



## NASA Alloy Helps BRP Revive the Two-Stroke Engine



Above: NASA photo. Top and right: Photos courtesy of BRP

An alloy originally developed to produce cleaner burning automotive pistons has helped revive the two-stroke engine. NASA's Marshall Space Flight Center licensed its high strength, heat-tolerant MSFC 398 aluminum alloy to BRP (Bombardier Recreational Products) in 2003 for marine applications, and the company uses it in its two-stroke Evinrude™ E-TEC™ outboard engine. The alloy offers three times the tensile strength of comparable materials at high temperatures, allowing BRP to produce a quieter, more durable, lower cost, more fuel efficient, and cleaner burning piston.

### Benefits of Technology Transfer

- **Profitability:** NASA's investment in the alloy's development has paid off many times over in royalty earnings, benefitting taxpayers.
- **New applications:** Research is ongoing in use of the alloy for net shape casting of some propulsion systems in rocket-powered engines.
- **Cost savings:** The alloy's durability and heat resistance places it in a class with forged pistons that typically cost twice as much to manufacture.
- **Product sophistication:** BRP used the alloy to create the first outboard motor that does not require oil changes, winterization, spring tune-ups, or scheduled maintenance for 3 years or 300 hours of normal recreational use.
- **Environmental advantages:** The alloy has re-invigorated two-stroke engine design, allowing BRP to create an eco-friendly version that showcases the engine's power and simplicity.
- **Public acclaim:** The Society of Automotive Engineering recognized BRP and NASA with its Environmental Excellence in Transportation award in 2004. The innovation also earned the National Federal Laboratory Consortium's Excellence in Technology Transfer award in 2006 and the 2005 NASA's Marshall Space Flight Center's Invention of the Year Award.

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## On the Record

“We worked hard with BRP and the casting vendor to perfect the piston casting process, make it repeatable, and bring it to the market. We still have to pinch ourselves occasionally to realize that BRP’s commercialization effort for this alloy has become a reality..” — *Jonatban Lee, Structural Materials Engineer, NASA’s Marshall Space Flight Center*

“We wanted to bring a paradigm shift to how people looked at two-stroke engines. We wanted to re-educate consumers about these engines.”— *Serge Thibault, Purchasing Manager, BRP*

“The team from NASA was on the fast track, learned all the intricacies, and delivered an outstanding product.”  
— *Dennis Morin, Vice President of Engineering, BRP*

## About BRP

Bombardier Recreational Products (BRP), a privately-held company, is a world leader in the design, development, manufacturing, distribution, and marketing of motorized recreational vehicles. Its portfolio of brands and products includes: Ski-Doo™ and Lynx™ snowmobiles, Sea-Doo™ watercraft and sport boats, Evinrude and Johnson™ outboard engines, E-TEC direct injection technologies, Can-Am™ all-terrain vehicles and roadsters, as well as Rotax™ engines and karts. BRP has manufacturing facilities on three continents and distributes its products in more than 80 countries.

The company’s license from NASA was issued to its Evinrude Outboard Engines Division, located in Sturtevant, Wisconsin.

## Technology Origins

The alloy originally was developed under the Partnership for Next Generation Vehicles (PNGV), a 1990s era government/corporation program. The work was begun in conjunction with a large U.S. automotive manufacturer and NASA’s Marshall Space Flight Center in Huntsville, Alabama. NASA’s scientists often are tasked with creating alloys that can work at extremely high or low temperatures. NASA’s onsite foundry contributed to this aspect of the research. When the PNGV funding for the program ran out, NASA continued to support the in-house development work with the help of the Innovative Partnerships Program (IPP) Office.

## Finding a New Use

At about the same time that the IPP office began looking for other licensees, BRP was trying to revive the two-stroke engine that the company had inherited when it purchased the Outboard Motor Corporation in 2001. The challenge was to produce a two-stroke engine that met the then California Environmental Protection Agency (and now U.S. EPA) pollution standards. BRP’s Evinrude E-TEC engine project needed a heat-resistant piston that was not expensive to produce.

## The Transfer Process

BRP’s engineers were skeptical about finding a solution until they read about the NASA technology. BRP and NASA collaborated extensively on testing, enabling BRP to see the true value and viability of the technology prior to licensing. The Evinrude E-TEC engine with NASA’s patented alloy was brought to market in 2003. Since that time, the company has produced more than 500,000 pistons using the alloy.

## Looking Ahead

BRP plans to continue using the piston for its Evinrude E-TEC engine, and NASA intends to license the alloy for additional uses. The agency has one agreement executed with PAC Materials, LLC of Huntsville, Alabama to place its alloy in four-stroke air-cooled engines that power motor scooters. NASA also hopes to find additional licensees that are interested in the alloy for other two-stroke and air-cooled four-stroke uses.

## For More Information

If you would like more information about this technology (MFS-31294 and MFS-31828-1) or about other technologies available for license, please contact:

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