Silicone Improves Charge Air Cooler Performance, Reduces Costs

By switching from a brazed metal component to silicone rubber, a manufacturer and distributor of heat transfer and temperature control products was able to help its customers improve performance efficiency that increased the average lifespan of an air cooler product from six months to 10 years.

Proliance International, Inc., is a New Haven, CT-based aftermarket and original equipment manufacturer (OEM) for automotive, truck and industrial applications. Among its many products are charge air coolers, part of a high tech induction system that increases engine combustion efficiency by cooling compressed air that is forced through the intake side of the engine. When operating correctly, the cool air improves horsepower and fuel efficiency while reducing emissions.

However, because today’s machines are asked to perform faster and longer, engine operating pressures are being increased to gain more horsepower. In addition, trucks are running more miles per year at higher speeds, creating excessive heat variations on the cooler. Due to road conditions and miles driven, the charge-air-cooler is subjected to more vehicle vibration affecting critical areas. The stresses-operating temperatures and pressures, vehicle vibration, and climatic conditions—often exceed the limits of many current charge air cooler designs resulting in premature failures.

In particular, Proliance engineers were finding that thermal contraction and expansion due to inlet air temperature ranges of -40°F to 450°F (can reach up to 600°F), along with internal pressures of up to 40 psi (pounds per square inch), were combining to create high stresses at the tube-to-header joints. This leakage required OEM’s to replace this part approximately every six months. The maintenance was expensive and time consuming for repairs and time out of service.

When Proliance engineers decided to replace the aluminum brazen joints with silicone rubber for its temperature resistance capabilities, they turned to Dow Corning for its expertise in custom high consistency rubber and having previously been serviced by Dow Corning with the supply of other materials. Proliance sent the product requirements to Dow Corning and after careful testing and laboratory analysis, Silastic® 25785-V RED was selected as the material of choice based on its high temperature resistance performance.
"Dow Corning was able to demonstrate an innovative technical solution and product superiority that made our decision to switch to custom high consistency rubber easy", said John Kolb, Vice President Engineering at Proliance.

To ensure the elastomer composition, the product was manufactured in Kendallville, IN then sent to a Proliance supplier where the grommets are molded. The result became Ultra-Seal®, a new long-life, leak resistant, silicone polymer grommet sealing system that greatly extends heat exchanger life.

The Ultra-Seal charge air cooler design was tested in an exhaustive series of pressure cycle, vibration and low temperature sealing tests. Before introducing Ultra-Seal charge air coolers to users, field trials involving several thousand units were conducted under severe duty conditions both on- and off-highway over four years. None of the units examined leaked.

Maintenance, replacement and warranty costs were drastically reduced through improved part design. The improved performance of the silicone grommet seal also impacts other total life costs such as reduced production lost to operational down time and energy savings through improved fuel efficiency. Ultra-Seal leak-resistant charge air coolers with unitized manifolds are commercially available and in use worldwide with OEM’s utilizing a wide range of engine sizes from 50 to 1200 hp.

"Silicone is extremely versatile in solving sealing problems, especially when temperature extremes are involved," said Chester Jeffery, Dow Corning account manager. "This new silicone grommet system is a good example of partnering to find new ways to meet performance goals."

Ultra Seal® is a registered trademark of Proliance International, Inc.