DOCTOR

Doctor Software Version 6
Step-by-Step Guide

Revision 1.2
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ICON RESEARCH

AUTHORISED AGENT

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Chapter 1 - Introduction

1.1   The Doctor Diesel Engine Analysis System

Congratulations on your purchase of Icon Research's "Doctor Diesel" analyser system. Since the early 1990's the Doctor has been used to optimise engine performance and has been continuously improved over time. The latest DK-20 Doctor instrument along with the new software have been developed by listening to and acting on customer's feedback over the past twenty years.

The result is a ground breaking system which combines extreme user-friendliness with new levels of engine analysis, fuel cost saving, optimising performance and minimising down-time, thereby reducing maintenance and running costs.
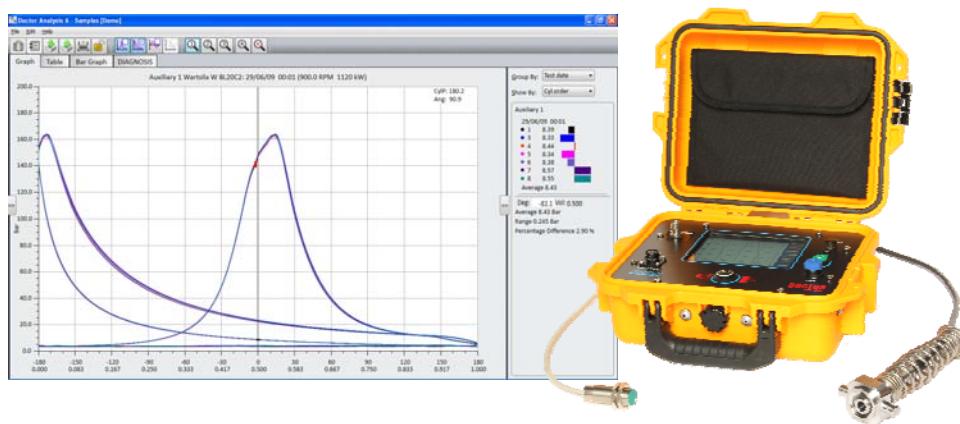
1.2   Version 6 Analysis Software Compatibility

Version 6 of the Doctor software interfaces to both the DK-20 and DK-2 series instruments from Icon Research. It is compatible with Windows XP, Windows 7 and Windows 8 platforms. It contains many of the features that existing users are familiar with but adds new capabilities enabling faster, better engine analysis.

1.3   How to use the Doctor System

It is recommended that customers take advantage of Icon's setup service. If this has been done the system is supplied to the vessel with all hardware and software necessary to start taking measurements immediately after installation. Details of the vessels engines will have been supplied to Icon and the instrument will have been programmed accordingly. A logbook file will have been created for the vessel and is provided on a memory stick along with the software installation program and all the support documentation.

The Doctor instrument is ready to take engine readings which can be downloaded to the PC for analysis.

It is envisaged that the Doctor software be installed on both the vessel and the on-shore office. Monthly readings can be taken by the crew and emailed to the shore where Fleet Managers can keep libraries containing logbooks of all vessels under their management. If a copy of the software is not available in the on-shore office please contact Icon who will provide it.

1.4   How to use this Manual

Start by going to Chapter 2 - *Software Installation*. After this, if the database setup has been purchased then go to the Chapter 3 or Chapter 4 - *Getting Started*, depending whether you have a DK-20 or DK-2. If no database has been purchased then go to Section 6.7 - *Creating a new library for your vessel*. For information relating to the Doctor instrument, refer to the Doctor DK-2 or Doctor DK-20 Operating Guide documents which are provided with your instrument.

1.5   Logbooks and Libraries

The Doctor software provides flexible and intuitive ways of transferring measurements and engine data. It is important to understand the basics of how this works.

All measurement data together with the engine and operator data is held in a library. This is a file with suffix *.idl* (icon data library) which resides on your computer. Data is transferred between libraries by way of logbooks which have suffix *.ilb* (icon log book). When data is exported from the Doctor software, a logbook is automatically created which can be transferred by any means (eg. as an attachment to an email). On receipt, the logbook is imported by a simple drag-and-drop action, and all data is automatically inserted into the correct place (eg. measurements are filed under the engine with which they are associated). Note that logbooks are automatically zipped (compressed) to minimise file size when being transferred.

In summary, there are two main file types used by Doctor analysis version 6 software:

Logbooks (.ilb)

Logbooks are compressed files that are <u>used to transfer data</u>, for example, between the vessel and the shore office. A logbook is what is provided by Icon research for the initial setup. Logbooks cannot be modified.

Libraries (.idl)

Libraries are where <u>all engine and test result data is stored</u> either on the vessel or in the shore office. On the vessel it is envisaged that only test data taken for that ships' engines are stored whereas in the shore office the superintendent can have his whole fleet conveniently stored in his

library. Within the library is a *Hierarchy* with a basic structure of *Operator .. Vessel Names(s) .. Engines .. Tests*.

Further information on importing and exporting log books is contained in Chapter 6.

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Chapter 2 – Software Installation

2.1   Installing Doctor Software

IMPORTANT: Your computer must have Microsoft® Windows XP™, Windows 7™ or Windows 8™ installed in order to run DOCTOR Analysis Software.

It is possible to run both Version 5 and Version 6 Doctor software concurrently on the same PC, however if you have an earlier version of the Doctor analysis software on your PC it is recommended to uninstall this before installing the new version.   To do this, use Windows Explorer to highlight the folder where you current version of the Doctor application file is located. In this folder you will find the file UNWISE.EXE. Double click on the file to uninstall the earlier version.

Your software has been provided on a USB flash card. The installation process varies slightly depending upon operating system.

Windows XP

1. *Insert USB flash drive*

2. *Open **My Computer**: **Start->My Computer***

3. *Open the drive called **Doctor Analysis 6***

4. *Double click the installer called **DoctorAnalysis6Setup.exe***

5. *Follow the on screen instructions until the installation is complete. On the final screen leave the "Launch the Program" checkbox ticked and click "Finish". The program will launch.*

Windows 7

1. *Insert USB flash drive*

2. *Open **Computer**: **Start->Computer***

3. *Open the drive called **Doctor Analysis 6***

4. *Double click the installer called **DoctorAnalysis6Setup.exe***

5. *Follow the on screen instructions until the installation is complete - you may be required to give permissions for the installer to make changes to your computer, click yes both times. On the final screen leave the "Launch the Program" checkbox ticked and click "Finish". The program will launch.*

Windows 8

1. *Insert USB flash drive*

2. *Navigate to this drive which is called **Doctor Analysis 6** and open it*

3. *Double click the installer called **DoctorAnalysis6Setup.exe***

4. *Follow the on screen instructions until the installation is complete - you may be required to give permissions for the installer to make*

changes to your computer, click yes both times. On the final screen leave the "Launch the Program" checkbox ticked and click "Finish". The program will launch
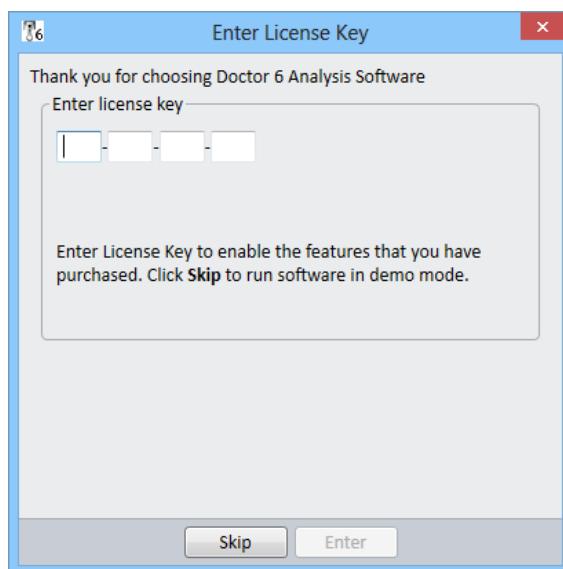
2.2   Initial Setup of Doctor V6 Software

The first time that the software is run the following screen is displayed:

Your license key is printed on the inside of the case containing the USB flashdrive. Type this code into the boxes and press **Enter** to run the full version of the software. If you have lost your license key please contact Icon who can provide it to you.

If you press **Skip** then you will go into demo mode. This will let you experiment with all the features of the software, but you will not be permitted to import or export data from a Doctor instrument. Additionally, any changes that you make will not be saved. On subsequent runs of the software you will have the opportunity enter your license key or to continue working in demo mode. Refer to section 2.3 for further details.

On successful entry of your License Key you will see the following screen:

The full software version can now be run but an Activation Code is required to be entered within 30 days to continue operation.

If email access is available, click the activation@iconresearch.co.uk link to send an email requesting an Activation Code from Icon Research. The email will automatically include your License Key and Activation Token. If email is not available on the local PC, then send an email from another PC to activation@iconresearch.co.uk stating the License Key and Activation Token. This must be done once for each computer the software is installed on, but you have 30 days in which to activate the software. The four-digit Activation Code will be emailed back to you.

At this stage you can either wait to receive the Activation Code but, if you want to carry on, click **Later** to move onto the next screen where you can browse and import a logbook (see figure below). You have 30 days in which to enter the Activation Code. After you have received and entered the Activation code the full software version will run permanently and you will not be prompted to enter the code again.

The Doctor V6 software utilises a system of logbook (.ilb) and library (.idl) files. Refer to section 1.5 for details. It is recommended that, on a vessel, a library file is maintained containing specific information for the vessel. On-shore the Fleet Manager can maintain a library containing a number of vessels that he manages. If you have ordered Icon's setup service, you will have received a customised logbook (.ilb file) containing engine data. This is on the same USB flashdrive that contains the main software program in location *customer specific files*.   Click **Browse** to navigate to your logbook and click **Next**.
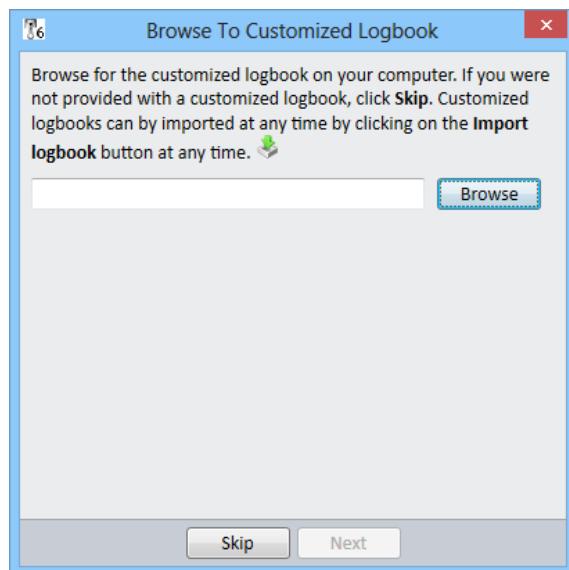
Note that you can load the data in the customised logbook at any time by clicking on the **Import Logbook** button.

Before you run the software you will see a screen telling you the software is ready to use and displaying the features of the software you have available (Standard, Diagnostics and/or Shop/Sea Trial, Propeller Curve).
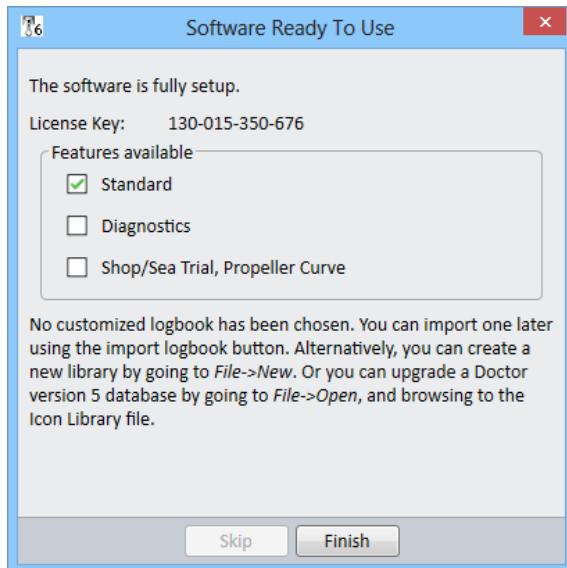
Press the **Finish** button to enter the program.

2.3   Demo Mode

If you selected **Skip** during initial setup, you will have entered demo mode. You can enter demo mode at any time by selecting **Help .. Enter demo mode**. Sample vessels and test results are available in this mode for experimenting with the features of Doctor V6 software. Note that any changes you make will not be saved so that, if you close and relaunch the Doctor software, the demo library will revert back to its default content.

Chapter 3 – Getting Started with the DK-20

3.1 Introduction

This chapter assumes you have received a customized logbook from Icon Research. If this is not the case, refer to *Chapter 6 – Setting Up Your System*. The intention is to get to the stage where you have been able to successfully download initial measurements from the Doctor instrument to the version 6 software.

3.2 Importing a Logbook

During the installation phase you will have had the opportunity to "Browse to your customized logbook" as described in chapter 2.2. If you have not done this then you can import the logbook by using the import button.

The logbook will be included on the USB flashdrive provided with the software program in location *customer specific files*.

After importation you should see a screen similar to the one below with the name of your vessel and its engine configuration listed in the *Hierarchy* panel of the display:
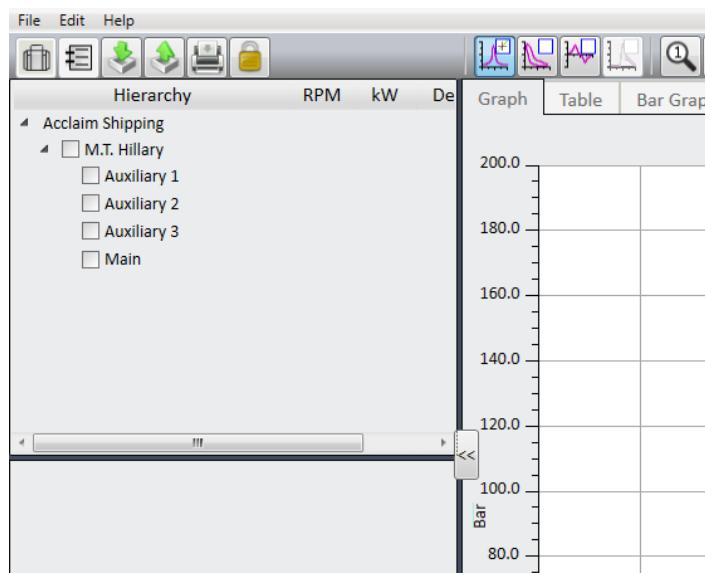

3.3 Connecting the DK-20 to your PC

This section assumes that engine tests have successfully been carried out using your DK-20 instrument and are stored in memory on the instrument.

Before you try to start communication between the DK-20 and your computer, check that the Doctor software is set to use the DK-20 by going to

Edit ... System preferences and make sure that *Doctor unit type* is set to *DK-20*.

Connect a USB cable between the DK-20 and your computer and turn on the DK-20. Note that you do not have to press any buttons or interact with the DK-20 while the USB cable is connected. If this is the first time that you have plugged it in, it will need to install the DK-20's driver.

Once the DK-20 has been detected, it will display a window that looks like this:
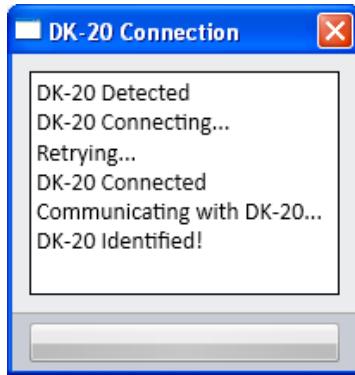
If this window does not disappear automatically after 20 seconds or so, and looks like the window below, click on the **Troubleshoot** button to assist with the connection.
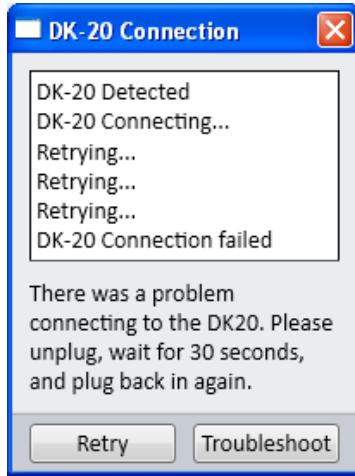
Once the DK-20 has been successfully identified, you can transfer data to and from it.

3.4   Downloading Tests from the DK-20 to your PC

Once you have taken some tests (as described in Chapter 2 of the DK-20 Operating Guide), then you can download them onto your computer.

Connect the USB cable between the DK-20 and your computer. The *DK-20 Connection* window will appear and once this disappears, the **DK Instrument button** [icon] will turn yellow. Click on this button to open the *DK-20 Transfer* window.

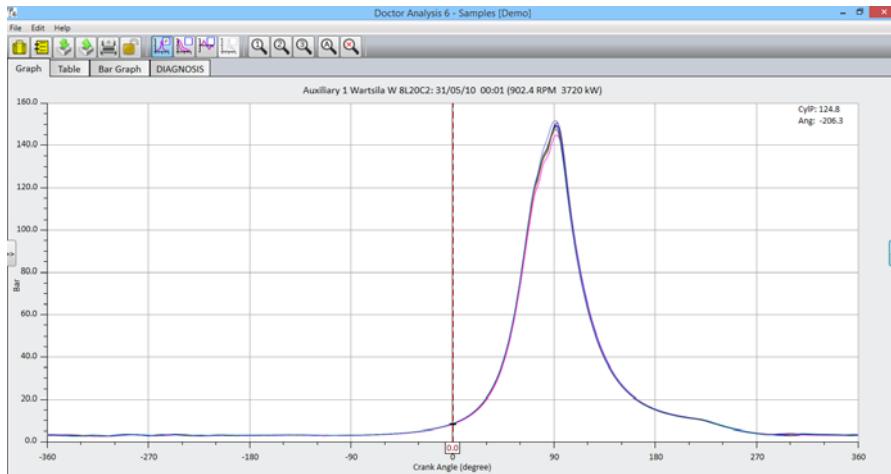In the example below, there is now one new test in *Main Engine*:
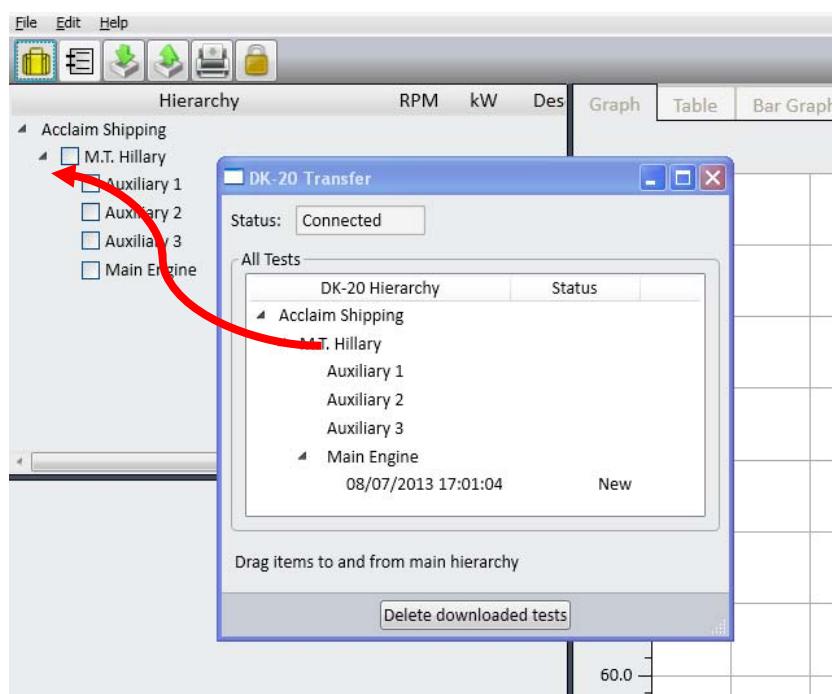
To download this test, drag and drop it into the main hierarchy. Any test will automatically attach to its corresponding engine. If you have more than one test in an engine, just drag and drop the engine to download them all. This also works with the ship or operator. The *Status* will change to *Downloaded* for tests that have been transferred.

The next step is to ensure that the TDC adjust is made correctly after which you can select and view your test results.

3.5 Top Dead Centre (TDC) Adjustment

Accurate pressure measurement relies upon synchronisation of the pressure variation inside cylinders to the crank angle. In order to do this a marker is inserted on the flywheel of each engine. This marker position is sensed and used to synchronise the Top Dead Centre of the piston as it moves through its cycles. As the position of the marker is random it is necessary to adjust the position of the TDC in the software prior to any analysis being done. This need only be done once as long as the position of the marker on the flywheel does not change.

The screen below shows an incorrect TDC setting.

The screen below shows the correct TDC setting.

If you have purchased Icon's setup service then you should send the first set of results for each engine back to Icon at doctor@iconresearch.co.uk who will carry out a TDC adjust and an initial review of the results. If you prefer to do the TDC adjust yourself, you can right-click on a test result from an engine in the hierarchy and click on **Adjust TDC**. You may need to change permissions to carry out this operation.

## 3.6   Deleting Data from the DK-20

Once you have downloaded a test, you can click **Delete downloaded tests** to delete all tests whose statuses are *Downloaded*. To delete individual tests, right click on it and choose **Delete**. You will see a warning message if you have not already downloaded that test. To delete an engine or ship from the DK-20, right click on it and choose **Delete**.

If you have accidentally deleted a ship or engine that you did not mean to, these can easily be replaced by dragging them from the PC *Hierarchy* to the DK-20 window.

3.7   Fuel Pressure Readings

With the DK-20/FV instrument it is possible to take readings of fuel pressure as well as cylinder pressure.

Cylinder pressure or Cylinder pressure and Fuel pressure readings can be selected by going to the engine settings. To do so right click on the engine and select EDIT then DK-20 Settings tab. Fuel pressure sensitivity sensitivity is also set here.
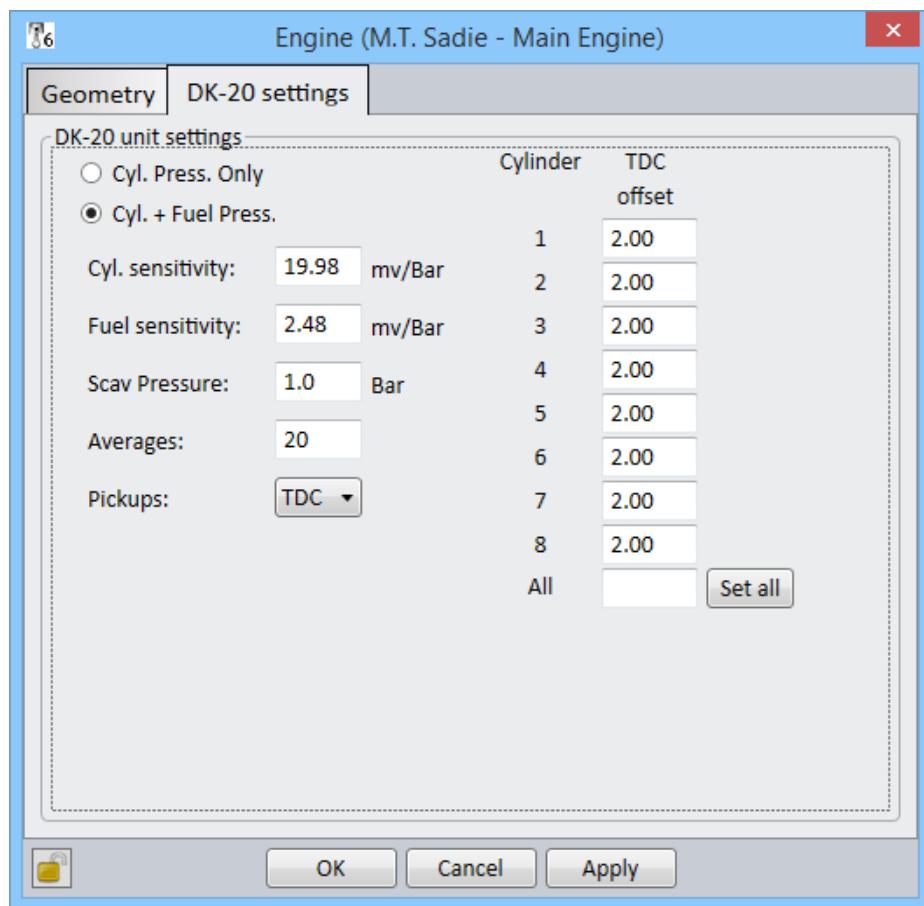
Fuel pressure readings are downloaded from the DK20/FV in the same manner as cylinder pressure readings. They can be displayed with cylinder pressure readings by selecting the appropriate display icons.
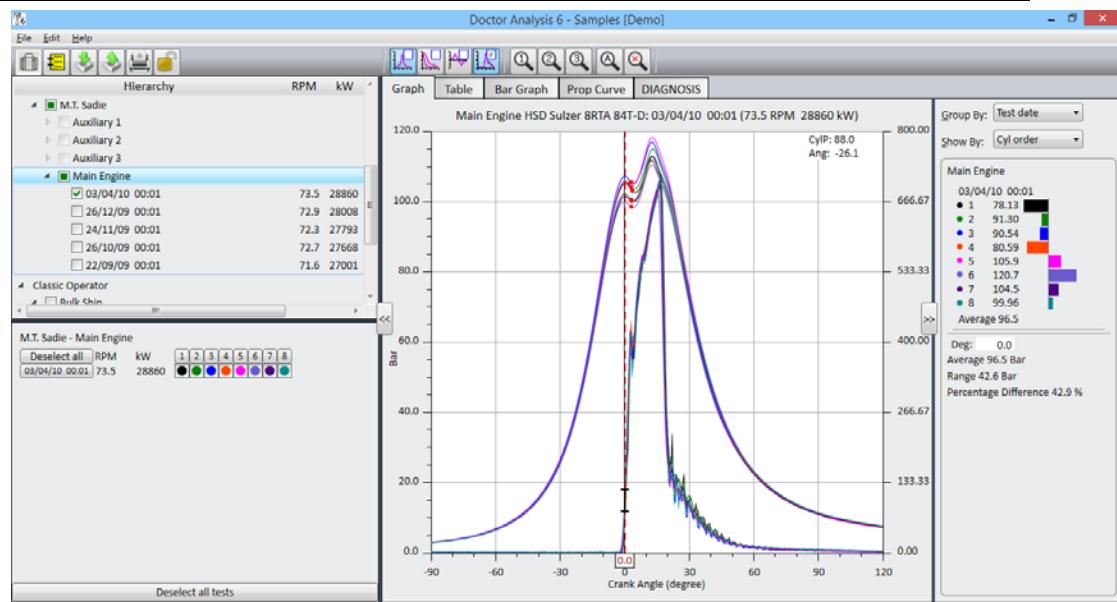
Chapter 4 - Getting Started with the DK-2

4.1   Introduction

This section assumes you have received a customized logbook from Icon Research. If this is not the case, refer to *Chapter 6 – Setting Up Your System*. The intention is to get to the stage where you have been able to successfully download initial test results from the Doctor instrument to the version 6 software. If you are upgrading from version 5 software, refer to section 6.4.

4.2   Importing a Logbook

During the installation phase you will have had the opportunity to "Browse to your customized logbook" as described in chapter 2.2. If you have not done

this then you can import the logbook by using the import button.

The logbook will be included on the USB flashdrive provided with the software program in location *customer specific files*.

After importation you should see a screen similar to the one below with the name of your vessel and its engine configuration listed in the Hierarchy section of the display:
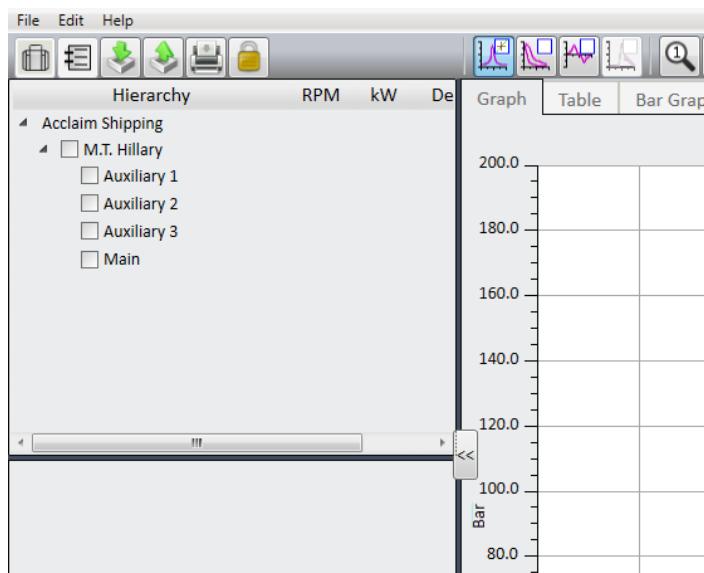

4.3   Connecting the DK-2 to your PC

This section assumes that engine tests have successfully been carried out using your DK-2 instrument and are stored in memory on the instrument.

Before you try to start communication between the DK-2 and your computer, check that the Doctor software is set to use the DK-2 by going to **Edit … System preferences** and make sure that *Doctor unit type* is set to *DK-2*.

Connect the RS232 cable to the serial port on your PC. If you are connecting to a USB port, connect the RS232 cable with the USB adapter supplied. Turn on the DK-2. Note that you do not have to press any buttons or interact with the DK-2 yourself while the cable is connected. If this is the first time that you have plugged it in, it will need to install the DK-2's driver.
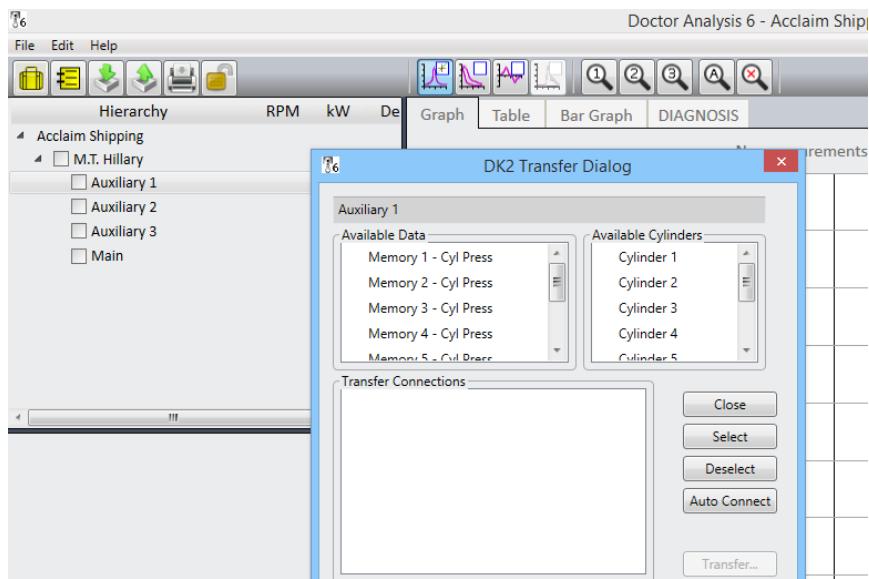
Press the **DK Instrument** button. It may be necessary to select the correct COM port for the PC. To do this go to **Edit … System preferences** and select the correct COM port.
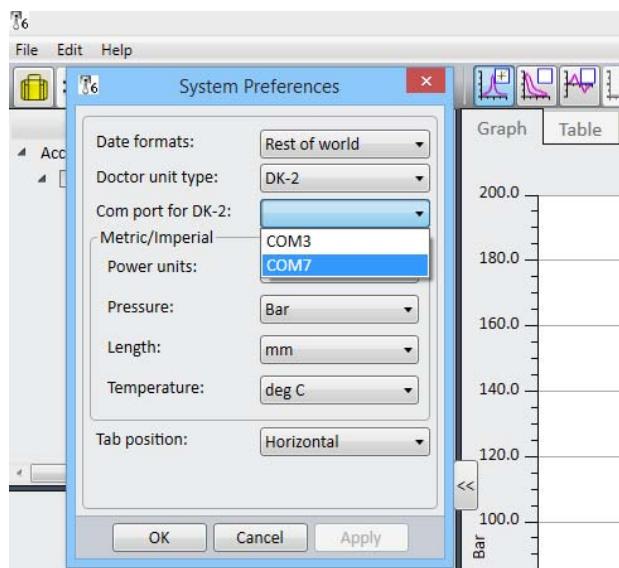

When the correct COM PORT is selected you will be asked to select an engine to download tests into. Highlight the appropriate engine and press to get the following screen:

The **Auto Connect** button will connect each available cylinder to a data set from the EPU. So, as long as data was taken in order, this is the quickest option to use.

Alternatively, you can select the first store for the test on the target engine by clicking next to it and select Cylinder 1 in the same manner. The **Select** button will couple the selected data with the selected cylinder. The select option is normally only used for special tests where individual cylinder readings have been taken for some reason.
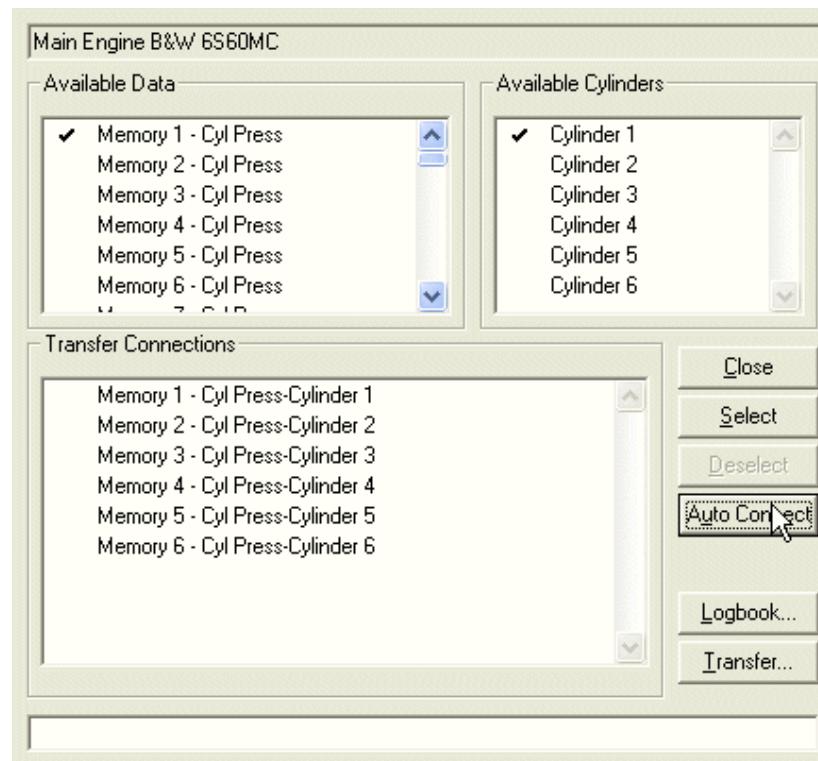
Click on **Transfer**, and you will need to enter the scavenge pressure (boost pressure). For in-line engines, just enter one value in the top section and for V

engines, enter a value for each bank. This dialogue box also lets you enter the date of the test as the day you are downloading may not be the same day the test took place.
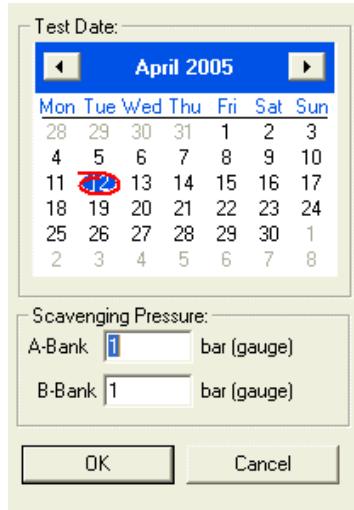
Click **OK** and your results will be transferred into the database. During transfer of data, a tick mark will progress from one result to the next until all results have been transferred. It is advisable to wait until the process is complete before doing anything else on the PC.

4.4   Top Dead Centre (TDC) Adjustment

Accurate pressure measurement relies upon synchronisation of the pressure variation inside cylinders to the crank angle. In order to do this a marker is inserted into the flywheel of each engine. This marker position is sensed and used to synchronise the Top Dead Centre of the piston as it moves through its cycles. As the position of the marker is random it is necessary to adjust the position of the TDC in the software prior to any analysis being done. This need only be done once as long as the position of the marker on the flywheel does not change.

The screen below shows an incorrect TDC setting.

The screen below shows the correct TDC setting.

If you have purchased Icon's setup service then you should send the first set of results for each engine back to Icon at doctor@iconresearch.co.uk who will carry out a TDC adjust and an initial review of the results. If you prefer to do the TDC adjust yourself, you can right-click on the engine in the hierarchy and click on **Adjust TDC**. You may need permissions to carry out this operation.

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Chapter 5 – Analysis

5.1   The Main Display

When the software is launched, the main screen will be displayed and will look similar to the one shown below. There are three panels. The one on the left shows the hierarchy of ships and engines, and is used for selecting tests in and out of the display area. The centre panel is the main display. At the top of the display are a range of tabs which select different views in this area. For example, graph or table views can be selected by clicking on the appropriate tab. The right panel is the cursor readout panel which shows a histogram of cylinder data and other values at the cursor position for comparison purposes.

The bar with words *File, Edit* and *Help* is called the menu bar. The bar below with various icons is called the toolbar.
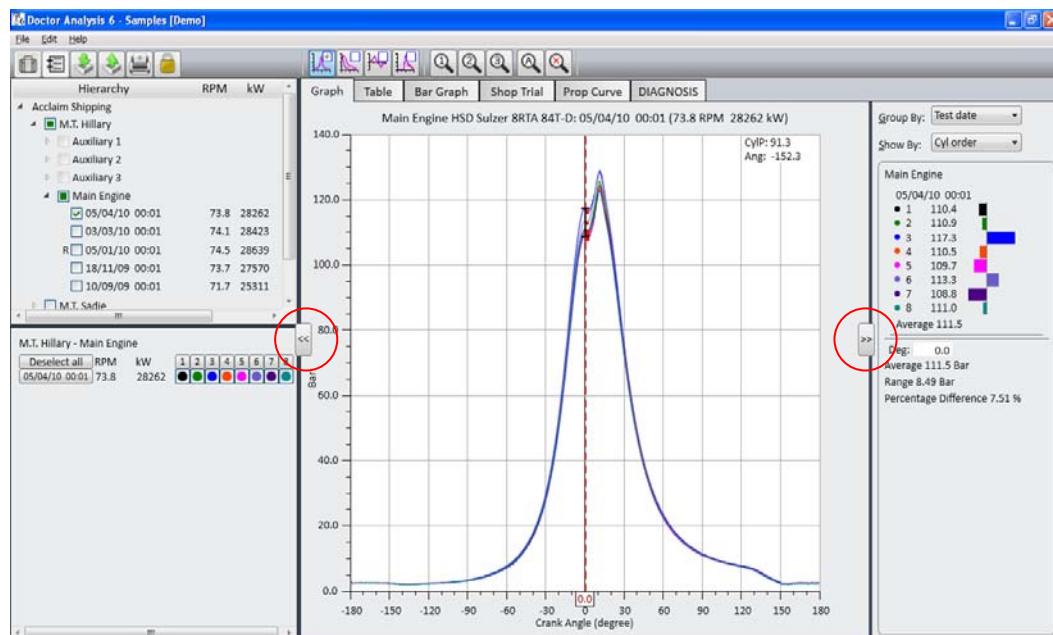
The right and left panel control buttons (circled in red) select the left and right panels in and out. If these are clicked, the main display can be expanded to the whole screen, as below.
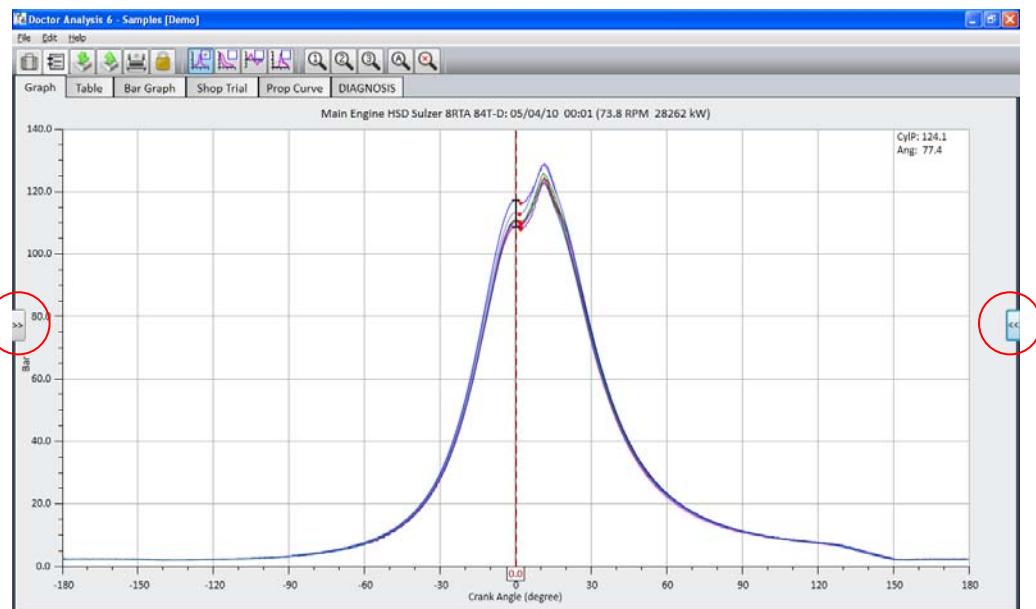
5.2 Setting your Preferences

Before you start to use the software, you should set your preferences by selecting **Edit ... System preferences**. The dialogue box below will appear. Here you can set your preferred time format, which type of instrument (DK-2 or DK-20) that you wish to work with, metric or imperial units and you can also move the graph tab positions to the top or side of the display.
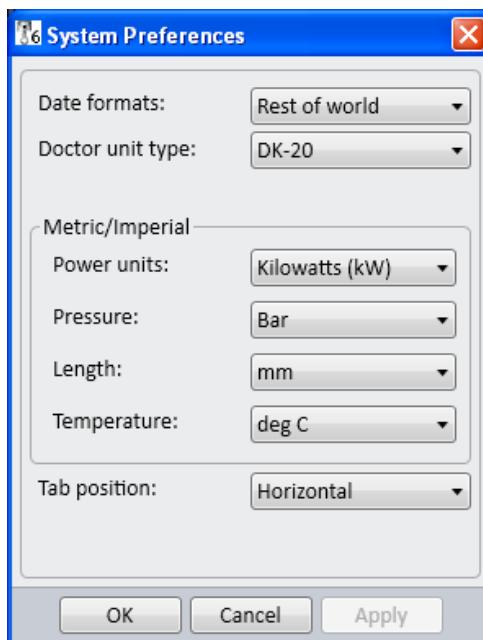
5.3   Setting your Password and Permissions

In order to prevent unauthorised personnel from changing important parameters in the software, various areas are password protected. You can choose which areas you want to protect.

To do this first select **Edit … System preferences** and the box below will appear.

At this point, you can click on **View permissions** but you cannot make any changes unless you enter the correct password. The default password is *doctor* and, when entered, the box will appear as below.

You can now change the password to one of your choice and change what is password protected by clicking on **Edit Permissions**. The following box will appear.
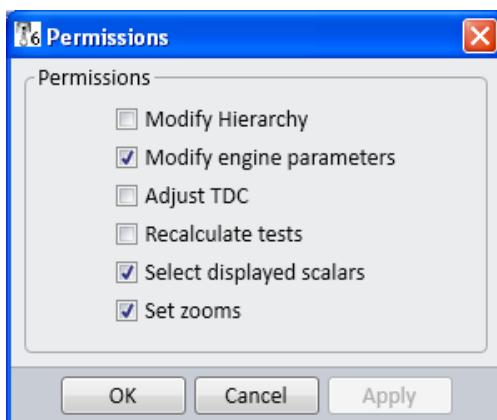
By ticking and unticking the various check boxes, you can allow or block users from making changes. A tick means that the user can make changes in that area – unticked means that it is blocked unless the correct password is entered. <u>If you change the password, make sure that you remember it or write it down in a secure place as the default password will no longer allow access.</u>

The padlock symbol on the toolbar indicates whether permissions are locked or unlocked. Click on the symbol at any time to access the *Unlock* dialogue box.

5.4   Selecting Tests in the Hierarchy

The contents of all of the display modes (graph, table etc) are selected in the hierarchy.

The upper window enables navigation to the particular engine or engines that you are interested in, together with the sets of tests that will appear in the lower window. The lower window allows you to select which tests you wish to view.

In the upper window, you can expand selections in the hierarchy by clicking the right pointing arrow to the left of an entry in the table. The arrow will then point downwards at 45 degrees. Click on the arrow again to collapse the tree. A green square indicates that that element in the table has been selected but not all sub-entries are shown. A tick indicates that everything below is on view. These are shown below.
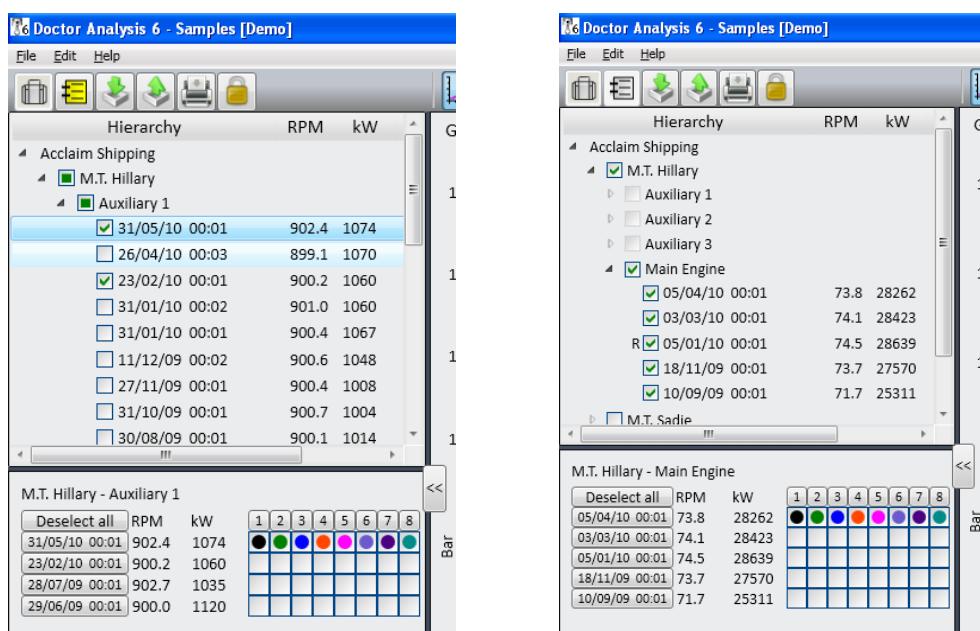
Note that engines of different types (eg. a 2-stroke and a 4-stroke) may not be selected at the same time as the number of cycles is different.

Individual tests can be selected and deselected in the lower window. Clicking on a coloured dot in the array selects or deselects a particular cylinder. Clicking on the button on the left (with test date) selects that entire test. Clicking on a cylinder on the top row does the same for an entire cylinder. Note that the colours of the dots correspond to the colours of the traces in the graph display and the bar on the histogram display.

The **Shift** and **Ctrl** keys on your keyboard can be used for selecting multiple tests. Holding down the **Ctrl** key while clicking on tests in the left column will display all those selected. Holding down the **Shift** key does the same but selects every test in between.

Right clicking on a test dot highlights that particular test by applying a thicker line in the graph display or a highlight colour on tables and histograms. The dot changes to a triangle on the array.

Spend a minute or so trying the various options to see how powerful the selection and deselection processes are.

You can add a note to any engine or testset in the upper window by clicking on the notebook symbol in the toolbar. An example of a note tagged to a testset is shown below.
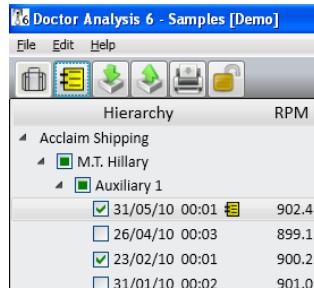
5.5   Graph Display

An example of a graph display with the cursor histogram panel is shown below. Graph mode is selected via the *Graph* tab.
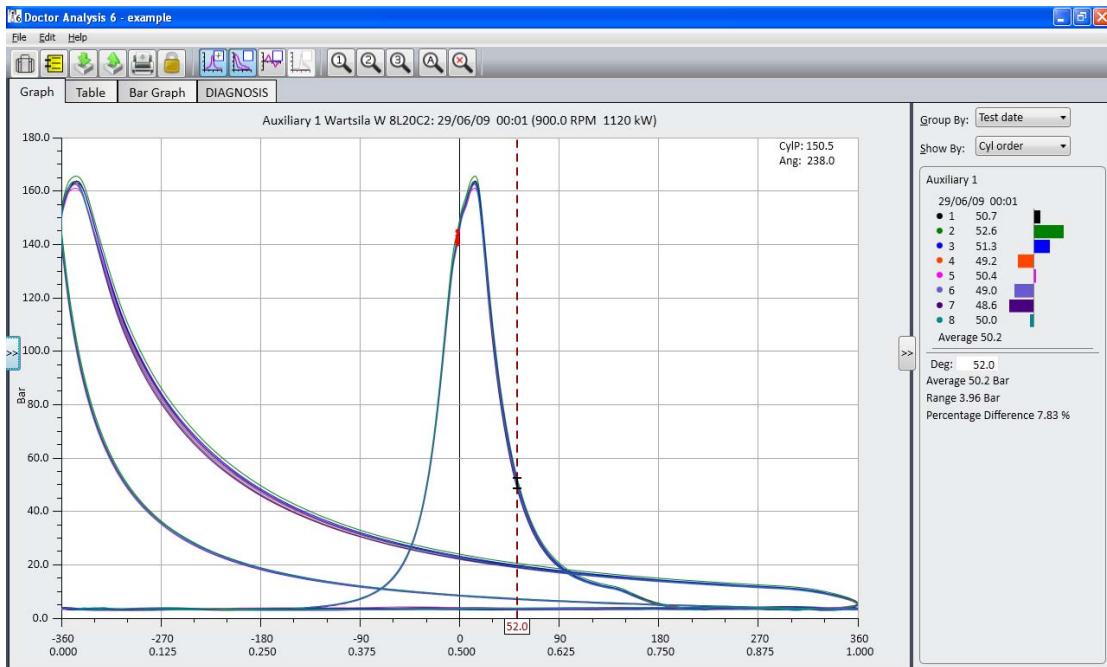
The first thing to notice is that the three main trace types namely, P-A (pressure angle), P-V (pressure-volume) and Derivative (rate of change of pressure versus angle) are selected using the icon in the tool bar with the corresponding symbol. Within each symbol is a cursor enable box – click on this to enable the cursor for the selected trace type. Note that if no cursor is selected, then the cursor readout panel on the right disappears.

The zoom buttons in the toolbar labelled 1, 2 and 3 enable the user to define his own favourite zooms. Right click on the display area to bring up a selection box and click on **Define zoom ...** . You can store the zoom you have currently displayed immediately or define the parameters manually.
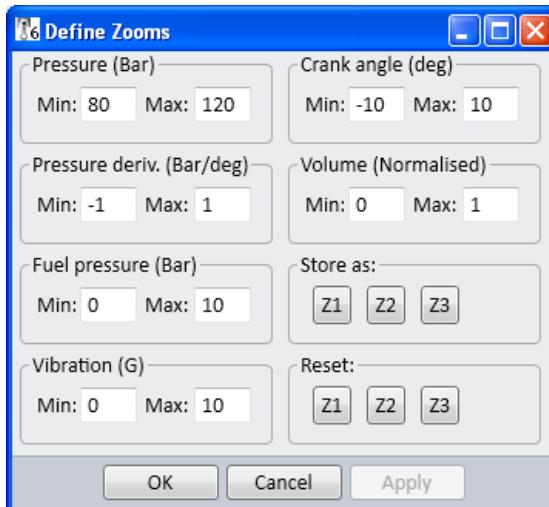
Zooms can be reset here also.

In the main screen, autozoom ![autozoom icon] zooms into the area normally of most interest around TDC. Zoom out by clicking on the ![zoom out icon] symbol. Note that the red dots on the graph curves are the ignition points calculated by the ignition point finder algorithm in the software.
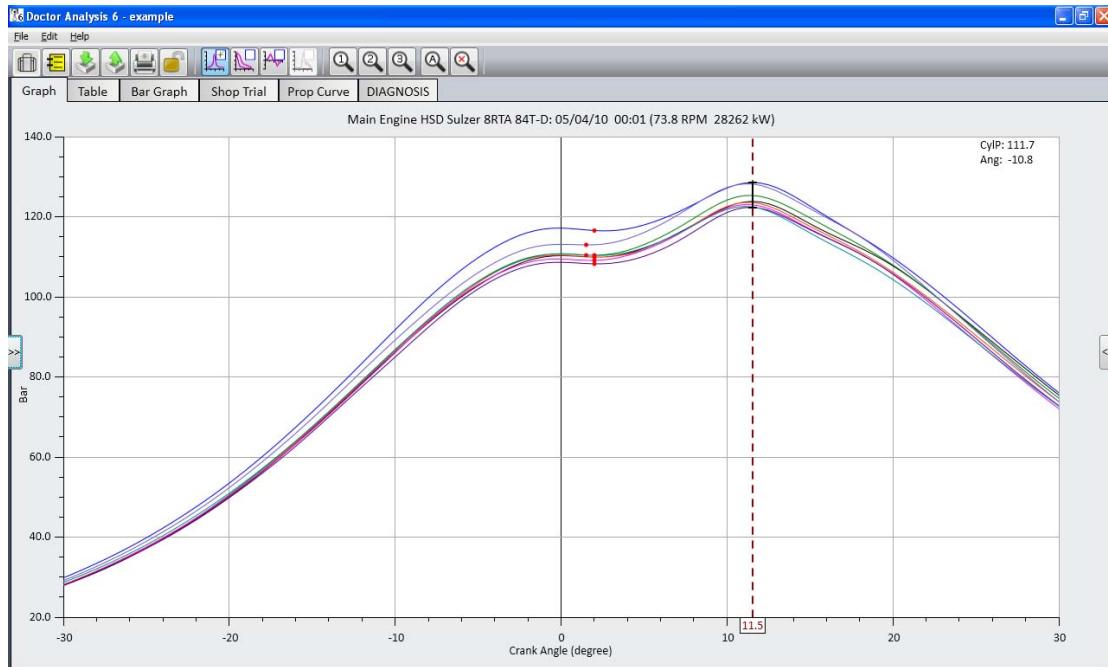
The cursor can be moved by moving your mouse pointer over it, pressing the left button and dragging the cursor to the desired position. It can also be finely adjusted in 0.1 degree increments using the left and right arrow keys on your keyboard. Hold the key down for continuous movement.

Also note that there is a readout of your mouse pointer position in the top right corner of the graph which is useful for precise readouts of random postions.

Right clicking on the display enables other advanced display features. You can

- Manipulate zooms (as already described)
- Increase or decrease the smoothing of the curves
- Add and remove valve timing markers
- Add and remove the ignition point finder red dots
- Adjust the line thickness of the graph traces.

5.6   Table Display

An example of a Table display is shown below.
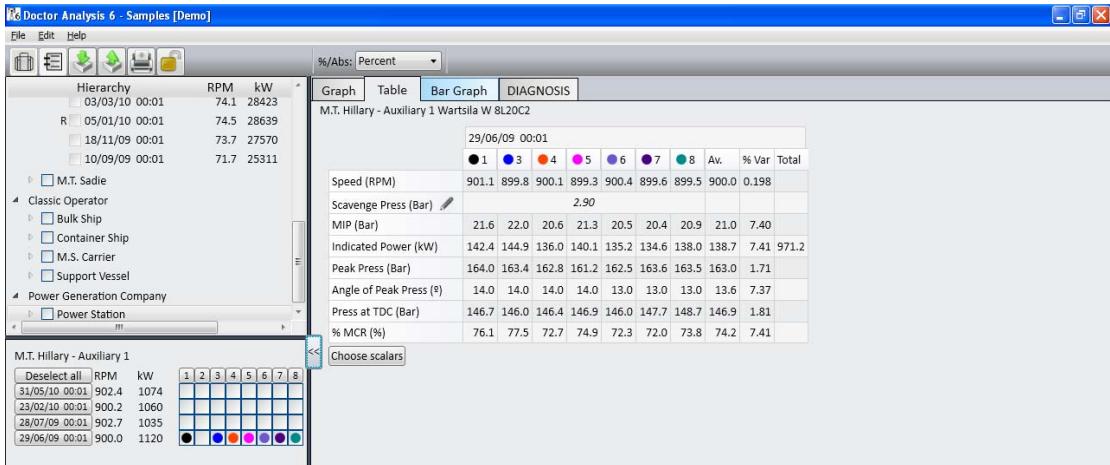
There are three types of entry on a table, namely

- Direct measurement from Doctor instrument (eg. RPM)

- Calculated measurement from Doctor (eg. power or MIP)

- Manually entered scalar (eg. exhaust gas temperature)

Calculated measurements are processed and displayed automatically. Certain statistical information is also available such as totals and variations. Note that variations can be shown as a percentage or as absolute by using the *%/Abs* dropdown above the *Table* tab.

A manually entered scalar is indicated by a pencil symbol ✎ next to it. Simply click on the appropriate field and type in the value followed by **ENTER** on your keyboard.

You can add parameters to the table by clicking on the **Choose scalars** button. Select the scalar(s) you want by clicking on the appropriate check box(es). You can also generate your own scalar by clicking on the **Custom scalars...** button.

5.7 Bar Graph Display

An example of a Bar Graph display is shown below. The Bar Graph displays the same scalars as in the Table display and the bar graphs shown are selected using the **Choose scalars** button as in Table view.
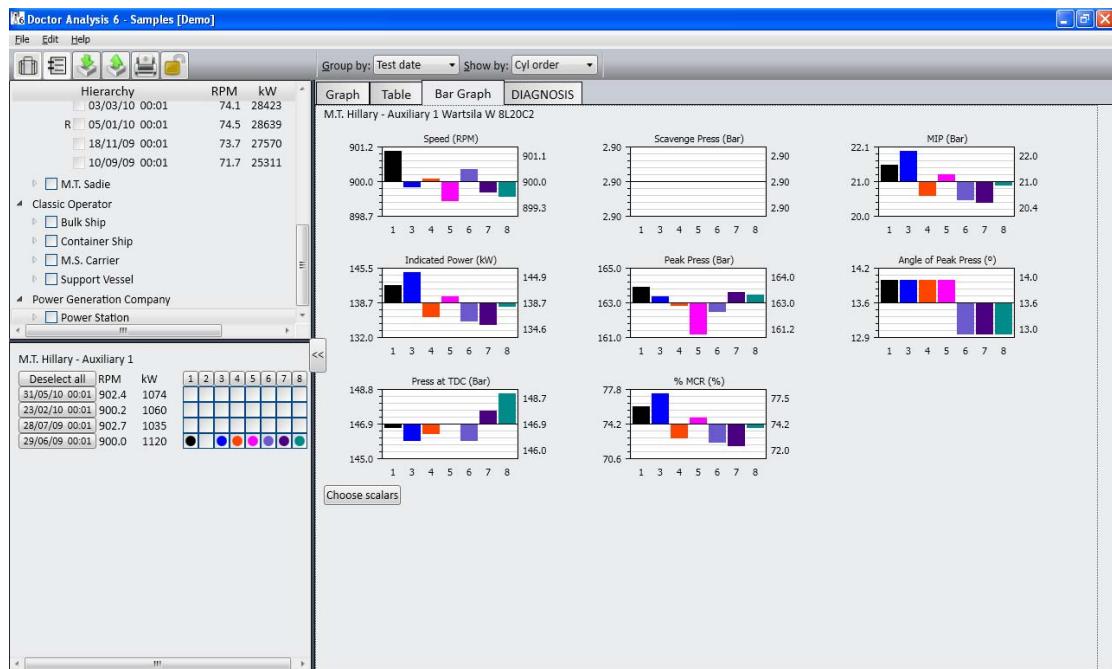
Bar graphs are useful for comparing cylinder readings. Cylinders can be displayed in sequence (1,2, 3 etc) or in firing order, and grouped by test date or cylinder using the drop down selections above the *Bar Graph* tab.

Test are selected and deselected in the *Hierarchy* panel in the usual way. Right-click on a barchart to select *Relative*, *Relative %* or *Absolute* displays.

5.8 Diagnosis

The Doctor software contains powerful diagnostics capability and these functions are selected by clicking on the **DIAGNOSIS** tab. An example of a real diagnosis is shown below with some sections expanded to reveal more details on the diagnosis.
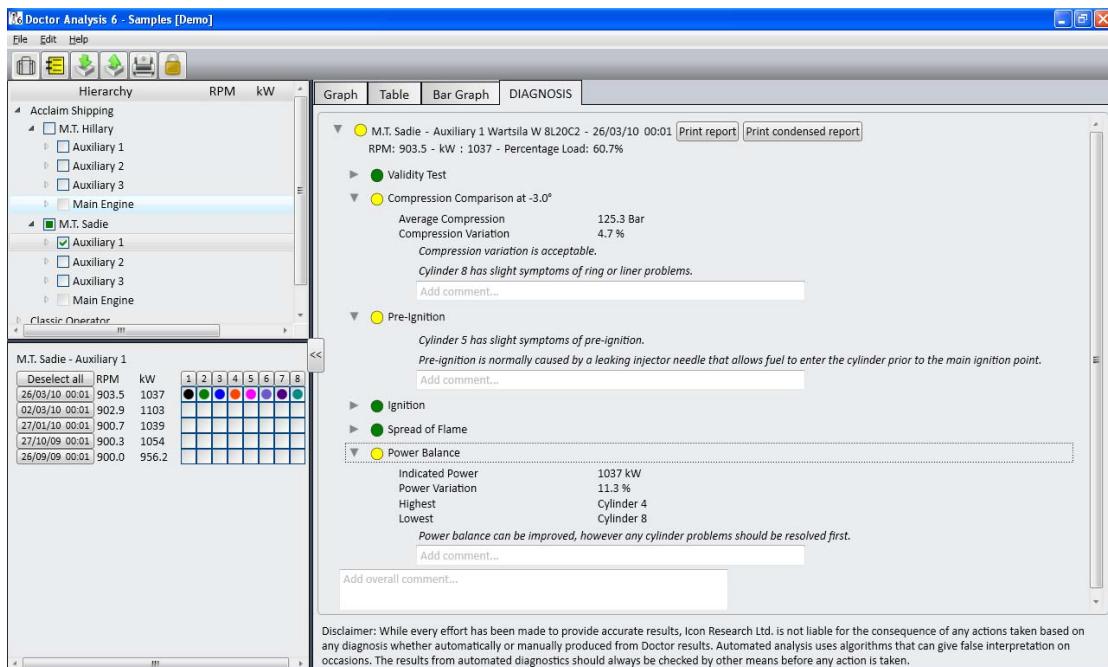
The diagnostics operate on a "traffic light" system. Green means that all appears good, yellow is a warning of a minor or possibly impending problem and red means that some further investigation should be carried out. The software contains a sophisticated rule base that automatically generates the diagnosis. A full report with graphical backup or a condensed report (ie. the summary page) can be printed in pdf format using the **Print report** and **Print condensed** report buttons.

Notes can be added for each diagnostic, or an overall comment at the end.

Automated diagnostics require the traces for a test to be in good condition and properly adjusted for TDC position. Also, the ignition point for each cylinder must be correctly identified.

Quality of Traces: Validity checks are incorporated and can identify readings taken with the indicator cock closed, faulty indicator cocks, clogged indicator passageways, and a variety of other conditions that can affect the accuracy of results. The diagnostic routines will identify most questionable traces, however in some cases suspect readings may not be identified. Traces should be checked visually to ensure they are of good quality with no "electronic" interference, or no effects from clogged indicator passageways or faulty indicator cocks. The traces should be smooth and free of glitches.

Position of Traces: The TDC reference must be correctly set. If traces are not positioned correctly relative to TDC, then the calculated power will be incorrect. Note that TDC setting is a service offered by Icon Research and is free of charge on new systems for initial readings. Send an archive copy of your database to doctor@iconresearch.co.uk for this service.

Ignition Points: The ignition point for each trace must be correct for the analysis module to work properly. The Doctor program automatically identifies ignition points but the algorithm used can occasionally fail to find

an ignition point especially if the traces are of poor quality. In these cases the system will prompt you to enter a value. In a very few other cases the program may identify ignition incorrectly, and in these cases, you should manually alter the value that the system has generated in the *Table of Results*. Double click on the entry in the table and a new value can be entered as shown below.
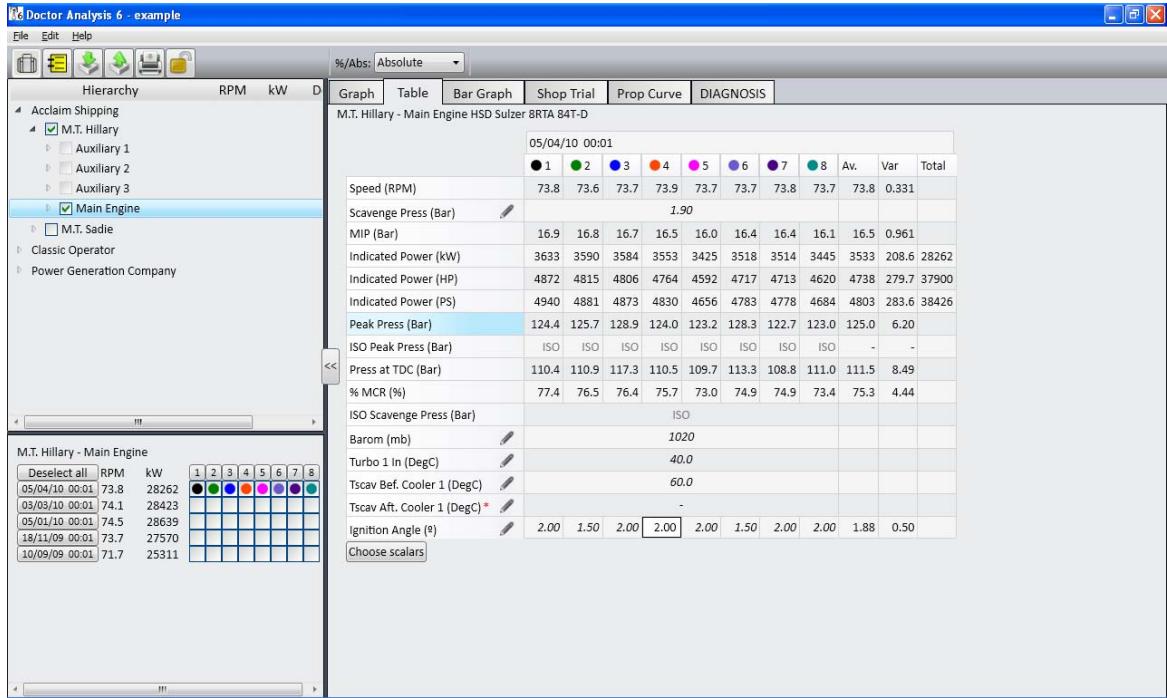
Disclaimer:

While every attempt is made to optimise the accuracy of a diagnosis, attention should be paid to the disclaimer at the foot of the display.

Chapter 6 – Setting Up Your System

6.1   Introduction

This chapter explains how to set up your system from the beginning if you have not received a customised logbook from Icon Research. Details of how to set up your own hierarchy of engines are shown.

6.2   Importing and Exporting Data

Version 6 of the Doctor Analysis software introduces the concept of libraries and logbooks for the handling of data. Databases from version 5.x can be imported directly into the new software and stored along with new data.

There are two main file types used by Doctor analysis version 6 software:

Logbooks (.ilb)

Logbooks are compressed files that are <u>used to transfer data</u>, for example, between the vessel and the shore office. A logbook is what is provided by Icon research for the initial setup. Logbooks cannot be modified.

Libraries (.idl)

Libraries are where <u>all engine and test result data is stored</u> either on the vessel or in the shore office. On the vessel it is envisaged that only test data taken for that ships' engines are stored whereas in the shore office the superintendent can have his whole fleet conveniently stored in his library. Excerpts of libraries can be exported as logbooks which are for emailing to and from vessels.
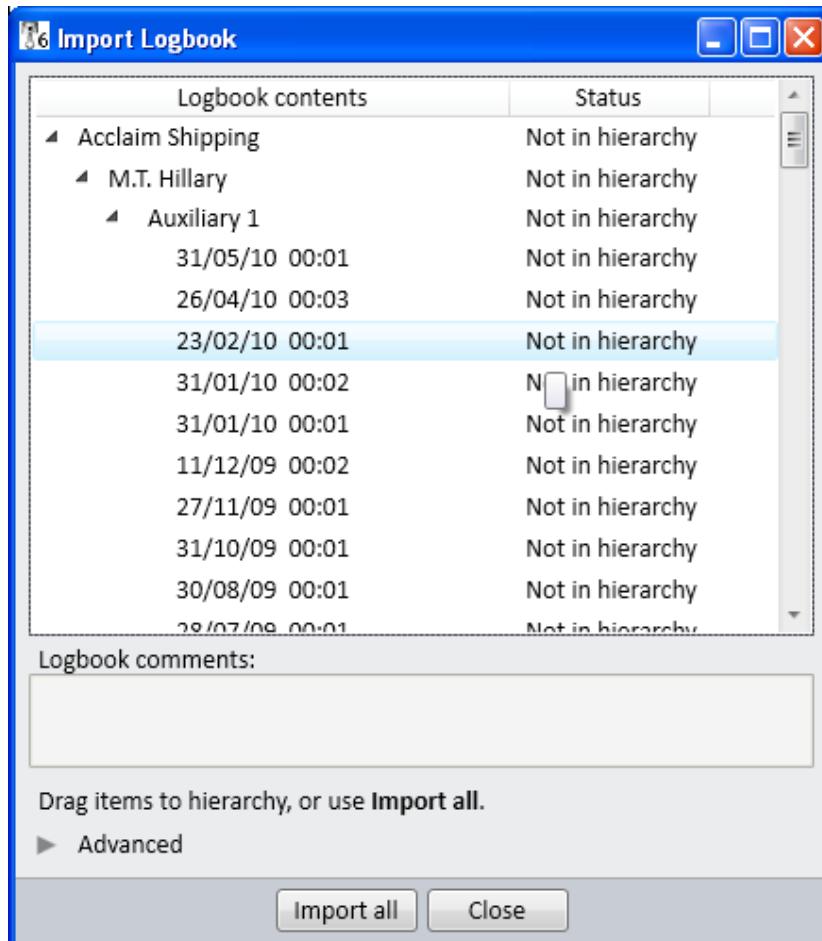
6.3   Importing Version 6 Logbooks

To import a logbook, select the Import button. You will be presented with the following screen:
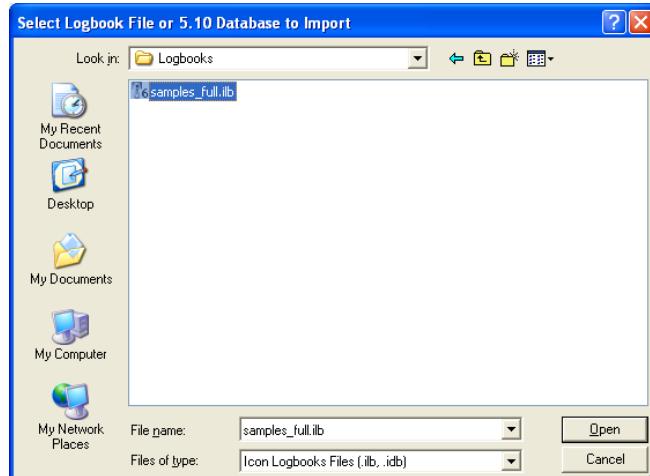
Browse to the appropriate location, select the logbook that you wish to import (.ilb file), select the file (.ilb) that you wish to import and click **Open**.

You will now see the following screen:

At this stage you have the opportunity to **Import all** the data shown or drag only the data you wish to the **Hierarchy** section. When you have transferred the data you wish select **Close**.

Note that you can update or retain engine parameters by clicking on the **Advanced** button. The screen below will appear. Select the appropriate radio button whether you wish to update the engine parameters to those contained in the logbook or retain those already in your library.
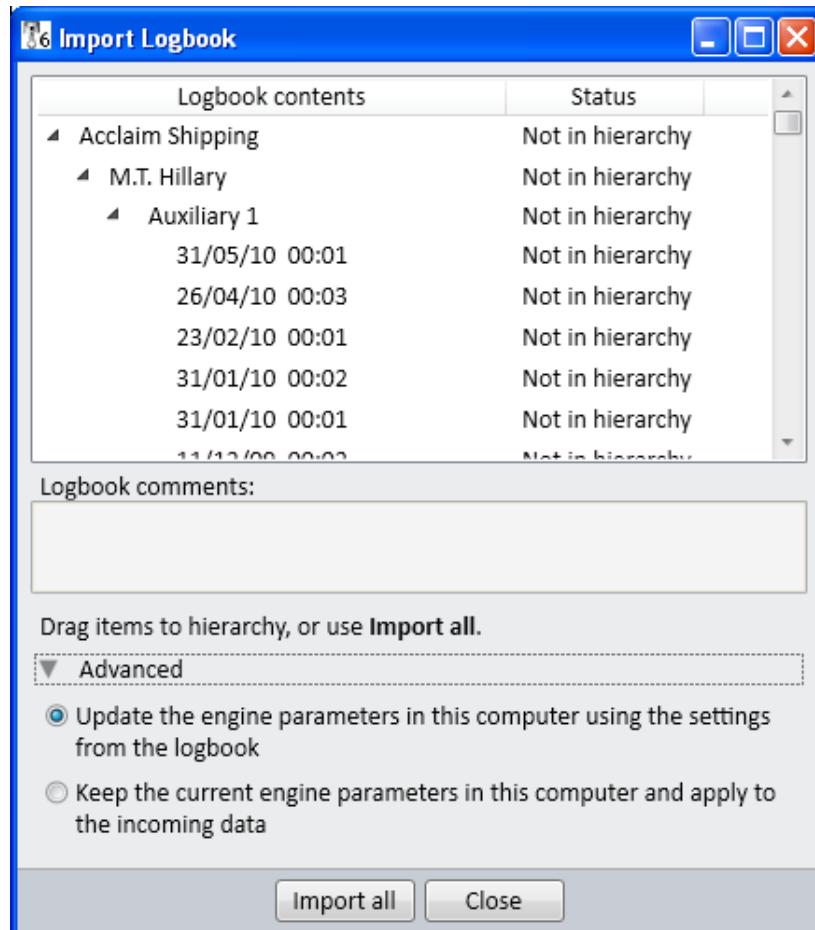
Recalculating Previous Readings

If you are importing the logbook into a library holding existing readings you can recalculate these readings based on the new engine parameters. The procedure is as follows:

1. Select an engine by clicking on the arrow to the left of the name of that engine. Select the readings to be recalculated by left clicking on them. To select a number of individual engines press CTRL and at the same time as clicking the engine with the mouse button. To select a range of contiguous readings, click on the first engine to be recalculated then select SHIFT and then click on the last reading in the list to be recalculated. The reading values must be highlighted in blue (see picture below) which indicates they are correctly selected.

2. Next right click on the mouse and select **Recalculate.** You will be asked to confirm, so accept this. All tests will now be updated with values calculated using the imported engine parameters.

6.4   Importing Version 5 Logbooks

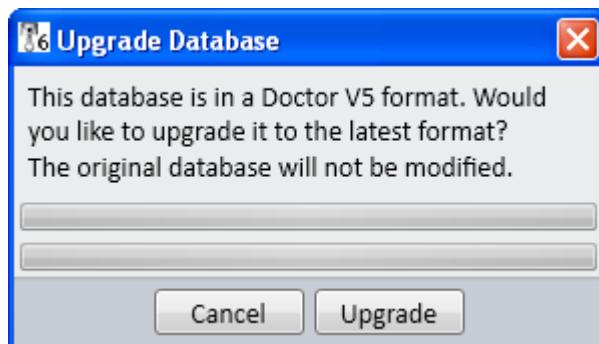Any software version 5.x may be imported. To import any pre-version 5 software please contact Icon Research who can assist.
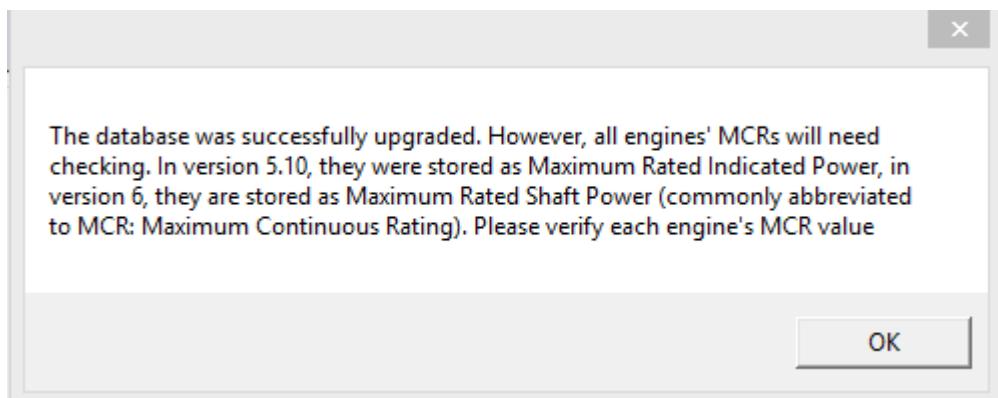
To import a version 5 database (.idb) select the Import button.

You will then be asked for the file name. Browse to the appropriate location, select the file you wish (.idb) and select Open.

You will be presented with the *Upgrade Database* screen:

Select **Upgrade**. You will see the following message:

Ensure that the correct figures for MCR are included in your new logbook.

At this stage you have the opportunity to Import all the data shown or drag only the data you wish to the *Hierarchy* panel. When you have transferred the data you wish select **Close.**

6.5   Exporting Data via Logbooks

Once you have taken measurements using the Doctor instrument and downloaded these to your computer, the measurements will be held in the Doctor library on your computer. You will be able to export all or some of this data to a logbook which you specify, for forwarding to another location (eg. the office on-shore).

Select the Export Logbook icon. You will then be asked to *Create Logbook For Export*. By default, the dialogue box contains all data that have not yet been exported. This data can be removed by right clicking on it or added to by dragging more data from the hierarchy section in. In the example below, data for the *Main Engine* on the *MT Hillary* has been selected.
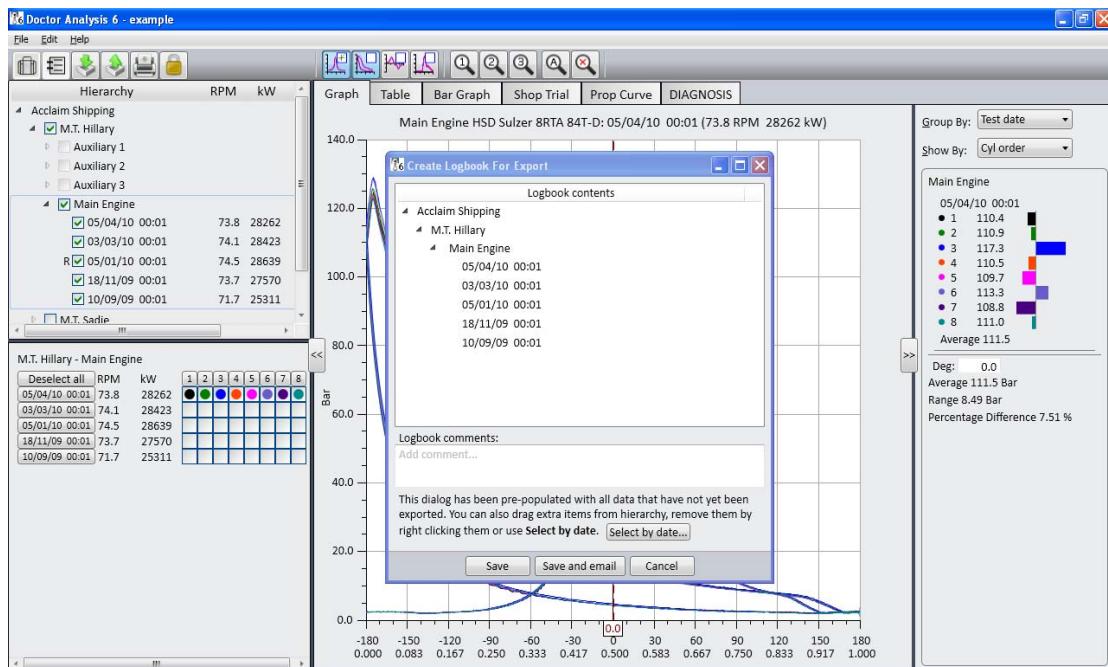
Click **Save** and the following screen appears. Give your logbook the name you wish and save it in an appropriate location. Alternatively, you can click on **Save and email** and your logbook will automatically be attached to an email in your default mail service.
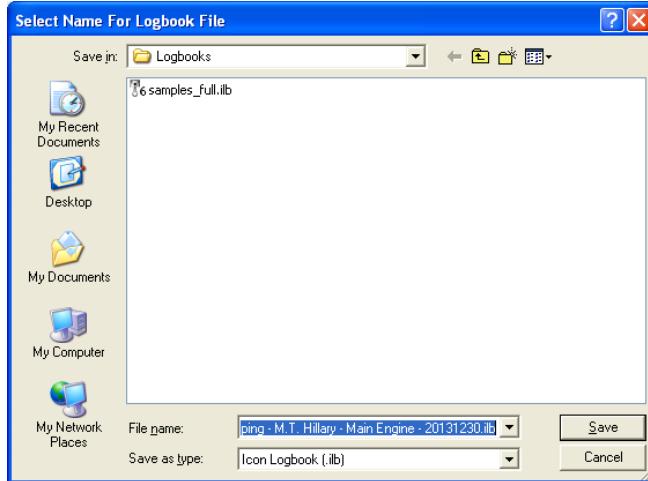
6.6   Exporting to other applications

It is possible to export raw data from any test to a Comma-Separated Values (CSV) file for use by other applications such as Excel.

In the *Hierarchy* panel, select the reading you wish to export and right click. Select the option **Copy to CSV file**. Select a file name and save in the appropriate place.
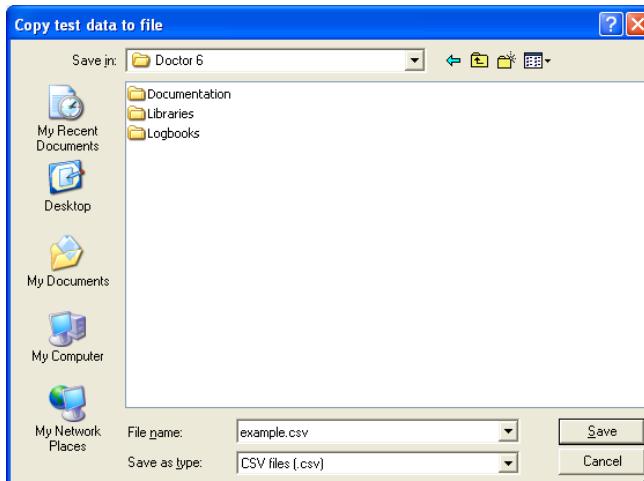
6.7   Creating a new library for your vessel

A library is a file which contains all the information about vessels and engines and is where your test results are stored. A library file has the suffix ".idl" (icon doctor library) eg. "myship.idl".

Within the library is a hierarchy containing a tree of how you want to organise your vessels. At the top of the hierarchy is the Operator (typically your company or division name). Below this you will have one or more vessels identified by their names. Under each vessel will be one or more engines.

When the software is installed, a template library is installed for you. The following is an example of how to set up your own hierarchy within the library.

Start the Doctor program. Click on **File** in the top menu bar, as shown below:
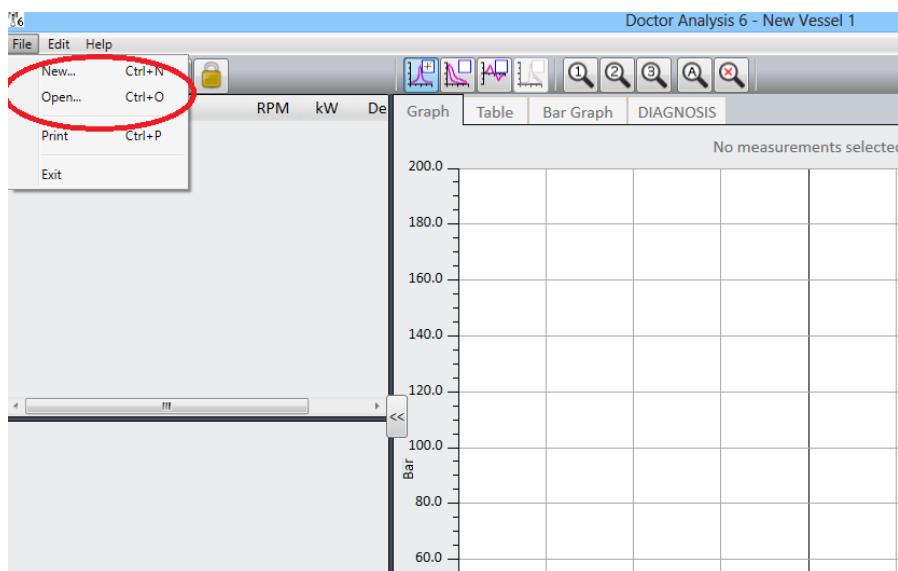
Now click **New**.   If you have not already unlocked your software, the following screen will appear:

Enter your password, or the default password of *doctor* if you have not changed it, and click on **Create new library**.

A pop-up box will appear asking you to name your library. Type in the name of your vessel and save it in a convenient location. You will now see the following screen:
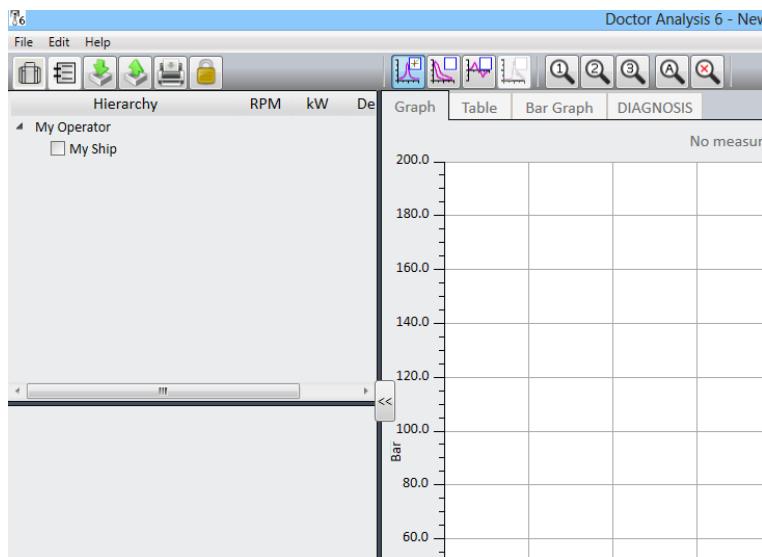
In the *Hierarchy* panel, right-click *My Operator* and select **Edit**. You will need enter the password again as above. Rename to a name of your choice.

Right-click *My Ship* and repeat the process. You will now see your *Operator Name* and *Vessel* in the *Hierarchy* panel. You can add further vessels by right-clicking on the operator name and selecting **Add ship**.

6.8   Inputting Engine Data

Right-click on the name of your vessel and select **Add Engine**. You will see the following screen which is opened under the *Geometry* tab.
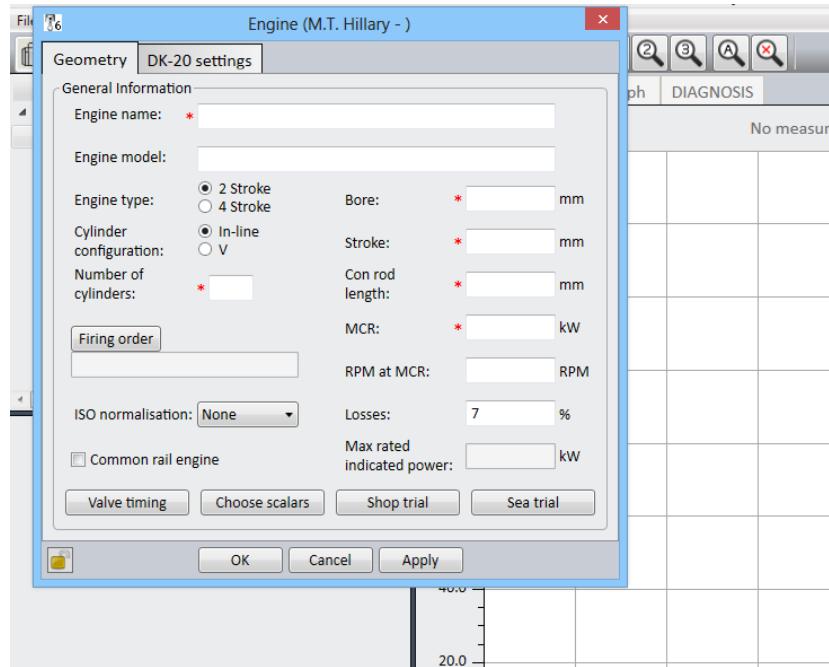
All items marked with a red asterisk * must be entered. The engine name, model, type, number of cylinders, firing order, bore, stroke are all readily available from the engine manufacturer.

The con rod length can be difficult to obtain and Icon should be able to provide this for most engines, otherwise contact the engine manufacturer.

The Maximum Continuous Rating (MCR) must be entered. This is the power in kW and is provided by the engine manufacturer. This figure is the actual power produced at the shaft and is inclusive of friction and heat losses along with energy lost due to driving pumps and cams.

The Doctor system measures the actual power produced in the cylinders which is called "Indicated Power". A percentage figure is included in the set-up screen which compensates for these losses. This figure is adjustable but by default is set to 7% for 2-stroke engines and 12.5% for 4-stroke engines. The resultant *Max rated indicated power* is included and displayed on the screen.

RPM at MCR must be entered if any sea, shop trial or propeller curve analysis is required.

If you are defining a V engine, you will need to enter three additional parameters ie. angle between banks in degrees, engine rotation (*A to B* or *B to A*), and the cylinder numbering format, all from the drop-down menus.

The *ISO Normalisation* drop-down menu allows you to select between Wartsila/Sulzer or MAN B&W for the calculation method required to work out ISO normalised values in the sea and shop trial analysis. Alternatively it can be turned off by selecting None.

There are four additional buttons for optional data entry. These are described below.

Valve Timing

It can be useful to see on the traces where valves open and close. This button allows manual entry of the appropriate angle for valves and pressure for fuel injection, as shown in the screen below.
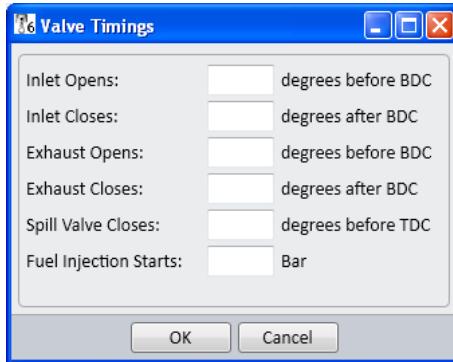
Choose Scalars

Scalars are simply engine parameters that can be selected for display in the tables. Those scalars that are calculated by the software are automatically included. There are others that require to be entered manually. There are a number of scalars that are selected by default. There are many others that can be selected as desired.
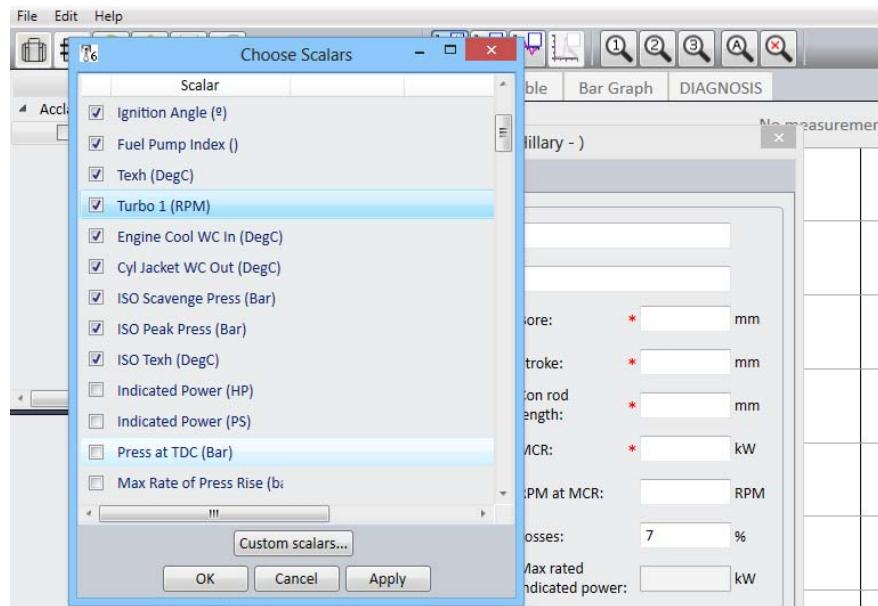
There are three types of scalar, namely

- Direct measurement from Doctor instrument (eg. RPM)

- Calculated measurement from Doctor (eg. power or MIP)

- Manually entered scalar (eg. exhaust gas temperature)

There are also four *User Angle* scalars included in the list that can be set if pressure is required to be recorded at any specific angle. Custom Scalars can be generated by pressing the **Custom scalars...** button, adding a scalar and completing the form that appears.

Shop Trial / Sea Trial

It can be very useful to compare ongoing main propulsion engine performance versus initial shop or sea trial data. Even if this data is not available, the change in performance of these parameters can provide valuable information as to an engine's condition. Refer to Chapter 7 for details.

6.9   Instrument Settings

After completing all the required data in the *Geometry* tab section, now go to the *DK-20 settings* or *DK-2 settings* tab. Note that your choice of DK-20 or DK-2 is selected in **Edit..System** preferences if you have not already selected the model of instrument you are using.
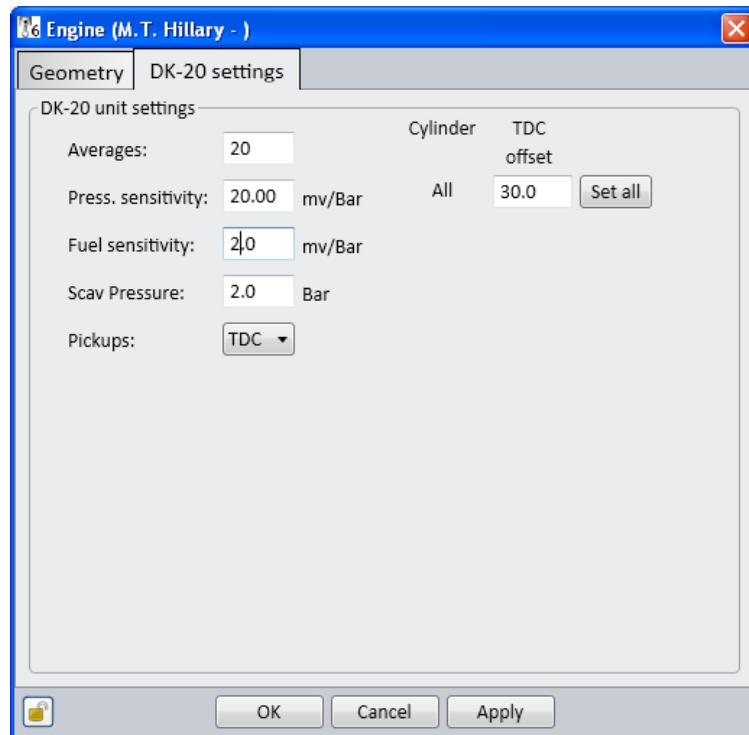
Here you need to enter the settings for the instrument which will be downloaded when connected.

The settings are as follows:

Averages (configurable in DK-20 only)

This is the number of sample averages taken during a reading. The default is 20 for a 2-stroke and 40 for a 4-stroke. In the DK-2 this must be set on the instrument itself.

Pressure sensitivity

This is the sensitivity (in mV/bar) of the pressure sensor. The default is 20mV/bar. The actual number can be found on the calibration certificate of the sensor.

Fuel Sensitivity (Fuel Versions Only)

This is the sensitivity (in mV/bar) of the fuel sensor. The default is 2.5mV/bar. The actual number can be found on the calibration certificate of the sensor.

Scav Pressure

This is where the default scavenge pressure for the engine can be entered. This will be over-written by the actual scavenge pressure entered into the instrument when taking a reading.

Pickups (DK-20 only)

This is the pickup configuration as installed on the engine. The default is *DUAL* (two pickups) for a 2-stroke engine and *TDC* (one pickup) for a 4-stroke engine. The DK-20 also has an Auto detect mode which will automatically detect the number of pickups. In the DK-2 this must be set on the instrument itself.

TDC Offset

The position of the Top Dead Centre must be set after the first reading. Adjustment angles can either be entered here or in Graph mode. In Graph mode, right-click on the engine in the hierarchy and click on **Adjust TDC**. You may need permissions to carry out this operation.

After you have entered all the required data, click **Apply** followed by **OK**.

6.10   Duplicating an Engine

Very often there is more than one engine of the same type on board a vessel. To duplicate an engine right click on the name of the engine and select **Copy**.

Right click on the name of the ship then select **Paste**. This can be repeated until all the required engines are included. Edit the engine names appropriately.

You have now completed your library and you should see a screen similar to the following:
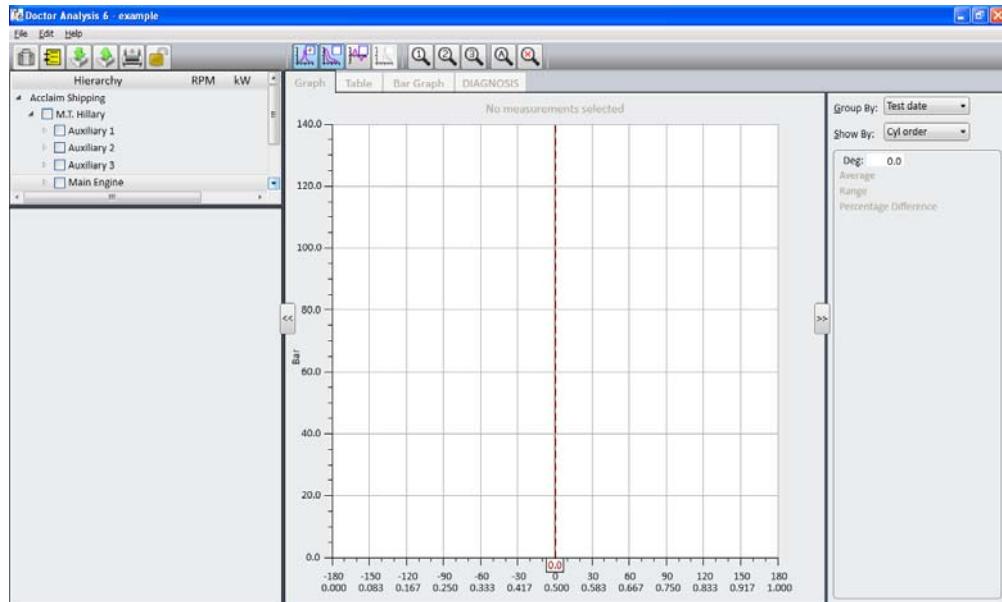
6.11 Transferring Engine Data to DK-20

When you have set up your engine data you may now transfer it to your DK-20 instrument. Refer to chapters 3 and 4 for connecting your PC to your Doctor instrument. After successful connection you may click on the yellow Doctor Icon at the top left corner of the screen. Your DK-20 window will appear and you can simply drag the engine data from the Hierarchy to the Doctor window.
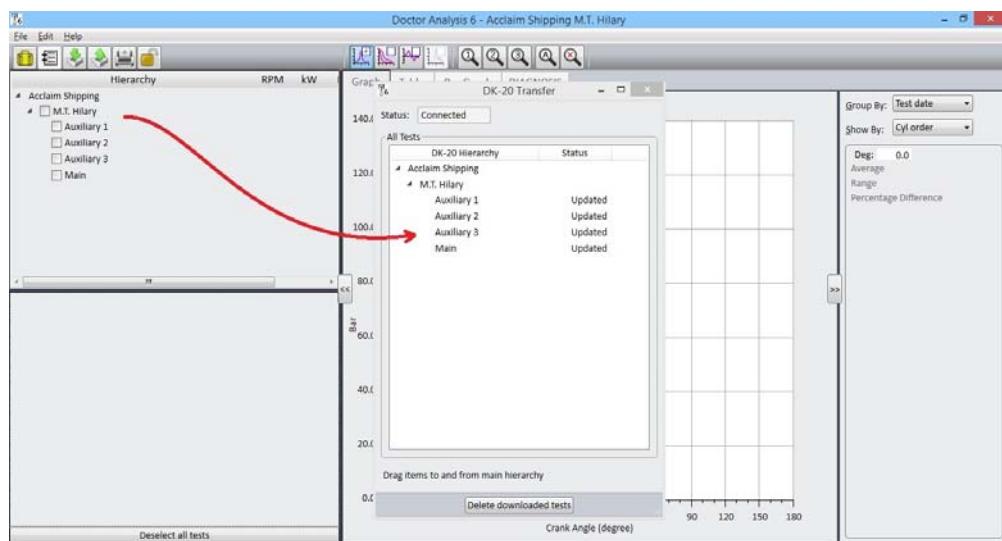
Chapter 7 – Shop/Sea Trial Data and Propeller Curves

7.1   Introduction

The Doctor V6 software offers a means to quickly and easily measure key parameters of your main engines performance against the tests made during shop or sea trial tests. Even if the sea or shop trial is not available the analysis software can be used to measure performance trends of your engines against a known starting point.

The propeller curve automatically plots *% MCR against % RPM @ MCR* which provides instant analysis on the operating point of the engine.

Shop and Sea Trial

Icon Research offers a setup service for shop and sea trial whereby the customer provides the parameters they wish to measure along with data from shop and/or sea trials. Icon then enters the data and it will be available in the custom logbook provided to the customer with the system.

The parameters used in shop and sea trial analysis to be measured against different load levels are flexible and can be selected by the customer as required.

For the setup service Icon Research provide a standard template for this data but it can be modified per your requirement as long as you are able to provide the data to be input. Where appropriate this data should be in ISO normalised format.

Thresholds for alerts and alarms should also be entered. These will trigger appropriate warnings in the diagnostic reporter module.

The default parameters are shown below:

Parameter
Engine Speed (RPM)
Turbo Speed (RPM)
Fuel Pump Index
Shaft Power(kW)
Maximum Pressure Pmax (bar)
Compression Pressure Pcomp (bar)
Exhaust Gas Temperature Texh - Manifold(°C)
Turbo Exh In (°C)
Turbo Exh Out (°C)
Scavenge Air Pressure (bar)
Turbo Air Inlet Temperature - T (°C)
Air Cool WC In Temperature -C (°C)
Specific Fuel Oil Consumption (g/kWhr)
ISO Specific Fuel Oil Consumption (g/kWhr)
Fuel Flow (m³/hr)
Fuel Temperature (deg C)
Fuel Specific Gravity (g/cm²)

The following parameters may also be provided by the customer or can be calculated using the values shown above.

| |
|---|
| Indicated Power (kW)- Calculated |
| ISO Maximum Pressure Pmax ISO |
| ISO Compression Pressure Pcomp (bar) |
| ISO Exhaust Gas Temperature Texh - Manifold(°C) |
| Turbo Exh In ISO (°C) |
| Turbo Exh Out ISO (°C) |
| ISO Pscav Normalised |

7.2   Entering Shop/Sea Trial Data

Icon Research offers a setup service for shop and sea trial data but it is possible for users to enter data themselves.

Separate tabs exist for entry of shop or sea trial. In either case the process is identical. The following is an example of how to enter sea trial data.

In the *Hierarchy* panel, right-click the engine which the data refers to and click on **Edit**. You will see the screen below:
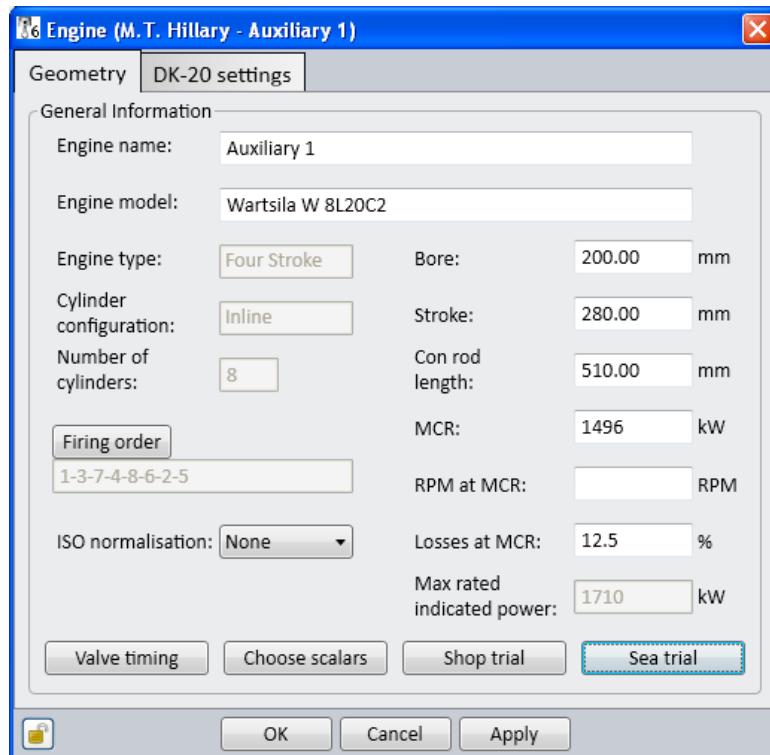
Now click on **Shop Trial** or **Sea Trial**. You can apply different data in each trial. In this example, we have selected *Sea Trial*. This brings up the Sea Trial Setup Screen. It may be necessary to enter the password to enable entry of scalars.

Firstly set the % load points at which tests have been carried out. Right click on the load point at the top of each column at which point you can edit, add or remove a % load point.

The next step is to press **Choose scalars** as in the screen below.
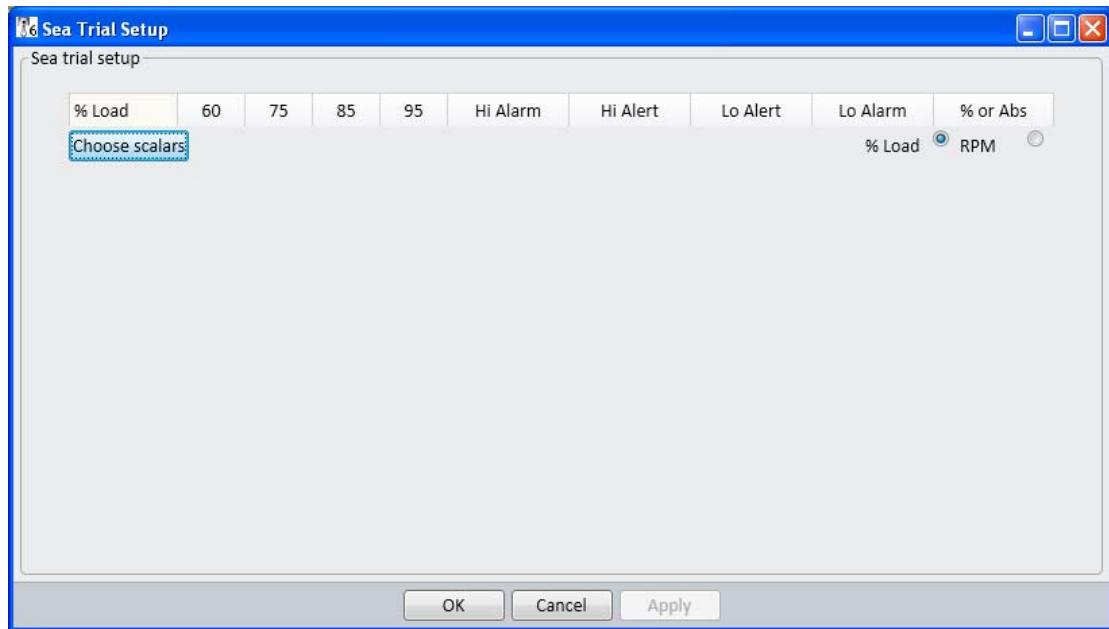
Select the scalars that you wish to measure then press **Apply** and then **OK**. Note that you can add and remove scalars at any time by checking and unchecking the corresponding tick boxes. The scalars you have selected will now appear in the sea trial setup chart and you can enter the data for each load point. Where appropriate ISO normalised data should be entered to provide as accurate a comparison as possible. The screen below shows an example of a single scalar setup (in this case, *ISO Peak Pressure*).


It is necessary to select high and low threshold levels for both alarm and alerts by clicking on the appropriate cell under *Hi Alert, Lo Alert, Hi Alarm and Lo Alarm* and entering either a % or an absolute figure. The *% or Absolute*

number is selected on the final column of the table. Each parameter selected will then have a black nominal performance curve along with amber thresholds for *alert* levels and red threshold curves for *alarm* levels.

7.3   Reviewing Shop and Sea Trial Comparisons

Each time an engine reading is made, the measurement data can be automatically compared to the shop or sea trial data. The crew may need to enter manual scalars into the Table section if these are part of the comparison.   The comparisons make it possible to quickly see if any parameters are deviating outside the alert or alarm levels. Click on the *Shop Trial* or *Sea Trial* tab and results of readings appear as black dots on the charts. Any transgressions above these alarm levels will also be highlighted in the diagnosis section of the software. The example below shows a *Shop Trial* comparison.
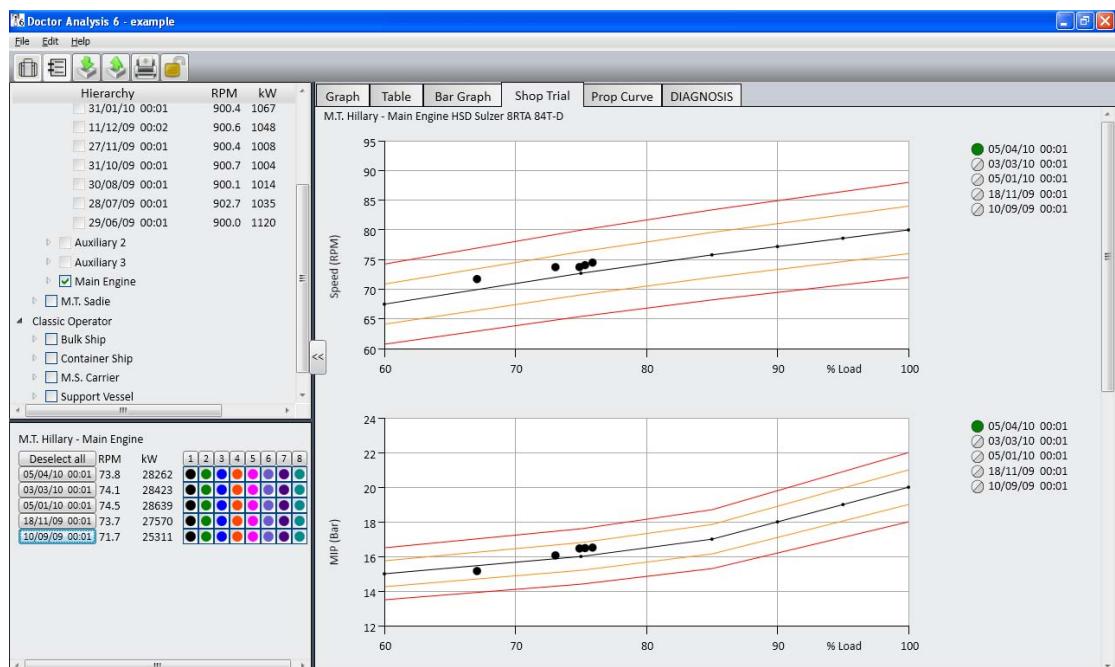
7.4   Reviewing Propeller Curves

The program provides a standard propeller curve chart which plots % MCR against % RPM @ MCR. Results of engine tests are automatically plotted on this chart which provides instant analysis on the operating point of the engine.

Click on the *Prop Curve* tab. Test results appear as black dots on the chart. If the cursor is held over a black dot the date and time of the reading are displayed. The values of % power and % RPM are continuously shown on the upper-left hand corner of the chart.

Any test results which show an engine being operated in an overloaded state can be viewed immediately and are also highlighted in the diagnostic section of the program.