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Thanks to NASA technology, patented high-strength aluminum alloy makes outboard motors quieter and cleaner

Some boating excursions are now quieter, cleaner and their boat engines enjoy improved fuel mileage and increased durability — all thanks to a NASA invention. The Boats and Outboard Engines Division at Bombardier Recreational Products of Sturtevant, Wis., uses NASA's patented High-Strength Aluminum Alloy for pistons in its Evinrude® E-TEC™ outboard engine line. The technology was developed at NASA's Marshall Center.

A NASA invention that can make outboard engines quieter, cleaner, gives better fuel mileage and increased durability has been adapted for commercial use by a major international corporation.

The Boats and Outboard Engines Division at Bombardier Recreational Products (BRP) of Sturtevant, Wis. — has begun using NASA's patented High-Strength Aluminum Alloy for pistons in its new Evinrude® E-TEC™ outboard engine line.

The alloy, developed at NASA's Marshall Space Flight Center in Huntsville, Ala., is used in a new piston design that reduces the so-called "slapping" sound when pistons slide up and down in the engine's cylinder. The alloy can greatly improve piston durability because it is two and half times stronger than conventional cast aluminum pistons at high temperature and can be produced with a material cost of less than $1 per pound. It exhibits dramatic strength at temperatures as high as 500 to 700 degrees Fahrenheit.

Engineers working on BRP's Evinrude E-TEC engine also saw environmental advantages from the alloy; it would help the new engines comply with California Air Resources Board emissions standards—some of the most stringent in the United States.

It was simply a matter of searching the information highway. BRP met with NASA in April 2002, after seeing an ad on the Internet for a high-strength aluminum alloy. The prototypes were complete by July, and the final product was ready in February 2003. "We worked very closely with NASA to refine the details," said Bob Young, vice president of

product development for BRP. "The demands of the outboard engine are more significant than any other engine NASA had encountered, even those in the auto industry. The team from NASA was on the fast-track, learned all the intricacies and delivered an outstanding product."

Development of the NASA High-Strength Aluminum Alloy began seven years ago when a major automobile manufacturer approached NASA seeking a solution to reduce the costs of aluminum engine pistons, as well as to lower engine emissions. NASA was also interested in developing an alloy with higher strength and wear-resistance at elevated temperatures, for aerospace applications. So, in this case "necessity as the mother of invention" was a motivator from two directions and the Partnership for Next Generation Vehicles was born.

Jonathan Lee, a structural materials engineer in the Marshall Center 's Materials, Processes and Manufacturing Department, and co-inventor PoShou Chen, a scientist with Morgan Research Corp., in Huntsville, tackled the project. The result was discovery of what would become the basis for a new aluminum alloy, MSFC-398 or NASA High-Strength Aluminum Alloy. The NASA Technology Transfer Partnership introduced it during the 2001 National Manufacturing Week show in Chicago.

Evinrude's outboard engine piston is the result of more than a year of intensive work between the company's piston casting vendor and NASA's inventors to learn about and refine the process of casting the new alloy.

"Having a proper mixture of the alloy's composition with the correct heat treatment process are two crucial steps to create this alloy for high temperature applications," said Lee. "The team at Bombardier Recreational Products worked hard with the casting vendor and NASA inventors to perfect the casting of pistons, learn and repeat the process, and bring its product to market. Chen and I are honored to see something we invented being used in a commercial product in a very rapid pace. We still have to pinch ourselves occasionally to realize that BRP's commercialization effort for this alloy has become a reality. It's happened so quickly."

"The usual cycle for developing this type of technology, from the research stage to the development phase, and finally into a commercial product phase may take several years and more than a $1 million investment," Lee said. In this case, it has occurred in less than four years at a fraction of the cost.

The Evinrude E-TEC outboard engine line uses pistons made with the NASA High-Strength Alloy in its mid-power range of recreational boating in its current 40-90 horsepower engine offering.

BRP projects it will manufacture several hundred thousand pistons for outboard motors using the NASA High-Strength Aluminum Alloy over the next several years.

"The weak link in any two-cycle engine has always been the piston, due to the high operating temperatures. The strength of this piston is stronger than anything we ever used or ever seen," said Young. "It's now at least double the strength of the previous alloys and within our rigorous testing schedule, we have yet to see an alloy-related piston failure."

The license agreement between BRP and NASA was signed in July 2003. The Research Triangle Institute in Raleigh, N.C., a contractor to NASA, working with Marshall 's Technology Transfer Department, played a key role in bringing the parties together. The Institute offers research and development in areas ranging from health and environmental protection, education and training, economic and social development and advanced technology.

"This is another outstanding example of NASA's Innovative Technology Transfer Partnerships program at work with a variety of industries to move the benefits of aerospace technology to the public and private sector while supporting NASA's goal of improving life on Earth," said Sammy Nabors, commercial technology lead in the Marshall Center 's Technology Transfer Department. Nabors predicts many other uses for the alloy in the future, as well, as additional commercial licensing agreements.

For more information on the Marshall Center 's Technology Transfer program, visit:

http://www.nasasolutions.com

For more information about Bombardier Recreational Products visit:

http://www.recreation.bombardier.com

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