This course can be adapted to virtual classroom mode

Vehicle Emissions

3 days **PRESTAE-EN-A**

Overview

LEVEL

Expert

PURPOSE

This course provides a deeper knowledge and competencies on emissions and after-treatment systems.

LEARNING OBJECTIVES

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

know the fundamentals on the physics of the combustion and the mechanisms of pollutants formation,

master the contribution of alternative engines to atmospheric pollution phenomena,

know the regulations restrictions,

know the nature of the emitted pollutants,

use emission reduction levers at source,

know testing methodologies, the standard tools used to measure pollutants (gas analyzers, opacity meters), the kind of measurements and analyses done on exhaust gases,

understand on board diagnostics (OBD) requirements,

know how the gasoline and diesel fuel characteristics affect the engine behavior,

understand the structure of engine management system and its impact on emissions.

Agenda

AIR POLLUTION, ROOTS & CONSEQUENCES, REGULATIONS — 0.5 d

Fundamentals of combustion.
Mechanisms of pollutants formation.
Primary and secondary pollutants.
Regulated and non-regulated pollutants (NRP).
Regulations: CO_2, emissions, WLTP.
Influence of vehicle characteristics and powertrain adaptation on emissions (cost down, inertia class, gear ratios, …).
Homologation.
Production conformity.

ATMOSPHERIC PHENOMENA — 0.25 d

Air quality: space (local or global) and time scales. Consequences and impacts.
Phenomena: ozone layer, greenhouse effect, acid rains, photochemical smog, …
Air quality standards, regulations applied to the car emissions and approval cycles.

TESTING METHODOLOGY - MEASUREMENTS ON ENGINES & EXHAUST GAS ANALYSIS — 0.25 d

Measurements of pollutants on engine test bench.

Measurements of exhaust emissions and evaporation losses on chassis dynamometer: operation of a chassis dynamometer, key features to monitor, calibration of analyzers, control of the stability of analyzers/ control of leaks, conditioning of the vehicle.
Evolution of analysis materials: trends and developments.

EMISSIONS REDUCTION LEVERS AT SOURCE

1 d

Diesel: combustion, mechanisms of formation of pollutants, influence of engine parameters, operating limits, injection equipment, air loop engine management, fuel impact, calibration.
Gasoline: combustion, mechanisms of formation of pollutants, influence of engine parameters, operating limits, injection equipment, air loop engine management, fuel impact, calibration.

EXHAUST GAS AFTER TREATMENT OXIDATION & TRI-FUNCTIONAL CATALYSIS

0.75 d

Oxidation and tri-functional catalysis:
Automotive exhaust catalysis: catalytic reactions, mechanisms, catalysts, precious metals, performance criteria, functional definitions (conversion rate, after-treatment related constraints, gasoline and Diesel).
Oxidation catalysis: efficiency, field, initiation, conversion rate, case of methane, sulfur and particles oxidation.
Tri-functional catalysis: stoichiometric conditions, air/fuel ratio control, cold conditions (HC, exhaust thermal management), high power loop opening.
Catalysts ageing: ageing nature, thermal (temperature and sintering), chemical (poisoning), by the accumulation of deposits coming from the lubricants, the fuels or the additives. Functional limit of catalysts ageing.
Nitrogen Oxides Treatment:
NOx traps: operating principle (storage mechanisms, range of temperatures to use, rich mixture reduction phase), trap desulfurization.
Selective reduction catalytic (SCR): by ammonia, urea injection strategy, use restrictions. “Clean-up” catalysts.
Particulate filter: filtration element structure and composition regeneration strategy either by fuel additive, fuel born catalyst or by Catalytic diesel Particulates Filter (CdPF). Use of the 5^{th} or the 7^{th} injector.
Installation on the vehicle: evolution towards the 4-way catalysis: in the same converter, combining the particulate filter of a nitrogen oxides treatment system (SCR or non-trap) with an oxidation catalyst.

DIAGNOSIS & OBD REGULATIONS

0.25 d

Introduction to the OBD in France and in the world.
Evolutions.
OBD homologation.
OBD validations.