**Management Level Simulator**
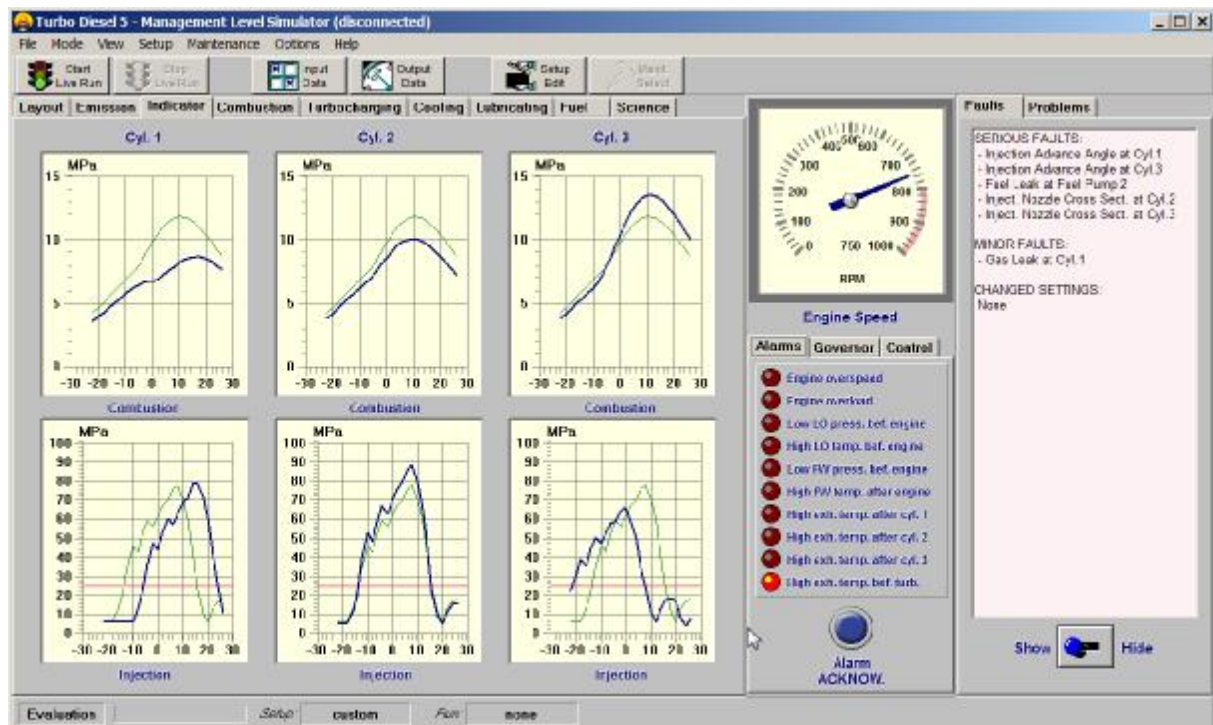
# Turbo Diesel 5

**Turbo Diesel 5** is a management level simulator which makes the engineer responsible for the operation and maintenance of a marine diesel engine. **Turbo Diesel 5** is particularly effective in teaching how load and other operating conditions affect engine parameters; fault recognition; breakdowns; and the relationship between engine technical state and maintenance actions. **Turbo Diesel 5** also simulates the influence of the engine technical state on the exhaust emission which is compared with MARPOL limit curve.



**Turbo Diesel 5** is an ideal complement to the marine engineer training syllabus. It enhances student's understanding of engine operations, and gives valuable transfer training to more experienced engineers.

**Turbo Diesel 5** has been developed to comply with:
- **STCW 2010 Code: Table A-III/2,** with the following **c**ompetencies:
  "Manage safe and effective maintenance and repair procedures" *including knowledge of planning maintenance and planning repairs.*
  "Detect and identify the cause of machinery malfunctions and correct faults" *including the location of faults and action to prevent damage, the adjustment of equipment and non-destructive examination.*
- **STCW Model Course 7.02 Function 3** "Maintenance and repair at management level".

**Turbo Diesel 5** has two main operation modes:
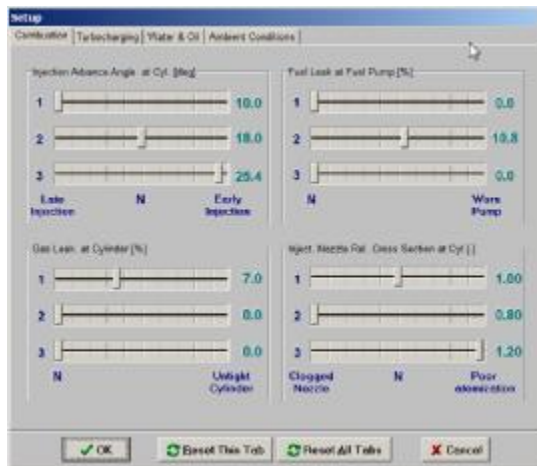


**Evaluation mode** (default): The trainee can freely change the technical state of the engine elements as well as the engine load and operation conditions. This includes the possibility of inspecting the present technical state of the engine elements. This mode can be used for testing the relation between the engine operation conditions or the technical state on one hand, and the engine operation parameters on the other hand.
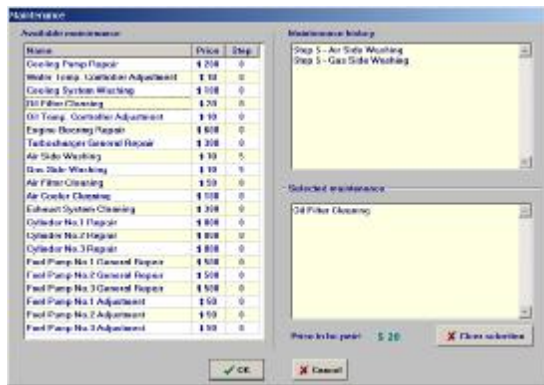


**Live Run mode**: Changes in the engine technical state are simulated automatically in the background. The trainee can perform maintenance and repair actions and change engine speed, but he cannot directly control the current technical state. Maintenance tasks have their conventional "prices" and all these expenses will be taken into account later while calculating the final results. Successful diesel operation gives the trainee certain "incomes"; so the final result is the difference between total income and total cost. Live Run is very useful for diagnostic knowledge assessment.

**Turbo Diesel 5** can display:
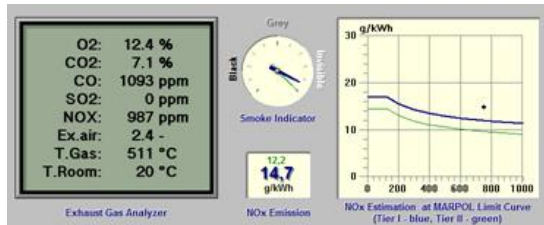


**Exhaust gas content:** The $O_2$, $CO$, $CO_2$, $NO_x$ concentration in the exhaust gases are displayed online. Many faults will influence this and an additional, customizable fine can be applied in Live Run mode for increased $NO_x$ emission which is also compared to the MARPOL limit curve.
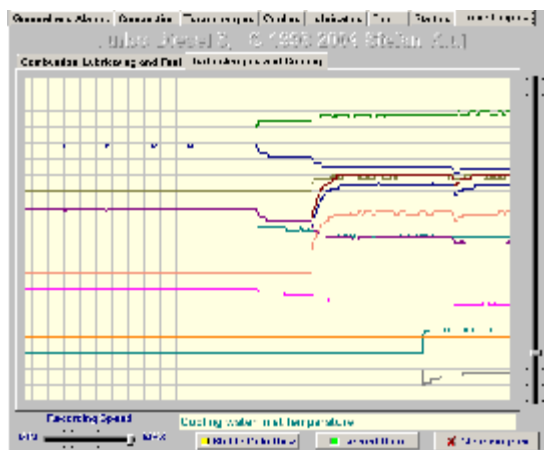


**Time diagram**: The time diagram shows parameter deviation change as a function of a time. This feature is especially useful in Live Run mode.
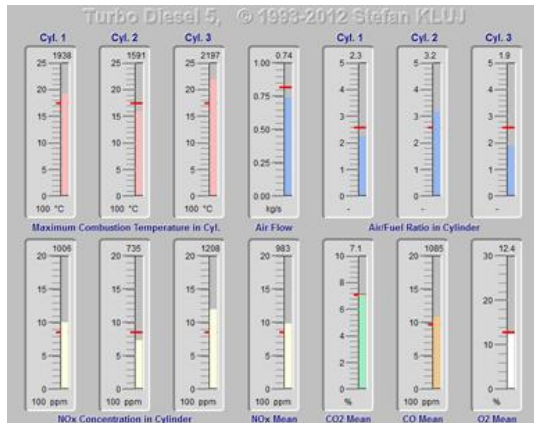
**Scientific Data:** A certain number of calculated engine data like max. combustion temperature, air flow, air/fuel ratio in cylinders or $NO_x$ concentration in single cylinders can be also displayed on request. This data is very useful for understanding how engine faults influence air pollution and what maintenance strategy should be followed for prevention. The instructor can select an information scope which is displayed on the screen. This feature is especially useful for knowledge assessment.



**Turbo Diesel 5** shows plenty of very useful information in Live Run Mode. Every day of the engine operation brings a certain profit counted in dollars. However, maintenance also has to be paid for and the cost of necessary, but not applied, maintenance will be added at the end. The cost of additional fuel consumption caused by poor engine technical state engine will be taken into consideration as well. Finally any fine for additional, unnecessary NOx emission will be counted. Every emergency stop caused by the engine bad technical state will receive a special fine. Typically, a score above 60% is necessary in order to pass the assessment.
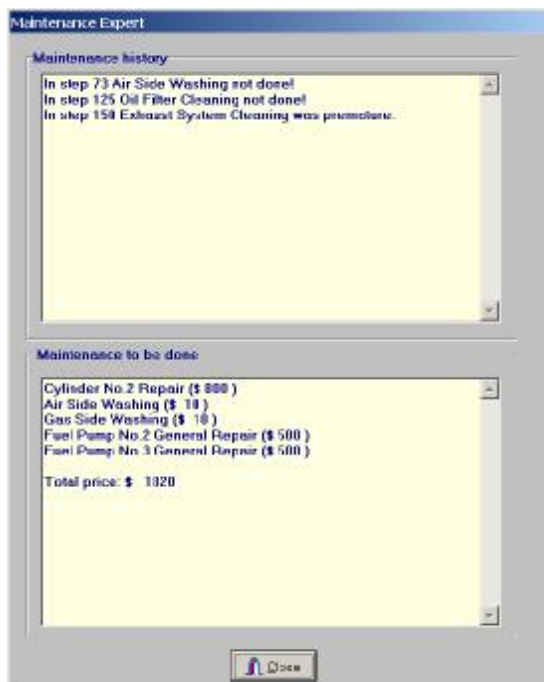


The **Maintenance Expert** can suggest necessary maintenance and evaluate what maintenance was necessary but not done. The upper **History** sub-window shows information about necessary (but not done) and unnecessary maintenance. This information is very useful when working in Run Replay mode. The lower **To Do** window shows all maintenance necessary in the current technical state. This feature is very useful, mainly in the early stages of training.

**The following engine parameters can be observed in Turbo Diesel 5:**
· set engine revolution speed
· set engine load
· actual engine revolution speed
- engine torque
- engine power
- engine specific fuel consumption
- engine mean effective pressure
- cylinder combustion pressure curves (for each cylinder separately)
- fuel pump injection pressure curves (for each cylinder separately)
- cylinder maximum pressure (for each cylinder separately )
- cylinder exhaust gas temperature (for each cylinder separately)
- cylinder mean indication pressure (for each cylinder separately)
- lubricating oil inlet pressure
- lubricating oil inlet temperature
- lubricating oil outlet temperature
- cooling water inlet pressure
- cooling water inlet temperature
- cooling water outlet temperature
- ambient air pressure
- ambient air temperature
- turbocharger revolution speed
- scavenge air pressure
- scavenge air temperature
- air flow
- exhaust gas pressure before turbine
- air pressure drop at the air filter
- air pressure drop at the air cooler
- air temperature after the air cooler
- exhaust gas temperature before turbine
- exhaust gas pressure after turbine

**The following simulations can be chosen and mixed in Turbo Diesel 5:**
- air filter - an increase of the air path resistance
- air blower - a decrease of the air flow efficiency
- gas turbine - an increase of the gas path resistance
- air cooler - a decrease of the air resistance
- gas leak through the piston rings or valves (or both)
- fuel effective quantity decrease
- injection advance angle change
- decrease of cooling efficiency
- friction coefficient increase
- set engine speed change
- engine load change
- ambient air (pressure and temperature)
- air cooling water flow change
- cylinder cooling water temperature
- lubricating oil temperature change
- lubricating oil pressure drop at the oil filter
- clogged and worn injector nozzle

**The following maintenance and repairs can be simulated in Turbo Diesel 5:**
- cooling pump repair,
- water temp. controller adjustment,
- cooling system washing,
- lubricating pump repair,
- oil filter cleaning,
- oil temp. controller adjustment,
- engine bearing repair,
- turbocharger general repair,
- air side washing ,
- gas side washing,
- air filter cleaning,
- air cooler cleaning,
- exhaust system cleaning,
- cylinder general repair (piston rings and cylinder head)
- fuel pump general repair,
- fuel pump adjustment.
- injection valve repair.

**Hardware and software requirements:**
- PC-class computer (min. Pentium i3)
- minimum 2 GB of RAM (recommended 4 GB)
- hard disk drive with about 300 MB free space
- graphic adapter, working with min. resolution 1280x768, 512 MB RAM and True Color mode (the program cannot be used at lower screen resolutions)
- Microsoft Windows™ XP, Vista, 7
- Sound card with speakers or headphones

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