▶ Stephen Busch, Sandia Senior
Member of Technical Staff,
discusses details of the design of an
optical piston bowl with University
of Wisconsin-Madison Distinguished
Professor Rolf Reitz.

Engine Research Informs Automotive Improvements

> "Sandia's unique and highly informative experimental engine data has spurred the development of accurate simulation models at the ERC that are now being used by the industry."

— **Dr. Rolf Reitz**

Distinguished Professor
Director
UW-Madison Engine
Research Center

▶ **CHALLENGE**

U.S. and global vehicle manufacturers need to continue improving their engine designs in order to remain competitive, continue to lower pollutant emissions, and help reduce CO_2 emissions.

▶ **PARTNERSHIP**

Sandia National Laboratories' Engine Combustion Department has studied the science of engine combustion for over 30 years. For the last two decades, they've worked closely with the University of Wisconsin-Madison's Engine Research Center (ERC).

The ERC is the largest academic research center focusing on internal combustion engines in the U.S., and has been a leader in advanced combustion research. Graduate students, led by faculty and staff, conduct research to help meet the national goals of reduced emissions and reduced fuel consumption while preparing for careers in industry, government, and academia.

Sandia researchers provide high resolution experimental data that is used to validate computational fluid dynamics models developed by the ERC to study engine combustion processes. Together, their efforts further our understanding of the science and physical processes of combustion, and result in the modeling tools required to refine the design of clean, high-efficiency combustion engines.

▶ **SOLUTION**

Improving our understanding and ability to predictively simulate engine combustion involves carefully coordinated experimental, modeling, and simulation efforts. Detailed measurements of in-cylinder flows, fuel and pollutant spatial distributions, and other quantities are made in optical engine facilities at Sandia that closely match the combustion and engine-out emissions behavior of traditional, all-metal test engines. These measurements are closely coordinated and compared with the simulation results obtained by partners at the ERC.

Results from the collaboration include the development of more accurate turbulent flow and spray models to describe the details of fuel-air mixing, as well as better models for combustion and pollutant emissions. More predictive simulations enable new, more efficient engine designs for cars and trucks.

▶ **IMPACT**

The models and understanding developed by the Sandia-ERC collaboration are now in use by the automotive industry. Engine modeling, guided by a better physical understanding, is used by virtually all engine companies to increase the pace of engine concept evaluation, and to reduce the costs of new engine development—ultimately leading directly to improved fuel efficiency, lower emissions, and lower greenhouse gases.

Students who have worked on this research have gone on to become technical leaders in the field. This research has also helped the industry to meet federal emissions mandates and engine fuel efficiency targets.

PARTNERSHIP TYPE: Collaborative research effort
GOAL: Optimizing high-efficiency, low emissions combustion engines