Air blasting and shot peening drive performance and fuel efficiency

by Herb Tobben

Race car teams, car and truck owners alike are interested in performance. And with the high prices we are now paying for fuel, anyone who drives a motor vehicle wants to get the best mileage possible. In the most basic of terms, the internal combustion engine converts fuel into motion. Engines are made up of a number of critical components that work together to power the car. My job is to speak about air blasting and shot peening, and you guessed it…once again, they come to the rescue.

Shot peening, as of course you all know by now, is the cold working of a metal surface through massive bombardment of round particles to the surface. The purpose of shot peening is to put a uniform compressive layer into the surface to relieve the residual stress created during the manufacturing process. As each particle strikes the surface, it produces a round indentation. The edge of each indentation is raised slightly above the surface. The residual compressive layer may vary up to 0.062 inches below the surface.

So, you ask, how does shot peening make engines more fuel-efficient? Shot peening reduces friction, improves oil retention, and by improving fatigue life helps to minimize a vehicle's overall weight. Shot peening helps to improve performance, which in turn helps to conserve energy. Today's engines are seeing fuel-injection pressures of up to 30,000 psi compared with 900 psi a mere two decades ago. The reason for higher pressure is to use smaller amounts of fuel and help the engine to run more cleanly and efficiently. Shot peening the components that have to handle the very high pressures prolongs their service-life. They are otherwise susceptible to early fatigue failure that leads to cracking followed by breakage or complete failure.

The combustion cycle converts fuel into motion beginning with the intake stroke, in which the piston moves downward to allow the engine to take in air. Just a small amount of fuel is needed to mix with the air and when vaporized and compressed becomes energy. The very high injection pressures put repeated enormous stress on the components—the fuel injectors, nozzles, bodies and fuel pumps. Cylinders, pistons, valves and valve springs, the camshafts, crankshafts, and the connecting rods also see a lot of cycle loading.

Racecar engines are beginning to employ titanium valves for increased performance due to their light weight, durability, and heat resistance.

A certain enemy to fuel-efficiency is friction, and some friction loss in engines cannot be avoided and accounts for significant energy expenditure. Components that contribute to friction loss, which can be shot peened, include the piston, valves and drive train gears. Beyond the benefits associated with shot peening, blasting plays another role in improving fuel economy. Numerous car makers are employing specialty coatings to increase wear resistance or reduce friction. The coatings have properties that reduce friction; they are hard and are being likened to carbide or titanium nitride. Their successful application relies upon proper surface preparation, among them grit blasting.

Over the years, I've seen many, many engine-related applications. Usually, they've involved shot peening or grit blasting. However, a recent project in the lab involved blasting titanium valves with a shot and grit mixture. The purpose of combining shot and grit media was to achieve a shot peened surface to improve fatigue life and at the same time create a surface profile for coating adhesion. For a competitive edge, race car teams are beginning to use titanium valves. While expensive, titanium is lightweight, durable, and able to withstand high heat. It is commonly used in demanding aerospace applications.

As the racing technologies, component materials, and processes evolve and as race speeds, safety concerns, and costs increase, the applications for peening and blasting change accordingly. The constant remains that the objective of blasting and peening is to prolong life and to meet the needs of industry for quality, efficiency and economy. ●

Herb Tobben, the Sample Processing Manager of the Technical Services Department for Zero Cabinets and Zero Automation at Clemco Industries, creates solutions to customer problems. You may contact Herb at 1-636-239-8172 or htobben@clemcoindustries.com