

Engine, Emissions & Vehicle Research



D014831-0052

Mounting competition in the automotive industry is requiring manufacturers to compress product development cycles. To get products to market faster, manufacturers must develop **powertrains** and other **vehicle components** at the same time. Southwest Research Institute is responding to this industry challenge with several unique hardware-in-the-loop systems.

Our highly successful transmission **hardware-in-the-loop** system helps automakers develop and optimize transmissions independent of other vehicle components. Using similar technology, we are demonstrating the

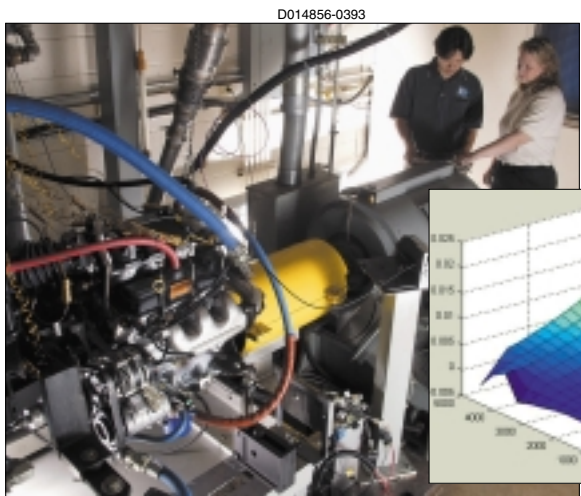
SwRI engineers recently developed a low-emission, heavy-duty natural gas engine that surpasses the stringent Environmental Protection Agency 2010 emissions standards. The next-generation engine greatly reduces oxides of nitrogen and particulate matter pollutants (engineersearch.swri.org).

ability to replicate real-world vehicle operations in a laboratory engine ([vehicle simulation.swri.org](http://vehicle.simulation.swri.org)). An electric motor simulates the torque converter, transmission, and the inertia, rolling resistance and

aerodynamic drag of the vehicle. Overall, the system allows manufacturers to calibrate engines in a laboratory before the transmission and other components are available, saving development time and expenses.

We have also developed two transaxle hardware-in-the-loop evaluations systems to help a major automobile manufacturer's **product development** efforts. Each of these systems uses modeling and simulation software to emulate the engine and vehicle around the transaxle (raptor.swri.org).

As part of the Department of Energy's Next-Generation Natural Gas Vehicle Program, we developed a low-emission, heavy-duty **natural gas engine** that more than meets the stringent 2010



D014856-0393

D015092

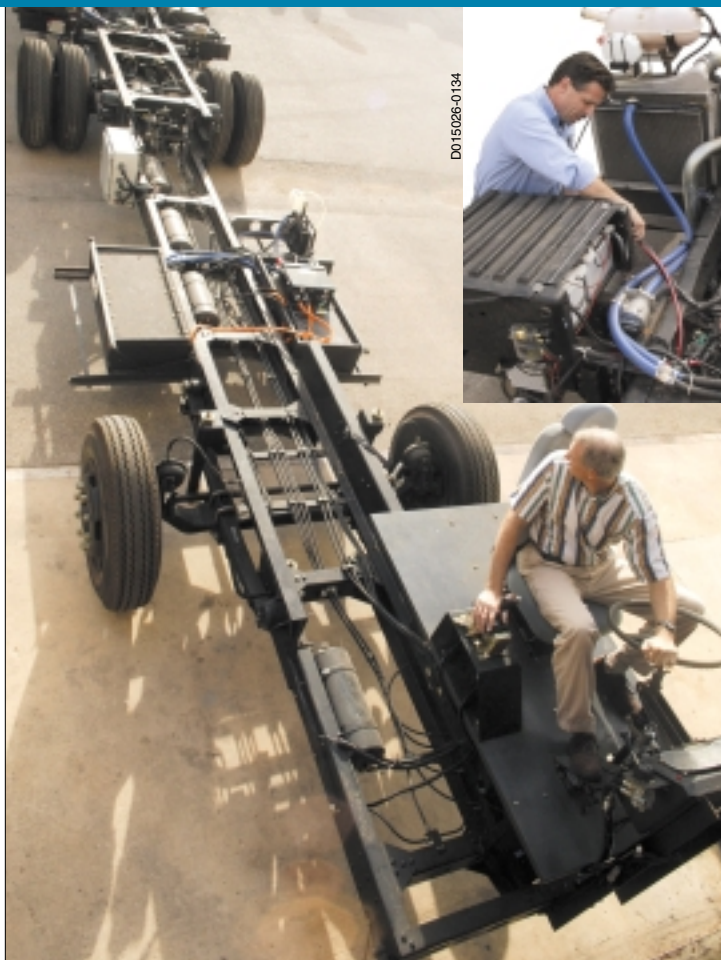
Our engine hardware-in-the-loop system helps vehicle manufacturers develop powertrains in a virtual environment. A vital element of the system, our award-winning RAPTOR® software (inset), simulates the associated powertrain components.

- model-based controls • emissions reduction • engine design • powertrain modeling • fuel cell development • hydraulic design • transmission design • hardware-in-the-loop evaluations • powertrain controls development • hybrid vehicle design • vehicle testing • contamination research •

emissions standards set by the Environmental Protection Agency. The next-generation engine emits greatly reduced levels of oxides of nitrogen and particulate matter, significantly reducing the pollutants typically emitted by heavy-duty trucks.

We continue to lead several successful government and industry consortia. Our High-Efficiency, Dilute Gasoline Engine program, called **HEDGE**, is developing pre-competitive technologies for the gasoline engine market (hedge.swri.org). The **Clean Diesel IV** program is developing technologies to meet 2010 diesel emissions goals (cleandiesel.swri.org). We also offer an **engine consulting service** that provides complete engine design, development and product planning assistance.

Manufacturers need to know how unconventional emissions control strategies affect **engine wear** (enginewear.swri.org). Our real-time engine wear capabilities use radioactive



D015026-0134

D015026-0071

SwRI developed a hybrid bus powertrain (inset) that substantially improves stop-and-go driving efficiency compared to conventional buses. Our automated manual transmission and hybrid powertrain system are the key technologies responsible for the improvement in fuel efficiency.

under certain engine operating conditions.

Rising fuel costs are piquing interest in higher fuel efficiency and alternative fuel sources. We recently developed a **hybrid bus powertrain** that improves fuel efficiency by more than 30 percent. In addition, we evaluated the **fuel economy** of a diesel-fueled tractor-trailer equipped with a fuel cell auxiliary power unit. The fuel cell powered many of the traditional engine-driven loads, removing parasitic losses from the engine. The truck then successfully completed a cross-country trek from California to Washington, D.C.

We are also involved in **fuel cell** research activities such as supply fuel reformation, fuel cell packaging, membrane contamination and fuel cell-vehicle integration challenges ([fuel cell.swri.org](http://fuelcell.swri.org)). ♦

Visit engineandvehicle.swri.org for more information or contact Vice President Nigel F. Gale at (210) 522-3024 or ngale@swri.org.

tracer technology to rapidly assess wear in days or weeks rather than in months or years of engine operation.

In addition to developing engines and components that reduce emissions production, we also develop various **aftertreatment** technologies to mitigate emissions before they exit the tailpipe (emissionsresearch.swri.org).

We are leading industry- and government-sponsored research to improve particulate matter (PM) **sampling efforts** using filter media and real-time particle instrumentation from diesel engines meeting 2007 EPA standards. Our research shows that exhaust particle filters reduce PM mass by 95 percent, but volatile nanoparticle “number” emissions in the size range from 3 to 50 nanometers remain high

We developed a “super cell” to simulate altitude and other environmental conditions for evaluating heavy-duty engines, as well as fuels, lubricants and exhaust treatments. The system simulates altitudes up to 12,000 feet above sea level, as well as variations in temperature and humidity.



D014952-0006