Marine Propulsion Plant Simulator

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the format of this book is copied from the original work of Serhat Beyenir

Dedication

The Simulator Laboratory Worksheets are open educational resources that align with BCIT's Marine Campus Engine Simulator courses.

Open educational resources (OER) are defined as "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others." (Hewlett Foundation).

Funding for this project was provided through an OER Grant from the B.C. Open Textbook Project. The B.C. Open Textbook Project began in 2012 with the goal of making post-secondary education in British Columbia more accessible by reducing student cost through the use of openly licensed textbooks and other OER. The B.C. Open Textbook Project is administered by BCcampus and funded by the British Columbia Ministry of Advanced Education, Skills and Training and the Hewlett Foundation.

Credits

Images of simulator user interface courtesy of Kongsberg Digital Simulation.

We wish to thank Kongsberg for their continuous support.

Preface

The broader theoretical concepts that students learn in the classroom are better understood by them if they carry out pre-programmed hands on exercises in the Engine simulator, as sometimes the subject textbooks or videos don’t address these concepts directly.

The primary purpose of this project was to design and develop simulator lab exercises (SIM LABS) that could be used as ancillary resources for all Propulsion plant simulator courses as well as Engineering knowledge courses.

Propulsion plant simulator course Instructors have limited time to lecture on the basic concepts of engineering and yet have to offer practical operational skills to our students, so having many pre-programmed SIM LABS which students can load and work on their own time would help them to practice and enhance their understanding of the systems and prepare them to handle various malfunctions in the plant in a timely and safe manner

I consider this project as a first step in creating multiple Simlabs starting with one for Main Engine combustion malfunctions and adding more to the data bank in pressbook

Through this project I also want to introduce the students to what is available for them in Open Educational Resources (OER) and Open Education in general especially pressbook.

Acknowledgements

I owe my gratitude and thanks to Serhat Beynir for introducing me to the concept of open education and thereafter guiding and helping me to create the Sim Lab exercises to enhance student learning. I also want to thank BCcampus and openBCIT for co-sponsoring my project and making my humble dream take shape .

And last but not least, I would like to thank our students, the entire Class of 2018 for participating in the pilot run of the developed Sim lab exercises and thereafter providing their feedback .

Sim Labs

Objective

To operate the MC-90 ship model fully loaded on “At sea” mode and compare the NO_x and SO_x emissions when the plant is operating with :

- SCR unit by passed while on “At sea” passage mode at full speed
- SCR unit by passe while on “At sea” passage mode at reduced speed of 45 RPM
- SCR in use while on “At sea” passage mode at full speed
- SCR in use while on “At sea” passage mode at reduced sped of 45 RPM
- SCR unit by passed, but with Fuel emulsion of 20% while “At sea” passage mode at full speed
- SCR unit by passed, but with Fuel emulsion of 20% while “At sea” passage mode at reduced speed of 45 RPM
- SCR unit and Fuel emulsion by passed during maneuvering (various RPM) – 58, 48, 37 and 30

Deliverable

Your lab report is to include the following:

- **Trend plots:** Supply all plots taken for this lab (make sure plots are labeled properly),
- **Conclusion:** Write a summary of your analysis and suggest ways to economically and effectively reduce NO_x and SO_x emissions from Ships flue gases.

Theory

NOx: What is it? Where does it come from?

Nitrogen oxides (NO_x), are the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Many of the nitrogen oxides are colorless and odorless. However, one common pollutant, nitrogen dioxide (NO_2) along with particles in the air can often be seen as a reddish-brown layer over many densely populated industrial and urban areas.

Nitrogen oxides form when fuel is burned at high temperatures, as in a combustion process in a Marine Diesel Engines. The primary sources of NO_x are ships, motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels.

Advances in thermal efficiency have directly contributed to a rise in NO_x emission. Dominating factors in the formation of NO_x are temperature and oxygen concentration – the higher the temperature and the higher the residence time at the high temperature in the cylinder the greater the amount of NO_x that will be generated. A longer combustion time span means that the low speed engines generate more NO_x than medium or high speed engines.

NO_x and the pollutants formed from NO_x can be transported over long distances, following the pattern of prevailing winds. This means that problems associated with NO_x are not confined to areas where NO_x are emitted. Therefore, controlling NO_x is often most effective if done from a regional perspective, rather than focusing on sources in one local area.
NO_x emissions are increasing and since 1970, EPA has tracked emissions of the six principal air pollutants – carbon monoxide, lead, nitrogen oxides, particulate matter, sulfur dioxide, and volatile organic compounds. Emissions of all of these pollutants have decreased significantly except for NO_x which has increased approximately 10 percent over this period.

Harmful effects of NO_x

- contributes to the formation of ground-level ozone, which can trigger serious respiratory problems.
- reacts to form nitrate particles, acid aerosols, as well as NO_2, which also cause respiratory problems.
- contributes to formation of acid rain.
- contributes to nutrient overload that deteriorates water quality.
- contributes to atmospheric particles, that cause visibility impairment most noticeable in national

parks.

- reacts to form toxic chemicals.
- contributes to global warming.

Ground-level Ozone (Smog) – is formed when NO_x and volatile organic compounds (VOCs) react in the presence of heat and sunlight. Children, people with lung diseases such as asthma, and people who work or exercise outside are susceptible to adverse effects such as damage to lung tissue and reduction in lung function. Ozone can be transported by wind currents and cause health impacts far from original sources. Millions of people live in areas that do not meet the health standards for ozone. Other impacts from ozone include damaged vegetation and reduced crop yields

Acid Rain – NO_x and sulfur dioxide react with other substances in the air to form acids which fall to earth as rain, fog, snow or dry particles. Some may be carried by wind for hundreds of miles. Acid rain damages; causes deterioration of cars, buildings and historical monuments; and causes lakes and streams to become acidic and unsuitable for many fish.

Particles – NO_x reacts with ammonia, moisture, and other compounds to form nitric acid and related particles. Human health concerns include effects on breathing and the respiratory system, damage to lung tissue, and premature death. Small particles penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory disease such as emphysema and bronchitis, and aggravate existing heart disease.

Water Quality Deterioration – Increased nitrogen loading in water bodies, particularly coastal estuaries, upsets the chemical balance of nutrients used by aquatic plants and animals. Additional nitrogen accelerates “eutrophication,” which leads to oxygen depletion and reduces fish and shellfish populations. NO_X emissions in the air are one of the largest sources of nitrogen pollution in the Chesapeake Bay.

Global Warming – One member of the Nitrous oxide (NO_X), is a greenhouse gas. It accumulates in the atmosphere with other greenhouse gasses causing a gradual rise in the earth’s temperature. This will lead to increased risks to human health, a rise in the sea level, and other adverse changes to plant and animal habitat.

Toxic Chemicals – In the air, NO_X reacts readily with common organic chemicals and even ozone, to form a wide variety of toxic products, some of which may cause biological mutations. Examples of these chemicals include the nitrate radical, nitroarenes, and nitrosamines.

Visibility Impairment – Nitrate particles and nitrogen dioxide can block the transmission of light, reducing visibility in urban areas and on a regional scale in national parks.

Regulations applying to the Marine industry:

The Marpol Protocol of 1997 (Annex VI – Regulations for the Prevention of Air Pollution from Ships). Adoption: 26 September 1997

“Subject to the provision of regulation 3 of this Annex, the operation of each diesel engine to which this regulation applies is prohibited, except when the emission of nitrogen oxides (calculated as the total weighted emission of NO_2) from the engine is within the following limits:

Limits for NO_x Emission from a Merchant Vessel

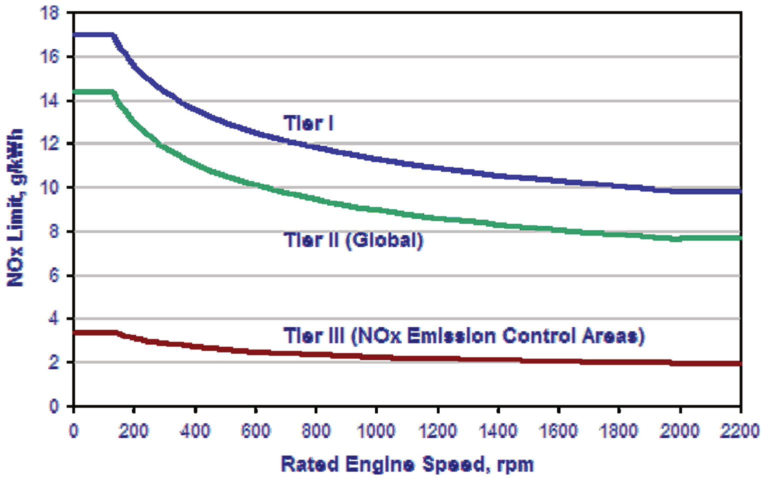
Tier 2 – From 1st Jan 2011

1. 14.4g/kWh when n is less than 130 RPM
2. 40*n(-0.23) g/kWh when n is 130 or more but less than 2000 RPM
3. 7.7 g/kWh when n is 2000 RPM or more

where n = rated engine RPM

Tier 3 (for Emission control areas only) – From 1st Jan 2016, applies only in ECA (not in SECA).

1. 3.4g/kWh when n is less than 130 RPM
2. 9.0*n(-0.2) g/kWh when n is 130 or more but less than 2000 RPM
3. 2.0 g/kWh when n is 2000 RPM or more


NOx Limit, g/kWh
18
16
14
12
10
8
6
4
2
0
Tier I
Tier II (Global)
Tier III (NOx Emission Control Areas)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
Rated Engine Speed, rpm

For ships fitted with NO_x certified engines, replacement of NO_x critical components must be logged as required. Record book of Engine parameters must be completed, even for smaller changes. The approved Technical File must be on-board for inspection when requested.The direct measurement and monitoring method is an alternative way to demonstrate compliance.

Methods for Reducing NOx Emissions

The primary problems with controlling NO_x emissions within the engine itself is that it is a natural byproduct of the combustion process, and linked to the formation of CO_2 and particulates (unburnt fuel). The higher the combustion temperature, the more fuel is burned, and the lower the CO_2 and particulates, but the reaction with the nitrogen is greater, producing more NO_x gases.The methods recommended by Engine manufacturers are:

1. **Injection Retardation**: By injecting fuel later in the compression cycle of the piston, the fuel has less time to burn, creating less NO_x. However, it still leaves the other byproducts. This is usually combined with **higher injection pressures,** which cause finer fuel droplets, which burn more quickly, leaving the opposite problem of too much NO_x. Despite this, there is a measurable drop in both levels when compared to unmodified engines.
2. **Charge Air Cooling**: The use of a cooling agent to cool the air before it enters the piston, lowering the burn temperature, and creating less NO_x.
3. **Catalytic Converter**: Due to the cost of materials, this is exclusively for small land based units and automobiles. It utilizes rhodium as a catalyst to change nitrogen oxides back to nitrogen gas and water.
4. **Direct Water Injection (Wartsila):** The key element in the DWI system is the combined injection nozzle which has one needle valve for the fuel and another

one for the fresh water. Water to fuel Injection nozzle injects both water and fuel in the ratio 0.4 to 0.7, coating droplets of water with fuel. This increases atomization of the fuel, and creates a low temperature combustion which reduces NO_x emissions by 50%-60%, with unaffected or slightly improved specific fuel consumption.

5. **Selective Catalytic Reduction System (Wartsila)**: By spraying the exhaust gases with a mist of ammonia, and passing it through a catalyst, the ammonia and NO_x react, and change to nitrogen gas and water. 85%-95% emissions reductions are possible. This equipment can be retrofitted; however it is bulky and has to be fitted before the exhaust boiler.

6. **Exhaust gas recirculation**
   50 to 60% reduction of NO_x is possible for 15% recirculation of exhaust gases into the inlet manifold. The exhaust gases being recirculated are cleaned and cooled before recirculation to the scavenge air side. It reduces NO_x by lowering the oxygen concentration in combustion zone.

7. **Fuel water emulsion**
   Adding water to the fuel dramatically sinks both soot emissions and nitrogen oxide emissions from diesel engines. This equipment can be retrofitted on all diesel engines, regardless of whether they are pre-chamber/swirl chamber engines or unit injector/common rail direct injection engines. The emulsion is

produced immediately before the injection pump; no intervention in the engine or the direct injection system is required.

The MC-90 Ships model SCR Plant Description

This ship is fitted with two options for reducing NOx

1.**Selective Catalytic Reduction unit** which treats the exhaust gases before they enter the turbocharger. Pre-programmed quantity of Ammonia is added to the exhaust gas stream, and the mixture passed through a catalyst at a temperature between 300°C and 400°C. Within the SCR Reactor the hot exhaust gases containing NO_x gases are mixed with the ammonia stream. This reduces the NO_x to N_2 and H_2O.
If the temperature of reaction is too high (above 490°C), the ammonia burns and does not react, and at low temperatures (below 250°C) the reaction rate is low and the catalyst can be damaged therefore the SCR is not used for lower engine RPMs

2. **Fuel water emulsion s**ituated between the fuel oil meter and the venting box is the *Fuel-Water Emulsion Control Unit* which is designed for emulsification of the fuel to reduce the NOx values in the exhaust gas from the engines.

SULPHUR OXIDES

Sulphur oxides (SO_x) are the generic term for Sulphur dioxide (SO_2) and sulphur trioxide (SO_3). The sulfur oxides emission in the Diesel Engine exhaust gases is due to the presence of Sulphur in the marine fuels used on Ships. Better the grade of the fuel the lower will be the sulfur content as it is removed by refining of the fuel. All sulphur entering the engine combustion chamber is oxidized forming SO_x, which is emitted to the atmosphere with the exhaust gases. The sulphur absorbed by the alkaline cylinder lubricant being negligible the SO_x emissions from the engine are directly proportional to the fuel sulphur content and fuel consumption.

For regulatory purposes the sulphur oxides concentration in the Engine exhaust gases are generally calculated from the sulphur content of the fuel, as its physical measurement is challenging and expensive.

Environmental Impact

• Acid rain.

• Contributes to formation of small size particulates as part of SO_x forms SO_3 and sulphates which condense to particulates

• Contributes to detrimental effect on human health, vegetation, and buildings

Methods for Reducing SO_x Emissions

1. Using low-sulphur fuel (or LNG and other cleaner fuels)
2. Installing Exhaust gas Cleaning (EGC) systems which include closed-loop, open-loop, and hybrid systems.

Exhaust Gas Cleaning systems:

Based on the natural alkalinity of seawater,the open-loop system uses sea water to scrub and neutralize the SO_2 in the exhaust gases in the scrubber tower. After scrubbing, this water is discharged into the sea, however, this can cause secondary pollution and contribute to the greenhouse effect due to the release of carbon dioxide. Furthermore, it has high energy consumption.

The closed-loop system uses fresh water or seawater as the scrubbing liquid dosed with caustic soda (NaOH) as the absorbent to remove SO_2 in exhaust gases. This system removes 95% of SO_x has low energy consumption, and eliminates CO_2 emissions as by product. The scrubbing water with dissolved SO_x is sent to a water treatment effluent emulsion breaking plant after which it can be discharged overboard or pumped ashore .

- **Compatibility with waste heat recovery units and SCR systems**

  All wet SOx scrubbers significantly cool the exhaust gas. Therefore, they are not suitable for installation before a waste heat recovery unit. For the same reason, it would not be possible to install a wet SOx scrubber before an SCR system unless a reheater was fitted after the wet scrubber to raise the exhaust gas temperature back up to around $300^{o}C$

Limits for SOx Emission from a Merchant Vessel

Outside the emission controlled area, the sulphur content of any oil used on board ship must not exceed 3.5% m/m.

When the ship is within emission controlled area, the sulphur content of any fuel oil used on board ships must not exceed 0.1% m/m., alternatively the ship should be fitted with an exhaust gas cleaning system or any other technological process to reduce the sulphur emission from ships including auxiliary and main propulsion engine to 6.0g SO_x/kWh or less

Lab Instructions

Press F6 and from right hand view box select " Initial condition"

Select Box 10 – "ready to start" exercise. Ensure it is CPP model

Suggested pen recorder variables that need to be plotted and monitored are:

Z00518 – g/kwhr ME exh SOx content

E03760 – Propeller power output in MW

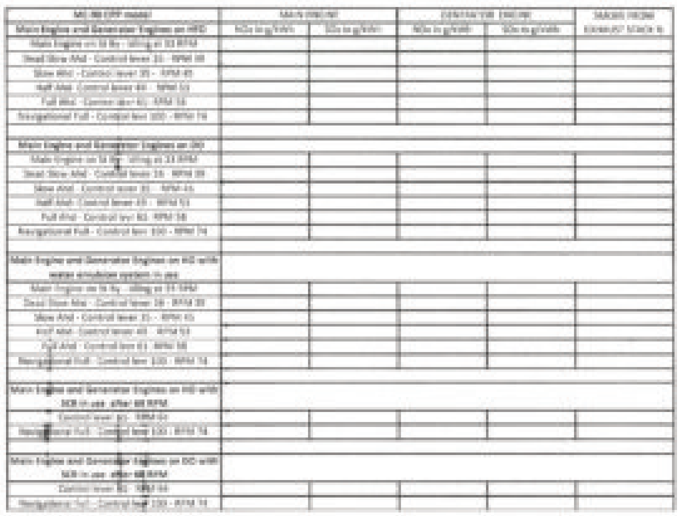
N02015 – ME RPM

Z02013 – ME exhaust gas smoke content

N06312 – Ships speed in Knots

Z01970 – g/kwhr ME exh NOx content final

Tabulate your data as shown below:



[illegible]	MAIN ENGINE		GENERATOR ENGINE		SMOKE FROM
Main Engine and Generator Engines on HFO	NOx in g/kWh	SOx in g/kWh	NOx in g/kWh	SOx in g/kWh	EXHAUST STACK %
Main Engine on St By - Idling at [illegible] RPM					
Dead Slow Ahd - Control lever [illegible] - RPM [illegible]					
Slow Ahd - Control lever [illegible] - RPM [illegible]					
Half Ahd - Control lever [illegible] - RPM [illegible]					
Full Ahd - Control lever [illegible] - RPM [illegible]					
Navigational Full - Control lever [illegible] - RPM [illegible]					
Main Engine and Generator Engines on DO					
Main Engine on St By - Idling at [illegible] RPM					
Dead Slow Ahd - Control lever [illegible] - RPM [illegible]					
Slow Ahd - Control lever [illegible] - RPM [illegible]					
Half Ahd - Control lever [illegible] - RPM [illegible]					
Full Ahd - Control lever [illegible] - RPM [illegible]					
Navigational Full - Control lever [illegible] - RPM [illegible]					
Main Engine and Generator Engines on HO with water emulsion system in use					
Main Engine on St By - Idling at [illegible] RPM					
Dead Slow Ahd - Control lever [illegible] - RPM [illegible]					
Slow Ahd - Control lever [illegible] - RPM [illegible]					
Half Ahd - Control lever [illegible] - RPM [illegible]					
Full Ahd - Control lever [illegible] - RPM [illegible]					
Navigational Full - Control lever [illegible] - RPM [illegible]					
Main Engine and Generator Engines on HO with SCR in use after [illegible] RPM					
Control lever [illegible] - RPM [illegible]					
Navigational Full - Control lever [illegible] - RPM [illegible]					
Main Engine and Generator Engines on DO with SCR in use after [illegible] RPM					
Control lever [illegible] - RPM [illegible]					
Navigational Full - Control lever [illegible] - RPM [illegible]					

Deliverables

Your lab report is to include the following:

- **Trend plots:** Supply all plots taken for this lab (make sure plots are labeled properly)

- **Data table :** with all findings entered
- **Conclusion:** Write a summary (max. 500 words in a text box, if using Excel) comparing your results and suggestions for further study.

Further Reading:

Previous (Chapter)
Next (Chapter)

Sim Lab 1

Lab Instructions

From Box 10 in “initial condition” load the “ready to start” exercise. Ensure it is CPP model

Stay on Freeze and set up the following;

In picture dir 01 open select MD 130 – “Trend group Directory”

Left Click on Trend group #01

Set time window (top left hand) as 30 minutes

Variables that need to be plotted and monitored are to be entered under Trend Tag , whose numbers are as follows:

Scale (Min – Max)

Z00518 – g/kWh, ME exh SOx content 00 – 20

E03760 – Propeller power output in MW 00 – 20

N02015 – ME RPM 00 – 100

Z02013 – ME exhaust gas smoke content 00 – 100

N06312 – Ships speed in Knots 00 – 40

Z01970 – g/kWh, ME exh NOx content final 00 – 50

Note: change any of the above Scale limits if the pen recorder traces goes off the screen. Also you may change one or more of the above variables, if you consider it more relevant to your investigation.

Press F6 and in the “View” box select “Scenario”
In the left hand column select S01 – ” NOx and SOx Simlab”
Next , in the View box select Ed Act
Select A01 – Fuel lever – ECR control
Hit F1 to run exercise – ensure the ME control lever starts ramping and that the trend recorder is recording.
At the end of 30 minutes press F2 to Freeze the exercise , print trend recorder screen.
Observations are made and recorded by ramping the Fuel control lever from 0 to 100 over 30 minutes while observing changes to the variables being monitored.
Repeat above exercise with SCR in Use

Repeat above exercise with SCR not in use but Fuel emulsion (20%) in use

Make sure your trend printouts are labeled properly otherwise, data analysis will be very confusing.

Objective

To operate the MC-90 ship model fully loaded on "At sea" mode and use Indicator cards to accurately predict the cause of deviation in the operational parameters of the main Engine and suggest appropriate corrective action.
The student would be required to inject the various malfunctions in sequential order and at any deviation of Exhaust temperature take a set of indicator cards and analyze them to suggest corrective action.
The following common malfunctions need to be injected in sequential order, indicators cards taken, analysed and corrective action outlined, as shown in the attached example:

- Cyl #1 Injection timing early
- Cyl #2 Injection timing late
- Cyl #3 Injection valve nozzle wear
- Cyl #4 Injection valve nozzle clogged
- Cyl #5 Piston ring wear
- Cyl #1 Piston ring blow-by
- Cyl #2 Piston ring sticking
- Cyl #3 Exhaust valve leakage
- Cyl #4 fuel oil pump sticking
- Cyl #5 fuel oil pump wear
- Cyl #1 fuel oil puncture valve leak
- Cyl #2 Scavenge air port deposits

Theory

Indicator cards

The Marine Engineer Officer of the Watch, during his watch, must ensure that the Main propulsion engine is performing at its optimum level. This will not only reduce the fuel consumption for a given voyage, but also reduce maintenance requirements and down time.

There are various methods by which this can be achieved, namely:

- Trend analysis
- Indicator cards

The Trend analysis of engine performance has been traditionally used for a number of years by marine engineers to identify the malfunctioning component by comparing the observed engine parameters with shop test parameters. Example of some of the parameters compared are:

- Exhaust temperatures
- Fuel rack setting.
- T/C revs
- scavenge pressure
- Pressure drop across scavenge coolers and T/C air filters
- Temp & pressure of fuel input

The cylinder indicator cards are used as a teaching aid and diagnostic tool to allow regular monitoring of the engine cylinders. Using indicator cards, faults within the combustion system can be accurately identified allowing the engineers to take the safe corrective action.

There are three different displays that are recorded to indicate the cylinder pressure conditions:

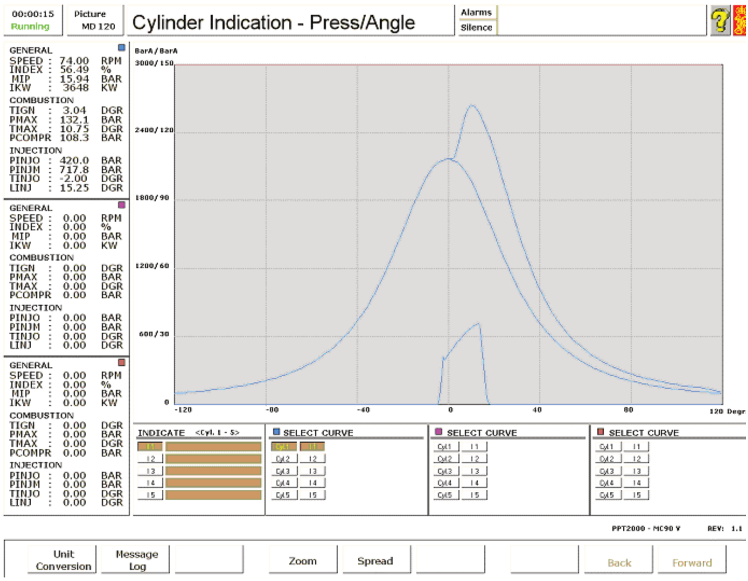
1. pressure/angle (also called a draw card or out of phase diagram),

2. pressure/volume (also called a power card, or in-phase diagram), and

3. the weak spring diagram,

Each diagram can be used to illustrate differing combustion traits and combustion malfunctions. Example: The pressure/angle diagram would be used to:

- Indicate cylinder sealing efficiency by comparing the compression pressure curve of one cylinder with the other cylinders
- Display the approximate timing of the fuel ignition
- Display the fuel pressure trace



At the instant when the cylinder indicator is taken, the following parameters are displayed on the left hand side, in the numeric data display,

Speed – the engine RPM (N).
Index – measure of the fuel index
MIP – Mean Indicated Pressure (MIP) measured in bar. This pressure is the equivalent pressure that acts on the piston throughout its vertical power stroke.
IkW – Indicated Power of the cylinder
T_{IGN} – Is the timing of the ignition. The time between the T_{INJO} and T_{IGN} indicates the ignition delay present for that cycle. Increasing ignition delays will cause increased P_{Max} and large delta pressure/angle (dP/da)
P_{Max} – is the maximum pressure present during the working cycle. This will be affected by the quantity and timing of the

fuel injection.

T_{Max} – Is the maximum temperature during the working cycle.

P_{COMPR} – Is the compression pressure after the compression stroke. It provides valuable information to the sealing efficiency of the piston rings, liner, and cylinder cover valves.

P_{INJO} – Is the fuel pressure when the fuel injector opens. It provides useful information about the correct functioning of the fuel injector.

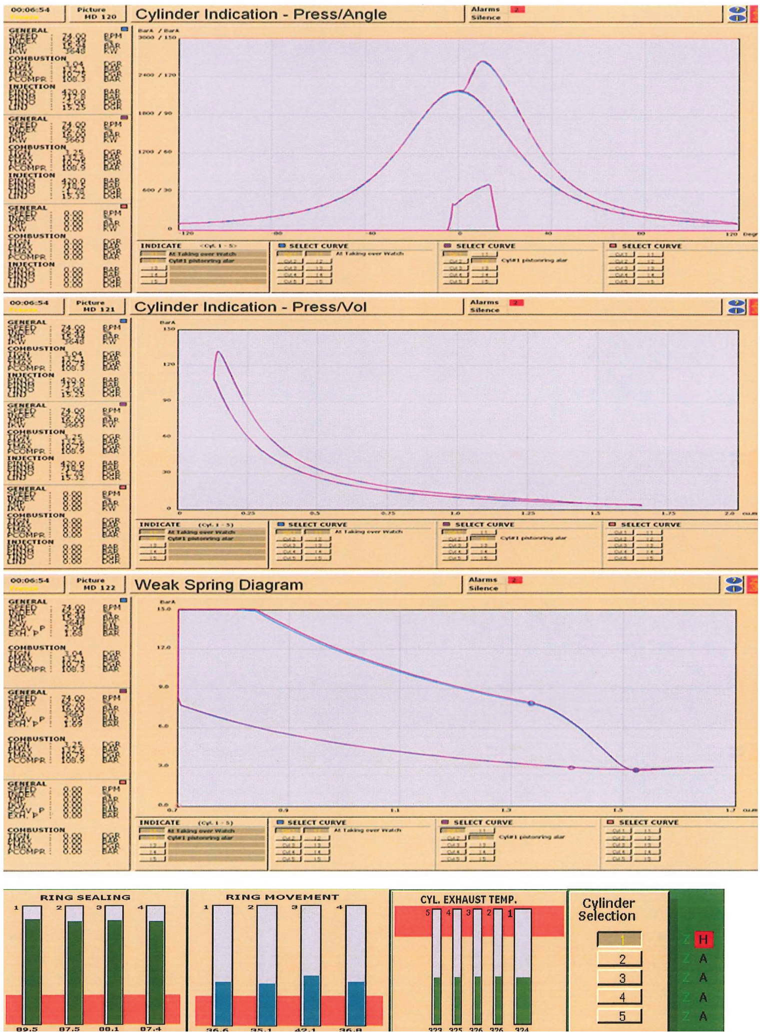
P_{INJM} – Is the maximum fuel pressure generated by the fuel pump which indicates the internal sealing properties and internal wear of its components.

T_{INJO} – Is the timing of the fuel injection and any deviation from normal values indicates shift of the cam.

L_{INJ} – Is the length of the fuel injection period, and is dependent on the setting of the fuel control lever.

Example of recorded images for an Engine with sticking piston rings in Cylinder #1 :

CYL #1 PISTON RING STICKING



Observation summary:

1. Ring movement – reduced from 90 to 40
2. Ring sealing unchanged
3. No deviation in Exhaust gas temperatures
4. No change in the profile of all the Indicator cards of Unit #1
5. No change in the profile of all indicator cards when comparing Unit #1 with Unit #2

Corrective action:

1. Monitor Main engine parameters , do not reduce main engine RPM
2. Inform Chief Engineer and slightly increase cylinder lubrication of the unit with sticking piston rings
3. At first opportunity overhaul the unit

Sim Lab 2

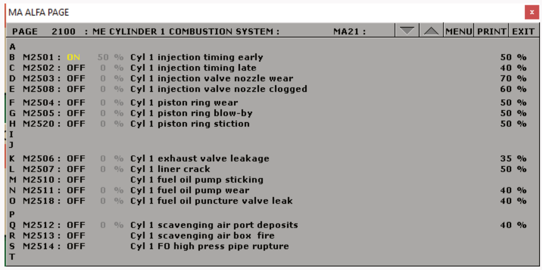
Lab Instructions

1. From the desktop, left double click on MC-90 Icon
2. Select box 105 and click on “Full ahead loaded” exercise
3. Press Home key on the Keyboard to access “The process display directory”
4. Press F1 – exercise is now running
5. Take 5 minutes to take over your watch and establish the Machinery status
6. Select “Panel directory” from the bottom task bar
7. Select MD 120 by Clicking on “Cylinder indication – Pressure/angle”
8. Take a set of Indicator cards by following

the steps as under

- In the INDICATE column, select one of the field button (I1 to I5)
- In the INDICATE field, type in “At taking over watch” or any other identifying comment to aid future fault identification.
- In the SELECT CURVE column, select the same field button (I1 to I5) . Either the blue, magenta, or brown curve can be selected.
- In the SELECT CURVE column, select the cylinder 1 to 5 that you wish to observe.

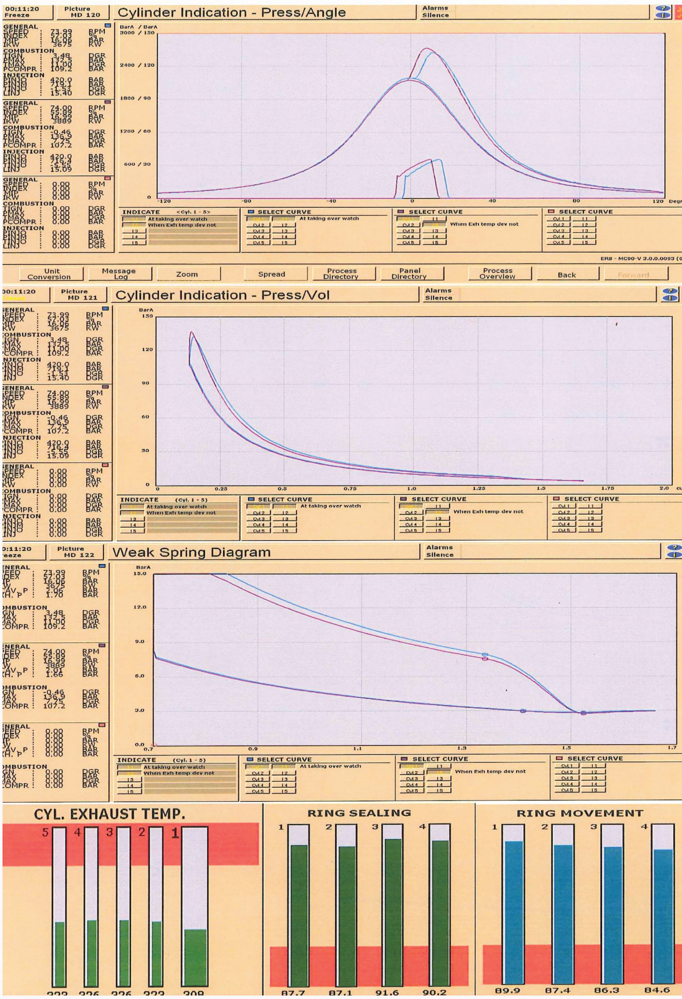
9. Press F2 to freeze your exercise
10. Go back to “Home” and Open MD 21
11. Click on the “M” box at the bottom left of the screen and on the drop down menu for M2501 click on “OFF” which will turn to “ON’ and turn yellow indicating that it is active as shown below:



12. Press F1 to run your exercise – over the next 5 minutes continue to monitor engine parameters and when the Engine has adjusted and stabilized to the injected malfunction or if Exhaust temp deviation alarm operates then it is time to take another set of cards.
13. Take indicator cards as in step #8, in the INDICATE field , label this as “When Exh Gas Dev noticed”
14. Press F2 to freeze your exercise
15. Take snapshots of all the indicator cards, Exhaust temperature bar chart, ring sealing and ring movement bar charts by using the Snipping tool from the desktop.
16. Paste all the snapshots on the wordpad , try and fit them onto one page and label the page as: “Cylinder #1 Injection timing early” . Take a print (ctrl + P)

Your print out should look like:

CYLINDER #1 INJECTION TIMING EARLY



Observation summary:

1. Ring movement unchanged
2. Ring sealing unchanged
3. Exhaust gas deviation 12^{o}C which is well below manufacturers recommended level of +/- 50^{o}C
4. T_{INGO} – advanced
5. P_{MAX} – increased
6. IkW – increased

Corrective action:

Based on the findings the Engineer Officer of the Watch must outline his/her immediate corrective action for safe operation of the ship

1. Do not reduce Engine RPM but monitor the ME parameters.
2. As the ship is fitted with VIT adjustment – after informing the Chief Engineer, consider possible adjustments to VIT setting of the

Cyl #1 fuel pump may be carried out to reduce the exhaust gas temperature deviation. Take indicator cards to confirm that changing VIT setting helped in correcting early injection

Continue and do the same for the other 11 malfunctions. Always start from scratch i.e.

1. Press F6, and in View box select " Initial condition"
2. De-select Box 105 " Full ahead loaded", and then re-select Box 105 " Full ahead loaded"
3. Now follow step 3 onward of earlier exercise

Practice Exercise for PPS 1

Exercise 2

The Briefing notes for SimLab #2

The Ship is a very large crude carrier (VLCC), fully loaded powered by a turbo charged slow speed Marine diesel engine (MAN B&W 5L90MC) with a fixed pitch propeller directly driving a single propeller

The Vessel is fully loaded and is “At sea” proceeding to the discharge port.

ME and OF Boiler is on HFO, while the Generators are on DO.

The Generators have been optimized for “At sea” passage as per Chief engineers standing orders

Practice Exercise for PPS 2

Exercise 1

Introduction:

Transport Canada "Marine Safety" expectations are, that upon completion of the PPS Level 2 Course, the course participants will be able to demonstrate sound management and engineering practices to manage, monitor and organize operation of the Ships power plant as implemented onboard a vessel.

The Scenario could include various vessel operations such as:

- Taking over a warm/hot watch and preparing the plant for "Stand-by" Departure/Arrival.
- Taking over a warm/hot watch and preparing the steam plant for carrying out cargo operations.
- Managing the plant under various operating conditions and on detecting machinery malfunction carry out systematic diagnostics to resolve the malfunction by taking timely corrective action
- Responding correctly and in a timely manner to all Main engine malfunctions that could affect the safe propulsion of the ship.
- Maintaining good communications with the bridge; request clearance from Bridge before soot blowing, using OWS and or testing any equipment that may affect the safety of others outside of the engine room.
- Taking quick preventive action to deal with high-pressure fuel leaks, scavenge fires and crankcase explosions.

To help students familiarize and practice with the above scenarios the following two SimLab exercises have been created which students can load and run on their workstations and based on the outcome of their operation make checklists and validate them in other exercises and later implemented them into real life situations

The more self paced exercises that the students practices on their own the better their understanding of the plant and its operational procedures would be.

The Briefing notes for SimLab #1

The Ship is a very large crude carrier (VLCC), fully loaded powered by a turbo charged slow speed Marine diesel engine (MAN B&W 5L90MC) with a fixed pitch propeller directly driving a single propeller

The Vessel is fully loaded and is “At sea” proceeding to the discharge port.

ME and OF Boiler is on HFO, while the Generators are on DO.

The Generators have been optimized for “At sea” passage as per Chief engineers standing orders

Exercise 2

The Briefing notes for SimLab #2

The Ship is a very large crude carrier (VLCC), fully loaded powered by a turbo charged slow speed Marine diesel engine (MAN B&W 5L90MC) with a fixed pitch propeller directly driving a single propeller

The Vessel is fully loaded and is “At sea” proceeding to the discharge port.

ME and OF Boiler is on HFO, while the Generators are on DO.

The Generators have been optimized for “At sea” passage as per Chief engineers standing orders

This is where you can add appendices or other back matter.

Author

Revision History