The type of two stroke oil you use in your ultralight aircraft engine DOES make a difference!

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www.ultralightnews.com/features/oiltest.htm

When Pennzoil-Quaker State Company decided to upgrade its popular Pennzoil, Outboard and Multi-Purpose Two-Cycle Oil formulation, they felt it was necessary to look at all niche markets the product was used in to be sure the changes would be beneficial for the end user.

Because of the popularity of Pennzoil products in the sport aviation market, it was imperative that the product upgrade be tested in two- cycle sport aviation engines.

So, they teamed up with Rotax engine experts, Lockwood Aviation in Sebring, Florida, to design a test that would assure the new product would continue to protect these engines.

Four different oils were chosen for the test. The oils tested were:
1) Pennzoil" Two-Cycle Air-Cooled Engine Oil;
2) Pennzoil' Premium Out- board and Multi-purpose Two Cycle Oil;
3) A conventional petroleum two-cycle oil; and
4) A two-cycle synthetic oil.

Each oil was color coded for identification and assigned to a particular engine (see Table 1 end). To ensure a "blind test," the technicians operating the test stand were unaware of which product was used in each engine.

Pennzoil' Two-Cycle Air-Cooled Engine Oil is a low ash, two-cycle oil meeting API TC requirements. API TC is the American Petroleum Institute standard for Two-Cycle air cooled engines. Detergent additives incorporated into this product help protect against high temperature piston ring sticking. This product has gained wide popularity over the last ten years in sport aviation two-cycle engines and is used in both air- and water-cooled two-cycle sport aviation engines with great success.

Pennzoil' Premium Outboard and Multi-purpose Two-Cycle Oil is a National Marine Manufacturers Association

(NNOAA) TC-W3* certified two-cycle oil (see sidebar - "How Two-Cycle Oils Work") that also meets API TC. This product incorporates ashless dispersant chemistry. This product is also used in both air and water-cooled two-cycle sport aviation engines and is now gaining popularity in Rotax 618 engine models, which are equipped with Rotax Adjustable Variable Exhaust (RAVE) valves.

In this test, the Pennzoil oils were compared to typical petroleum-based and synthetic low-ash two-stroke oils.

It is worthy to note that many pilots using synthetic oil may mix at a higher (leaner) fuel/oil ratio than the engine manufacturer may specify. Synthetic oils tend to work well against deposit formation at these higher ratios, however engine manufacturers generally state that the higher (leaner) oil ratio may not provide enough residual protection from corrosion

during extended storage conditions. Therefore, all oils run in this test were run at the manufacturer's recommended fuel/oil ratio of 50:1.

Four new Rotax 503 two-cylinder fan- cooled engines were purchased and utilized since it is one of the most popular engines in this market. Each engine used a premix oiling system instead of the oil injection option. The engines were fueled with premium unleaded gasoline that was mixed with the test oils at the engine manufacturer's recommended ratio of 50: 1. The engines were set up identically to achieve 6300 rpm at full throttle. After a one hour prescribed break-in cycle, the engines were run under strenuous one- hour cycles simulating a typical flight routine - i.e., full power takeoff, cruise, descent, and idle conditions (See Table 2 at end).

The Test

After 280 grueling hours, the engines were disassembled, rated for deposit accumulation, piston ring sticking and measured for wear. Independent certified engine raters used Coordinating Research Council (CRC) industry standards to evaluate each engine in the areas of piston, ring and exhaust port deposit accumulation, piston ring sticking, piston scuffing, and ring and cylinder wear. Keeping these critical areas clean and free of deposits and wear helps ensure longer engine life.

The rating standards are based on a scale from 1 to 10. The higher the rating, the better the evaluation or performance of the lubricant in the specific area rated.

The piston rings were rated as to the state of sticking and the degree of circumference around the piston that they were stuck. Deposits were evaluated by volume and appearance, ranging from 10 (clean- absence of deposits) to 0.0 (maximum deposits - those deposits which take up ALL of the available space between moving parts and display rubbed or polished characteristics).

Resistance against cylinder head, piston and ring land deposits is very important in engines. Piston rings help remove heat from the piston and transfer it to the cooler cylinder walls, as well as provide sealing between the combustion chamber and crankcase. If deposits become too heavy and piston rings become stuck in their grooves, then premature wear and damage will occur due to the ring's inability to properly seal the combustion chamber and transfer heat. Excessive cylinder head de- posits increase the octane requirement of the engine and may also cause pre-ignition and detonation, leading to engine damage.

Graph 1 shows that Pennzoil' Premium Outboard & Multi-purpose Two-Cycle Oil (identified as the red oil) performed exceptionally well, particularly in the areas of combustion chamber cleanliness and piston crown deposits. Pennzoil" Two-Cycle Air-Cooled Engine Oil (blue oil) performed exceptionally well in the areas of resistance to piston ring sticking and piston ring land deposits.

Graph 2 evaluates piston skirt deposits on both the thrust and anti-thrust sides of the piston. The thrust side of the piston is the side that tends to bear most heavily against the cylinder wall during the power stroke. The anti-thrust side of the piston tends to bear most heavily against the cylinder wall during the compression stroke. When the transition occurs from the compression stroke to the power stroke, the connecting rod angle will change. This change causes a sudden shift of the side thrust on the piston. If there is any appreciable piston wear or deposits, contact of the piston skirt with the cylinder wall can occur.

Exhaust Port Deposits

The photographs below show the deposits inside of the exhaust port. Deposit buildup in the exhaust port can affect the scavenging proper- ties of the two-cycle engine. Also, in Rotax engines that use RAVE valves, resistance of an oil to deposit buildup is critical for proper operation of the variable exhaust valves.

The blue oil (Pennzoil* 2-Cycle Air- Cooled Engine Oil) performed extremely well as did the red oil (Pennzoil' Premium Outboard And Multi-Purpose Two-Cycle Oil). The purple oil (conventional mineral) and the yellow oil (synthetic) formed significantly more deposits in the exhaust port area. However, "real world" tests using synthetic oils at typical leaner mixtures show far less deposits.

If we had any doubts, these tests confirmed that oil obviously does make a difference in the performance of a sport aviation engine! Pennzoil was proud to confirm that its line of two-cycle oils continue to provide the highest degree of performance in this demanding application.

Table 1

Oil Code	Product	Description
Blue	Pennzoil 2 cycle air cooled engine oil	Low ash
Red	Pennzoil Outboard and multipurpose 2 cycle oil	Ashless TC-W3/API TC
Purple	Conventional petroleum 2 cycle oil	Low ash API TC
Yellow	2 cycle synthetic oil	Low ash API TC

Table 2
Operating conditions per hour of
operation - 280 hours total

Idle
5 minutes

Take Off - Full Power
4 minutes

Cruise - 5800 rpm
47 minutes

Descent and landing - 4000 rpm
4 minutes