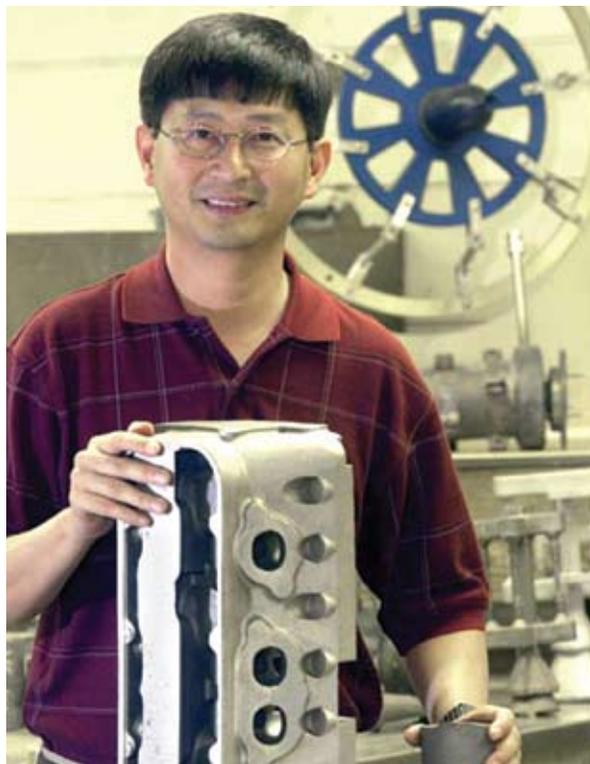


# Alloy-Enhanced Fans Maintain Fresh Air in Tunnels

## NASA Technology

The Partnership for Next Generation Vehicles (PNGV) is not a NASA initiative to develop powerful new rockets and spacecraft, even though it may sound like one. PNGV was a partnership established by the Clinton administration between the Federal government and the U.S. Council for Automotive Research to develop technologies that improve fuel efficiency and reduce emissions from cars and trucks. More than 20 Federal laboratories from the Departments of Commerce, Energy, Transportation, and Defense; the Environmental Protection Agency; the National Science Foundation; and



Jonathan Lee is one of the inventors of MSFC-398, a high-strength aluminum alloy.

NASA were all involved in PNGV, in addition to more than 350 automotive suppliers, universities, and small businesses.

In support of this tremendous effort, Jonathan Lee, a materials engineer at Marshall Space Flight Center, worked with a major automobile manufacturer in 1995 to develop a strong aluminum alloy for high temperature applications. The aim was to use the alloy for manufacturing parts for an internal combustion engine, as well as for NASA's propulsion applications. When funding from PNGV ended, Marshall continued to support the alloy's development with help from NASA's Innovative Partnerships Program (now the Office of the Chief Technologist). Together with PoShou Chen, a scientist with Morgan Research Corporation, Lee invented a high-strength aluminum alloy called MSFC-398 that, when tested, was three to four times stronger than conventional aluminum alloys at high temperatures.

By the late 1990s, Lee says, NASA's scientists had successfully developed and patented this technology, which has great potential applications not for just automotive, but also for aerospace, marine, and commercial applications.

## Partnership

After Marshall made the technology available for licensing in 2001, Bombardier Recreational Products Inc. licensed the alloy to cast parts for outboard marine engines (*Spinoff* 2004 and 2008). By 2005, the alloy had won Marshall's "Invention of the Year" award, and a year later, the National Federal Laboratory Consortium recognized the alloy with an "Excellence in Technology Transfer" award.

The most recent success of this technology, however, was in 2010. Twin City Fan Companies Ltd. in Minneapolis, Minnesota, licensed the alloy to make impellers (blades and hubs) for safety ventilation fans in rail and road tunnels. "We wanted a high temperature alloy that would have the strength and properties needed for safety fan impellers at very high temperatures. We found the

NASA alloy, and upon further investigation, we knew that it was the right path for us," says Dan Hartlein, executive vice president at Twin City Fan Companies Ltd.

The division of Twin City Fan Companies Ltd. that is marketing the first fans made with the NASA aluminum alloy is Clarage, which is based in Pulaski, Tennessee. However, Michael Barry, president and COO of Twin City Fan Companies Ltd., finds there are broad application possibilities for all of the company's global brands, including Twin City Fan and Blower and Aerovent. "Twin City Fan is a global American company. It gives us great pride to be able to utilize the special technology created by a technology leader like NASA," says Barry.

## Benefits

Twin City Fan licensed the NASA alloy with a specific application in mind: tunnel safety fans for the European market, where fans must be able to operate in 752 °F for two hours in order to be certified for use. The reason for the high temperature requirement is the fan must be able to operate successfully when there is a fire in a road or rail tunnel. When spinning in one direction, the fan provides clean air to the people inside; when spinning the other direction, it removes the smoke and gasses from the fire.

Before the NASA alloy, there were two ways to meet these temperature requirements, says Hartlein. One method was to use existing aluminum to make a bigger fan that spins more slowly. The drawback to this approach was that a bigger fan requires more space. "If we use the NASA alloy, the fan is smaller relative to the competition, and the tunnel can be smaller as well. Even if you can take a foot out of the construction of a new tunnel, there are massive potential savings," says Hartlein. "In addition, the properties of this material allow us to run even hotter, leading to safety smoke exhaust at temperatures beyond what tunnel designers anticipated."

The other solution, Hartlein says, was to make the fan blades out of steel, but this required a specialized motor to turn and reverse the fan. "Steel weighs roughly three

times more than aluminum. If it is three times as heavy on the rotating parts, the bearings are heavier, the shaft is heavier, and the motor is heavier—a lot comes with it. The motivation and opportunity for us to use aluminum, where in the past we would have had to use steel, is quite attractive to us. We can lower the cost of the overall product and provide better performance through the use of this alloy. We are just beginning to find applications that will provide value to our industry using this alloy.”

While Twin City Fan Company has purchased the tools to produce 3 sizes of the fan, it plans to manufacture 12 different sizes in total. In 2011, Clarage sold the first of its fans made with the NASA alloy to a company testing the fans to certify them to European standards. Hartlein says he has met with a major engineering company in the United States, and the representatives are very interested in the capabilities of new fans. “We are bidding many projects now and should be shipping our first projects by the end of the year,” he says.

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—Jonathan Lee, Marshall Space Flight Center

According to Hartlein, the tunnel industry is busy and is projected to continue growing. “If you look around major metropolitan areas, there’s no place to put traffic, so it goes underground. This is driving a busy tunnel ventilation market,” he says. There are also opportunities for installing fans in existing tunnels due to stricter air quality standards.

As this innovative application of NASA technology is projected to keep people safer, it is also helping the inventor of the technology answer an important question. “One

of the most frequently asked question that I have encountered over the years is, ‘What does the Space Program do for me?’ Unfortunately, few people are aware of the benefits that NASA technology provides to our society,” says Lee. “I am honored to know that my innovation has moved beyond NASA to benefit private companies and their customers in a way that can significantly improve the quality of our daily lives.” ❖



Clarage, a division of Twin City Fan Companies Ltd., is using MSFC-398 to make the impellers of tunnel safety fans for road and rail tunnels.