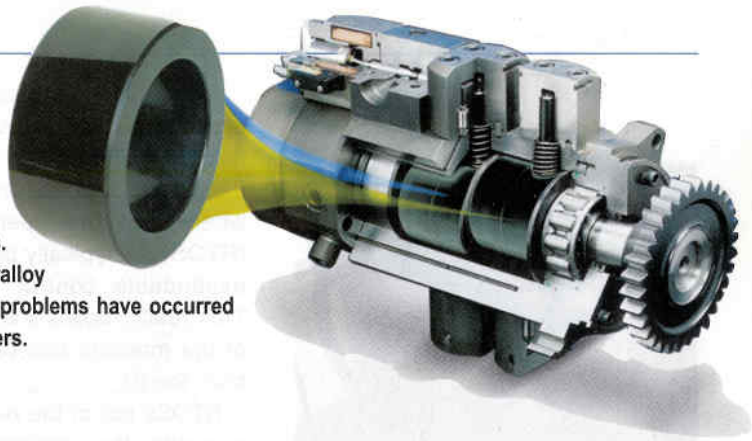


The advent of common rail fuel systems in emissions-era diesel engines has led some designers to consider different materials. Ceradyne's fuel pump rollers are one such example. The Ceralloy 147-31N silicon nitride rollers have been used where warranty problems have occurred due primarily to excessive wear, scuffing and galling of the rollers.



EMISSIONS DRIVES INTEREST IN CERAMIC ENGINE COMPONENTS

Higher engine pressures and stresses cause designers to look at material alternatives

BY MIKE OSENGA

Ceradyne Inc., Costa Mesa, Calif., has built its business around a variety of advanced ceramics, mostly silicon nitride materials. A highly vertically integrated manufacturer, Ceradyne's most visible application of its materials may be the military body armor it provides various branches of the U.S. military, as well as other ceramic composite armor systems for military vehicle, watercraft, helicopter and aircraft applications.

Outside of military uses, Ceradyne also manufactures a range of ceramic materials for the automotive, engine, industrial wear, medical and electronic markets. It was Ceradyne's experience with automotive engines that has led it to the diesel engine industry.

Now, with challenges presented by diesel emissions regulations, standards that have caused designers to look into every nook and cranny of industrial engines, some of these investigations have led engine designers to consider different materials than have been used on earlier generations of diesels, especially for internal engine components.

As a result, Ceradyne has found a

growing diesel market driven by increasing fuel injection pressures and cylinder operating pressures and other component modifications designed to improve emissions and fuel economy. According to Andy MacQueen, sales manager, Ceradyne has seen these higher pressures exacerbate the warranty problems with metal components, which has led manufacturers to consider ceramic materials.

For the diesel engine market, Ceradyne has centered its efforts around Ceralloy 147 silicon nitrides that MacQueen indicated exhibit mechanical, thermal and electrical properties not found with other materials. "Ceradyne's unique grade of silicon nitride offers engine designers a new material that is proven to solve these warranty problems," MacQueen said.

He listed light weight, high-strength fatigue resistance, superior thermal shock behavior, wear resistance, a low coefficient of friction against steel, excellent high temperature oxidation and high chemical corrosion resistance as key features.

As a result of that, MacQueen noted that Ceradyne has developed silicon

nitride to a level where valvetrains of heavy-duty diesel engines, high-pressure common rail fuel pumps and unit fuel injection systems can operate with these ceramic components in conditions where more conventional metal components might fail.

Specifically, he noted that Ceradyne silicon nitride cam rollers operate at contact stresses of 150,000 to 350,000 psi with no measurable wear to the silicon nitride or the companion metallic



Ceramic cam rollers, which Ceradyne has been manufacturing since the early 1990s, have been a major point of entry for the company to the diesel markets. The rollers have been used because of the increasing stress levels these and other valvetrain components have encountered with the overall internal pressure increases in emissions-era diesel engines.



While not yet used in diesel engine or off-highway powertrain applications, Ceradyne also manufactures silicon nitride rolling elements for hybrid bearings. High compressive strength, contact fatigue resistance, electrical resistivity and low coefficient of friction are key properties.

components, MacQueen said. This, he said, eliminates the primary mode of failure of metallic cam rollers, i.e., galling between the mating metallic components.

Ceramic cam rollers, which the company has been manufacturing since the early 1990s, have been a major point of entry to the diesel markets for Ceradyne. MacQueen said the rollers have found acceptance because of the increasing stress levels these and other valvetrain components have encountered with the overall internal pressure increases in diesel engines.

MacQueen said silicon nitride was selected as the material choice for its contact fatigue resistance, as well as a coefficient of friction that is significantly lower. Plus, he said, the weight was 40% less, which reduced the rotating moment of inertia of the rollers.

Ceradyne has developed high-volume machining techniques that allow precise formation of crowned profiles on the outer diameters of cam rollers that result in minimum contact stress distributions on the ceramic and the mating metallic component, further increasing reliability of the system, he noted.

Rollers for high-pressure fuel pumps for heavy- and light-duty diesel engines are another product for these markets. The Ceralloy 147-31N silicon nitride rollers have been used where warranty problems have occurred due primarily to excessive wear, scuffing and galling rollers in common rail fuel

pumps. All, again, because of the higher pressures needed to achieve current and future emission standards.

While not used in the diesel markets, Ceradyne also manufactures silicon nitride rolling elements for hybrid bearings. Ceradyne supplies both cylindrical rollers for use in Formula One bearings and balls for use in bearings for the electric motors.

Again, the high compressive strength, contact fatigue resistance, electrical resistivity and low coefficient of friction are key properties, MacQueen said. He added that these properties allow bearings to operate with reduced or no lubrication, at higher stress levels or higher speeds and under conditions that are not favorable to other materials.

MacQueen said hybrid bearings using silicon nitride rolling elements can operate at much higher efficiencies and with reduced audible noise levels.

As diesel emissions move into Tier 3 and Tier 4, MacQueen said there were other component areas starting to look at ceramic components. He specifically mentioned piston pins, EGR valves and possibly turbocharger components as future application possibilities. **dp**

**For More Information Now
On This Company Go To:
DirectLink®
WWW.DIESELPROGRESS.COM**