WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

Department of Engineering
Professional Development

The University of Wisconsin–Madison offers courses at your location focusing on diesel thermodynamics and combustion system development. Curriculum for course topics is designed by UW–Madison faculty and industry experts, and in cooperation with the Engine Research Center (ERC). The University's ERC has a long and distinguished record of research and education pertaining to internal combustion engines and advanced propulsion systems.

Our staff will work with you to tailor our programs to meet your development goals.

Diesel Thermodynamics and Combustion System Development

Topic *(Each session is approximately 1 hour 10 minutes)*	**Five-day course**	**Four-day course**	**Three-day course**	**Two-day course**
Introduction	X	X	X	X
Applying Thermodynamics to Engines ■ Heat engines and internal combustion engines ■ Maximum work ■ Property and state determination	X	X	X	
Pressure-Volume Analysis, Work, and Power ■ Calculating and measuring pressure-volume work ■ Boosted engines ■ The roles of the crankcase	X	X	X	X
Thermodynamics in Compression, Expansion ■ Heat release placement and compression ratio ■ Roles of heat transfer ■ Specific heat ratio	X			
The Torque Curve and Engine Application ■ Torque curve shaping ■ Limits and torque curve modification ■ Example applications		X	X	X
Air Handling Considerations in Diesel Engines ■ Valve event optimization ■ Port and manifold design ■ Use and control of swirl and tumble		X	X	X
System Development through Analysis and Exp. ■ Discharge coefficients ■ Standard and optical measurements ■ CFD in air handling development		X		
Turbocharging I ■ Turbocharger design and application ■ Compressor maps and system optimization ■ Approaches to boost control		X	X	X
Turbocharging II ■ Charge air cooling ■ Approaches to two-stage systems ■ Further notes on emission control		X		
Fuel Chemistry and Energy ■ Hydrocarbon fuel chemistry ■ Bio-fuels ■ Enthalpies and heating values		X	X	X
Combustion and Stoichiometry ■ Global combustion reactions ■ Stoichiometry, mass, and volume ■ Lean and rich mixtures		X	X	X
Combustion Equilibrium Calculations ■ Equilibrium concentrations ■ Adiabatic flame temperature ■ Practical significance of equilibrium		X		

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Diesel Thermodynamics and Combustion System Development *continued*

Topic *(Each session is approximately 1 hour 10 minutes)*	**Five-day course**	**Four-day course**	**Three-day course**	**Two-day course**
Kinetics and Combustion Reactions ■ Forward and reverse reactions ■ Reaction time and activation energy ■ Types of reactions		X		
Combustion in Diesel Engines ■ Approaches to combustion chambers ■ Physical and chemical ignition delay ■ Characterizing the diesel flame ■ White smoke		X	X	X
Diesel Combustion II ■ Temperature and species concentration ■ Key reaction sequences ■ Roles of lift-off length and delay ■ Wall interactions		X		
Heat Release Analysis ■ Governing equations ■ Critical variables ■ Measurement and the use of filters				
Exhaust Emission Considerations and Regulation ■ Atmospheric reactions ■ Overview of measurement techniques ■ Overview of regulation approaches		X	X	
Exhaust Emission Mechanisms ■ Soot and particulate ■ Hydrocarbon mechanisms and control ■ Nitric oxide mechanisms and control		X	X	X
Emission Control, In-Cylinder, and Aftertreatment ■ System development for efficiency, emissions ■ Spark timing maps ■ Aftertreatment system development		X	X	X
In-Cylinder Development and Optimization ■ Combustion chamber design ■ Injection parameters, split injections ■ Exhaust gas recirculation ■ Injection timing maps		X	X	
Lean NO_x Aftertreatment ■ Aftertreatment chemistry ■ SCR systems ■ NO_x trap systems		X	Reduced	
Particulate Filters and Trapping ■ Particle capture mechanisms ■ Passive and active regeneration ■ Assembling and controlling the aftertreatment system		Reduced	Reduced	
Big Picture Perspectives ■ Well-to-wheels assessments ■ Customer and societal perspectives ■ Alternative powertrains		X	X	

For more information about courses available at your site, including optimal group size and costs, contact:
Michael J. Andrie, Program Director
Phone: 800-462-0876; 608-263-1615 **Email:** mandrie@wisc.edu
Website: epd.engr.wisc.edu/2012onsiteengine