Rigorous Testing Readies Parker RunWise® Advanced Series
Hybrid Drive for Commercialization with New Autocar E3

The technology has been in development for years. Durability trucks have been running around the clock. Field-testing with fleet operators is complete. And now, this September, the most advanced hybrid technology ever developed for severe-duty Class 8 trucks will be on the streets providing fuel consumption savings of 30% to 50% with a corresponding reduction in CO₂ emissions, reduced brake and engine wear, and increased driver productivity.

Autocar is introducing its new E3 hybrid refuse truck – with Parker Hannifin’s RunWise Advanced Series Hybrid Drive – in limited production this year and full production in 2011.

The RunWise Advanced Series Hybrid Drive achieves unprecedented fuel savings by decoupling the engine from the rear axle during low speed stop-and-start operation and recovering energy normally lost during braking. Parker’s RunWise replaces a refuse truck’s conventional drive train with a series hybrid drive – combining the flexibility and responsiveness of hydrostatic operation for low and medium speeds with the unsurpassed efficiency of mechanical operation for highway speeds.
RunWise Track Testing Validates Product Robustness

Building upon proven Parker hydraulic, pneumatic, filtration, and driveline components, the Parker Energy Recovery team was able to focus on developing and validating the innovative electronic control and systems technology contained within RunWise. A disciplined stage-gate product development process was established. Technical experts were recruited from across the globe. And, accelerated track testing of a fleet of refuse trucks with the RunWise Advanced Series Hybrid Drive has been ongoing for more than three years.

On the track and in the lab, prototype trucks with RunWise are subjected to severe operating conditions, including high loads and heavy repetitive start-stop cycles, to compress one week of customer field operations into one day of round-the-clock testing. In addition, product robustness is validated in extreme hot and cold weather conditions, up and down mountain grades, over rough-roads, and through a variety of other severe-duty tests.

“When we started the program, our goal was to gain the equivalent of 20 years’ operating experience before bringing RunWise Advanced Series Hybrid Drive to the commercial market. I’m proud to say we surpassed that goal, six months ahead of schedule, thanks to the exceptional performance of the RunWise system and its proven Parker components,” says Vance Zanardelli, manager of Parker’s Energy Recovery Business Unit.

Of course, track and lab testing are only two aspects of the product development process. To fully understand how the product will perform in customer hands, there is no substitute for real-world field experience with actual fleet operators.

RunWise Field-Testing Provides Real-World Results

Since 2008, Parker has been continually performing field tests to obtain real-world results in a variety of severe-duty environments, climate conditions, and geographic
locations. Extensive field data has been gathered and evaluated using refuse truck drivers working their regular routes in Michigan, Texas, South Florida, and Nevada. Resulting information helped the Parker development team improve RunWise Advanced Series Hybrid Drive quality, develop product enhancements, and validate performance and durability.

**Texas (September 2008)** – Parker’s first field trial with RunWise included 10 days of evaluation by a private fleet operator customer on an existing route with about 1200 homes. During this field trial, the truck consumed 27% less fuel than the customer’s conventional trucks – while collecting 3% more cans and 3% greater tonnage of refuse. The customer also evaluated acceleration, braking, grade performance, truck responsiveness, as well as vibration, harshness and noise levels – all of which received positive feedback from the driver.

“The most obvious advantage of the Parker hybrid drive system is fuel savings,” the fleet manager explained. “We’ve got about 22,000 trucks in operation across North America. Installing this hybrid system on our entire fleet would save hundreds of thousands of gallons of fuel a day.”

The RunWise drive system was 100% operational during the field test. As a result of the lessons learned in Texas, several product enhancements were incorporated, which proved their value during subsequent fleet trials.

**South Florida (May 2009)** – During trials and detailed interviews conducted in the City of Miami, the City of Hialeah, and Miami-Dade County, a Runwise-equipped truck consumed an average of 42% less fuel than the normal trucks; collected refuse from 700 to 1,100 homes per day; and drivers evaluated the same performance categories as in Texas (above).

“I have challenged my staff to find clean energy options and continue to reduce the City of Hialeah’s carbon footprint. Autocar E3 trucks, with Parker hybrid technology, will play an important role in our energy-efficiency plans by reducing emissions and
saving on fuel costs,” Hialeah Mayor Julio Robaina said. “These trucks will provide vital services to the citizens of Hialeah, while caring for our future generations.”

A highlight of this field test was the high satisfaction of drivers evaluating the smooth, automatic shifting of the hydrostatic drive during urban driving and collection on the route. The smoothness of shifting and downshifting was described as “amazing.” One driver said the ease of shifting “contributes to less fatigue and enhanced ability to monitor surrounding situations.”

During these field tests, brake wear was studied in detail and an independent party verified “replacement cycle” for brakes at 102 weeks, nearly two years, versus the standard 12 week replacement cycle.

“Miami-Dade County is constantly looking for ways to ‘go green’ and become environmentally friendly so we are happy to be the first municipal government in the nation to use this unique hybrid technology in our waste collection vehicles,” said Carlos Alvarez, Mayor of Miami-Dade County. “We will consume less diesel fuel and reduce our carbon footprint with the help of this new equipment.”

As a result of the field-testing experience, following an analysis of the savings potential, three South Florida communities purchased a total of 11 Autocar E3 trucks equipped with RunWise to be delivered in September 2010. Miami-Dade County purchased six trucks, the city of Hialeah purchased four trucks, and the City of Miami purchased one.

“The City of Miami is excited and proud to be one of the first cities to receive the Autocar E3, equipped with Parker Hannifin’s RunWise hydraulic technology,” said Tomás Regalado, Mayor of the City of Miami. “The addition of this eco-friendly vehicle to our fleet is another step we are taking to make Miami one of the cleanest cities in America.”
**Nevada (August 2009)** – The refuse hauler participating in these tests was in the process of transitioning from manual, rear-load applications to automated side loaders. Seven different route profiles were used during these “peak hot weather” field trials. Despite not having routes optimized for automated side loader operation, fuel savings still averaged 34%. Following further testing with this refuse hauler team, side loader optimized routes achieved greater than 40% fuel savings. RunWise achieved 100% uptime, with no operational or functional impact from the extreme heat. Again, driver feedback was extremely positive in terms of acceleration, smoothness, quietness, and braking.

During these tests, the brake wear “replacement cycle” was calculated by the hauler to be the best yet: 30 months or 2 ½ years.

**Michigan (March 2010)** – This recent field trial featured five different route profiles and measured fuel consumption based on driver data, as well as considering pickup and tonnage differences.

Driver fuel filling data and ECU (Engine Control Unit) snapshots documented that the trucks achieved an average savings of 38%. Factoring in improved can pickup and increased tonnage on routes, along with driver learning, the adjusted fuel savings averaged 45%.

“During our testing over five routes, fuel savings ranged from 31% to 49%,” Dan Cowher, fleet director for Veolia ES, said. “We had very positive driver feedback that emphasized benefits such as improved acceleration, smoothness, quietness, and better braking. In addition to these benefits we had no down time and no measurable brake wear during this testing.”

Once again, drivers were impressed with the trucks’ acceleration, smoothness, quietness and braking. The brake wear “replacement cycle” improved yet again to a 30 to 36 month cycle.
“Veolia ES is very excited to partner with Parker for potential implementation of RunWise into our North American fleet,” Cowher concluded.

**RunWise Class-Leading Technology to Drive the Refuse Industry**

These field tests validate that the RunWise Advanced Series Hybrid Drive delivers class-leading technology and is ready for commercialization with Autocar E3 this year.

Jim Johnston, President of Autocar, summed it up best: “Autocar is committed to producing new products that deliver where it matters – environmentally, efficiently, and economically. Our pledge to being the industry’s Green Leader is demonstrated by the release of the Xpeditor E3 series. These vehicles, which utilize the RunWise® Advanced Series Hybrid Drive from Parker Hannifin, offer the greatest fuel savings of any comparable product or technology, while lowering emissions, decreasing noise, and contributing to the operator’s bottom line.”

While other motion control companies are introducing parallel hybrid systems (which feature a hydraulic drive installed alongside a conventional drive train), only Parker’s RunWise Advanced Series Hybrid Drive has the power, performance, and capability to provide 30% - 50% fuel savings, carbon emissions reductions, and enhanced driver satisfaction and productivity – all at the same time.

No other Class 8 refuse hybrid matches the fuel savings or performance of the Parker RunWise Advanced Series Hybrid Drive.

**Reduced Fuel Consumption** – Average annual fuel consumption for operating a Class 8 vehicle is about 9,800 gallons. The E3, with RunWise, reduces fuel consumption 30%-50% per truck, depending on route density and operating conditions. That is a substantial reduction in full usage and costs by anybody’s measure. Vehicles can utilize full engine power at any time, but the RunWise hydraulic system design optimizes efficiency by matching engine load with vehicle
requirements, ensuring optimum fuel efficiency and extending engine life. Reduced engine loads also contribute to lower engine cooling requirements, minimizing horsepower loss to fan drives.

**Lower Emissions** – Less fuel consumption results in a corresponding reduction in CO₂ emissions. If fuel consumption is reduced by 35%, well below field test highs of 50%, a single truck’s CO₂ emissions are reduced by up to 38 tons per year. Based on recent EPA figures, this reduction in CO₂ emissions is equivalent to removing 6.7 mid-sized cars from the road or planting 1,500 trees. RunWise is contributing to a greener planet.

**Less Brake Wear** – Absorption and storage of energy by the system’s hydrostatic pumps during deceleration results in less wear on brakes and the rear tires run cooler for longer life. The “replacement cycle” for new brakes increases up to eight times, from every few months to 24 or 36 months, depending on driving practices and route conditions. Fewer brake jobs saves money in maintenance costs and reduces vehicle downtime. Improved braking repeatability results in reduced brake fade. RunWise accommodates ATC and ABS. Using hydraulic braking on collection routes reduces brake dust normally generated by shoes and drums by hundreds of pounds per year – another environmental advantage.

**Better Drivability** – The responsive RunWise hydrostatic drive minimizes turbo spooling, eliminates torque converter pumping, and is smoother and quieter than traditional trucks, with little vibration. The hydrostatic drive contributes to smooth starts and launch acceleration, eliminating the lag encountered with traditional drive trains. No hesitation enables drivers to cover routes quicker, increasing productivity. Route drivers say that trucks equipped with RunWise are a “pleasure to drive.”

**Lower Operating Costs** – Because the hydrostatic drive powers the refuse truck during route collection, the engine is used less, reducing engine wear and lowering maintenance costs. Brake life is extended up to eight times, reducing maintenance costs and additional downtime for shoe and drum replacement. If carbon emissions
are taxed under the proposed cap-and-trade laws currently being considered by Congress, RunWise will minimize fleet owners’ exposure to carbon emission taxes.

**Parker RunWise and the Autocar E3**

The Autocar E3 hybrid-powered refuse truck features Parker RunWise, the most advanced hybrid technology and energy recovery system available. These vehicles provide fuel savings, reduced emissions, less brake and engine wear, enhanced drivability, and cleaner and greener communities. Waste collection fleet owners are excited about RunWise and its ability to increase their productivity and profitability, as illustrated during two years of field-testing with fuel savings of 30% to 50%, along with typical collection gains of 3% to 5%, all without requiring changes to driver behavior. Autocar E3, with RunWise from Parker, greener and more efficient than any other refuse truck on the road today – sets the new standard for Class 8 refuse vehicles.

Jeff Cullman, Group President, Hydraulics for Parker Hannifin Corporation, summarized RunWise Advanced Series Hybrid Drive technology:

“Parker Hannifin is a global leader in motion and control technologies and we are focused on applying our broad technology platforms to address some of the greatest engineering challenges of our time. Among those challenges is the ability to reduce energy consumption and to protect our environment. We have had this particular advanced series hybrid drive technology in development for a number of years now, and to see it become viable and in-use is particularly gratifying, both for me, and for hundreds of Parker employees who have had a hand in its development and production. The beauty of this system is that it makes use of well proven technology rather than relying on something novel and not yet tested over time.”