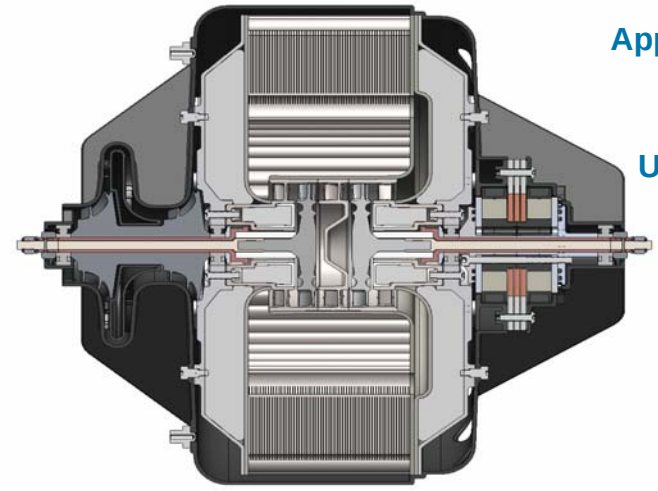
# NAVAL RESEARCH LABORATORY

## TECHNOLOGY TRANSFER OFFICE

# Small, High Efficiency, Recuperated Ceramic Turboshaft Engine



**Approx. 4hp, 9 lbs., 0.6 lb/hp-hr SFC**

**Up to 3kW generator output**

The Naval Research Laboratory (NRL) is developing a small recuperated ceramic turboshaft engine with the fuel efficiency of a diesel. The engine will produce about four horsepower engine and weigh roughly nine pounds complete, including an integral three kilowatt generator and power electronics. It will be about twice as efficient as a typical gasoline engine, and will achieve ten times the life and reliability while producing less noise and no vibration.

This will be the first reliable, efficient miniature engine that complies with DoD 4140.43, which requires all future military engines to operable on "heavy fuel" (JP5/JP8/Jet-A). The fuel-flexible design can also be operated on biodiesel, gasoline, ethanol, and other liquid hydrocarbons without compromising efficiency, performance, reliability, or emissions.

This novel design uses low cost ceramics for the turbomachinery and heat exchanger components. The recuperated design enhances efficiency, and allows operation with a very lean fuel-air mixture that reduces emissions. Scalable in the 1-10 KW range, this engine is suitable for any small turbogenerator application, including small unmanned air vehicle (UAV) propulsion, turbine-electric hybrid drive, and portable field generators

### References


"Design Overview of a Three-Kilowatt Recuperated Ceramic Turboshaft Engine," *Journal of Engineering for Gas Turbines and Power,* 132(9) p. 092301-1

"Design Strategies to Maximize Ceramic Turbine Life and Reliability," Proceedings of ASME Turbo Expo 2011: GT2011-46784, June 6-10, 2011, Vancouver, B.C. Canada


**Licenses are available to companies with commercial interest. NRL is also interested in developmental collaboration.**

technology

### Advantages/Features

Higher efficiency than existing small gasoline and turboprop engines, for similar weight & cost

Much higher reliability than existing piston engines

Long life (1000 hours)

Flexible fuel operation

Low noise and vibration

No cooling needed

Much better high-altitude performance than any other UAV propulsion system

### Applications

Small, long endurance UAV and hybrid turbo-electric applications

Small, lightweight portable turbine generators

Propane/natural gas generators for combined heat & power (CHP) or emergency backup power


**For more information contact:**

Rita Manak, Ph.D. Head, Technology Transfer Office

(202) 767-3083

rita.manak@nrl.navy.mil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