# WANKEL ENGINE ADVANTAGES AND DISADVANTAGES

## Advantages

Wankel engines have several major advantages over reciprocating piston designs, in addition to having higher output for similar displacement and physical size. Wankel engines are considerably simpler and contain far fewer moving parts. For instance, because valving is accomplished by simple ports cut into the walls of the rotor housing, they have no valves or complex valve trains; in addition, since the rotor is geared directly to the output shaft, there is no need for connecting rods, a conventional crankshaft, crankshaft balance weights, etc. The elimination of these parts not only makes a Wankel engine much lighter (typically half that of a conventional engine with equivalent power), but it also completely eliminates the reciprocating mass of a piston engine with its internal strain and inherent vibration due to repetitious acceleration and deceleration, producing not only a smoother flow of power but also the ability to produce more power by running at higher rpm.

In addition to the enhanced reliability due to the elimination of this reciprocating strain on internal parts, the construction of the engine, with an iron rotor within a housing made of aluminum which has greater thermal expansion, ensures that even when grossly overheated the Wankel engine will not seize, as an overheated piston engine is likely to do; this is a substantial safety benefit in aircraft use.

The simplicity of design and smaller size of the Wankel engine also allow for a savings in construction costs, compared to piston engines of comparable power output.

As another advantage, the shape of the Wankel combustion chamber and the turbulence induced by the moving rotor prevent localized hot spots from forming, thereby allowing the use of fuel of very low octane number without preignition or detonation, a particular advantage for Hydrogen cars. This feature also led to a great deal of interest in the Soviet Union, where high octane gasoline was rare.

# Disadvantages

The design of the Wankel engine requires numerous sliding seals and a housing that is typically built as a sandwich of cast iron and aluminum pieces that expand and contract by different degrees when exposed to heating and cooling cycles in use. These elements led to a very high incidence of loss of sealing, both between the rotor and the housing and also between the various pieces making up the housing.

Further engineering work by Mazda brought these problems under control, but the company was then confronted with a sudden global concern over both hydrocarbon emission and a rise in the cost of gasoline, the two most serious drawbacks of the Wankel engine.

Just as the shape of the Wankel combustion chamber prevents resignation; it also leads to incomplete combustion of the air-fuel charge, with the remaining unburned hydrocarbons released into the exhaust. At first, while manufacturers of piston-engine cars were turning to expensive catalytic converters to completely oxidize the unburned hydrocarbons, Mazda was able to avoid this cost by paradoxically enriching the air/fuel mixture enough to produce an exhaust stream which was rich enough in hydrocarbons to actually support complete combustion in a 'thermal reactor' (just an enlarged open chamber in the exhaust manifold) without the need for a catalytic converter, thereby producing a clean exhaust at the cost of some extra fuel consumption.

A related cause for unexpectedly poor fuel economy involves an inherent weakness of the Wankel rotor design when used with conventional fuels. Some studies have indicated that at high speeds, the rate at which the volume of the combustion chamber increases in the moments after ignition actually outpaces the expansion of the burning fuel.

The result is that, at high speeds, less useful energy is extracted from the same volume of fuel, as the exhaust has to expend time and energy "catching up" to the rotor before it can accomplish any work.

A typical production two-rotor Wankel engine does not utilize a bearing between the two rotors, allowing a one-piece eccentric shaft to be used. This tradeoff allows for cheaper manufacture at the expense of peak engine rpm, due to eccentric shaft flex. In engines having more than two rotors, or two rotor race engines intended for high-rpm use, a multi-piece eccentric shaft must be used, allowing additional bearings between rotors. While this approach does increase the complexity of the eccentric shaft design, it has been used successfully in some automobile manufacturer's production of three-rotor engine, as well as many low volume production race engines.

Many disadvantages of the Wankel engine have been solved by another manufacturer. The exhaust ports, which in earlier rotaries were located in the rotor housings, were moved to the sides of the combustion chamber. This approach allowed the earlier manufacturer to eliminate overlap between intake and exhaust port openings, while simultaneously increasing exhaust port area. Fuel consumption is now within normal limits of some State emissions requirements.

Source: http://engineering.wikia.com/wiki/Wankel_engine