

DOCTOR

Troubleshooting Guide For Doctor Portable Series

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CHAPTER 1 - Instrument Operation

1.1 Battery and Power Issues

The EPU screen should illuminate and show text indicating a test sequence on switching the instrument on. If this does not happen, it is likely that there is no power in the battery.

Try switching on with the battery charger connected. If the instrument switches on, the battery may either have been deep discharged, or it may require replacement.

If the Doctor is left switched on for an extended period, or occasionally on new units, the battery charging circuit may switch off before a full charge is reached.

If the battery seems to be losing charge quickly when in use, this may be the cause.

To remedy this, the following procedure should be used:

1. Connect the charge lead to the mains and check that the POWER light comes on. The CHARGING light should also come on, however if not, unplug, leave for 30 secs and try again.
2. Keep an eye on the unit for the first 10 to 20 mins of charging. If the CHARGING light goes out during this time, repeat step 1. A full charge from a flat battery condition will take 2 to 3 hours.
3. Ideally, after a deep discharge, the battery should be cycled by fully charging it, fully discharging it and then fully charging it again. To discharge, leave the unit switched on and make sure the BATTERY LEVEL selection in the *UTIL* screen is set to 5.90. When the BAT warning appears in the top right of the screen, the unit is quite close to being discharged and can be charged up again.
4. The batteries in the Doctor are Ni-Cad batteries and these should be allowed to discharge before being charged up in normal operation of the system. Failure to do this or constant “topping-up” of the batteries can induce a “memory” in the battery that results in reduced battery capacity.
5. If the battery still fails to power the unit, or only powers the unit for a short time, the battery should be replaced. In most Doctor units, the battery is fitted with a quick change connector. If this is the case, then a new battery should be ordered from Icon. If there is no connector present, the EPU must be returned to Icon for fitting of a connector and replacement of the battery.

To check inside the unit for a connector

Before starting, switch on the instrument and go to the *SET* screen and take a note of any settings you have made in the instrument for your engines. Battery changing will not affect the memories in the instrument.

Chapter 1 – Instrument Operation

Switch the instrument off and remove the 10 screws holding the front panel.



Lift the panel slightly and move it towards you before tilting the back up to remove the chassis from the case.

Turn the panel over and place it in the case as a convenient support.

Note that newer units do not have the internal power supply fitted (lower right in picture)



Check to see if a connector is fitted to the battery.

CHAPTER 2 - Problems with Taking Readings

If the unit fails to take a reading, but the screen is operating normally, it is best to determine if the pressure sensor and the crank pickups are functioning correctly.

2.1 Checking the Pressure Sensor

From the *UTILS* screen in the EPU, select **READ PMAX**. In this mode the instrument acts as a peak pressure gauge, independent of the crank pickups.

With the engine running, attach the pressure sensor to an indicator cock on a running engine, open the cock fully and press **[ENT]**. This will start peak pressure measurement. If a normal pressure reading is obtained, the pressure sensor and lead are OK.

If the pressure sensor gives a reading, but it is too low or too high, check that the sensitivity that has been entered for the sensor is correct.

If not, the following can be checked:

Clogged Thompson Adapter	In very exceptional circumstances, the Thompson Adapter may become clogged. This is most likely to be due to incorrect storage (may be clogged with melted plastic for example if placed on plastic surface when hot).
Faulty extension lead	Check lead for continuity and for shorts. If any problems are found, it is likely that a replacement will be needed.
No power to pressure sensor	Check on the TNC connector on the EPU for 24V between the inner contact and the outer thread on the connector. If the voltage is found to be significantly lower than this, the instrument should be returned for investigation.
Faulty pressure sensor	The pressure sensor can be visually inspected for damage. Removal from the Thompson Adapter using the supplied tube spanner may assist this. It cannot be electrically checked. If the sensor is suspected to be the cause of lack of readings after other tests, it should be returned to Icon for repair or replacement.

2.2 Checking Operation of the Crank Pickup(s)

In the EPU, press **[UTIL]** and select **CRANK SETUP** from the menu. This utility checks the crank pickups for the engine type selected in the *MAIN* screen.

Connect the instrument to the pickup(s) on the engine and press **[ENT]** to start the test.

For a TDC ONLY pickup, a steady RPM should be found and the RPM should be the correct value for the engine.

For a DUAL pickup, the RPM should be steady for both TDC and FLYWHEEL, and the MAX TOOTH DEVIATION should be under 10%. Note that the deviation should be under 4% to get acceptable readings, however operation is possible up to 10%.

CHAPTER 3 - Inductive Pickups

The most common faults found are:

3.1 TDC ONLY Operation

RPM is double expected.	Two TDC markers on flywheel
RPM too low or unsteady.	Unreliable signal – check gap, pickup and marker.
RPM too high.	Pickup too close to flywheel.
No reading	Check that the engine selected has <i>TDC ONLY</i> selected in the <i>SET</i> screen.

3.2 DUAL Operation

RPM is double expected.	Two TDC markers on flywheel.
RPM too low or unsteady.	Unreliable signal – check gap, pickup and marker.
RPM too high.	Pickup too close to flywheel.
RPM steady but number of teeth low and or unsteady.	Pickup too far from flywheel teeth. Check that target diameter is machined and there is no run-out on the flywheel.
RPM steady but number of teeth too high and /or unsteady.	Pickup too close to flywheel teeth. Check target diameter is machined and free of burrs or dents.
Max tooth variation > 5% and RPM and No of teeth steady.	Teeth probably worn or damaged – move pickup to a more uniform diameter on teeth or revert to TDC ONLY operation.
RPM correct but tooth reading fails at higher RPM's.	The gap between the tooth readings is insufficient. Move the tooth pickup to a larger diameter where the gaps are larger or use a smaller diameter pickup with a higher response.
RPM very high	Check that the engine selected has DUAL selected in the <i>SET</i> screen.

CHAPTER 4 - Full Diagnostics for Inductive Pickups

4.1 Single Pickup – No RPM indication at EPU

Check for 24V at pin E on Mil spec connector on EPU.	✘	Check EPU operates normally otherwise and if so, return EPU to Icon for investigation.
✓		
Check 24V at Junction boxes on terminal E of Mil Spec connector and to all power connections (brown wires).	✘	Check CIC-3 cable for continuity and shorts. If faulty, either repair or replace.
✓		
Check pickup for physical damage.	✘	Damage normally impairs operation. Replace pickup.
✓		
Check that the LED is lit when metal is present in front of the pickup.	✘	Replace pickup.
✓		
Check that the LED is NOT lit when metal is NOT present in front of pickup.	✘	Check wiring and if correct, replace pickup.
✓		
With LED lit (metal in front of pickup) check voltage on black wire from pickup. This should be 24V.	✘	Replace pickup.
✓		
With LED lit (metal in front of pickup) check voltage on terminal 2 in junction box (signal wire after resistor pack). This should be 5V.	✘	Check resistor values and connections. Remedy any faults found.
✓		
With LED NOT lit (no metal in front of pickup) check voltage on terminal 2 in junction box (signal wire after resistor pack). This should be 0V.	✘	Replace pickup.
✓		
Check for continuity and no shorts back to Pin A of CIC-3 cable at EPU end. Check for 5V here with LED lit and for 0V with LED not lit.	✘	Repair or replace CIC-3 cable.
✓		
Rotate flywheel on engine slowly and check LED on pickup goes on when target is in front of pickup and off when not.	✘	Check pickup gap and that the pickup is far enough away from flywheel surface when target is not in front of pickup.
✓		
Check that the engine selected in the EPU has TDC ONLY set in the <i>SET</i> screen.	✘	Alter EPU <i>SET</i> screen setting to TDC ONLY .

CHAPTER 4 – Full Diagnostics for Inductive Pickups

✓		
With the engine running and EPU connected to crank pickup, enter <i>UTILS</i> screen. Select CRANK SETUP and follow on-screen instructions to test TDC ONLY pickup. RPM should be correct and steady.	✗	If OK on other engines, review above. If problems persist, contact Icon for advice.
✓ Crank pickup is operating correctly.		

4.2 Dual Pickup – No RPM indication at EPU

Check for 24V at pin E on Mil spec connector on EPU.	✘	Check EPU operates normally otherwise and if so, return EPU to Icon for investigation.
✓		
Check 24V at Junction boxes on terminal E of Mil Spec connector and to all power connections (brown wires).	✘	Check CIC-3 cable for continuity and shorts. If faulty, either repair or replace.
✓		
Check pickups for physical damage.	✘	Damage normally impairs operation. Replace pickup.
✓		
Check that each LED is lit when metal is present in front of the pickup.	✘	Replace pickup. Note that the system can be re-configured for TDC only operation as a stand-by until a replacement is available.
✓		
Check that the LED is NOT lit when metal is NOT present in front of each pickup.	✘	Check wiring and if correct, replace pickup.
✓		
With LED lit (metal in front of pickup) check voltage on black wire from each pickup. This should be 24V.	✘	Replace pickup.
✓		
With flywheel LED lit (metal in front of pickup) check voltage on terminal 2 in junction box (signal wire after resistor pack). This should be 5V. Repeat for TDC pickup and terminal 6.	✘	Check resistor values and connections. Remedy any faults found.
✓		
With flywheel LED NOT lit (no metal in front of pickup) check voltage on terminal 2 in junction box (signal wire after resistor pack). This should be 0V. Repeat for TDC pickup and terminal 6.	✘	Replace pickup.
✓		
Check for continuity and no shorts on the green and yellow wires back to the junction box with the Mil spec connector.		Repair or replace connecting cable or make connections good.
✓		
Check for continuity and no shorts back to pins A and B of CIC-3 cable at EPU end. Check for 5V here on each with LED lit and for 0V with LED not lit.	✘	Repair or replace CIC-3 cable.

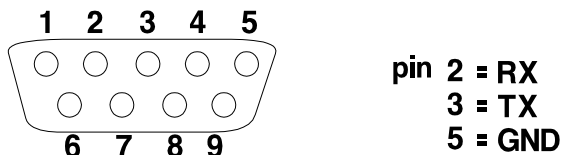
CHAPTER 4 – Full Diagnostics for Inductive Pickups

✓		
Check that pin A on the CIC-3 connector at the EPU end corresponds to the Flywheel pickup (monitors the teeth on the flywheel) and that pin B corresponds to the TDC pickup (monitors bolt in the flywheel).	✗	Swap connections for pickups at junction box nearest to flywheel.
✓		
Rotate flywheel on engine slowly and check LED on pickup goes on when target is in front of pickup and off when not. Check that the flywheel pickup flashes each time that a tooth is in front of the pickup.	✗	Check pickup gap and that the pickup is far enough away from flywheel surface when target is not in front of pickup. Note that flywheel pickups should have at least twice the pickup diameter as free space between each tooth. If not, move pickup to achieve this, or replace with smaller pickup.
✓		
Check that the engine selected in the EPU has DUAL set in the <i>SET</i> screen.	✗	Alter EPU <i>SET</i> screen setting to DUAL .
✓		
With the engine running and EPU connected to crank pickup, enter <i>UTILS</i> screen. Select CRANK SETUP and follow on-screen instructions to test DUAL pickups. RPM should be correct and steady. The MAX TOOTH DEVIATION should be under 10% as a maximum (note that for good readings this should be under 4%).	✗	If OK on other engines, review above. If problems persist, contact Icon for advice.
✓		
Crank pickup is operating correctly.		

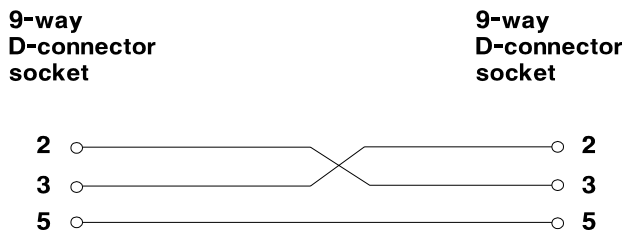
CHAPTER 5 - Downloading Issues

5.1 Cable specification

A download from the Doctor EPU to the Doctor software in a PC is made using an RS232 crossover cable. The pin-out of the connector on the instrument is shown below.




For connection to the 9-pin connector on a PC, an industry-standard PC AT-AT DB9 cable is recommended. Alternatively, a cable as shown in the diagram below can be used.



For connection to a PC fitted with USB ports, a USB to serial converter will work quite adequately with the RS232 cable supplied.

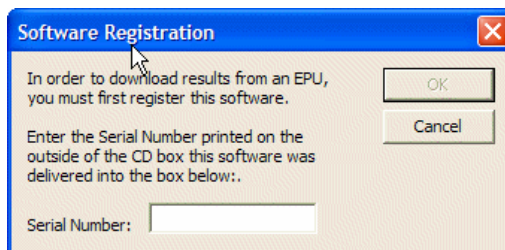
5.2 No serial number entered

Check that the RS232 cable is connected at both ends and that the instrument is switched on.

From your database, click on the Yellow Box Button  and you should see the dialogue for transfer of results.

If the programme requests a serial number, this can be found on the cover of the CD that was used to install your software.

You will only be able to download data using a fully licensed copy of the Doctor software. The first time you download, the following window appears. Enter your serial number to continue.



5.3 Timing Issues

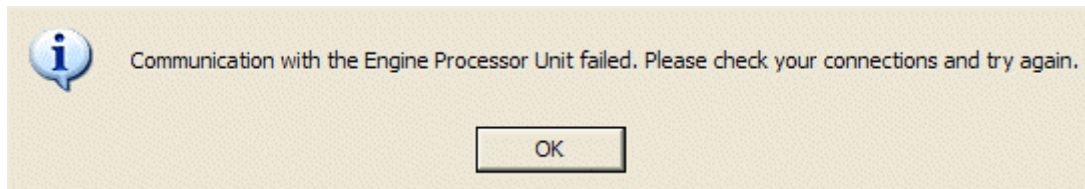
On a very few older PC's, the timing for the RS232 may be incompatible with the EPU. For such cases, the EPU has a SLOW transfer mode. To select this, in the EPU, enter the *UTILS* screen and select the **SLOW** option for *SERIAL TRANSFER*.

5.4 Incorrect Com Port Selected

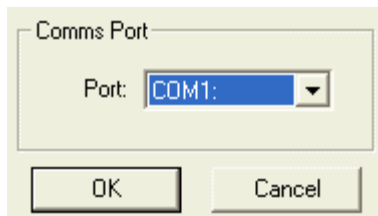
The COM port that is selected by default is COM 1. If this is not the one you are using, it is possible to change the port. If you know the COM port number for the socket you have used, you can enter it, however if you don't know, you can keep trying until one works.

There are 8 COM port selections to choose from. Note that if you are using a USB to serial adapter, you will always need to change from the default setting of COM 1.

If connection is unsuccessful, you will see the following window.



From the drop down menus, select **Download... Comms Setup** and choose the COM port you need. Click on **OK** and try downloading again.



Click on the  button after the correct COM port has been selected.

5.5 Problems with the PC's RS232 connection

As an initial test, it may be easiest to install the Doctor programme on another PC and test downloading. If this works, then the cable and the EPU are OK.

To check further, the following tests can be made.

To test RS232 operation of EPU, cable and PC, the unit displays a short message on start-up.

If you connect *HyperTerminal* using the following settings you will get a message on the PC saying "I'm Alive" when you switch on the EPU.

CHAPTER 5 – Downloading Issues

To use *HyperTerminal*, use **Start... All Programs... Accessories... Communications... HyperTerminal**.

Use the **Set up a New Connection** option (this will appear automatically the first time you use *HyperTerminal*).

Enter a name for your connection, e.g. Doctor.

From the drop down list, choose COM1, or the COM port number you are testing.

Set up the following:

- 9600 Bits per Second
- 8 Data Bits
- No Parity
- 1 Stop Bit
- No Flow Control

Click **OK** and *HyperTerminal* is ready to use.

Connect up to the EPU and then switch on the EPU. If you get the message “I’m Alive” then the correct port has been selected and communication is established.

HyperTerminal must be closed before a transfer with the Doctor software.

5.6 Further tests

If the computer has only one serial port, an additional computer will be required to perform all of the tests.

Firstly using *HyperTerminal*, connect to the suspected faulty serial port using the settings of:

- 9600 Bits per Second
- 8 Data Bits
- No Parity
- 1 Stop Bit
- No Flow Control

If *HyperTerminal* states that it cannot connect it may be due to one of the following:

- The serial port does not exist - Check using the *Windows Device Manager* which is found in the *Control Panel - System Tools*.

CHAPTER 5 – Downloading Issues

- The hardware driver for the serial port is faulty - Check using the *Windows Device Manager*.
- Another application is currently using the serial port - this must be closed before it can be used by the Doctor Software.

If the computer has another serial port, repeat the process above using a second copy of *HyperTerminal*, or else use a second computer.

Connect your RS232 cable between the serial ports, and type a message on each of the *HyperTerminal* windows. The message should be displayed on the other *HyperTerminal* window. If it does not it may be due to one of the following:

- The cable is not actually connected to the correct serial port on the computer
- The cable is not a crossover cable or is faulty
- One or other of the serial ports is faulty

If the message only appears on one of the *HyperTerminals* it may be due to one of the following:

- The cable is not a crossover cable or is faulty
- One or other of the serial ports is faulty

If the serial port works correctly, *HyperTerminal* can also be used to check the workings of the DK-2 unit (Firmware Version 3.xx only). To do this:

- Start *HyperTerminal* in the same manner as above.
- Connect the DK-2 to the computer using the serial cable.
- Switch on the DK-2 and observe a single line message displayed.

CHAPTER 6 - Issues with Results – Incorrect Power Results

6.1 TDC Offset

By far the most common reason for unacceptable results is that the TDC offset has not been correctly adjusted.

A 1° error in TDC adjustment will give an error in power of 7% or so.

The manual for the software fully covers how this adjustment may be made. Alternatively, Icon provides a service for initial results free of charge. To use this service, just send an archived database to doctor@iconresearch.co.uk

6.2 Sensitivity of sensor incorrectly entered

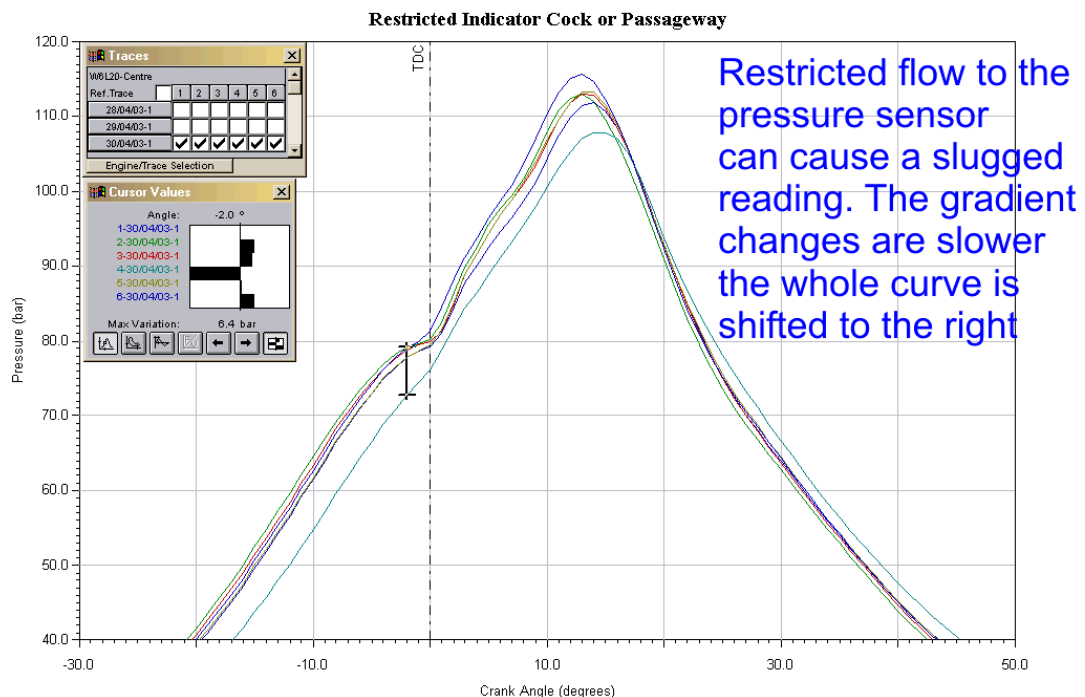
The sensitivity of the pressure sensor must be correctly entered into the database in the software on the PC. The default value is 20mV/bar, and all sensors supplied today are close to this value. Older sensors had a sensitivity of 25mV/bar, and if the two are confused a 20% to 25% error in pressure and power values can result.

6.3 Incorrect dimensions in the database

The values for bore, stroke and con rod length all need to be correct in the database to provide correct power values.

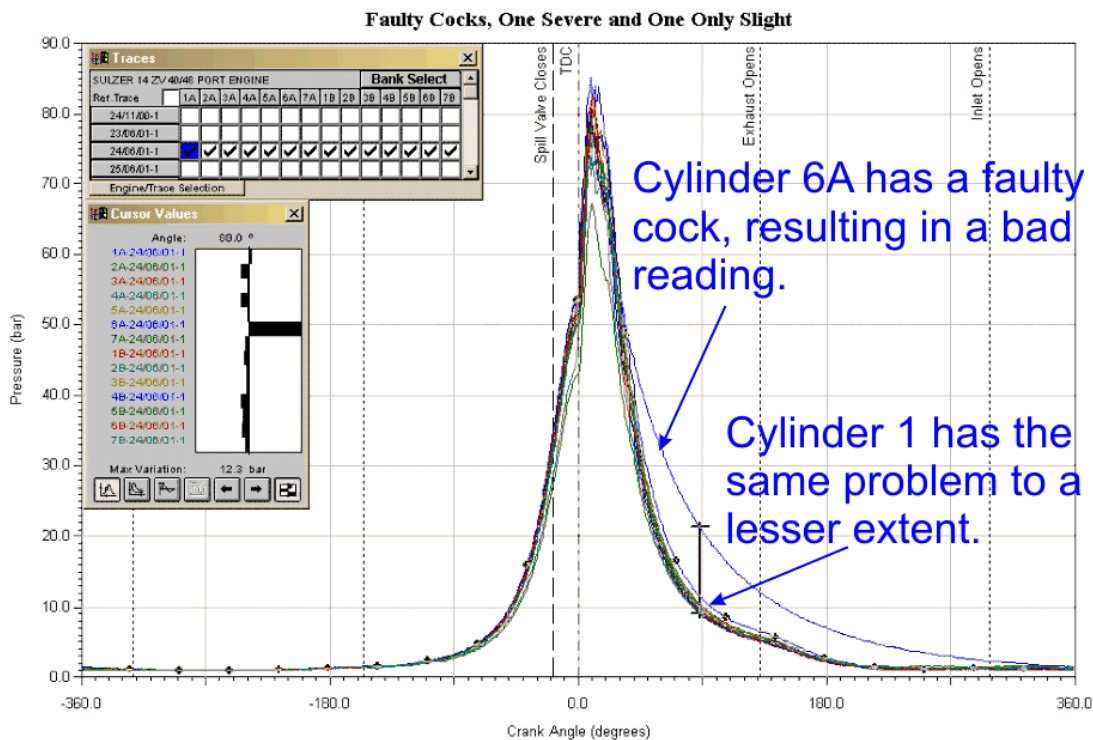
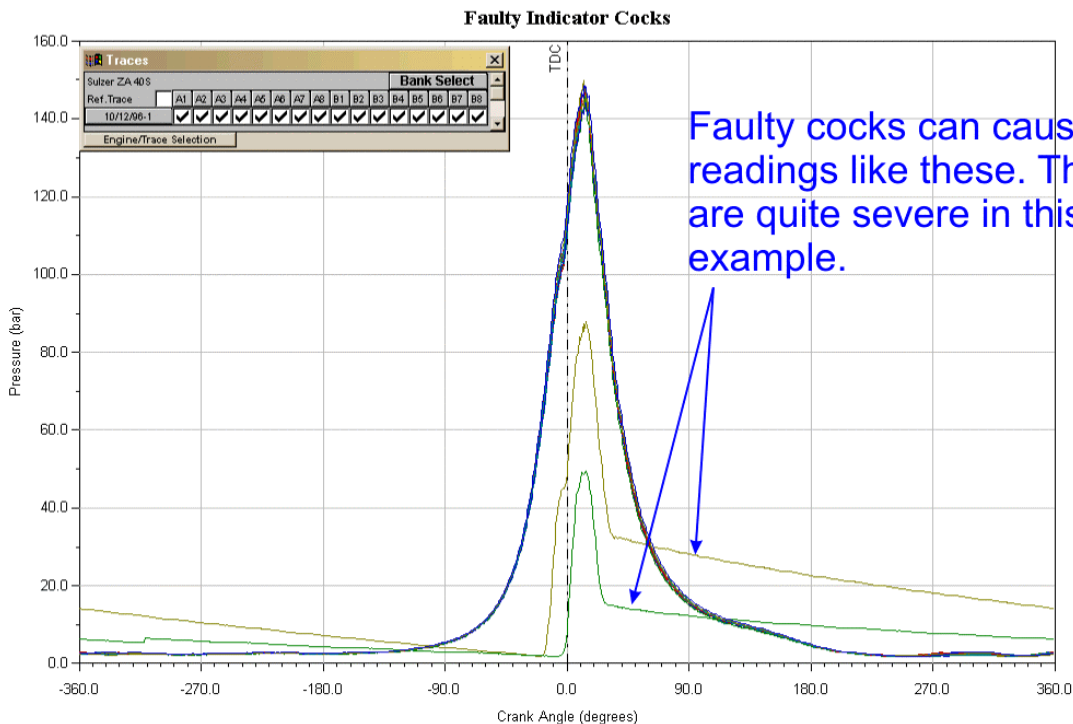
6.4 Clogged or restricted indicator passageways

Partial clogging of the indicator cock or passageways will affect the results.



6.5 Faulty indicator cocks

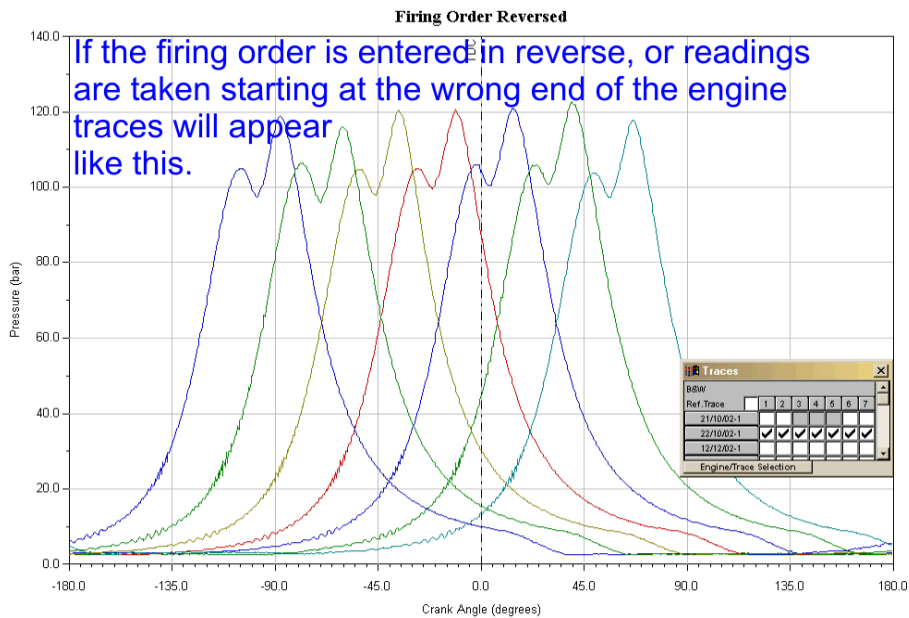
If a cock has a damaged seat inside, the results often look like the ones shown below. The cylinders affected will show much higher power than is actually present in the cylinder.



CHAPTER 7 - Database Setup Issues

7.1 Firing order incorrect

Incorrect entry of the firing order can result in traces like this. A similar effect is seen if readings are taken starting at the wrong end of the engine.



7.2 Bank angle on V configuration engine incorrect

The graph below shows the effect of an incorrectly entered bank angle for a V engine

