lack of poppet valves getting in the way of the intake and exhaust ports.

The idea of an aircraft engine turning 6000 rpm takes some getting used to. However, only the eccentric shaft turns at this speed; everything else turns at 2000 rpm. At these rotational speeds, the gas pressure and centrifugal force are balanced, and this is actually easier on the engine.

Valveless Marriage

The Achilles heel of the aircraft piston engine is the exhaust poppet valve. Typically it runs at 1200° to 1400° F. Aircraft engine exhaust valves are constantly on the verge of failure. These valves are made from the finest materials available and, in the case of Lycoming, are also sodium cooled internally. This brings a high price, and a Lycoming exhaust valve costs more than $250. The rotary intake and exhaust valving system, on the other hand, has no moving parts of its own. It's like a two-stroke engine: The rotor itself opens and closes the ports.

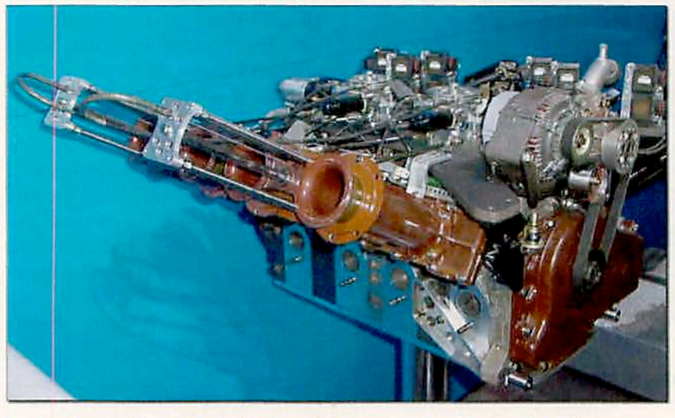
Unlike any piston engine, the Wankel rotary is in complete and precise balance, just like a turbine engine or electric motor. Despite commonly held beliefs, it is impossible to precisely balance any piston engine, as there are always reciprocating parts that oscillate back and forth.

You might surmise from this that the Wankel rotary is able to revolve at unlimited rpm because there are no reciprocating parts, but you would be wrong. The Wankel rotary also has its rpm limits when centrifugal force rears its ugly head. The weight of the rotor spinning around the center of the e-shaft creates a terrific centrifugal force on the rotor bearing at speeds of 10,000 rpm or more. Turbine engines are also subject to the same centrifugal force limits on compressor and turbine blades.

Nevertheless, the Wankel rotary can rotate far faster than an equivalent horsepower piston engine, adding to its intrinsic power-to-weight ratio and small size advantages. Also this centrif-



Still in love with your poppet valve now? They break, and when they do, mayhem ensues.



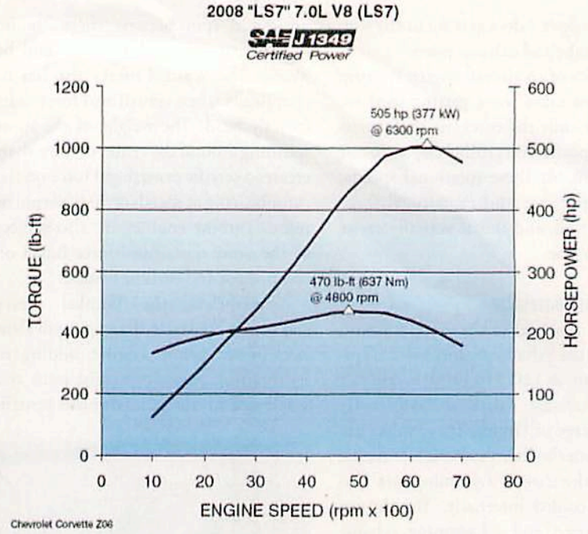
Note the long and variable intake tubes on this racing rotary. An aircraft application wouldn't need this complication if it were properly designed to run in a narrow rev band.



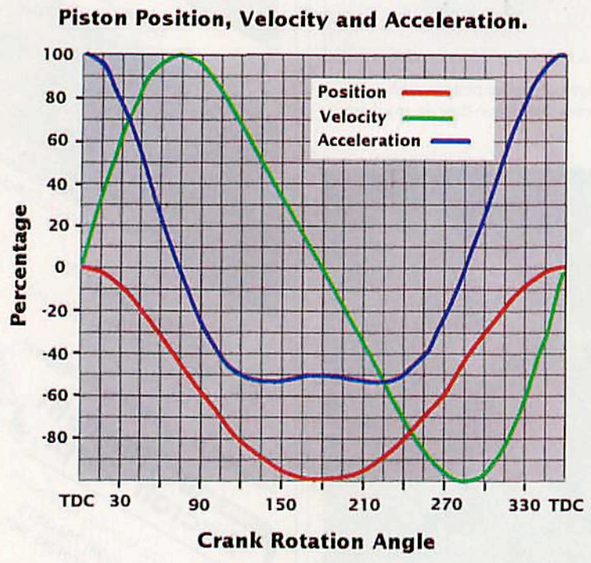
ugal load due to the weight of the rotor never changes direction on the e-shaft at high speeds, so a cracked or broken e-shaft on a Wankel rotary is unheard of. This is why the Wankel rotary engine manufacturer can afford to make the rotor out of low cost and extremely durable but heavy cast iron.

Further development of the rotor is possible. Better casting techniques are used by Mazda to reduce the weight of the rotor in the RX-8 engine, which is rated at 250 hp at 8500 rpm. Not bad for a 200-pound engine that's 12 inches wide, 14 inches high and 17 inches long. This is an exceptional power-to-weight ratio and power-to-size ratio that exceeds any piston aircraft engine despite its use of low-cost cast iron rotors and end housings. What's more, Mazda has now developed this engine to have better fuel burn efficiency than its four-cylinder piston engines.

Rotors made from other material with a better strength-to-weight ratio than cast iron may eventually be used. A more costly aluminum rotor is possible with steel inserts in the high-wear areas of the apex-seal slots. A titanium rotor is also a possibility, as is a sheet-steel rotor, perhaps one that is laser-welded together.



While the 7-liter Chevy V-8's horsepower curve is impressive, this is a 220-hp engine unless you want to run a gear-reduction drive.



Piston velocity and forces change dramatically in the course of a conventional piston-engine's work. This is one revolution of the crank.

Curtiss Wright failed to take advantage of this weight reduction, not realizing that some day the rpm of the rotary would be limited to 11,000 by the weight of the rotor. Modern material, like beryllium aluminum alloy, would make aluminum rotors even better. Be/Al alloy is three-quarters the weight of just aluminum. My guess is the rpm of a two Be/Al-rotor rotary engine (weighing 180 pounds) would double to around 22,000 rpm and the horsepower would also double to about 1600 for an all-out, p-port turbocharged racing version. That would be a power-to-weight ratio much better than a pure turbine, with about half the fuel burn and one-tenth the cost of a turbine.

When this happens it will be an earth-shaking event. A 300-hp car engine could shrink to less than the size of a football. The empty weight of the car would also decrease, as it is largely a function of the engine weight. The light-aircraft industry would never be the same if these super power-to-weight-ratio rotary engines were used in VTOL designs. ÷

For more information, visit www.rotaryeng.net. A direct link can be found at www.kitplanes.com.