

# **Heat Transfer and Engine Cooling**

*University of Wisconsin, Engine Research Center*



## **Day 1 AM**

### **In-Cylinder Heat Rejection**

This course begins within the cylinder, taking a detailed look at the convection process throughout the engine operating cycle and radiation during combustion. Temporal and spatial variations in gas temperature, velocities, and the thermal boundary layer are discussed. Measurement techniques are presented. The correlations used to describe heat transfer in engine simulation, and their physical rationales are then discussed. Approaches to heat transfer in multi-dimensional modeling are presented. The section concludes with a discussion of boundary conditions for combustion chamber component analysis.

## **Day 1 PM**

### **Component Temperature Control**

This section addresses each of the combustion chamber components in turn, and covers the critical temperature control issues. The discussion will include thermal fatigue of the cylinder head and piston crown; the role of temperature control in spark-ignition engine knock; piston ring and land temperature and deposits; and valve temperature control. Examples from analysis and experiment will be presented on each topic. Further aspects of temperature control such as lubricant temperature, intake charge heating, and port and manifold temperatures will also be discussed.

## **Day 2 AM**

### **Cooling Jacket and Circuit Design**

The use of oil, ambient air, and glycol/water solutions for cooling will be briefly discussed. Most of the focus will then be on cooling jacket optimization in water-cooled engines. Experimental, flow visualization techniques for jacket design optimization will be presented. The use of computational fluid mechanics in jacket design will also be covered. Attention will then turn in more detail to the roles of the engine lubricant in cooling. Much of the focus will be on piston cooling techniques, but other aspects of heat transfer to and from the oil will also be covered.

## **Day 2 PM**

### **Cooling System Components and Analysis**

This section begins by discussing various approaches to coolant circuit layout. Component design and testing (water pumps, thermostats) will then be covered. The course will conclude with a discussion of cooling system analysis. Circuit and system analysis software will be demonstrated, and cooling system testing will be discussed with examples.