UNITEST Marine Training Software Part 10 is the software package consisting of several independent educational modules.

The following modules are included:

1. Diagnostics of Modern Marine Diesel Engines.
2. ALFA Laval ORCA Offshore.
3. ALFA Laval Steam Boilers
Diagnostics of Modern Marine Diesel Engines

The diagnostics of marine diesel engines requires the knowledge about the engine operation principles but also the knowledge about the diagnostic methods, the diagnostic parameters and the reasoning rules. This applies especially in a case of the modern low speed diesel engines where the electronic control system can be used in order to partially compensate the negative influence of the engine deteriorating technical state on its operation.

The principles of the diagnostic parameter selection and their evaluation have been explained at the beginning of this training module. The main diagnostic methods especially those based on the analysis of the operational parameters have been discussed in detail. The problem of the main engine overload and the engine behaviour in the stormy weather has been presented as well.

The combustion process is the most vital for the diesel engine operation so its diagnostic methods have been discussed in detail. The typically available parameters like MIP, an exhaust gas temperature and a combustion pressure will be used for that purpose. The module includes the information how to analyse the indicator diagrams and how to compare them with the reference curves.
The another part of the diagnostic module describes the turbocharging system parameter selection, their mutual relations and the interpretation of their deviations. This includes also the concept of the model diagrams and the methods how to analyse the deviation time diagrams.
When evaluating the scavenge air pressure, the first step should be to compare the actual value of the scavenge air pressure with the value from the model diagram for the same engine power, and record the deviation.

This should be done at least once a week.

The diagnostic methods of the other important engine sub-systems like the cooling system and the lubricating system have been presented in this module as well. At the end of the teaching material the self-assessment tests have been included.
- Water content in the lubricating oil
- Lubricating oil pH
- Lubricating oil viscosity

Main bearing temperatures, if available
ALFA Laval ORCA Offshore

ALFA Laval ORCA Offshore is a system for desalinating seawater into fresh water under a vacuum, using a patented heat transfer technology with ALFA Laval plate heat exchangers.

The feed water is evaporated at sub-atmospheric pressure on one side of a heat transfer surface, producing pure water vapor. This vapor is compressed to rise its saturation temperature, and then condensed on the opposite side of each plate to produce freshwater or distillate. The feed water is pre-heated using latent heat from brine and distillate before the distillate is extracted from the distiller.

The ORCA Module explains the operating principles in detail including the animation showing the details of the heat exchanger operation.
The step by step operating procedures of the ORCA Offshore distiller have been included in the training module.

General

The plant can be in 3 different modes (and one mode only at a time):

- Manual
- Automatic
- Remote

When power is switched on, OPERATION picture is shown on the HMI.

The current login level is shown on the top of the HMI.

The current software version of the PLC and HMI program can be seen on the HMI.
The dedicated, 3D simulator of the ORCA Offshore is the important part of the training module. The trainee can operate the whole system but he can also change different setting of the automation system. The training material and the simulator have been approved by Alfa Laval.
**ALFA Laval Steam Boilers**

Alfa Laval boilers on ships are used for a steam supply for the various processes such as pumping, heating, cooling, cleaning and a hot water for the accommodation. Exhaust gas economizers after diesel engines are unfired and utilize the otherwise wasted heat from the exhaust gas of the diesel engine/gas turbine to produce energy/heating. Particularly on small vessels, a composite boiler can be an economical solution that saves space and reduces pumping needs.

Two most popular types of the ALFA Laval boilers have been described in this training module:

- **Aalborg OS-TCi** boiler is a vertical oil-fired auxiliary marine boiler with a burner body ready for mounting in the furnace and connection of pre-marked electric wiring. The control system supplied with the Aalborg OS-TCi boiler unit provides fully automatic operation of the boiler.

![Aalborg OS-TCi Boiler Diagram]

The Aalborg OS-TCi boiler is a vertical oil-fired auxiliary marine boiler with a shell (1) surrounding a cylindrical furnace (2), and a convective section consisting of helix smoke tubes (3). With burner insulated and assembled as a unit with the boiler mountings mounted on the boiler body. The boiler mountings (4) are mainly mounted on top of the boiler in order to allow a simple connection to the piping systems on board the ship.

- **Aalborg XS-2V** boiler is a smoke tube exhaust gas boiler with steam space used for heat recovery from engine exhaust gas. The steam space is formed by the shell plate and internal cone.

![Aalborg XS-2V Boiler Diagram]
The boiler construction details have been described in this module, together with the popular KBM burner.

The burner (5) is body ready for mounting in the furnace and connection of pre-marked electric wiring. The control system (6) supplied with the Aalborg OS-TCI boiler unit provides fully automatic operation of the boiler.
The special attention has been paid in order to describe the boiler control system and the operation including the step-by-step illustrated instruction.

**Start-up**

Before start-up of the boiler plant, some general work and check procedures must be considered.

**Step A:**
Check that the main steam valve, by-pass valve and circulation valves if provided, scum valve, and blow-down valves are closed.
Additionally, the dedicated 3D simulator is an integral part of the boiler training module.