HIGH TECH SECURES YOUR FUTURE

EMISSIONS DIAGNOSTIC PLATFORM

- **Operator's Manual**

Operator's Manual

EMISSIONS DIAGNOSTIC PLATFORM

Software Version V5.X.X.X

Models: DGA5000, Geogas5000

Diagnostic Gas Analyser

Part number : ZEEEAGB132A 30-J-164 UK Rev.:G

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Whilst the authors have taken due care in the preparation of this manual, nothing contained herein:

- modifies or alters in any way the standard terms and conditions of the purchase, lease or rental agreement under the terms of which the equipment to which this manual relates was acquired,
- increases in any way the liability to the customer or to third parties.

TO THE READER

Whilst every effort has been made to ensure that the information contained in this manual is correct, complete and up-to date, the right to change any part of this document at any time without prior notice is reserved.

Before installing, maintaining or operating this unit, please read this manual carefully, paying extra attention to the safety warnings and precautions.

CE

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Trademark Information

Table of Contents

1 Safety

All Safety Precautions relevant to the unit are described in the Safety Precautions book, part number: EAZ0007E04A

Figure 1-1 part number: EAZ0007E04A

The Safety Precautions book should be fully understood by every operator. We suggest that (a copy of) of the Safety Precautions book be stored near the unit, in sight of the operator.

The Operator's Manual will contain specific warnings and cautions when possible dangerous situations may be encountered during the described procedures.

1.1 Safety Signal Words

All safety messages contain a safety signal word that indicates the level of the hazard. An icon, when present, gives a graphical description of the hazard. Safety Signal words are:

⚠ DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury to the operator or to bystanders.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to the operator or to bystanders.

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury to the operator or to bystanders.

1.2 Safety Notice

Read this manual thoroughly before operating the unit.

The unit is intended for use by properly trained, skilled professional automotive technicians. The safety messages presented in the Safety Precautions book and throughout this manual are reminders to the operator to exercise extreme care when using this unit.

There are many variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. Because of the vast number of test applications and variations in the products that can be tested with this instrument, we cannot possibly anticipate or provide advice or safety messages to cover every situation. It is the automotive technician's responsibility to be knowledgeable of the system being tested. It is essential to use proper service methods and test procedures and to perform tests in an appropriate and acceptable manner that does not endanger your safety, the safety of others in the work area, or vehicle or equipment being tested.

It is assumed the operator has a thorough understanding of vehicle systems before using the unit. Understanding of these system principles and operating theories is necessary for competent, safe and accurate use of this unit.

Before using the unit, always refer to and follow safety messages and applicable test procedures provided by the manufacturer of the vehicle or equipment being tested.

⚠ WARNING ***Use equipment only as described in the manual.***

1.2.1 Read all Instructions

Read, understand and follow all safety messages and instructions in the Safety Precautions book, this manual and on the unit.

1.3 Conventions

This manual contains text styles that ask you to pay extra attention:

Note:

Suggestion or explanation.

⚠ CAUTION ***Stresses that the following action may cause damage to the unit or objects attached to it.***

⚠ WARNING ***Stresses that the following action could cause (severe) injury to the operator or others.***

⚠ WARNING ***The operator must have full knowledge of all information stated in the Operator's Manual.***

2 Product Specification

2.1 General

This section provides details of the power supply and dimensions of the Diagnostic Platform and the minimum PC specifications.

2.2 Gas Bench

2.2.1 SGM II

Table 2-1 Operation & Storage

Operating Conditions	
Max. ambient temp.	+40 °C
Min. ambient temp.	+5 °C
Rel. humidity:	up to 90%, non-condensing
Max atmospheric pressure variation	750 – 1150 mbar
Storage Conditions	
Temperature:	-20 to +55 °C
Rel. humidity:	Up to 90%, non-condensing

Table 2-2 Measurements

Parameter	**Range/ Resolution**	**Accuracy: Relative/Absolute**
%vol CO:	0.000 – 15.00	0.01 %vol
%vol CO_2:	0.00 – 20.00	0.1 %vol
ppmvol HC:	0 – 9999	1 ppm vol
%vol O_2:	0 – 25.00	0.01 % vol O2<4% / 0.1%vol
rpm	0 – 9999	±1.0%
°C:	0 – 120	
°F:	14 –302	

☞ *Note:*

**accuracy according to OIML Class 0*

2.2.1.1 Propane Equivalence Factor

The P.E.F. value is variable.

3 Introduction

3.1 The DGA 5000\Geogas 5000

The SUN® DGA 5000\GEOGAS5000 is a versatile, high-performance PC-based test instrument for the analysis of motor vehicle exhaust gases. The unit is designed to meet the performance requirements of OIML Class 0 and ISO 3930.

The basic configuration of the unit comprises:

- A gas analysis module containing a NDIR gas bench.
- An rpm/oil temperature module (ROTI) for the measurement of engine speed and oil temperature.
- An exhaust probe and hose assembly, used for the collection of the gas sample from the vehicle tailpipe.

The DGA 5000\Geogas 5000 forms part of the Emissions Diagnostic Platform System.

Specific software versions will be available for performing the emissions tests specified by separate national or international jurisdictions. Although this jurisdiction specific software may alter the DGA 5000 standard software described herein, this manual is also applicable to these specific programs when used in conjunction with the specific documentation relating to such programs.

With the standard software the unit is capable of measuring the concentrations of up to five gases in vehicle exhaust emissions:

- Carbon Monoxide, Carbon Dioxide and Hydrocarbons (CO, CO_2 and HC) by infra-red absorption.
- Oxygen (O_2) by an operator changeable electrochemical cell.

In addition to the gas measurements the unit also displays:

- Lambda (λ) according to Brettschneider.
- Engine speed (rpm) via the ROTI module.
- Oil temperature via the ROTI module by means of an oil temperature probe substituted for the oil dipstick.

Note:

In cases where a EOBD Device is connected to the analyser, rpm and oil temperature data will be obtained via the OBD device.

- CO corrigé (CO_c) may be displayed using a formula corrected for fuel type.

3.2 Maintenance

Details of the maintenance operations that should be carried out by the operator are included in this manual together with a list of operator service messages and a list of maintenance parts.

All maintenance operations, other than those specifically described in this manual, must be carried out by trained service personnel authorised by the manufacturer.

In particular, full gas calibrations must only be performed by a qualified representative of the manufacturer.

3.3 Options

Can differ depending on market, please refer to your Sales group for a list of options if applicable to your market.

4 Functional Description

4.1 Platform Layout

This section provides details of the Diagnostic Platform general layout.

4.2 Gas Module Layout

4.2.1 Gas Module Layout - SGMII

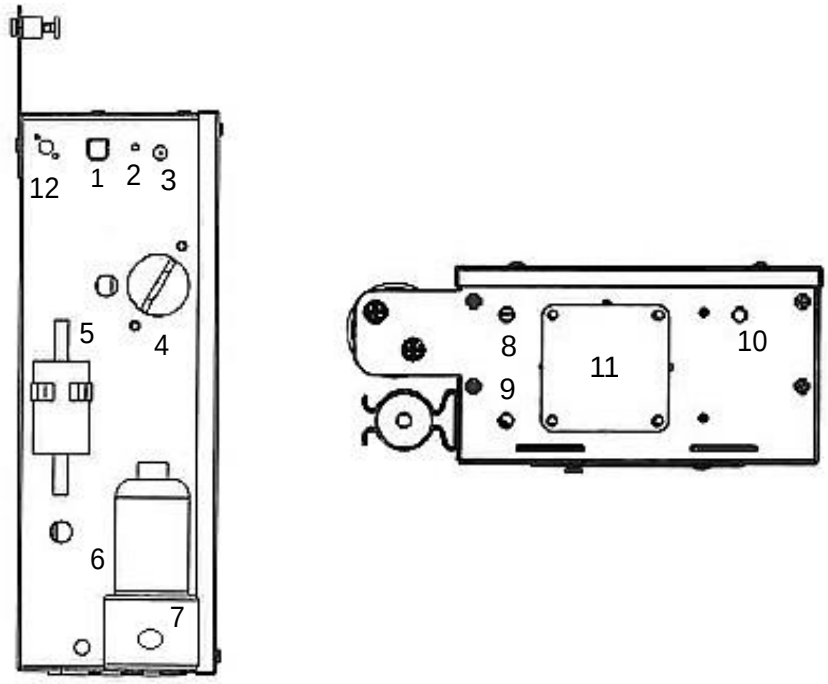

Figure 4-2 The Gas Module - Side & Bottom Panels

1. USB connection for PC interface
2. Power LED indicator
3. 12vDC power input jack
4. O2 Sensor (p/n 7096E4060-31)
5. Clean air inlet (with charcoal filter (p/n 7096E9061-54) to filter incoming air)
6. Water Bowl (p/n 1-41780A)

7. Gas Sample inlet (connection point for exhaust probe/ sample hose assembly).
8. Gas sample outlet (outlet for gas sample from gas bench)
9. Water outlet (connect a tube to this outlet to drain water from the water removal system)
10. Gas sample outlet (outlet for gas sample from gas bench)
11. Fan Assembly
12. Optional Bluetooth Antenna for Wireless connectivity (future option)

4.3 Common Program Elements

For details of program elements that are common across the Emissions Diagnostic Platform system, refer to the following sections of the Emissions Diagnostic Platform Operator's Manual:

- For details of screen elements, refer to the Manual 4.2: 'Screen Elements'.
- For details of buttons together with an illustrated guide to icons used in common by all system modules, refer to the Manual 4.3: 'Buttons'.
- For details of the use of drop-down menus, refer to the Manual 4.4: 'Drop-down Menus'.
- For details of Diagnostic Platform System Screens, refer to the Manual 5: 'Diagnostic Platform System Screens'.
- For details of controls and navigation, refer to the Manual 6.1: 'Navigation'.

4.4 Gas Analyser Icons

The toolbar and menu icons shown in the tables are specific to the Gas Analyser.

Table 4-1 Gas Analyser Toolbar Icons

Icon	Name	Description
	**Home**	Use this button to return to the Home Page Main Menu.
	**Vehicle Setup**	Use this button to access the vehicle setup screens (see 'Free Measurement Vehicle Setup')
	**Print Preview**	Use this button to preview the data to be printed.

Table 4-1 Gas Analyser Toolbar Icons

Icon	Name	Description
	**Standby**	Use this button to place the unit in standby mode.
	**Zero-calibration**	Use this button to manually initiate a zero-calibration (see 6.2.4: 'Zero-calibration').
	**Toggle Limits** 1	Indicates that limit set 1 is currently applied; click to toggle to limit set 2; (see 8.2: 'Free Measurement Vehicle Setup' and 8.5: 'Free Measurement Test Procedure').
	**Toggle Limits 2**	Indicates that limit set 2 is currently applied: click to toggle to limit set 1; (see 8.2: 'Free Measurement Vehicle Setup' and 8.5: 'Free Measurement Test Procedure').

Table 4-2 Gas Analyser Menu Icons

Icon	Name	Description
	**Free Measurement**	Selects the Free Measurement Program (see 8.5: 'Free Measurement Test Procedure')
	**Gas Analyser System Setup**	Selects the The Gas Analyser System Menu

Table 4-2 Gas Analyser Menu Icons

Icon	Name	Description
	**Maintenance**	Selects the Gas Analyser Maintenance Menu
	**Settings**	Selects the Gas Analyser System Settings
	**Gas Analyser System Information**	Selects Gas Analyser System Information
	**Gas analyser Software Update**	Allows updated software to be loaded. Currently disabled.
	**Leak Check (Vacuum)**	Initiates the Leak Check (Vacuum) maintenance procedure.
	**Leak Check (Gas)**	Initiates the Leak Check (Gas) maintenance procedure.

Table 4-2 Gas Analyser Menu Icons

Icon	Name	Description
	**Gas Calibration Check**	Initiates the Gas Calibration Check maintenance procedure.
	**Check/install O_2 Cell**	Initiates the Check and/or Install the O2 Cell maintenance procedure.

5 System and Gas Analyser General Screens

This Chapter contains:

- A description of the DGA 5000 Gas Analyser System Screens. Gas Analyser System Screens are defined as being screens shown by the DGA 5000 that do not relate to a specific test procedure. These Screens comprise:
  - The Gas Analyser Main Menu (5.1: 'Gas Analyser Menu').
  - The Gas Analyser System Menu (5.2: 'The Gas Analyser System Menu').
  - The Gas Analyser Maintenance Menu (5.3: 'Gas Analyser Maintenance Menu').
  - The Gas Analyser System Settings Screen (5.4: 'Gas Analyser System Settings').
  - The Gas Analyser System Information Window (5.5: 'Gas Analyser System Information').
- Details of the procedure to be followed in order to obtain a printout of the DGA 5000 gas analysis test results (5.6: 'Print').

Descriptions of the Emissions Diagnostic Platform Startup and General System Setup screens may be found in the Emissions Platform Operator's Manual (5.1: 'Gas Analyser Menu' & 5.2: 'The Gas Analyser System Menu').

5.1 Gas Analyser Menu

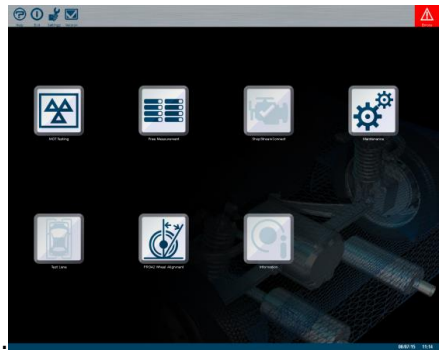

Figure 5-1 *Gas Analyser Menu* Screen

Figure 5-2 *Free Measure Menu* Screen

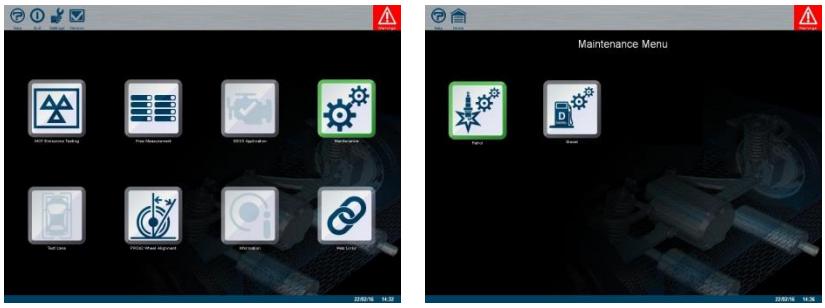

Figure 5-3 *Maintenance Menu* Screen

- To access the Gas Analyser Menu , select the “Gas Analyser” option from The SUN Diagnostic Startup Screen (see the Emissions Diagnostic Platform Operator’s Manual 5.1: ‘Gas Analyser Menu’).

The following options may be selected:

- Free Measurement Procedure (see 5-2 for selection sequence).
- The Petrol Maintenance Menu (see 5-3 for selection sequence)

Note:

- The “Free Measurement” procedure.

  The Free Measurement procedure continuously measures and displays the values for all available test parameters. Upper and lower limits for any or all of these parameters may be introduced as required. Refer to 8: ‘Operation - The Free Measurement Procedure’ for further information.

The Gas Analyser Maintenance Menu allows operator maintenance functions to be initiated, gas analyser system settings to be made, gas analyser system information to be consulted and updates to the gas analyser software to be loaded. Refer to 5.2: 'The Gas Analyser System Menu' for further information.

- To return to the Gas Analyser Menu, press the "Home" icon button on the toolbar.
- To place the Gas Analyser in Standby Mode, press the "Standby" icon button on the toolbar.

  Once the Gas Analyser is switched on, it should remain on for the whole working day, however, it is recommended that the unit should be put into Standby Mode when tests are not being performed. This will reduce wear and tear to the pump and increase the effective life of the filters.

The unit will return to the normal operating mode when:

- The "Standby" button is pressed once more, or
- One of the Gas Analyser Main Menu option buttons ("Free Measurement" or "System Setup") is pressed.

On leaving the Standby Mode, a Zero-calibration and HC Residue Check will automatically be performed before the unit returns to normal operation.

5.2 The Gas Analyser Maintenance Menu

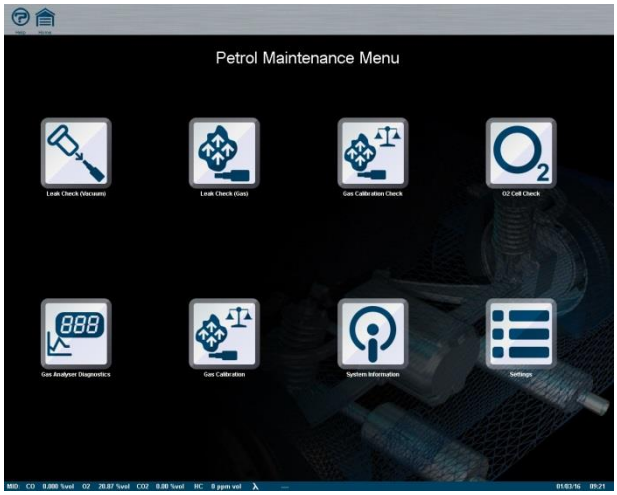

Figure 5-4 The Gas Analyser Maintenance Menu

- To access the Gas Analyser Maintenance Menu , select the “Petrol” option from the Gas Analyser Menu (see 5.1 , 5.3).

  The Gas Analyser Maintenance Menu allows access to:

  - The Gas Analyser Operator Maintenance Procedures.
  - The Gas Analyser System Settings Screen.
  - The Gas Analyser System Information Screen.

- To following Maintenance procedures can be initiated from this menu:

  - leak, gas calibration checks and O2 sensor checks
  - Diagnostics & Calibration procedures (Service Technician level only)

  Refer to 5.3 for a description of the Maintenance features and to Chapter Maintenance’ for details of the available maintenance procedures.

- To access the Gas Analyser System Settings Screen, select the “System Settings” option.

  The System Settings Screen allows settings to be made affecting the operation of the gas Analyser. Refer to 5.4 for further information.

- To reveal the Gas Analyser System Information window, select the “System Information” option.

  The System Information Pop-up Window provides details of gas calibration dates, software versions etc. Refer to 5.5 for further information.

- Press “Back” or the “Gas Analyser” toolbar icon button to return to the Gas Analyser Menu.

5.3 Gas Analyser Maintenance Menu Options

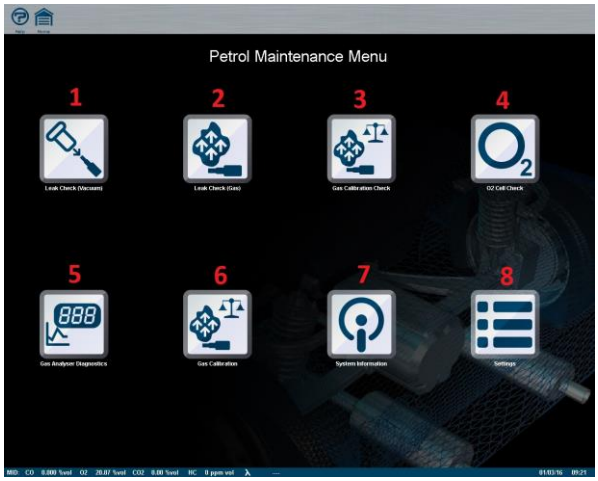

Figure 5-5 The Gas Analyser Maintenance Menu

The Maintenance procedures that can be initiated from the Gas Analyser Maintenance Menu are:

- Leak Check (Vacuum) (see 10.2). (item 1)
- Leak Check (Gas) (see 10.3). (item 2)
- Gas Calibration Check (see 10.4). (item 3)
- Check and/or Install the O2 Cell (see 10.5). (item 4)
- Diagnostics/Gas Calibration (item 5 &6) are restricted to Service Engineers only.

- To initiate a Leak Check (Vacuum), select the “Leak Check (Vacuum) option.
- To initiate Leak Check (Gas), select the Leak Check (Gas) option.
- To initiate a Gas Calibration Check, select the Gas Calibration Check Option.

- To Check and/or Install the O2 Cell, select the O_2 Sensor Check Option.

Details of the procedures for these checks are to be found in 10: 'Maintenance'.

5.4 Gas Analyser System Settings

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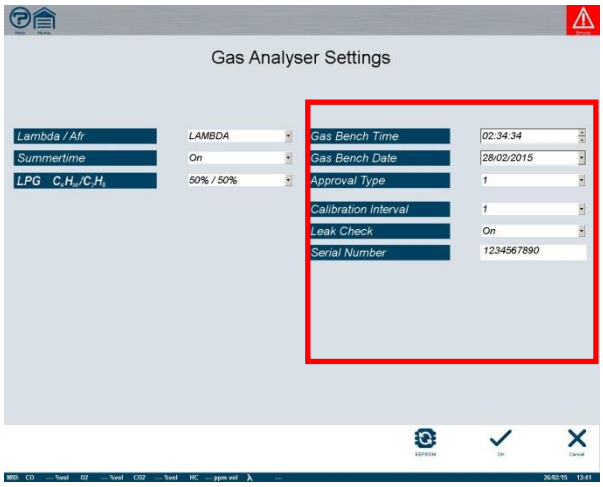


Figure 5-6 The Gas Analyser System Settings Screen

To access the Gas Analyser System Settings Screen, select the "System Settings" option from The Gas Analyser Maintenance Menu (see 5.2).

The Gas Analyser System Settings Screen comprises drop-down menus for the selection of:

- Lambda/AFR.
- Summertime On/Off.
- LPG composition.

- Use the "Summertime On/Off" drop-down menu to switch between Summertime/Wintertime.

  The Summertime/Wintertime information is required by the gas module for the calculation of daily leak check and gas calibration intervals.

- Use the Lambda/AFR drop down menu to select either Lambda or Air Fuel Ratio (AFR).

  Depending on the selection, the unit will calculate and display either Lambda or Air Fuel Ratio.

- Use the LPG Composition drop-down menu to specify the appropriate ratio of Butane (C_4H_{10}) to Propane (C_3H_8) in the LPG fuel used by the test vehicle.

  The available range is from 100% Butane to 100% Propane in 10% increments. This information is required for the determination of the ratio of Hydrogen to Carbon present in the fuel, which information is, in turn, used for the accurate determination of Lambda.

Note:

The composition of LPG fuel may vary from country to country. If the composition of the LPG fuel is not known, set the Butane/Propane ratio to 50%/50%. If the composition is known (e.g. LPG used in the United Kingdom has a composition of 0% Butane/100% Propane), this ratio should be selected.

Note:

The section marked with the RED outline is not accessible by an end user and is pre-configured in manufacturing.

- Press “OK” to apply the settings made in the Gas Analyser System Settings Screen and return to The Gas Analyser Maintenance Menu.
- Press “Cancel” to return to The Gas Analyser Maintenance Menu without applying any changes made in the Gas Analyser System Settings Screen.
- Press the “Gas Analyser” toolbar button to return to the Gas Analyser Menu.

5.5 Gas Analyser System Information

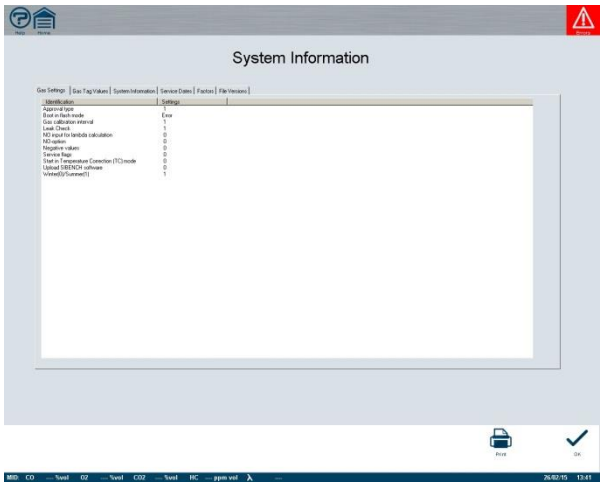


Figure 5-7 The Gas Analyser System Information Window

- To open the Gas Analyser System Information Window, select the “System Information” option from the The Gas Analyser System Menu (see 5.2).

The Gas Analyser System Information Window comprises six tabs:

- System Information (includes application versions, checksums etc.).
- Gas Tag Values (displays the composition of the gases used for gas calibration)
- Gas Settings (includes approval type, gas calibration interval, summertime on/off setting, daily leak check requirement etc.).
- Service Dates (shows the last and next calibration dates, last leak check date, date of sensor installation etc.)
- Factors (includes the applied PEF, NO gain and NO cell aging factors).
- File Versions (Lists the version numbers of .dll and .exe files in the DGA software)

5.6 Print

Figure 5-8 The “Notes” Dialog Box 1

Note:

The DGA 5000 uses the same “Print” procedure to provide a printout of all gas analyser test results. The following description is, therefore, applicable irrespective of whether the Free Measurement or Country Specific test procedure is employed.

- Open the “Notes” dialog box:
  - By pressing the “Print” toolbar icon button, or
  - By pressing the “Print” text button in the The Print Preview Window (Free Measurement procedure only (see 8.5)).

  The “Notes” dialog box will be displayed. The vehicle identification information headings, entered via the “Printout Footer” box of the The General System Setup Screen (see the Diagnostic Platform Operator’s Manual 5.2: ‘The General System Setup Screen’), will be shown in the left-hand text box.
- Enter the vehicle identification information for the test vehicle in the right-hand text box, opposite the appropriate heading.

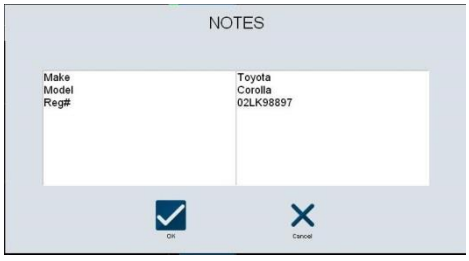


Figure 5-9 The “Notes” Dialog Box 2

- Press “OK” to make a printout of the test results.

A typical sample results printout is illustrated below..

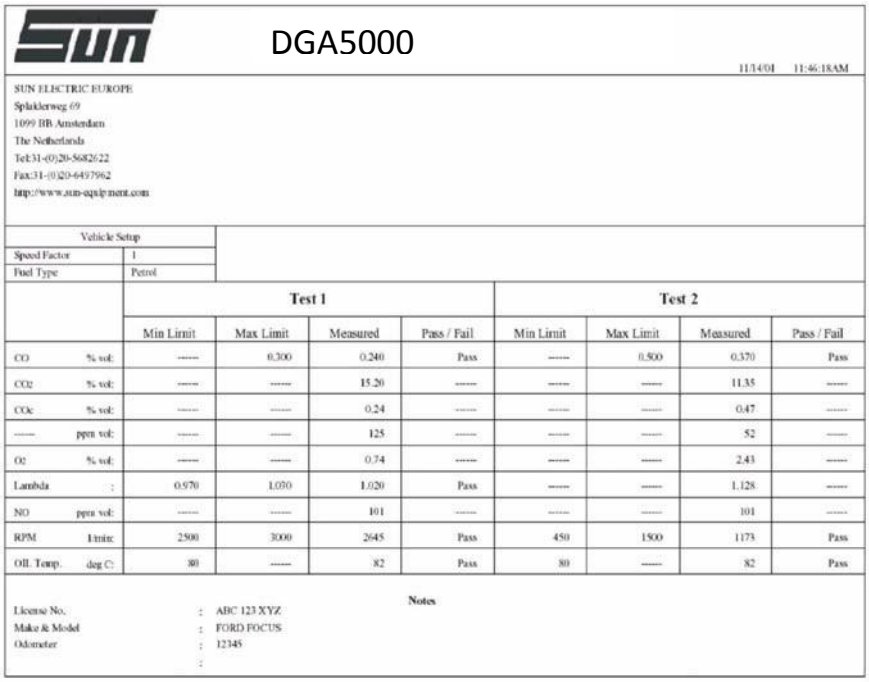
- Press “Cancel” to abort the print instruction and return to the test procedure.

Note:

Calculated values will be shown for either Lambda or AFR depending on the setting made in the Gas Analyser System Settings Screen (see 5.4).

Note:

Although the printout format allows all test parameters to be shown, numerical values will only be shown for the limit values applied and test results obtained during the current test. Fields for which no data is available will show a series of dashes.



DGA5000

11/14/01 11:46:18AM

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http://www.sun-equipment.com

Vehicle Setup	
Speed Factor	1
Fuel Type	Petrol

		Test 1				Test 2			
		Min Limit	Max Limit	Measured	Pass / Fail	Min Limit	Max Limit	Measured	Pass / Fail
CO	% vol:	-----	0.300	0.240	Pass	-----	0.500	0.370	Pass
CO2	% vol:	-----	-----	15.20	-----	-----	-----	11.35	-----
COc	% vol:	-----	-----	0.24	-----	-----	-----	0.47	-----
-----	ppm vol:	-----	-----	125	-----	-----	-----	52	-----
O2	% vol:	-----	-----	0.74	-----	-----	-----	2.43	-----
Lambda	:	0.970	1.030	1.020	Pass	-----	-----	1.128	-----
NO	ppm vol:	-----	-----	101	-----	-----	-----	101	-----
RPM	1/min:	2500	3000	2645	Pass	450	1500	1173	Pass
Oil. Temp.	deg C:	80	-----	82	Pass	80	-----	82	Pass

Notes

License No. : ABC 123 XYZ
Make & Model : FORD FOCUS
Odometer : 12345

Figure 5-10 Sample Printout

6 Preparatory Steps

6.1 Connections

⚠ WARNING

For your own and other people's safety the DGA 5000 must only be used in a well-ventilated clean air environment.

6.1.1 Power Connections

⚠ CAUTION

Before making any power connections ensure that the mains power switch is set to "off" and that the mains voltage selector switch is set to correspond with the local mains supply voltage.

Power is supplied to the Gas analyser from the Emissions Diagnostic Platform electrical distribution block via an electrical input socket located on the rear panel of the Gas Module (see 4.2: 'Gas Module Layout').

6.1.2 Data Connections

Communication between the PC. Gas Module takes place via the USB (Universal Serial Bus) connectors located on the Gas Module rear panel (see 4.2: 'Gas Module Layout').

- Connect the PC USB port to the Gas module via the USB P.C. interface connector on the Gas Module side panel.

☞ *Note:*

If the DGA 5000 is used in conjunction with an EOBD Device, the unit will derive rpm and oil temperature data direct from the test vehicle engine management system via the EOBD unit. In this case the use of the ROTI Module is unnecessary.

- Connect the Printer (wirelessly), Mouse and Keyboard to the P.C. Printer, Mouse and Keyboard ports.

6.1.3 Gas Module Pneumatic Connections

- Connect the Exhaust Sample Probe and Hose to the Gas Sample Inlet on the Gas Module rear panel.

☞ *Note:*

Do not insert the Sample Probe into the vehicle exhaust tailpipe at this stage.

6.2 Start-Up

6.2.1 Power Up

- Set the Main, PC and Gas Module power switches to “On”.

  The PC will load the Windows Operating System. After a short interval the Windows desk-top will be displayed.

☞ *Note:*

For normal operating purposes it is recommended that the PC and Gas Module power switches be left permanently in the “On” position and that the unit be turned on and off with the Diagnostic Platform main power switch.

- Select the SUN® Diagnostic Platform program using either the Windows start menu or the shortcut on the desk-top.

  The operating system will load the software and the Gas Analyser Menu will be displayed (see the Diagnostic Platform Operator’s Manual 5.1).

- Select the Gas Analyser option from the Main Menu.

  Selecting the Gas Analyser mode will display the Gas Analyser Menu (see 5.1).

☞ *Note:*

The body of this manual concerns the operation of the DGA 5000 in Gas Analyser mode only. Information concerning the use of the unit in conjunction with the Diesel Smoke Meter, EOBD Device menu options will be provided as separate documentation.

6.2.2 Gas Analyser Start-up

At start-up, the analyser will automatically perform the following functions in sequence:

- Warm up.
- Zero-calibration.
- HC residue check.

While these functions are being performed, “pop-up” windows will be automatically displayed showing the status of the unit. These windows will automatically close when the function has been successfully completed. They may be manually closed at any time to give full access to the screen buttons.

☞ *Note:*

A manually closed pop-up window can reappear if a new screen is selected which requires a change in the Gas Analyser mode, e.g. a pop-up screen can reappear if a leak check is selected but will not reappear when moving to a different menu or set-up screen.

If the system is configured to require a Daily Leak Check (see 6.3), the operator will be prompted to perform this during the initial start-up sequence.

6.2.3 Warm up

The warm-up and stabilisation period depends ambient temperatures, this warm-up period can last up to 9 minutes if ambient temperature is 0°C for the SGMII.

During this time:

- The pump will run continuously.
- The unit will check for condensation in the gas bench.
- The warm up pop-up screen will be displayed showing the elapsed warm up time (unless manually closed).

☞ *Note:*

The warm up period cannot be overridden by the operator.

At the end of the warm up period the unit will proceed to zero-calibration.

6.2.4 Zero-calibration

Zero-calibration, which allows the Gas Module to determine the correct zero reference and gain settings.

During this time:

- The zero-calibration pop-up screen will be displayed showing the elapsed calibration time.

An zero-calibration may be triggered in three ways:

- As part of the start-up procedure or on return from standby mode (initial zero-calibration).
- Automatically by the Gas Bench as required (automatic zero-calibration; see note below).
- Manually by the operator from Operation - The Free Measurement Procedure (see 8) (manual zero-calibration).

An initial or manual zero-calibration (but not an automatic zero-calibration) will be followed by a HC residue check (see below).

If the system is configured to require a Daily Leak Check, the unit will prompt the operator to perform this at the end of the zero-calibration period. Until a successful leak check has been performed all measurements will be blocked and it will not be possible to proceed beyond the Gas Analyser Menu (see 6.3: 'Daily Leak Check' below for further details).

Note:

The gas bench automatically assesses the stability of the zero reference and gain settings and will perform an zero-calibration as and when required. The frequency with which an automatic zero-calibration is performed will depend on the stability of the environment in which the analyser is operated. If a CO_2 concentration of 0.5 % vol. or greater is detected at the time the gas bench determines that an automatic zero-calibration is necessary, the software will assume that gas measurements are currently being taken. In this case the zero-calibration will be delayed until the CO_2 measurement has fallen below 0.5% vol. or for a maximum of 30 minutes. The Error/Warning toolbar button will be displayed. If this button is pressed, error/warning code 06 will be seen, advising that a zero-calibration is pending

☞ *Note:*

During zero-calibration the DGA 5000 derives the zero reference point settings from the atmospheric conditions of the environment in which it is operated. If the operating environment is poorly ventilated, or if sources of atmospheric pollution (e.g. petrol soaked rags etc.) are present in close proximity to the unit, this may lead to the zero reference points being set too high. This may, in turn, lead to vehicle emission readings that are below the zero reference settings of the analyser ("negative indications"). To avoid this problem, the operating environment should be well ventilated and possible sources of atmospheric pollution should be removed.

6.3 Daily Leak Check

The accuracy of test measurements will be compromised if ambient air is allowed to enter the analyser sampling and/or pneumatic systems. In order to ensure the integrity of the system, the standard software configuration requires that a leak check should be carried out prior to the commencement of each day's operation. The unit will not be capable of normal operation unless a successful leak check has been carried out within the preceding 24 hours. If the operator fails to carry out a daily leak check, or if a leak check is failed, an error warning will appear in the toolbar and all gas measurements will be blocked until a satisfactory leak check has been performed.

☞ *Note:*

If the unit is left running continuously, the standard software configuration will require a leak check to be performed within 24 hours of the previous check. If the unit is switched off (e.g. overnight) the software will require a leak check at the start of each operating day even if the previous leak check was performed within the last 24 hours.

☞ *Note:*

The daily leak check requirement may be deactivated by Sun service personnel unless the unit is configured for an approval type under which such a check is mandatory

The leak check requirement may be satisfied by the successful performance of either:

- A Leak Check (Vacuum) (see 9.2), or
- A Leak Check (Gas) (see 9.3).

6.4 HC Residue Check

A HC residue check will follow every initial or manually triggered zero-calibration.

The HC residue check will be aborted or postponed if a maintenance function is selected (e.g. in order to perform a leak check) The residue check will be resumed when the maintenance function is exited.

The HC residue check lasts a minimum of 20 seconds with no upper time limit. During the check the unit will:

- Display the HC Residue Check pop-up window.
- Determine the concentration of hydro-carbons present in the gas circuit. If a concentration greater than 20 ppm is found the pop-up window will continue to be displayed and all measurements will be blocked until the concentration of HC present in the analyser has fallen to within the acceptable limits.

⚠ CAUTION

The sample probe must not be allowed to remain in the vehicle exhaust tailpipe during the HC residue check. A concentration of more than 0.5 % vol. co2 detected during the check indicates that vehicle exhaust gases are being drawn into the unit. The program will prompt the operator to remove the sample probe from the tailpipe and all measurements will be blocked until this has been done.

As ambient air is drawn through the gas circuit, the concentration of HC should fall. If the residue has not fallen to within acceptable limits within a reasonable time (1 – 2 minutes), the sample hose and probe should be cleaned in accordance with the instructions contained in 9.6: 'Routine Maintenance Procedures' and the zero-calibration procedure repeated.

If the concentration of HC does not fall to within acceptable limits after the sample hose and probe have been cleaned the HC residue check pop-up window will continue to be displayed. Switch the unit off and back on in order to reset the machine. Repeat the calibration and HC residue check procedure. If the concentration of HC is still too high, service is required. Contact your SUN service centre or dealer.

6.5 Settings

The following settings must be made before the unit is ready for operation:

6.5.1 Fuel Type Selection

The correct fuel type for the vehicle under test should be selected in the Vehicle Setup screen.

- Select the vehicle fuel type (LPG, CNG or Petrol) from the fuel type drop down menu as described in 8: 'Operation - The Free Measurement Procedure'

6.5.2 Speed Factor Setting

Refer to the SUN® Diagnostic Platform Operator's Manual (6.5.2: 'Speed Factor Setting') for details of factors governing Speed Factor selection.

To set the Speed factor:

- Open the vehicle setup screen.
- Select and apply the Speed Factor as described in 8: 'Operation - The Free Measurement Procedure'

6.5.3 Lambda/AFR Selection

The DGA 5000 calculates and can display either Lambda (λ) or Air Fuel Ratio (AFR).

To select Lambda or AFR:

- Open the Gas Analyser System Settings screen (see 5.4).

  To reach the Gas Analyser System Settings screen select the "System Settings" icon button in the Gas Analyser Menu (see 5.1). The Gas Analyser System Menu (see 5.2) will be displayed. Select the "Settings" Icon button in the The Gas Analyser System Menu, the Gas Analyser System Settings page will be shown.

- Select Lambda or AFR as required.

6.6 Vehicle Connections

⚠ CAUTION

Route the rpm pick-up lead and oil temperature probe clear of any hot or moving engine parts.

6.6.1 RPM Pick-Up

Refer to the Emissions Diagnostic Platform Operator's Manual (6.2: 'RPM Measurement and Speed Factor Selection') for details of rpm pick-up connection.

6.6.2 Oil Temperature Probe

Refer to the Emissions Diagnostic Platform Operator's Manual (6.3: 'Oil Temperature Measurement') for details of oil temperature measurement.

7 Operation - General

The following sections contain general information applicable to all test procedures. Specific information relating to the performance of tests using the Free Measurement Procedure may be found in 8: 'Operation - The Free Measurement Procedure'.

Information necessary to conduct country specific tests (MOT, AU, APK etc.) will be provided in separate documentation.

7.1 Testing Tips

- Read and follow the procedures in this manual.
- Keep the probe tip openings clean and free from debris.
- Do not place the probe tip in liquids or allow liquids to be drawn into the analyser sampling system. Contamination will affect the accuracy of any future tests.
- Do not insert the probe into an exhaust pipe until the vehicle engine is at normal operating temperature. This allows time for the exhaust system to vaporize any residual moisture.
- Never move the analyser by pulling on the probe, sample hose or power cord.
- Never drive over the probe, sample hose or power cord.
- Never place any liquids on the analyser that could spill and run into the ventilation holes.
- Clean any spilt liquids (gasoline, brake fluid, cleaning solvents etc) from the exterior of the analyser immediately in order to protect the finish.
- In order to ensure accurate test results, perform a daily Leak Check (Vacuum) as described in 9.2: 'Leak Check (Vacuum)' below. This check should also be performed after probe changes or filter service.
- Prolonged use of the analyser in conjunction with a dynamometer and a hot running vehicle under load may damage the sample probe and affect readings. An alternative sample probe (P/N: 7009-1869-00) is available for use in these circumstances.

- The O_2 Sensor is stated by the manufacturer to have life expectancy of 24 months from the date of manufacture, irrespective of how often the analyser is used.
- The (optional) NO sensor has a minimum life expectancy of 24 months after installation or until it undergoes a 20% signal strength loss, whichever occurs sooner. It is powered by an internal battery. The analyser must run at least 12 hours over a 30 day period to maintain this battery at full charge.

7.2 Measurement Procedure

⚠ CAUTION

In order to ensure representative measurements, The engine should be at normal operating temperature.

☞ *Note:*

Under moderate loads and operating at moderate speeds a typical nominal oil temperature is approximately 85 °C. Under these circumstances a temperature of 65 °C is considered to be low and a temperature of 105 °C is considered to be high. At idling speeds engine oil temperature does not, generally, reach a nominal value. Proper oil temperature depends on the engine operating conditions, but may be considered acceptable if falling within the range mentioned above.

During testing, engine exhaust gas samples are continuously gathered by means of the Exhaust Sample Probe inserted into the vehicle's exhaust tail pipe.

The DGA 5000 continuously determines the amount of CO, CO_2, HC and O_2 present in the exhaust sample. In the Free Measuring Procedure these values are continuously displayed in the parameter windows together with the values for CO corrigè, engine speed and oil temperature. If the optional NO sensor is present the value for NO will also be measured and displayed. Depending on the selection made (see 6.5.3: 'Lambda/AFR Selection'), the value for Lambda or Air Fuel Ratio will also be displayed.

Besides determining whether or not the vehicle exhaust emissions comply with legal requirements, emissions tests may be performed at various engine speeds and under various conditions, forming a valuable diagnostic aid in the discovery of a variety of engine, ignition and fuel system service requirements.

After all necessary settings and connections have been made, proceed as follows:

- Start the vehicle engine and allow the oil temperature to come up to normal operating temperature (see Note above).
- Insert the sample probe fully into the vehicle tailpipe.

Note:

On exhaust systems having twin tail pipes that exit a common resonator or muffler the exhaust gas sample may be diluted by ambient air entering the system via the tail pipe that is not in use for sampling. To prevent this, block off the tail pipe that is not in use for the sample probe.

Note:

Do not block off a tail pipe if the vehicle is being operated on a chassis dynamometer. Always be sure to unblock the tail pipe when testing is complete.

⚠ CAUTION

Do not leave the sample probe in the tail pipe when measurements are not being made, as this will shorten the life of the filter elements.

- When testing has been completed and the test results have been printed or noted, remove the sample probe from the tail pipe and store it in a dust and water free environment until it is required again.
- Remove the Oil Temperature probe from the dipstick tube and reinsert the oil dipstick.
- Disconnect the rpm pick-up.

⚠ CAUTION

If the dipstick is of an adjustable type, ensure that it is properly adjusted before re-inserting it into the dipstick tube.

7.3 Shut Down Procedure

Refer to the Emissions Diagnostic Platform Operator's Manual (6.4: 'Shut Down Procedure') for details of the shutdown procedure.

8 Operation - The Free Measurement Procedure

The Free Measurement program allows the DGA 5000 to be used as a diagnostic tool for the investigation of the fuel, ignition and emission control systems of a vehicle without applying the limits and procedures specified in any local, national or international test. By operating the vehicle under varying conditions (if necessary on a chassis dynanometer) it is possible to:

- Identify emission failure areas.
- Reduce emissions in general.
- Locate/correct drivability problems.

The drivability and emissions symptoms (or combinations of symptoms) that can be addressed include:

- Engine will not crank.
- Engine will crank but will not start.
- Engine is hard to start.
- Malfunction lamp is on.
- Engine stalls.
- Engine shows hesitation, sag, stumble and/or lack of power, is sluggish or feels spongy.
- Engine surge.
- Engine misses or cuts out.
- Engine backfires.
- Excessive engine noise.
- Excessive emissions or a failed emission test.
- Poor fuel economy.
- Incorrect idle.
- Engine jumps or jerks.
- Excessive exhaust odor.
- Excessive exhaust smoke.
- Fuel odor and/or dieseling or run-on.

In testing emission control devices any of the following tests may be performed as necessary, applicable or useful:

- Exhaust Gas Recirculation Valve.
- Positive Crankcase Ventilation (PCV) Valve.
- Air Pump
- Carburetor Adjustments for Vehicles Without Feedback Systems,
- Lean-misfire Adjustment.
- Lean-drop Adjustment.
- Accelerator Pump.
- Power Valve.
- High Fuel Level in Float Chamber.
- Testing the Cooling System for Combustion Gases.
- Fuel Leak.
- Exhaust Leak.
- Testing for Fumes in the Passenger Compartment.
- No-start Condition – Fuel.

The following section provides a brief description of the screens that will be encountered during the Free Measurement Procedure

8.1 The Free Measurement Screen

Figure 8-1 The Free Measurement Screen

- To open the Free Measurement Screen, select the “Free Measurement” option from the Gas Analyser Menu (see section 5.1).
  - If the ROTI Rpm and Temperature selection in the General Settings screen is set to “Standard”, the Free Measurement screen will be shown immediately.
  - If the Rpm and Temperature selection in the General Settings screen is set to “8520” , the Engine Speed Measurement Setup screen will be shown before the Free Measurement screen opens (see 8.1.1: ‘Engine Speed Measurement Setup’).

  The Free Measurement Screen displays the current values for the test parameters that are continuously being analysed by the unit. These values may be compared with two Limit Sets stored in the unit memory. Limit Sets 1 and 2 are intended for use with measurements at high and low engine speeds respectively.

  Unlike the MOT specific test procedures, available under the DGA 5000 software, the Free Measurement Procedure does not incorporate the requirements of any regulatory authority. The upper and lower limits for each test parameter may be either edited by the operator or disabled entirely.

  Numerical values for the measured gas emissions, lambda/AFR, oil temperature and engine speed are shown in the nine fields comprising the bulk of the screen. The field background will be Green so long as the measured value for a particular parameter falls within the applied limits but will change to Red if the values fall outside these limits.

  An analog representation of the current test values, in relation to the applied limits, is given by the coloured bars associated with each parameter field. The Green section of these bars shows the range of values falling within the limits whilst the Red sections indicate values above and below the acceptable range. The relative proportions of the Green and Red areas will reflect the limits applied. The value currently measured for each parameter is represented by a thin Yellow band.

  If no limit sets are applied, or if no measurements are available, the parameter field backgrounds and the analog bars will be Grey.

  The current parameter values may be frozen, stored in the unit memory or printed out at any time during normal operation.

- To specify the vehicle setup via the Free Measurement Vehicle Setup Screen, press the “Vehicle Setup” toolbar button (see 8.2).
- To print test result data, press the Print button (see 5.6).
- To review or delete data stored in the data buffers, press the “Print Preview” button to open the The Print Preview Window (see 8.7).

- To manually initiate an Zero-calibration, press the “Zero-calibration” button (see 6.2.4).
- To toggle between limit sets, press the “Toggle Limit Sets” button (see 8.6: ‘Storing Data in the Data Buffers’).
- To freeze the current readings, press the “Freeze” button (see 8.6: ‘Storing Data in the Data Buffers’).
- To store the current readings, press the “Store” button.

  The “store” button is only available after the “Freeze” button has been pressed (see 8.6: ‘Storing Data in the Data Buffers’).
- To unfreeze the frozen readings, press the “Unfreeze” button.

  The unfreeze button is only available after the “Freeze” button has been pressed (see 8.6: ‘Storing Data in the Data Buffers’).
- To return to the Gas Analyser Menu, press the “Gas Analyser” toolbar button.

8.1.1 Engine Speed Measurement Setup

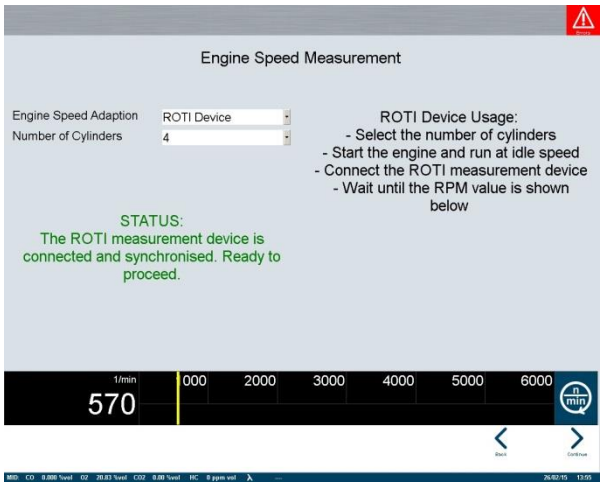

Figure 8-2 Engine Speed Setup screen

The Engine Speed Setup screen (Figure 8-2) opens automatically when Free Measurement is selected from the Gas Analyser Main menu and “8520” has been selected as the RPM and Oil Temperature measurement device in the General settings screen.

The Engine Speed Measurement Setup screen displays:

- Instructions for setting up engine speed measurement.
- The current status of the 8520 measurement device.
- A scale for the selection of the number of cylinders in the engine.
- The currently recorded engine speed.

To set up engine speed measurement:

- Select the number of cylinders in the engine.
- Start the engine and allow to run at idle speed
- Connect the measurement device.
- Wait for the engine speed to be displayed correctly
- Press OK to proceed to the Free Measurement screen.

8.2 Free Measurement Vehicle Setup

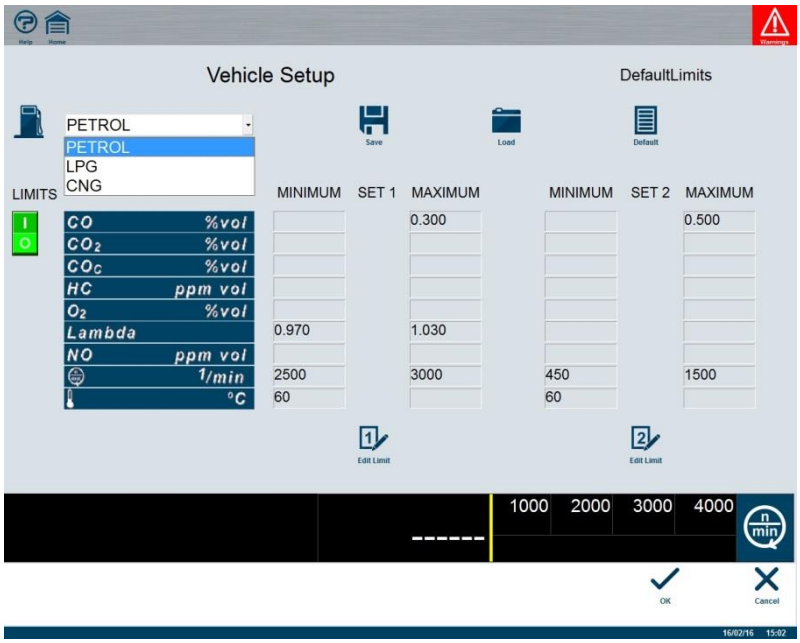

Figure 8-3 The Free Measurement Vehicle Setup Screen

To access the Free Measurement Vehicle Setup Screen, press the "Vehicle Setup" toolbar button in the The Free Measurement Screen (see section 8.1).

In the Free Measurement Vehicle Setup Screen it is possible to:

- Specify the vehicle fuel type.
- Save the current set-up to file.
- Load a previous set-up from file
- Load the SUN default set-up.
- Enable/disable limit sets.
- Edit limit sets.
- Enter the speed factor.

The vehicle fuel type, limit set values, limit sets On/Off setting and the speed factor are collectively referred to as the “Vehicle Setup”.

8.3: ‘Saving and Loading Vehicle Setups’ and 8.4: ‘Editing Limit Sets’ provide information on saving, loading and editing Vehicle Setups.

- Use the Fuel Type Drop-down Menu to select the correct fuel type for the vehicle under test (see 6.5.1: ‘Fuel Type Selection’).

  The available alternatives are:

  - Petrol (default).
  - LPG (Liquefied Petroleum Gas).
  - CNG (Compressed Natural Gas).

  Refer to the Diagnostic Platform Operator’s Manual (4.4: ‘Drop-down Menus’) for details of the use of drop-down menus.

☞ *Note:*

In the event of the fuel type LPG being selected, ensure that the correct Butane/Propane ratio is entered in Gas Analyser System Settings Screen (see 5.4). Failure to set the correct ratio may result in inaccurate lambda calculation.

- Select the appropriate Speed Factor.
- The Speed Factor is the factor that must be applied to the raw rpm data received by the unit (e.g. from the inductive pick-up) in order to arrive at a true engine speed reading. For further information concerning Speed Factor selection refer to the Emissions Diagnostic Platform Operator’s Manual (6.2.2: ‘Speed Factor Setting’). The Speed Factor currently applied is highlighted in green in the Speed Factor section of the Vehicle Setup Screen. To change the applied factor:
- Click with the mouse on the desired new Speed Factor, or
- Select the new Speed Factor using the keyboard or remote control left and right cursor keys and press the “Enter” key to confirm the new factor.

  A thin yellow frame will move along the series of Speed Factor values as the cursor keys are pressed. When the “Enter” key is pressed the green highlight will move to the newly selected value.

- Use the “Limits” button to enable or disable the Limit Sets.

  Pressing the “Limits” button will change the status of the limit sets from ON to OFF and vice versa. The “Limits” button will be Green when the limits are switched ON and Red when the limits are switched OFF.

To toggle between “Limit Sets On” and “Limit Sets Off” or vice versa:

- Click with the mouse on the “Limits” button, or
- Select the “Limits” button with the cursor keys and press “Enter”.

8.3 Saving and Loading Vehicle Setups

The vehicle setup currently displayed in the Vehicle Setup Screen can be saved in the PC memory for future use.

The information stored will be:

- Fuel type
- Speed Factor
- Limits On/Off
- Limit set values.

To save the current vehicle setup:

- Press the “Save Setup” button.

  The Save Limits File dialog box will be displayed

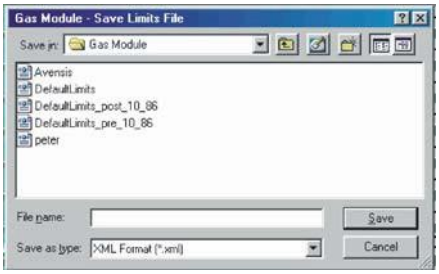

Figure 8-4 The Save Limits Dialog Box

- Check the location to which the file is to be saved.
- Enter a name for the file in the File name box.
- To save the setup click “Save” or press the “Enter” key.

  The file containing the vehicle setup will be saved and can be recalled for future use using the “Load Setup” button.

- To cancel, click the “Cancel” button or press the”Esc” key.
  The Save Limits File box will be closed without storing the setup.

To load a previously saved setup:

- Press the “Load Setup” button.
  The Load Limits File dialog box will be displayed).

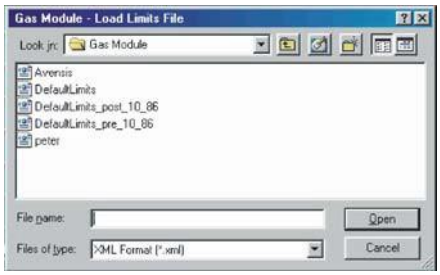

Figure 8-5 The Load Setup Dialog Box

- Select the file to be loaded with the mouse or enter the file name in the file name box.
- Click “Open” in the dialog box or press the “Enter” key.
  The loaded set-up will be applied in the Free Measurement Screen.
- To load the SUN default set-up, press the “Load Default” button.
- The software will warn that loading the default set-up will cause data stored in the buffers to be lost and ask for confirmation before continuing. Click “Yes” to proceed with loading the defaults or “No” to continue using the current settings.

8.4 Editing Limit Sets

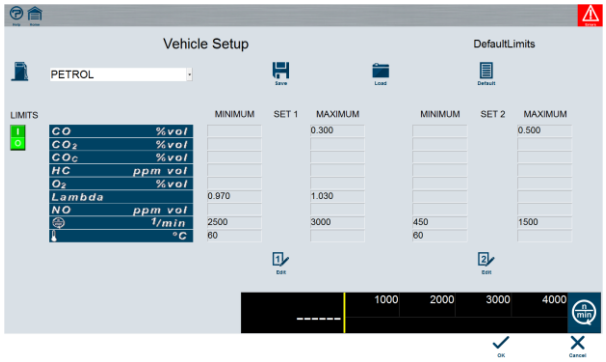

Figure 8-6 The Edit Limit Sets Window

To alter any or all of the limit values currently shown in the Vehicle Setup Screen:

- Press the “Edit Limit Set” button corresponding to the Limit Set to be edited.

  The Edit Limit Set Window will be displayed.

- Use the keyboard to make the required alterations.

To alter a limit value:

- Select the value to be altered using the “Tab” key.

  The selected field will be highlighted in Blue.

- Use the “Backspace” key to delete the current value.
- Enter the required new value.
- Repeat the procedure for all values that are to be altered.
- If required, repeat the procedure to edit the other limit set.
- To apply the new values, click “OK” or press the “Enter” key.

  The new values will be applied and the window will be closed.

- To cancel the alterations and return to the Vehicle Setup Screen, click “Cancel” or press the “Esc” key.

  The window will be closed and the current limit values will continue to be applied.

8.5 Free Measurement Test Procedure

Note:

The following description of the Free Measurement Test Procedure assumes that the Limit Sets are applied and that gas readings are required at both high and low engine revolutions. This may not be the case in all circumstances. Since the Free Measurement Procedure is highly flexible and is suitable for a variety of diagnostic purposes, the description below should be considered to be a guideline only. An experienced operator may, for instance, consider that to perform both a high speed and a low speed test is, in certain cases, unnecessary in view of the diagnostic purpose of the test.

To make gas measurements using the Free Measuring procedure:

- Select the The Free Measurement Screen from the Gas Analyser Menu (see 8.1 and 5.1).
- Make any necessary amendments to the vehicle setup in the Free Measurement Vehicle Setup Screen (see 8.2).
- Allow the vehicle to come to normal operating temperature.
- Insert the exhaust probe fully into the vehicle tail pipe.

  Refer to the notes to 7.2: 'Measurement Procedure' if the test vehicle is equipped with twin tail pipes.
- Select Limit Set 1 (see 8.1: 'The Free Measurement Screen')
- Accelerate the engine until the rpm reading falls within the Green band of the Free Measurement Screen rpm indicator.
- Maintain a steady engine speed and allow the gas readings to stabilize (approx. 30 seconds).
- Store the Limit Set 1 test results in data buffer 1 as described in 8.6: 'Storing Data in the Data Buffers'.

  After the test data for Limit Set 1 has been stored Limit Set 2 will be automatically selected and the "Toggle Limit Sets" button will show Limit Set 2. The Green and Red indicator bands will change to represent the Limit Set 2 values. The fact that data is now stored in data buffer 1 will be confirmed by the appearance of the figure "1" in the Free Measurement Screen toolbar.
- Reduce the engine speed until the rpm indicator is between the upper and lower limits specified for Limit Set 2, maintain a steady engine speed and allow the gas readings to stabilize once more.
- Store the Limit Set 2 test results in data buffer 2.

After the test data for Limit Set 2 has been stored the “Toggle Limit Sets” button will show that Limit Set 1 has been automatically reselected and the indicator bands will change accordingly. A figure “2” will appear in the toolbar, confirming that data is stored in data buffer 2.

The data stored in the data buffers can be reviewed, printed or deleted via the The Print Preview Window (see 8.7).

8.6 Storing Data in the Data Buffers

Current test readings to which a Limit Set has been applied may be temporarily stored in one of the two data buffers. This temporary storage allows the second Limit Set to be applied without the loss of the initial test results. Data to which Limit Set 1 is applied will be stored in buffer 1 and data to which Limit Set 2 is applied will be stored in buffer 2.

☞ *Note:*

The following description assumes that the Free Measurement Procedure is performed as outlined in 8.5: ‘Free Measurement Test Procedure’ (i.e. the data to which Limit Set 1 has been applied is to be stored before Limit Set 2 is applied). Although this will be the usual procedure, it should be noted that it is possible to apply Limit Set 2 before Limit Set 1 or to apply either Limit Set independently.

To store data in data buffer 1:

- Apply Limit Set 1 using the “Toggle Limit Set” button .

Figure 8-7 Apply Limit Set 1

- Take the Limit Set 1 gas measurements as outlined in 8.5: ‘Free Measurement Test Procedure’.
- Press the “Freeze” toolbar button.

Figure 8-8 Freeze Limit Set 1 Readings

The “Freeze” button will be replaced by the “Store” and “Undo” buttons. The “Store” button will be automatically selected (indicated by a Green background – see Figure 8-9).

- Press “Store” to store the data or “Undo” to unfreeze the data and return to continuous measurement..

Figure 8-9 Store Limit Set 1 Readings

If the “Store” button is pressed:

- The “Store” and “Undo” buttons will be replaced by the “Freeze” button.
- The “Freeze” button will be automatically selected.
- The number “1” (corresponding to the Limit Set and data buffer selected) will appear in the toolbar indicating that the data is stored in data buffer 1.
- Limit Set 2 will be applied automatically and the “Toggle Limit Sets” button will change accordingly.

☞ *Note:*

If the “Undo” button is pressed the “Store” and “Undo” buttons will be replaced by the “Freeze” button. The “Freeze” button will be automatically selected. Limit Set 1 will continue to be applied.

- Take the Limit Set 2 gas measurements as outlined in 8.5: ‘Free Measurement Test Procedure’.
- Press the“Freeze” toolbar button.

Figure 8-10 Freeze Limit Set 2 Readings

The “Freeze” button will be replaced by the “Store” and “Undo” buttons. The “Store” button will be automatically selected (indicated by a Green background – see figure below).

- Press “Store” to store the Limit Set 2 data or “Undo” to unfreeze the data and return to continuous measurement.

Figure 8-11 Store Limit Set 2 Readings

The number “2” will appear alongside the number “1” in the toolbar indicating that data is now stored in both buffers.

Limit Set 1 will be automatically applied for the next set of measurements and will be shown by the “Toggle Limit Sets” button. The “Freeze” button will be automatically selected.

Figure 8-12 Limit Set 1 and 2 Readings Stored

- Press the “Print preview” button to review the stored data

8.7 The Print Preview Window

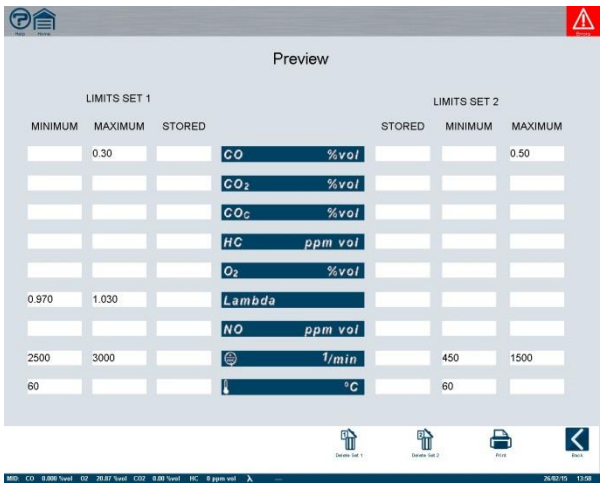

Figure 8-13 The Print Preview Window

- To open the Print Preview Window, press the “Print Preview” toolbar button on the The Free Measurement Screen toolbar.

  The Print Preview Window will be displayed. The window shows the measurements stored in the data buffers (1 & 2) together with the limit values applied. By using the text buttons in the Print Preview Window it is possible to:

  - Delete either or both sets of test measurements.
  - Proceed to the “Print” Window.

- To delete data stored in buffer 1 (Limit Set 1), press “Delete Set 1”.

  The gas measurements stored in buffer 1 will be deleted.

- To delete data stored in buffer 2 (Limit Set 2), press “Delete Set 2.

  The gas measurements stored in buffer 2 will be deleted.

☞ *Note:*

Pressing the delete buttons in the Print Preview Window will only cause the stored test data to be deleted. The limit set values will continue to be shown and applied until either a new vehicle setup (having different limit values) is applied or the limit sets are disabled.

- To access the Print Screen, press the “Print” button.
- To return to the The Free Measurement Screen, press the “Back” button.

8.8 Printing Test Results

Refer to 5.6: ‘Print’ for information on printing test results

9 Maintenance

The “Maintenance” section of this manual is divided into three main sub-sections:

- Operator initiated system checks.
- Routine maintenance procedures.
- Error codes and warnings.

9.1 System Checks

The operator may initiate the following system checks:

- Leak Check (Vacuum).
- Leak Check (Gas).
- Gas Calibration Check
- Check and/or Install the O2 Cell.

All the above checks are initiated via the Gas Analyser Maintenance Menu (see 5.3).

9.2 Leak Check (Vacuum)

Note:

A daily check of the gas analyser pneumatic circuit for air leaks that could compromise the accuracy of the test results is a mandatory requirement of many country specific test procedures (see 6.3: ‘Daily Leak Check’). If the DGA 5000 is configured for an approval type that requires such a daily leak check, the appropriate settings will be made at the time of the installation of the test software. In this case the unit will not commence normal operation unless a satisfactory leak check has been carried out. In order to ensure the continued accuracy of the test results, it is recommended that a daily leak check be carried out at the start of the day’s operation even in cases where such a test is not a statutory requirement. To conduct a Leak Check (Vacuum):

- Select the “Leak Check (Vacuum)” option from the Gas Analyser Maintenance Menu (see 5.3)

The Leak Check (Vacuum) screen will be displayed instructing the operator to block the sample probe inlet.

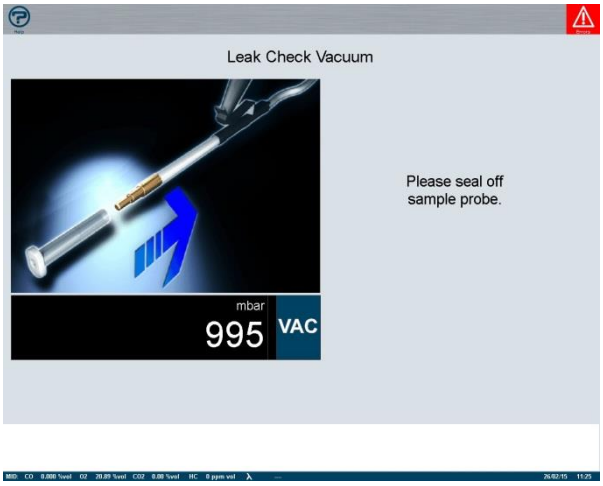

Figure 9-1 Leak Check (Vacuum) Initialization

- Block the probe inlet using the Probe Sealing Tool (p/n 7009E9317-46) supplied with the unit.

The screen will indicate that the unit has entered a stabilisation period during which the pump will build up a vacuum in the gas analyser pneumatic circuit. The current vacuum will be displayed in mBar and a status bar will indicate a 20 second countdown.

At the end of the stabilisation period, the pump will cut out and the unit will measure the vacuum decay over a further 20 second period. During this measurement period the current vacuum and the vacuum decay will be displayed. A status bar will show a 20 second countdown.

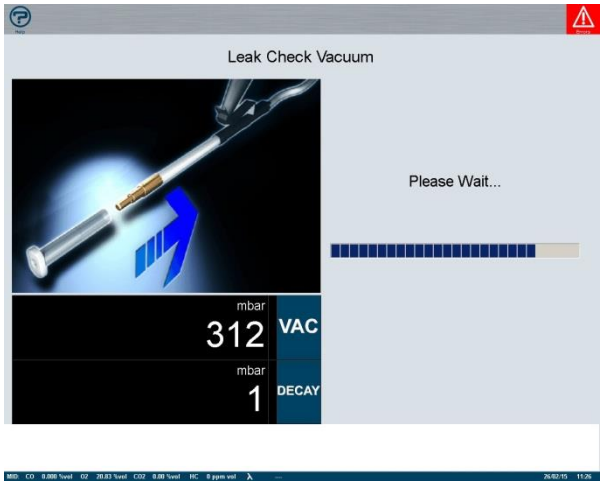

Figure 9-2 Leak Check (Vacuum) Measurement

After the elapse of the decay measurement period the screen will indicate either a successful or unsuccessful test result

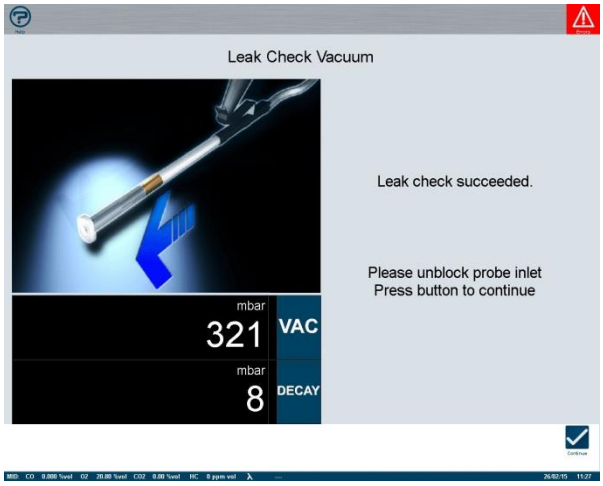

Figure 9-3 Leak Check (Vacuum) Result

- If the leak check is successful, unblock the probe tip, store the Probe Sealing Tool in a safe place until it is required again and press “Continue” to return to the Gas Analyser Maintenance Menu.

- If the leak check is unsuccessful, check all filter and hose connections for tightness and ensure that the sample hose is not damaged. Repeat the Leak Check (Vacuum). Refer to 9.6.3: 'Sample Probe and Hose') for information on how to isolate possible leaks in the sampling system (Probe, Hose and Gas Filter).
- If a satisfactory result is still not obtained, and the sample hose and connections are in order, conduct a Leak Check (Gas) (see below, 9.3: 'Leak Check (Gas)') to eliminate the possibility that a leak in the gas module water circuit is influencing the result of the Leak Check (Vacuum).

9.3 Leak Check (Gas)

The Leak Check (Gas) tests for gas/air leaks in the pneumatic system of the gas analyser but is not influenced by leaks occurring in the gas module water circuit. Since leaks in the water circuit do not compromise measurement accuracy, a successful Leak Check (Gas) is considered to fulfill the requirement for a daily leak check even if a previous Leak Check (Vacuum) has been unsuccessful (see *6.3: 'Daily Leak Check'*).

Note:

It will be apparent that a successful Leak Check (Gas) following an unsuccessful Leak Check (Vacuum) indicates an internal leak in the gas module water circuit. Although measurements will not be blocked and normal unit operation may continue, contact your SUN dealer or Service Representative to arrange for water circuit service.

To conduct a Leak Check (Gas):

- Select the "Leak Check (Gas)" from the Gas Analyser Maintenance Menu (see 5.3).
- The Leak Check (Gas) screen will be displayed instructing the operator to inset the sample probe in the vehicle tail pipe and showing the current measured level of CO_2.

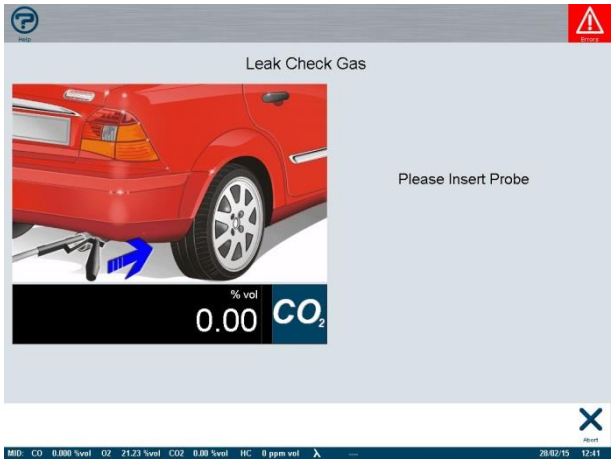

Figure 9-4 Leak Check (Gas) Initialization

- Start the vehicle engine (if not already running) and insert the sample probe fully into the exhaust tailpipe.

The unit will collect an exhaust gas sample from the vehicle and the CO_2 concentration will be continuously measured and displayed. When the proper CO_2 threshold has been reached (+/- 5% vol) the screen will indicate that a 20 second stabilisation period has begun. A status bar representing a 20 second countdown will be shown (figure 10-5).

At the end of the stabilisation period the pump will switch off and the screen will ask the operator to remove the probe from the tailpipe and block the probe tip using the Probe Sealing Tool (p/n 7009E9317-46)

.

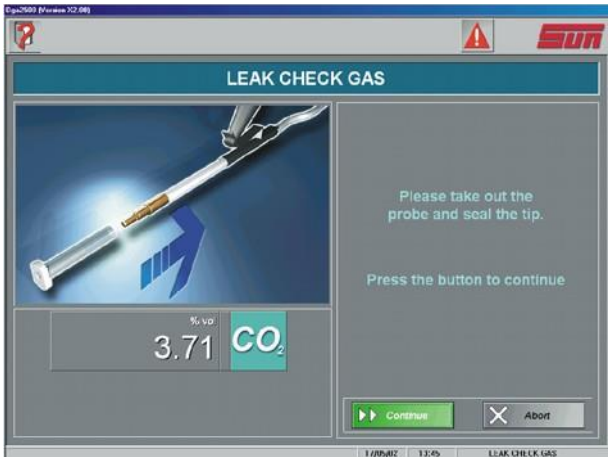

Figure 9-5 Leak Check (Gas) - Block Probe Tip

- Remove the sample probe from the vehicle exhaust, block the probe tip and press the “Continue” button to proceed.

After the “Continue” button is pressed, the pump will re-start and the unit will enter the measurement phase in which the decay in the concentration of CO_2 will be determined. The vacuum, CO_2 level and CO_2 decay will be continuously measured and the values for CO_2 and CO_2 decay will be displayed. The status bar will show a 20 second countdown during the decay measurement phase

.

Figure 9-6 Leak Check (Gas) - Measurement

At the end of the measurement phase the screen will indicate whether the leak check was successful or unsuccessful.

- If the leak check has been successfully performed, unblock the probe tip, store the Probe Sealing Tool in a safe place until it is required again and press “Continue” to return to the Gas Analyser Maintenance Menu. If the leak check was unsuccessful, check the sampling system for loose connections and/or damage and repeat the test.

If the sampling system is in good order and the leak check is still not satisfactory, an internal leak in the gas module is indicated. Contact your SUN® dealer or Service Representative.

9.4 Gas Calibration Check

The Gas Calibration check tests the calibration of the gas measurement system against a calibration gas of a known composition. This check should be carried out by the operator as and when necessary using a 1% accuracy gas mixture of:

- 1.3 – 1.7% vol CO
- 10.5 – 11.55 %vol CO_2
- 540 – 660 ppm vol HC.

Note:

The Gas Calibration Check should not be confused with the full gas calibration that should only be carried out by a SUN Service Engineer. The DGA 5000 system may be set to specify that a full gas calibration be performed at specified intervals (normally once every 12 months). If such a setting has been entered into the system, the unit will give a warning that a full gas calibration is required.

- Select the “Gas Calibration Check” option from the Gas Analyser Maintenance Menu.

  The Gas Calibration screen will be displayed holding two drop-down menus (“Lambda calculated for” and “HC represents”) and measurement fields for CO, CO_2, HC, NO, O_2 and lambda.

- Select a fuel type from the “Lambda calculated for” drop-down menu.

  The alternatives (Petrol, LPG, and CNG) represent the three possible fuel types available.

- Select a gas mixture from the “HC represents” drop-down menu.

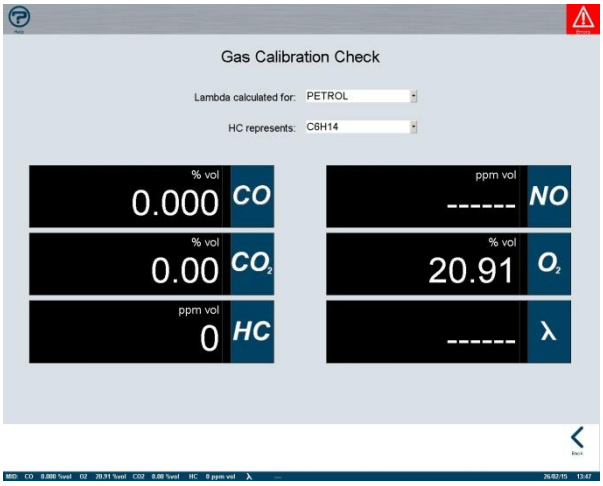

Figure 9-7 Gas Calibration Check

The available options are:

- C_3H_8 (Propane)
- C_6H_{14} (Hexane)
- CH_4 (Methane)
- LPG (Liquefied Petroleum Gas).

The default setting is HC represents C_6H_{14} (Hexane).

- Connect the calibration gas bottle to the calibration gas inlet on the gas module rear panel, set the flow to 5 liters/min and turn on the gas.
- Allow the readings to stabilise and compare the readings obtained by the analyser with the known composition of the calibration gas. The indicated ppm vol reading for HC must be the same as the known concentration of HC in the gas bottle.
- When the check is completed, turn off the gas and disconnect the gas cylinder from the calibration gas inlet.
- Press “Back” to return to the Gas Analyser Maintenance Menu.

9.5 Check and/or Install the O2 Cell

The O_2 cell generates an electrical voltage proportional to the O_2 present in the exhaust sample. The analyser interprets this voltage and displays the O_2 content as a percentage. After a zero calibration the O_2 concentration should read approximately 20.93 %vol.

Due to the chemical processes within the O2 cell it has a limited life. The current status of the cell may be derived from its output voltage which is monitored by the unit software. If the output voltage falls below 7.5 mV the unit will display a warning that the cell will soon require replacement ("Pre-warning – change O_2 cell"). The unit will display an error message that cell must be changed if the output voltage drops to 7 mV ("Change O_2 cell"). The condition of the cell may be checked at any time by using the O_2 Check/Install facility built into the software.

To check the status of the cell:

- Select the "O_2 Check/Install" option from the Gas Analyser Maintenance Menu.

  The "O_2 Check/Install" screen will be displayed showing the message "CHECKING O_2 CELL – PLEASE WAIT" .

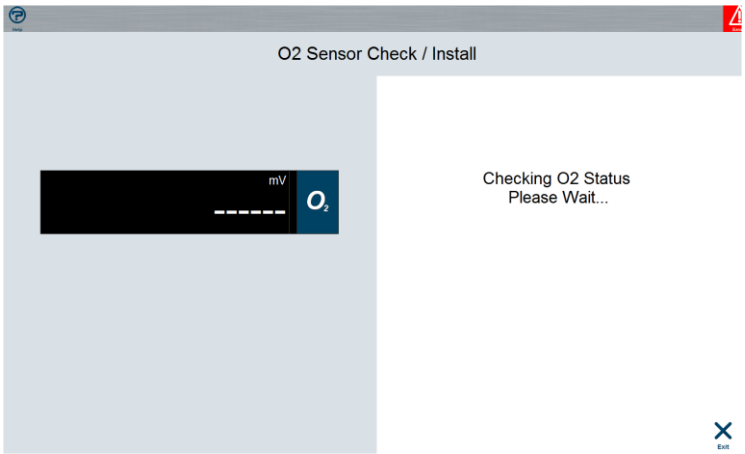

Figure 10-8 O2 Sensor Status Check

- The unit will proceed to determine and display the cell output voltage and will show the cell status as follows:
  - Output voltage 7.5 mV or more – "Acceptable O_2 cell".
  - Output voltage between 7.0 mV and 7.5 mV – "Pre-warning change O_2 cell".
  - Output voltage less than 7.0 mV – "Change O_2 cell".
  - Output voltage –2.5 mV – "No O_2 cell connected".
- Press "Exit" to return to the Gas Analyser Maintenance Menu or "Continue" to proceed with the installation of a new cell .

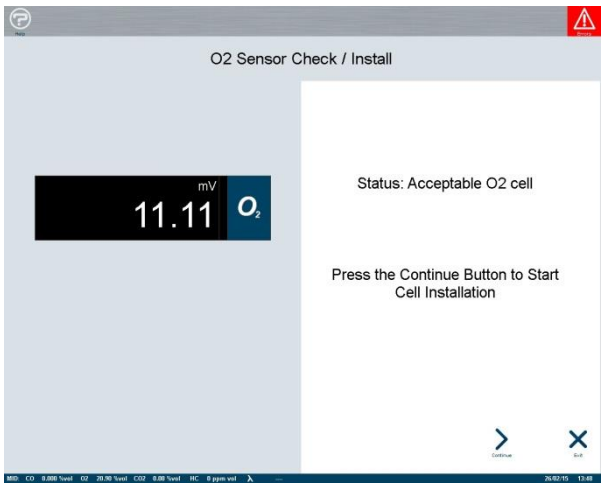

Figure 9-9 O2 Sensor Status Check - Result

Note:

Once "Continue" is pressed the installation procedure must be completed even if a new cell is not installed. If the old cell remains in situ the software will see the existing cell as a new cell and will require that the auto-calibration referred to below be performed.

The screen will show "Change O_2 cell" and ask the operator to press "Continue" in order to proceed with the installation of a new cell.

To install a new cell:

- Remove the O_2/NO cell cover plate on the rear panel of the gas module (if applicable).
- Remove the connector from the existing O_2 cell and turn the cell anti-clockwise to remove it.
- Install the new cell and replace the connector.
- Press "Continue".

  The unit will determine the output voltage of the new cell. If the new cell is acceptable the screen will prompt the operator to press "Continue" to initiate an auto-calibration.
- Press "Continue" to initiate the auto-calibration

.

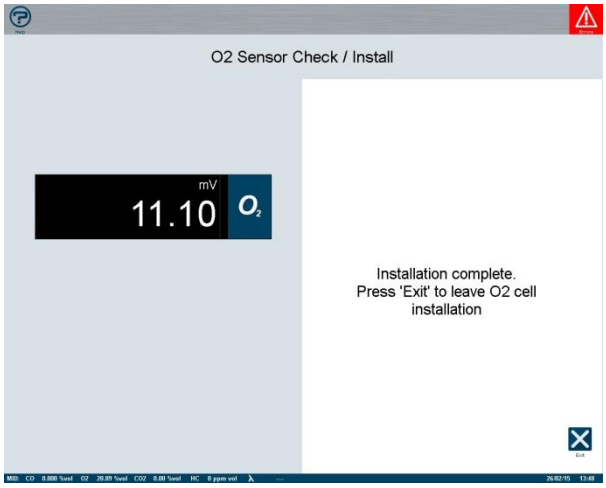

Figure 9-10 O2 Sensor Replacement - Auto-calibration

The unit will initiate the auto-calibration and the auto-calibration pop-up window will appear showing the auto-calibration countdown. At the end of the auto-calibration the screen will show the message “Installation complete” and prompt the operator to press “Exit” to leave the installation procedure.

- Press “Exit” to return to the Gas Analyser Maintenance screen.
- Replace the O_2/NO sensor cover plate (if applicable).

9.6 Routine Maintenance Procedures

⚠ CAUTION

The maintenance and service procedures presented in this section are those that the operator may perform. All other service procedures should only be carried out by an authorised sun service representative.

The Emissions Diagnostic Gas Analyser is a precision measurement instrument that requires little maintenance, nevertheless, the following maintenance and service procedures should be carried out in order to maintain the accuracy of the test results.

9.6.1 Periodic Checks

- A Leak Check (Vacuum) or a Leak Check (Gas) should be carried out daily, before the start of operation. Refer to 9.2: ‘Leak Check (Vacuum)’ and 9.3: ‘Leak Check (Gas)’ for further information.
- A Gas Calibration Check should be carried out as and when required or when indicated by the system. Refer to section 9.4: ‘Gas Calibration Check’ for further information.

9.6.2 Filters

⚠ CAUTION

Failure to adequately maintain the filters will invalidate the DGA 5000 Warranty.

- CHARCOAL FILTER (p/n 7096E9061-54). The charcoal filter should be replaced when the annual gas calibration is carried out.
- PRIMARY (PETROL) FILTER (p/n 7096E9062-98. The primary filter should be replaced when clogged.
- WATER BOWL PARTICLE FILTER (p/n 1-33081A. The particle filter should be replaced when the "Low Flow" warning message is displayed, or when it has become very dirty or clogged.
- WATER BOWL COALESCING FILTER (p/n 1-32981A. The coalescing filter should be replaced when it has become very dirty or clogged .

More frequent filter service will be required when:

- The analyser is in constant use.
- Testing vehicles not warmed up to normal operating temperature.
- Testing vehicles with very high emissions.

9.6.3 Sample Probe and Hose

Periodically check the inlet holes at the probe tip for dirt and debris. To clean:

- Disconnect the sample hose from the analyser at the sample inlet.
- Clean the probe tip using a small pointed tool or piece of thin wire.
- Blow any remaining debris away using compressed air.

⚠ CAUTION

Do not apply compressed air to the probe tip without first disconnecting the sample hose from the sample inlet. Backpressure could damage the sampling system.

The sample hose should be free of any cuts or abrasions that may cause leaks. Follow the leak check procedures in this manual and replace any damaged hoses.

Use the following test/repair procedure if the analyser fails a Leak Check (Vacuum) or a Leak Check (Gas):

1. Ensure that assembly connections on the exhaust sample probe and filters are tight.
   a. If tight, continue with step 2.
   b. If loose tighten and repeat the leak check.
   c. If the analyser fails the leak check, proceed with step 2.
2. Remove the sample probe from the hose and plug the hose. Repeat the leak check.
   a. If the test fails, continue with step 3.
   b. If the test is successful, install a new sample probe and repeat the test to check for other leaks.
   c. If the test still fails, continue with step 3.
3. Remove the exhaust sample hose from the inlet fitting and plug the inlet fitting. Repeat the leak check.
   a. If the test fails, proceed with step 4.

b. If the test is successful, install a new hose and repeat the leak test to check for other leaks.

c. If the test still fails, continue with step 4.

4. Pinch off the tube connected to the gas filter with a small vise grip or needle nose style pliers. Repeat the leak check.

a. If the test fails, the problem is either the hose or there is an internal leak in the analyser. Contact your SUN Service Representative for repair service.

b. if the test is successful, a gas filter leak is indicated. Replace the gas filter and repeat the leak test.

c. If the test is successful, the leak is repaired.

d. If the test fails, contact your SUN Service Representative for repair service.

9.6.4 Test Leads

- Inspect all test leads weekly for any cuts, kinks or abrasions and replace any faulty pick-ups or leads.
- When routing leads across an engine, ensure that they do not come into contact with any moving engine components or hot surfaces such as exhaust manifolds etc.
- Trigger clamps should be kept free from oil, grease and other contaminants and should be cleaned to minimise false triggering and, therefore, false measurements.

9.6.5 O2 Cell

- The unit will indicate when the O2 cell requires replacing by showing the “Pre-warning change O_2 cell” and “Change O_2 cell” warning messages. Refer to 9.5: ‘Check and/or Install the O2 Cell’ for further information.

9.6.6 General

- The exterior of the cabinet may be cleaned using a damp soft lint-free cloth. Use a mild detergent to remove grease.

⚠ CAUTION

Do not use solvents (acetone, benzine etc.). These can damage plastic components and affect sampling accuracy if they contaminate the sampling system.

- Clean up any liquid spills immediately to protect the exterior of the unit and to prevent any spillage from entering the ventilation vents.
- Test leads and the main power cable may be cleaned by using a water-free hand-cleanser and wiping dry with a cloth.

9.7 Error, Warning and System Status Messages

The DGA 5000 system gives error, warning and system status messages in two ways:

- By means of automatic pop-up windows.
- By means of the “Error/Warning” button on the toolbar.

9.7.1 Automatic Pop-up Windows

Automatic pop-up windows will be displayed to indicate the following system statuses:

- Warm-up
- Zero-calibration.
- HC residue check .

Figure 9-11 Warm-up

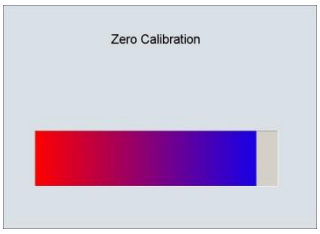

Figure 9-12 Zero Calibration

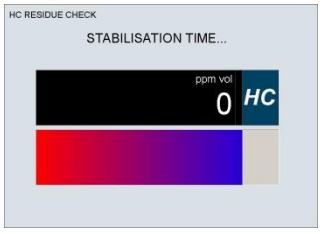

Figure 9-13 HC Residue Check

Each of the above statuses is represented by its own automatically displayed pop-up window, showing the status concerned together with a countdown of the time remaining in that status.

The windows can either be closed manually to allow access to the screen buttons or will close automatically when the system moves into another status. In the event of a pop-up window being automatically closed, it will remain hidden when moving between menu or setup screens but will reappear if a different mode (e.g. leak check, system information display etc.) is selected.

☞ *Note:*

The three statuses will be run in sequence upon power-up or when returning from standby mode.

a. *The Zero-calibration and HC residue check will be run in sequence following the manual initiation of an auto-calibration.*

b. *An automatically triggered auto-calibration will not be followed by an HC residue check.*

c. *In the event of maintenance function (e.g. leak check) being selected whilst a power-up or manually initiated auto-calibration is in progress, the auto-calibration pop-up window will be displayed and the auto-calibration will be completed. The subsequent HC residue check will be postponed or aborted until the maintenance mode is exited.*

9.8 The Error/Warning Button

The “Error/warning” button will appear on the right hand side of the toolbar whenever an error or warning condition is detected. Examples of such conditions are messages concerning the status of the O_2 Sensor, insufficient gas flow, daily leak check requirement etc.

- Select the Error/Warning button in order to review the error/warning messages.

  The Error/Warning pop-up window will be displayed showing the error/warning code together with a brief description of the cause of the error/warning message.

The Error/Warning pop-up window may be closed at any time by selecting the “Close” button.

The Error/Warning button will disappear automatically when the conditions giving rise to the error/warning message(s) are rectified.

Error/Warning codes and messages may be of two types:

Messages relating to the DGA 5000 system.

- Messages relating to the gas bench

The possible error codes are show by the tables below.

Table 9-1 Gas Bench Error Codes SGMII

Error Code	Description
0	Detector temp O.O.R
1	Ambient temp O.O.R
2	Pressure O.O.R
3	Calibration required
4	Calibration in progress
5	Warm-up in progress
6	Zero required
7	Zero in progress
8	Vacuum O.O.R
9	Rpm O.O.R
10	Oil temp O.O.R
11	NOx O.O.R
12	O2 O.O.R
13	CO2 O.O.R
14	CO O.O.R
15	HC O.O.R
16	Channel error
17	HCpropane
18	CO3digits
19	VACUUM SWITCH
20	SOLENOID2
21	SOLENOID1
22	PUMP2
23	PUMP1
24	Lamp error
25	New rpm data
26	New gas data
27	Initial Zero in progress
28	Bad nox sensor
29	Detector Low Signal
30	Bad O2 sensor
31	EEPROM failed

Table 9-2 SUN System Error Codes

Error Code	Description
00	Change O2 Cell
01	Pre_Warning Change O2 Cell
02	Temperature limit exceeded
03	BGL
04	Water Detected
05	Sibench errors
06	Auto zero calibration pending
07	Condensation in Sibench Detected
08	Low Flow
09	Vacuum Error
10	Temperature Error
11	Co2 too high while HC-residue check active
12	Gasbench driver error
13	No NO-CELL
14	No O2-CELL
15	No Flow
16	No Acceptable new cell
17	Change NO-CELL
18	NO-CELL gas required
19	Gas calibration required
20	Pre Warning Gas calibration required
21	Leak Check Required
248	Error cannot open the device ROTI
249	Error cannot open the device SGM
259	GasModule can’t connect
260	Error Time Out
261	Error Nak
262	Error Crc Cmd

9.9 Maintenance Parts

The following maintenance parts are available for Operator Maintenance Procedures:

Table 9-4 Operator Maintenance Parts

Part No.	Description
7096E9321-25	Exhaust Probe Assembly
7009E9317-46	Exhaust Probe Sealing Tool
7096E9061-02	Water Filter
7096E9061-54	Charcoal Filter
7096E4060-31	Oxygen Sensor
1-32981A	Water Bowl Coalescing Filter
1-33081A	Water Bowl Particle Filter
1-32881A	Condensing Chamber Coalescing Filter
5-09331A	Exhaust Sample Hose

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