PicoDiagnostics

Automotive Software

User's Guide

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1 Welcome

Welcome to PicoDiagnostics, the automotive fault-finding software for your PicoScope Oscilloscope.

With a PicoScope, PicoDiagnostics turns your PC into an automotive diagnostics tool. The program includes a range of built-in tests that are easy to operate, even if you haven't used them before.

If you need to go beyond the built-in tests, an additional program is available: PicoScope Automotive. This software will have been downloaded and installed along with PicoDiagnostics. This gives you all the features of an advanced oscilloscope and can be used to diagnose almost any electrical component in any vehicle.

This manual has been updated to be brought in line with release version 1.4 of the software.

2 Introduction

PicoDiagnostics supports the PicoScope 3000 and 4000 Series diagnostic oscilloscopes.

How to use PicoDiagnostics

- Getting started: see Using PicoDiagnostics for the first time 2.
- For further information: see descriptions of Menus 4.

2.1 Contact information

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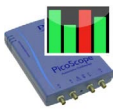
Web site: www.picotech.com

2.2 Using PicoDiagnostics for the first time

We have designed PicoDiagnostics to be as easy as possible to use, even for newcomers to automotive diagnostics. Once you have followed the introductory steps listed below, we hope that you will soon become an expert.

1. Plug in your PicoScope oscilloscope. Windows will recognise it and make the necessary changes to allow your computer to work with it. Wait until Windows tells you that the device is ready to use.



2. Click the new PicoDiagnostics icon on your Windows desktop.

3. Click the button for the test you wish to perform.

4. Follow the on-screen Setup Wizards or instructions on connecting your scope and running the test.

2.3 Licence agreement

The material contained in this release is licensed, not sold. Pico Technology grants a licence to the person who installs this software, subject to the conditions listed below.

Access. The licensee agrees to allow access to this software only to persons who have been informed of these conditions and agree to abide by them.

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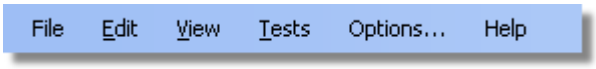
Support. If you are dissatisfied with the performance of this software, please contact our technical support staff, who will try to fix the problem within a reasonable time. If you are still dissatisfied, please return the product and software to your supplier within 14 days of purchase for a full refund.

Upgrades. We provide upgrades, free of charge, from our web site at www.picotech.com. We reserve the right to charge for updates or replacements sent out on physical media.

Trademarks. *Windows* is a registered trademark of Microsoft Corporation. *Pico Technology, PicoScope* and *PicoLog* are internationally registered trade marks.

3 Menus

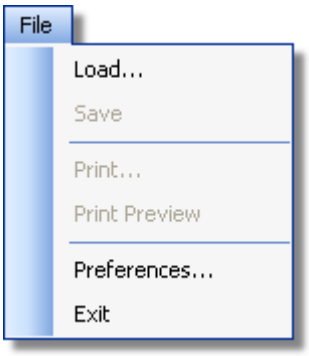
Menus are the quickest way to get to the main features in PicoDiagnostics. The Menu bar is always present at the top of the PicoDiagnostics main window, just below the window's title bar. You can click any of the menu items, or press the Alt key and then navigate to the menu using the cursor keys, or press the Alt key followed by the underlined letter in one of the menu items.



The list of items in the menu bar may vary depending on which test you are running.

3.1 File menu

Click File on the Menu bar. 4



Load. Allows you to load a test from disk to review the result. Loading a test result from disk will clear any captured data and results.

Save. Some tests allow you to save test data to disk.

Print. Opens a standard Windows print dialog, which allows you to choose a printer, set printing options and then print the selected view.

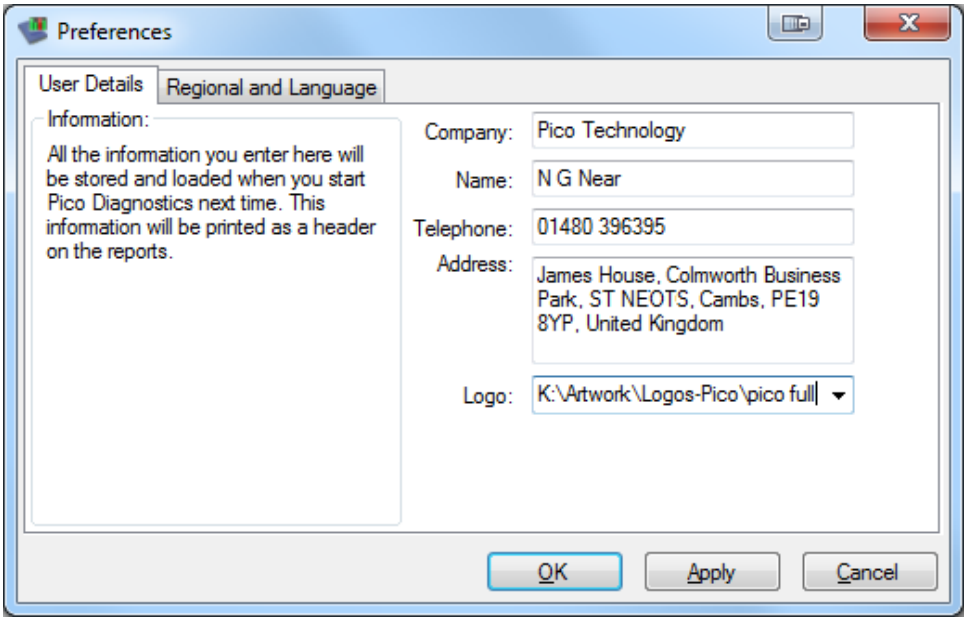
Print Preview. Opens the Print Preview window, which allows you to preview the report before printing it with the Print command.

Preferences. Opens up the User Details dialog. 5

Exit. Close PicoDiagnostics without saving any data.

3.1.1 User Details dialog

This dialog appears when you select Preferences on the File menu 4. It allows you to enter details about your company and your name. These will appear on the report.



How to use the dialog
Enter all the values you want.

Click OK to close the dialog and save the changes.

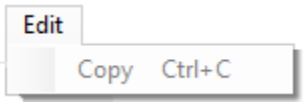
Click Cancel to close the dialog and discard the changes.

The items in the dialog

Company:	The name of your company. This will be displayed on the report if no logo has been selected.
Name:	Name of the technician, or the contact name, to appear on the report.
Telephone:	The contact number that the customer will see on the report.
Address:	The address of your company. There is space for four lines.
Logo:	Your company logo (selecting a file here will enable it to appear on your reports).

3.2 Edit menu

Click Edit on the Menu bar. 4



Here you will find the Copy option, available only when data is shown on screen.

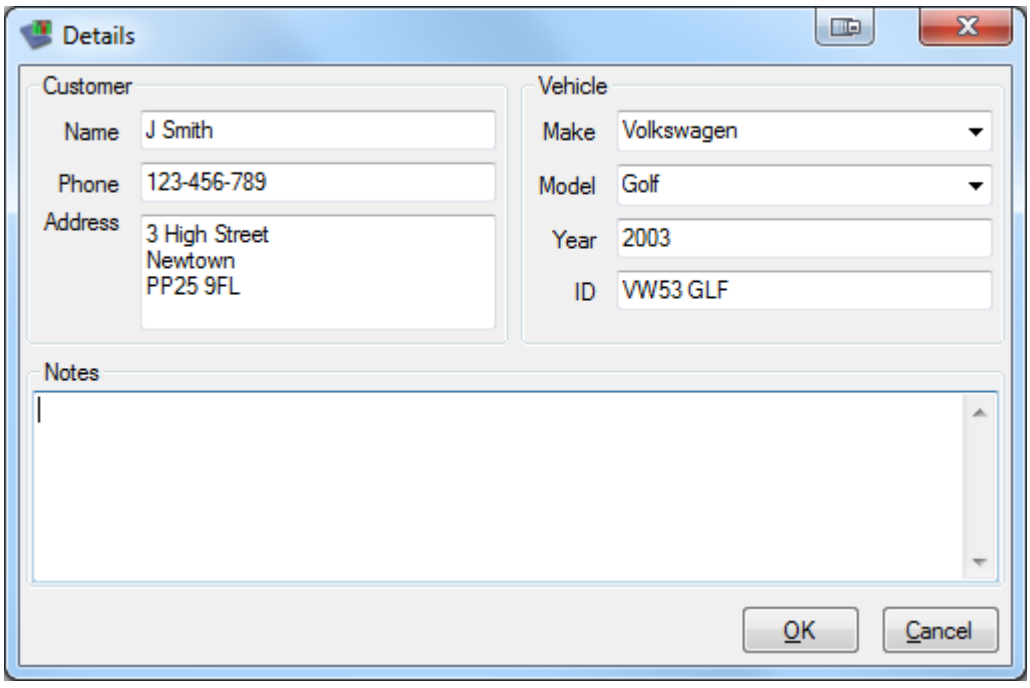
3.3 View menu

Click View on the Menu bar. 4

Details. Edit the customer and vehicle details and notes 6.

3.3.1 Customer details dialog

This dialog appears when you select Details on the View menu 6. It allows you to enter details about the customer and the vehicle you are testing. There is also a space for entering notes about the test.



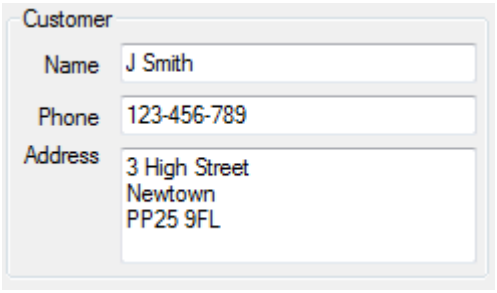
How to use the dialog

This dialog is for you to store data about the customer and the vehicle that the test applies to. The data in this dialog will be saved with the test and printed on the report.

Click OK to close the dialog and save the changes.

Click Cancel to close the dialog and discard the changes.

Customer details



Name. The customer's name.

Phone. The customer's phone number.

Address. The customer's address. There is space for 4 lines.

Vehicle details

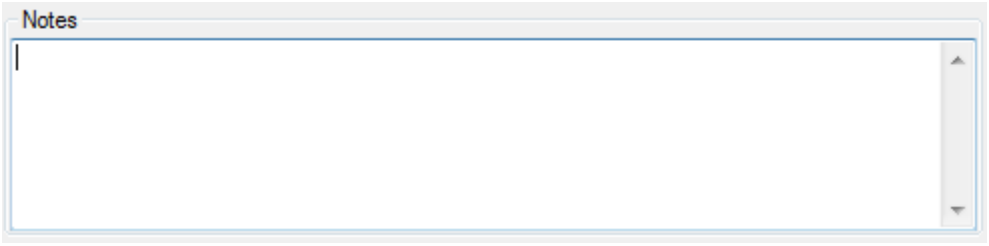
Make. The make of the vehicle. The makes of vehicles are stored in a database. If you manually enter a make which is not already saved, a message box will pop up.

Model. The model of the vehicle. When a make has been selected, this list is populated with all the currently known models of that make.

Year. The year of the vehicle.

ID. An identification number for the vehicle. Can be the VIN or anything else you choose.

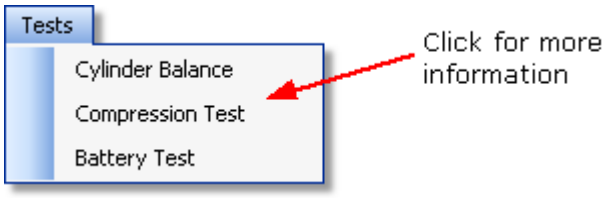
Notes



In the Notes field you can enter additional information that you want stored with the test.

3.4 Tests menu

Click Tests on the Menu bar. 4



This menu lists all the tests available. Click one of the tests to proceed.

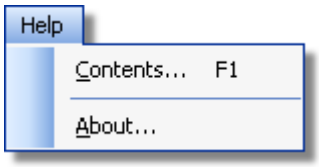
3.5 Options menu

The Options menu changes depending upon which test you are carrying out at the time. Please see below for links to the test options you require:

- Cylinder balance options 12
- Compression test options 18
- Battery test options 24

3.6 Help menu

Click Help on the Menu bar. 4

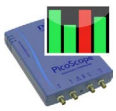


These are the standard Windows options for access to this help file.

4 Tests

PicoDiagnostics is a collection of specific automotive tests. They are all designed to be easy to use, even if you have little or no experience of automotive diagnostics.

To begin any test, click the PicoDiagnostics icon on your computer:



These tests are available with this installation of PicoDiagnostics:

4.1 Cylinder balance

4.1.1 Cylinder balance introduction

The cylinder balance test measures how much each cylinder contributes to the engine's total power output. There are a number of things that can cause a cylinder to contribute less than the other cylinders. These include but are not limited to:

- low compression
- faulty injector
- faulty spark plug.

A slightly uneven balance does not necessarily mean that there is a fault in the engine. During warm-up, most engines run slightly unevenly. Deposits and engine wear may also have an effect on the engine's performance.

To use the cylinder balance, start PicoDiagnostics and set the test conditions 9.

4.1.2 Cylinder balance test conditions

Setting the test conditions

The following test conditions must be met before running the test:

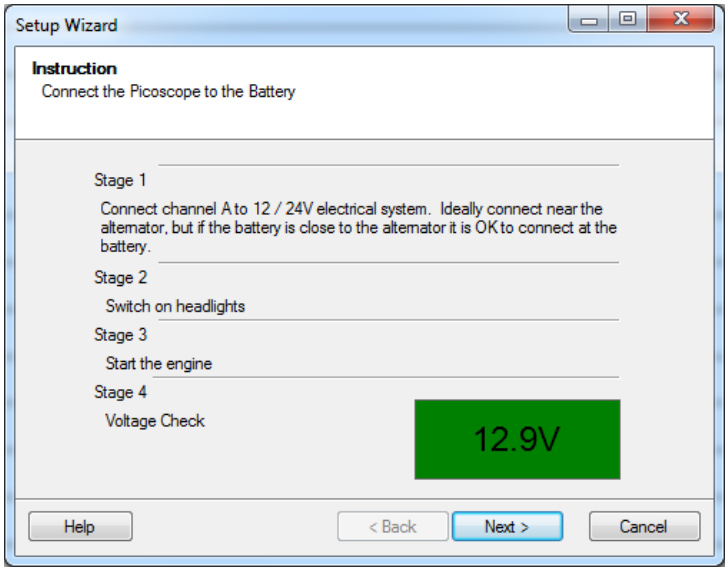
- The engine must be at normal running temperature. This can be confirmed when the cooling fan has activated twice, and by referencing the temperature gauge on the vehicle's dashboard.
- The engine must be off before connecting the oscilloscope.

If this is the first cylinder balance test you are running, load the test using the Tests menu 8. Follow the on-screen wizard instructions to connect your PicoScope to the vehicle. If however you have already run a cylinder balance test, simply click the button labelled "Setup" and follow the on-screen wizard instructions.

4.1.3 Cylinder balance wizard

The cylinder balance setup wizard consists of 3 screens. These screens are shown below:

Screen one



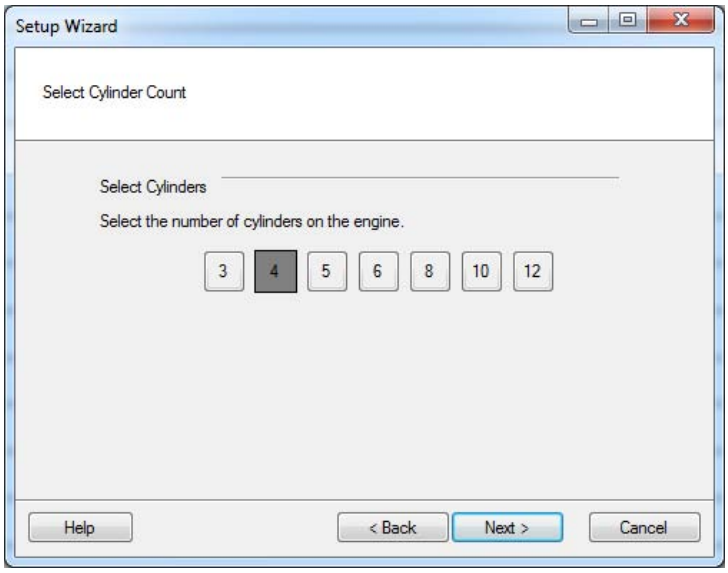
This screen gives the user guidance on connecting the PicoScope ready for the Cylinder Balance test

Connect the oscilloscope

Connect the scope to a free USB port on your PC using the USB cable.

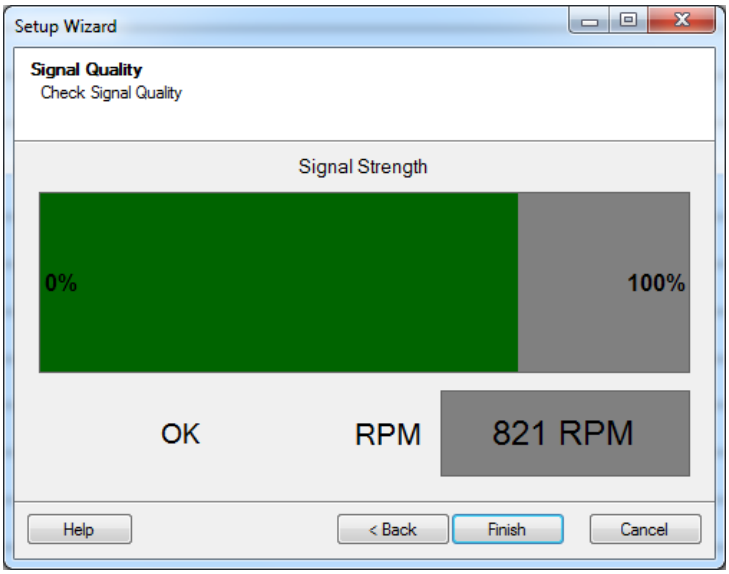
Connect one of the general test BNC cables to Channel A on your oscilloscope. On the other end, connect a large red crocodile clip to the red cable and a large black crocodile clip to the black cable. Connect the red clip to the battery positive (+) and the black clip to the battery negative (-) as shown in the picture above.

Screen two



On screen two, the user must identify the number of cylinders the vehicle to be tested has

Screen three

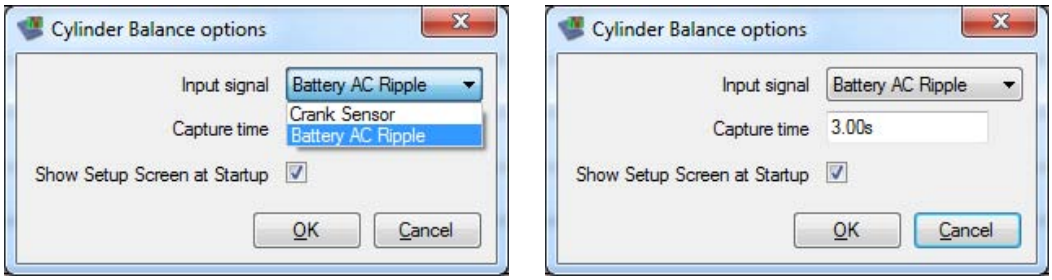


This screen shows the signal strength between the PicoScope and the vehicle to be tested.

Note: If the signal strength is low you can improve it by switching on various ancillaries i.e. Mainbeam lights, fog lights, interior fan (full), rear demister.

4.1.4 Cylinder balance options

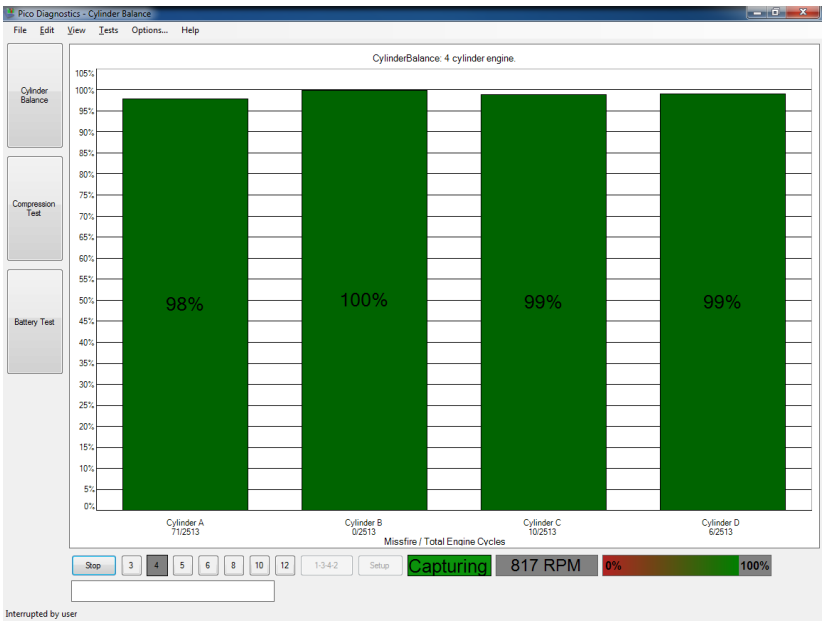
This dialog appears when you click the Options... menu on the main Menu bar 4 while the Cylinder Balance Test 9 is selected. It allows you to set special options before running the test.



4.1.5 Cylinder balance test

Run the test

To start the test click the button labelled Start at the lower left corner of the window. If the test successfully starts, a new window with a progress indicator will briefly appear on the screen. The data is now being analysed and shown in real time on screen with the results appearing in the bar graph as shown below.



The result

If the test could not produce a result see: Failed cylinder balance. 15

You can stop the test at anytime by simply clicking the button labelled Stop. It is possible to then scan through the results by clicking the button labelled Play. The results are always scaled to show the highest cylinder at 100%.

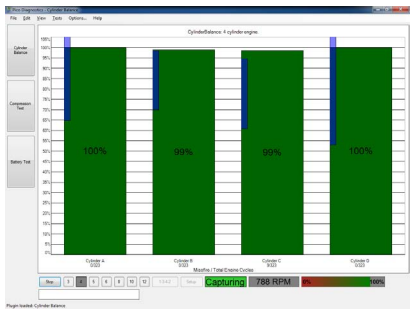
Cylinder balance controls

During the test you can right-click on the bar graph to get a control menu. See: Cylinder balance controls. 13

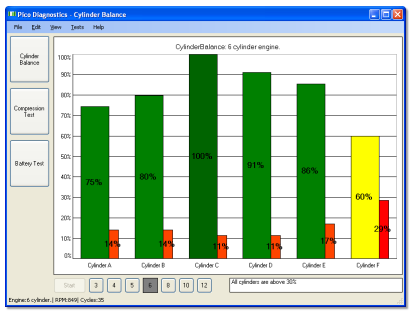
4.1.6 Cylinder balance controls

Right-click the cylinder balance bar graph to bring up a menu with display options. You can use this menu to access more information concerning the test and its result.

Variation
Displays the variation in contribution for each cylinder as an overlaid blue bar.



Misfire
Displays suspected misfires as a separate bar for each cylinder.



Signal
Not required for basic testing

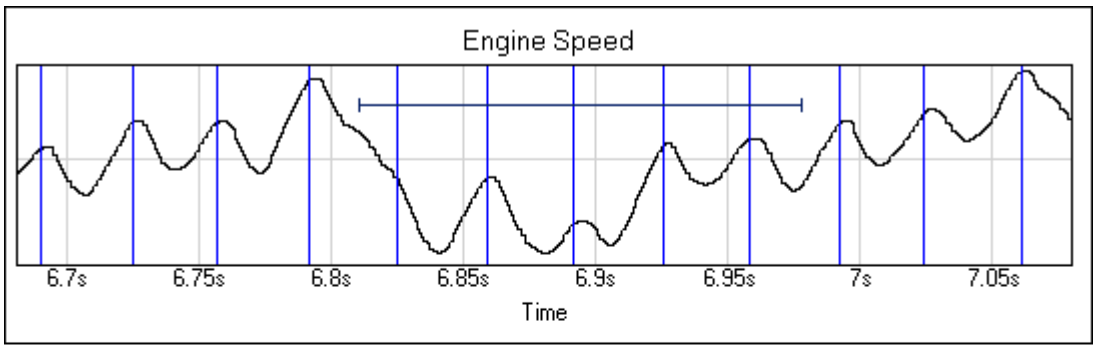
Brings up a second graph, the signal graph, 14 that can display the engine speed or the contribution for each cylinder over time. To zoom in on the data, click and drag to select the range to display.

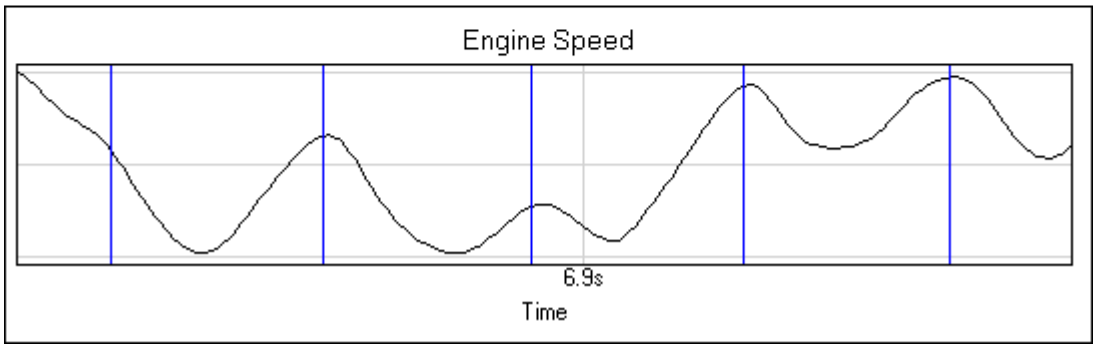
4.1.7 Cylinder balance signal graph

The signal graph displays the captured data as engine speed or cylinder contribution.

Zooming

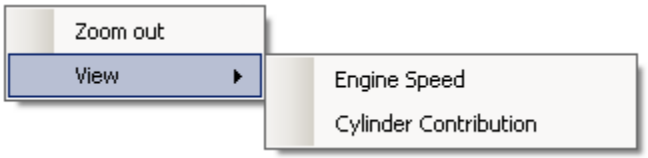
You can use the mouse to zoom in on the data. Use the context menu (right-click) to zoom out again.





Signal graph context menu

Right-click the graph to bring up a menu with display options. You can use this menu to access more information concerning the test and its result.



Zoom out

This zooms out to display the full dataset.

View

You can choose to view the engine speed or the cylinder contribution. 12

4.1.8 Failed cylinder balance

If the test could not produce a result, make sure that:

- the connection to the battery is good
- the tension of the alternator belt is adequate.

It may also help if you you switch the headlights on full beam and switch on other electrical loads, such as the rear windscreen heater and fog lights.

There are some engines for which the test has difficulties producing a result. These include:

- engines with more than 8 cylinders
- some engines with dual mass flywheels
- engines with inertial dampers
- vehicles with xenon lights

If there is still a problem

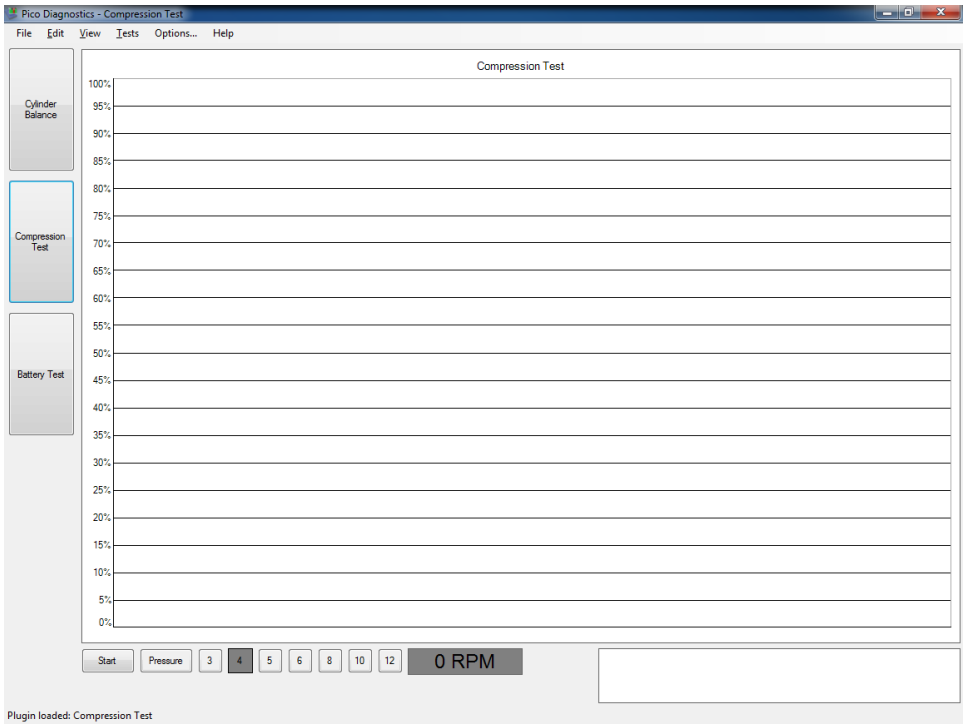
If you have checked the points mentioned above and the software still cannot produce a result, we would like you to send us a copy of the of the failed test data. Please enter as much information as possible about the vehicle tested. This is done via the Details dialog 6. Save the test to a file using the File | Save menu and email the file to us on picodiagnostics.feedback@picotech.com.

4.2 Compression Test

4.2.1 Compression test introduction

The compression test is meant to be a first check. If the compression looks good, you can quickly move on and investigate other components which might be the cause of the fault. If the test detects a low cylinder, you should perform a manual compression test to verify the results and to work out which cylinder is low.

To use the compression test, start PicoDiagnostics and click the Compression Test button.



Compression test - before starting the test

There are two types of compression test:

- Relative compression - requires no pressure transducer, only a connection to the battery.
- Absolute compression - requires a connection to the battery and a pressure transducer connected to a spark plug port.

Follow the instructions below to connect your PicoScope to the vehicle and run the test.

- Set the test conditions 16
- Connect the oscilloscope 17
- Connect the pressure transducer 17 (only for the absolute compression test)
- Disable the engine
- Run the test
- If the result is blank 20

4.2.2 Compression test conditions

Setting the test conditions

The following test conditions must be met before running the test:

- The engine must be at normal running temperature, which is indicated by the Cooling Fan switching on.

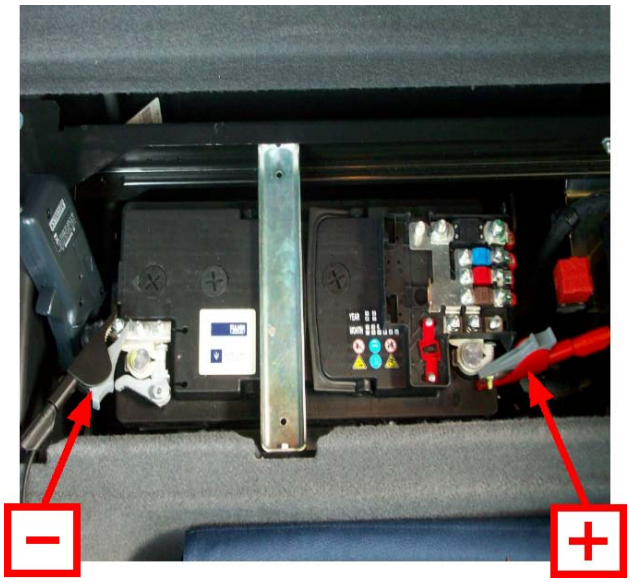
- The engine must be off before connecting the oscilloscope.
- The cranking speed must be normal (battery must be charged).

4.2.3 Compression test connections

Connecting the oscilloscope

Connect the oscilloscope to a free USB port on your PC using the USB cable.

Connect one of the general test BNC cables to Channel A on your scope. On the other end, connect a large red crocodile clip to the red lead and a large black crocodile clip to the black lead. Connect the red clip to the battery positive (+) and the black clip to the battery negative (-) as shown in the picture below.



Connecting the pressure transducer (absolute compression test only)

Remove the spark plug from any convenient cylinder. Fit a compression hose into the empty spark plug socket, then attach it to the pressure transducer's inlet port, as shown in the picture below. Then connect a BNC to BNC cable from the pressure transducer to Channel B on your scope.

Disabling the engine

The compression test can be done only when cranking, so the engine must be prevented from starting. This can be done by removing the engine management relay from the fuse box or disabling the injectors.

4.2.4 Compression test setup

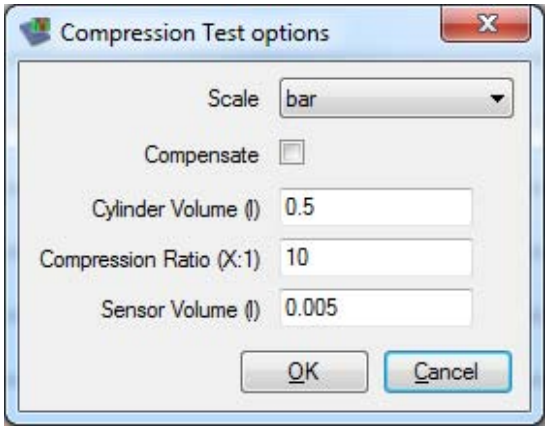
Setting up the test

The compression test should be performed according to the vehicle manufacturer's specification.

- If you are using the pressure transducer, click the Pressure button.
- Next, click the numbered button corresponding to the number of cylinders in the engine.

4.2.5 Compression test options

This dialog appears when you click the Options... menu on the main menu bar while the Compression Test 18 is selected. It allows you to set special options before running the test. These options apply only to the absolute compression test, and not to the relative compression test.



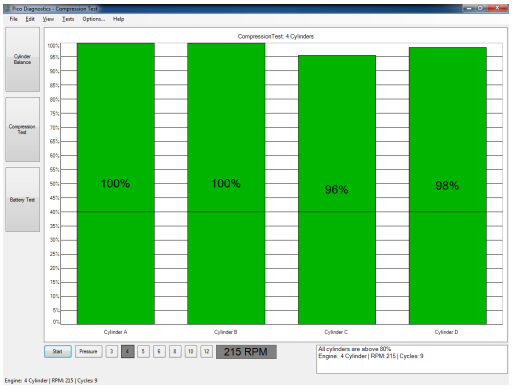
Scale:	The units in which the pressure sensor is calibrated.
Compensate:	Check to use the Cylinder Volume, Compression Ratio and Sensor Volume parameters. Leave unchecked to ignore these values.
Cylinder Volume (l):	The volume of the cylinder in litres.
Compression Ratio (X:1):	The compression ratio of the cylinder. For example, if the compression ratio is 11:1, enter 11.
Sensor Volume (l):	The volume of the pressure sensor in litres. This information should be available from the manufacturer of the sensor. If in doubt, do not alter the value in this box.

4.2.6 Compression test

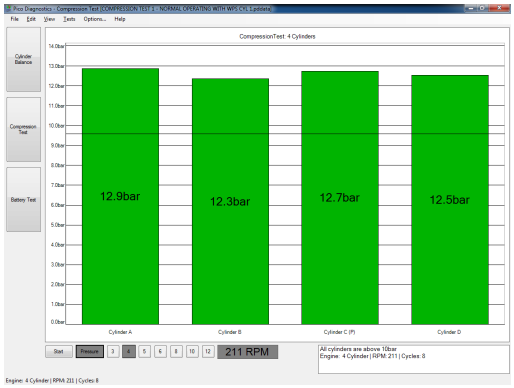
Running the test

- To start the test, click the button labelled Start at the lower left corner of the window.
- A new window with a progress indicator and instructions will appear on the screen. Wait until the message in the window is "Crank engine".
- With the throttle wide open (accelerator pedal fully pressed), crank the engine until the progress indicator reaches 100%.

The data is now analysed and the result appears in a bar graph, as in one of the examples below:



Compression test result - without pressure sensor (relative mode)



Compression test result - with pressure sensor (absolute mode)

In relative compression mode, the result is always scaled to show the highest cylinder at 100%. The bars are ordered according to the engine's firing order. The cylinders are named A, B, C and so on, because with only a connection to the battery the software has no way of knowing which cylinder is number one. This may cause the result to be shifted if you run the test on the same engine more than once.

In absolute compression mode, PicoDiagnostics shows the true compression in each cylinder. As in relative compression mode, the bars are named A, B, C and so on.

The result

If the test could not produce a result, see Failed compression test 20.

4.2.7 Failed compression test

If the test could not produce a result, make sure that:

- the connection to the battery is good
- there is not a battery charger connected to the vehicle's electrical system.

If there is still a problem

If you have checked the points mentioned above and the software still can't produce a result, we would like you to send us a copy of the of the failed test data. Please enter as much information as possible about the vehicle tested. This is done using the Details dialog 6. Save the test to a file using the File | Save menu 4 and email the file to us at picodiagnostics.feedback@picotech.com.

4.3 Battery Test

4.3.1 Battery test introduction

To use the battery test, start PicoDiagnostics and click the Battery Test button.

Tip: If the battery has been recently charged, there is a risk of “surface charge” affecting the state-of-charge results. To eliminate the surface charge, switch the lights on full beam for about 2 minutes and then wait for about 2 minutes before performing the test. If you are only measuring cold cranking amps then you can ignore this precaution.

Follow the instructions below to connect your PicoScope to the vehicle and run the test.

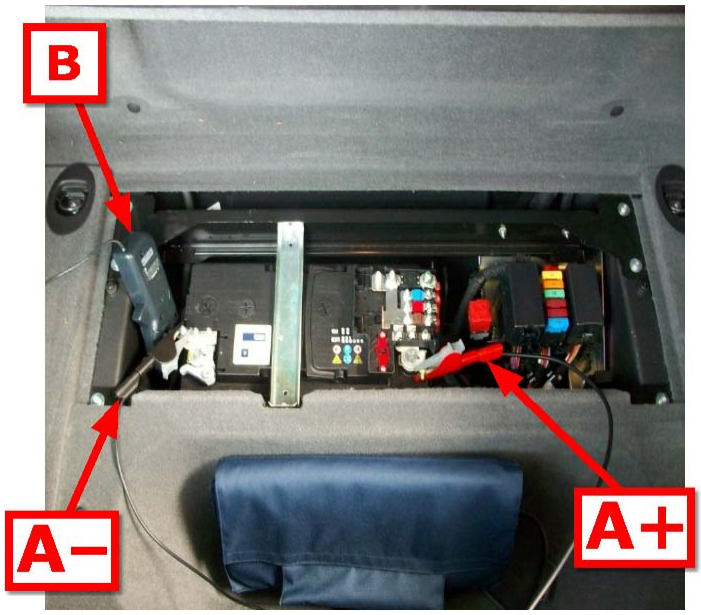
- Connect the PicoScope
- Set any special test options 24
- Run the test
- If the result is blank 26

4.3.2 Battery test connections

Connect the PicoScope

Connect the PicoScope to a free USB port on your PC using the USB cable.

Connect one of the general test BNC cables to Channel A on your PicoScope. On the other end, connect a large red crocodile clip to the red lead and a large black crocodile clip to the black lead. Remove the cover from the fuse box. Connect the red clip to the battery positive (A+) and the black clip to a secure earth or ground point (A-) as shown in the picture below.



Battery test connections:
A– : Ch A ground (black) clip
A+ : Ch A positive (red) clip
B : current clamp

Connect the 600 A or 2000 A current clamp to Channel B on the PicoScope. Place the amp clamp (600 amp clamp for light vehicle applications or 2000 amp clamp for heavy duty applications), so that it is positioned around the positive cables which are connected to the positive battery terminal. More importantly make sure the amp clamp is positioned around the starter motor feed cable (main positive cable from battery to starter motor).

If you have a 4-channel scope then you can run the optional extended drop test.

Additional connections for extended drop test

In addition to connecting channels A and B as described above, channels C and D must also be connected as follows:

Channel C: Using a BNC to 4 mm lead, connect the red 4 mm plug to the positive terminal of the starter motor using the appropriate clip / connector. This is the terminal that the main positive cable from the Battery Connects to.

Channel D: Using a BNC to 4 mm lead, connect the red 4 mm plug to the negative terminal of the starter motor using the appropriate clip / connector.

Note: Most modern vehicles don't have earth cables to the starter motor. In this case connect to one of the mounting bolts by which the starter motor is attached to the engine or gearbox bell housing, as the starter will earth through to chassis and/or battery.

This will enable PicoDiagnostics to separate the cable resistance from the starter motor resistance.

All connections must be clean and free from oil, grease and dirt to ensure the readings are accurate.

4.3.3 Battery test setup

First, click either the 12 V or the 24 V button depending on the voltage of your electrical system.

Tip: If you have a 24 V system with two 12 V batteries, test each battery separately. Otherwise one good battery could hide a fault in the other battery.

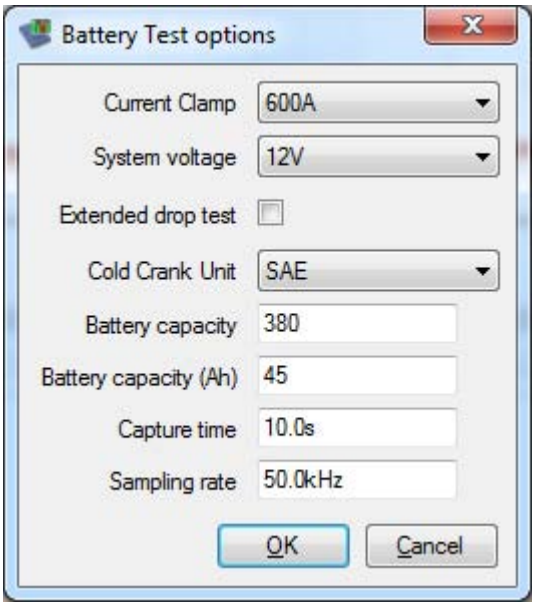
Next, set the temperature control to the local air temperature in degrees Celsius.

Now, set the battery test options (see Battery test options 24).

4.3.4 Battery test options

This dialog appears when you click the Options... menu on the main menu bar while the Battery Test 23 is selected. It allows you to specify the characteristics of the battery before running the test. Refer to battery manufacturer's specification for CCA and Ah figures.

- Change any options in the Battery Test Options dialog 24 that are different from the standard test



Battery capacity (CCA): The battery capacity in cold cranking amperes.

Battery capacity (Ah): The battery capacity in ampere-hours.

- Click OK to confirm

4.3.5 Battery test

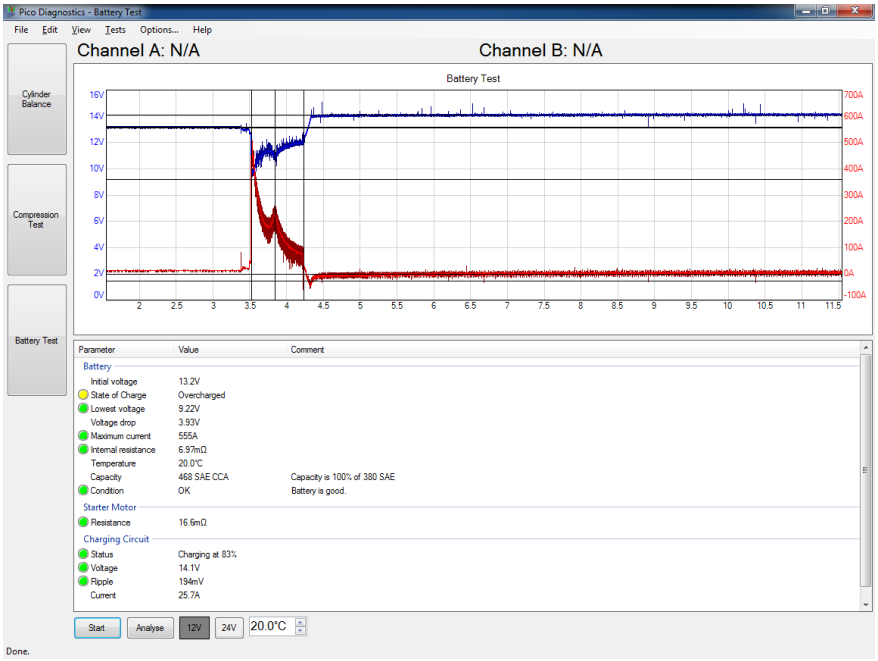
Click the Start button in the bottom left corner of the window.

> *Note: Because the engine is not drawing any current at this stage, the program will draw a horizontal line showing zero amps of current. If this line is not at zero amps, the current clamp may need to be adjusted. Press the "Zero" button or turn the "Zero" dial on the clamp until the horizontal line is at zero amps.*

Start the engine.

While the test is running, the program shows the voltage on Channel A and the current on Channel B, and a graph is drawn from left to right. The program automatically stops recording data when it has enough information, so there is no need to click the Stop button unless you wish to stop the test early.

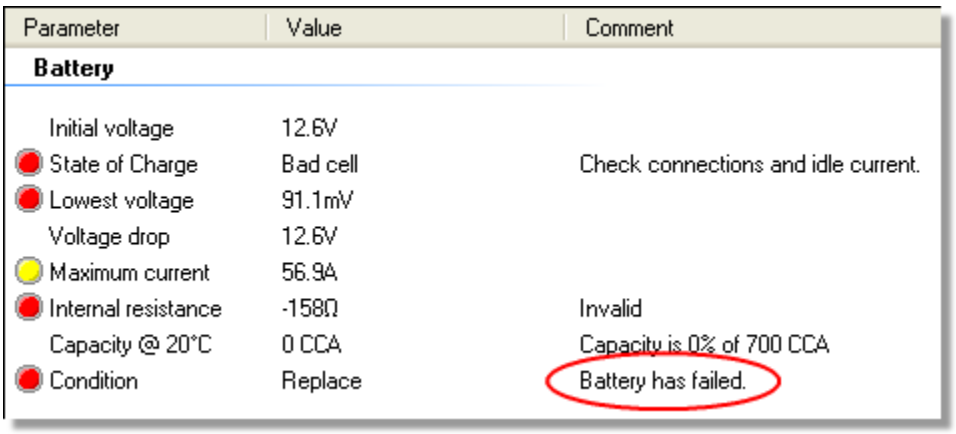
The program then analyses the data and shows the results in a table, as in the picture below:



If the program reports "Battery has failed the test - refer to help file for advice", see Interpreting the Results 26.

4.3.6 Battery Test: interpreting the results

If the state of charge is low then recharge the battery and re-test.



Parameter	Value	Comment
Battery		
Initial voltage	12.6V	
State of Charge	Bad cell	Check connections and idle current.
Lowest voltage	91.1mV	
Voltage drop	12.6V	
Maximum current	56.9A	
Internal resistance	-158Ω	Invalid
Capacity @ 20°C	0 CCA	Capacity is 0% of 700 CCA
Condition	Replace	Battery has failed.

If the state of charge is all right but the CCA (cold cranking amps) is low then check these things before replacing the battery:

- Check the battery connections. If they are loose, they could increase the internal resistance.
- If the battery is not a sealed type, check the fluid levels in each cell.

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