



Diesel Engine Technology Engineering Academy

Two course offerings available:

June 6 - 10, 2011 • SAE Automotive
Headquarters • Troy, Michigan, USA

NEW European Offering!

July 18 - 22, 2011 • Delphi Diesel
Systems Ltd. • Warwick, UK

“It would have taken months in job experience for me to gain the diesel engine knowledge that I did in this class.”

Kent Brown
OEM Cooling
Application Engineer
John Deere Power Systems

“As an engineer relatively new to the diesel engine industry, my competence regarding, and appreciation for, diesel engine technology has improved significantly because of this Academy.”

Christopher A. Brown
Senior Project Engineer
Detroit Diesel Corporation

Dear Colleague:

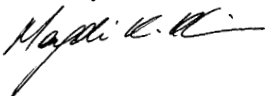
As testament to the importance of this subject to the automotive community, the June and December 2010 Diesel Engine Technology Engineering Academies presented at the SAE International® Automotive Headquarters were a tremendous success, providing a comprehensive overview of this technology to engineers from leading industry companies. This Academy was developed to provide an in-depth and "hands-on" approach to bringing the newly hired or transferred engineer quickly up to speed on modern diesel engine technology and expanding the knowledge of experienced engineers.

Now more than ever, well trained and knowledgeable engineers are critical to the success of an organization. An organization must depend on all team members performing at maximum capacity. This includes newly hired engineers and those recently transferred and looking to expand their diesel engine technical knowledge. This Academy delivers the technical information needed by engineers seeking knowledge that will assist in ensuring personal and organizational success.

I invite you to register for one of the two scheduled dates of the **2011 Diesel Engine Technology Engineering Academy**. In the United States register for **June 6 – 10 at the SAE International® Automotive Headquarters** in Troy, Michigan. **Or register for July 18 – 22 at Delphi Diesel Systems Ltd., Warwick, UK—the first ever offering in Europe**. You will experience five days of intensive training comprised of lecture, demonstration, structured practical sessions, and case problems for immediate knowledge transfer.

After reviewing the enclosed information, I think you'll agree this could very well be the most results-oriented diesel engine technology course on the market. If you have questions or would like more information about the Diesel Engine Technology Engineering Academy, please contact SAE Customer Service – US dates: 1-877-606-7323 or 1-724-776-4970 or UK dates: +32 (0)2 740.2223. I look forward to seeing you at this year's Academy!

Sincerely,



Magdi Khair

Lead Instructor, SAE Diesel Engine Technology Engineering Academy

Institute Engineer; Engine, Emissions, and Vehicle Research Division Southwest Research Institute



Magdi Khair

About our UK host:

Delphi is a leading global supplier of mobile electronics and transportation systems for original equipment and the aftermarket, including powertrain, safety, thermal, controls & security systems, electrical/electronic architecture and in-car entertainment and communication technologies. Recognized for operational execution with a global manufacturing footprint - strategically located to support our customers, operating major technical centers, manufacturing sites and customer support facilities in 30 countries, Delphi delivers real-world innovations that make products smarter and safer as well as more powerful and efficient. Committed to the Kind of Innovation that Will Keep Our Planet Green and Its Occupants Safer and More Connected. Connect to innovation at www.delphi.com

About the Diesel Engine Technology Engineering Academy

SAE Engineering Academies provide comprehensive and immersive training experiences, helping new and re-assigned engineers become proficient and productive in a short period of time. Join us for this dynamic event, covering the diesel engine engineering principles and practices necessary to effectively understand a modern diesel engine. Types of engines addressed include naturally aspirated, turbocharged, pre-chamber, open chamber, light duty, and heavy duty.

Agenda highlights:

- Copy of the text, *Diesel Emissions and Their Control*, co-written by Magdi Khair, is included
- Technical tour
- Comprehensive & immersive training
- Hands-on equipment demonstrations
- Case study problem solving with project teams
- Principles and practices necessary to effectively understand the modern diesel engine
- Expert instructors who are experienced and knowledgeable

Practical Component:

This Academy includes several practical activities, including a team-solved case study and a diesel engine facility tour.

Pre-Academy Activity:

Prior to the Academy, you will be asked to complete a pre-assessment. Results will be shared with the lead instructor to help customize the learning experience to specific attendee needs.

This Academy Prepares You To:

- Articulate basic diesel engine terminology and principles
- Describe the key features of the basic types of diesel engines
- Compare various diesel fuel injection systems and their components
- Analyze the effects of different fuels on engine performance and durability
- Compare the function and applicability of various air management systems
- List the various emission standards and testing requirements
- Detail the elements of post-combustion emission control devices
- Discuss emerging diesel engine technologies

Who Should Attend:

Engineers who design diesel engines in the following types of vehicles:

- Passenger cars
- Light trucks
- Heavy trucks
- Off-highway vehicles
- Farm machinery

Technical Tours

United States – Troy, Michigan

Bosch Farmington Hills Diesel Facility Farmington Hills, Michigan, USA

After a short briefing, participants will tour the facility and see applications of high-pressure diesel fuel injection characterization and analysis, the diesel fuels lab, and a diesel passenger car display.

Special thanks to Vince Piacenti and Bosch Automotive

United Kingdom – Stonehouse, Warwickshire

Delphi Stonehouse Plant Stonehouse, UK

The Delphi Stonehouse plant manufactures Heavy Duty Diesel Injection Systems for trucks, buses, off-highway vehicles and marine applications for use throughout the world. A tour of this facility has been arranged which will include a short briefing on the facility followed by a tour of the manufacturing area, including a review of the 2,500bar FIE manufacturing line.

Special thanks to Mike Rayne, Bharat Fatania, and Delphi

DAY ONE

- Opening Remarks & Introductions
- Terminology and Performance Parameters
- The Case for the Diesel Engine
- Air Management Systems
 - Turbocharging and supercharging
 - Purpose of turbocharging
 - Supercharging vs. turbocharging
 - Thermodynamic principle of turbocharging
 - Description of turbocharger
 - Performance of turbomachinery (swallowing-lines)
 - Types of turbochargers (fixed, variable, waste-gate)
 - Special arrangements (sequential, turbo compounding)
 - An exercise in turbomatching
 - New role of turbochargers in EGR control
 - Superchargers
 - Mechanically driven
 - Electrically driven
 - Hydraulically driven
 - Role of superchargers in modern diesels
- Fuel Injection Systems I
 - Requirements and function
 - Injection timing
 - Injection metering
 - The fuel injection system
- The Fuel Injection Systems II
 - Types of fuel injection systems and main components
 - Diesel control
 - Mechanical Governor
 - Electronic control systems
- Fuel Injection Systems III
 - Nozzle and nozzle holders
 - Application
- European Diesel Engines
- Modern Technology Engines & Fuel Systems

DAY TWO

- Thermodynamics I
 - First Law
 - Energy balance for a closed system
 - Energy balance for an open system
 - Property Evaluation
 - Second Law
 - Definition of entropy
 - Irreversibility
 - Entropy balance for a closed system
 - Entropy balance for an open system
 - Definition of availability
 - Availability balance
 - Air standard cycle analysis
 - Otto cycle
 - Diesel, Dual, Atkinson, Miller cycles
 - Lessons to be learned from air standard cycles
 - Effect of compression ratio
 - Effect of fuel H/C ratio
 - Effect of combustion timing
 - Chemical reactions
 - Stoichiometry (balancing chemical reactions)
 - Definition of equivalence ratio
 - Calculating exhaust gas composition from F/A ratio
 - Calculating F/A ratio from exhaust gas composition
 - Computation of brake specific emissions
 - Energy equation with chemical reactions (combustion reactions)
 - Adiabatic flame temperature
 - Higher/lower heating value
 - Detailed example of energy balance on engine
 - Fuel energy in=coolant + exhaust + work out
- Thermodynamics II: Combustion in Diesel Engines
 - Basic combustion theory - definitions and concepts
 - Complete combustion vs. Equilibrium composition (dissociation)
 - Equilibrium assumption vs. kinetics (rate limited reactions)
 - Global vs. elementary reactions
 - Basic flame theory (Ignition, flame propagation & speed, quenching, flammability limits)
 - Basic combustion theory - definitions and concepts
 - Autoignition theory
 - Hydrocarbon combustion
 - Laminar and turbulent flame speeds
 - Premixed and diffusion combustion
 - Diesel combustion
 - Phenomenological description of diesel combustion
 - Ignition delay, premixed combustion, diffusion combustion
 - Burning rate diagram (heat release diagram)
 - Combustion chamber design considerations
 - Relationship between air motion, fuel injection system (injection pressure, number of nozzle holes, orifice size), and combustion chamber geometry (bowl size and shape)
 - Modeling the diesel combustion process
 - Fuel-air standard Otto cycle/Diesel cycle (Assumptions, Thermodynamics)
 - Single zone models-heat release type (Assumptions, Thermodynamics)
 - Multi-zone models, phenomenological models
 - CFD modeling
 - Lessons to be learned from each approach
 - Advantages/disadvantages of each approach
 - Heat release analysis
 - Collection of cylinder pressure data (transducers, encoders, data acquisition)
 - Analysis of cylinder pressure data (smoothing, frequency characteristics, mean effective pressure)
 - Heat release model (Krieger and Borman assumptions)
 - Interpretation of heat release diagrams
 - Diesel Combustion & Emissions in DI Engines
 - Review of previous discussion on diesel combustion

- Premixed/diffusion combustion
 - Effect of low temperature, low cetane number
 - Effect of turbocharging
- Factors affecting the combustion process
 - Injection pressure
 - Air swirl
 - Atomization
 - Penetration
 - Drop size distribution
 - Vaporization
 - Ignition delay
- Combustion influence on fuel economy
 - Effect of heat release
 - Effect of heat transfer -Compare to "adiabatic" engine results
- Combustion influence on emissions
 - Origin of hydrocarbon emissions
 - Origin of carbon monoxide
 - Origin of NOx emissions
 - Relation to premixed combustion, aromatic content of fuel, cetane number
 - Origin of particulates and smoke
 - Relation to diffusion combustion
 - Effect of fuel sulfur
- Tradeoffs
 - BSFC vs. NOx
 - NOx vs. particulates
 - HC vs. ignition delay
- Effect of ignition timing on heat release rate and cylinder pressure
 - Effect of timing of combustion, ignition delay
- Effect of injection pressure on heat release rate and cylinder pressure
 - Effect of mixing rate on diffusion combustion
- Fuels Technologies
- Presentation of Case Study & Team Session

DAY THREE

- The Role of Lube Oil in Modern Diesel Engines
 - How are Lubricants Specified
 - Viscosity Grades, Quality
 - Lubricant Performance Categories:
 - North America
 - Europe
 - Japan
 - OEM Specifications
 - Future Developments - Low Emission Fluids
 - Composition of Typical Crankcase Lubricants
 - Drivers for Novel Lubricant Development
 - Aftertreatment Compatible Lubricants: SAPS
 - Beyond Current Lubricant Specification - System Approach
- Engine Controls I
 - Engine Controls and Diagnostics
 - Electronic fuel injection system control
 - Control system architectures and hardware
 - Fundamentals of control
 - Design approaches for diesel engine controls
- Development methods
 - Application requirements
 - Fuel injection volume, timing and rate shaping
- Engine Controls II
 - Vehicle aspects
 - Ancillary system control and integration
 - Variable geometry turbocharger control
 - EGR scheduling and control
 - Control of other subsystems - today and tomorrow
 - Adaptive controls and the future
- On-Board Diagnostics
 - Legal Requirements
 - Fault Detection & Resolution
 - Fault Resolution
 - Diagnostic Tools - OBD and General
 - Future Paths
 - Noise
 - Simulation in Diesel Engines
- In-Cylinder Measures to Control Emissions

DAY FOUR

- In-Cylinder Measures to Control Emissions
 - Passive Regeneration Systems
- Diesel Exhaust Aftertreatment I
 - Exhaust system-based emission reduction technologies (aftertreatment)
 - NOx reduction catalysts
 - Selective Catalytic Reduction
 - With Supplemental HC
 - With Urea and Ammonia
 - Lean NOx Traps
 - Diesel Particulate Filters
 - Active Regeneration Systems
- Diesel Exhaust Aftertreatment II
 - Combination Trap/Catalyst Systems
 - Catalyst Assist
 - Catalytically Regenerated Traps
 - Special Aftertreatment Systems
 - Non-Thermal Plasma
 - Non-Thermal Plasma Assisted Catalysts
- Technical Tour - Bosch Farmington Hills Diesel Facility
- Case Study Presentations

DAY FIVE

- Diesel Exhaust Aftertreatment III
 - Combination Trap/Catalyst Systems
 - Catalyst Assist
 - Catalytically Regenerated Traps
 - Special Aftertreatment Systems
 - Non-Thermal Plasma
 - Non-Thermal Plasma Assisted Catalysts
- Engine Performance Simulation
- Emerging Technologies
 - Variable Valve Actuation
 - Camless Valvetrain
 - Air Hybrids
- Academy Wrap-up and Evaluation

***Diesel Academy agenda may differ from published agenda;
visit www.sae.org/academies for agenda updates**



Magdi Khair, Lead Instructor, is an Institute Engineer in the Engine, Emissions and Vehicle Research Division for Southwest Research Institute. Mr. Khair's expertise focuses on engine emissions testing, calibration of fuel injection systems, development of intake manifolds, optimization of intake ports, development of electronic engine controls, and exhaust emissions controls. Mr. Khair received a B.S. in Automotive Engineering from Ain Shams University, an M.S. in Thermodynamics from the University of Birmingham, England, and an M.B.A. from Michigan State University.



Ewa Bardasz is currently a Principal Scientist at The Lubrizol Corporation. Her work in detailed understanding of lubricant behavior related to corrosion inhibition in petroleum and aqueous systems, structure/performance studies of the metal surface/lubricant interactions, compositions of lubricants for low heat rejection engines, fuel conserving diesel engine lubricants, and lubrication of ceramic surfaces has led to numerous technical publications and over 20 patents. Dr. Bardasz received her Ph. D. in Chemical Engineering from The Case Institute of Technology.



André Boehman a Professor of Fuel Science and Materials Science and Engineering in the Department of Energy & Geo-Environmental Engineering in the College of Earth and Mineral Sciences the Pennsylvania State University. At the Penn State Energy Institute, Prof. Boehman manages the Diesel Combustion and Emissions Laboratory. His present research activities are focused on alternative diesel fuels, diesel combustion, and diesel exhaust aftertreatment. He holds a B.S. in Mechanical Engineering from the University of Dayton (1986), an M.S. and a Ph.D. in Mechanical Engineering from Stanford University.



Bernard Challen an engineering consultant and currently serves as a member of the SAE International Board of Directors. His technical areas of interest include electronics and control, the use of computer-aided engineering tools, and vehicle noise and vibration. Mr. Challen is a recipient of the SAE Forest R. McFarland Award, was elected an SAE Fellow, and is a SAE Medal of Honor recipient. Mr. Challen earned a B.Sc. (Eng.) in Mechanical Engineering and M.Sc. Noise and Vibration from the Institute of Sound and Vibration Research, Southampton University.



Philip Dingle is a Diesel Technology Specialist in the Advanced Engineering Innovation Center at Delphi Diesel Systems. His previous experience includes the R&D group of Lucas Diesel Systems where he worked on several advanced engine and fuel system technologies and has gained broad experience in achieving performance and emissions targets from both DI and IDI combustion systems. He holds twelve US or European patents for fuel system innovation. He received his engineering education in England.



Michael Levin holds the position of Technical Expert at Ford Motor Company. His current responsibilities include development of hydrocarbon and urea dosing for advanced diesel aftertreatment systems. Mr. Levin has co-authored 18 publications and holds 13 patents. He received his M.S. in Mechanical Engineering from Moscow Automobile and Road Institute in Russia.



Helmut Tschoeke Professor and Head of the Chair of Reciprocating Machines at the Institute of Mobile Systems. During his career he held positions as Department Head, Chief Engineer, and Executive Plant Manager. Dr. Tschoeke's credentials include the Dipl.-Ing. and Dr.-Ing from the University of Stuttgart and an honorary doctorate from the Technical University of Kiev.

John E. Wilken, is currently a Principal Engineer at Gamma Technologies, Inc. (GTI). As lead engineer of software design at GTI, Mr. Wilken has been instrumental in the development of GT-POWER, engine cycle simulation software for engine performance, acoustics, turbocharger matching, and combustion. Mr. Wilken is a graduate of the University of Illinois at Urbana-Champaign. He will present the Engine Performance Simulation module during the June Academy in Troy, MI.

Mike Rayne, our host for the Diesel Technology Engineering Academy in Europe is the Vice President of Delphi Diesel Operations, Delphi Product & Service Solutions will be presenting the Modern Technology Engines & Fuel Systems module during the July Academy in Warwick, England.

Les Smith, Principal CAE Analyst at Jaguar-Land Rover, will present the Engine Performance Simulation module during the July Academy in Warwick, UK.

To view the complete instructor biographies, visit www.sae.org/pdevent/ACAD03

Registration Information

US Event Registration:

Fees: \$3,345

SAE Members -

Classic: \$3,011

Premium: \$2,843

Elite: \$2,676

Register for US date:

- Call SAE Customer Service at 1-877-606-7323 (outside the US & Canada) 1+724-776-4970 or
- Email to CustomerService@sae.org or
- Visit the Web site at www.sae.org/pdevent/ACAD03 and click on the US registration
- When registering refer to Product Code ACAD03

The fee for this program includes handout materials, continental breakfast, lunch each day, and dinner when evening sessions are conducted. Telephone registrations must be guaranteed with a credit card. Registration for this Engineering Academy is limited to 30 participants.

Academy Site

The Diesel Engine Technology Engineering Academy will be conducted at the SAE Automotive Headquarters, PNC Center, Suite 1600, 755 West Big Beaver Road, Troy, Michigan 48084, USA; 1-248-273-2455.

Cancellations

If you cannot attend, you may send a substitute or transfer to a future offering. A full refund is issued if you notify SAE at least 14 days prior to academy start date. If canceled less than 14 days prior, the full fee is charged. For \$50, you may process a onetime transfer to a future offering within one year of canceled academy. Canceling may reduce group discounts. To cancel, transfer or send a substitute, call SAE Customer Service (numbers listed above).

Continuing Education Units

Upon completion of the Academy, students will receive a Certificate of Achievement awarding 4.0 Continuing Education Units. CEUs are a nationally recognized unit of measurement based on one CEU for every ten hours of classroom contact. This Academy is approved for IACET CEUs.

SAE Customer Service

1-877-606-7323 or 1+724-776-4970

CustomerService@sae.org

UK Event Registration:

SAVE £100 on your fee when you register no later than 17 June 2011

Fees: £2,400 +VAT

SAE Members -

Classic: £2,160 + VAT

Premium: £2,040 + VAT

Elite: £1,920 + VAT

Register for UK date:

- Call SAE Europe Training Customer Service at +32 (0)2 740.2223 or
- Email to EuropeTraining@sae.org or
- Visit the Web site at www.sae.org/pdevent/ACAD03 and click on the UK date
- When registering refer to Product Code ACAD03

The fee for this program includes handout materials, continental breakfast, lunch each day, and dinner when evening sessions are conducted. Telephone registrations must be guaranteed with a credit card. Registration for this Engineering Academy is limited to 25 participants.

Academy Site

The Diesel Engine Technology Engineering Academy Europe is hosted by Delphi and will be conducted at Delphi Diesel Systems Ltd, Spartan Close Warwick, Warwickshire, UK CV34 6ag (CV34 6RS if using a Satnav)

Cancellations

If you cannot attend, you may send a substitute or transfer to a future offering. A full refund is issued if you notify the SAE International® European office +32 (0)2 740.2223 at least 14 days prior to academy start date. If canceled less than 14 days prior, the full fee is charged. For £50, you may process a onetime transfer to a future offering within one year of canceled academy. Canceling may reduce group discounts. To cancel, transfer or send a substitute, call SAE Europe Training Customer Service (number listed below).


SAE Europe Training

+32 (0)2 740.2223

EuropeTraining@sae.org

Hotel Accommodations

Hotel reservations and ground transportation to and from the Academy sites are the responsibility of the attendee. For hotel and travel information visit www.sae.org/academies, click on Diesel Academy, then Hotel & Travel Information or contact Customer Service – US event: 1-877-606-4323; UK event: +32 (0)2 740.2223

 SAE will do what is feasible to make its events reasonably accessible to attendees. If you have special accommodation needs, please let us know in advance of how we can serve you better. Accommodations requested on-site will be provided only if possible for us to do so on short notice.

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