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GOING UPSTREAM FOR FUEL QUALITY

Precision of modern engine fuel systems turns development focus on filtration technology farther up the distribution channel

BY CHAD ELMORE

Having access to clean diesel fuel has always been an important way to ensure machine uptime and reduce costly repairs and warranty claims. But in today's diesel engine world, clean fuel has taken on a whole new importance.

Modern fuel injection system components are machined to tight tolerances — sometimes as close as 2 microns, roughly the size of a single E. coli bacterium — to help boost injection pressures. One system supplier advertises that its "ultra-high pressure" diesel common rail system delivers peak pressures of up to 43,500 psi. And these pressures are expected to increase as engine manufactures tweak the combustion process in order to reduce emissions.

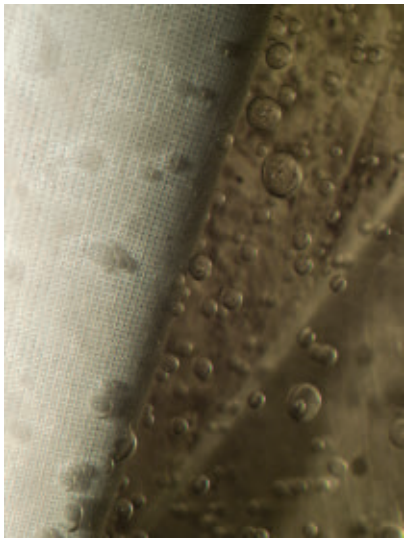
The act of visually inspecting fuel while filling the fuel tank of a diesel-powered machine while on the job site is no longer enough. These days, invisible contaminants have the potential to cause thousands of dollars in repairs and downtime.

Fuel injection system specialists work with engine builders to ensure that proper filtration is included to combat fuel-borne particles and water before they can damage expensive components. That's typically when fuel filtration specialists such as the Racor division of Parker Hannifin get called in to engineer and supply filtration systems designed for the application. Engine and chassis-mounted fuel filter/water separators have protected millions of engines from the effects of contaminated diesel fuel worldwide.

However, that may no longer be enough protection. "It's only a matter of time before most, if not all, equipment manufactures will find themselves working further up the fuel distribution channel to ensure their customers have access to the quality of fuel that is required for their new engines," said Tom Muzik, engineering manager, Velcon Filtration, Colorado Springs, Colo.

Many large fleet operators, particularly at remote mine sites, have taken fuel quality matters into their own hands. Velcon's Diesel Filtration Skid was designed for such operations.

Velcon was acquired by Parker Hannifin Corp. in November 2012 and joined Parkers' Filtration Group, which is also home to Racor. "It's such a natural marriage," said Dan Walters, Racor's global marketing and sales manager in Modesto, Calif. "Together we can protect the engine and fuel injection equipment in a systematic and cost effective way."



This is a close-up view of a coalescing filter in action. Coalescer cartridges are typically used as the first stage in filter and separator vessels for hydrocarbon fluids. They coalesce highly dispersed, emulsified water particles into larger water drops and remove particulate contaminants.

Distributors for both companies can now work together to support the OEMs and end users to ensure clean diesel throughout the fuel delivery stream, Walters said. The Velcon Clean Diesel high-flow, high-capacity fuel filter/water separators and filters are used to pretreat the fuel upstream at delivery, transfer and dispensing operations. While on board the machine, the Racor fuel filter/water separators condition the fuel prior to it entering the fuel injection system.

"The timing is right," Muzik said. "More of those distribution channels should be working together. There is a real need to provide more prefiltration steps. When the fuel is at the refinery it is generally clean. Afterward, each time the fuel is moved it picks up tank residue, contaminants and air is drawn into the tanks along with contaminants. Fuel tanks breathe and when they do they draw in airborne dust and moisture."

Most engine and equipment manufactures specify onboard fuel filter/water separators. In realizing the importance of upstream fuel filtration, Velcon said some manufacturers have started to work with it to develop the necessary upstream protection.

A manufacturer of bulk fuel filtration systems, Velcon got its start in the aviation business. In the 1950s, it developed a coalescer filter to remove water and other contaminants from fuel. Today, commercial and military aviation is a significant portion of the company's global business. Its vessels and replacement cartridges purify and remove water and particulates from aviation fuel throughout the supply chain — from the refinery to the aircraft — in flow rates from 5 to more than 25,000 gpm.

The company's Clean Diesel product line has brought some of that same technology to the off-highway

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Parker Racor's FBO fuel filter and water separator assembly is designed for fuel dispensing pumps or as a primary fuel filter and water separator on a large diesel engine, or in bulk fuel handling, fuel transfer and other higher flow applications.

equipment industry, as the chemical composition of aviation fuel and diesel is nearly identical.

"Our strength has always been taking a tremendous amount of fuel to a high quality standard and doing it quickly," Muzik said. "There is no trouble lane for aircraft, and they use millions of gallons of jet fuel globally. Because of today's engine technology, off-highway equipment manufacturers need fuel at quality levels they have never seen before. The new diesel fuel requirements are equal to or better than aviation fuel.

"Every transfer point between the refinery and the actual point of use can add contaminants to the fuel. In more remote applications such as in Australia or Africa, there are many transfer points. Different climate conditions add to the challenge by creating water in the fuel tanks and promoting rust and algae contamination. While engine manufacturers continue to upgrade their onboard filtration systems, in many cases it is not enough. The diesel equipment industry needs to work upstream to ensure fuel quality."

To measure fluid cleanliness, the International Organization for Standardization (ISO) developed the ISO 4406 Solid Contamination Level Code. While commonly used for measuring contaminants in hydraulic oil, it is also widely used for determining particle counts in diesel fuel. It specifies the size of particles and the method for coding the contamination level.

The standard uses a three-digit code. As an example, one injector manufacturer would like to see diesel fuel at 13/11/9. The first number represents the particle count range of all particles greater than 4 microns in size, the second is the range of particles greater than 6 microns and the third number presents all particles greater than 14 microns. In this example, 13 allows for 40 to 80 4 micron particles per milliliter, 11 is 10 to 20 per milliliter and the number nine represents 2.5 to 5 particles larger than 14 microns in a milliliter.

"The biggest particle the unassisted eye can see is 40 microns," Muzik said. "The old-fashioned way of measuring fuel quality by looking at it in a glass jar is long gone. Your vision isn't sharp enough to see what would be considered gross contamination today. As the industry moves away from the diesel engines of yesterday, you can't put up with that any longer."

Several major equipment manufacturers are working to mitigate fuel-related problems by making filtration products and education available to dealers and end users. At least one of them is going so far as to supply one of Racor's inline fuel dispensing filters with every new farm tractor it sells. In other cases, manufacturers have adapted industrial-grade hydraulic filtration solutions and made them available.

"Racor and Velcon have the products to solve the problem for the OEMs and end users" said Rene Wiebe, market development manager, Velcon. "We are investing in an educational campaign to inform our customers — the OEM, distributors and end users — that a solution is available to ensure machine up time and reduce operational costs."

Equipment operators can take matters into their own hands and many have. The Diesel Filtration Skid from Velcon combines particulate filtration with the company's water coalescing

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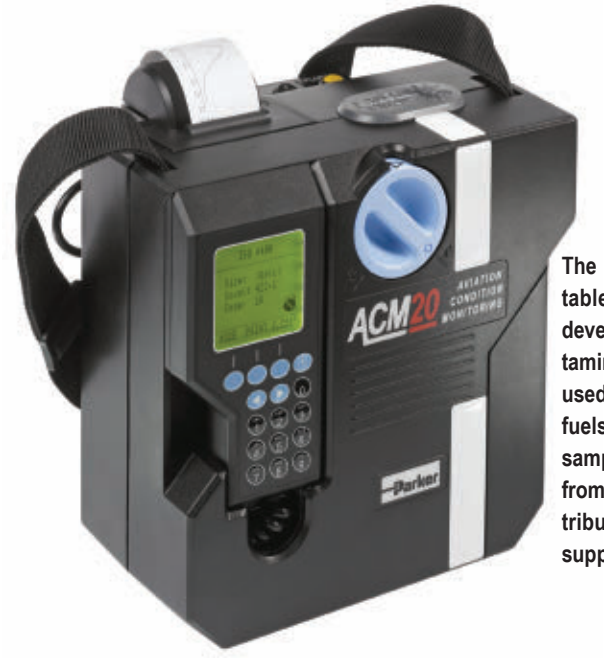
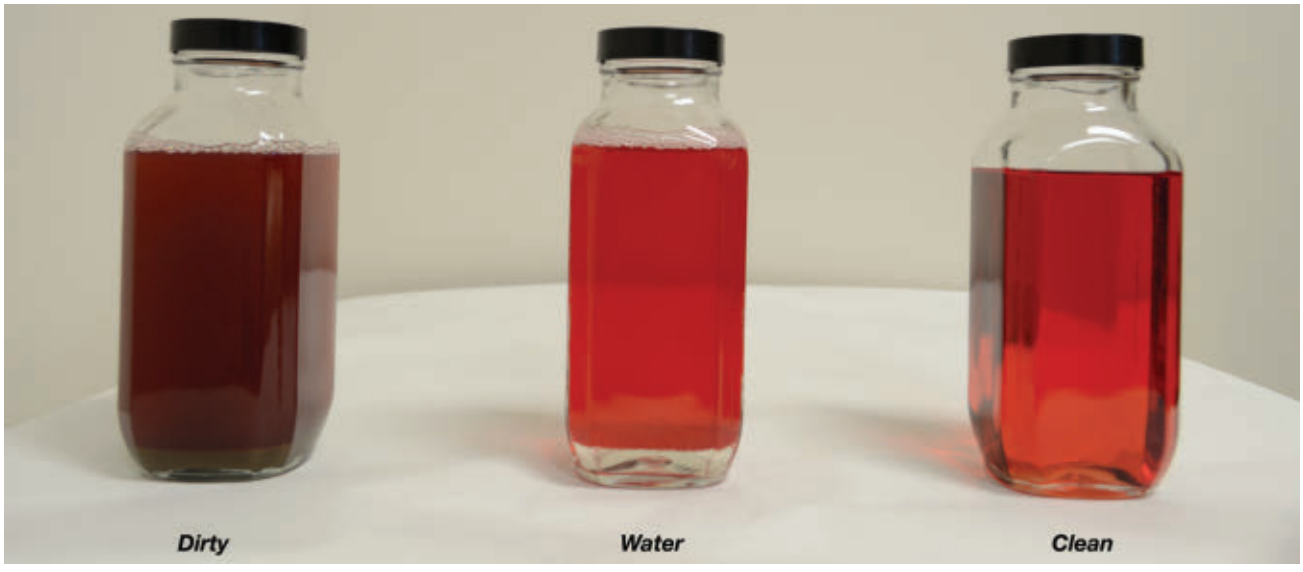


The Parker IcountACM20 portable particle counter was developed for monitoring contamination in jet fuel. It is also used to inspect various other fuels, including diesel, from sampling points in locations from refineries, pipelines, distribution terminals and fuel supply systems.



The fuel injection systems and other components in today's diesel engines are machined to such a high tolerance that even a small amount of water and dirt could cause expensive downtime and repairs.

technology to handle flow rates up to 3955 gpm. The skid is composed of epoxy-painted carbon steel vessels and the company's DFO filtration products, available in a variety of micron ratings including 2 and 4 microns. Velcon can also customize systems for higher flows.

"If they're running a fleet of vehicles, not having filtration at the dispenser is poor form," Wiebe said. "It's not too expensive when it's amortized across the cost of fuel. In some cases it's less than a tenth of a penny per gallon."

The concept of using a dispensing filter might be obvious to some, but both Muzik and Wiebe offered stories that show it's not universally understood. Muzik mentioned a transportation fleet that purchased several new buses equipped with 2010 diesel engines. "They were still fueling like they always did," he said. "But when they were using the buses the engines suddenly de-rated to 10 mph, which is unnerving with 40 people on board. We asked if they filter the fuel at the dispenser and they said, "We used to, but the filters always loaded up so we got rid of them.

"We feel the customer's pain there. But that was a case of using a filter that was too small for the application. We can work within those filtration requirements and solve those problems."

Fuel monitoring options from Velcon include the Contaminant Analyzer (VCA), which is engineered to provide real-time detection of water and particulate contaminants in diesel delivery systems.

Velcon initially targeted the system at the mining industry. "The mines want to make sure they have the systems in place to ensure they are using the fuel quality they need, but they don't know what those systems look like," Wiebe said. "Many are reaching out to anyone who is offering something. We can offer something that is sized right and fits exactly what they need for their fuel delivery."

A full-flow analyzer, the VCA mounts within a fuel delivery system and analyzes fuel in pipelines up to 10 in. in diameter. It uses two separate sensor technologies to consistently differentiate between water and solid contaminants, analyzes the contents of flowing fuel in a pipeline 600 times per second and produces an averaged result every two seconds in parts per million (ppm) and ISO 4406 codes, the company said. Velcon also offers other analyzers for lower flow rates (Icount, ACM 20, etc.) and fuel farm laboratories.

"OEMs have started to look beyond their equipment to find solutions to the problem of contaminated fuel," Muzik said. "This is something the entire fuel industry needs to take a look at, from the oil companies to the fuel deliverers to the fuel dispensing pump manufactures. Efficient fuel filtration throughout the entire delivery stream is a must." **dp**

Racor's intergrated filter/separator pump systems adapt aerospace technology for diesel engine-driven applications to help deliver clean, dry fuel to diesel engine fuel injection systems.

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- Nitrogen Tire Inflation Systems

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- Water Chillers
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- High Purity Gas Filters
- Hydrogen Gas Generators
- Nitrogen TriGas Systems
- Sterile Water Filters
- Syringe Filters

MARINE

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- ASME High Flow Vessels
- Crankcase Emission Filter Systems
- Fuel Dispensing Filters
- Engine Fuel Filter/Water Separators
- Engine Oil & Coolant Filters
- Gasoline Filters
- Hydraulic Filters
- Hydrocarbon Fluid Filters
- Oil/Water Separators
- Submarine CO_2 Reduction Units
- Water Desalination & Purification Systems

OIL & GAS

Key Products

- Air Intake Filters
- ASME High Flow Vessels
- Compressed Air Filters & Dryers
- Compressed Air Water Separators
- Crankcase Emission Filter Systems
- Engine Fuel Filter/Water Separators
- Engine Oil & Coolant Filters
- Fluid Condition Monitoring Systems
- Fuel Dispensing Filters
- Hydraulic Filters
- Hydrocarbon Fluid Filters
- Integrity Test Equipment
- Nitrogen Generators
- Mechanical Separators
- Membrane & Sterile Air Filters
- Oil/Water Separators

POWER GENERATION

Key Products

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- ASME High Flow Vessels
- Bioenergy Water Chillers
- Crankcase Emission Filter Systems
- Engine Fuel Filter/Water Separators
- Fluid Condition Monitoring Systems
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- Load Tap Filters
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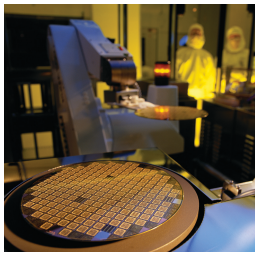
- Magnetic Prefilters
- Nitrogen Generators
- Portable Hydraulic Systems
- Water Sensors



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TRANSPORTATION & MOBILE EQUIPMENT

Key Products

- Air Intake Filters
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- ASME High Flow Vessels
- Crankcase Emission Systems
- Fuel Delivery Systems
- Fuel Dispensing Filters
- Fuel Filter/Water Separators
- Multi-stage Filter Systems
- High Pressure Natural Gas Filters
- Nitrogen Tire Inflation Systems
- Suction & Return Line Hydraulic Filters
- Transmission Filters
- Truck & Railway Dryers

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- Oil/Water Separators
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- Stainless Steel Prefiltration Vessels
- Sterile Water Filters

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