This course can be adapted to virtual classroom mode

Module 3S: Diesel Engines

4 days **MOT3S-EN-A**

Overview

LEVEL

Knowledge

PURPOSE

This course provides technical knowledge on Diesel engines for cars and industrial vehicles and the knowledge of the operating parameters.

LEARNING OBJECTIVES

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

know how direct injection Diesel engines work: ignition physics, design and adjustment parameters optimization,

master high pressure injection systems operation and evolution,

understand how Diesel fuel characteristics affect the engine behavior,

select a depollution strategy and an after-treatment system,

match a turbocharger with an engine,

explain the evolution of the main parameters (pollutants, CA50, CSE, SMEs, volumetric efficiency, energy release, the different yields, …): a change of injection advance, a change of rail pressure, a change of EGR rate, a change of boost pressure, a change of injection quantity,

specify a type of test campaign for the basic settings of Diesel engine with DOE.

WAYS AND MEANS

To practice the knowledge on simulator using combustion models developed with GT Power: to understand the influence of various parameters settings on a supercharged EGR Diesel engine; to know how to conduct a test and analyze the data.

Lecturers are industry experts, delivering real life examples.

Use of numerical simulator: active learning.

The participant can directly visualize the influence of each engine parameter.

MORE INFO

The Diesel Engineers course may replace module 3 for participants who wish to have a 5-day enhanced version.

Agenda

COMBUSTION SYSTEM OPTIMIZATION — 1 d

Pollutants formation mechanisms
Formation conditions of particles, nitrogen oxides, unburnt hydrocarbons, carbon monoxide. Representation in a temperature-air/fuel ratio diagram. Influence of injection pressure, swirl, injection advance parameters.
Fuel jet gas and liquid parts behaviors.
Combustion system optimization
Streamline inlet: swirl roles and measurement; trade-off with cylinder head tightness.
Drawing of the cavity (bowl) machined in the piston head.
Injection system required qualities.
Combustion noise. Advantage of multiple injections.

Exhaust gas recirculation (EGR)
How it reduces nitrogen oxide rate. Interest of EGR cooling.
High and low pressure EGR.
Start and cold start
Combustion deterioration factors causing fumes and noise.
Structure and control strategy of glow plugs used on car engines.

SUPERCHARGING

0.5 d

Turbocharger operating and technology.
Turbocharger adaptation process on an engine: determining the flow and the density in the intake manifold, choosing the supercharger, calculating the flow and the turbine expansion ratio, choosing the turbine.
Fixed or variable geometry turbocharger (FGT or VGT), supercharging by two sequential turbochargers.

COMPRESSION IGNITION ENGINE FUEL CHARACTERISTICS

0.5 d

Diesel fuel main characteristics and specifications (density, cetane rating, viscosity, lubricating capacity, volatility, sulfur, …) and impact on the engine behavior, additive properties.
Impact of the fuel composition on the regulated and non regulated pollutant emissions.
Biofuels: vegetable oil esters.

INJECTION SYSTEM TECHNOLOGY & MONITORING

0.5 d

Common-rail injection system: system description; systems evolution.
High pressure pump; high and low rail pressure control.
Fuel injector operating; flow in the injector nozzle, hydraulic flow.
Rail technology; flow balance.

EXHAUST GAS AFTER-TREATMENT

0.5 d

Regulations evolution, depollution strategies.
Oxidation catalysis: efficiency, initiation temperature, sulfur effect, positioning in the exhaust line.
Nitrogen oxides after-treatment: NOx traps, selective reduction catalyst (SCR).
Diesel particles after-treatment: Diesel particle filter (DPF); DPF regeneration with additives in the fuel or by filter catalytic coating; associated engine monitoring strategy.

SIMULATOR: ENGINE CHARACTERIZATION

1 d

The proposed simulator is a virtual engine bench on which we will conduct virtual testing by varying the parameters to show their impact:
Change of injection advance.
Change of rail pressure.
Change of EGR rate.
Change of boost pressure.
Change of injection quantity.
Study of the evolution of the engine main parameters (pollutants, CA50, CSE, SMEs, volumetric efficiency, energy release, specify type of test campaign for the basic settings of Diesel engine with DOE.
Curves analysis from an engine bench.