

CRYPTON

HANDY GAS

4 & 5 GAS PORTABLE EMISSION ANALYSERS



Operating and Maintenance Instructions

TES 1383/B
Dec 2003

IMPORTANT

Every reasonable effort has been made to ensure that information within these Operating Instructions is correct at the time of release, but Crypton cannot accept-responsibility for any errors that may occur.

The information in these Operating Instructions is subject to change without notice, and does not represent a commitment on the part of Crypton.

Service & Warranty

The reliability of this equipment is fully supported by our service agent, with repair workshops and field service engineers to provide a full range of After-Sales Care, including installation, contract maintenance, factory overhaul and emergency repairs on site. Please refer to the page at the end of this manual for full details.

Note:

Your attention is drawn to our Terms & Conditions of Sale, particularly paragraph 2. If a service engineer is called out under service warranty where, upon inspection and test the equipment is found to be in full working order and no fault found, the user is liable to be charged the cost incurred for this call out. Before calling out an engineer, ensure your equipment is faulty by checking its operation, particularly mains supply and fault codes/self test if applicable.

WARNING:

Do not attempt to operate this equipment unless you have read and understood these instructions.

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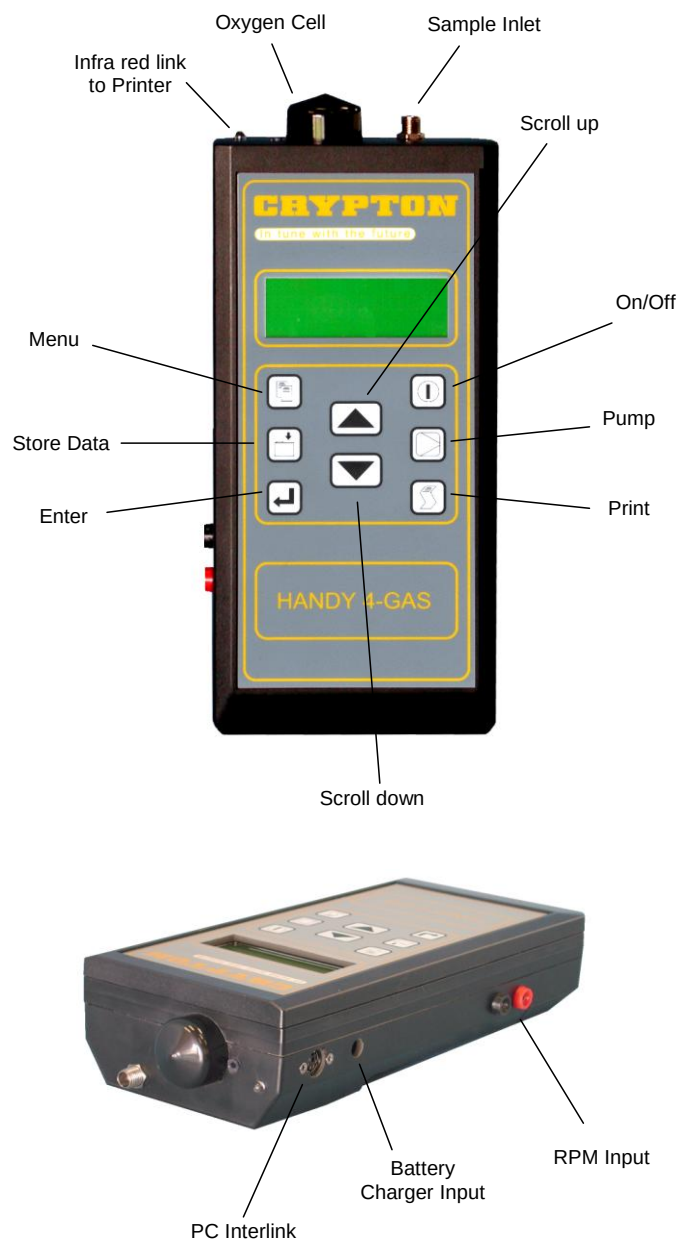
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1. ANALYSER LAYOUT AND FEATURES

1.1 Instrument Features and Keypad



2. SAFETY WARNING

This analyser extracts vehicle exhaust gases that may be toxic in relatively low concentrations. These gases are exhausted from the top of the instrument. This instrument must only be used in well ventilated locations. It must only be used by trained and competent persons after due consideration of all the potential hazards.

Do not use analyser on a Dynamometer - Refer to Supplier/Manufacturer.

Protection Against Electric Shock (in accordance with EN 61010-1 1993)

This instrument is designated as Class 111 equipment and should only be connected to SELV circuits. The battery charger is designated as:

Class 11 equipment

Installation category 11

Pollution degree 2

Indoor use only

Altitude to 2000m

Ambient temperature +5°C - +40°C

Maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50%RH at 40°C

Mains supply fluctuations not to exceed 10% of the nominal voltage.

3. FIRST TIME USE

Charge the battery for 12 hours, following this an overnight charge should be sufficient for an average 8 hour day (turning pump off to save power between tests). See Main Parameter displays for Battery Indicator.

The Handy 4-Gas has a rechargeable lead acid battery, use only the mains charger supplied or damage may occur to the instrument and battery.

Check that you have all the items you have ordered.

Take time to read this manual fully.

When using the analyser for the first time you will need to choose from:-

Language selection

Time

Printed header name and telephone number

The SET UP MENU (Section 5.2.) gives details of how to change the above settings.

4. NORMAL START UP SEQUENCE

4.1 Every Time You Use The Analyser

BEFORE SWITCH-ON CHECK THAT:

The particle filter is dry and not dirty or damaged.

The water trap and probe line are empty of water.

All hose connections, etc, are properly made and the probe is sampling CLEAN AMBIENT air.

****DO NOT RUN ANALYSER WITHOUT WATER TRAP FITTED****

Switch ON the instrument by pressing



4.2 Automatic Zero Calibration

During this sequence the analyser pumps fresh air into the sensors to allow them to zero and the oxygen sensor to be set to 20.9

After switch-on the analyser will briefly display

**CRYPTON
+44 (0)1278 436200**

And then show the initialising screen

**INITIALISING
Time : 75
FRESH AIR PURGE**

The time will count down in seconds to zero and is pre-set by the instrument. During countdown the instrument will check flow rate and initialise the measuring system, do not block the end of the probe or insert into or near the vehicle exhaust.

Once the initialisation time has reached zero an audible beep will be heard and the unit will request a leak check as on the following display:-

LEAK CHECK
REMOVE EXHAUST PROBE
FIT PROBE SEAL
THEN PRESS ENTER

Fit the probe seal as detailed in Section 10.3 and press



Once the test has PASSED remove the probe seal and press



If the test fails see Section 10.3.

Once the leak test is completed the instrument will zero the CO, HC and CO2 sensors and set oxygen to 20.9%. Keep the instrument and exhaust probe sampling fresh air.

Following the countdown the instrument will take approximately 75 seconds to set the zero.

ZERO CAL.
Time : 75
FRESH AIR PURGE

If the readings are outside the allowable zero range as detailed in section 10 it is advisable to perform a manual zero also detailed in section 5.2.2.

The next screen is the **MAIN DISPLAY** of the analyser:-

CO % vol ... 00.00
HC ppm vol .. 0000
CO2 % vol ... 00.0
O2 % vol ... 20.90

Use



to change the display.

CO % vol ... 00.00
HC ppm vol .. 0000
CO2 % vol ... 00.0
LAMBDA ... 0.000

All parameters are detailed in Appendix A - MAIN DISPLAY PARAMETERS.

4.3 Main Displays

There are three display modes:

Line scroll mode
4 page mode
8 page mode

Changing between the different modes is detailed in **Display Menu Section 5.2.4.**

4.3.1 Line Scroll Mode

Line scroll mode allows you to customise the display. This is the default mode following first switch on of the analyser. However, subsequent user settings will be retained.

Use the up/down arrow keys to change the bottom line of the display.

Change bottom line using



or



CO	% vol	...	00.00
HC	ppm vol	..	0000
CO2	% vol	...	00.0
LAMBDA	...		0.000

4.3.2 4 Page Mode

Use the up/down arrow keys to change the information that is displayed on the screen. The following pages are available.

PETROL	
DATE	... 02- 07- 02
TIME	... 15:25:40
BATTERY%	.. 65

RPM	4	00
------------	---	----

CO % vol	... 00.00
HC ppm vol	.. 0000
CO2 % vol	... 00.0
O2 % vol	... 20.90

COK – CO corrected. This is a calculated value and is designed to compensate for oxygen dilution as in a leaking exhaust system.

LAMBDA	-----
COK % vol	... 0.00
TIME TO ZERO	09
OIL deg C	50

Note: The Lambda reading will be displayed as a series of '-----' if the unit is not sampling gas.

4.3.3 8 Page Mode

Displays 8 parameters on the screen at one time. Symbols used in this mode are different to those used in 4 page and line scroll modes and are detailed in **Appendix A - MAIN DISPLAY PARAMETERS**.

λ - Lambda

TZ – Time until the next zero request

CO :00.00	O2 :20.90
HC :0000	CO2:00.0
λ :00.0	TZ : 25
02-07-02	15:40:25

The bottom line of the display can be changed to display other parameters using the arrow keys.

CO :00.00	O2 :20.90
HC :0000	CO2:00.0
λ :00.0	NO :0000
OIL : -----	COK: 0.00

4.4 Sampling the Exhaust Gas

Once the zero calibration and test procedures have been completed and the fuel has been selected (See SELECT menu) the probe can be inserted into the desired vehicle exhaust.

Ensure the probe is inserted as far as possible into the exhaust pipe so as to not allow air into the probe. Attach clip to the exhaust pipe to secure the probe in position

4.5 Turning the pump ON/OFF

The analyser is fitted with a pump to draw gas from the vehicle exhaust. To conserve battery power, switch off the pump when measurements are not being taken

Use the  key to turn ON and OFF the pump.

The analyser will block readings while the pump is off and display '----' on all gas channels. It will also display PUMP OFF every 30 seconds.

It is recommended that the analyser samples fresh air for 60 seconds before the pump is turned off.

4.6 Taking an oil temperature reading

WARNING:

Great care must be taken when setting the temperature probe insertion depth to ensure that no damage to the probe and/or engine is incurred by contact with moving engine parts.

Connect the oil temperature probe to the instrument and check it reads ambient temperature. Turn off the vehicle engine. Remove the oil dip stick from the engine and set the depth of the probe to that of the dip stick using the stop. Insert the probe into the engine.

The oil temperature will be displayed

LAMBDA	----
COK % vol ...	0.00
TIME TO ZERO	09
OIL deg C	50

4.7 Reading the engine speed (RPM)

Connect the induction pickup to one of the spark plug leads ensuring the side indicated by 'SPARK PLUG SIDE' points to the spark plug. Connect the pickup to the instrument ensuring correct polarity, "+" to red and "-" to black. Set 4 cycle/2 cycle or DIS as detailed in section 5.2.2.

Note: If the pickup is positioned close to other leads false readings may occur. For some types of ignition system (e.g. DIS) the probe may need to be fitted "reversed" to produce readings.

4.8 Regular Checks During Sampling

Care must be taken at all times not to exceed the analysers operating specifications, in particular ensure the following:

DO NOT PLACE THE INSTRUMENT IN-THE ENGINE BAY.

THE ANALYSER IS NOT EXPOSED TO TEMPERATURES OUTSIDE ITS NORMAL OPERATING RANGE.

DO NOT PLACE THE INSTRUMENT ON A HOT SURFACE.

Liquid in the water trap does not go over the level indicator. Note! The indicator only works while the trap is vertical. Water condenses in the probe line and can quickly fill the water trap when the probe is moved. Take care and watch the water trap closely.

THE IN-LINE PARTICLE FILTER IS CLEAN AND DOES NOT BECOME BLOCKED.

LOW FLOW:

During sampling or at anytime the pump is running the screen may display LOW FLOW. This is an indication of the following:

The particle filter needs replacing (a visual check is also necessary)

Probe or tubing is blocked.

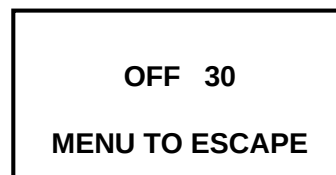
Internal filters are blocked (Contact service agent).

4.9 Normal Shutdown Sequence

DO THIS EVERY TIME YOU USE THE ANALYSER

Remove the probe from the vehicle exhaust - TAKE CARE! THE PROBE WILL BE HOT - and allow it to cool naturally. Do not immerse the probe in water as this will be drawn into the analyser and damage the pump and sensors.

Once the probe is removed from the exhaust, allow the readings to return to zero and switch off. The analyser will count down from 30 to switch off.



5. MOVING THROUGH THE MENUS

5.1 Basic Operation

From the MAIN DISPLAY

```
CO % vol ... 00.00
HC ppm vol .. 0000
CO2 % vol ... 00.0
O2 % vol ... 20.90
```

Press  to access the MAIN MENU

MAIN MENU

```
1. SELECT  3. DISPLAY
2. UNITS   4. SETUP
```

Move cursor using up/down arrows.

Press  to select desired menu.

Press  to select parameter.

```
ZERO      :NO
FUEL      :PETROL
RPM       :4 CYCLE
CAL       :CHECK
```

Use arrow keys to change setting
i.e. petrol, LPG etc.

Press  to select and move to

next parameter.

```
ZERO      : NO
FUEL      : PETROL
RPM       : 4 CYCLE
CAL       : CHECK
```

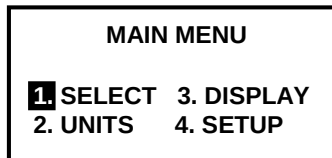
Press  to save settings and return to MAIN MENU.

Press again to return to readings.

5.2 Menu Options and Settings

5.2.1 Main Menu

The MAIN MENU consists of 4 sub menus, which are shown below and detailed on the following pages.

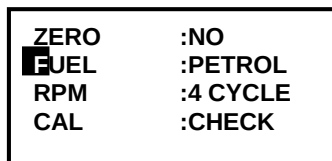


All sub-menus are accessed using  and exited using .

The  and  keys move the cursor within a menu to allow parameters to be changed.

TIP Holding down one of these keys scrolls through the data quicker.

5.2.2 Select Menu



This menu allows selections to be made for the parameters detailed below.

		OPTIONS
ZERO:	Allows the user to set the Oxygen cell to 20.9% and zero the other sensors without turning the analyser off. More details on zero functions can be found in Section 10 - Zero checks and recalibration.	YES NO
FUEL:	Select the fuel the vehicle is using	PETROL LPG CNG
RPM): (optional)	2 Stroke, 4 stroke or Distributorless Ignition System. DIS vehicles produce a spark for EVERY engine revolution. Thus if DIS is not selected for a vehicle fitted with this type of system, the engine speed will read double.	2 CYCLE 4 CYCLE DIS

CAL: Allows the user to check the calibration of the analyser using precision calibration test gases. It is recommended this is done every 3 months. Test gas is available from your service centre. The following can be performed in this menu:

- Set the calibration test **GAS VALUE** in the analyser.
- **CHECK** the calibration accuracy against the test gas,
- **RESET** calibration values to factory settings.

Comment [AE1]:

Use the  or  to select from the **GAS VALUE**
Following functions. Press  to select. **CHECK**
RESET

Details for performing the above functions can be found in Section 10.4 - Gas calibration verification.

5.2.3 Units Menu

DATA	: T123 ABC
TEMP	: C
EFF	:LAMBDA
PEF	: 0.512

Allows the vehicle registration number to be changed and all displayed units to be changed.

Vehicle Registration Data

DATA	: <u>T</u> 123 ABC
TEMP	: C
EFF	:LAMBDA
PEF	: 0.512

Allows the vehicle registration number to be entered. The format for the data is 8 characters alphanumeric as follows:

1234567890;,<>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ/space/

The cursor _ indicates this character can be changed. Select the correct character from the list using the arrow keys and press enter when correct.

Repeat until all the vehicle registration is correct .

TEMP): Choose selections from Centigrade °C or Fahrenheit °F.
(optional)

Select main menu followed by units menu.

DATA	:012345
TEMP	: C
EFF	: LAMBDA
PEF	: 0.512

Move cursor using arrow keys and press enter to select desired parameter. Use arrow keys to change parameter and enter to select.

EFF: Changes the calculation used in the Lambda calculation. Change from **LAMBDA** to **AFR**. Formulas used in the analyser are detailed in appendix B.

PEF: Propane equivalence factor or n-hexane to propane ratio as set in the instrument. This is not a user variable parameter but is displayed for reference.

5.2.4 Display Menu

LIGHT	OFF
MODE	:8-PAGE
CONTRAST	:DEFAULT
LANGUAGE	: ENGLISH

OPTIONS

LIGHT: Turns the backlight ON or OFF.

ON
OFF

MODE: Select 4 or 8 Page Mode or Line Scroll Mode as detailed in section 4.3 Main Displays.

4PAGE
8PAGE
LINE

CONTRAST: The contrast is set to a DEFAULT value or can be adjusted **↑ LIGHTER** or **↓ DARKER**. Use the up or down arrow key to adjust. Note the display may jump from dark to clear

LANGUAGE: Changes the analysers displayed and printed language.

ENGLISH
SPANISH
DUTCH
FRENCH
ITALIAN
GERMAN

5.2.5. Set-Up Menu

The set up menu allows the following parameters to be set / altered.

- Format of the date.
- Time
- Printout Header

FORMAT : DD-MM-YY	
DATE	: 02-03-99
TIME	: 09:10:31
HEADER	:NO

FORMAT: Changes the date format set on the analyser. **DD-MM-YY**
Contact your service centre if this is incorrect. **MM-DD-YY**
YY-MM-DD

DATE: Allows the user to change the date. **Change each**
Change each number of the day, month and year **number using**
until correct. **the arrow and**
enter keys

TIME: Allows the user to change the time. **Change each**
Change each number of the hours and minutes **number using**
until correct, the seconds will reset to zero **the arrow and**
automatically. **keys**

HEADER: Allows two lines of 20 characters to be programmed
into the analyser. The header appears on the top of the
standard printout. This can be used to print your company
name and/or phone number.

Name/Phone
<u>C</u> RYPTON
+44(0)1278 436200
'LEFT' USE STORE KEY

The screen above shows the standard header setting with the cursor now shown underlining the C in Crypton. By using the arrow keys any letter or number can be chosen.

Once the correct character is displayed, use enter to move right to the next. Move along until all characters spell the desired name or phone number. If you need to go back and change a character use



to move left.

Press Menu to return to the SET UP menu.

6. PRINTING

An optional infra-red thermal printer is available for the analyser. Read the manual supplied with the printer prior to operation.

No physical connections (i.e. cables) are required as the printer uses an infra red link similar to a TV remote control. The IR emitter is positioned on the top of the Handy 4-Gas and the receiver on the bottom of the printer. Ensure they are pointing at each other and within 300mm (12"), with no obstructions in the way. Data may be lost if transmission is interrupted. Missing characters or black squares are evidence of this. Loss of data can also happen if the analyser is pointed away from the printer. Keep the Handy 4-Gas pointing at the printer until the printout has finished.

Data can either be printed from a 'live' test or from stored data. Printing of stored data is detailed in **STORING AND RETREIVING DATA**.

6.1 Printing a 'Live' Test

During a vehicle test the Handy 4-Gas will print data on request. With the analyser showing the MAIN DISPLAY press and hold  and current data will be sent to the printer.

The display will show the following until data transmission is complete.

****Printing****

6.2 Typical printout

A typical printout is shown below:-

```
CRYPTON
+44(0)1278 436200

VEHICLE: T123 ABC

FUEL.      PETROL

DATE:      02-07-02
TIME:      09:10:31

CO  % vol ... 3.5
HC  ppm vol.. 1234
CO2 % vol...  14
O2  % vol...  2.1

LAMBDA ... 1.010
```

7. STORING AND RETRIEVING DATA

The Handy 4-Gas can store up to 255 emission tests. Once stored, the data can be viewed on the display or downloaded to a printer.

7.1 Storing a 'Live' Test

While performing a test, data can be stored as follows:

Press to  access the STORE MENU

STORE MENU
MODE : STORE
TEST : 3
PRESS 'STORE' TO LOG

Mode: Select from the following:-

STORE - Allows data to be stored in memory.

VIEW / PRINT - Stored data can be viewed or printed.

DELETE - Clears all data in memory.

Location: Automatically allocates a location in the memory of the instrument for the next test. On the display shown above the next location will be 3.

To store a test, set **MODE** to **STORE** and press  The current readings will be stored in the analyser's memory.

NOTE: The analyser will stop logging once it has reached 255 readings and will return to the main display if the store key is pressed. Data can still be viewed and printed.

TIP : Make a note of the location number for your particular test as it may be useful when printing.

7.2 Viewing and Printing a 'Stored' Test

Press  to access the STORE MENU

STORE MENU
MODE : VIEW/ PRINT
TEST : 001 TO 010
PRESS 'ENTER' TO VIEW

Move the cursor to Location and press enter. The cursor will move to the first digit of the first number, use up arrow to select the correct digit and enter when correct. Repeat on the second digit until the location to view from is correct.

Press enter to move the cursor to the second number, select the last location to view using the same procedure.

To view the stored data press enter.

TEST	...	1
VEHICLE	T123 ABC	
DATE	...	02-07-02
TIME	...	12:31:35

Use the arrow keys to page through data as in MAIN DISPLAYS.

TEST	...	1
FUEL	PETROL	
CO % vol	00.00	
HC ppm vol h	0000	

TEST	...	1
02 % vol	...	20.90
C02 % vol	...	00.0
LAMBDA		0.000

Press enter to advance to the next test.

TEST	...	2
VEHICLE	P456 DEF	
DATE	...	02-07-02
TIME	...	13:31:10

Press store to go back to the previous test. Press menu to return to the MAIN MENU.

Note: Stored and displayed with the data are actual time and date of the test.

7.3 Deleting Data

To delete the data in stored memory press store to obtain the STORE MENU (as above) : -

STORE MENU
MODE : **D**DELETE
TEST : 3
PRESS 'ENTER' TO DELETE

Press enter to access delete data screen

ENTER to ERASE DATA
MENU to ESCAPE

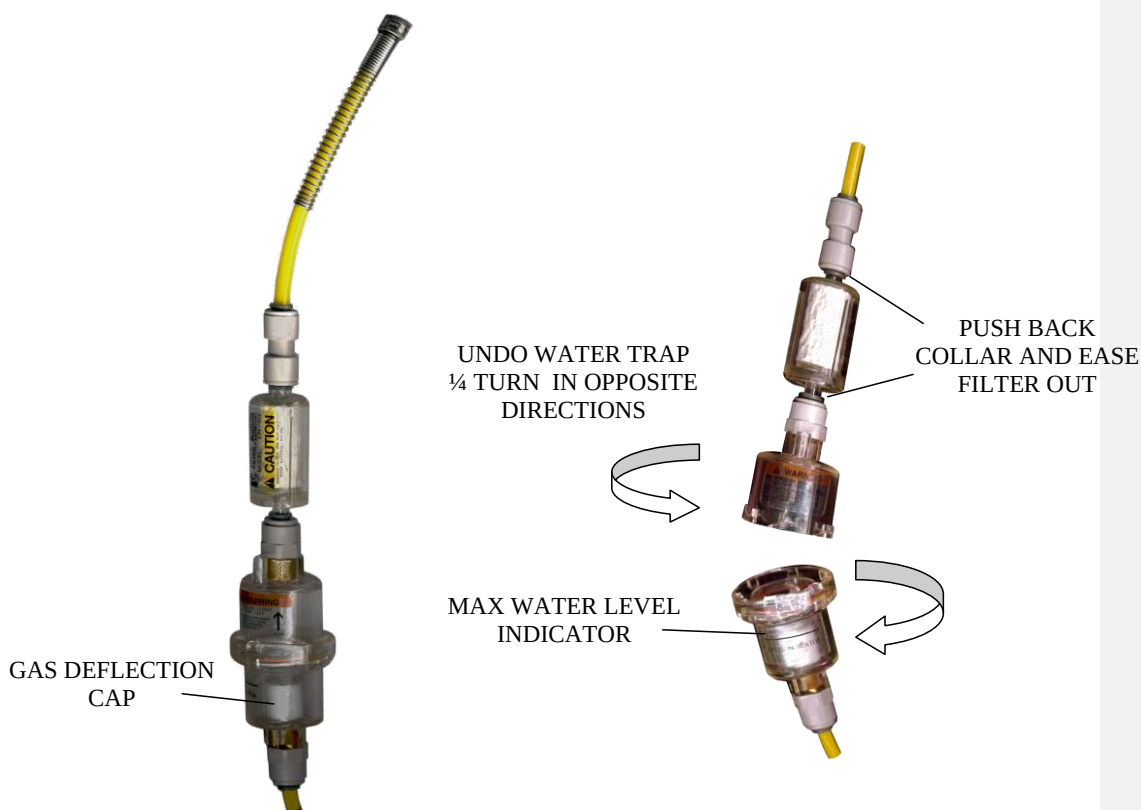
Press enter to delete data in memory, press menu to exit delete data.

8. MAINTENANCE AND FILTER SERVICING

A two stage filtration system is employed to remove moisture and carbon particles from the exhaust gases.

The system comprises a water trap and disposable gas filter.

NOTE: the water trap is not 'self emptying' and should be checked and emptied, if necessary, before each use. NEVER allow the water level to exceed the max water indicator on the water trap.



To empty the water trap, twist top and bottom sections in opposite directions 1/4 turn. Empty water, check condition of the rubber 'O' ring and reassemble. Ensure that the white gas deflection cap situated in the bottom of the trap does not become dislodged/lost.

The gas filter element should be replaced regularly and not be allowed to become heavily sooted. To remove, push back collar of push - in connector and pull filter out. Repeat for other end. Replace filter by simply pushing firmly into connector.

Important:

A considerable amount of water can accumulate in the sample pipe during normal use. NEVER roll up the pipe towards the analyser whilst still connected as this may result in flooding of the unit.

If a blockage occurs in the sampling system, the message 'LOW FLOW' will be displayed.
To determine the fault:

Replace the gas filter. If the problem persists, disconnect the sample hose and blow through with an airline. If this still does not cure the problem, check the sample probe and hose for blockages.

9. PROBLEM SOLVING

The following is a list of problems that may occur on the instrument during its operating life. If the cause of the fault is not easy to identify then we advise you contact Crypton Product Support or an International Distributor for expert advice.

Fault symptom	Causes
Oxygen too high	• Air leaking into probe, tubing, water trap, connectors or internal to instrument.
Oxygen Error (FAULT)	• Zero calibration fault. • Oxygen cell needs replacing
Infrared gas Error (FAULT)	• Instrument has been stored in a cold environment and is not at normal working temperature. • Infrared bench faulty.
Analyser not holding charge	• Battery exhausted.
Analyser not charging	• Charger not giving correct output. • Fuse blown in charger plug.
Analyser does not respond to exhaust gas	• Particle filter blocked. • Probe or tubing blocked. • Pump not working or damaged with contaminants.
Oil temperature readings erratic	• Temperature plug reversed in socket. • Faulty connection or break in cable or plug.
Analyser automatically switches off in operation	• Battery below alarm level. • Ambient temperature above 50°C. • Battery quickly discharging and is faulty.

INTERNAL FILTER

To protect the analyser from water ingress a filter is installed inside the casing to protect the infrared measuring system. This filter will block if care is not taken during sampling:

- **Do not allow water to build up in the water trap or sample pipe**
- **Change the particle filter regularly.**
- **Allow the analyser to sample fresh air on a regular basis.**
- **Allow the instrument to sample fresh air for 3 minutes before switch off.**
- **Do not blow smoke from a cigarette into the instrument.**

If you suspect the internal filter is blocked perform the following:

- Remove the probe connection from the water trap.
- Empty and clean the water trap with a dry cloth.
- Fit a new external particle filter.
- Run the instrument in fresh air (pump ON) for at least one hour.

If the problem does not clear contact a service agent.

10. ZERO CHECKS AND RE-CALIBRATION

During normal operation of the analyser the following checks may be requested:

- Zero setting of all sensors (can also be selected manually)
- Leak test
- Calibration check.
- Recalibration.

10.1 Zero setting

The zero setting function sets the working sensors to zero using fresh air. This function is activated as follows:

- Following analyser switch ON.
- On a timed basis if the analyser is exposed to exhaust gases for long periods.
- On request by the user from the **SELECT MENU**

The zero sequence is as follows, ensure the on screen commands are followed or the analyser may not zero correctly.

ZERO CHECK
REMOVE PROBE
FROM EXHAUST
THEN PRESS ENTER

Ensure the probe is removed from the vehicle exhaust and is sampling fresh air, in the garage environment this should be 500mm or 18 inches above the ground. Once this is done press enter to activate the pump.

WARNING: **The sensors will only be reset if the probe is sampling fresh air for at least 60 seconds.**

Once the zero is complete the screen will return to the **MAIN DISPLAY**.

10.2 Leak check

To ensure the gas sampling system is sealed correctly and not letting in air, the analyser will perform a leak check. This requires the user to block the probe inlet and perform the test. This check is done every time the analyser is switched on or every 24 hours. It is also advisable to perform a leak check if the water trap is removed and replaced i.e. for particle filter renewal.

The leak check procedure is as follows:

**LEAK CHECK
REMOVE EXHAUST PROBE
FIT PROBE SEAL
THEN PRESS ENTER**

CAUTION! When fitting the SEAL ensure the exhaust probe has been removed from the vehicle for some time and is cool.

When fitting the SEAL ensure the two inlet holes at the end of the probe are covered and are gas tight. If air leaks in at this point the test will fail.

Press enter when the seal is in place. The check will take a few seconds. Following a successful test the analyser will return to the **MAIN DISPLAY**.

**LEAK CHECK
PASSED
REMOVE PROBE SEAL
THEN PRESS ENTER**

If a leak is detected in the gas system the test will fail.

**LEAK CHECK
FAILED
CHECK PROBE & SEAL
THEN PRESS ENTER**

Check for the following:

- The seal is correctly positioned over the holes in the end of the probe.
- There are not apparent cracks in the probe or tube.
- The water trap housing is not cracked and the ends are in place.
- All O-rings on the probe connections are in good condition and in place.
- There is no physical damage to the analyser case.
- The water trap fitting on the analyser is in good condition.

Once the above has been checked press enter to perform the leak test again.

If the analyser continues to fail contact your service centre.

10.3 Gas Calibration Verification

Calibration of the Handy 4-Gas involves the use of precision calibration gases. If there is any doubt as to the accuracy of your instrument contact your local authorised service agent.

11. PRODUCT SPECIFICATION

Parameter	Resolution	Accuracy	Range
Carbon Monoxide	0.01%	±5 % of reading ±0.5 % volume	0-5 % Over range 20%
Oxygen	0.01%	±5 % of reading ±0.1 % volume	0-21 % Over range 25%
Hydrocarbon	1ppm	±5 % of reading ±12 ppm volume	0~2000 ppm Over-range 10,000 ppm
Carbon Dioxide	0.1%	±5 % of reading ±0.5 % volume	0-16 % Over-range: 20%
Oil Temperature	1.0°	±2.0°C ±0.3% of reading ±3.6°F ±0.3% of reading	0- 150 °C 32-302°F
RPM	1 rpm	50 rpm	200-4000 rpm.
Lambda	0.001	0.8-1.2	
AFR	00.01	11.76-17.64	
Sensor response T ₉₅		15 seconds	
Pre-programmed Fuels		Petrol, LPG and CNG.	
Dimensions			
Weight	1kg		
Handset	270mm (inc. Oxygen cell) x 62mm x 120mm		
Probe -Insertion depth	400mm		

Ambient Operating Range +5°C to +40°C
0% to 90% RH non condensing

Battery Charger Input: 230 Vac nominal
Output: 12 Vdc off load

Analyser battery run time >4 hours from full charge with the pump running

To obtain the quoted specification an instrument should be calibrated with clean ambient air (normally outside the workshop) at standard temperature and pressure (STP).

Note: The analyser is not for use with a Dynamometer (Refer to the manufacturer for advice)

APPENDICES

A - Main Display Parameters

The parameters and their meanings are detailed as follows

FUEL:	The selected fuel will be, displayed, i.e. PETROL. See Select menu section 5.2.2 to change. • PETROL - Leaded or Unleaded petrol/gasoline. • LPG - Liquid Petroleum Gas • CNG - Compressed Natural Gas
DATE:	Analyser date. See Set-Up menu section 5.2.5 to change.
TIME:	Analyser time. Use Set-Up menu section 5.2.5 to change.
BATTERY: (BAT)	Displays the battery level from 0- 100%. The analyser will flash RECHARGE BATTERY at less than 10 % of charge. Note! Allowing the battery to discharge fully may damage it.
O2:	Oxygen measured in the exhaust gas indicated in percentage %. With the pump off the analyser will display - - - -. If there is a fault with the oxygen sensor then FLT will be displayed.
CO:	Carbon monoxide measured in the exhaust gas indicated in percentage %. With the pump off the analyser will display - - - -. If there is a fault with the CO reading then FLT will be displayed.
CO2:	Carbon dioxide measured in the exhaust gas in percentage %. With the pump off the analyser will display - - - -. If there is a fault with the CO, reading then FLT will be displayed.
HC:	Hydrocarbons measured in the exhaust gas indicated in ppm (parts per million) n-hexane (petrol). With the pump off the analyser will display - - - -. If there is a fault with the HC reading then FLT will be displayed.
OIL:	Oil temperature as measured by the dip stick probe. Displays in either °C (deg C) or °F (deg F) and will display N/F if the probe is not connected.
RPM:	Revolutions per minute of the engine as detected by the induction pickup clamp. This probe is plugged into the two connectors on the bottom of the instrument case, ensure correct polarity. NOT FITTED (N/F) will be displayed if the probe is not connected.

- LAMBDA:** The value of Lambda gives an indication of the burning efficiency of the engine. This can be replaced with the Air Fuel Ratio (AFR) below. See section 5.2.3.to change between displays. Appendix B gives the formula used.
- When sampling fresh air and lambda is outside operation range this indication will show -----
- AFR:** Air Fuel Ratio is another method for displaying the efficiency of an engine. The calculation for the AFR is Lambda multiplied by 14.7. When sampling fresh air this indication will show -----
- LOW FLOW:** During sampling or at any time the pump is running the screen may display LOW FLOW.
- PUMP OFF:** Indicates the pump has been manually turned off using the  key.
- TIME TO ZERO:** The analyser requires to regularly zero the sensors. Once a zero has been performed the time to the next zero is displayed in minutes. Check there is sufficient time remaining before starting a test and perform a manual zero if not.

B. LAMBDA CALCULATION

The value for Lambda is a determinant for the burning efficiency of an engine. The value depends on the composition of the fuel, the air that is used for the combustion and on the combustion products as found in the exhaust gases.

A basic formula, taking into account:

- Components of the fuel: carbon, hydrogen, oxygen and water content;
- Water content of the air;
- Components of the exhaust gases: carbon dioxide, carbon monoxide, hydrocarbons and nitrogen oxide;

has been developed by J. Brettschneider and published in Bosh Technische Berichte, Volume 6 (1979), No. 4, page 177-186.

A simplified formula, derived from the basic formula, and based upon the assumption that the water content of the fuel and air and the NOx content in the exhaust gases are negligible, allows the computation of Lambda when certain components of the exhaust are measured.

B. 1 Oxygen balance formula

For Lambda calculation, based upon measurements of CO, CO₂, HC and O₂, the following formula is standardised: Displayed on the instrument as LAMBDA (0)

$$\lambda = \frac{[\text{CO}_2] + \frac{[\text{CO}]}{2} + [\text{O}_2] + \left(\frac{\text{H}_{\text{cv}}}{4} \times \frac{3.5}{3.5 + \frac{[\text{CO}]}{[\text{CO}_2]}} - \frac{\text{O}_{\text{cv}}}{2} \right) \times ([\text{CO}_2] + [\text{CO}])}{(1 + \text{H}_{\text{cv}} - \text{O}_{\text{cv}}) \times ([\text{CO}_2] + [\text{CO}] + (K_1 \times [\text{HC}]))}$$

Where:

CO = Carbon monoxide % volume measured.

CO₂ = Carbon dioxide % volume measured.

HC = Hydrocarbon ppm volume measured.

O₂ = Oxygen % volume measured.

K₁ = Conversion factor for HC is expressed in ppm vol n-hexane (C₆H₁₄) equivalent. Its value in this formula is 6 · 10⁻⁴

H_{cv} = Atomic ratio hydrogen to carbon in the fuel. Nominal value is 1.7261 Atomic ratio oxygen to carbon in the fuel. Nominal value is 0.0176

O_{cv} = Atomic ratio oxygen to carbon in the fuel. Nominal value is 0.0176.

TERMS AND CONDITIONS

Quotations given are open for acceptance within 14 days and are subject to revision should the state of the raw material market or other circumstances render this action necessary.

Orders, whether received as a result of a quotation or not, can only be accepted for execution at prices ruling at date of despatch.

Payment - except where otherwise stated in our invoice, or agreed in writing, our terms are nett cash and payment is due on presentation of invoice. Where we have agreed to open an account with the Purchaser invoices are due for payment by the 25th of the month following month of invoice and interest will be charged on overdue accounts at the prevailing County Court rate.

VALUE ADDED TAX

VAT is not included in our prices and will be shown separately on all invoices at the rate ruling at date of despatch and subject to current legislation.

CARRIAGE

Carriage is paid to destinations on the mainland of England, Scotland and Wales on all orders of £500 Nett or over, except accessories, spare parts and repairs. Where carriage is chargeable its cost is added to the invoice value at current rates.

PACKING AND UNLOADING

Damages or shortages must be signed for as such and claim made on the carriers, in writing, within three days of delivery. Where Company vehicles are used the driver must be notified at the time of unloading and the consignment note marked to indicate the damage or shortage. The practice of signing for the goods "not examined" does not absolve the Purchaser from this condition. The consignee is responsible for unloading. Packing cases and slings, when used, are charged extra but credited in full on return, carriage paid and in good condition.

LOSS IN TRANSIT

Public Transport Companies and the Post Office only accept claims for loss in transit made within a limited period. If goods are not received within 14 days of the date of our invoice, we must be advised immediately otherwise neither the carriers nor ourselves will be liable for any loss involved.

PASSING OF RISK

The risk in the goods shall remain in us until delivery to the Purchaser or his agent. In the absence of written notice from the Purchaser to us and the carriers, as prescribed above, the goods shall be deemed to have been delivered complete and in satisfactory condition.

PASSING OF PROPERTY

Until such time as all sums due to the Company from the Purchaser whether in respect of goods delivered by the Company to the Purchaser or otherwise have been paid the provisions of this Condition shall have effect:

- (a) All goods delivered by the Company to the Purchaser will remain the property of the Company to the intent that the whole legal and beneficial interest therein shall remain that of the Company.
- (b) If the Purchaser becomes or threatens to become insolvent or being a body corporate has a Receiver appointed or passes a resolution for winding up or if a Court makes an Order to that effect or being an individual or partnership makes any composition or arrangements with his or their creditors or has a receiving order made against him or them or if the Purchaser shall be in breach of these Conditions, then the Company shall be at liberty to forthwith remove and repossess all goods which remain the property of the Company in accordance with this Condition and enter upon any property to do so or to inspect goods to identify the Company's goods.
- (c) The Purchaser shall only be at liberty to resell the goods purchased from the Company prior to the passing of title on the understanding that if it does not resell the goods then it will hold on trust for the Company so much of the proceeds of sale received by it under contracts which include any of the goods hereby sold either in their original or altered state as are necessary to discharge payment in full to the Company.
- (d) No provision of this Condition shall be deemed to cause a Mortgage or Charge of the Property or undertaking of the Purchaser or any part thereof to have been created by the Purchaser in favour of the Company.

SEPARABILITY

Any failure by us in respect of one delivery shall not entitle the Purchaser to treat the contract as repudiated, each delivery being, for such purpose, deemed a separate contract.

INSTALLATION

The Purchaser is responsible for the preparation of the site, where such a site is necessary, together with the provision of any supplies and services that may be required. The specifications and the responsibilities of agents, distributors and end-users are clearly set forth in separate leaflets, available on the various products concerned.

If failure to fulfil this responsibility extends the time taken to commission equipment or results in extra visits by engineers the Purchaser is fully liable for the extra cost. If installation of equipment is unduly delayed, the Company reserves the right to pass on cost inflation as a supplementary charge.

REFUSAL

Goods consigned to the order of end-users and/or distributors render them liable for all carriage and handling charges incurred, if delivery of the goods is refused on arrival at destination.

RETURNED EQUIPMENT

In exceptional conditions, subject to agreement in writing, and the equipment being of current standard design, new equipment in good condition will be accepted, carriage paid to factory, subject to a handling charge. Any costs incurred in making the equipment as new will be charged in addition to the handling charge.

SPARES AND AFTER SALES SERVICE

Spare parts and service are available through our service agent. Initial contact should be made via the Crypton Product Support Helpline on 01278 436225. All spare parts purchases are subject to minimum order values.

RIGHT TO TERMINATE

If the Purchaser breaks any of these conditions or becomes insolvent or subject to any law relating to bankrupts or being a corporation goes into liquidation, whether voluntary or compulsory or has a receiver appointed over its assets, we may suspend deliveries or, by notice to the Purchaser, terminate the contract and such termination shall be without prejudice to any other rights or remedies to which we may be entitled.

All quotations and tenders are given and contracts are made by the Company subject to the above terms and conditions and unless previously agreed in writing by an authorised officer of the Company:

- (i) no verbal, written or other addition hereto or variation hereof including (without prejudice to the generality of the foregoing) any representation or warranty relating to the goods or services to be provided by the Company shall be effective; and
- (ii) these terms and conditions supersede any other terms and conditions appearing elsewhere and shall prevail over and exclude any course of dealing established between the Company and the Purchaser and any other terms and conditions stipulated or incorporated or referred to by the Purchaser or his agent or any third party; and
- (iii) it shall be a pre-condition of the Company giving any quotation or tender or entering into any agreement for the supply of any goods or services that such agreement be made subject to these terms and conditions.

CRYPTON

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