

Bios International Corporation

10 Park Place

Butler, New Jersey, USA 07405

Phone (973) 492 8400

Toll Free (800) 663 4977

Fax (973) 492 8270

Email sales@drycal.com

Web www.drycal.com

DryCal® DC-Lite Manual



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MK01-1 Rev. D

DryCal® DC-Lite Specifications

Size 5.25" H x 5" W x 2.75" D • 133 mm H x 127 mm W x 70 mm D

Weight 42 oz • 1200 g

Flow Ranges | Air Flow Accuracy Specifications based on averaged readings. Lower limit is based on self-tested maximum leakage.

Model	Optimum Flow Range ($\pm 1\%$)	Extended Flow Range
L	10 ml/min–500 ml/min	1 ml/min–500 ml/min
ML	50 ml/min–2 L/min	5 ml/min–5 L/min
M	100 ml/min–7 L/min	10 ml/min–12 L/min
MH	200 ml/min–20 L/min	20 ml/min–20 L/min
H	500 ml/min–30 L/min	50 ml/min–30 L/min

Contact Bios for extended flow range specifications, or visit our website at www.drycal.com/products/dclite_models.htm

Battery System 6V rechargeable, sealed lead-acid, 6-8 hours typical operation

AC Battery Charger | Power Adapter Wall-mounted, single-station charge, input: 100–120 VAC, 60 Hz., output: 12 VDC. Optional input: 200–240 VAC, 50 Hz., output 12 VDC.

Operating Modes Single reading, 10 readings, or auto-mode.

Temperature Range 0–55 °C

Humidity Range 0–70% non-condensing

Printer Port Standard parallel (IBM Centronics, for printing to Bios' battery-powered printer)

Warranty Product, 1 year; battery, 6 months

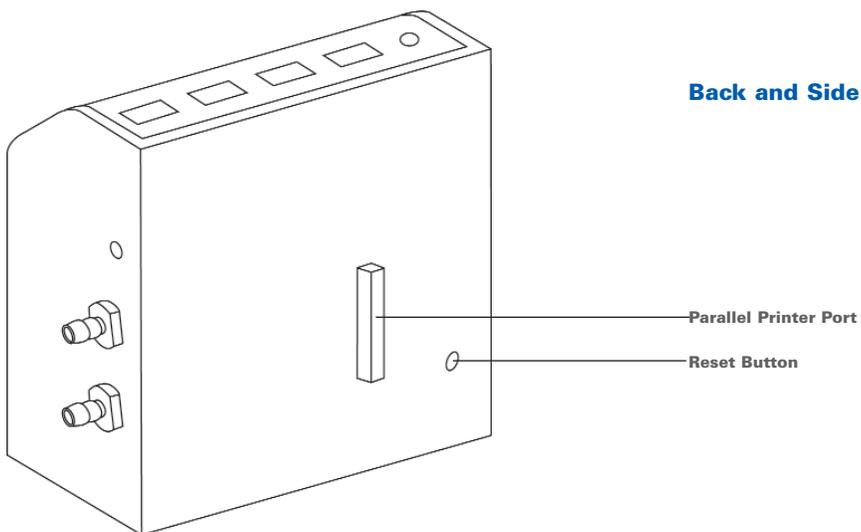
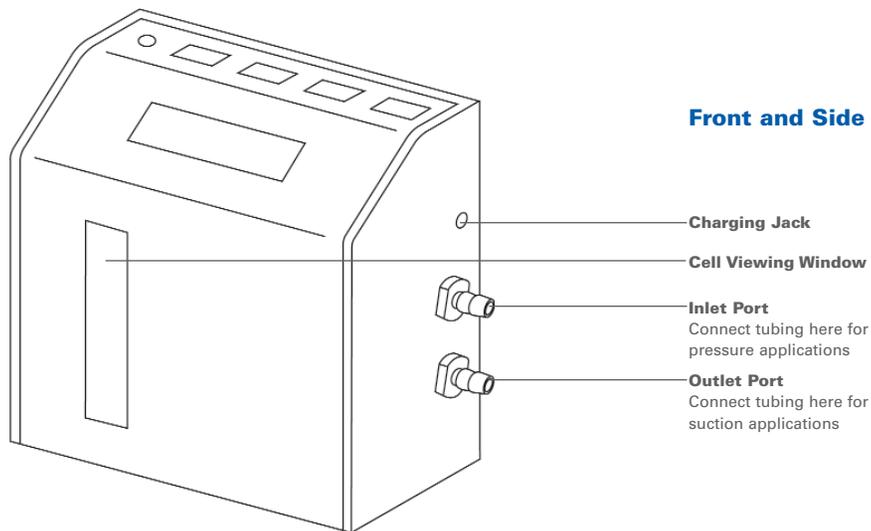
The annual recertification program offered by Bios is elective and is not included as a warranty item. Please contact Bios or visit our web site at www.drycal.com for the most current information.

All specifications are subject to change.

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1.0 DC-Lite Features



2.0 Unpacking Checklist

Your DryCal DC-Lite has been packaged with care and includes all components necessary for operation. Please check that you have received the following items. If you believe you have not received a full shipment, please contact Bios immediately.

Your DryCal DC-Lite Includes

- Single-Station Battery Charger
- Tubing Kit
- Additional High Flow Tubing (with DCL-MH and DCL-H only)
- Certificate of Calibration
- Instruction Manual
- Registration Card

3.0 Warnings

⚠ The DC-Lite is not rated intrinsically safe and is not for use with explosive gasses or for use in explosive environments.

⚠ The DC-Lite is not designed for pressurization above 0.35 bar (5 PSI) or for gas flows above the rated specifications of the flow cell in use. Please consult the product specification on the inside front cover of this manual for acceptable gas flow ranges, or visit our website at www.drycal.com for the most current product specifications.

⚠ For use with clean laboratory air or other inert, non-corrosive gasses only.

4.0 General Description

The DryCal DC-Lite is a field-portable primary flow calibrator used for industrial hygiene, environmental, and laboratory flow measurement applications. Using patented, near-frictionless dry piston technology, it combines the accuracy of a primary standard with speed and convenience.

The DC-Lite can be used to measure gas flow for either a vacuum flow source (connected to the outlet port) or a pressure flow source (connected to the inlet port).

Compact and housed in a small, sturdy case, the DC-Lite offers user-conveniences such as simple push-button operation, auto-read, measurement averages, battery level indicator, 5-minute auto shut-off, and a parallel printer port.

5.0 Theory of Operation

The DryCal DC-Lite is a primary standard. The time required for the graphite composite piston to traverse a known distance within the glass flow cylinder (cell) is precisely measured, and an internal computer calculates the flow. The volumetric accuracy of the instrument is built into its dimensional characteristics.

The DryCal, like other piston provers, is characterized by the most basic of quantities: length and time. Because flow is necessarily a derived unit, a dimensionally-characterized system would be as close as possible to direct traceability from national dimensional standards.

An idealized piston prover would consist of a massless, frictionless, leakproof, shape-invariant and impermeable piston inserted within the flow stream and enclosed by perfect cylinder. The time the piston takes to move a known distance (which implies a known volume) yields the volumetric flow as:

$$q = v / t = \pi r^2 h / t$$

Where

- q = volumetric flow rate
- v = measurement volume
- t = measurement time
- r = radius
- h = measurement path length

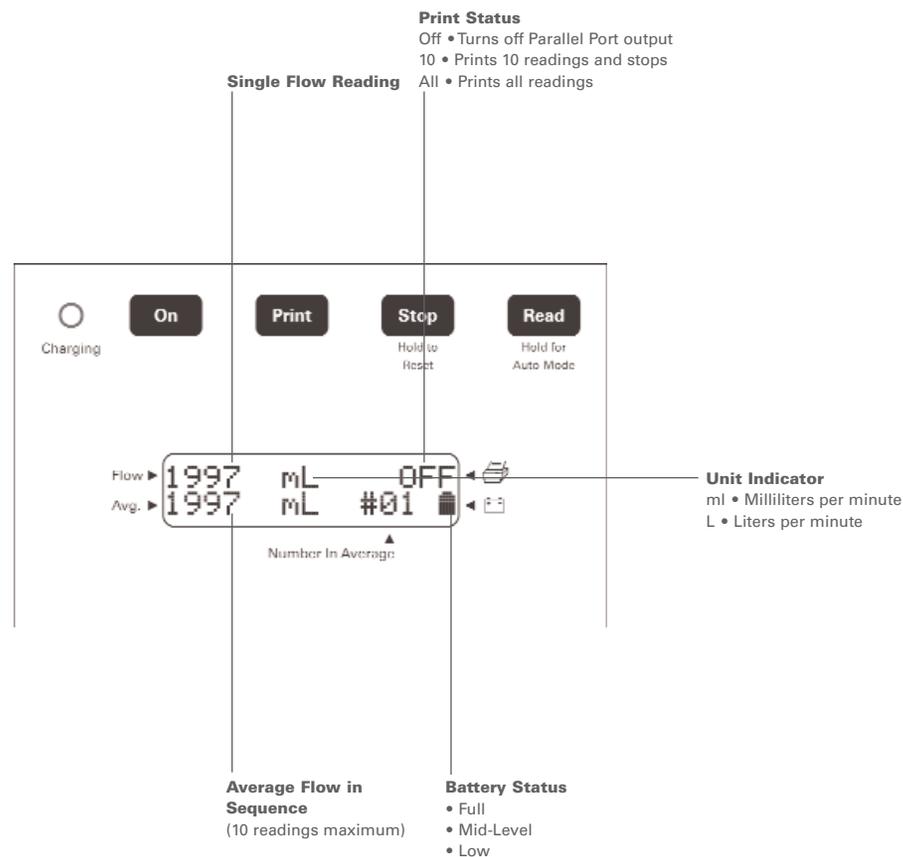
This piston prover would be as accurate as its physical dimensions and its clock, with almost insignificant drift mechanisms. Although such idealized devices do not exist, we believe the DryCal offers close to ideal performance.

When a flow reading begins, the DryCal's internal valve closes, diverting gas into the glass flow cylinder (cell) for measurement. The piston rises—at the rate of gas flow between two finely-collimated light beams of known distance apart (Point A and Point B). After a suitable acceleration period, the rate of piston travel between Point A and Point B is timed. As the piston passes Point B, the flow reading ends, the valve opens, the gas is released, and the piston drops (resets). The gas is allowed to pass directly through the DryCal, bypassing the flow cell until the next reading begins. The volumetric flow measurement, based upon the parameters of length and time, is instantly displayed on the LCD in milliliters per minute (ml) or liters per minute (L).

6.0 Operating Instructions

The following pages will guide you through the operation of your DC-Lite primary flow calibrator.

6.1 DC-Lite Button Panel



6.2 Turning the Power On

The DC-Lite has an energy saving 5-minute auto shut-off feature.

- 1 Press the **On** button to turn the DC-Lite on.
- 2 An initializing screen will display the microprocessor revision number, then the standard screen will be displayed.

6.3 Disabling & Re-Enabling the 5-Minute Auto-Shutoff Feature

5-minute auto-shutoff is the default setting for the DC-Lite. This feature can be disabled if your application requires a longer standby time. The 5-minute auto-shutoff feature must be disabled each time the unit is powered on or reset.

Please note that the DC-Lite's protective circuitry prevents the battery from over-depletion. If the battery is too weak, the DC-Lite may automatically shut off due to low battery voltage. This is more likely to occur if the 5-minute auto-shutoff feature is disabled.

Disabling the 5-minute auto-shutoff feature

- 1 Press and hold the **Read** button, then press the **On** button (or the **Reset** button if the unit is already on).
- 2 The display will read, "Auto-Off Disabled" until the **Read** button is released.

Re-enabling the 5-minute auto-shutoff feature

With the unit on, push the **Reset** button.

6.4 Taking Readings

Taking Single Readings

The DC-Lite's inlet and outlet ports are located on the right side of the unit. The upper port (inlet) is for use with a pressure flow source, and the lower port (outlet) is for use with a vacuum flow source. Tubing is connected to either port, depending upon the flow source being used. After the first single reading, all subsequent readings will be used to calculate the average flow. After 10 readings, the average will be cleared to begin a new averaging sequence.

You will know a reading has begun when the valve "clicks" shut, the flow cell's green LEDs light, and the piston rises within the flow cell.

- 1 Connect the tubing from the flow source to the DC-Lite's inlet or outlet port. If using a sampling medium, such as a filter cassette, connect it to the tubing between the flow source and the DryCal (in-line).
- 2 Press and release the **Read** button to obtain a single flow measurement. The flow measurement will appear on the LCD display in milliliters or liters, as applicable.
- 3 Continue pressing the **Read** button for single measurements until you have reached the required number of flow readings.

Taking Auto-Repeat Readings

Readings can be taken continuously in the auto-repeat mode for hands-free operation. The unit will automatically clear the average after 10 readings to begin averaging a new sequence.

- 1 Press and hold the **Read** button to initiate a reading, then release. A continuous read session will begin.
- 2 To end the continuous read session, press the **Stop** button once. The display will indicate the current flow reading (Flow), the average flow value (Average) and the number of readings in the average (Number in Average) up to 10.

6.5 Resetting the Averaging Sequence

The number of readings in an averaging sequence can be reset to (00) at any time by pressing and holding the **Stop** button for 2 full seconds.

6.6 Printing

The DC-Lite must be turned on before connecting a printer cable to its parallel port, located on the back of the unit. Failure to do so will result in the display stating "Nexus Control." If this occurs, remove the printer cable and reset the DryCal using the white recessed **Reset Button** on the back of the unit as described in Section 6.10.

The DC-Lite sends basic ASCII text in IBM/Centronics parallel format to a printer. Bios cannot guarantee compatibility with any printer other than the Bios BP-1 battery-powered thermal printer. Bios offers the BP-1 stand-alone printer for hard copy output of the DC-Lite's flow readings. The printer is small, portable, and easy-to-use, printing data to 4" wide thermal paper. It makes an excellent dedicated printer for use with most Bios products. Although the DC-Lite may indeed work with older and some stand-alone, IBM-compatible office printers (those not requiring an attached computer and software for operation), we do not recommend their use, as you may receive only one line per page, or other poor results. If you wish to experiment, try the "Wide 1" and "Wide 2" formats to test compatibility.

Print Setup

- 1 Turn the DC-Lite on before connecting the printer cable to avoid "Nexus Control."
- 2 Turn on the flow source and connect the tubing to either the inlet or outlet port of the DC-Lite.
- 3 Connect the printer cable to the parallel port on the back of the DC-Lite, and turn the printer on.

Selecting a Print Setting

After the printer setting selection has been made a print mode selection (All, 10 or Off) must also be made to initiate printing. The **Print** button will toggle between three print settings.

- 1 The default setting is "Off." When the power is turned on the printer setting will always be in the "Off" position.
- 2 To engage the printer, press the **Print** button once for the "Print 10" setting (this will allow the printer to print 10 readings and stop). Press the **Print** button twice for the "Print All" position (to print continuously).
- 3 After the printer setting selection has been made, a **Read** mode selection (single or auto) must also be made to initiate the flow measurement process as described in Section 6.4.

6.7 Stop & Reset

A flow reading can be stopped at any time by pressing and releasing the **Stop** button. This process opens the valve and allows the gas to bypass the flow cell, ending the flow reading. The piston will fall to the bottom of the flow cell.

The DC-Lite can be reset by pressing and holding the **Stop** button for two full seconds. During a reset, the display is cleared and the number of readings in an averaging sequence is reset to zero.

6.8 Resetting a Printed Sequence

When connected to a printer, the reset process initiates a printed heading for a sequence of readings and resets the number of readings in an averaging sequence to zero. The printed heading includes a column for each flow reading (Flow), the running average (Average) and the number of samples in the average (# Samples)

6.9 Printing to a PC

The DC-Lite does not have a built-in serial port for transfer of data to a PC. Bios offers a parallel-to-serial converter kit, part PSC-1, to act as a serial port, enabling the DC-Lite data to be imported into MicroSoft Excel. The PSC-1 kit includes everything needed to export flow readings from your DC-Lite to a Windows-based PC.

Bios only guarantees DC-Lite compatibility with part PSC-1, but does not offer technical support on serial port configuration. For serial port assistance, such as determining the correct Com Port number or port configuration, or for other computer-related issues, please contact your IT professional.

6.10 Hard Reset Button

If for any reason the DC-Lite does not respond to push-button commands, it may be necessary to reset the instrument. For this purpose there is a white recessed button on lower right side of the back panel near the parallel printer port. The button resets the unit back to the initializing screen and the printer setting will revert to the "Off" position. Before resetting, be sure to remove the printer cable from the back of the DC-Lite. Failure to do so will result in the display reading "Nexus Control." If this occurs, remove the printer cable and reset the unit again.

7.0 Battery System

The DryCal DC-Lite is powered by an internal lead-acid battery. The battery will power the instrument for 6–8 hours of continuous use and has a typical service life of approximately 2–5 years, depending on use. The DC-Lite provides a convenient 5-minute automatic shut-off feature to extend battery life. Use of a printer or DC-Lite's Nexus companion product does not affect the battery life.

The DC-Lite can be charged by the Bios single-station charger when plugged into a standard 115 VAC power source outlet (220 VAC optional). Provided that the battery has sufficient charge to operate the DC-Lite, the DC-Lite can be charged indefinitely using the AC wall adapter provided.

Although the DC-Lite may be plugged into AC power, if the battery is exceptionally weak the DC-Lite may not function. Please read all setup and charging instructions indicated in this manual before using equipment.

7.1 Charging the Battery

Before using your DryCal DC-Lite, be sure that the battery system has been fully charged to ensure that unit will perform without interruption. Using the DC-Lite with a low battery will not affect the product's accuracy, but may affect the valve performance.

The DC-Lite is equipped with a battery indicator that provides battery charge indication at three levels. When the battery indicator on the display is empty the unit will continue to operate for a limited period of time before shutting down.

To Charge the DC-Lite

To view the actual charging status during the charging period, disconnect the battery charger and wait 3–5 minutes. When the indicator is solid black the battery is fully charged. Bios recommends leaving the DC-Lite on charge when not in use to prevent battery degradation.

- 1 Connect only the appropriate Bios 12 VDC charger, provided with the DC-Lite calibrator, into a standard wall outlet.
- 2 Insert the charger barrel plug into the charging jack located on the right side of the DC-Lite housing above the inlet and outlet ports. A green Charge LED will illuminate while the unit is charging. Full charge takes 8–12 hours, and the DryCal can be used while charging.

7.2 Battery Maintenance & Storage

The DC-Lite's lead-acid battery will not exhibit the memory effect common to nickel-cadmium batteries. It may be left on charge for an indefinite time period without damage.

Long-term storage without charging can damage the battery pack, therefore if the DC-Lite cannot be left charging continuously, it should be fully charged at least once every three months and should be placed in storage only after achieving a full charge.

8.0 Isolating the DryCal from Other Instruments

The DryCal DC-Lite will mimic the flow source being used. Therefore, if the flow source exhibits flow pulsation, Bios recommends the use of an isolation device.

Use of a 25mm, 0.8m filter cassette creates a suitable backpressure for most flow rates used in industrial hygiene applications. This smoothes the slight pulsation caused by the stroke of the sampling pump's piston, allowing for more stable DC-Lite flow readings.

In addition to flow source pulsation, the closure of the DC-Lite's valve at the beginning of each flow reading inserts a small pressure spike into the flow stream. Generally, the pressure spike is negligible. However, it may interact with some instruments (such as some mass flow controllers). A common solution is to isolate the DryCal with a restriction as described in Sections 8.1–8.4

8.1 Use with Instruments that Contain Internal Mass Flow Controllers (MFCs)

For some flow instruments with MFCs and large internal dead volumes (such as some PM 2.5 monitors) results may not correlate between the instrument and the DryCal, for the reasons describe in Section 8.0. To eliminate these discrepancies, Bios offers an active regulation device, part DC-IR-H, to provide a constant insertion pressure that renders the DC-Lite's pressure spike negligible.

8.2 Use with Personal Air Samplers

The DC-Lite may be used to verify the flow rate of personal air samplers. Due to flow source pulsation, to ensure accurate calibrations Bios recommends the use of an isolating flow restriction, as described in Section 8.0. When placed in-line between the sampling pump (flow source) and the DC-Lite, a standard MSHA-approved respirable dust filter or equivalent should provide sufficient flow source isolation.

8.3 Calibrating Rotameters

When calibrating rotameters the DryCal DC-Lite should be used as a transfer standard only. Do not use the DC-Lite in line with a rotameter. For optimum accuracy, use a rotameter over its mid-range.

- 1 Attach an isolating restriction or sample medium, with a pressure drop of about 8–12 inches of water column, in line with a stable sampling pump and a DryCal.
- 2 Calibrate the sampling pump at the desired flow setting (ie: 2.0 L/min) with the DryCal. When the desired flow setting is obtained, disconnect the DryCal and attach the tubing to the outlet port of the rotameter.
- 3 When the rotameter ball stabilizes, mark the rotameter for the true flow rate (2.0 L/min for example) using tape and a permanent marker to denote the calibrated flow setting or note the point on a rotameter flow chart. Repeat this procedure for any additional flow settings.

8.4 Use with Magnehelic Manometers

High-capacitance spring-loaded gauges such as Magnehelic manometers can cause vibration of the DryCal piston. This is not a defect in the DryCal. The piston is accurately mirroring the transient internal vibrations of the gauge. This type of gauge must be isolated from the DryCal by inserting a suitable restriction between the gauge and the calibrator.

9.0 Maintenance, Quality Assurance

Although the DryCal DC-Lite is a rugged instrument, certain care and maintenance requirements must still be met.

Current service and calibration information and pricing can be found at www.drycal.com/service/dclite.htm.

9.1 Maintenance

When not in use always store your DC-Lite in a clean, dry environment. When possible leave the unit on charge. Wipe only with a damp cloth and do not spray with liquid solvents or use abrasive cleaners.

9.2 Leak-Test Procedure

A quality assurance self-test feature allows DC-Lite users provided to verify integrity of the flow cell. It is recommended that the self-check leakage test be conducted periodically as part of an on-going quality assurance program.

Passing the leak test does not ensure proper function of the DC-Lite. It does ensure that total leakage is within the product's allowable limits. To ensure proper function of the DC-Lite annual factory calibration is recommended.

To Initiate the Leak-Test

The leak-test tubing accessory is a short piece of latex with a red plug. It is found in the tubing kit shipped with your DC-Lite. Place the leak-test accessory over the inlet port (top port).

If at any time the unit fails the leak test, the display will read "Maintenance Req'd Push Read." Try the test again, and if necessary, call Bios for technical assistance.

- 1 If the DC-Lite is turned off, press and hold the **Stop** button, then press the **On** button. If the DC-Lite is already turned on, then press and hold the **Stop** button while also pressing the white recessed **Hard Reset** button on the back of the DC-Lite.
- 2 The display will read "LeakTest, Invert & Push Read." If it does not say this, follow the previous instructions again, or call Bios for technical assistance.
- 3 Invert the DC-Lite so that the piston moves to the top of the cell, which is now facing downwards. Press the **Read** button to close the internal valve.
- 4 Return the unit to an upright position, make sure that the piston is beginning at the top of the cell, and place the DC-Lite on a flat, vibration-free surface.
- 5 As the piston falls from the top of the cell, its descent is timed. This may take as long as 15–20 minutes. Note that the piston may not fall to the bottom of the cell, and may not move far at all.
- 6 If completed successfully, the display will read "Test OK Press Read."
- 7 Press the **Read** button and the internal valve will open, allowing the piston to fall any remaining distance to the very bottom of the cell.
- 8 Repeat this test with the leak-test accessory connected to the outlet port (lower port).

9.3 Air Containing Particulates

As of January 1, 2001, the DryCal DC-Lite includes either a 5-micron or 30-micron inlet filter inside the inlet fitting (depending on model ordered). Older DC-Lites sent to Bios for calibration will be retrofitted with these inlet filters, free of charge. However, air containing cigarette smoke, excessive dust, or other particulates should be additionally pre-filtered. A particulate filter, part AF-516, is available for this purpose. The filter should be placed ahead of the DryCal in the flow stream, on the inlet side.

9.4 Return Authorization

Before sending your DryCal to Bios for maintenance, please contact Bios for technical support, troubleshooting assistance and an RMA number if necessary. Any DryCal maintenance must be performed by Bios personnel in Bios' New Jersey facility

You can telephone Bios at (800) 663 4977 or (973) 492 8400, or send an email to service@drycal.com.

9.5 Shipment

When shipping the DryCal DC-Lite please ensure that the packaging is adequate to protect the instrument. When possible the DC-Lite should be shipped in the original packaging. Bios International Corp. is not responsible for damage that occurs during shipment.

9.6 Long-Term Storage

DryCal calibrators can remain on charge until needed without causing damage to the battery. If the DryCal is stored for long periods of time the battery should be charged at least once every three months.

Always store DryCal calibrators in a clean, dry environment and recharge the unit prior to use after long-term storage.

9.7 Calibration

As a quality assurance measure, Bios recommends annual calibration of all DryCals, although how often you have your DryCal calibrated is an internal quality control decision. The determining factors are whether the unit passes the internal leak-test, quality system requirements if applicable, and the conditions in which the unit is used. Units used in a laboratory setting may require calibration less frequently than a unit that is used in a dusty environment.

The annual calibration program is an elective and is therefore not included as a warranty item. Called "Recertification," our program includes pre flow data, product refurbishment, post flow data, and a Calibration Certificate. Please contact the factory for more information on available calibration services and pricing.

Calibration Includes

- Clean flow cell and piston
- Valve mechanism adjustment (as required)
- Change inlet filter (as required)
- Battery capacity test
- Performance test
- 3-point "As-Received" and "As-Shipped" flow data
- NIST-Traceable Calibration Certificate

10.0 Calibration Statement

Calibration refers to a set of operations that establish, under specified conditions, the relationship between the values of a quantity indicated by a measuring instrument (the device under test, such as your DC-Lite) and the corresponding values of a standard. In other words, to calibrate is to check, or determine, the validity of a measuring instrument by comparison with a standard. Calibration may also include adjustment to restore the device under test to its original specification, although adjustment is not possible with a DryCal, because of its primary nature: the dimensional characteristics of the flow cell do not change over time. At Bios, calibration of your DryCal DC-Lite is a comparison against our laboratory standard, which is a primary piston prover of similar operating principals to your DC-Lite.

Bios is an ISO-17025 accredited laboratory. ISO 17025 is the ISO standard (International Organization for Standardization) specifically designed to assess the competence of testing and calibration facilities. The requirements of ISO 17025 encompass all aspects of laboratory management, including calibration procedures, analytical testing proficiency, report generation and record keeping, and ensure calibrations are performed by properly-trained personnel using controlled test methods and procedures. All ISO 9000 elements relevant to the testing and calibration services within a laboratory's quality system are incorporated in ISO 17025.

Upon arrival at Bios and prior to shipment from Bios, your DC-Lite is dynamically tested by comparing it to our laboratory piston prover of at least 4x greater accuracy ($\pm 0.25\%$ volumetric), the 4:1 ratio recommended by the *GUM* (*International Guide to the Expression of Uncertainty in Measurements*). We use a stable, triple-regulated flow source of $\pm 0.01\%$ stability (factored into the prover's accuracy) running from high-purity bottled nitrogen.

Our piston prover standard is qualified by direct measurement of its dimensions (dimensional calibration): diameter of the piston and glass assembly, length of measured path, and time, against NIST-traceable instruments and gauges. A rigorous analysis of its uncertainty in accordance with the *GUM* has been performed, assuring its traceable accuracy. Test procedures ensure temperature matching of the standard to your DC-Lite. The calibration dates for each parameter of our standard (diameters, encoder spacing, time base) are included in our calibration certificates, along with identification of the devices used for calibration, their calibration dates, and NIST calibration numbers.

11.0 Limited Warranty

The Bios DryCal DC-Lite is warranted to the original end user to be free from defects in materials and workmanship under normal use and service for a period of one year from the date of purchase as shown on the purchaser's receipt. The DC-Lite's battery is warranted for 6 months from the original purchase date. If the unit was purchased from an authorized reseller a copy of an invoice or packing slip showing the date of purchase may be required to obtain warranty service.

The obligation of Bios International Corporation under this warranty shall be limited to repair or replacement (at our option), during the warranty period, of any part which proves defective in material or workmanship under normal use and service provided the product is returned to Bios International Corporation, transportation charges prepaid.

Notwithstanding the foregoing, Bios International Corporation shall have no liability to repair or replace any Bios International Corporation product:

- 1 Which has been damaged following sale, including but not limited to damage resulting from improper electrical voltages or currents, defacement, misuse, abuse, neglect, accident, fire, flood, act of God or use in violation of the instructions furnished by Bios International Corporation,
- 2 When the serial number has been altered or removed or
- 3 Which has been repaired, altered or maintained by any person or party other than Bios International Corporation's own service facility or a Bios authorized service center.

This warranty is in lieu of all other warranties, and all other obligations or liabilities arising as a result of any defect or deficiency of the product, whether in contract or in tort or otherwise. All other warranties, expressed or implied, including any implied warranties of Merchantability and fitness for a particular purpose, are specifically excluded.

In no event shall we be liable for any special, incidental or consequential damages for breach of this or any other warranty, express or implied, whatsoever.