The BUCK Cali-Logger
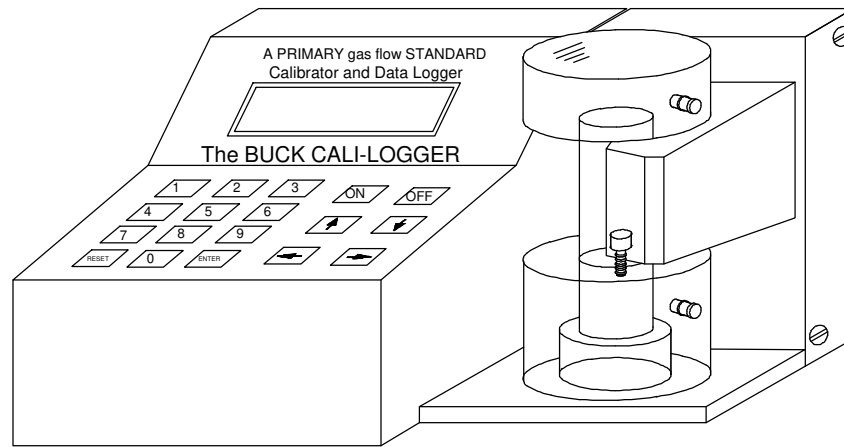
A PRIMARY gas flow STANDARD
Calibrator and Data Logger

The BUCK CALI-LOGGER

The Model C-5
Range 5cc/min to 6,000 cc/min.

The Model C-30
Range 100 cc/min to 30 LPM/min

Instruction Manual

<u>BUCK</u>
A.P. BUCK, INC.

Fellow Industrial Hygienist:

When the idea for a Cali-Logger was conceived, my purpose was to assist in the field sample note taking requirements and at the same time provide a credible computer report of the work.

The Buck Cali-Logger does this by using a Chain of Custody Form. From the time the sample is initiated until it is sent to the laboratory for analysis, the progression of collecting is traceable and performed in a manner consistent with good industrial hygiene practice.

The tedious note taking calculations of sample volume and STP correction are greatly simplified. This eliminates the possibility of human error in the time and flow rate mathematics while providing all the data necessary in a standard format for the laboratory to perform the analysis.

It is my desire to improve the quality of field sampling while reducing the work time to accomplish this goal.

Sincerely,

Al Buck, CIH (Retired)

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AIR FLOW MEASUREMENT AND CALIBRATION

a. Physics of Measurements:

At room temperature, all gases obey - to a very close approximation - the ideal gas equation PV = nRT, where P is the newtons per square meter, V is the volume in cubic meters, n is the number of moles of gas, R is the empirically determined gas constant with the approximate value 8.31 joules/mole degrees Kelvin and T is the temperature in degrees Kelvin.

The method of measuring flow rates in the Buck Cali-Logger is the technique known as the <u>soap film bubble test</u>. A frictionless soap bubble is suspended perpendicular to the air flow up a small bore tube. This soap bubble film forms a complete seal across the tube. This effect causes the soap film to rise up the tube at exactly the same rate as the air flow. Knowing a measured distance and tube bore size a volume can be calculated. Thus a flow rate can be determined by the movement of a soap film bubble across a fixed volume per unit of time. This techniques is classified as a Primary Flow Standard.[1]

By comparing the four variables of the Ideal Gas Law with this detection technique, the validity of measurement can be assessed. The fixed volume (V) is known and therefore cannot change or be considered variable. The mass (m) of the gas being measured is not changed in this technique as the soap film is simply suspended across the tube cross-section and moves with the gas flow rate. Mass is not affected. This leaves pressure and temperature. These are expressed by Boyle's Law $P_1 x V_1 = P_2 x V_2$ and Charles Law $V_2 / V_1 = T_2 / T_1$. There is no pressure change from the ambient during a test as the soap film is practically frictionless. Temperature has no influence in this type of flow measurement when all elements are at an ambient. This includes the calibrating device, the flow of gas and room temperature. These conditions are the general circumstances in which tests are performed.

Conclusion: The detection method of measuring gas flow rates over a fixed volume per given unit of time for all practical purposes is independent of all variables in the Ideal Gas Law. Thus, the Buck Cali-Logger serves as a <u>Primary Flow Standard</u> calibration method.

[1] Lippman, Morton, "The Industrial Environment - its Evaluation and Control," (U.S. Department of Health,Education and Welfare), NIOSH,1973, Ch 11, pp.

b. Accuracy of Gaseous Flow Measurements

To properly evaluate the accuracy of flowing gases, two parameters must be considered. First, the steadiness of the flow rate must be known. Almost every type of pump creates some pulsing of the moving gas.   The other parameter is the rate of flow can drift up and down over some range. Current battery powered personal air sampling pumps use various techniques to dampen pulsing and special circuitry to monitor pump speed, thereby, attempting to generate constant and steady flows.

The Buck Cali-Logger is an improved automation of the "Classic" technique of using a soap film to measure flow over a fixed volume in a known time period. A microprocessor, operating at 6 megahertz per second using precision optical sensors, detects the passing of the soap film seal along the established flow tube volume and automatically calculates the rate of flow. The traditional or classic apparatus, a 1,000 ml buret, using a stop watch can be significantly reduced in size since the microprocessor can detect and measure the speed at 50 microsecond intervals. Compare this precision to a technician's response time. With good practice on a stop watch, a technician could be repeatable within 50,000 microseconds (0.05 seconds), 1000 times slower and less accurate than the microprocessor.

Consider an example analysis: 1,000 cc buret NIST traceable; 0.01 second stop watch crystal controlled with clock accurate to ± 15 sec per month; 1,000 c/min steady flow source (constant flow ± 1 cc/min),

Example: Measure the flow rate using 1,000 cc buret by a skilled technician. All devices are at a constant room temperature.

Test	Time	Actual Flow Rate
1	60.06 sec	999.0 cc/min
2	60.00	1000
3	59.94	1001

At 1,000 cc/min of flow ± 0.06 seconds is equal to 1 cc/min change or ± 0.1% accuracy. Repeatability is strictly a function of the technician's skill.

Mathematically, a 0.1% accuracy could be obtained by a skilled technician with a 1000 cc/min steady source. If the volume is smaller than 1,000 cc or the flow is faster, the percent of accuracy is further reduced by this manual method.

To summarize: The accuracy of measuring air flow relies on quality measurement tools, NIST traceable volume, crystal control timer, constant air flow source and the method of detecting of the soap film.

CALI-LOGGER FEATURES

Product Description

The Buck Cali-Logger combines a Primary Flow Calibrator with a sample data storage and retrieval system. It functions as an application specific notebook computer programmed to meet the sampling requirements of an Industrial Hygienist. This combination is packaged in a battery powered, rugged portable case designed for field use. Data is displayed on a 16 alpha numeric, 2 line display. Both a communication port and printer port are located in the rear of the unit. The two flow cells available are interchangeable providing flow measurements from 5 cc/min to 30 LPM.

A. Primary Flow Calibrator

The Buck Cali-Logger utilizes the principle of measuring the flow rate of gases over a fixed volume per unit of time. A quartz controlled timer is the timing device and the fixed volume is located in the flow cell center tube. A microprocessor measures the time for a frictionless soap film to travel from the first sensor to the second sensor (detected by infrared beams during the passage up the tube) and then calculates the volume per unit of time. The results are displayed in flow rate, in cubic centimeters/ minute (cc/m) for the Model C-5 and in liters per minute (LPM) for the Model C-30 via the 16 character liquid crystal display. The decimal point floats to present the data in the proper range. The timer is capable of detecting a soap film at 50 microsecond intervals. This speed allows, under steady flow conditions, an accuracy of 1% of any display reading. Repeatability is 1% of any display. The unique design of the flow cell can create a soap film over a flow range of 5 cc/min to 6000 cc/min for the C-5 and .100 to 30 LPM for C-30.

The flow cell in both models is constructed with a "sunblock" black plastic (to eliminate infrared interference) and are spill proof when properly filled with soap solution.

B. Data Logging System

Sample information in entered by the keypad for all information required by the Cali-Logger. Basic function of the keys are as follows:

            ON OFF   Turns Cali-Logger on or off.
            UP ARROW   Scrolls through 5 Main Menus:
                                1.) Date/Clock/Temperature/Barometric Pressure
                                2.) Flow Calibration Procedures
                                3.) Sample Data Edit Mode

Data Logging (continued)

4.) Data output Mode Select: Printer or PC
5.) Memory and I/O configuration
This key also acts as an ESCAPE key in sub menus to return to Main Menus.

DOWN ARROW   Scrolls through 5 Main Menus. Serves to
                 set time and date under Sub Menu.

RIGHT/LEFT
 ARROWS   Scrolls through Sub Menus and serves to
                 input alpha characters for samples and addresses
                 in Configure Mode.

RIGHT ARROW   From Date/Clock menu: Toggles temperature
                 from °F to °C and B.P. from inches to mm.

ENTER   Enters Sub Menus and accepts data and other
                 information as stated on display.

RESET   Clears the display for inputted data and resets computer
                 when calculating average difference between flow measurements.

Up to 100 samples are stored and retrieved by Date and Sample Number with associated Data. A battery back-up feature will save the sample indefinitely. All input data may be erased under the Main Menu "MEMORY AND I/0 CONFIGURATION" . Data is outputted in the format of the Chain of Custody Form. See examples of various menus and the Chain of Custody Form in Section 4.

Output of data is performed by sending the information to a personal computer (PC) or printer. PC output is by the RS-232 communication serial port also on rear of the unit. Printer output is via the parallel port on the rear of the Cali-Logger.

C. Download of Sample Data to a P.C.

A communication package is provided. This includes software on disk and a special serial cable which connects the serial port of the Cali-Logger and the P.C. Data is in the form of the Chain of Custody report by date. It may be saved under any file name allowed by MS-DOS operating system. The data may be incorporated into most application programs which can read as ASCII data file.

D. Data Output to a Printer

A standard parallel printer cable is connected to the parallel port of a dot matrix or laser printer with a 8½ x 11" sheet capacity. Most printers will serve. All data is downloaded by the date it was initially stored.

E. Standard Temperature and Pressure (STP)

STP correction is a unique feature of the Cali-Logger. This correction is provided automatically on the Chain of Custody Form from internal sensors. The STP is defined as 25º Celsius and 760 mm of Mercury.

For pricing and details, see last page of this manual or call A.P. Buck for current pricing and product offerings.

PERFORM PRIMARY FLOW MEASUREMENTS

A.   Read the previous section if unfamiliar with the Cali-Logger. In addition, review Section 4 to be familiar with the 150 plus displays of the Cali-Logger.

B.   The appropriate flow range is obtained by installing one of the flow cells:
       C-5 for 1 cc/min to 6000 cc/min
   C-30 for .100 LPM to 30 LPM

Use a regular screw driver to unscrew the (2) screws on the right side of flow cell. The screws are retained in the cell for convenience. Gently pull flow cell away from keypad base. The 9-pin connector will then be visible for connection of another flow cell.
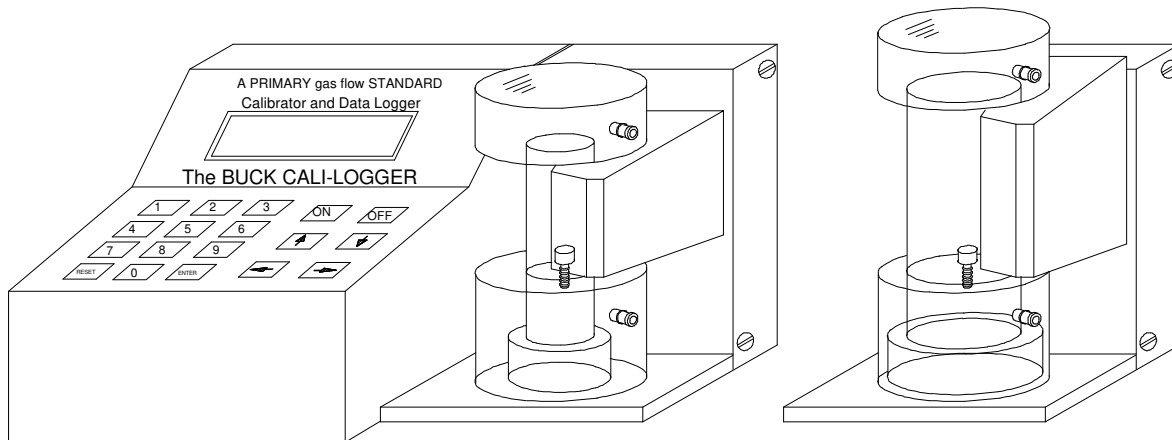
C.   Add calibration soap solution to bottom hose connector (lower nipple).

A PRIMARY gas flow STANDARD
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LOWER NIPPLE
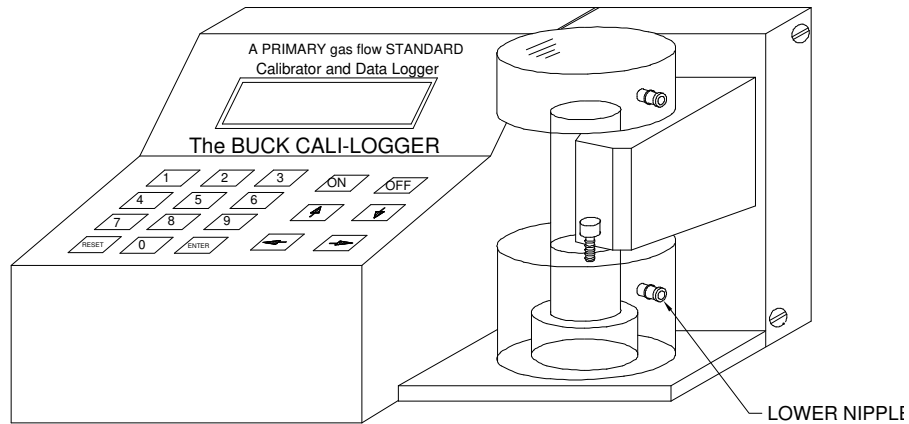
D.   Each of the flow cells (C-5 or C-30) incorporate a spill prevention feature which allows for the retention of the maximum volume of soap needed in the flow cell. When the cell is rotate on its side, as shown in picture, below, excess soap will exit the lower hose nipple.
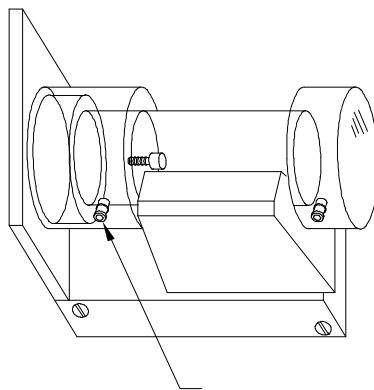
E.   How to make flow readings:

These instructions relate to industrial hygiene air sampling. It basically applies to any gases flow rate measurements either vacuum or pressure. These instruc-   tions are for a quick start to make PRIMARY FLOW (PF) tests. For greater de-   tail on the function of the keys and various MENUS, see Section 4.

1. Start pump and allow a few minutes to stabilize. Perform this step before connecting pump to flow cell as air flow dries center tube of flow cell if bubbles are not initiated at frequent intervals.

2. Wet the flow cell by connecting a vinyl hose of 1/4 I.D or 5/16 I.D. from a pump to the upper hose fitting flowing at 1000 to 2000 cc/min. Initiate soap film up the center tube by repeatedly pressing down and slowly releasing the flow cell button causing the bubble ring to be inserted into the soap solution. (A luer taper connector will also fit in the top hose connector of the flow cell.)

FLOW CELL
BUTTON
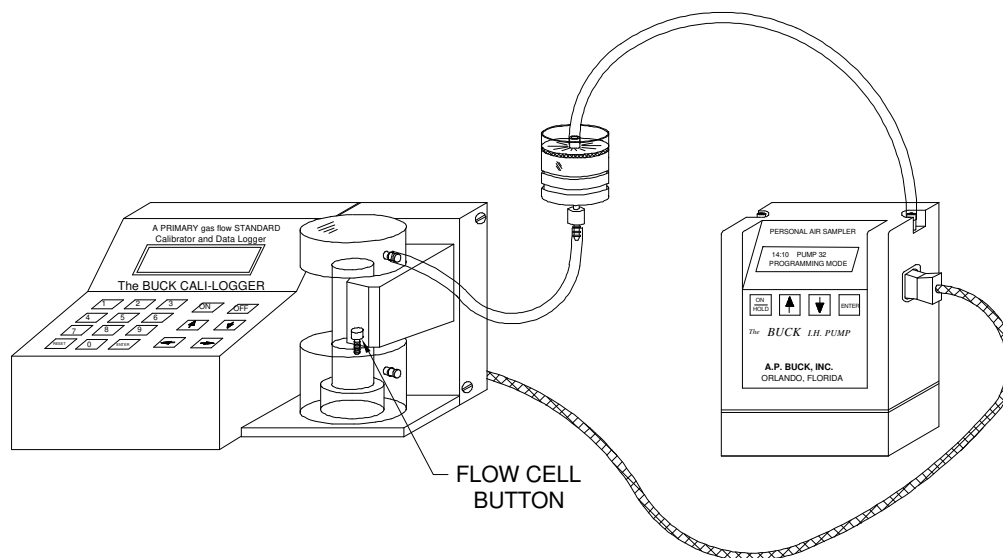
3. Begin Calibration:
   Press the ON button which allows the computer to load the Menu routine and performs a diagnostic test of all sensors, clock, memory and battery power. If the diagnostic test fails for some reason, press ENTER to acknowledge and continue unless the failure is pertinent to a valid sampling.

4. Press UP key once to obtain the next Main Menu named "FLOW CALIBRATION PROCEDURES"

5. Press ENTER and the display will change to:
   SAMPLE # NEEDED
   SAMPLE # ??????
   A sample # must be entered to proceed. Press keypad to enter a new sample number, use any number except a number which starts with a 9 or 0. The leading 9 numbers are reserved for passive badge samples for which PF flow is not required.   Sample #'s with a leading zero "0" will be considered blank and PF flow is not allowed. Letters may be used along with numbers from the keypad for the sample #. The RIGHT ARROW scrolls through the alphabet, the LEFT ARROW moves the cursor for the next character. The DOWN ARROW deletes individual letters and numbers. RESET will clear the sample number data.

6. Press ENTER to accept the sample number. For other than A.P. Buck I.H. Pumps, the display will change to:
   Pump # needed
   Pump number: ????
   Note: If Cali-Logger asks you to enter pump #,then pump and Cali-Logger are not communicating. Check data cable or reset Cali-Logger by turning Off then On
   Use keypad to enter a 1 to 3 digit pump number or press ENTER to leave blank. Then press enter and the display will change to:
   PF = 0.00 cc/m
   Make 1st PF test

7. Enter test Start, Break and Lunch times available only with Buck I.H.Pumps.

8 Depress flow cell button into soap solution and release. Different flow rates may require quicker or slower release of the button. Low flows (less than 50.00 cc/m) may require the button to remain depressed until a bubble is formed and starts up the center tube of flow cell.

9 Carefully observe the bubble passing through the sensor area. A single straight bubble, perpendicular to the tube wall, is necessary for an accurate

If several (usually two) bubbles go up the tube at once, it will not affect the test data because the start sensor will not reset until the stop sensor has been tripped (3 sec. interval). A good technique is to watch the bubble pass properly across the sensor zone to ensure a good test has been conducted.

10. A minimum of 2 tests is required. As each test is completed, a beep will sound. After a 3 sec. delay from the time of the beep sound (stop sensor was tripped), another test can be performed. Upon completing the second bubble test, the display will become:

> PF = XXXX cc/min
> DIFFERENCE X.X%

F.   Display Readings

The difference X.X% indicates the difference between the last 2 bubble tests. If sequential tests are performed, the display continues to update to the current bubble tests. When large flow changes are made without pressing RESET, the Difference X.X% reading will reflect a large percentage of change.

When RESET is pressed during flow tests, the data is reset to zero. This allows for individual readings to be performed by pressing RESET after each test. If a series of bubble tests are done without pressing RESET, the display is being updated by taking the last bubble test and adding it to the display's last reading, dividing this in half and re-displaying the results. In effect, an averaging is being performed, a software feature to minimize the variation in tests because of the pulsing action of personal sampling pumps at low flows. This provides more consistent results.
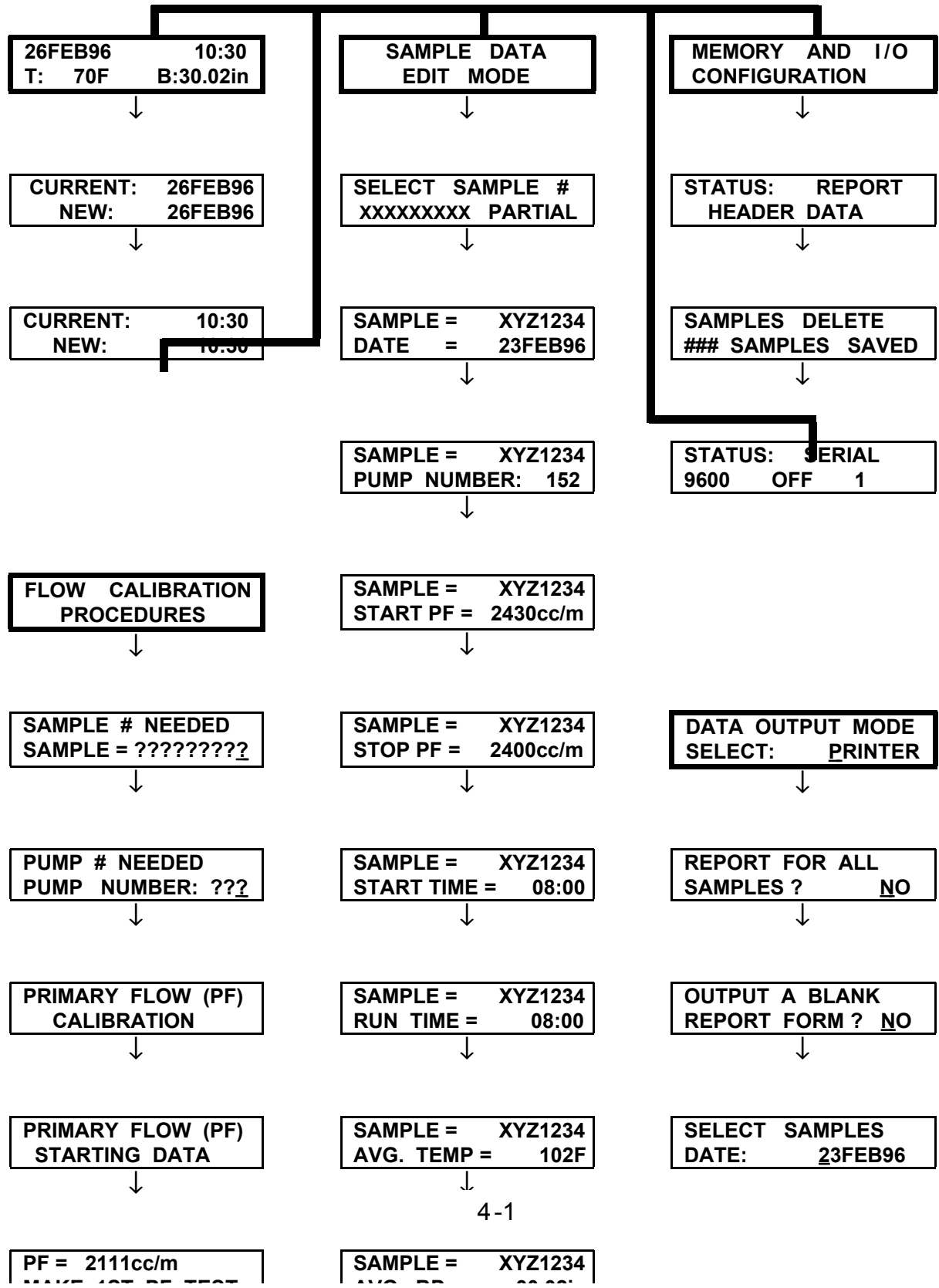
It will be noted when a large change is made, the display, PF readings, will lag in presenting the new flow reading while the Difference X.X% may show little change in the last 2 tests (meaning the new flow rate was maintained). This lag can be eliminated by pressing the RESET button. It is recommended the Difference X.X% be 2% or less before accepting the current PF reading.

G.   Accepting Results

When the bubble testing is accepted as displayed, press ENTER!
This will now store the flow data by sample number in the battery
backup memory storage for later recall. At this point, the next sample
is requested. See Section 5 for full details on menu parameters. If
flow readings were desired (but aren't to be saved as a sample),
press the UP ARROW twice instead of the ENTER key. Then no data
will be stored. Editing other sampling data for the currently entered
sample # are performed under the Main Menu SAMPLE DATA EDIT.

This section explained the basic process to make air flow measurements of
pump and sampling media. The following Section presents the program-
ming displays to conduct a sampling for evaluation of a work place for air-
borne contaminates.

Graphic Overview
of Main Menus

26FEB96 10:30 T: 70F B:30.02in	SAMPLE DATA EDIT MODE	MEMORY AND I/O CONFIGURATION
↓	↓	↓
CURRENT: 26FEB96 NEW: 26FEB96	SELECT SAMPLE # XXXXXXXXX PARTIAL	STATUS: REPORT HEADER DATA
↓	↓	↓
CURRENT: 10:30 NEW: 10:30	SAMPLE = XYZ1234 DATE = 23FEB96	SAMPLES DELETE ### SAMPLES SAVED
	↓	↓
	SAMPLE = XYZ1234 PUMP NUMBER: 152	STATUS: SERIAL 9600 OFF 1
	↓	
FLOW CALIBRATION PROCEDURES	SAMPLE = XYZ1234 START PF = 2430cc/m	
↓	↓	

SAMPLE # NEEDED
SAMPLE = ?????????
	SAMPLE = XYZ1234
	STOP PF = 2400cc/m
		DATA OUTPUT MODE
		SELECT: PRINTER

↓	↓	↓
PUMP # NEEDED PUMP NUMBER: ???	SAMPLE = XYZ1234 START TIME = 08:00	REPORT FOR ALL SAMPLES ? NO
↓	↓	↓
PRIMARY FLOW (PF) CALIBRATION	SAMPLE = XYZ1234 RUN TIME = 08:00	OUTPUT A BLANK REPORT FORM ? NO
↓	↓	↓
PRIMARY FLOW (PF) STARTING DATA	SAMPLE = XYZ1234 AVG. TEMP = 102F	SELECT SAMPLES DATE: 23FEB96
↓	↓	

4-1

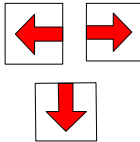| PF = 2111cc/m MAKE 1ST PF TEST	SAMPLE = XYZ1234 AVG. BB = 30.02i	

DATE & TIME

MAIN MENU

```
18NOV95   17:45
T:76F  B:30.00IN
```

→ Toggles Barometric Pressure (BP) in inches and in Fahrenheit (°F) or BP in millimeters of Mercury (Hg) and temperature in Celsius (°C). Press ENTER to obtain SUB MENUS.
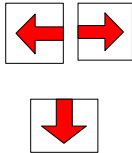
SUB MENUS

```
CURRENT:  18NOV95
NEW:      19NOV95
```

← → Adjusts day.

↓ Moves cursor under Day, Month or Year. Press ENTER to accept new date.

```
CURRENT:  17:45
 NEW:      18:00
```

← → Adjusts hours & minutes.

↓ Moves cursor under hours or minutes. Press ENTER to accept new hours or minutes.

```
18NOV95   17:45
T:76F  B:30.00IN
```

Returns to initial menu.

NOTE: This internal clock will accurately maintain the set time and date. Hours are displayed in a 24 hour basis. The Cali-Logger default mode for the temperature and barometric readings are shown in this sample in Fahrenheit and inches of Mercury. By pressing the RIGHT ARROW, the information would be in Celsius and millimeters of Mercury. Which mode, "English" or Metric, chosen, at this point will be utilized by the Cali-Logger on all data recorded and then outputted to the Chain of Custody Form.

FLOW CALIBRATION PROCEDURES

MAIN MENU

FLOW CALIBRATION
PROCEDURES

Main Menu to initiate a sample number and perform flow tests. Press ENTER for SUB MENUS.

SUB MENUS

A sample # must be entered to continue. Use keypad for numbers.
To scroll to next alpha character, use

SAMPLE # NEEDED
SAMPLE= ????????

To advance cursor to next position, use
To delete character, use
Press ENTER to accept.
RESET clears all data.

PUMP # NEEDED
PUMP NUMBER:???

A pump # may be entered by keypad. May be omitted by pressing ENTER.

PRIMARY FLOW (PF)
CALIBRATION

Display 1 second then goes to next display.

PRIMARY FLOW (PF)
STARTING DATA

Display 2 seconds then goes to next display.

PF=0.00 CC/M
MAKE 1ST PF TEST

Requires a bubble test to continue. After 1st test goes to the next display.

PF=XXX CC/M
REPEAT TEST

A minimum of two bubble tests are necessary. After 2nd test goes to next display.

PF-XXX CC/M
DIFFERENCE Y.Y%

PF reading indicate an average of last two bubble tests. Difference indicates % of change in last two test. Press ENTER to save this sample # PF data.

Returns to Sample # for next pump

* Reads ENDING DATA after START PF has been performed.
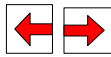
SAMPLE DATA EDIT MODE

MAIN MENU

SAMPLE DATA
EDIT MODE

Press ENTER for
SUB MENUS

SUB MENUS

SAMPLE SELECT #
XXXXXXXX PARTIAL

← → Scrolls stored
sample #.
Press ENTER at
desired sample #.

Status of sample is displayed:
    PARTIAL: Incomplete data,becomes
    "ABORTED" when printed on form.
    FULL: All data recorded.
BADGE: Passive Badge sample ("9" first digit)
BLANK: Sample Blank (Zero "0" first digit)

SCROLLS WITH ↓ (L) & ↑ (R) Arrows

SAMPLE = AB1234567
DATE= 12 NOV95

Date from internal clock was entered when sample
initialized under Flow Calibration. May be edited by
pressing ENTER. Then using ↓,←,→arrows.

SAMPLE: AB11234567
PUMP NUMBER: 188

Entered under FLOW CALIBRATION, may be
edited. Press ENTER to edit. Reset to clear old # ↓
to erase character at cursor.

SAMPLE: AB1234567
STARTPF=2430CC/M

Performed under Flow Calibration, not editable.

SAMPLE:AB1234567
STOP PF=2400CC/M

Performed under Flow Calibration, not editable.

SAMPLE: AB1234567
START TIME=00:00

Press ENTER to input start of actual sampling time.
Use ↓, ←,→ arrows.

SAMPLE: AB1234567
RUN TIME=00:00

Press ENTER to input actual elapse
time of sampling

SAMPLE: AB1234567
AVG. TEMP=70F

A value defaulted to display by internal sensor, may
be edited to reflect field conditions.
ENTER ←,→

SAMPLE: AB1234567
AVG. BP = 30.41 IN

Edited same as temperature above.

DATA OUTPUT MODE
TO PRINTER

MAIN MENU

```
DATA OUTPUT MODE
SELECT:    PRINTER
```

Toggles select to IBM compatible PC (Personal Computer) or PRINTER. Press ENTER.

SUB MENUS

```
REPORT FOR ALL
SAMPLES?   NO
```

Toggles
NO or YES

If Enter <u>NO,</u> go to select by Date.
If ENTER: <u>YES</u>, all samples stored in memory will be sent to the printer in the Chain of Custody Format.
Samples are printed in order by date of sample.

```
OUTPUT A BLANK
REPORT FORM?   NO
```

Toggles to
NO or YES

If YES, prints a blank Chain of Custody Form.
Press ENTER.

```
SELECT SAMPLES
DATE:   26 OCT95
```

Scrolls through each date

Press ENTER to print samples by

DATA OUTPUT MODE
TO PC

MAIN MENUS

| DATA OUTPUT MODE |
| SELECT: PRINTER |

Press ← to toggle to PC.

| DATA OUTPUT MODE |
| SELECT: PC |

Press ENTER.

Note: To continue, the Serial Communication Program (Part #APB-107024) is required. This communication package consists of a cable, 9-pin, RS-232 connector and a software program to download sample data files to a floppy disk on a P.C.

SUB MENUS

Press ← to YES for all samples in memory by Date.

| REPORT FOR ALL |
| SAMPLES?   NO |

Press ENTER.

Press ← to YES for a blank Chain of Custody.

| OUTPUT A BLANK |
| REPORT FORM? NO |

Press ENTER.

| SELECT SAMPLES |
| DATE: 10NOV95 |

← → To scroll through each sample by date.

Press ENTER to download the data from the displayed sample.

MEMORY AND I/O CONFIGURATION MENU

MAIN MENU

```
MEMORY AND I/O
CONFIGURATION
```

ENTER: Begins Sub Menus

⬅ Scrolls Sub Menus

⬆ Returns to Main Menu

SUB MENUS

```
STATUS:  REPORT
HEADER  DATA
```

ENTER: Will allow the Company, address,
State, Telephone, Collector and
Sample Site to be entered in memory
edited or deleted.

⬆ ⬇ To scroll through Character Set.

⬅ ➡ To move cursor.

ENTER to accept input.

```
SAMPLES DELETE
### SAMPLE SAVED.
```

ENTER: Will allow samples to be deleted
by   # or date. Displays total # of
samples in memory.

⬅ Toggles by # or by Date.

⬅ ➡ To select Samples to Delete.

```
STATUS:  SERIAL
9600   OFF   1
```

ENTER: Allows configuration of RS-232
Port, or PC. Allows adjustment of
BAUD, PARITY, and STOPBITS.

See examples on the following pages

EXAMPLE OF CHAIN OF CUSTODY FORM
(HEADER, COLLECTOR, SITE)
EDITED BY IN MEMORY AND I/O CONFIGURATION MENU

MAIN MENU

MEMORY AND I/O CONFIGURATION

ENTER to begin SUB MENUS.

SUB MENUS

STATUS: REPORT HEADER DATA

ENTER to change or enter company name, address, city, phone #, collector and site.

CHANGE COMPANY: A.P. BUCK, INC.

⬆ ⬇ Will scroll through numbers & alphabet characters.

⬅ ➡ Moves cursor left or right, up to 30 spaces on the second line of the display

ENTER will store company name.
RESET will clear all.

CHANGE ADDRESS: 7101 PRESIDENTS DR.

⬆ ⬇ Will scroll through alphabet.
Numbers may be entered by keypad.
⬅ ➡ Moves cursor left or right to desired space and to observe the full 30 spaces available.

ENTER will store company address.
RESET will clear all.

CHANGE CITY: ORLANDO, FL 32809

Same as above two menus. Enter the state and zip code on this line.
RESET will clear all.

CHANGE PHONE: 407-851-8602

Same as above.

CHANGE COLLECTOR

Same as above

CHANGE SITE: PENTAGON

Same as above

EXAMPLE OF MEMORY AND I/O CONFIGURATION
SAMPLE DISPLAY BY NUMBER

MAIN MENU

```
MEMORY AND I/O
CONFIGURATION
```

ENTER to begin SUB MENUS.

⬅ ➡ Scroll to Samples Delete.

EXAMPLE - DELETE BY SAMPLE #

SUB MENUS

```
SAMPLES DELETE
## SAMPLES SAVED
```

Number of samples in memory.
Maximum is 128 samples.
ENTER to delete samples from
memory by # or date.

```
DELETE SAMPLE BY
DATE OR #?        #
```

⬅ Toggles between # and date.
ENTER

```
ERASE SAMPLES
ERASE ALL?        NO
```

⬅ Toggles between YES & NO
CAUTION: If you toggle to Yes, all
samples will be cleared from memory.
ENTER to continue.

```
STATUS:  SAMPLE #
XXXXXXXXXMESSAGE
```

⬅ ➡ Scrolls through all numbers in
memory.
   Message will read:
   BADGE for passive badge
   FULL for all data entered.
   PARTIAL for missing data
   BLANK for lab blank.
ENTER to continue with Deletion

```
ERASE ONE SAMPLE
XXXXXXXXXX   YES
```

⬅ Toggles YES or NO
ENTER

```
CONFIRM ERASE
XXXXXXXXX  YES
```

⬅ Toggles YES or NO
ENTER

```
SAMPLE #:  XXX
HAS BEEN ERASED
```

Returns to

Displayed for 5 seconds then returns to
STATUS: SAMPLE #

EXAMPLE OF MEMORY AND I/O CONFIGURATION
SAMPLE DELETE BY DATE

MAIN MENU

| MEMORY AND I/O CONFIGURATION |

ENTER to begin SUB MENUS.
⬅ Toggle to: DELETE SAMPLE

EXAMPLE DELETE BY DATE

SUB MENU

| DELETE SAMPLE BY DATE OR #?   DATE |

⬅ Toggles between # and Date
ENTER

| SELECT SAMPLES DATE: 18AUG95 |

⬅ ➡ Scrolls through different Dates
for which one or more samples
were recorded.
ENTER to select sample(s) for Deletion.

| DELETE 18AUG95 SAMPLES   YES |

⬅ Toggles YES or NO
ENTER CAUTION: When deleting
by Date all sample(s) with that date will
be erased.

| DELETE 18AUG95 CONFIRM?   YES |

➡ Toggles YES or NO
ENTER

Returns to

| X SAMPLES DATED 18AUG95 DELETED |

Displayed for 5 seconds then returns to
SELECT SAMPLES DATE.

EXAMPLE
SERIAL RS232 CONFIGURATION

MAIN MENU

MEMORY AND I/O
CONFIGURATION

ENTER to begin SUB MENUS. Then
⬅ Press to: STATUS: SERIAL

SUB MENU

STATUS: SERIAL
9600   OFF   1

ENTER to change configuration. Displays
actual configuration.In this example, the de-
fault is shown.

Returns to

CHANGE SERIAL:
BAUD RATE: 9600

⬅ ➡ Scrolls through 300, 600,1200,
    2400, 4800, and 9600.
ENTER to accept.

CHANGE SERIAL:
PARITY: OFF

⬅ ➡ Scrolls through OFF, EVEN, ODD

ENTER to accept.

CHANGE SERIAL:
STOP BITS: 1

⬅ ➡ Scrolls through 1, 1.5, 2
    ENTER to accept and return to
    STATUS: SERIAL.
⬆ To SAVE and return to Main Menu

SAMPLING REPORT & CHAIN OF CUSTODY FORM
(THIS IS AN EXAMPLE, YOUR'S MAY BE DIFFERENT, DEPENDS ON PRINTER USED)

BUCK CALI-LOGGER™

SAMPLING DATE: 24JAN95

COLLECTOR: MICHAEL

SAMPLING SITE: BATTERY PLANT

COMPANY: A.P. BUCK, INC.
ADDRESS: 7101 PRESIDENTS DR. STE 110
CITY, ST, ZIP: ORLANDO, FL 32809
TELEPHONE: 407-851-8602

SAMPLE: LOT NUMBER _____ CASSETTE SIZE_____
BATCH NUMBER _____ FILTER PORE SIZE _____

Sample No.	Pump No.	Start Time	Elapsed Time	Start Flow	Stop Flow	Avg. BP	Avg. Temp	Total Volume	Volume (Stp)	Analyze For
				1pm	1 pm	inHg	degF	Liters	Liters	
FZ8900010	106	07:30	08:00	2.002	2.017	30.51	72	964.6	992.9	
BK890088	444	09:00		1.461		30.31	73	ABORTED SAMPLE		
123456789	123	06:00	17:00	4.071	4.009	30.31	74	4120.8	4199	
9589002		08:00	03:00			30.31	73	BADGE SAMPLE		
B85901	654	08:00	06:00	4.039	4.012	30.31	73	1449	1476	
89A0134	111	03:30	08:00	4.060	3.727	30.31	72	1869	1912	
300001	879	08:00	06:30	0.490	0.049	30.26	74	191.3	194.7	
30BAA02	789	08:00	04:00	1.033	1.009	30.28	74	245.1	249.6	
098765431						30.41	72	SAMPLE BLANK		

Sampling remarks:_____

Sample Receiver:
1. _____
Name and address of organization receiving sample
2._____
Chain of Possession
1._____   _____   _____
signature   title   inclusive dates
1._____   _____   _____
signature   title   inclusive dates

I.H. PUMP CALIBRATION & PROGRAMMING
WITH PUMPS **USING VERSION 18 3-95 OR OLDER** SOFTWARE

The Buck Cali-Logger will provide direct calibration and programming of the Buck I.H. Pump™ through the RS-232 connection of each unit. A cable with 9 pin RS-232 connectors is provided with the purchase of both units or may be ordered separately. Use of a commercial RS-232 cable is NOT recommended.
NOTE: The Cali-Logger will help automate working with non-I.H. pumps and pumps from other manufacturers. However, the pump programming and Cali-Logger data entry will vary somewhat depending upon which pump is being used. A Table overview of the displays using the I.H. pump follows this page.

OPERATION

Turn each unit on, then connect the data cable to the pump. The pump can be in any display mode. The Cali-Logger must be placed in the FLOW CALIBRATION PROCE-DURES menu. When ENTER is pressed on the Cali-Logger, the next display will ask for a sample number. This sample number must be the sample number of the filter currently attached to the pump. Once the number is entered and ENTER is pressed, the Cali-Logger will take control of the pump by doing two events:

- It reads the pump number into memory and verifies communication is established. If not, a warning is displayed on the Cali-Logger to verify cable connection. With communication established, the pump is turned on to the MAXIMUM flow point for calibration. Perform Primary Flow tests until the result is 2% or lower and press ENTER. The pump will next go to MINIMUM flow point.
- The second event will be to again perform a Primary Flow test until results are 2% or lower. A minimum of two tests are necessary for each of the MAX/MIN points.

The pump number is read automatically into the Cali-Logger memory for use in the printing of the "Chain of Custody Form". If another number is desired, change it under the EDIT menu prior to printing the Form.

The balance of the menus are self-explanatory or presented on the following page of this manual.

Cali-Logger Auto Programming a Buck I.H. Pump
With Version 18 3/95 Software
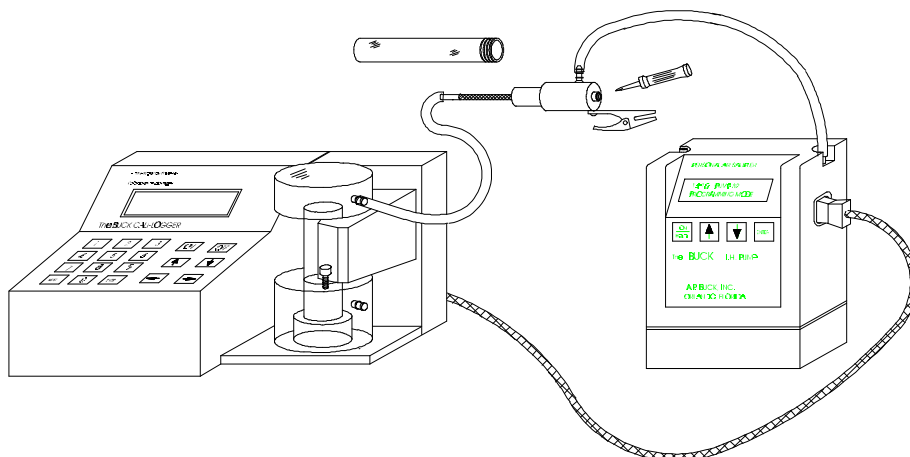
Drawing of Cali-Logger programming an I.H. Pump for gas sam-

1).Turn on Cali-Logger and pump. 2).Connect data cable from Cali-Logger to pump. 3).Connect pump and filter to flow cell.

Step #	Cali-Logger Display	Cali-Logger Data Entry / Actions	Pump Display
01	**14FEB96** **07:30** **T: 70F** **B:30.02in**	Display after both Cali-Logger and Pump have finished power up self-test. Press the ↑ key on the Cali-Logger	**07:30** **PUMP 29152** **PROGRAMMING MODE**
02	**FLOW CALIBRATION** **PROCEDURES**	Press ENTER.	**07:31** **PUMP 29152** **PROGRAMMING MODE**
03	**SAMPLE # NEEDED** **SAMPLE=?????????**	Use ↑ to return to previous display, ↓ to delete character ← & → to scroll alphabet. Use keypad for #'s. **ENTER.**	**07:32** **PUMP 29152** **PROGRAMMING MODE**
04	**HI-FLOW MAXIMUM** **ACTUAL: 3864cc/m**	Pump is running at maximum flow. Test for a minimum of two bubbles. Then **ENTER.** (See Note #1)	**100% 70F 07:32** **AUTO : PROGRAM**
05	**HI-FLOW MINIMUM** **ACTUAL : 933cc/m**	Pump is running at minimum flow. Conduct two bubble tests, Press ENTER. Pump stops. (Note # 2)	No change in pump display until step 22.
06	**SET DESIRED FLOW** **RATE: 2000cc/m**	Use ← & → to set desired flow rate for pump. Press **ENTER**. (Note # 3)	"
07	**SET START TIME** **FOR TEST: 08:00**	Use ← & → to scroll hours or minutes. Use ↓ to toggle cursor between hours & minutes. Press **ENTER.**	"
08	**SET SAMPLE RUN** **DURATION: 08:00**	Use ← & → to scroll time. Use ↓ to toggle cursor. Use ↑ to return to previous display. Press **ENTER.**	"
09	**SET 5 MIN CYCLES** **Yyyyyyyyyyyy / HR**	Use same keys as steps 7 & 8 above. Use ↓ to toggle **Y** or **N**. See Pump Manual for details on 5 min. cycle use.	"
10	**ENTER START TIME** **BREAK # 1: 10:00**	Use same keys as steps 7 & 8 above. Note: Cali-Logger will ignore invalid time entries.	"
11	**ENTER TOTAL TIME** **BREAK # 1: 15min**	Use same keys as steps 7 & 8 above.	"

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Step #	Cali-Logger Display	Cali-Logger Data Entry / Actions	Pump Display
12	ENTER START TIME FOR LUNCH 12:00	Use same keys as steps 7 & 8 above.	"
13	ENTER TOTAL TIME FOR LUNCH: 60min	Use same keys as steps 7 & 8 above.	"
14	ENTER START TIME BREAK # 2: 15:00	Use same keys as steps 7 & 8 above	"
15	ENTER TOTAL TIME BREAK # 2: 15min	Use same keys as steps 7 & 8 above	"
16	ELAPSED TIME IS 06:30 OK ? YES	Use ← & → to toggle **Y** or **N**. Use ↑ το return to previous display.	"
17	PRIMARY FLOW (PF) CALIBRATION.	Pump starts for primary flow calibration. No action, momentary display.	"
18	PRIMARY FLOW (PF) STARTING DATA	No action, momentary display.	"
19	PF= 2023cc/m MAKE 1ST PF TEST	Depress flow cell button to make bubble and test flow.	"
20	PF= 2012cc/m REPEAT TEST	Repeat bubble test until difference in step (21) is less than 2%.	"
21	PF= 2008cc/m DIFFERENCE 0.4%	Actual flow is displayed. To change flow use ↑ to return to step 6, then raise or lower flow. Press **ENTER**.	100% 70F 07:32 AUTO: PROGRAM
22	SAMPLE # NEEDED SAMPLE=?????????	Pump is calibrated and programmed. Cali-Logger is ready to program the next pump with filter. (Note # 4).	100% 71F E00:00 AUTO: WAIT
	See Notes Below		**See Notes Below**

NOTES:

1). Display shown in cc/m is for a model C-5 flow cell. A M-30 flow cell display will be in LPM. The displayed flow is the maximum flow with this pump and filter combination and will vary by pump type and filter media.

2). Displayed flow in this example is with a 37mm 0.8 micron 3 piece cassette and is the minimum for this pump and filter combination.

3). Later on, the programming procedure will allow the user to return to this step to allow fine tuning of the pump flow rate.

4). Disconnect pump from Cali-Logger. Do not turn pump off, and pump will start sampling as programmed. The above example shows an I.H Pump programmed at 7:32 am to begin sampling at 8:00 am the same day. However, batteries will be drained at 5% per hour while in AUTO: WAIT. If sampling start time is not to start, within a couple hours of programming, the pump should be turned off: **1)-**Press **HOLD**. **2)-**Enter key pad code if requested 1,2,3,4. **3)-**Press **ENTER**. **4)-**Use arrow to toggle to **YES, press ENTER** to turn off pump. **5)-**At sampling site and before the programmed auto start time, press **ON** to turn pump on, wait until self test is finished, now press **ENTER** to reactivate AUTO:WAIT and pump motor will start at programmed time.

I.H. PUMP CALIBRATION & PROGRAMMING
WITH **VERSION 95.XX PUMPS**

The Buck Cali-Logger will provide direct calibration and programming of the Buck I.H. Pump™ through the RS-232 connection of each unit. A cable with 9 pin RS-232 connectors is provided with the purchase of both units or may be ordered separately. Use of a commercial RS-232 cable is NOT recommended.

NOTE: The Cali-Logger will help automate working with non-I.H. pumps and pumps from other manufacturers. However, the pump programming and Cali-Logger data entry will vary somewhat depending upon which pump is being used. A Table overview of the displays using the I.H. pump follows this page.

OPERATION

Turn each unit on, then connect the data cable to the pump. The pump can be in any display mode. The Cali-Logger must be placed in the FLOW CALIBRATION PROCE-DURES menu. When ENTER is pressed on the Cali-Logger, the next display will ask for a sample number. This sample number must be the sample number of the filter currently attached to the pump. Once the number is entered and ENTER is pressed, the Cali-Logger will take control of the pump by doing two events:

• It reads the pump number into memory and verifies communication is established. If not, a warning is displayed on the Cali-Logger to verify cable connection.

The pump number is read automatically into the Cali-Logger memory for use in the printing of the "Chain of Custody Form". If another number is desired, change it under the EDIT menu prior to printing the Form. **Warning**: If the enter Pump Number display appears with an I.H. pump and the cable is connected, the two are not com-municating and must be corrected to proceed as described.

The balance of the menus are self-explanatory or presented in other parts of this manual.

VERSION 95.XX I.H. PUMP

I.H. Pump with Version 95 software. The most dramatic change is the elimination of the Maximum, Minimum and Set Desired Flow Rate. Now, a single calibration point is established after changing the Power Bar Scale by physically pressing the arrow key on the Pump Keypad.

The next page presents a table at programming events. Refer to Pump manual for further details of Version 95.XX software.

Cali-Logger Auto Programming a Buck I.H. Pump
With Version 95.XX Software
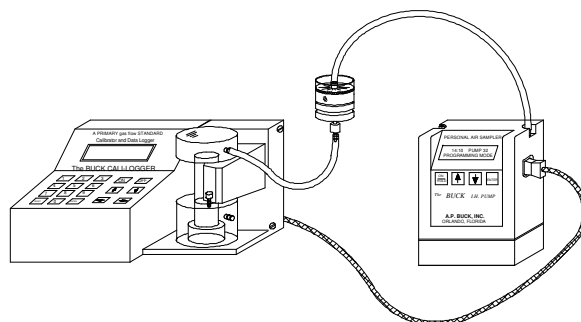
1).Turn on Cali-Logger and pump. 2).Connect data cable from Cali-Logger to pump. 3).Connect pump and filter to flow cell.

Step #	Cali-Logger Display	Cali-Logger Data Entry / Actions	Pump Display
01	**17FEB96 07:30** **T: 70F B:30.02in**	Display after both Cali-Logger and Pump have finished power up self-test. Pump display alternates between time/date and battery/temperature/elapsed time. Press ↑	**7:30A 17Feb96** **100% 73F 0:00E** **SAMPLING MODE**
02	**FLOW CALIBRATION** **PROCEDURES**	Press **ENTER** key. (See Note # 1).	No change in pump display until step 4.
03	**SAMPLE # NEEDED** **SAMPLE=????????<u>?</u>**	Use ↑ to return to previous display, ↓ to delete character ← & → to scroll alphabet. Use keypad for #'s. Press **ENTER** to accept sample #.	"
04	**ARROW & HOLDER** **TO ADJUST FLOW**	Momentary Cali-Logger status display. Pump display now alternates between time/date and Cali-Logger Mode.	**7:30A 17Feb96** **CALI-LOGGER MODE** **SET TIME ON CALI-LOG**
05	**SET START TIME** **FOR TEST: <u>0</u>8:00**	Use ← & → to scroll hours or minutes. Use ↓ to toggle cursor between hours & minutes. Set time on Cali-Logger. Press **ENTER**.	No change in pump display until step 15.
06	**SET SAMPLE RUN** **DURATION: <u>0</u>9:00**	Use ← & → to scroll time. Use ↓ to toggle cursor. Use ↑ to cancel programming. Press **ENTER**.	"
07	**SET 5 MIN CYCLES** **<u>Y</u>yyyyyyyyyy / HR**	Use same keys as steps 5 & 6 above. Use ↓ to toggle Y or N. See Pump Manual for details on 5 min. cycle use.	"
08	**ENTER START TIME** **BREAK # 1: <u>1</u>0:00**	Use same keys as steps 5 & 6 above. Note: Cali-Logger will not accept invalid time entries.	"
09	**ENTER TOTAL TIME** **BREAK # 1: <u>1</u>5min**	Use same keys as steps 5 & 6 above.	"
10	**ENTER START TIME** **FOR LUNCH: <u>1</u>2:00**	Use same keys as steps 5 & 6 above.	"

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Step #	Cali-Logger Display	Cali-Logger Data Entry / Actions	Pump Display
11	ENTER TOTAL TIME FOR LUNCH: 30min	Use same keys as steps 5 & 6 above.	"
12	ENTER START TIME BREAK # 2: 15:00	Use same keys as steps 5 & 6 above.	"
13	ENTER TOTAL TIME BREAK # 2: 15min	Use same keys as steps 5 & 6 above.	"
14	ELAPSED TIME IS 07:30 OK ? YES	Use ← to toggle **Y** or **N**. **N**o, returns user to step 5. **Yes**, onto next step. Press **ENTER.**	"
15	PRIMARY FLOW (PF) CALIBRATION	Pump starts for primary flow calibration. No action, momentary information display.	**press ENTER ON CALI-L** WAIT: 20 SECONDS [l] [l] [l] **24%**
16	PRIMARY FLOW (PF) STARTING DATA	No action, momentary information display.	**CALI-LOGGER SET !** WAIT: 17 SECONDS [l] [l] [l] **24%**
17	PF= 2044cc/m MAKE 1ST PF TEST	Depress flow cell button to make bubble and test flow. Use ↑ & ↓ arrows **on the pump** to adjust rate of flow. Repeat these actions to set desired flow. (See Note # 2).	**press ENTER ON CALI-L** WAIT: 14 SECONDS [l] [l] [] **22%**
18	PF= 2007cc/m REPEAT TEST	Repeat bubble test until difference in the next step (19) is less than 2% for I.H. Pumps.	**CALI-LOGGER SET !** WAIT: 9 SECONDS [l] [l] [] **22%**
19	PF= 2008cc/m DIFFERENCE 0.4%	Actual flow is displayed, to adjust flow use ↑ & ↓ arrows **on the pump**, to get desired flow. Press **ENTER**.	**press ENTER ON CALI-L** WAIT: 4 SECONDS [l] [l] [] **22%**
20	SAMPLE # NEEDED SAMPLE=?????????_	Pump is calibrated and programmed. Cali-Logger is ready to program the next pump with filter. (Note #3). Moving Display: **WILL START: 8:00A 17Feb96**	**DELAY START** **7:32A 17Feb96** **WILL START: 8:00A 17F**
	See Notes Below		**See Notes Below**

NOTES:

1). All Data Entry / Actions are via the Cali-Logger keys except for the pump power scale adjustment in step # 17 to # 19.

2). Display shown in cc/m is for a model C-5 flow cell. A M-30 flow cell display will be in LPM. The displayed flow is the flow with this pump and filter combination and will vary by the individual pump, pump type and filter media.

3). Disconnect pump from Cali-Logger. Do not turn pump off, and pump will start sampling as programmed. The above example shows an I.H Pump programmed at 7:32 am to begin sampling at 8:00 am the same day. However, batteries will be drained at 5% per hour while in **DELAY START**. If sampling start time is not to start, within a couple hours of programming, the pump should be turned off: **1)-**Press **HOLD**. **2)-**Enter key pad code if requested 1,2,3,4. **3)-**Press **ENTER**. **4)-**Use arrow to toggle to **YES,** press **ENTER** to turn off pump. **5)-**At sampling site and before the programmed auto start time, press **ON** to turn pump on, wait till self test is finished, now press **ENTER** to reactivate **DELAY START** and pump motor will start at programmed time.

SPECIFICATION

A.   PROGRAMMING

The Cali-Logger provides an extensive menu-driven interface to the operator, using the keypad and a 2 row X 16 character liquid crystal display. Examples and overview of the menus are provided in Section 5. This section provides a verbal description of the operation and functionality of the Cali-Logger software, and will define menus and system responses to possible user inputs at each Main Menu and Sub Menu.
The Cali-Logger has 6 distinct functions:

1.   Power Up including diagnostics
2.   Clock Menu allowing review and update of Date & Time and review-only of Temperature and Barometric Pressure.
3.   Calibration Menu allowing the user to create new samples and perform a Primary Gas Flow calibration.
4.   Sample Data Edit (or input) Menu allows the user to enter or edit data associated with the sample number from the Calibration Menu. Data to input/edit is, pump number, date, primary flow, start time, average temperature and barometric pressure. Start, Stop PF and Run Time are not editable.
5.   Data Output Menu allows the user to select where the Cali-Logger should output a report detailing all sample data currently saved in its battery backed RAM, and then actually writing the formatted report to the selected device, either a personal computer or a printer.
6.   Memory and I/O Configuration Menu allows the user to input Form Header information, delete stored samples and modify various system configuration options.

Each of these functions is discussed in more detail below:

Power Up Diagnostics
This test will be performed only once upon power up of the unit. It will conduct the following diagnostic tests:

♦   Testing of the battery backed RAM.
♦   Verify main power battery source is above 4.4 VDC.
♦   After 1 second from power up, verify the temperature sensor reads between 0 and 49 ° Celsius.
♦   Verify the barometric pressure sensor reads between 500 and 850 mm Hg.
♦   Verify the primary flow sensors (start and stop) are functional

If any of these tests fail, the user shall be immediately informed by an error message to the LCD Display and the user shall be forced to acknowledge the problem (by pressing ENTER). The Cali-Logger will then be usable though its functionality may be limited by the problem that was brought to the user's attention. If diagnostics pass, a "ALL SYSTEMS ARE OK" message shall be displayed for 3 seconds before the Cali-Logger becomes operational.

Clock Menu

This menu will allow the user to view the current time and date as stored in the clock chip, and modify those values which are determined incorrect. The main screen will show four values: Time, Date, Temperature and Barometric Pressure.
The latter two values are provided by sensors in the C-5 or C-30 Flow Cell and are not user modifiable. The user shall be allowed to select whether the temperature value is displayed in degrees Celsius or degrees Fahrenheit. The degrees displayed will be used throughout the remaining menus of the Cali-Logger whenever the temperature value is to be displayed or used in a calculation. Temperature shall be displayed in the range 0-49 degrees Celsius (32-120 degrees Fahrenheit). The user is allowed to select whether the barometric pressure value is displayed in millimeters of Mercury (mm Hg) or in inches of Mercury (Hg). The current barometric pressure display option is used throughout the remaining menus whenever the barometric pressure value is displayed. Barometric Pressure shall be display in the range of 523-815 mm Hg or as a floating point value in the range 20.6-32.0 in Hg.

Calibration Menu

The Calibration Menu will allow the user to create a sample number and to make PF readings. The following data items are stored in the battery backed RAM:

♦ Sample Number of nine digits in length.
♦ Pump Number (a 3 digit number may be inputted or press ENTER to leave blank)
♦ Starting Primary Flow rate.
♦ Ending Primary Flow rate.

Sample numbers adhere to the following protocol:

1 Sample numbers for cassettes and tube samples are allowed for any alphabetic or numeric digit NOT beginning with the digit "9" up to nine digits each.
2 A passive badge vapor monitor will be identified as a BADGE sample if the "9" digit begins the sample number.
3 A sample blank will be identified if, under the calibration menu, the user makes a zero "0" the leading number.
4 Primary flow tests are not allowed for either a BLANK or BADGE SAMPLE.
5 Blank samples do not allow input of temperature and B.P.
6 Badge samples allow input of temperature and B.P. values.

Once this menu is selected, the user is required to enter a sample number by the keypad. If the sample number selected is not found in the battery backed RAM but the RAM is full of samples, an error message shall be displayed. If there is room for a new sample and it is to be a flow sample or if the sample number selected has only starting data saved, the user may perform a (PF) calibration procedure. This procedure is defined as follows:

1 User must take at least two bubble tests.
2 After each test, an averaged PF rate is displayed, computer by the
   formula: $AVE(1) = PF(1)$
                $AVE(n) = (AVE(n-1) + PF(n)/2$
                 n = bubble test number
3 Beginning after test #2 and after all subsequent tests, a difference factor is displayed and computer by the formula
                $R = [ABS(PF(n) - PF(n-1) / PF(n))] * 100$
4 Start PF reading can only be performed on initializing a new sample number. Once saved (by pressing ENTER for acceptance), the START PF will not allow change or editing.
5 Only after START PF has been saved, can STOP PF be conducted.

Sample Data Edit Menu

This Menu will allow the user to examine data for a previously saved sample and modify these values: pump #, time, date, temperature or barometric pressure values. The Cali-Logger will save up to 100 samples in the battery backed RAM.

The average temperature and barometric pressure shown on the displays are from the internal Cali-Logger flow cell sensors. These readings are the readings obtained at the time of the START and STOP PF test. These readings are editable to allow changes for field conditions.

The barometric pressure sensor has a range of 523 to 815 mm of Hg. By user input, the calculated STP can be provided from 523 to 990 mm of Hg. (This will handle depths as in mines below the surface). The temperature and barometric pressure readings shown on the display are used in the STP calculation on the Chain of Custody Form.

Data Output Menu

This Menu shall allow the user to output a report concerning the saved samples in battery backed RAM to an external PC or printer.

When the user selects the printer as the output device, an extra verification prompt shall be issued and answered by the user before the output actually occurs. Once the output is started, it shall continue until complete. If the printer is not ready, the output will time-out in sixty (60) seconds.

The format of the sample data report is fixed within the Cali-Logger and is not user adjustable. The user is allowed to modify the company, address, collector and sampling site using the Memory and I/O Configuration Menu. All other display information will be filled in by the Cali-Logger automatically. If no samples are found in memory, a message stating so will be displayed in the area of the report reserved for the sample data. Otherwise, the report shall output all samples saved in the Battery Backed RAM. The samples shall be output such that each page of output contains 10 samples which were recorded with the same Date.

The output data may be directed to a personal computer by a serial cable and the provided software program. The data may be saved by a user defined file name for any specified date or all sample stored in the Cali-Logger. This output requires the Serial Communication Program (P.N. APB-107024).

Memory and I/O Configuration Menu

This menu allows the user to modify three different parameters:

1   This Chain of Custody Form may have the header portion changed for address, sampling site and collector. The user can edit one line at a time. Each line may be erased by pressing the RESET key.

2   This Sub Menu erases sample data stored in memory by the sample number or the date. The user is allowed to select all sample numbers or an individual number. On the sort for each sample, the display will indicate the status as partial, full, badge or blank sample. If the user chooses to delete by date, the LEFT & RIGHT ARROW will scroll those stored in memory. A confirmation will prompt the user to prevent accidental eraser.

3   The RS-232 serial port is adjustable for Baud Rate of 300,600,1200,2400,4800 or 9600. The power up default is 9600 to match the Bar Code Wand and the Serial Communications program. Also adjustable is the Parity as OFF, ODD or EVEN the default is OFF. The STOP BITS are adjustable for 1, 1.5 and 2. The default for the STOP BITS is 1.

Report Form

       The format of the report form is set in the Cali-Logger Program.   The report form is titled "Chain of Custody Form". The purpose is to provide traceability of a sample from start until shipment to the laboratory for analysis. This is documented for each sample by date and number, an example   from the form is shown below:

EXAMPLE OF CHAIN OF CUSTODY FORM FORMAT

Sample No.	Pump No.	Start Time	Elapsed Time	Start Flow cc/m	Stop Flow cc/m	Avg. BP inHg	Avg. Temp. degF	Total Volume Liters	Volume (Stp) Liters	Analyze For
FZ8900010	106	07:30	08:00	2.002	2.017	30.51	72	964.6	992.9	

This report is the only location in which the calculated Total Volume for the sample is displayed. The Form may be printed or observed from a PC screen. The calculation is the average of the START and STOP primary flows multiplied by the elapsed time for the sample. All samples are printed 10 at a time on the Form by their sample date. When there are more than 10 samples, the balance will be printed on the next 8½ x 11 form until all samples for that day are printed.

Under the column marked Volume (STP), liters is is the calculated volume corrected to Standard Temperature and Pressure (STP). Defined as 25° Celsius and 760 mm of Mercury (Hg) and calculated by the following equation:

$$\text{VOLUME (STP)} = \text{VOLUME} \times \left[\frac{P}{760 \text{ mm}} \times \frac{298K}{T + 273°K} \right]$$

        P = actual barometric pressure in millimeter of Mercury
        T = actual temperature in Celsius

Pressure changes of less than 250 ft. in altitude are ignored. This represents 1% accuracy. Altitudes from sea level up to 10,000 ft. are corrected to STP with a sensitivity of 250 ft. increments.

Temperature changes are performed in the range of 0 to 49 degrees Celsius or 32 to 120 degrees Fahrenheit. The temperature readings are accurate to ±1° Celsius.

The Chain of Custody Form can have the information at the top, modified by the user of the Cali-Logger. Under the Main Menu, MEMORY I/O CONFIGURATION, Sub Menu HEADER, the name and address, collector and sampling site can be edited.

K.   Battery Saver/Memory Guard

     The Buck Cali-Logger will automatically turn off for either of the following two reasons:

     1. If idle for 7 minutes
     2. Low batteries will display for 5 seconds, "Battery too low, use A/C adapter" and then turn off. This prevents the batteries from ever being discharged to the level where the battery backup memory storage could be affected.

SPECIFICATION OF THE CALI-LOGGER

B. ELECTRICAL SPECIFICATIONS

This section summarizes the electrical, sensors, software and peripherals used in the Cali-Logger.

ELECTRICAL
Microprocessor controlled. The Cali-Logger utilizes a 80C85 microprocessor.

Operating Power

Operating power is by a four cell 5 volt NiCad battery pack integral to the Cali-Logger. A charging circuit is provided in the Cali-Logger capable of charging the batteries at manufacturer recommended levels. An A/C charger/adapter is also provided to allow the Cali-Logger to operate from AC power while supplying a charge to the NiCad battery pack.

Power On-Off

A single momentary push button switch permits the user to turn the Cali-Logger on. In the OFF condition, power is removed from all components except the charging circuit while maintaining the sample data in the battery-backed RAM and to maintain the calendar clock chip.

Two methods are provided to place the Cali-Logger in the OFF condition:

♦ Pressing the OFF push button on the keypad for a minimum of 0.5 seconds will cause the Cali-Logger to turn OFF.

♦ The Cali-Logger will automatically turn off per above whenever no user input has been detected within the previous seven minutes.

LCD Display

A two line by sixteen character (2x16) LCD display is used in the Cali-Logger for display of alphanumeric information.

Sensors

The Cali-Logger utilizes the following sensors which provide the indicated data values:

Temperature Sensor
Temperature. A glass coated thermistor visible through a port hole in the rear cover Display range is 0° to 49° Celsius or 32° to 120° Fahrenheit. Accuracy is ±1% Celsius.

Barometric Pressure
A piezoresistive device with automatic or built in temperature compensation. Range 523 mm to 774mm of Mercury (Hg) Barometric Pressure (500 ft. below sea level to 10,000 ft. altitude). Accuracy 1% mm of Hg displayed reading. Manual input by keypad of the BP to pressures of 990mm approximately -10,000 ft. is allowed for the depth of mines.

Primary Gas Flow
Two - infrared optical sensors measure the passage of the soap film across a fixed volume per unit of time. Timer speed for this measurement is 50 microseconds.

The Cali-Logger supports the following external peripherals:

Bar Code Reader
The Cali-Logger is capable of interfacing to a Hewlett Packard Smartwand HBCR-8300 code reader for reading sample labels. A RS-232, 9 pin Subminiature D type socket connector is on the rear for interface to the Bar Code Reader and PC's. Additionally, a +5 VDC power is provided on the connector (9th pin of the RS232) to support the Bar Code reader. The connector is configured such that no special cabling or modifications to the Bar Code reader are required.

Computers

The Cali-Logger will support communication with an IBM.PC or 100% compatible personal computers via the RS-232 interface port. The Bar Code reader and computer are mutually exclusive; only one may be connected at a time. A special cable is required to support the computer interface and a program is available on 3½ "floppies" for communication to the PC. This allows for a download of sample data to a computer disk for storage or use in an Application Program which can read an ASCII data file. The following pins are identified for user information:

Cali-logger 9 pin (female)		Computer (PC) 9 pin (female)		Computer (PC) 25 pin (female)
No. 2	To	3	Or	2
No 3	To	2	Or	3
No 7	To	5	Or	7

Printers

The Cali-Logger as a minimum, will support the following 9" wide printers using a parallel interface:

Epson FX80
Epson RX80
Diconix 150 (parallel interface)

Most printers will communicate with the same software drivers. A 25 pin Sub-miniature D socket type connector on the rear of the Cali-Logger is provided for connection of the printer.

MAINTENANCE OF CALIBRATOR

Clean Flow Cell

First, remove flow cell (2 screws) from keypad base,secondly remove flow cell (3) screws) from flow cell stand, then squirt a few drops of calibration soap into slot between flow cell base and flow cell chamber to ease removal of base. Gently insert a coin or a flat screwdriver into the ridge between the bottom plate and chamber gently use leverage around the circumference of the cell until the cell base is removed.

Wipe surfaces with a damp towel using a mild cleaner to remove dirt/stains. Apply or spray cleaner on to a towel, never spray cleaners directly onto the Cali-Logger. As with any electronic device, - do **not** submerge or spray Cali-Logger or flow cell base with liquids. For stubborn dirt, use a dishwashing soap and warm water on a towel, Shake all water from the cell and dry outside surface with a soft cloth.

The acrylic flow cell can be easily scratched. NEVER clean with ACETONE.* Wet O-ring with soap solution prior to re-installation of bottom plate to the flow cell.

Add soap solution and run a bubble up the chamber to eliminate water spots inside the tube. Use hose fitting caps to prevent evaporation of soap solution.

Battery Replacement

A.) First, SAVE any sample data to PC or Printer output. Remove the back panel of the keypad base (2 screws top back, 1 screw each side) and disconnect the 4 wire (1 red, 1 blue, 2 black) connector from the keypad circuit board. Next, remove A/C adapter from back panel using a 3/8 inch nut driver.
B.) Remove the bottom panel (2 screws) and lift out battery pack. (Any sample data in memory will be lost).
C.) Install new pack and reassemble.
D.) Charge for 16 hours.
E.) Clear memory storage as stated in Section 10, No. 5.

LCD Display
No adjustment is necessary.   A slight difference in intensity is observable when charger is plugged in. Display will dim as batteries reach 4.4 volts - the automatic shut off level.

CALIBRATION CERTIFICATION

Primary Flow
The Cali-Logger is factory calibrated using a standard traceable to National Institute of Standards and Technology (NIST). User attempts to verify calibrator against a glass, one liter buret may be conducted at 1000 cc/min. for maximum accuracy. This will minimize error induced by technician/stop watch response time. The calibrator is linear throughout the entire range.

Barometric Pressure
This is not a field adjustable sensor. Return to factory if readings vary more than 1% (or ± 0.30 Hg) from the current local weather station.

Temperature Sensors
These sensors, one for temperature display and one for B.P. compensation, are not field adjustable. Return to factory if reading various more than ±1% of the Celsius scale. Allow time (one hour minimum) for sensor to acclimate to ambient temperature.

Charges for Calibration Services
Factory verification of (N.I.S.T.) for primary flow will be conducted as a service to Cali-Logger owners. The charge for calibration including the barometric pressure and temperature sensors is $175.00, shipped prepaid, RMA # is required.

Note: The Cali-Logger base does not require calibration. Only the flow cell (C-5 or C-30) needs to be returned for calibration. Within the Sub-Menus, the primary flow reading in the Cali-Logger menus are not adjustable by user input, but both the barometric pressure and the temperature sensors are adjustable. These inputs, as shown on that display, are used in calculating the S.T.P.

POWER REQUIREMENTS FOR THE CALI-LOGGER

1. The battery supply utilizes four (4) NiCad Sub C batteries. The unit will operate up to six (6) hours on a fully charged battery. The unit may also be operated directly from the AC charger when batteries are low.

2. Low battery indication on display will indicate the power supply is too low for accurate results.

3. Charge battery pack for sixteen (16) hours minimum using the A/C adapter charger. Connect to 110 VAC 50 or 60 Hertz outlet.

4. A special power saving feature is the Automatic Shut Off. After seven (7) minutes of non-use, the Cali-Logger will shut off automatically.

5. Memory back up battery power is also obtained from the Sub C battery supply. If disconnected, all memory stored is lost. On battery replacement, the Form Header may be re-entered by following the steps under the menu MEMORY AND I/O CONFIGURATION.

PRECAUTIONS OR WARNINGS

1. Avoid the use of chemical solvents on flow cell, Cali-Logger case and face plate. Generally, soap and water on a damp towel will remove any dirt.

2. Never pressurize the flow cell at anytime with more than 25 inches of water pressure.

3. Hose fitting covers help to reduce evaporation of soap in the flow cell when not in use.

4. The BUCK Calibrator soap is a precisely concentrated and sterilized solution formulated to provide a clean, frictionless soap film bubble over the wide, dynamic range of the calibrator. The sterile nature of the soap in important in the prevention of residue build-up in the flow cell center tube which could cause in-accurate readings. The use of any other soap solution is not recommended.

PARTS, ACCESSORIES & CONSUMABLES

	PART #
A/C Adapter Charger	APB-107018
Soap (8 oz. bottle)	APB-107030
Soap dispenser bottle (1 oz.)	APB-107032
Instruction manual	APB-107022
Air inlet caps (Pkg. of two)	APB-107014
Sub C battery pack w/connectors	APB-107000

MINIMUM ORDER: $25.00 FOB Orlando, Florida

SERVICE POLICY FOR OUT OF WARRANTY WORK

For a minimum of $300.00, A.P. Buck, Inc. will repair and return the Cali-Logger to its original condition. If major components must be replaced, the customer will be notified before repairs are performed and actual costs provided for his/her approval.

When a calibrator is to be returned, please call to obtain an RMA# prior to returning so we can track your unit while in-house. Also include a purchase order marked "Repair Cost not to Exceed $300.00 without Customer Authorization". Also include company name, return shipping address, contact name and phone number, serial number of unit, date of purchase and description of any problems. Please put RMA# on the outside of the box. Return to:

A.P. Buck, Inc.
7101 Presidents Dr., Suite 110
Orlando, FL 32809
(407) 851-8602

BUCK CALI-LOGGER BASIC PACKAGE
AND ACCESSORIES

Consists of a Keypad Base,software and I/O data cable, one Flow Cell (either C-5 or C-30), A/C adapter, soap solution, dispenser bottle and manual.

Kit Part No. C-5   APB-705000
Kit Part No. C-30   APB-703000

OPTIONAL ACCESSORIES FOR THE BUCK CALI-LOGGER

Flow Cell: Model C-5 (Part # APB-705012)
Flow Range: 1 cc/min. to 6,000 cc/min.
Barometric Pressure Range: 523mm to 815mm of Hg
Temperature Range: 0 to 49 degrees Celsius

Flow Cell: Model C-30 (Part # APB-703012)
Flow Range: 100 to 30 L/min
Barometric Pressure Range: 523mm to 815mm of Hg
Temperature Range: 0 to 49 degrees Celsius

Serial Communication Program (Part # APB-107024)
A communication package consisting of a program to download sample data files to a floppy disk on a PC. Includes one 3½" floppy.

Communication Cable (Part # APB-107010)
9 pin, RS-232 connectors for use with Buck Cali-Logger Communication Program. (Note: Cable may also be used for communication to the Buck I.H. Pump™)

Carrying Case (Part # APB-107016)
Convenient carrying case to accommodate Buck Cali-Logger, additional flow cell, A/C adapter, soap solution and dispenser bottle.

WARRANTY

The seller warrants to the Purchaser that any equipment manufactured by it and bearing its name plate to be free from defects in material or workmanship, under proper and normal use and service, as follows: if, at any time within 1 year from the date of sale, the Purchaser notifies the Seller that in his opinion, the equipment is defective, and returns the equipment to the Seller's originating factory prepaid, and the Seller's inspection finds the equipment to be defective in material or workmanship, the Seller will promptly correct it by either, at its option, repairing any defective part or material or replacing it free of charge and return shipped lowest cost transportation prepaid (if Purchaser request premium transportation, Purchaser will be billed for transportation costs). If inspection by the seller does not disclose any defect in material or workmanship, the Seller's regular charges will apply. This warranty shall be effective only if installation and maintenance is in accordance with our instructions and written notice of a defect is given to the Seller within such period. This warranty is exclusive and is in lieu of any other warranties, written, oral or implied; specifically, without limitation, there is no warranty of merchantability or fitness for any purpose. The liability of the Seller shall be limited to the repair or replacement of materials or parts as above set forth.

LIMITATION OF LIABILITY

The seller shall not be liable for any claim for consequential or special loss or damage arising or alleged to have risen from any delay in delivery or malfunction or failure of the equipment. The Seller's liability for any other loss or damage arising out of or connected with the manufacturer, sale or use of the equipment sold, including damage due to negligence, shall not in any event exceed the price of the equipment supplied by the seller.

A.P. Buck, Inc. reserves the right to make changes at any time, without notice, in prices, colors, materials, specifications and models; and to discontinue models.