddenbach

If 260 hp is good, is 400 hp better?

A word about the Piper PA-24-400 Comanche 400 for those who really like speed. The 400 was developed to cruise in the upper teens without the need of finicky turbochargers.

Back in the 1960s, turbos were a bit of a novelty for General Aviation aircraft. Howard "Pug" Piper wanted an airplane that he could fly from Lock Haven to Vero Beach in one go, and fairly quickly. Thus, the Comanche 400 was born.

Piper claims a 75% cruise speed at optimum altitude of 185 kts and 22 gph, and about 170 kts at 55% and up in the mid-teens, burning 17 gph. The PA-24-400 holds 130 gallons of usable fuel, giving it a pretty good range. 1,300 to 1,350 pounds of useful load seems a real-world figure, which leaves only about 550 pounds or so

for people and baggage.

Climb rate improves, though, at the gross weight of 3,600 pounds, it is not as much as you might expect over the Comanche 250/260. Piper claimed 1,600 fpm, but my limited experience in the plane and reports from owners suggest it is a bit better than that.

The 400 is a plane that needs to be flown long distances and above 15,000 feet msl. It is not economical, but it is fun.

The market suggests where the sweet spot is for an airframe. The Comanche 250 and 260 were certainly the sweet spot for the majority of buyers, though I have a soft spot for the 180 if the mission suits.

This principle holds for other Pipers as well. In the PA-28 series, the 180 hp seems to hit the sweet spot, though the other

PA-24-250 Comanche 250

Whether the trade-off for more horsepower at a higher cost is worth it depends more on the mission than the aircraft, unless one wants to admit to the pure emotional pleasure of going faster and climbing faster.

Cherokees have their niches.

The most important factor when choosing between horsepower or economy is finding the airframe that fits your mission at the cost with which you are comfortable.

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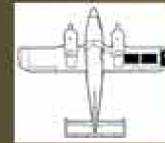
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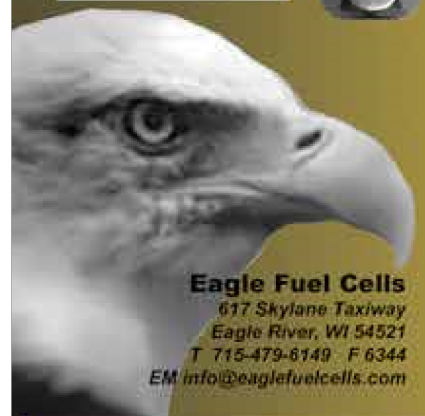
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