



lion alcolmeter[®] SD-400

User Handbook: General

Issue 5 [RM40977]



0086

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WEEE Directive

English

Do not throw away or dispose of in landfill site - return to local distributor or manufacturer

Francais

Ne pas jeter ou ne pas s'en débarrasser dans un site d'enfouissement de déchets – retourner au distributeur local ou au fabricant.

Italiano

Non disperdere nell'ambiente o gettare nei rifiuti urbani - ritornare al distributore locale o al fabbricante





Certificate of Compliance

Issued to: Lion Laboratories Ltd
Item: Hand Held Breathalyser
Type Reference: Model No.: SD-400

This is to certify that one sample of the equipment defined above has been tested by ERA Technology Limited as follows:

Electromagnetic Compatibility:


EN 50081-1 : 1992 and EN 50082-1 : 1997

Full details are given in ERA Report No. 4324/275/1

Certificate prepared by:


.....
J Davies

Certificate approved by:


.....
B Lofthouse
Manager
Blackwood EMC Facility

Certificate No. 4324-99-275-COPY

This Certificate is dated 3 March 1999

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PLEASE!

Read this Handbook carefully, ***BEFORE*** using the instrument for the first time.

1: Introduction

The **lion alcolmeter® SD-400** is a hand-held, breath alcohol analyser for use in traffic law enforcement, medical and industrial safety applications. The instrument is easy-to-use, and allows a complete breath test to be completed in about one minute.

The standard instrument version has a 500-test memory. This records the date, time and result of each test, from where it can be downloaded to a PC using software available from Lion.

This handbook is written for the **lion alcolmeter® SD-400** as it is most commonly used. However, because many of its operating functions are configurable, it is not possible to cover all the permutations of method operation in this handbook. Information on the use of these additional features is available from Lion.

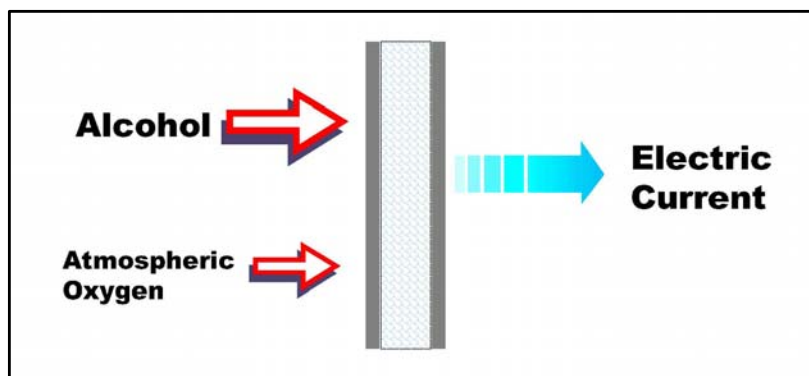
This handbook explains the following aspects of the instrument, so please read it carefully:

- basic principles of operation
- how to run a breath test
- interpretation of results
- calibration checking
- calibration adjustment
- care and basic maintenance

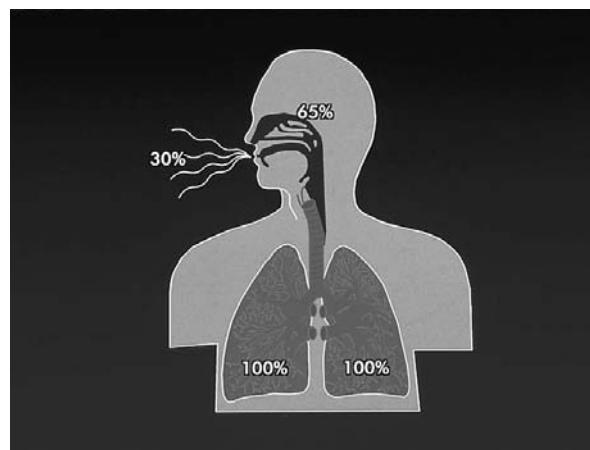
2: Principle of Operation

The lion alcolmeter® SD-400 uses an electrochemical fuel cell sensor to measure the concentration of alcohol vapour in the subject's expired breath; a measured amount of which is drawn from the mouthpiece into the fuel cell by means of the sampling system.

In the fuel cell a voltage is generated in proportion to the breath alcohol concentration: it is therefore amplified and displayed in terms of the subject's alcohol level.



The breath sampling system is factory-set to sample deep-lung air; it is the breath from the bottom of the lungs that truly reflects the amount of alcohol in the body.



3. Instrument Features



Please note the following user features of the instrument:

1	On/Off Switch	6	Spigot Mouthpiece
2	Indicator Lights	7	Function Switches
3	Display	8	Communications Port
4	Beeper	9	Power supply Unit
5	Sampling Port	10	Dongle Electronic key



On/Off Switch (I-0)

Press once to switch on, press again to switch off. Use of the **On/Off** switch is inhibited to prevent switch-off during a breath test.

Indicator Lights

- **WAIT** the system is not ready to sample; probably because the sensor is not clear of alcohol from the last test.
- **READY** the instrument is ready to sample.
- **FLOW** the subject is blowing hard enough.
- **ANALYSING** a sample has been taken: its alcohol content is being measured.

Digital Display

Shows the subject's alcohol level, time and date, the battery condition, and error messages. It is illuminated for use at night.

Beeper

Gives audible messages of certain events and conditions.

Sampling Port

The entrance to the fuel cell and breath flow sensor. This port must **NOT** become blocked or restricted.



Spigot Mouthpiece

A new mouthpiece is fitted to the sampling port for each breath test. This disposable item is individually and hygienically wrapped.



A NEW mouthpiece MUST be used for each complete breath test: but NOT essentially for repeated blows by a subject in the same test

The Four Function Switches

These have various uses, as stated in this handbook. From the left, they are referred to as **B**, **C**, and **D** (the **On/Off** switch is **A**).

Communications Port

This allows access to certain software routines (such as calibration adjustment), when the **Dongle** key is fitted. If the instrument is used with a printer, the printer cable is connected here. This port is also used for transferring stored breath test data to a PC.

Power Supply

This is located on the back of the instrument and fitted with either 5 disposable alkaline batteries (AA) - the **PSU**; or the rechargeable power unit the **RPU**. To remove from the main case, press and hold down the release button on the main case, then pull down.

Dongle Electronic Key

A security key which is fitted to the communications port so as to access certain software routines, such as for instrument calibration adjustment.



4. Subject Breath Test

4.1 The Breath Test Procedure: Step-by-Step

Preliminary Questions

Ensure the subject has taken **nothing** by mouth for at least 15 minutes, and not smoked for at least 2 minutes. **If necessary, wait.**

Mouth alcohol generally disperses within 10 or 12 minutes, so a 15-minute wait ensures its complete dispersal. Remember though that many foods and even some 'non-alcoholic' drinks actually contain traces of alcohol. Also, a glass of cold water will cool the mouth and dilute saliva, and so temporarily **reduce** the breath alcohol level.

Switch On Instrument

Press and release the **On/Off** switch (1-0).

Diagnostics Test

The four indicator lights and the display bar segments are tested. The sampling system is activated and the **WAIT** light comes on. The time and date are then shown [any inaccuracy here has no effect on the alcohol measurement]. The **WAIT** light stays on while the fuel cell is checked to ensure there is no alcohol from a previous test.

READY – Attach Mouthpiece

When the **READY** light shows, unwrap a mouthpiece (don't touch the lipped end that



the subject will put in his/her mouth), and attach it to the sampling port: either way round.

Instruct the Subject

Tell the subject to take in a deep breath, hold it, then place the lipped end of the mouthpiece in their mouth and seal their lips around it. They must then blow **STEADILY** [*not hard*] and **CONTINUOUSLY** until you say stop, and keep their hands away from the instrument.

Take the Breath Sample

The subject now blows. If he or she blows **hard** enough the **FLOW** light comes on and there is a continuous tone; the subject must then **continue** to blowing until the **ANALYSING** light appears and a double beep is heard. This means that the breath sample has been taken into the sensor for analysis, so the subject can now stop blowing.



Note the Alcohol Reading

Wait for the **ANALYSING** light to go off, then note the subject's reading. If **no** alcohol was present this will appear very quickly; but if alcohol **was** present it may take up to 30 seconds for the final reading to be obtained. This will then be displayed for a pre-set time.



Discard Mouthpiece

Remove and discard the mouthpiece in a hygienic manner.

A NEW mouthpiece MUST be used for each complete breath test: but NOT essentially for repeated blows by a subject in the same test

Wait or

Wait for the **READY** light to come back on [which shows that the instrument is now clear of any alcohol from the last sample] before proceeding to test either the same or a different subject. The time taken for this to occur will depend on how much alcohol was present.

or Switch Off

Switch off manually, or let it to do so automatically after a preset time.

4.2 Invalid Breath Samples

If the subject sucks back, blows too gently, or does not blow for long enough, the **ANALYSING** light will not come on, so no sample will be taken for analysis. Depending on the situation, you may allow a further try, perhaps after re-instruction. ***There is no need to change the mouthpiece for repeated blows for the same sample.***

4.3 The E2 Message

If **E2** is displayed after the **ANALYSING** light comes on, the breath alcohol level of alcohol in the breath sample was too high for accurate measurement. This ***could*** be a genuine result, but more

likely it means *mouth alcohol* was present. The instrument will now take some time to clear before the **READY** light comes back on.

4.4 Manual Breath Sampling

The standard factory setting is that a breath sample can also be taken manually. To do this, press **C** *while the subject is still blowing, but just before they run out of breath - so that deep-lung air is still taken for analysis.*

4.5 Automatic Switch Off

If the **SD-400** is left switched on but not used, after a pre-set time it will switch itself off automatically. Before doing so it emits a series of high-pitched beeps. To cancel auto-power down at this time, press and hold down the **On/Off (1-0)** switch until two beeps are heard.

4.6 Last Test Recall / Memory Capacity

When the **READY** light is on, press and release **D**. The display shows the remaining memory capacity, then the **Test Number** and the result of the last breath test, with its date and time. (See also '**Using the SD-400 with a Printer**').

As standard, the **SD-400** is supplied with 500-test memory, set to **Shunt** [when the memory is full, the newest test is saved and the oldest deleted].

5. Using the SD-400 with a Printer

The **SD-400** can also be used with a small, portable thermal printer (**Able Ap863**), to generate a permanent record of each breath test. This printout shows the instrument serial number, the dates of its last calibration and check; and the breath test result, with date, time.

The printer is powered by its own rechargeable battery; mains and 12v chargers are available.

When the printer is first received, its battery will be completely discharged. This means that the printer will not operate, even if it is connected to an external power source, until the battery has been fully charged. See the label on the printer battery pack for initial charging time.

Each printer is supplied with the manufacturer's User Guide.

Before carrying out a breath test, ensure that the printer cable is securely connected to the communications port on the **SD-400**. You do not need to switch the printer on: this is done automatically by the instrument itself at the appropriate time.

Follow the **Subject Breath Test** instructions as in Section 4.1. When the **ANALYSING** indicator light on the instrument goes off, the printer will switch on and generate a printout.

Last Test Recall [Reprint]

See page 13. Activating **Last Test Recall** also generates a further printout of the last test.

Automatic Test Numbering

Every time a breath test is carried out, a four-digit sequential number is printed automatically on the test record. This number is set to **0000** before dispatch of the instrument from Lion, and can then only be reset by Lion or a local Lion distributor.

6. Instrument Power Supply Systems

Low Power Warnings

The **SD-400** instrument uses two-stage low power warning system:

**a. *First Stage - Flashing WAIT Light
Plus Triple, Low Pitched Beep***

Power is low, but the instrument can still be used – with no effect on breath sampling or analytical accuracy.

Disposable batteries should be changed as soon as possible once this warning appears: rechargeable battery packs should be charged.

**b. *Second Stage - Four Flashing Bars (- - - -)
Plus Two Long, Low Pitched Beeps***

Battery power is too low for instrument operation, so further use of it is automatically inhibited.

AA Power Supply Unit [PSU]

To replace the batteries, ensure the instrument is switched off, then press the release catch on its back and slide down the battery pack to remove it. Remove all five batteries and replace with five new alkaline ones, ensuring correct polarity. Now slide the power supply unit into place, ensuring the release catch clicks positively to lock.

Use Only Alkaline AA Batteries

Rechargeable Power Unit

A rechargeable power unit (**RPU**) is also available. A fully-charged **RPU** should contain enough power for at least 1,200 breath tests, in continuous operation. Mains and 12volt DC chargers are available. When first received, the **RPU** will be fully discharged.

To fit the **RPU**, ensure the instrument is switched off, then press the release catch on the back of the unit and remove the existing power unit. Now fit the **RPU**, ensuring the release catch clicks positively into place. Connect the **RPU** to the appropriate charger and leave for about one hour to charge up fully, when the red LED goes out.

IMPORTANT - PLEASE NOTE:

- Switch the instrument off before removing and refitting either the **PSU** [disposable batteries], or the **RPU**.
- Don't attempt to recharge the AA cells.
- Don't switch the instrument on while the **RPU** is charging.
- Don't attempt to recharge the **RPU** when it is already fully charged.
- Don't leave the instrument with a flat power pack attached. This shortens the life of the internal lithium battery which powers the memory and clock circuits.
- Don't carry either the **PSU** or the **RPU** in your pocket. If the contacts were to short-circuit on a key or coin, serious burns to your body could result.

7. Clock and Calendar

The alcohol reading from each breath test is stored in memory, with time and date. To check the accuracy of the time and date function, switch the instrument on and when the **READY** light is on, press and release **B**. The time (hh:mm) then the date (dd:mm) are displayed.

To **re-set** the time and date, the **Dongle** security key is needed.

Follow the procedure set out below:

1. Fit the **Dongle** key into the communications port; switch on and, before the diagnostics sequence is complete, press and hold down **B**. The system is now in **Manual Time and Date Set** mode: release **B**.
2. The date and time can now be set against the symbols on the display. In each case, use **B** or **D** to adjust this value, then **C** to enter and move to the next.
3. When all five periods have been set, the **SD-400** displays the new time and date; then it switches itself off.



IMPORTANT NOTE:

Any inaccuracy in the time or date settings has no effect on breath sampling or the accuracy of alcohol measurement.

8. Some DO's and DON'T's

Some Important DO's ...

- DO.. press the **On/Off** Switch *gently*.
- DO.. keep the instrument in its leather pouch, whenever possible.
- DO.. store the instrument either with batteries installed or a power pack attached, to avoid discharging the internal battery.
- DO.. change the batteries as soon as possible once the first stage warning appears.
- DO.. switch the instrument off before removing the battery pack.
- DO.. use only genuine Lion mouthpieces and/or sampling cups, or as produced by a Lion approved supplier.
- DO.. use a clean Lion mouthpiece for each subject test.
- DO.. ensure the mouthpiece is properly attached and locked in place between the **400's** two upright mouthpiece locators.
- DO.. ensure the subject blows through the wide-bore, lipped end of the mouthpiece.
- DO.. as far as you can, ensure the unit is regularly checked.
- DO.. read this manual carefully, and follow the instructions given!
- DO.. report memory or error (**E**) messages to your **Supervisor**.
- DO.. keep the communications port fitted with its cover.
- DO.. use only alkaline batteries in the **PSU**.

And Some Important DON'T's ...

- DON'T.. test the subject if he may have been drinking or eating in the last 20 minutes or smoking in the last 2 minutes.
- DON'T.. permit the subject to hyperventilate immediately prior to supplying his or her breath sample.
- DON'T.. store the unit in extremes of hot or cold temperatures.
- DON'T.. leave the instrument for long periods with no batteries or a power pack attached to it. This will discharge the internal battery to the memory and clock circuits.
- DON'T.. subject the instrument to unnecessary shock.
- DON'T.. use excessive force on the **On/Off** switch.
- DON'T.. clean the case with chemical or abrasive products. These could cause permanent damage.
- DON'T.. allow the sampling port to get blocked. If you think it may be blocked or restricted in some way then hand the instrument to a **Supervisor** for checking.
- DON'T.. use other than the Lion mouthpieces. These have been carefully designed and are specifically manufactured for use with this instrument.
- DON'T.. block the mouthpiece end while the subject is blowing. This may harm the instrument.
- DON'T.. reuse mouthpieces, for reasons of health and accuracy.
- DON'T.. open the instrument or attempt any repairs. If you think it is not working properly, hand it in for checking.
- DON'T.. deviate from the instructions given in this handbook.

9. Calibration Checks and Adjustment

9A. *Background*

The sensitivity of fuel cell to alcohol vapour changes slowly with time. Therefore, to ensure continued optimum instrument operation, it is necessary to **CHECK** its accuracy at regular intervals, and to carry out an appropriate **ADJUSTMENT** when necessary.

It is for the user organisation to decide how often the accuracy is checked, but it is *recommended* that a **Calibration CHECK** is carried out at least once per month. **Calibration ADJUSTMENT** is only required when the reading obtained from the calibration check is unacceptable to the organisation; for example greater than 5% or 10% away from the value of the standard so used.

But of course, a calibration check can also be carried whenever it is necessary to verify the accuracy of a breath test reading.

9B. *AlcoCal® Alcohol Standards*

The calibration check and adjustment processes are most conveniently carried out using and **AlcoCal®** alcohol vapour standards. This is a mixture of alcohol vapour in air at a known concentration, contained in a pressurised cylinder.

Provided it is within certain limits, the actual value of the standard is not critical, but it must of course be known.

NOTE: a wet bath simulator may also be used for either process: please contact Lion for relevant information, if required.

Two types of **AlcoCal[®]** standard are available:

- **AlcoCal[®]-M:** this *disposable* cylinder has a six-months shelf life and contains sufficient vapour for approximately 50 samples. The alcohol concentration value is stated to within +/- 10% of the true value.
- **AlcoCal[®]-2AL:** a high-pressure *disposable* cylinder fitted with a *re-useable* regulator. It contains sufficient vapour for approximately 300 samples, and is supplied with Connector Tubes for attachment to a mouthpiece as used with the **SD-400**. The stated alcohol concentration is within +/- 3%, and is valid for approximately thirty-four months.

Units of Alcohol Measurement

The alcohol level in **AlcoCal[®]** standards is normally given in units of **mg/l BrAC** (ie milligrams per litre **B**reath **A**lcohol **C**oncentration). But if the **lion alcolmeter SD-400[®]** is reading in some other unit of measurement, the **AlcoCal[®]** standard will still be suitable for use, since each such standard is supplied with an Explanatory Booklet giving information on how to convert the mg/l BrAC value of the **AlcoCal[®]** to the units actually used by the instrument.

AlcoCal® Standards and Atmospheric Pressure Effects

The level of alcohol in a subject’s breath is completely unaffected by changes in atmospheric pressure; ***the information below applies only to the alcohol concentration in the AlcoCal® standard.***

The stated alcohol value of each **AlcoCal®** standard applies only when the cylinder is used at sea level at normal atmospheric pressure (1 bar). At ***lower*** atmospheric pressures the alcohol vapour concentration will be ***lower***, but it will be ***higher*** at atmospheric pressures ***greater than*** standard. This change in alcohol concentration due to normal atmospheric pressure changes at sea level is generally so small as to be negligible, but if the **AlcoCal®** is used at high altitude, significant error would be produced if a correction was not made. Finally, if the atmospheric pressure even at sea level is very low [such as during a tropical storm], or is very high, then must also be taken into account when using an **AlcoCal®**.

Barometric Pressure Correction Look-up Table for AlcoCal®

Atmospheric Pressure mB	AlcoCal® Value mg/l BrAC
650	0.22
700	0.24
750	0.26
800	0.28
850	0.29
900	0.31
950	0.33
1000	0.34
1010	0.35
1050	0.36

Example

A 0.35mg/l **AlcoCal**[®] is to be used where the atmospheric pressure is only 950mB. Standard atmospheric pressure at sea-level is 1,013mB, so the BrAC value of the standard now becomes:

$$\frac{950 \times 0.35}{1,013} = 0.32\text{mg/l BrAC} \quad (\text{rounded down})$$

But If the atmospheric pressure was *higher* than standard, say 1050mB, then the value of the same **AlcoCal**[®] would be:

$$\frac{1,050 \times 0.35}{1,013} = 0.36\text{mg/l BrAC} \quad (\text{rounded down})$$

AlcoCal[®] Standards and Atmospheric Temperature Effects

Large ambient temperature changes will also modify the alcohol level in the vapour leaving an **AlcoCal**[®] standard. They should therefore be kept away from excess heat and cold, and if they are exposed to such conditions, temperatures, should be allowed to recover. Ideally, an **AlcoCal**[®] standard should not be used if it is outside the temperature range 15 – 30°C.

9C. Calibration CHECKING

This procedure must be carried out when both the **AlcoCal**[®] and the **SD-400** are at room temperature in the range 15 – 30°C:

1. Prepare the AlcoCal[®] Standard

Note the value of the **AlcoCal**[®] to be used (making allowance for atmospheric pressure and units of

measurement, as previously described). Now fit the Dispensing Top to the **AlcoCal®-M**, or the Connector Tube to the regulator of the **AlcoCal®-2AL**. If the **AlcoCal®-2AL** has not been used within the previous two hours, press and hold down the push-button for about five seconds to flush out of the regulator of any stale and depleted alcohol vapour.

2. Prepare the SD-400 Instrument

First, ensure this has not been used at all in the last hour.

Now put it into its **Calibration Check Mode**. This ensures the **SD-400** is in its correct temperature range; sets up the digital display for use in this function; and stores the check readings in a separate memory to that used for subject tests.

Switch the instrument on and then **IMMEDIATELY** press and hold down **C**. This **MUST** be done **BEFORE** the diagnostics sequence is complete. When a continuous tone is heard, release **C** and wait for the **READY** light to flash [the display shows the software version (eg 3.9)]. When the **READY** light flashes, press and release **B**. The display shows **CHC**, meaning the **SD-400** is now in **Calibration Check Mode**.

3. Take Sample

When the **READY** light comes on, fit a new spigot mouthpiece to the **SD-400**, then push this over the Dispensing Top on the **AlcoCal®-M** or the Connector Tube on the **AlcoCal®-2AL** to form an airtight fit. Push down the Dispensing Top (**AlcoCal®-M**) or push-button (**AlcoCal®-**

2AL) and *allow vapour to flow for at least six seconds.* After about **five** seconds, *but with vapour still flowing*, press and release **C** to take a sample of the vapour into the **SD-400**. Now release the cylinder control to stop gas flow.

4. Note Reading

The reading given should normally be within plus or minus 0.03mg/l BrAC of the value of the **AlcoCal**® alcohol standard, at the 0.35mg/l level. In other words, for a 0.35mg/l standard, the reading should be in the range 0.32 – 0.38mg/l. Using an **AlcoCal**® at 0.22mg/l the acceptable range is proportionately lower, at 0.20 – 0.24mg/l. However, it is emphasised that these stated ranges are for **guidance only**: what constitutes an ‘acceptable’ reading during the check procedure must ultimately be a decision of the user authority, and the method and purpose of use of the instrument itself.

If the reading was outside the acceptable range, wait for the **READY** light to come on, then repeat the **Calibration Check** procedure. If the reading is still outside the acceptable range, the instrument requires **Calibration Adjustment**.

9D. Calibration ADJUSTMENT

First, you will also need a **Dongle** electronic key to put the **SD-400** into **Calibration Adjustment Mode**.

This procedure must be carried out when both the **AlcoCal®** and the **SD-400** are at room temperature in the range 15 – 30°C:

1. Prepare the AlcoCal® standard

Note the value of the **AlcoCal®** to be used (making allowance for atmospheric pressure and units of measurement, as previously described). Now fit the Dispensing Top to the **AlcoCal®-M**, or the Connector Tube to the regulator of the **AlcoCal®-2AL**. If the **AlcoCal®-2AL** has not been used within the previous two hours, press and hold down the push-button for about five seconds to flush out of the regulator of any stale and depleted alcohol vapour.

2. Prepare the SD-400 Instrument

First, ensure this has not been used at all in the last hour.

Now put it into its **Calibration Adjustment Mode**. This ensures the **SD-400** is in its correct temperature range; allows an actual resetting of the instrument's analytical function to be made; and ensures the event is not stored in the subject test memory. So insert the **Dongle** into the **Communications Port** on the side of the instrument.

Now switch the instrument on and then **IMMEDIATELY** press and hold down **C**. This **MUST** be done **BEFORE** the diagnostics sequence is complete. When a continuous tone is heard, release **C** and wait for the **READY** light to flash [the display now shows the software version (eg 3.9)]. When the **READY** light flashes, press and release **D**. The display now

shows **CAL**, meaning that the instrument is now in its **Calibration Adjustment Mode**.

3. Enter the Standard Value

You must now tell the **SD-400** the value of the alcohol standard that you are going to use to calibrate it: the instrument will then automatically adjust itself to that value, when you sample the vapour.

The word **CAL** disappears from the display and is replaced by a value, such as 0.35. If this is *not* the value of the **AlcoCal®** to be used, press **B** or **D** to adjust it so that it is: then press **C** to enter, and move on. The beeper sounds and the reading flashes five times to confirm that this is the standard value to be used for calibration.

4. Take Sample

When the **READY** light comes on, fit a new mouthpiece to the **SD-400**, then push this over the Dispensing Top on the **AlcoCal®-M** or the Connector Tube on the **AlcoCal®-2AL** to form an airtight fit. Push down the Dispensing Top (**AlcoCal®-M**) or push-button (**AlcoCal®-2AL**) and *allow vapour to flow for at least six seconds*. After about *five seconds, but with vapour still flowing*, press and release **C**: this takes a sample of the vapour into the **SD-400**. Now release the cylinder control to stop gas flow.

5. Automatic Calibration

The instrument now calibrates itself automatically, then switches itself off. You may now remove the **Dongle** key.

6. Confirmation Calibration Check

It is advisable now to carry out a **Calibration Check** to ensure that the calibration was completed properly. You may use the same or a different alcohol standard for this, as you wish. There is no need to allow any delay: simply switch on again and enter **Calibration Check Mode**, then wait for the **READY** light to come on before proceeding as before.

Calibration Error Messages

If the message **E3** is shown during this calibration, it means the fuel cell signal was too low for a proper automatic adjustment to be made. This is most likely due to:

- incorrect sampling: repeat the entire process if you think this might be the reason
- insensitive fuel cell: refer to service support
- faulty sampling system: refer to service support

Appendix 1: Warning & Error Messages

A1.1 Warning Messages

Flashing WAIT Light

This is the first-stage low battery power warning: you may still use the instrument, but batteries should be changed or recharged as soon as possible when this first appears.

Four Bars on the Display

This is the second-stage low power warning: use is inhibited until the batteries have been replaced or recharged.

Low Memory Countdown

When the remaining memory is within a preset number of tests of being full, the remaining test number capacity is shown on switch-on, plus three, long-and-short beeps.

A1.2 The E X Error Messages

The following messages will be shown on the digital display in the event of a component or system failure. If any of these messages appears, the instrument is automatically inhibited from further use.

E0	Communications error when PC connected.
E1	Loss of fuel cell calibration data from memory.
E2	The breath alcohol level, as measured, was too high for analysis [probably mouth alcohol].
E3	The fuel cell sensitivity is too low for calibration.
E4	The breath flow sensor output is too low for calibration.
E5	There is a fault with the breath sampling system.
E6	The instrument is either too hot [over +50°C] or too cold [below -10°C] for use in breath testing.
E7	Temperature too low for calibration checking or adjustment.

Appendix 2: Technical Details

A2.1 General

- **Name:**

- lion alcolmeter® SD-400 [version 3.4 or later].

- **Designation:**

- portable, hand-held breath alcohol measuring instrument.

- **Automation:**

- fully automatic, microcontroller-based operation. All operating parameters such as breath flow rates, discard volume and alcohol measuring units are pre-set using dedicated PC based software.

A2.2 Analytical

- **Sensor:**

- electrochemical fuel cell develops a voltage in response to alcohol.

- **Specificity:**

- unaffected by acetone, paint and glue fumes, foods, confectionary, methane and all other likely breath contaminants.

- **Response Time:**

- within 30 seconds at 20°C; 10 seconds at very low alcohol levels.

- **Recovery Time:**

- less than 10 seconds at zero alcohol; about 60 seconds at 0.35mg/l BrAC. Typically, 4 minutes at the top of the measuring range [or faster, depending on firmware version].

(Note: at low alcohol levels the software configured **Display Reset Time** may reduce the maximum possible breath sampling rate.)

- **Calibration Period:**

- recommended monthly **Calibration Check**, but actual **Adjustment** should not be required more than once every six months.

- **Long Term Drift:**

- less than 0.02mg/l BrAC (ie .005% BAC) per month.

- **Operating Temperature Range [Breath Analysis]:**

- -5 to +40°C, for optimum operation.

A2.3 Breath Sampling

- **Automation:**

- once the subject has complied with the minimum breath sampling requirements, a fixed volume sample of breath is drawn from the mouthpiece and passed directly into the fuel cell for analysis.

- **Breath Pressure Sensor:**

- high impedance, low power, silicon wafer diaphragm differential device, with in-built temperature compensation.

- **Minimum Breath Flow Rate:**

- normally set at 25 litres per minute, but variable in the range 20 to 50 litres per minute.

- **Minimum Breath Pressure:**

- 7.0hPa (at a flow rate of 25 litres per minute).

- **Minimum Breath Discard Volume:**

- normally set to 1.5 litres.

A2.4 Electronics and Microcontroller

- **Breath Test Data Memory:**

- 500 subject breath tests.

- **Internal Battery Backup:**

- internal lithium battery protects configuration and calibration.

- **Communications Port:**

- 2 channel, serial interface, for full RS232 data transfer to download stored data to a PC or Apple-Mac; or to a serial dot matrix printer.

- **Breath Flow Measurement:**

- precise flow measuring device and timer for determination of expired breath volume ensure automatic deep lung breath sampling.

- **Digital Display:**

- four digit, illuminated LCD.

- **Visual Indicators:**

- four coloured LED's show the current status:

WAIT, READY, FLOW or ANALYSING.

- **Audible Indicator:**

- beeper indicates such events as reversed breath flow (subject suck-back), a change of indicator light status, or a fault condition.

A2.5 Electrical

- **Power Supply Options:**

- a) 5 x 1.5v size `AA' alkaline cells.
- b) a sealed 6.0v Ni-Cad rechargeable battery pack.

- **Battery Capacity:**

- alkaline AA cells, at least 3000 tests and Rechargeable Power Unit typically 1500 tests per charge [depending on conditions of use]. Visual and audible warnings of imminent and actual battery failure.
-

A2.6 Physical

- **Dimensions:**

- 169 x 80 x 39mm

- **Weights:**

- 517g (in pouch, Alkaline batteries); 527g (in pouch, RPU fitted)

- **Shock and Vibration:**

- case construction is from impact resistant, modified ABS. Instrument complies with IEC 68-2-27 Part 2.1 Test EA and IEC 68-2-6 Part 2.1 Test FC (in or out of pouch).

Appendix 3: Alcohol Concentration Units

This is relevant in the instrument checking and calibration functions.

Like any other breath instrument, though it may be read in blood alcohol units, the **lion alcolmeter® SD-400** measures the concentration of alcohol in the expired *breath*. Having made this analysis it is then possible to report the result in *breath alcohol concentration units* (BrAC).

However, it is also possible to report the reading in terms of an equivalent *blood alcohol level* (BAC or BAL). To do this it is necessary to make use of an assumed *blood:breath ratio* [the actual value of this is close to 2,300:1, although this continues to be, the subject of much scientific (and often misinformed) discussion].

A3.1 Breath Alcohol (BrAC) Units

BrAC Units:	Written As:
milligrams per litre	mg/l or mg/L
micrograms per hundred millilitres	µg/100ml or µg/% or µg/dl
micrograms per litre	µg/l or µg/L
grams per two hundred and ten litres	g/210L

A3.2 Blood Alcohol (BAC) Units

BAC Units:	Written As:
milligrams per hundred millilitres	mg/100ml or mg/% or mg/dl
percent blood alcohol	%BAC or %BAL
promille [weight/volume]	g/l or ‰ w/v
promille [weight/weight]*	g/Kg or ‰ w/w

A3.3 Blood:Breath Ratios

The true *in-vivo* ratio is close to 2,300:1, as it relates to *pulmonary arterial* blood. The use of values lower than this will cause the breath analysis to under-read the blood alcohol level. This is sometimes adopted to as to give an allowance to the subject.

A3.4 Units and Ratio Conversion

The following measurements all represent the same absolute concentration of alcohol in an individual's body at some point in time:

Breath alcohol levels as measured absolutely:

0.35mg/l 35 g/100ml 350 g/l

These convert to the following blood alcohol concentrations (all figures are rounded down):

Ratio: 2 000:1			
70mg/100ml	.070%BAC	0.70‰ (w/v)	0.66‰ (w/w)
Ratio: 2 100:1			
73mg/100ml	.073%BAC	0.73‰ (w/v)	0.68‰ (w/w)
Ratio: 2 300:1			
80mg/100ml	.080%BAC	0.80‰ (w/v)	0.75‰ (w/w)

Note: the specific gravity of whole blood is about 1.06.

Appendix 4: Lion Contact Information

Mail

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