Engine Design

4 days	MOT/COMOT-E
Overview	

LEVEL

Advanced

PURPOSE

This course provides participants a deeper knowledge & competencies to design and use dimensioning criteria of reciprocating piston engines, particularly those for automotive applications.

LEARNING OBJECTIVES

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

choose the architectures of a new engine at pre-project stage: cubic inch displacement, bore-stroke ratio, cylinder head and block structures, timing drive,

select and use the adequate criteria to develop the cam laws,

use the main rules applied to block and cylinder head design,

choose materials for the main engine components and explain their selection.

WAYS AND MEANS

Many applicative examples of the real life, dimensioning exercises managed by learners, focused cases study.

PREREQUISITES

IC Engine Fundamentals.

Agenda

ARCHITECTURE OPTIONS
0.5 d

Specifications of a new engine.
Determining the main dimensions: bore, stroke, cylinder spacing, depending on the specifications: MEP characteristics and piston mean velocity on engines of the same range.
Global design process of mobile coupling system, crankcase-cylinders, cylinder head, timing.

MOBILE PARTS DIMENSIONING
1.5 d

Kinematics and dynamics of the mobile parts.
Choosing the conrod spacing. Conrod swept volume. Calculation of stresses in the links.
Functions to be performed by the piston and the rings. Dimensioning of the pin and the bosses. Bushing dimensioning.
Conrod: ring and bushing shrink fitting, resistance to fatigue and buckling, connecting rod screws dimensioning.
Crankshaft: shape depending on the cylinders number, material, counterweight, stresses, crank pin pre-dimensioning method, dowels, crank web, lubrication system.
Balancing and dimensioning of the balancing shafts for an inline-four engine.

CRANKCASE-CYLINDERS & LOWER CRANKCASE
0.5 d

Crankcase-cylinders functions and stresses.
Choosing the engine bottom material and architecture.
Building the conrod chamber. Determining the crankcase height. Choosing water circulation.

Oil circuits, oil returns, blow-by chimneys.
Timing face, coupling face, side faces.

CYLINDER HEAD

`0.75 d`

Cylinder head functions. General choices of cylinder head architecture. Material. Definition of bore spacing: setting the clamps, the injector, the valves, the timing control.
Intake and exhaust pipes. Water core, oil core. Lubrication system. Processing constraints.
Calculation of cylinder head pillar pre-dimensioning.
Failure modes. Validation.

TIMING

`0.75 d`

Valve control and timing drive technologies.
Valves, valve guide and seats, wedges, springs.
Timing diagram, path section. Determining the lift law. Margin to valve hunting. Dimensioning criteria: stresses, Hertz pressure, wear, noise. Cam drive torque.
Calculation exercise of a cam on tappet symmetric lift law. Calculation codes, modeling.
Variable timing system.