

Volumetric Efficiency

The following article was based on material taken from John Schwaner's Sky Ranch Engineering Manual (SREM). If you don't have it you are missing a lot of education. Call (916) 421-7672. At about a nickel a page you can't beat it!

"Volumetric efficiency is a performance measure of the cylinder as an air pumping device and measures just the efficiency of the cylinder and valves. Volumetric efficiency of a cylinder is limited by the flow resistance in the intake manifold and by the residual combustion products in the cylinder. The shape and size of the whole inlet system, from atmosphere to inlet ports, have a strong effect on the pumping efficiency of the cylinder."

*Improvements in volumetric efficiency increase fuel consumption. The more air you feed the engine the more fuel it needs to maintain the same fuel/air ratio. The more air and fuel you feed an engine, the more power is produced. Increasing air pumping efficiency through any means, including flow porting, requires additional fuel. Along with the increased fuel and air, comes **higher horsepower.**"*

The mass (weight) of the air entering the cylinder is of more importance than the volume of air. *"Power is roughly proportional to the rate of air*

flow through the engine, 6 pounds per horsepower on the average." We all know cold air has more mass than hot air and therefore provides a more powerful charge to the cylinder for combustion. *"Engine horsepower increases approximately 1% for every 10°F drop in air temperature."*

The cooler the fuel air mixture we feed the cylinder the greater power we will get from the engine. *"Lycoming engines have intake and exhaust pipes close together. An increase in volumetric efficiency can be gained by heat shielding or insulating the intake pipes. Bell Helicopter tried insulating intake pipes many years ago. Several problems resulted. The insulation trapped moisture and caused corrosion and the increased weight of the intake tubes wore the intake boss. Chrome plating the intake pipes was found to act similar to a heat shield by reflecting the radiant energy and slightly lowering the temperature of the intake air."*

There is no free lunch, however. When the induction air is cooler the engine will produce more power but with decreased fuel economy. "Cold induction air adversely affects fuel vaporization and consequently the fuel mixture has to be richer to compensate."

Many people believe if we ram the induction air into the induction system we will increase volumetric efficiency. While that may be true, it seems not a great deal is gained.

Impact pressure charts show only about 1/2 psi pressure increases at 170 mph. This all is effected by the design of the carb air box. There are many different designs out there and many different results.

Hal Hunt's Long-EZ Air Box literature states that Dave Ronneberg's air box design required, *"8 iterations in design and tooling (all of which degraded performance) before he hit upon the right balance of flow factors increasing engine top end performance."*

If you decide to build your own air box there are some "rules of the road" presented in the SREM.

"The air box represents a diffuser whose purpose is to turn high velocity, low pressure air into low velocity and high pressure air as quickly as possible and with as little turbulence as possible. Tests at Lycoming have shown that for a cone shaped diffuser, the optimum design for volumetric efficiency is one where the total angle of expansion of the cone is 7 degrees. For a rectangular diffuser, the rectangular sections should have an 11 degree total angle of divergence."

Next SREM addresses pressure drop across the air filter. It shows pressure drop across a new Brackett air filter to cut the ram speed by about 70 mph. As the filter is used this - - - **Hey, go buy the book! It is low cost but valuable education!**

Bostic Long-EZ

This Long-EZ appears to be mating with an other. It seems to explain why California builders put out EZs at such an incredible rate. They have simply found it is faster to grow them than build them.

This beautiful 961 pound example, N68MB, belongs to Miles Bostic. It cruises at 165 kts with an O-320 Lycoming and B&T prop.

