SwRI's hybrid ceramic-sand core casting technology wins R&D 100 award

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SwRI's Hybrid Ceramic-Sand Core Casting Technology, developed with Grainger and Worrall, Ltd. of the United Kingdom, combines aerospace ceramic and automotive sand core casting processes for precision casting of automotive cast iron/steel components. The technology won a 2012 R&D 100 Award. Credit: Courtesy of Southwest Research

A novel casting technology that combines aerospace ceramic and automotive sand core processes to allow for precision casting of extremely small passages in automotive cast iron/steel components has received a 2012 R&D 100 Award.

R&D Magazine selected Southwest Research Institute's Hybrid Ceramic-Sand Core Casting Technology as one of the 100 most significant technological achievements of the past year.

Developed in a joint effort with Grainger and Worrall Ltd. of the United Kingdom during a three-year, multi-phase research and development program, the technology was designed to enable the production of heavy-duty diesel engines with a higher peak cylinder pressure capability than current state-of-the-art engines. The new architecture enables future exhaust emissions-reducing and high-efficiency combustion technologies without sacrificing engine performance, size or weight.

Conventional iron cylinder heads are manufactured using a sand-casting process because the internal fluid passages are geometrically complex and sand-casting is inexpensive. The geometries developed for higher peak cylinder pressure operation and high cooling velocity and efficiency require internal passages too small to reliably manufacture with conventional sand casting.

"We needed to come up with a new way to create these very small passages. Ceramic cores, such as those used in the aerospace industry to cast cooling passages in turbine blades, do not break down in the presence of molten metal, even at very small sizes," said Marc Megel, assistant director of the Design Development Department in SwRI's Engine, Emissions and Vehicle Research Division and a principal developer of the technology with Keith Denholm of Grainger and Worrall. "Ceramic core casting is unusual in the automotive industry because it is expensive. In the new hybrid ceramic-sand core product, the ceramic section is used where coolant passages between the engine's gas exchange port walls and fuel injector or spark plug are formed. The Hybrid Ceramic-Sand Core Casting Technology will enable casting of narrow, complex passageways in a way not previously achievable with conventional iron casting techniques."

The award-winning hybrid design allows engine designers and manufacturers to use conventional sand core casting for the majority of the manufacturing process, but employ a ceramic casting insert to

achieve the small passages necessary for high cylinder pressures.

This technology could prove beneficial to engine manufacturers because high cylinder pressure is critical to high power density as well as nearly all of the ultra-low emission, high efficiency and low CO2 emission diesel, natural gas and gasoline combustion technologies required to meet heavy-duty engine emissions and Corporate Average Fuel Economy (CAFE) requirements around the world.

SwRI has won 37 R&D 100 Awards since 1971. This year's award will be presented Nov.1, 2012, in Orlando, Fla.

Provided by Southwest Research Institute