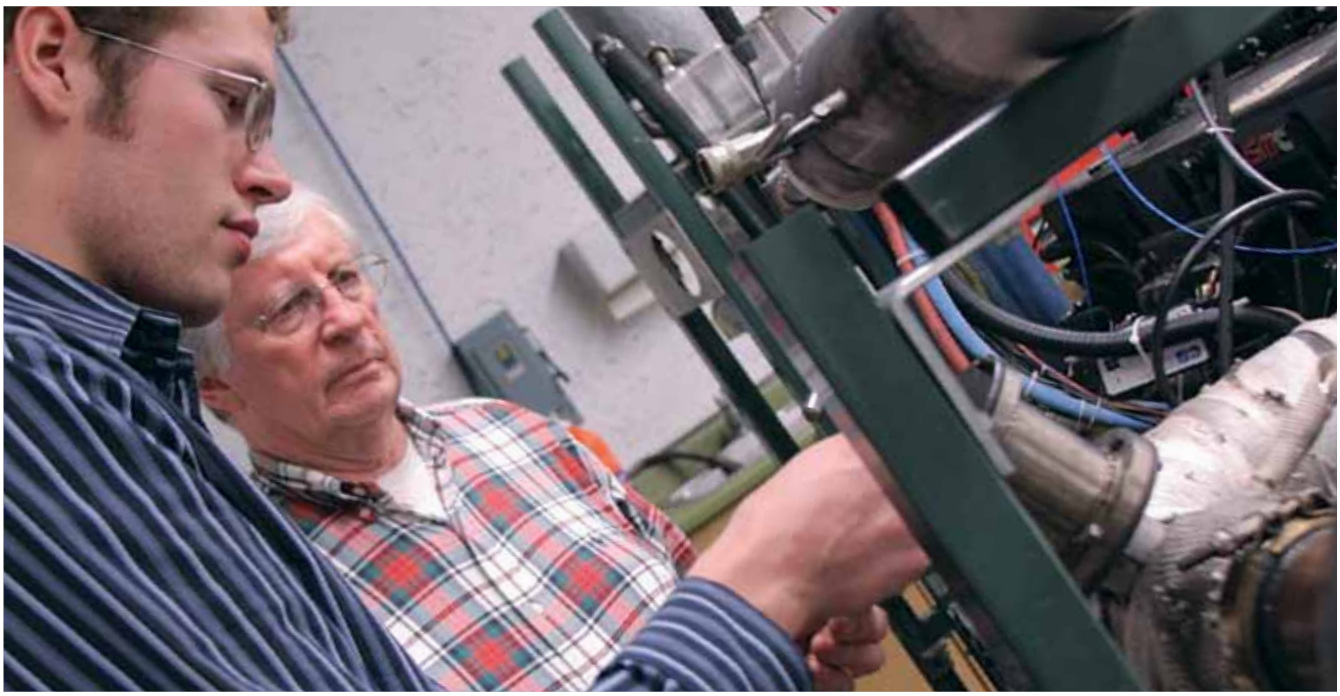

Graduate Research

EDUCATION FOR THE LONG HAUL

Dr. John Johnson believes in a "taking responsibility" style of graduate education, in which the professor acts as a guide rather than a micro-manager. A firm believer in self-starting, he expects students to define their own research objectives and test plans, coming to him for feedback on defined approaches. This method, he says, encourages students to think for themselves, dig into the material, and learn from their mistakes. "I'm demanding, and I believe that this method is an effective educational model that serves students well in industry and academia," he said. "Companies and universities are looking for employees who are proactive, employees that will keep the research or development projects moving." He believes in a team approach to research, and has regularly involved other faculty members in his projects.

Hard work notwithstanding, students clamor to work under Johnson, eager to learn from his decades of knowledge and expertise. During his long and prolific research career and seven years as the ME-EM Department Chair, Johnson used the same approach that made him a successful educator. He arrived at Michigan Tech in 1970, after two years serving as a project engineer in the U.S. Army Tank Automotive Center and over four years as the Chief Engineer, Applied Engine Research at International Harvester Co. During his years in the ME-EM Department, Johnson has added to the knowledge base of diesel engines and leveraged the discoveries of his predecessors to carefully plan and fund numerous groundbreaking findings as a result of his research.

Diesel Particulate Filter Research

One of Johnson's major contributions to diesel engine research was linking the exhaust gas measurements to the actual conditions in the exhaust gas system. Because exhaust gas sampling takes place after gases have traveled down the pipe, some of the compounds transfer to adsorptive states onto the carbonaceous particles from the gaseous states. In 1982, Johnson and a graduate student developed a seminal paper that described how to calculate the particulate concentrations in the dilution tunnel based on the exhaust hydrocarbon and particulate measurements in the exhaust.

The paper won the SAE Arch T. Colwell Merit Award, and led to the development of a modeling program to predict the partitioning of hydrocarbons between gas phase and adsorptive states. As a result of Johnson's research, his team and others in industry were able to improve diesel engine design, leading to emission reductions and increased fuel economy. Johnson's work is used even today by organizations planning instrumentation and modeling schemes. "Good research takes time," he said. "The strongest research has staying power."

With a comprehensive understanding of exhaust gas behavior, Johnson led numerous studies in diesel exhaust after-treatment technologies starting in 1980. Because diesel engines produce particles that represent an environmental risk, particle filters were developed to capture and oxidize them. However, the characterization of the behavior, performance, and control of the diesel particulate filter (DPF) has proved to be a significant challenge. Johnson's team has pursued effective tools for designing effective DPF systems, leading to the development of the MTU 1-D DPF model, a software tool that predicts the mass of diesel particulate matter as it accumulates along the axis of the DPF. The tool is currently being validated by industry research sponsors. A new version, to be published in 2009, will simulate the transient effects of light-off, where diesel fuel is injected upstream of the DPF and oxidizes the retained particles in a process called active regeneration. These filters became standard equipment in 2007 on heavy duty trucks and will soon be deployed on off-highway vehicles.

A Continuing Legacy

Throughout his years of research, Johnson has involved graduate students in every aspect of the process, from planning to execution to presentation. He places special emphasis on the importance of effective oral and written professional communication, saying, "I believe it is important for students to start to become effective communicators, and that this ability can be continually improved through the years of their professional career while doing planning, writing, and speaking. It is equally important that students be strong in both the work and in the sharing of the results." While not all graduate students have appreciated this demanding approach during their busy studies, many have commented to Johnson in subsequent years that it was foundational to their success. Johnson's no-nonsense style has proved bountiful; over the years, he has advised over 80 graduate students to the completion of their theses.

Johnson retired from classroom teaching in 2001, and maintains a significant involvement in both the Michigan Tech community and the worldwide diesel engine research community. A Presidential Professor Emeritus and Research Professor, he continues to co-advise five to six graduate students per year, and collaborates with ME-EM faculty to transfer his knowledge to the next generation of researchers. To further national understanding of diesel engine development, Johnson is active in committees within the Society of Automotive Engineers (SAE), the National Academy of Sciences, the Environmental Protection Agency (EPA), and the American Society of Mechanical Engineers (ASME). He received the ASME Soichiro Honda Medal in 2001, and sponsors the John Johnson Award for Outstanding Research in Diesel Engines, an annual SAE award for best student, industry, or government diesel engine research publication.

With over 200 publications and several patents to his name, Johnson has impacted diesel engine and after treatment design as few others have, contributing to both engine efficiency and emissions control technologies. Like the robust engines he has studied for decades, Johnson continues to work hard and operate effectively.

Career Highlights:

- ME-EM Department Chair, 1986-93
- SAE and ASME Fellow Grade Member
- Served as the SAE Board of Directors from 1982-1985, and proposed the creation of the Engineering Education Board (EEB), which is still in existence today.
- Proposed the creation of the SAE graduate student forgivable loan program, Chair of the committee from 1985-89
- Editor in Chief of the SAE Transactions Committee
- ASME Honda Award Committee Chair
- EPA Mobile Sources Technical Subcommittee
- National Academy of Sciences Committee to Review the 21st Century Truck Partnership Program, Chair
- National Academy of Sciences Committee on Light Duty Vehicle Fuel Economy