This course can be adapted to virtual classroom mode

Engine Cooling & Environment

2 days **REFEM-EN-A**

Overview

LEVEL

Expert

PURPOSE

This course provides a deeper knowledge and competencies on engine thermal behavior and the vehicle energy management through “external” cooling systems.

LEARNING OBJECTIVES

Upon completion of the course, participants will be able to:

know the main associated stakes,

implement a new engine in a new vehicle,

quickly size the cooling system and suggest the required trade-offs.

WAYS AND MEANS

This training uses simple exercises of cooling system sizing, giving orders of magnitude.

Clear progression from simple cooling loop up to very complex thermal management of hybrid electric vehicles.

In parallel many components, new, used or faulty will be circulated.

The last 0.5-day is dedicated to simulation of various in-use situations.

Agenda

ENGINE COOLING & EXTERNAL CIRCUITS — 0.4 d

Engine cooling requirements, cooling systems types, convection air system, induced air system, liquid system.
Engine heat balance, thermal power to be evacuated.
Automotive liquid cooling circuit architectures, engine internal component (water pump, thermostat), external components (exchangers, fans, …), split-cooling, coolant, non-automotive applications.

IMPACT ON VEHICLE - HOW DO THE INTERNAL COMPONENTS WORK? — 0.4 d

Cooling air circuit: air inlet, electric fan.
Coolant circuit: main radiator, engine oil cooler, transmission oil cooler, EGR cooler, passenger compartment heater core, charge air cooler, expansion tank, degassing tank.

CONTROL & DRIVING - APPROACH TO ENERGY MANAGEMENT — 0.5 d

Control parameters: temperature, pressure, flow.
Control units, sensors: thermostat, thermal switch.
Control units, actuators: driven thermostat, motorized shutters, multi-ways valves.

THERMOMANAGEMENT - THERMAL & ENERGY MANAGEMENT — 0.5 d

Objectives of thermal management.
Different ways for thermal management: electric water pump, split-cooling, multiways valves, multi temperature loops, multi-fluids loops.

Management of the passenger cab thermal comfort/fuel economy/emissions/reliability trade-off: emissions constraints, fuel economy constraints.
Strategies for thermal recovery: storage, exhaust calories recovery with a Rankine cycle, exhaust calories recovery with thermo-electricity.

THERMAL & ENERGY MANAGEMENT OF HYBRID & ELECTRIC VEHICLES

0.5 d

Objectives of the thermal management.
Passenger cab thermal management: use conditions, critical conditions, impact on fuel economy, solutions.
Thermal management of electric components: objectives, solutions for thermal/electric hybrids, solutions for full electric vehicles.

UNDER HOOD THERMICS

0.5 d

Identification of heat sources, impact of exhaust gas after-treatment systems.
Temperatures, hot air flow, components protection through thermal barrier, convective cooling or liquid cooling. Passenger cab thermal insulation.

SIMULATION EXERCISES

0.5 d

Application of the above chapters.
Sizing of the main cooling system components.
Simulation of the most severe in-use situations (max speed, hill climbing with trailer, zero flow) with GT Power software.
Choice of thermal strategy and components selection.