

This course can be adapted to virtual classroom mode

## Lubrication & Lubricants

5 days  
Overview

LUBLUB-EN-A

### LEVEL

Knowledge

### PURPOSE

This course is an overview on lubricants, their functional properties and their impact on the functioning of the machines and provides a deeper knowledge on basic mechanical organs, their integration in the various automotive and industrial equipment and their principles of functioning.

### LEARNING OBJECTIVES

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

- know the different basic organs of the mechanic and the principles of their lubrication,
- understand the importance of lubricants standardization (classifications and specifications),
- understand the whole mechanisms involved in the lubrication of automotive and industrial equipment: friction, lubrication, forms of wear,
- know the chemical composition of lubricants (base oils and additives),
- understand the mode of action of lubricants and the relationship between the chemical composition and the required functional properties for the various applications,
- know the different methods for evaluating the physicochemical and mechanical properties.

### WAYS AND MEANS

Interactive exercises of questions-answers between the participants using sets of play cards to synthetize the essential points of the lectures.

## Agenda

### LUBRICATED MATERIALS & MECHANISMS

0.5 d

General description of the main mechanical organs (journal and antifriction bearings, gears) and their integration in the various industrial and automotive equipment.  
Functional properties of lubricants.

### CLASSIFICATIONS & SPECIFICATIONS OF LUBRICANTS

0.5 d

Lubricants rheology: the different types of flow behavior (Newtonian, non Newtonian, Bingham fluid, Maxwell fluid, thixotropic), variation of viscosity with temperature, pressure, deformation, measuring methods of the rheological properties, viscosity classifications of automotive and industrial lubricants. Classifications and specifications of industrial lubricants: ISO classifications 6743-99 and ISO 6743-xx, specifications.  
Service specifications of engine lubricants: API, ACEA, ILSAC.

### ELEMENTS OF TRIBOLOGY

0.75 d

Friction laws.  
Study of the different lubricating regimes (hydrodynamic, hydrostatic, elastohydrodynamic, boundary, mixed, squeeze film) and their mechanism of generation. Stribeck curve. Sommerfeld number.

Study of the different forms of wear, their mechanism, the way to fight against them (abrasive, corrosive, fatigue, contact corrosion, cavitation wear).

Relationship between wear and tribology parameters.

## COMPOSITION OF LUBRICANTS

1.75 d

Mineral base oils: ATIEL groups, requested properties following the type of lubricant, chemical composition, succinct review of the different refining operations, composition evaluation methods.

Synthetic base oils: ATIEL groups, the different types of synthetic base stocks, synthesis of the products, application areas and comparative properties with the mineral base stocks.

Vegetal oils: modes of obtaining, properties, modifications, uses.

Lubricants additives: chemical structure, properties and modes of action (detergents, dispersing agents, antioxidants, rust and corrosion inhibitors, viscosity modifiers, pour point depressants, extreme pressure and anti-wear additives, anti-foaming agents).

Solid lubricants: the different types, characteristics and properties, main uses.

## EVALUATION OF THE PROPERTIES

0.75 d

Physico-chemical testing methods: thermal and oxidation stability, thermal properties (flash points, ash, carbon residues), rust and corrosion protection, surface properties (foaming, air release, water shedding, particulate contamination evaluation and filterability, compatibility with elastomeric materials).

Mechanical testing methods: notions on engine testing, tests on mechanical organs (bearing tests, gear tests, hydraulic pump tests), simulation machines testing and laboratory tribometers (4-balls, FALEX, TIMKEN, CAMERON PLINT, SRV, ...).

Analytical methods of the composition: elemental and spectrometric analysis.

## PRINCIPLE OF FORMULATION OF LUBRICANTS & EXAMPLES

0.5 d

Formulation of industrial lubricants.

Formulation of engine lubricants.

## HYGIENE - TOXICITY - ENVIRONMENT

0.25 d

Elements on toxicity, hygiene, labeling.

Ecological label of lubricants.