

# Piston engine propulsion



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Testing powerplants for the future



Keys to innovation: advanced materials and alternative fuels

As the propulsion industry looks to the future, the barriers remain challenging, the drivers more critical, but the innovations more promising. The struggle between power and weight, future availability and cost of traditional leaded and alternative fuels, and “digitization” of engine controls and diagnostics will force an evolution in powerplant design. At **Lycoming Engines**, a **Textron** company, the new-generation engine for general aviation aircraft is a race to combine proven technology enhancements with innovative designs for the industry’s most reliable performer, the reciprocating engine.

Rotary and fixed wing customers demand more power and simplicity without more weight and cost. Acquisition and operating costs are fundamental to remaining competitive, but so are performance, reliability, and quality. Innovation comes from a planned approach to meet customer requirements, but also from experimenting and testing new technologies for existing products. Incremental advancements are a hallmark of an aviation industry in which engine reliability is about far more than convenience. For example, improved valve train systems enhance the customer’s experience through decreased warranty issues, while the increased efficiency of newer cylinder designs reduces operating costs.

Yet the time is approaching when these incremental improvements will provide the platform for the next revolutionary breakthrough in powerplant development. Advancements in digital and glass cockpits will work their way forward and perhaps rearward of the firewall into the engine and airframe.

Imagine jumping into an airplane, powering up the batteries, and having a large digital screen display a complete diagnostic and health assessment of your engine and perhaps even your airframe. No more trying to look into the corners of cowlings or checking engine oil dipsticks or wire connections. “Smart” sensors detect electronic health, usage, and flight dynamics live on multifunction screens for quick interpretation by pilots and mechanics. Improved digiti-

zation of powerplant performance and reliability in cockpits will make the flying and fixing of airplanes easier and more affordable.

Elsewhere in the general aviation industry diesel-engine designs are attracting an increasing amount of attention, especially in Europe due to a substantial cost differential between gasoline and diesel fuel. However, turbochargers and high-pressure pumps often featured on diesel engines add complexity and increase maintenance costs, mitigating long-term savings. A lightweight, less complex system that would provide the efficiency and advantages of current diesel configurations could be the next step in a new family of diesels.

The future is ripe for developments in alternative fuels. The current general aviation fuel, 100 LL, is the last remaining leaded product sold in the U.S. It is likely that the lead will be mandated out within five to 10 years. Several major oil companies have developed unleaded fuel formulations that could serve as replacements. A final product has not been defined and it is unclear what changes might be necessary to accommodate an unleaded aviation gasoline. Nonetheless, Lycoming is committed to find a way with alternate fuels to bring piston engines to more markets across the globe.

Advanced materials also hold great potential for significant engine innovation. Pushing the envelope to a 2000-h overhaul is a function of materials and design. For design improvements, material enhancements are the ultimate achievement and a combination that cannot be ignored if we seek to break existing paradigms. Composites, new alloys, and new designs are required for significant operational gains. Visionary leadership will be required to incorporate these cutting-edge materials in a cost-sensitive environment.

As we conduct our own research and development, Lycoming will lead the way in many of these innovations. We will continue to monitor, learn, and partner with our engineering colleagues across aviation and other industries to help power the next century of flight. **AE**