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STATE OF CALIFORNIA
AIR RESOURCES BOARD

STANDARD OPERATING PROCEDURE FOR THE CERTIFICATION AND VERIFICATION OF FLOW PRIMARY AND TRANSFER STANDARDS USING A LABORATORY PRIMARY FLOW STANDARD

MLD METHOD 5721

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1. INTRODUCTION

1.1 The Standards Laboratory certifies low flow transfer standards periodically. These transfer standards are certified against a primary flow standard traceable to the National Institute of Standards and Technology (NIST). Flow transfer standards are used to support a number of air monitoring programs, which are listed below.

- Gaseous Criteria Pollutants
- Particulate Matter Pollutants (PM10, PM2.5)
- Toxic Air Contaminants
- Hydrocarbon Pollutants

1.2 This standard operating procedure outlines the certification process of low flow transfer standards and the verification process of primary flow standards.

1.3 This procedure will determine the guest primary or low flow transfer standard's ability to accurately and precisely measure flow.

2. SUMMARY OF METHOD

2.1 METHOD NOMENCLATURE

2.1.1 Calibration - establishes a correction factor to adjust or correct the output of an instrument. This is determined through a comparison between the flow instrument and primary flow standard at varying flow points.

2.1.2 Certification - establishes traceability of a flow transfer standard to the NIST traceable primary flow standard. The certification of a flow transfer standard requires the results of four calibrations to meet criteria established by the Standards Laboratory.

2.1.3 Verification - establishes comparability of a primary flow standard to the Standards Laboratory's primary flow standard. The verification of an instrument requires the results of one calibration to meet requirements established by the Standards Laboratory. Instrument output is not corrected based upon the results of the calibration.

2.1.4 Transfer Standards – a transportable device or apparatus that is capable of accurately measuring air flow. These types of instruments undergo a certification process. An instrument can be used as a transfer standard provided it meets criteria based on the certification process.

2.1.5 Primary Standards – a gravimetric, volumetric displacement or laminar device capable of accurately measuring gas flow rates with an accuracy of 2% of full-scale. Primary flow standards must also be NIST traceable and should be checked annually against a similar device.

3. ANALYSIS METHOD

3.1 The Standards Laboratory possess three primary flow standards traceable to the NIST. Two primary flow standards consist of three precision quartz borosilicate tubes of different volumes. As air is introduced into the bottom of the selected quartz cylinder, the near frictionless piston rises, starting the digital timer. Once the target volume is achieved, the timer stops. Flow rate is calculated by dividing the specified volume by the elapsed time. This flow rate is then corrected for piston backpressure and standard atmospheric conditions. The third flow standard is a laminar flow device. This device consists of a laminar flow element (LFE) based flow standard called a molbloc. Two pressure transducers measure the differential pressure across the LFE. The differential pressure and thermodynamics properties of the gas are used in a control unit called a molbox to calculate the flow rate.

3.2 The guest instrument is connected in series via a teflon line to the primary flow standard where the display reading from the guest instrument is directly compared to that of the primary flow standard. These flow measurements are evaluated statistically to determine the flow characteristics of the guest instrument.

4. INTERFERENCES AND LIMITATIONS

4.1 Avoid the over-pressurization or under-pressurization of guest flow devices. Operating a flow device outside its input pressure specification window can lead to erroneous data and or damage.

4.2 Avoid kinked or bent teflon lines. Bent teflon lines can restrict flow which can compromise a calibration.

4.3 Allow guest instruments to warm-up for approximately 30 minutes after powering on before initiating a calibration.

4.4 Do not over torque fittings. An over torqued a fitting can lead to leaks. Always use torque wrenches to tighten fittings.

4.5 Allow airflow to stabilize for a minimum of 5 minutes after setting flow point.

5. EQUIPMENT AND MATERIALS

5.1 Ultra pure grade air

5.2 Teflon (PTFE) lines

5.3 High accuracy barometer, for ambient pressure reading.

5.4 High accuracy thermometer, for ambient temperature reading.

5.5 Torque wrench model Ch-150 adjusted to 47in.-lb.: 7/16 and 9/16 inch size.

6. PRELIMINARY SETUP

6.1 Connect a teflon line from the pressure regulator assembly (ultra zero air source, figure 1) to the flow controller.

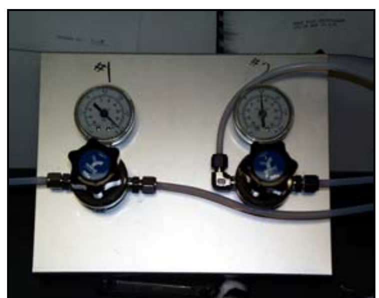


Figure 1

6.1.1 Choose from two types of flow controllers.

6.1.1.1 Needle Valve Assembly

6.1.1.2 Mass Flow Controller Assembly

6.2 Connect the output of the flow controller to the input of the guest instrument and connect the output of the guest instrument to the input of the primary flow standard. Use torque wrenches when tightening fittings (figure 2).

Figure 2

6.3 Retrieve the calibration worksheet associated to the Primary Flow Standard used. Fill out all preliminary data.

- ✓ Log Number
- ✓ Bar Code Number
- ✓ Instrument Description
- ✓ Calibration Date
- ✓ Client
- ✓ Position Number
- ✓ Barometric or Ambient Pressure (Refer to Barometer SOP)

6.4 If you are performing a Verification, skip to step 18..

6.5 The Standards Laboratory utilizes three primary flow standards. These standards are the Sierra Calbench, Brooks, and Molbloc/Molbox.

6.5.1 If the Brooks standard is used skip to step 7.

6.5.2 If the Sierra Calbench standard is used skip to step 8.

6.5.3 If the Molbloc/Molbox is used, skip to step 11.

7. BROOKS CALIBRATOR SETUP

7.1 Brooks power up procedure

7.1.1 Point the quartz tube selector to position 3 (figure 3) and then turn calibrator system on. Allow Brooks to warm up for about 30 minutes.

7.2 With the quartz tube selector, choose the tube that best matches the full-scale flow of the guest instrument. Each tube is classified as

Figure 3

- Large (2000 to 30000 cc/min)
- Medium (200 to 3000 cc/min)
- Small (1 to 500 cc/min).

7.3 Adjacent to each tube is a vernier assembly (figure 4) which can be adjusted to fine tune the selected tube to a specific volume. Adjust the vernier for a preferred elapsed time of 60 seconds but no lower than 24 seconds.

Figure 4

7.4 The pressure gauge used to measure the piston backpressure must be zeroed.

7.4.1 Rotate the adjustment ring accordingly to line up the zero marker of the scale to the meniscus of the water level (figure 5).

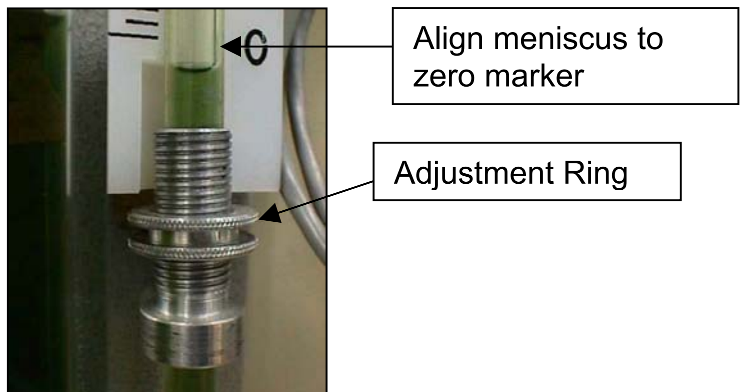


Figure 5

7.5 Power on the guest instrument and allow it to warm up for approximately 30 minutes.

7.6 Perform a system leak test. See step 7.9

7.6.1 If performing a Verification, skip to step 7.7.

7.6.2 Disconnect the input and output lines of the guest instrument and replace them with compression caps. After five minutes of stabilization, record the guest instrument display on the Brooks calibration worksheet in the space labeled, “initial reading”.

Re-connect the input and output lines of the guest instrument.

7.6.3 Adjust the flow controller to zero flow.

7.6.4 If the mass flow controller (MFC) is used, dial “000” on the MFC command box under the appropriate channel. If the needle valve is used, rotate the adjustment knob fully clockwise.

7.7 Adjust the pressure regulator on the pressure regulator assembly between 25 to 30 pounds per square inch (PSI).

NOTE

The manufacturers input pressure limitations take precedence and must not be exceeded.

7.8 Introduce 50 percent of the guest instruments full-scale flow through the system.

7.8.1 Mass Flow Controller: Dial the appropriate setting in percent of mass flow controller's full scale to achieve ≈50 percent of guest instrument's full scale.

7.8.2 Needle Valve: Rotate the adjustment knob counterclockwise until the guest display reflects ≈50 percent of the guest instrument's full-scale flow. DO NOT USE WHEN PERFORMING VERIFICATIONS.

7.9 Press the green momentary start button on the Brooks front control panel and allow the piston to rise halfway between the start sensor and stop sensor.

7.10 With the piston at the halfway point, close the input valve to the Brooks (figure 6).

Figure 6

7.11 Allow 5 minutes for stabilization before recording the guest display on the Brooks calibration worksheet in the space labeled, “post reading”.

7.12 Compare the initial reading with the post reading via the following formula

$$\frac{(\text{Post Zero} - \text{Initial Zero})}{\text{Full Scale Display}} = < .01$$

7.13 Monitor the suspended piston within the quartz tube for 5 minutes. Verify it does not move in the downward direction.

7.13.1 Stick a piece of tape on the glass cylinder of the primary flow standard and align it flush with the mercury ring (top) of the piston (Refer to fig. 7)

7.13.2 If after 5 minutes a gap is developed between the tape and the mercury ring, a leak exists.

7.14 If the criterion is not met in step 7.12, there is a leak from the input valve to the guest instrument. If the piston in step 7.13 moves down, there is leak from the input valve to the Brooks. Consult laboratory staff for assistance.

7.15 Press the black reset button and slowly open the input valve.

Figure 6

7.16 Skip to step 9

8. SIERRA CALBENCH SETUP

8.1 Turn on the Calbench Primary Flow Calibration System.

8.2 ` Turn on the Sierra Calbench Controller.

8.3 Allow the Sierra Calbench Controller and the Calbench Primary Flow Calibration System to warm up for approximately 30 minutes

8.4 Initiate the Sierra Calbench software by locating and double-clicking the "LANSIERRA" icon.

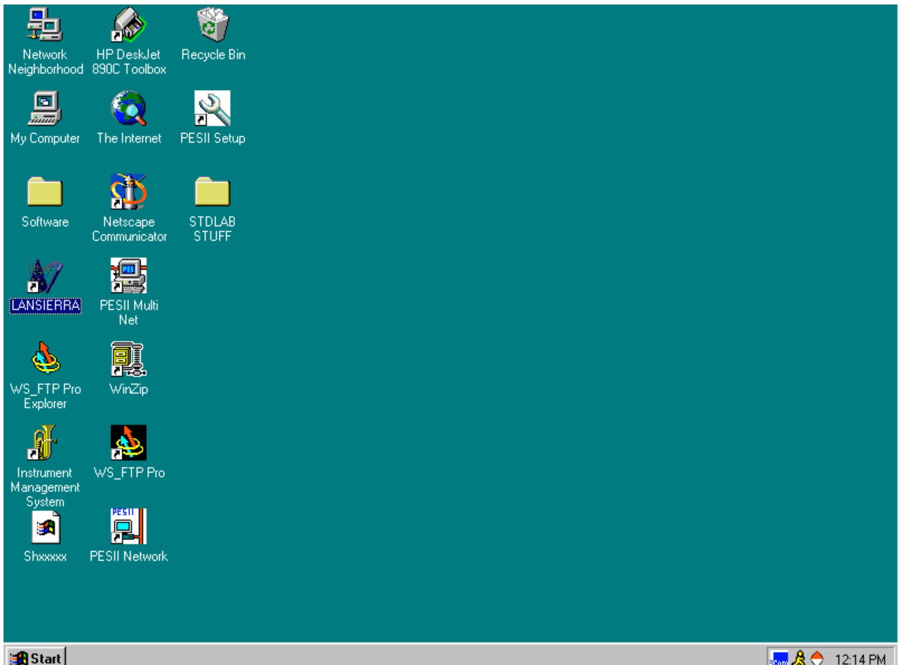


Figure 7

8.5 From the main menu, select "Calibrate" using the arrow keys then press **Enter**.

8.6 Type **G** for gas then **A** for air and select "Air, Air" using the arrow keys and press **Enter**. Press **Enter** for 100.00% air then **Enter** again for "Air, Air".

8.7 Type **O** for other and select "Units" then press **Enter**. Select "Flow Rate

SCCM", for standard cubic centimeters and press **Enter** until the desired flow rate unit is displayed. When done press **ESC**.

8.8 With the arrow keys, select "Ambient Pressure", and then press **Enter**. Type in the temperature corrected ambient pressure and press **Enter**, **Esc**.

8.8.1 Enter the following sequence of keys and data:

- **D** for device
- **N** for new device under test
- Type the log number of the unit under test, **Enter**
- Type the position number, **Enter**.
- Type the serial number, **Enter**.
- Type the full-scale flow of the device under test, **Enter**.
- Type the number of set points, **Enter**.
- Type the number of samples per set point, **Enter**.
- **T** -for tube size. Use the arrow keys to select the appropriate tube size.
  - Small 1-1000 sccm
  - Medium 1-10 LPM
  - Large 10-50 LPM

Press **Enter** and wait for about seven seconds for the transition to occur.

8.9 Perform a system leak test

8.9.1 Refer to steps 7.6.1 - 7.8.2

8.9.2 On the Sierra Calbench Controller, enter the leak test mode by pressing **Esc** to view the main menu. Then type **L** for leak test.

8.9.3 Select the tube that best matches the maximum flow to be run. Use the arrow key to choose the correct tube and press **Enter** or type **B** for big tube, **M** for medium tube, or **S** for small tube.

8.9.4 Instantly, the piston should rise. When the Cal-Bench Primary Flow Calibration System displays 1.8, shut off the input valve on the left of the Sierra Calbench by turning it to the vertical position.

8.9.5 Wait until the instrument display returns to the initial reading recorded earlier in step 7.6.2. Disregard this step when performing a Verification.

8.9.6 After 5 minutes type **A** for the tube leak test to begin. A value from the analog to digital converter of the sonar module will be captured and held in memory. Wait for approximately 30 seconds for the test to complete. After 30 seconds a second value from the analog to digital converter is captured again and compared to the value stored in memory. The difference must not be greater than 3 counts. The controller display will indicate if the leak test is a pass or fail.

8.9.7 If the tube leak test failed try the leak test again and increase the wait time for stabilization before typing **A**. Remember to slowly reopen the valve to allow air through the instrument again. If the leak test fails again, see staff for assistance.

8.9.8 Compare the initial zero reading with the current display. Refer to step 7.12.

8.9.8.1 Record the passing post zero on the Sierra Calbench calibration worksheet (Leak Check Display).

8.9.8.2 If the instrument fails the post zero criterion, check to make sure all fittings are properly tightened. If the criterion is still not met, see staff for assistance.

8.9.9 If both tests pass, press **Esc**, slowly reopen the valve on the Sierra, and continue with the calibration.

8.9.10 Skip to step 10.

9. CALIBRATION PROCEDURE USING THE BROOKS

9.1 Obtain five valid flow readings at the following set points:

- ✓ 100% of the guest instrument's full scale flow
- ✓ 75% of the guest instrument's full scale flow
- ✓ 50% of the guest instrument's full scale flow
- ✓ 25% of the guest instrument's full scale flow
- ✓ 12.5% of the guest instrument's full scale flow

9.1.1 Set desired flow by adjusting the flow controller valve appropriately.

9.1.2 Position the vernier assembly so the volume indicated closely resembles the airflow rate through the guest instrument being tested. The preferred elapsed time is 60 seconds, and must be no lower than 24 seconds. It is ok if the elapsed time exceeds 60 seconds.

9.1.2.1 Loosen small metal knob located on the left side of the marker while holding the column scale marker assembly. This will enable the marker to move freely along the column. Use large metal knob on right side of assembly and magnifying eyepiece on the front of assembly for fine-tuning of desired volume setting.

9.1.2.2 Once the appropriate volume has been set, lock the assembly in place by tightening the small metal knob. Note: Make sure tick marks are properly aligned.

CAUTION

Be certain the flow setting is within the operating range of the glass tube selected. Exceeding the upper flow limit of the tube could potentially damage the Brooks Calibrator.

9.1.3 Press the green momentary start button. The digital timer will automatically start when the piston passes the lower sensor and automatically stops when the piston reaches the upper sensor.

NOTE

Make sure timer does not start before piston reaches lower sensor! If this happens, press the "Reset" button and restart assay point.

9.1.4 Record the elapsed time. Press the black timer reset button when the piston has returned to base of tube.

9.1.5 Record three timer readings for each flow point. Calculate the relative sample standard deviation (RSD) and compare the result to established criteria. Refer to the RSD formula and criteria listed on the next page. If the RSD criterion is not met, take an additional sample, recalculate the RSD and compare the result to criteria on the next page. If after the fourth sample the criterion is not met, an additional sample must be taken and RSD recalculated and compared. Perform this function 2 more times (total of 7 samples) if needed.

9.1.5.1 If after the 7th sample, the criterion is still not met, consult laboratory staff for assistance.

$$\text{Relative Standard Deviation} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100 = \frac{\sqrt{\frac{\sum\left(\mathrm{X}-\overline{\mathrm{X}}\right)^2}{n-1}}}{\overline{\mathrm{X}}} \times 100$$

Number of Samples	% Relative Standard Deviation
3	≤ 0.4025
4	≤ 0.6285
5	≤ 0.8055
6	≤ 0.9500
7	≤ 1.1500

Once a flow point is deemed valid, record the sample mean on the calibration sheet under the heading, “Time”.

9.1.6 Record the gas temperature, backpressure, and guest display for each set point. This should be done when the piston is approximately halfway between the start timer sensor and the stop timer sensor. Record these values under their corresponding headings on the calibration sheet.

9.1.7 Repeat steps 9.1.1 to 9.1.6 until all valid flow points have been recorded. Note: When changing the flow rate, allow 5 minutes for the flow to stabilize before continuing calibration.

Example of the Brooks calibration worksheet (front).

State of California-Air Resources Board
Brooks Flowmeter Calibration

Log #: 99 250 Date: 8/13/99
Property #: 20004517 Property of: Special Purpose Unit / Support
Make: Tylan 4in 1 MFM Position #: 2 (3C)
Ambient Pressure (P_A): 762.5 (mmHg)

Leak Check:
Intital Reading: 0.016 Post Reading: 0.016

Flowmeter		Brooks Calibrator				
Setpoint	Display	Volume (L)	Time (sec)	Temp (°C) T_A	Pressure (" of H_2O) P_B	Flow Rate ( )
	2.897	1.2	25.179	23.7	1.70	2.8935
	2.252	1.2	32.588	23.8	2.10	2.2371
	1.489	1.2	49.402	23.8	2.05	1.4755
	0.748	0.6	49.615	23.8	2.00	0.7345
	0.376	0.4	67.298	23.8	2.00	0.3610

Flowrate = [298.15 / (T_A + 273.15)] * {[P_A + (P_B * 1.865)] / 760 }* [Volume / (Time / 60)]

Instrument:
Display = ____________ * (Flowrate) ± ____________
Correlation Coefficient .999995

Comments:

Calibrated By: BB. Checked By: JMC

PES1002/June1999

Figure 8

Example of the Brooks calibration worksheet (back).

25.171	32.612	49.386
25.180	32.589	49.397
25.186	32.562	49.423
25.179	32.588	49.402

49.452	67.140
49.621	67.346
49.573	67.408
49.615	67.298

Figure 9

9.2 Calculate the Brooks flow rate for each set point and record the result on the calibration worksheet under the heading, “flow rate”.

$$\text{Flow Rate} = \frac{298.15}{\text{Ambient Temperature} + 273.15} \times \frac{\text{Ambient Pressure} + (\text{Back Pressure} \times 1.865)}{760} \times \frac{\text{Volume}}{\text{Time (sec.)}} \times 60$$

9.3 Proceed to step 11 (Data Entry)

10. CALIBRATION PROCEDURE USING THE SIERRA

10.1 Obtain five flow readings at the following set points:

- ✓ 100% of guest full scale
- ✓ 75% of guest full scale
- ✓ 50% of guest full scale
- ✓ 25% of guest full scale
- ✓ 12.5% of guest full scale

10.1.1 From the main menu, select the “Calibrate” option and press **Enter**. Press **Enter** to continue the calibration procedure. Verify the Auto/Manual switches number 1 and 2 are in the manual mode for the Sierra Calbench instrument MFC box.

Figure 11

10.1.2 Adjust the flow controller to the first flow set point. Press **Enter** on the Sierra Calbench Controller to start the testing. Airflow sampling of the guest instrument will begin. After the sampling has finished, record the true standard flow rate on the reverse side of the flow calibration worksheet. Refer to example on the two following pages.

Example of the Sierra Calbench calibration worksheet (front).

State of California-Air Resources Board
Sierra Flowmeter Calibration

Log #: 99-275 Date: 9/23/99

Barcode #: 2000 4556 Agency: AM-Central

Instrument: Dasibi 5009-CP Position #: 2 (10 l)

Ambient Pressure: 759.1 (mmHg)

Intial Leak Check:

Initial Instrument Display: .05 ✓ Leak Check Display: ~~.05~~ .05 ✓

Setpoint	Instrument Display ( )	Ambient Temperature (°C)	Gas Temperature (°C)	Back Pressure (mmHg)	Standard Flowrate ( )
~~10~~ 999	9.95	23.9	23.8	4.321	9.4404 ✓
~~75~~ 750	7.49	23.9	23.8	3.836	7.0649 ✓
500	5.00	23.9	23.8	3.635	4.7016 ✓
250	~~2.48~~ 2.50	24.0	23.8	3.367	2.3496 ✓
125	~~1.25~~ 1.24	24.0	23.8	3.334	1.1583 ✓

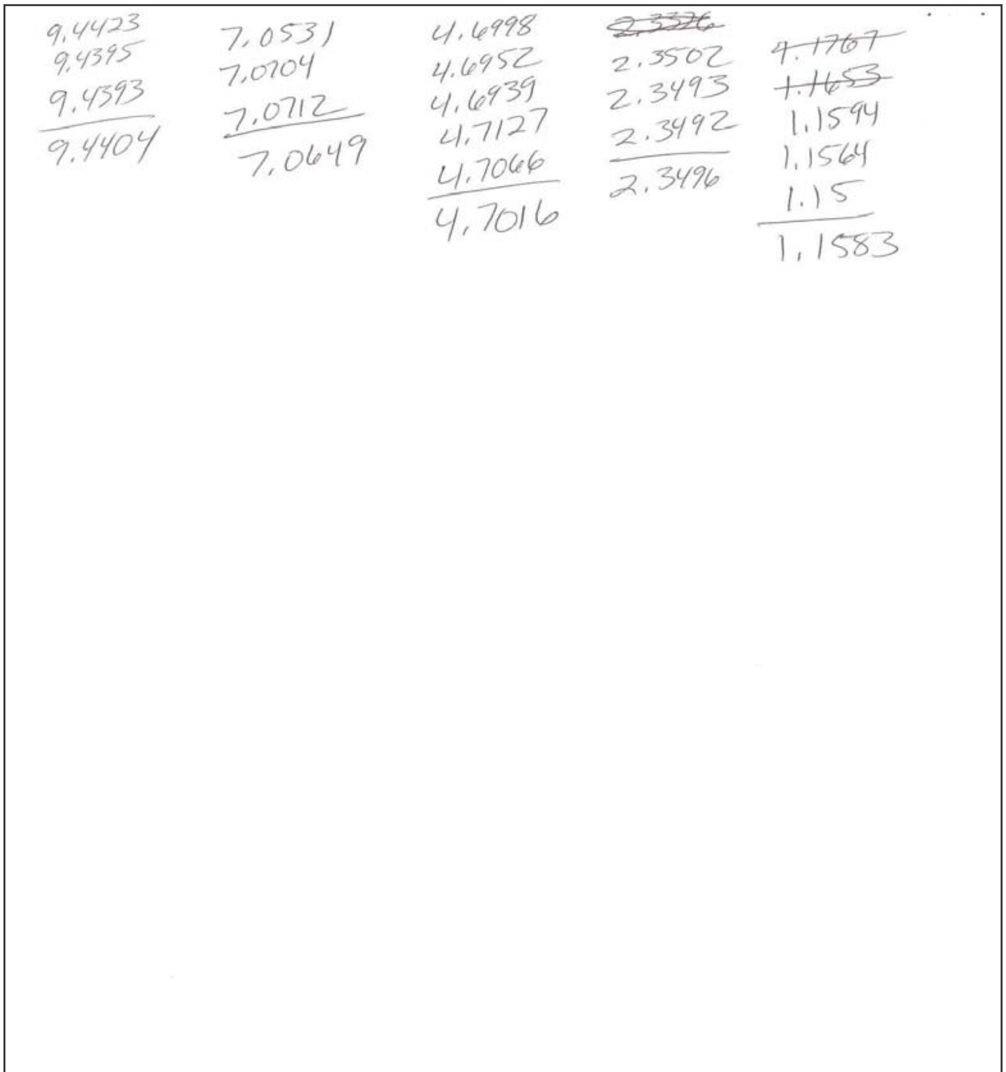
Comments:

Calibrated By: JMC Verified By: R. Young

PES-1001/June1999

Figure 12

Example of the Sierra Calbench calibration worksheet (back).



9.4423	7.0531	4.6998	~~2.3326~~	~~1.1767~~
9.4395	7.0704	4.6952	2.3502	~~1.1653~~
9.4393	7.0712	4.6939	2.3493	1.1594
9.4404	7.0649	4.7127	2.3492	1.1564
		4.7066	2.3496	1.15
		4.7016		1.1583

Figure 13

> *NOTE*
>
> *Press **R** to redo the sample, **V** to view selected sample points, or **Space Bar** to abort the run.*

10.1.3 To view the selected sample points, use the arrow keys to move the cursors on the graph (Samples vs. Delta Flow (%Full Scale)) displayed on the computer screen. When done viewing samples press **Esc**. To continue with the air sampling press **Enter** three times.

10.1.4 Repeat steps 10.1.2 to 10.1.3 three to seven times per set point. Calculate and record the mean value of each flow point and verify the mean value falls within the relative standard deviation (RSD) criteria below. If after the seventh sample the RSD does not pass, consult staff for assistance.

$$\text{Relative Standard Deviation} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100 = \frac{\sqrt{\dfrac{\sum X^2 - \dfrac{\left(\sum X\right)^2}{n}}{n-1}}}{\overline{X}} \times 100$$

Number of Samples	% Relative Standard Deviation
3	≤ 0.4025
4	≤ 0.6285
5	≤ 0.8055
6	≤ 0.9500
7	≤ 1.1500

10.1.5 Upon passing the RSD criterion, record the mean on the Sierra Calbench calibration worksheet under “Standard Flow Rate”. Also record the gas temperature, room temperature, and the backpressure for each flow set point. This should be done when the piston is approximately halfway up the tube. Record these values under their corresponding headings on the calibration sheet.

10.1.6 Record the guest instruments display reading on the calibration worksheet. Note: If full scale flow is greater than 1 liter per minute, flow units should be recorded in standard liters per minute (SLPM). For a full-scale flow less than 1 liter per minute, flows should be recorded in cubic centimeters per minute (cc/min).

10.1.7 Repeat steps 10.1.2 to 10.1.4 for each set point.

11. MOLBLOC/MOLBOX PRELIMINARY SETUP

11.1 Turn on guest instrument. Allow a minimum of one half-hour warm-up.

11.1.2 Turn on Molbox Primary Flow Calibration System. Allow a minimum of fifteen minutes warm-up.

11.1.3 Turn on **"Student 2"** computer.

11.1.4 Double click on the **"Shortcut to Comp_Box"** icon on the desktop (see figure 14).

11.1.5 Make sure gas is flowing. Click on **"Run"** and select **"Run Molbox"** from the pull down menu. Select "**Read Pressure**" and "**Read Temperature"** and Click on **"OK"** (see figure 15).

11.1.6 Take the ambient pressure reading. Convert the ambient pressure to Kpa (Kilopascal) by dividing the ambient pressure by **7.50061**. Example: 760/7.50061 = 101.325 Kpa. This is the pressure you will enter once the test begins.

11.2 SYSTEM LEAK TEST

11.2.1 Click on the **"Flow control"** button on the toolbar (see figure 16).

From the computer screen, read the Upstream and Downstream pressures; set the pressure to normal operating pressure**, 250 to 325 kPa absolute pressures***,* by entering a voltage between 0 - 5 volts that will get you within the normal pressure mention above. You may have to go back to the flow control window to get the pressures in range. Once the pressures are set, cap the exhaust downstream of the device under test. Close the pressure regulator valve upstream (see Diagram 1). Disconnect the gas supply, which will vent the system. Click on the leak test icon on the toolbar (see figure 16). Once the pressure has stabilized within the normal operating range mentioned above, click on **“OK”** (see figure 17). Then click on **“OK”** to start the test (see figure 18). Three test criteria must be met to pass this check: 1) The calculated flow from the upstream and downstream pressures must be less than 0.025% of the molbloc’s full scale. Ideally, the pressures will be equal and the flow equals zero. 2) The pressure drop over the 30 seconds must be less than 0.5% of the line pressure. 3) The average flow over 30 seconds must be less than 0.01% of the molbloc’s full-scale flow. These criteria are applied by the molbox.

After 60 seconds a test message box will pop up indicating pass or fail. If leak test is successful click on **“OK”** (see figure 19). If the test fails, check connections and redo leak test. If leak test fails again, let the owner know that a certification test can not be performed until the leak has been fixed. Reconnect the gas supply if you wish continue to use the Molbloc.

11.3 DASIBI 5009-CP/MOLBLOC SYSTEM LEAK TEST PROCEDURE

11.3.1 Remove the cover from the instrument. Disconnect the output line from the flow controller you want to test. Connect output of the molbloc to the input of the flow controller. Make sure gas is flowing. From the front panel of the Dasibi, dial in 100 percent flow range.

11.3.2 Click on **“Run”** and select **“Run Molbox”** from the pull down menu. Check “**Read Pressure**” and “**Read Temperature”** and Click on **“OK”** (see figure 15).

11.3.3 Using the computer monitor read the upstream and downstream pressures, set the pressure to normal operating pressure **(250 to 325 kPa absolute)**. Cap the output of the flow controller. Close the pressure regulator valve upstream. Disconnect gas supply (i.e. to vent the system). Once the pressure has stabilized within the normal operating pressure mentioned above click on the leak test icon on the toolbar (see figure 16). Click on **“OK”** to start the test (see figure 18). After 60 seconds a test message box will pop up indicating pass or fail. If the test fails, check connections and redo leak test. If leak test is successful undo leak test preparations and click on **“OK”** (see figure 19). If leak test fails again let the owner know that a certification test can not be performed until the leak has been fixed.

11.3.4 Click on **Stop.**

11.4 CALIBRATION PROCEDURES

11.4.1 See diagram 1 for MFM (Mass Flow Meter) setup. See diagram 2 for MFC (Mass Flow Controller) setup. Click on **"Run "** on the pull down menu and select **"Run test**" (see figure 16).

11.4.2 Select Molbloc (see figure 20). Each Molbloc is labeled "A" or "B".

11.4.3 Select **DUT** (Device Under Test): Dasibi 5009CP, Tylan 4 in 1, etc. (See figure 21).

11.4.4 Select the test profile that represents flow range of your DUT (See figure 22).

11.4.5 Enter the serial number and identification of the DUT (see figure 23).

11.4.6 Enter your name and click on **"OK**" (see figure 24).

11.4.7 Click on **"OK"** to begin test (see figure 25). Before the test begins, the software will prompt you to run a **"Tare"** (Zeroing the pressure transducers to eliminate the zero error in the measurement of the differential pressure). Click on "**Tare"** to start (see figure 26). The message bar at the bottom of the screen will say, **"Tare completed"**. Click on "**continue"** to start the test (see figure 27). The test consists of taking seven readings at each flow 100, 75, 50, 25 and 12.5 percent.

11.4.8 Monitor the **"Reference"** flow. When the Reference flow rate (sccm) becomes stable indicated by a steady green dot, click on **"Start Avg."** button to start taking averages (See figure 28). Do not disturb the Molstic components while flow averaging is taking place.

11.4.9 Average for twenty seconds and click on **"Stop Avg."** (See figure 29).

11. 4.10 Enter the DUT Output, Ambient Pressure, and Ambient Temperature. Click on **"OK"** (see figure 30).

11.4.11 Repeat steps 11.4.7 to 11.4.10 until test is finished.

Flow Rate [kg/s] = $\frac{(P1 - P2) * P(P,T) * R * h^3}{n(P,T) * 6 * L}$

P1 = upstream pressure [Pa]
P2 = downstream pressure [Pa]
P(P,T) = gas density under P,T conditions [Pa]
$P = \frac{P1 + P2}{2}$
n(P,T) = dynamic gas viscosity under P,T conditions [Pa*s]
R = flow passage radius [m]
h = gap between piston and cylinder [m]
L = length of laminar flow passage [m]

11.4.12 The system will allow you thirty seconds to repeat the last point (see figure 31).

11.4.13 **Sample Report** (see Figure 32). To create a report for the current test Click on **"Generate Report"** (see Figure 33).

11.4.14 Print report (see figure 34).

11.4.15 Click on "**OK"** to end test (see figure 35).

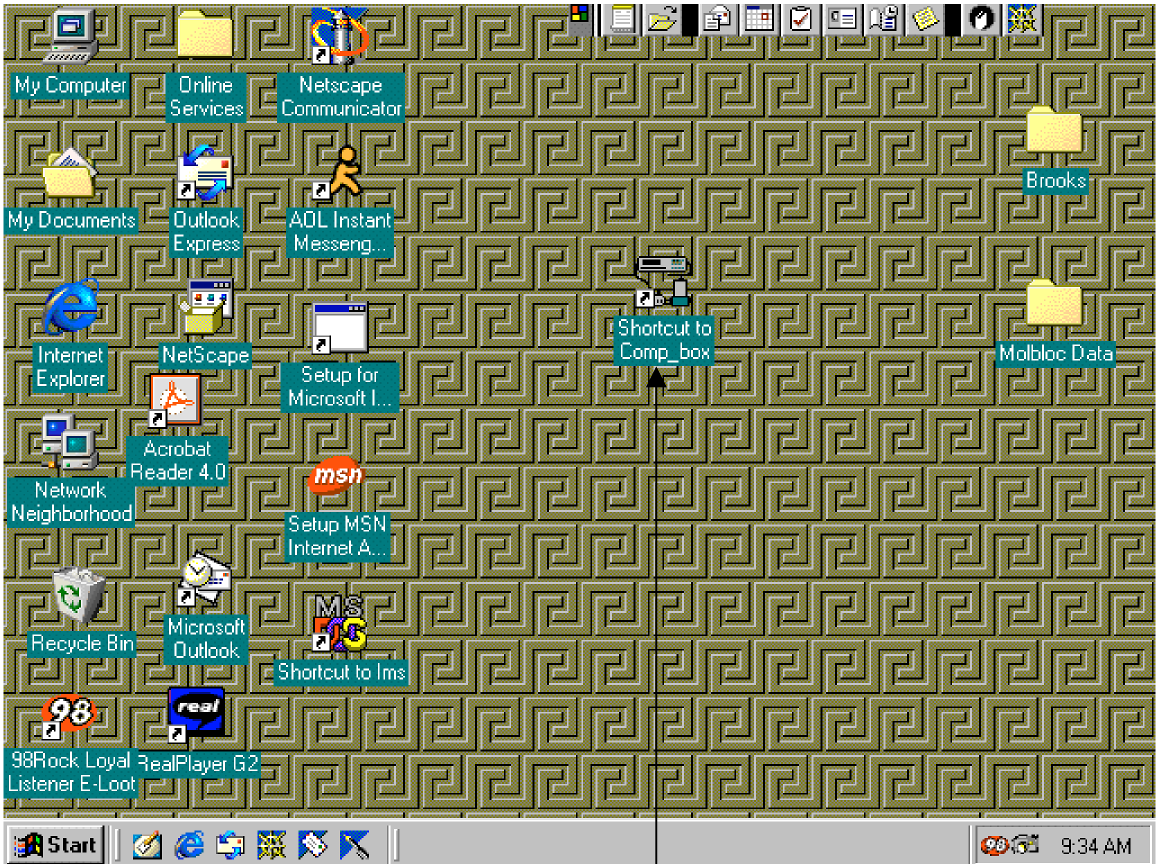


Figure 14 - Shortcut to Comp_box

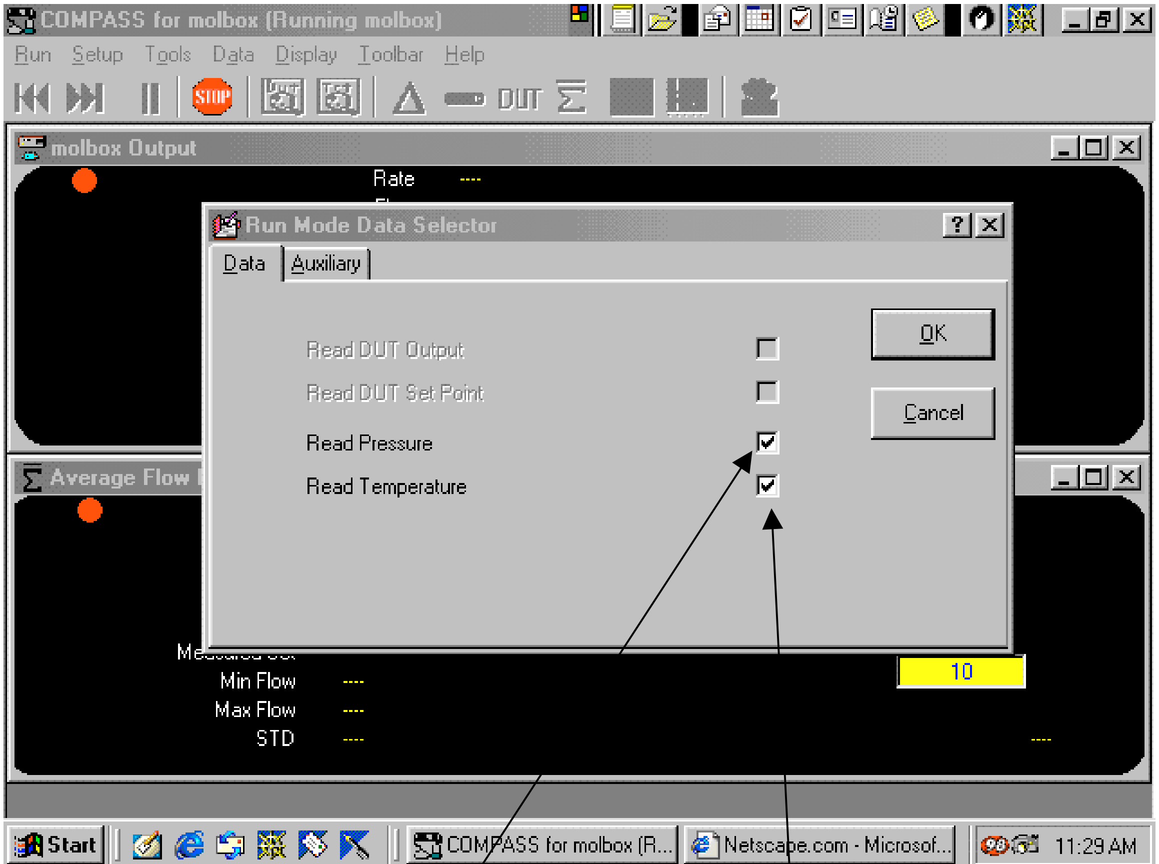


Figure 15 - Select Read Pressure and Read Temperature

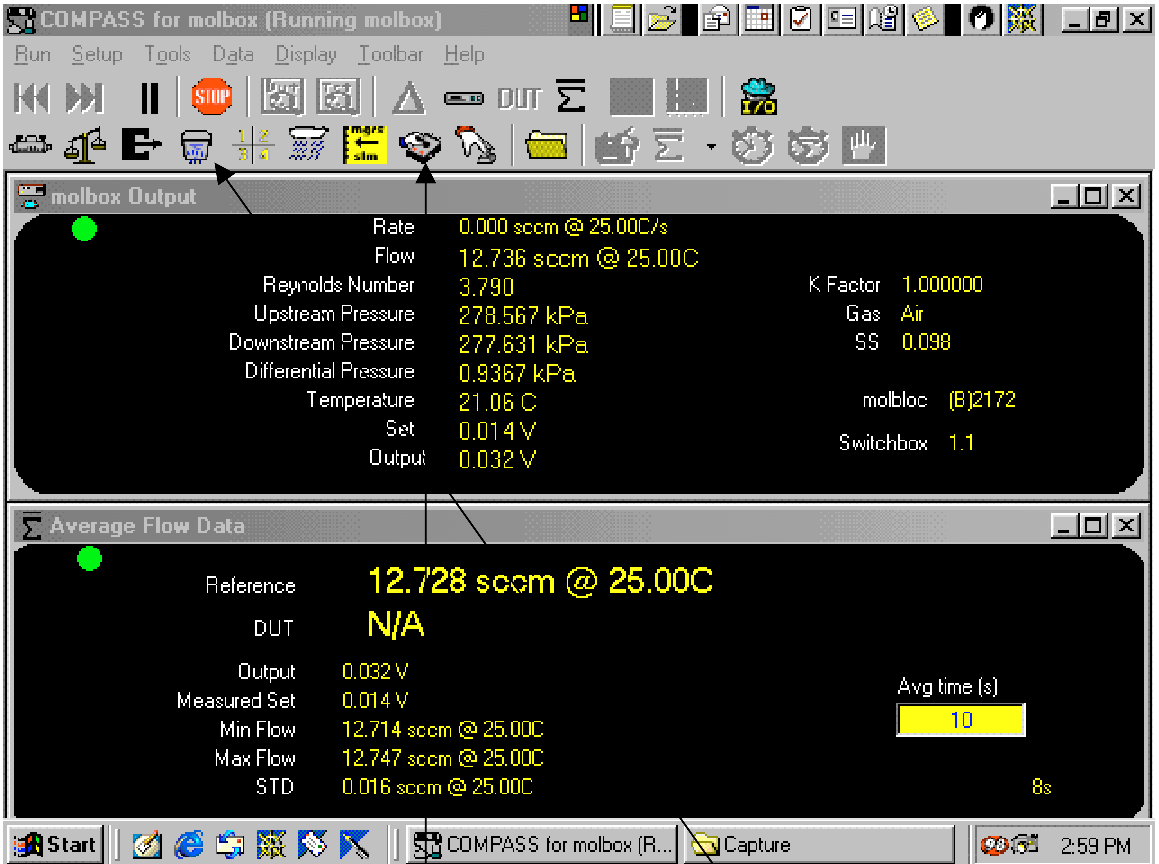


Figure 16 – Flow Control and leak test icons

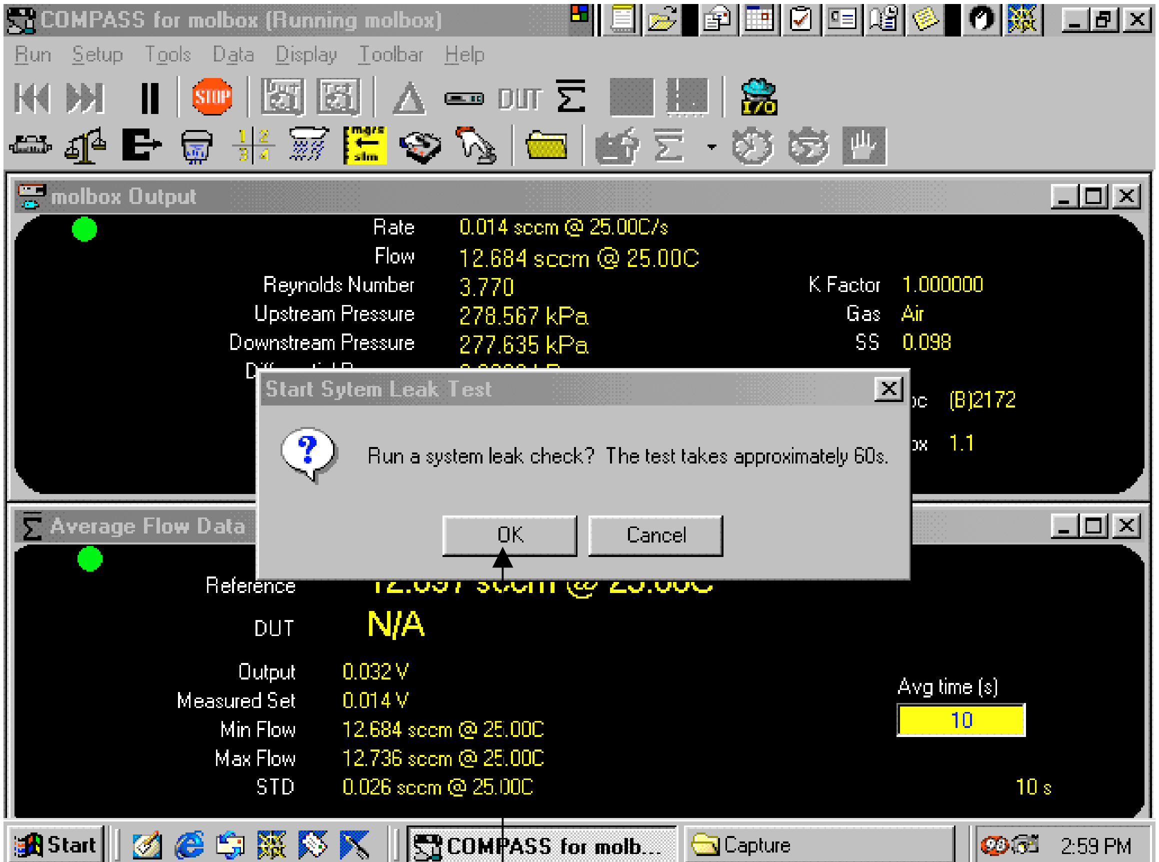


Figure 17 – Start system leak test

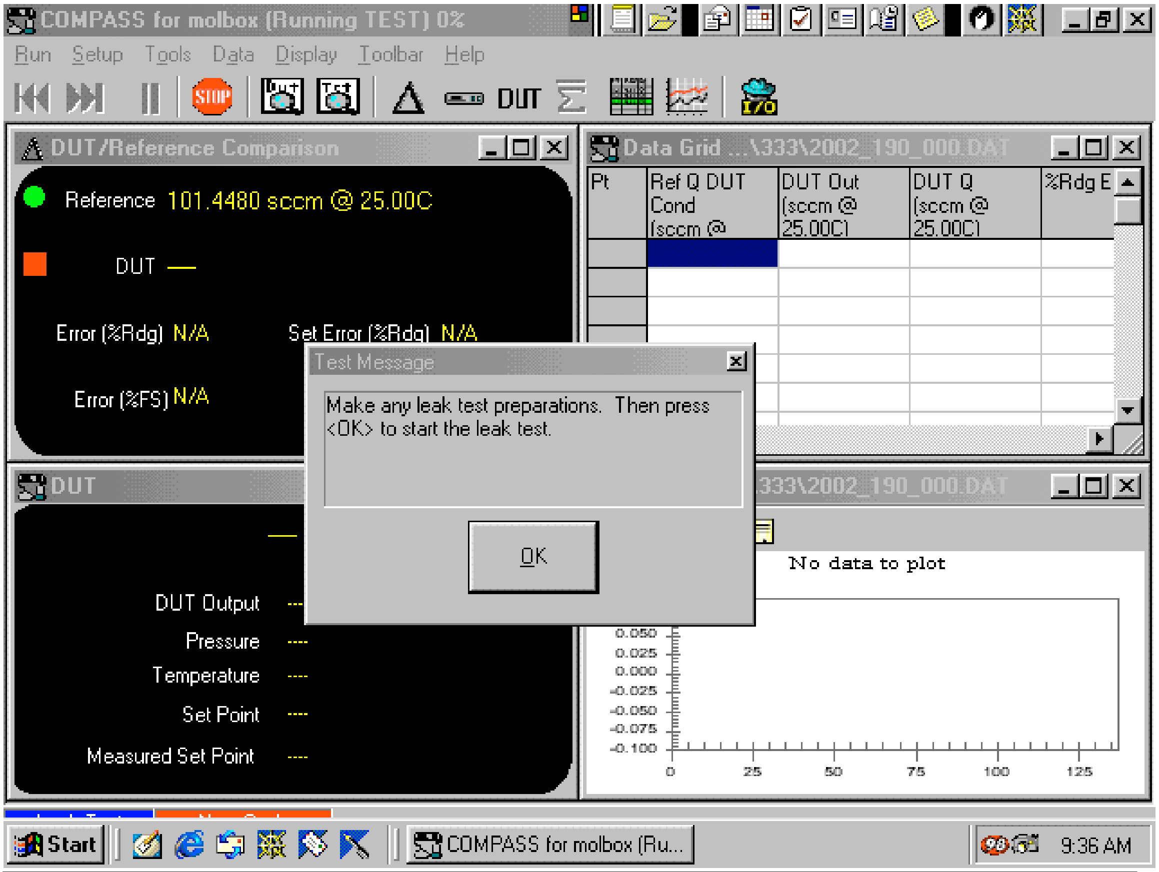


Figure 18 – Make preparations and begin leak test

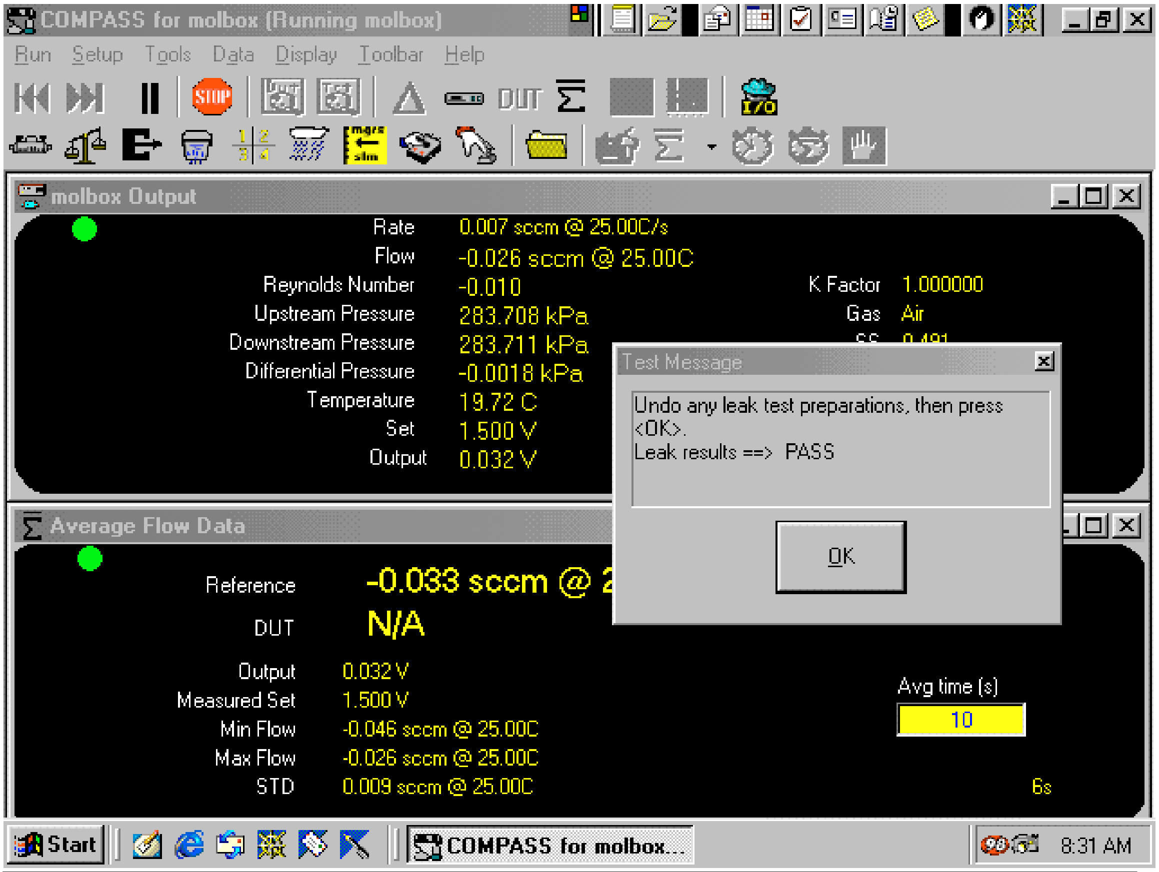


Figure 19 – Successful leak test

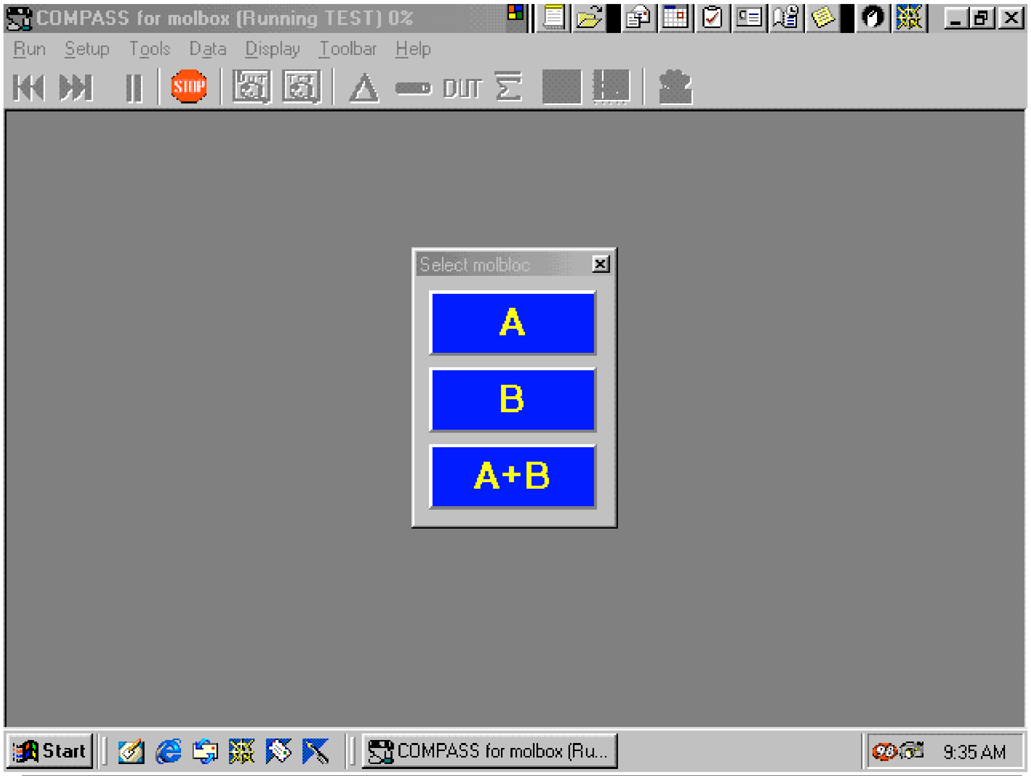


Figure 20 – Select Molbloc "A" or "B"

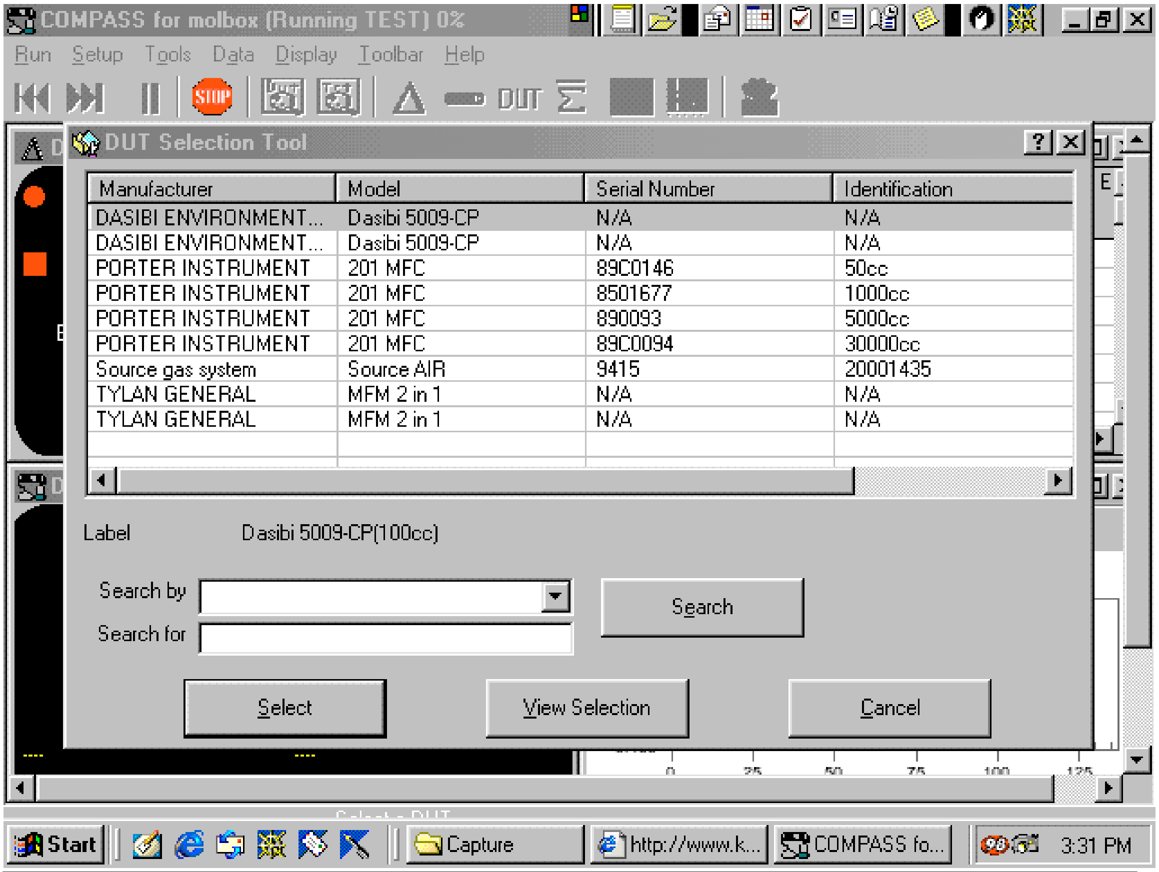


Figure 21 - Select DUT

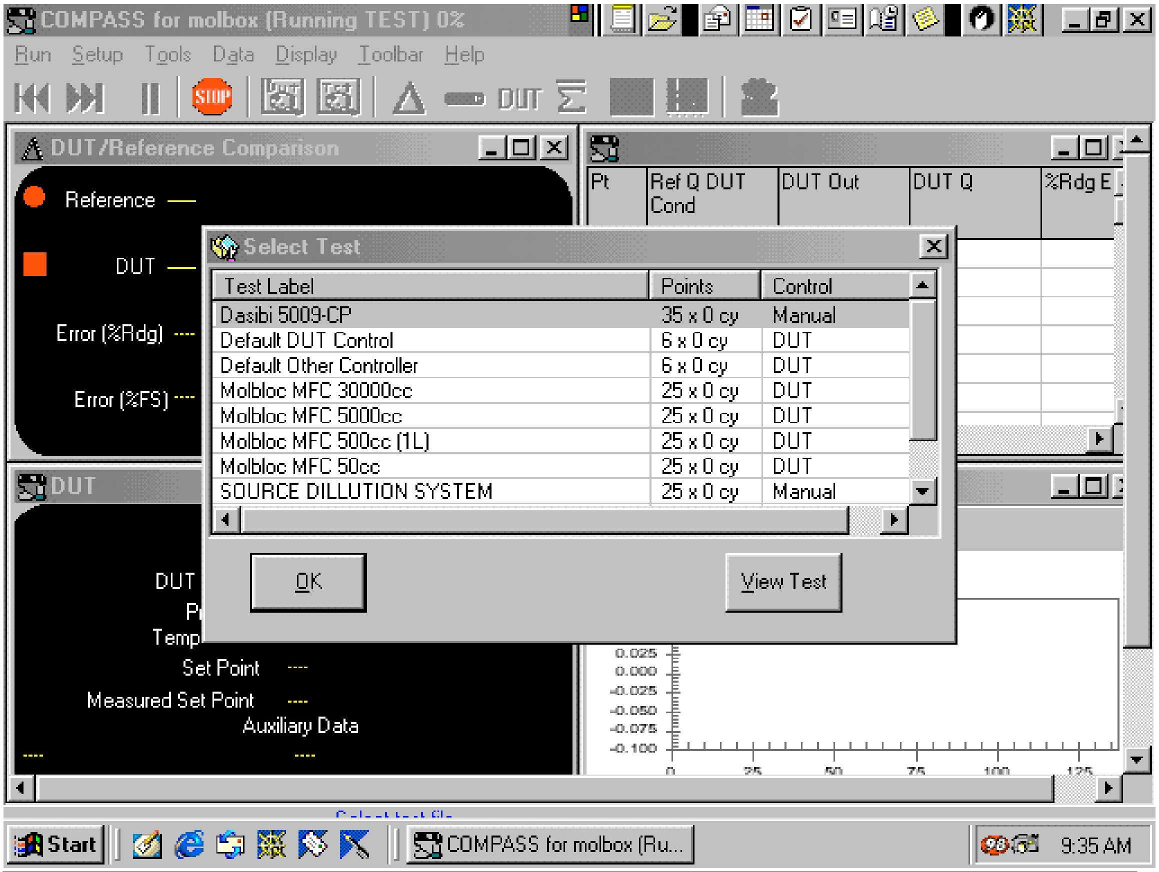


Figure 22 – Select test profile

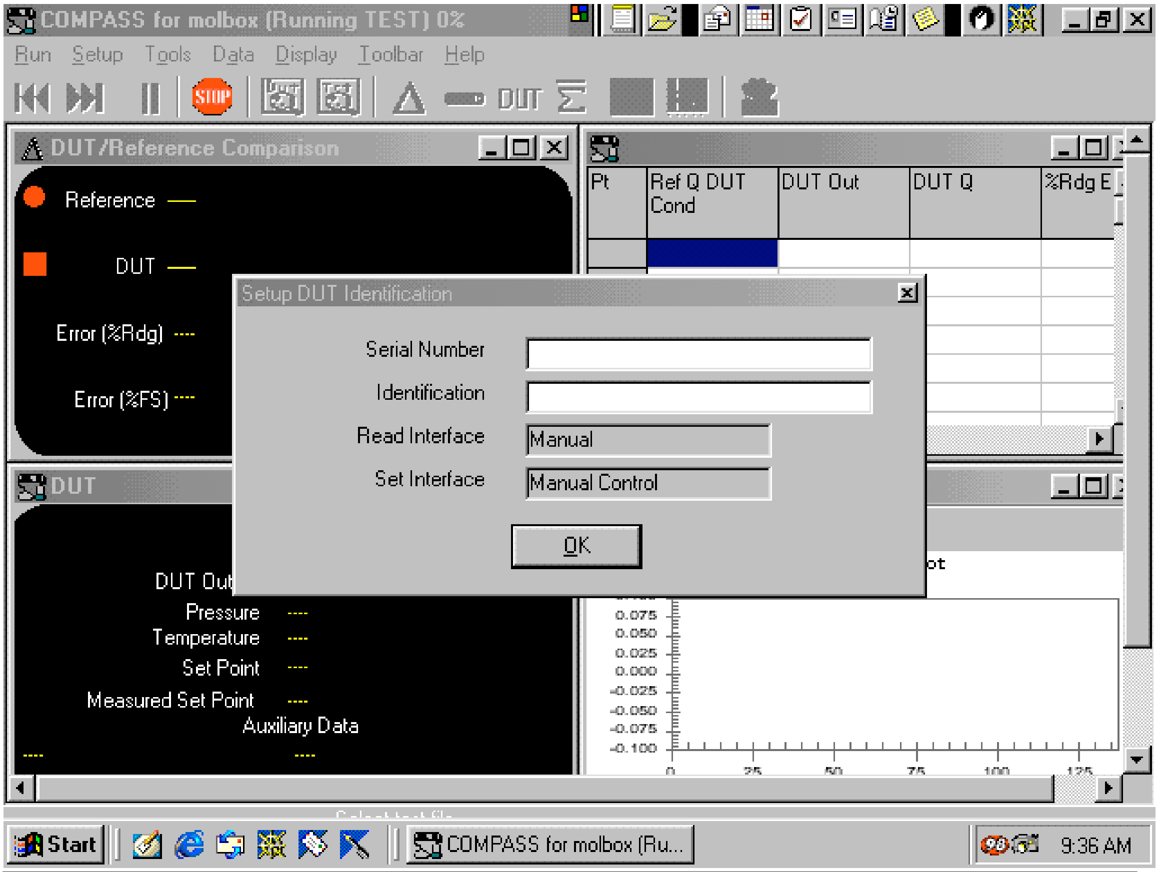


Figure 23 – Enter ID and serial number

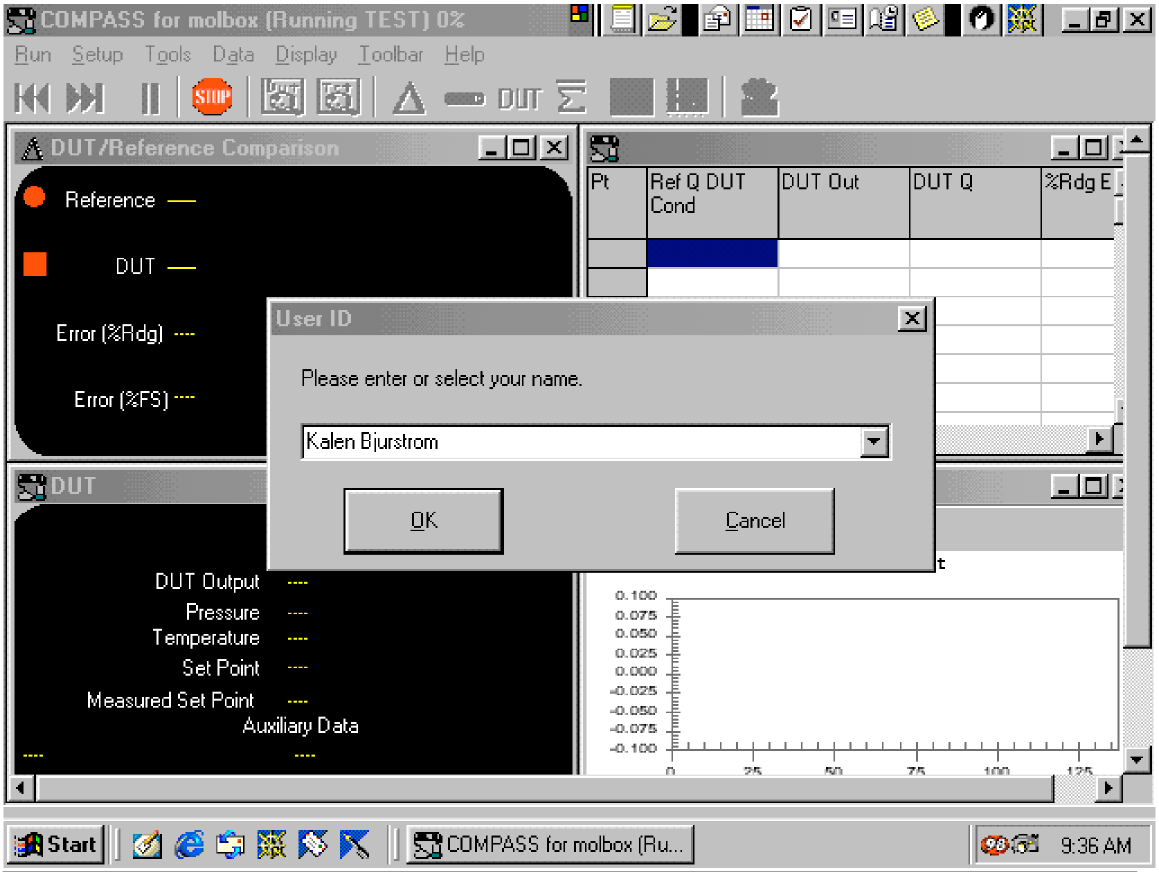


Figure 24 – Enter user name

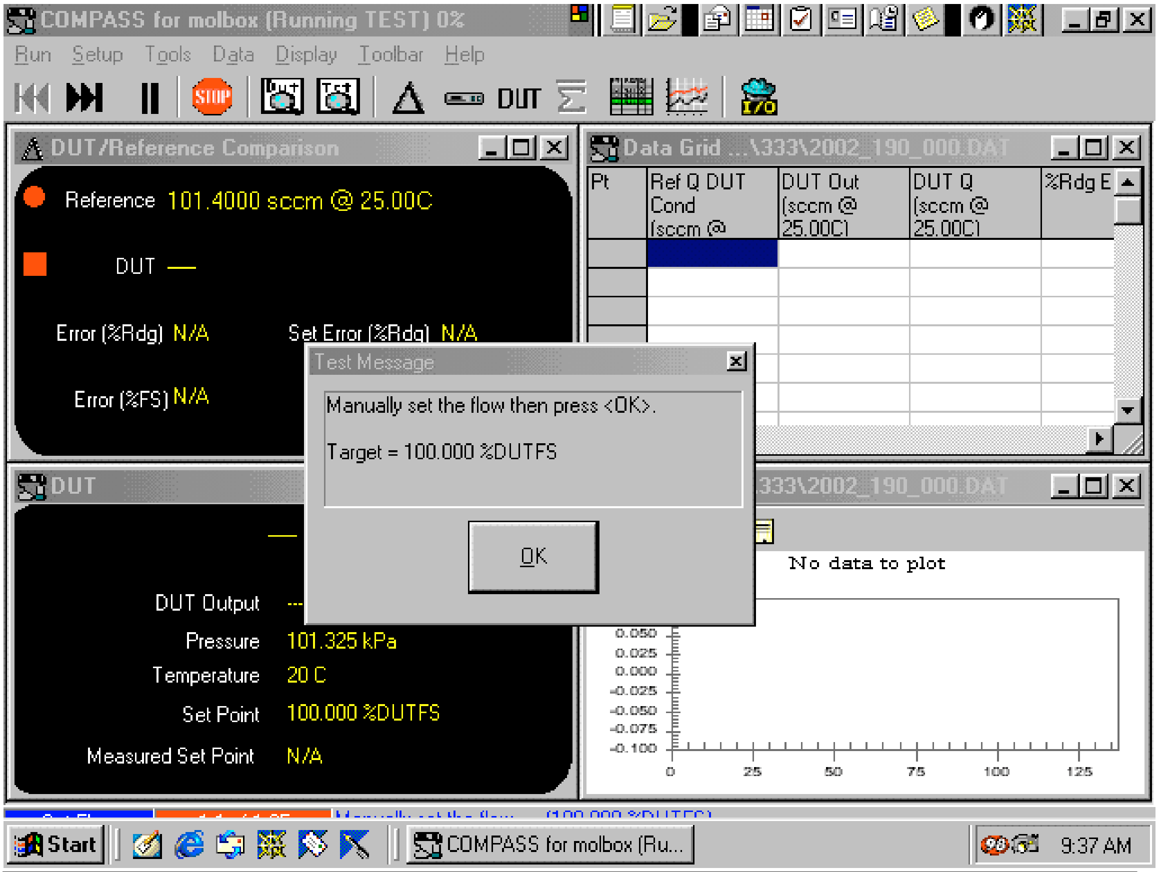


Figure 25 – Start taking data

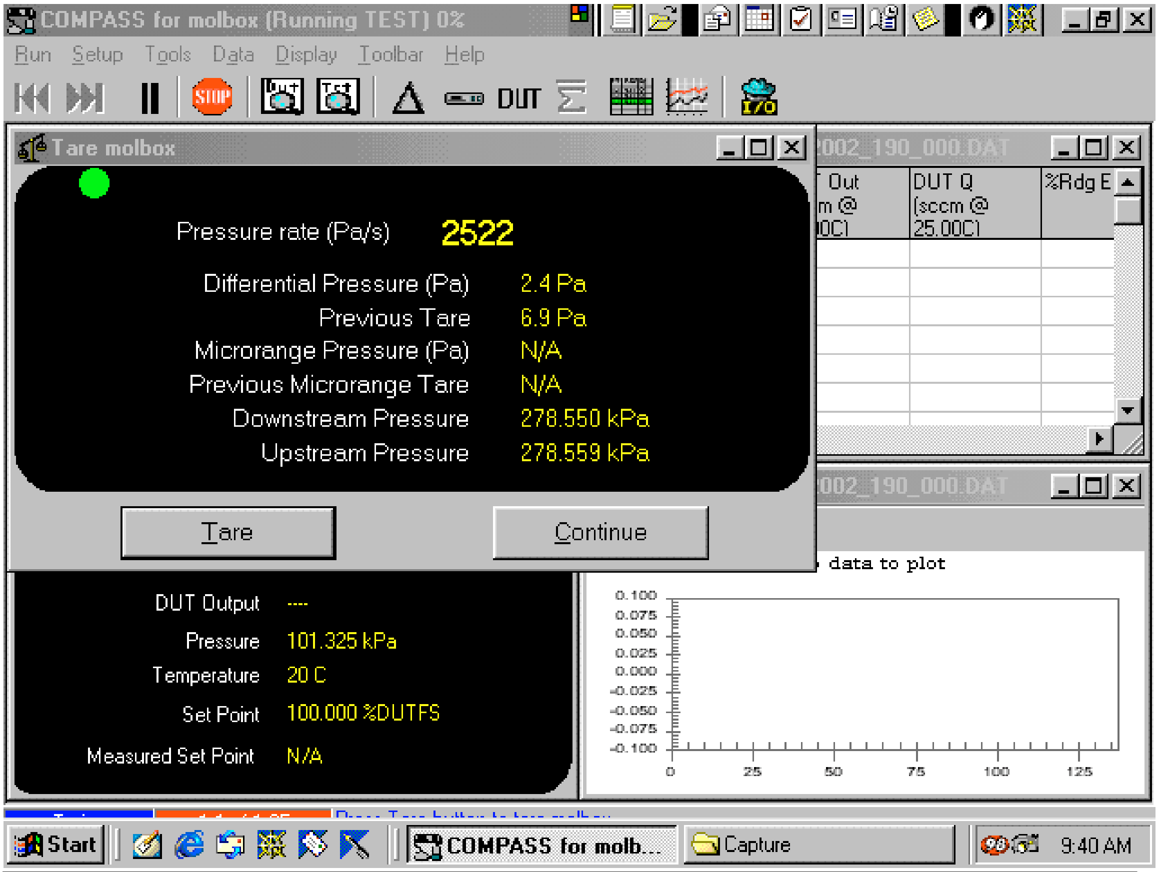


Figure 26 – Tare pressure transducer screen

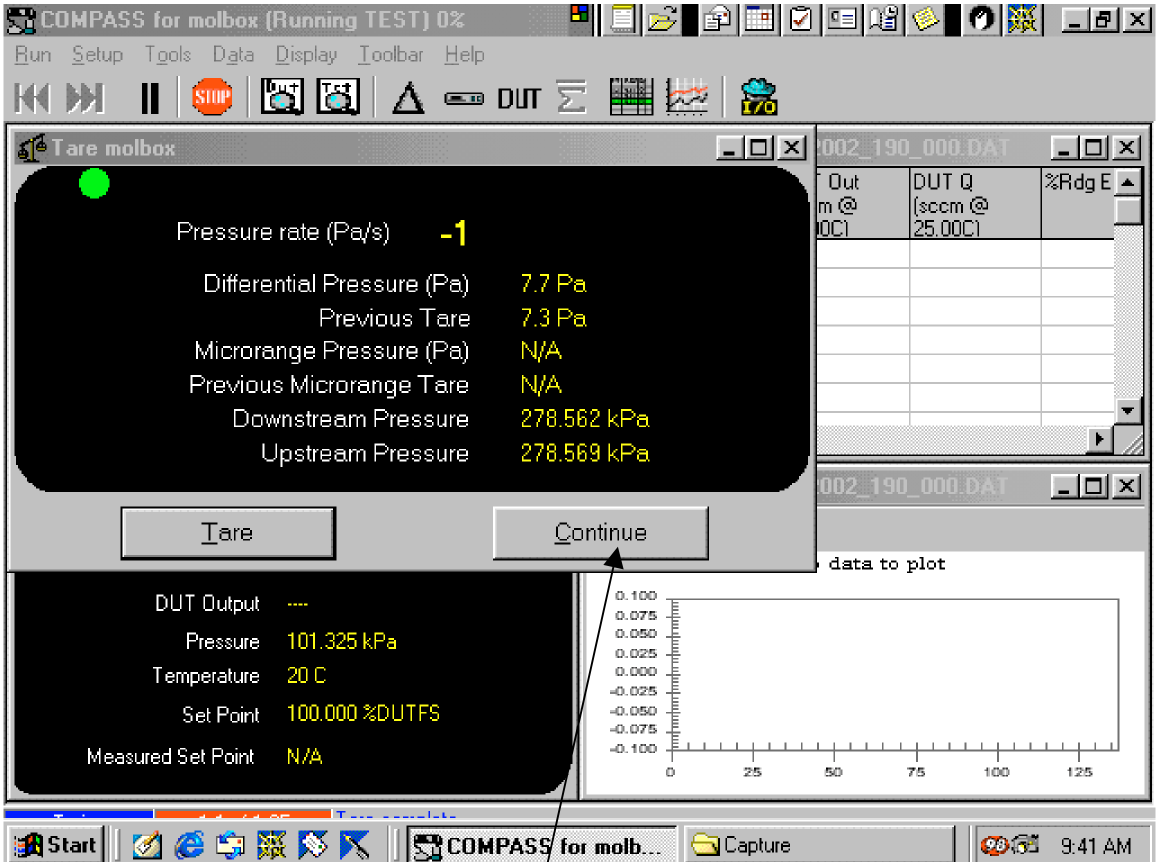


Figure 27 – Tare complete click on continue

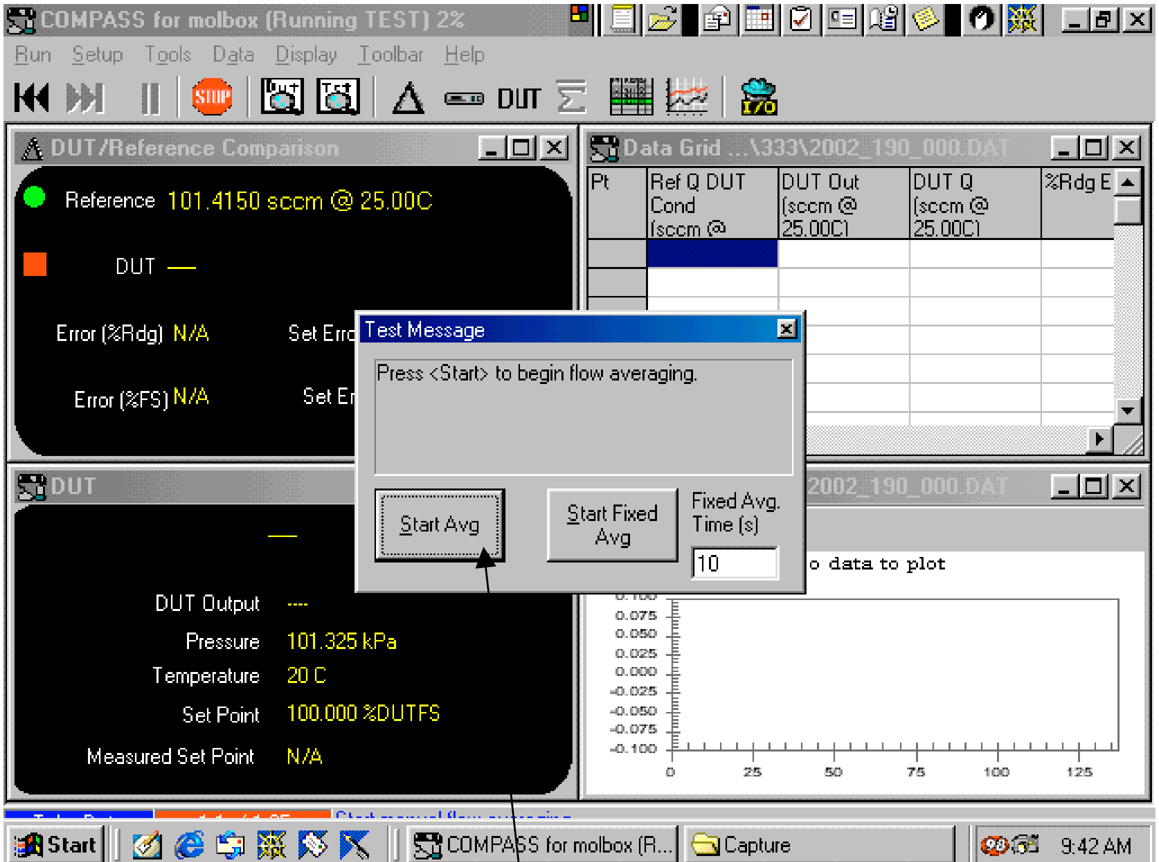


Figure 28 – Start flow averaging

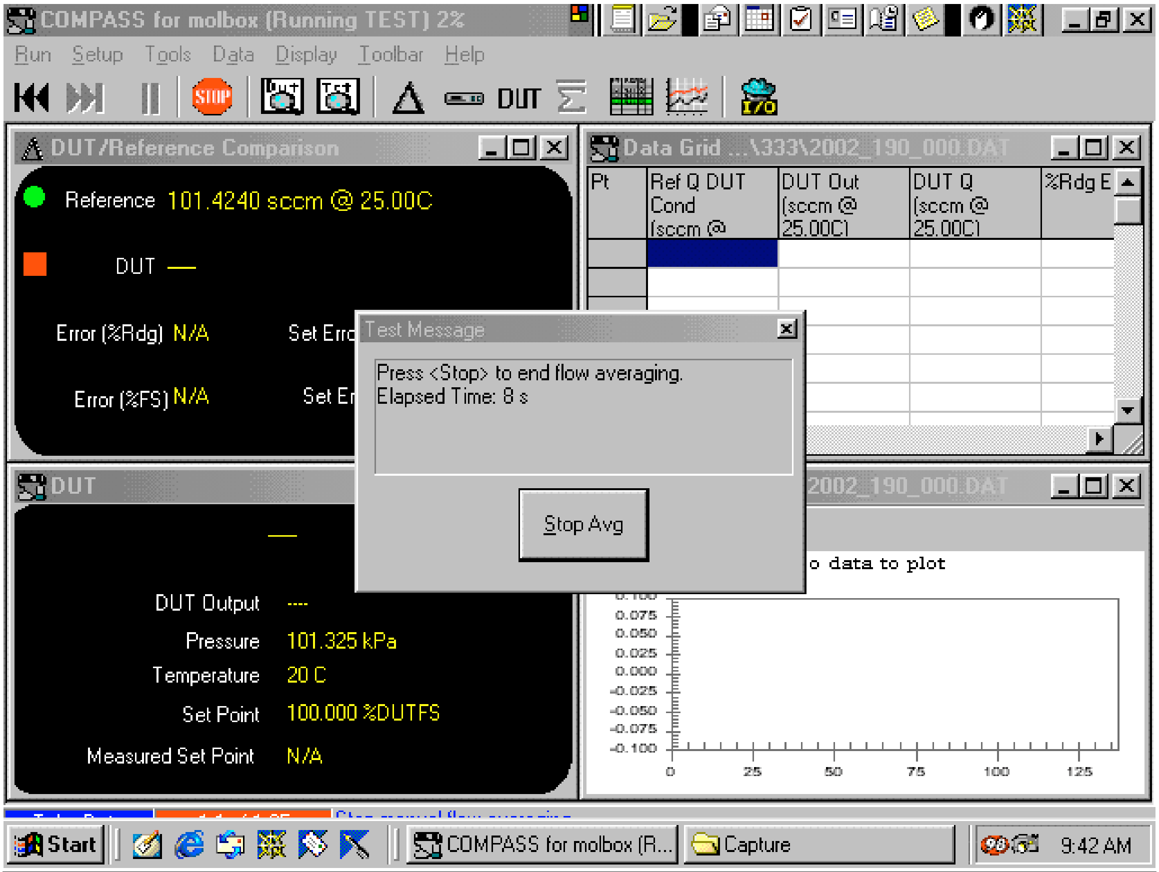


Figure 29 – Average for twenty seconds

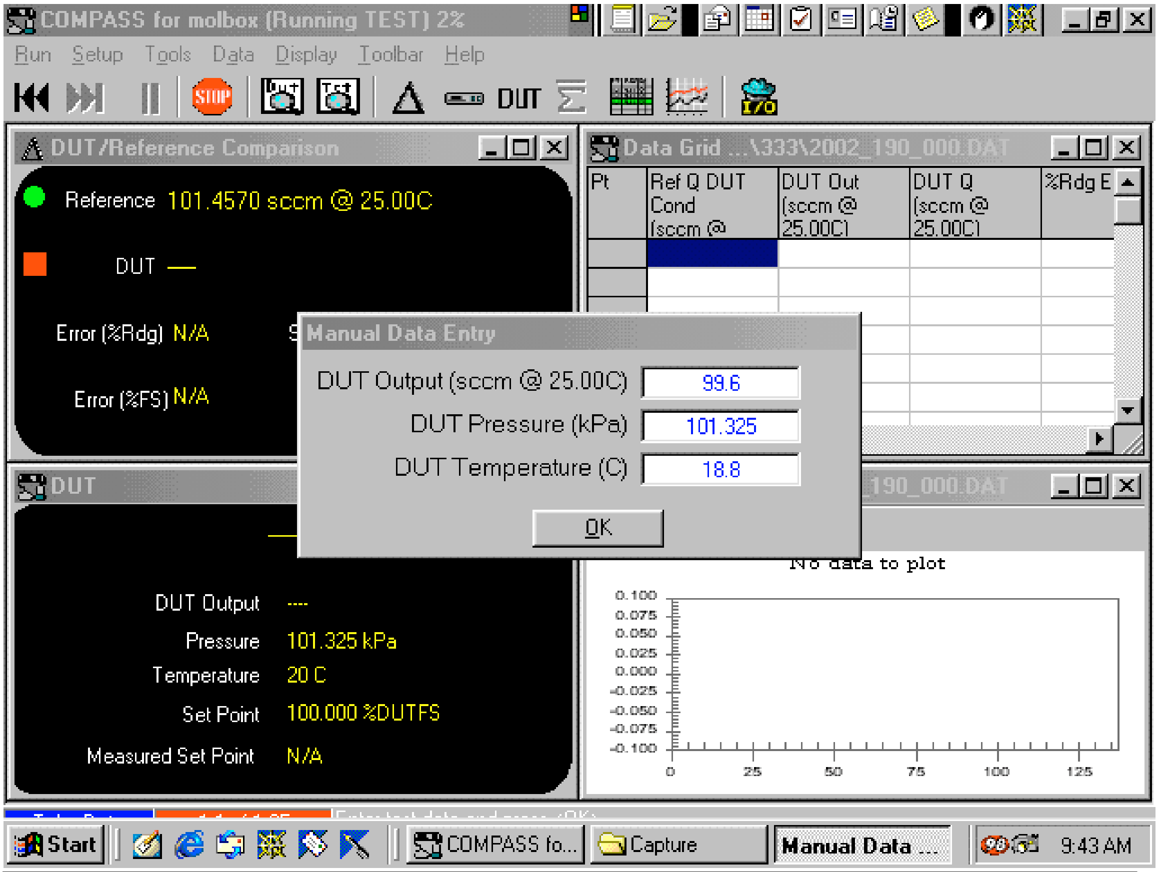


Figure 30 - Enter Dut output, ambient temperature and ambient pressure

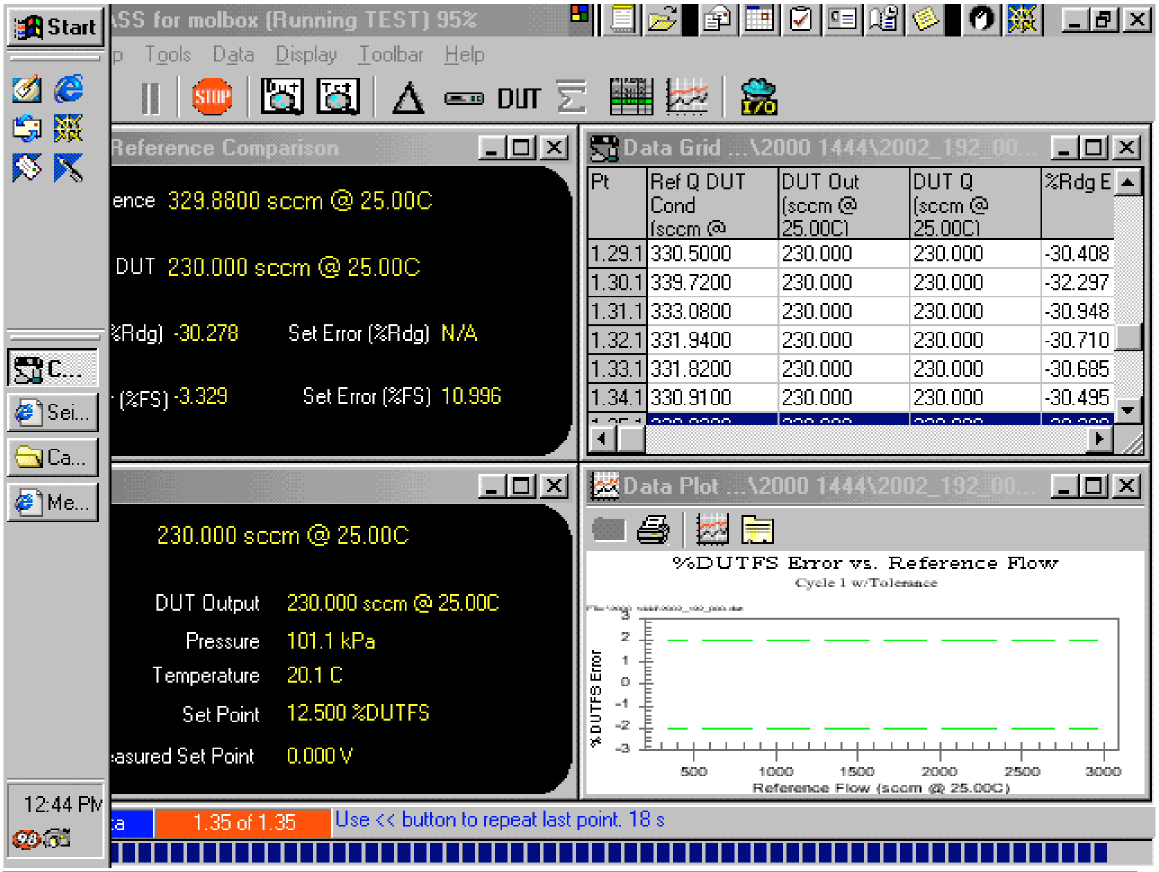


Figure 31 – Thirty seconds to repeat last point screen

COMPASS Report

Cycle 1 of 1

Date: June 13, 2002
Operator: Kalen Bjurstrom
Test Data File: C:\Program Files\COMPASS for molbox\data\89c0146\2002_164_000.dat

DUT		**Reference**	
Manufacturer	PORTER INSTRUMENT	Manufacturer	DH Instruments Inc
Model	201	Model	molbox1
SN	89c0146	SN	123
ID	89c0146	ID	DEFAULT Setup
Flow Range	0.000 to 50.000 sccm @ 25.00C	Range	50.00 sccm
		Output Range	0.000 to 50.000 sccm @
25.00C	molbloc SN	2123	
Data Acquistion	Manual		
Flow Control	Voltage/Current		
Tolerance	2 %DUTFS		

Ref Flow (sccm @ 25.00C)	DUT Flow (sccm @ 25.00C)	DUT Output	%Rdg Error	%FS Error	BF DUT Flow (sccm @ 25.00C)	BF %Rdg Error	BF %FS Error
51.1675	51.374	51.374	0.403	0.412	51.097	0.263	0.269
51.2227	51.518	51.518	0.576	0.590	51.152	0.435	0.446
51.2189	51.031	51.031	-0.368	-0.377	51.148	-0.504	-0.516
51.2318	51.290	51.290	0.113	0.116	51.161	-0.026	-0.026
51.2663	51.431	51.431	0.320	0.328	51.195	0.181	0.185
38.1221	38.246	38.246	0.325	0.248	38.106	0.282	0.215
38.1623	38.024	38.024	-0.362	-0.277	38.146	-0.403	-0.307
38.1515	37.806	37.806	-0.906	-0.692	38.136	-0.943	-0.720
38.1448	38.009	38.009	-0.357	-0.272	38.129	-0.396	-0.302
38.1802	38.107	38.107	-0.193	-0.147	38.164	-0.233	-0.178
25.5566	25.468	25.468	-0.347	-0.177	25.594	-0.199	-0.102
25.5268	25.700	25.700	0.677	0.345	25.564	0.823	0.420
25.5296	25.756	25.756	0.887	0.453	25.567	1.030	0.526
25.5166	25.410	25.410	-0.420	-0.214	25.554	-0.269	-0.137
25.4940	25.790	25.790	1.161	0.592	25.532	1.304	0.665
13.0938	12.939	12.939	-1.181	-0.309	13.184	-0.490	-0.128
13.0959	12.997	12.997	-0.754	-0.198	13.186	-0.064	-0.017
13.0857	12.944	12.944	-1.084	-0.284	13.176	-0.390	-0.102
13.0772	12.951	12.951	-0.964	-0.252	13.167	-0.272	-0.071
13.0848	12.979	12.979	-0.812	-0.213	13.175	-0.117	-0.031
6.7971	6.666	6.666	-1.932	-0.263	6.914	-0.204	-0.028
6.7945	6.666	6.666	-1.894	-0.257	6.911	-0.166	-0.023
6.8035	6.672	6.672	-1.930	-0.263	6.920	-0.210	-0.029
6.7933	6.668	6.668	-1.844	-0.251	6.910	-0.119	-0.016
6.7920	6.678	6.678	-1.680	-0.228	6.909	0.047	0.006

sccm @ 25.00C = -1.4364E-1 + 1.0042E0sccm
sccm = 1.4541E-1 + 9.9577E-1sccm @ 25.00C

Figure 32 – Sample report

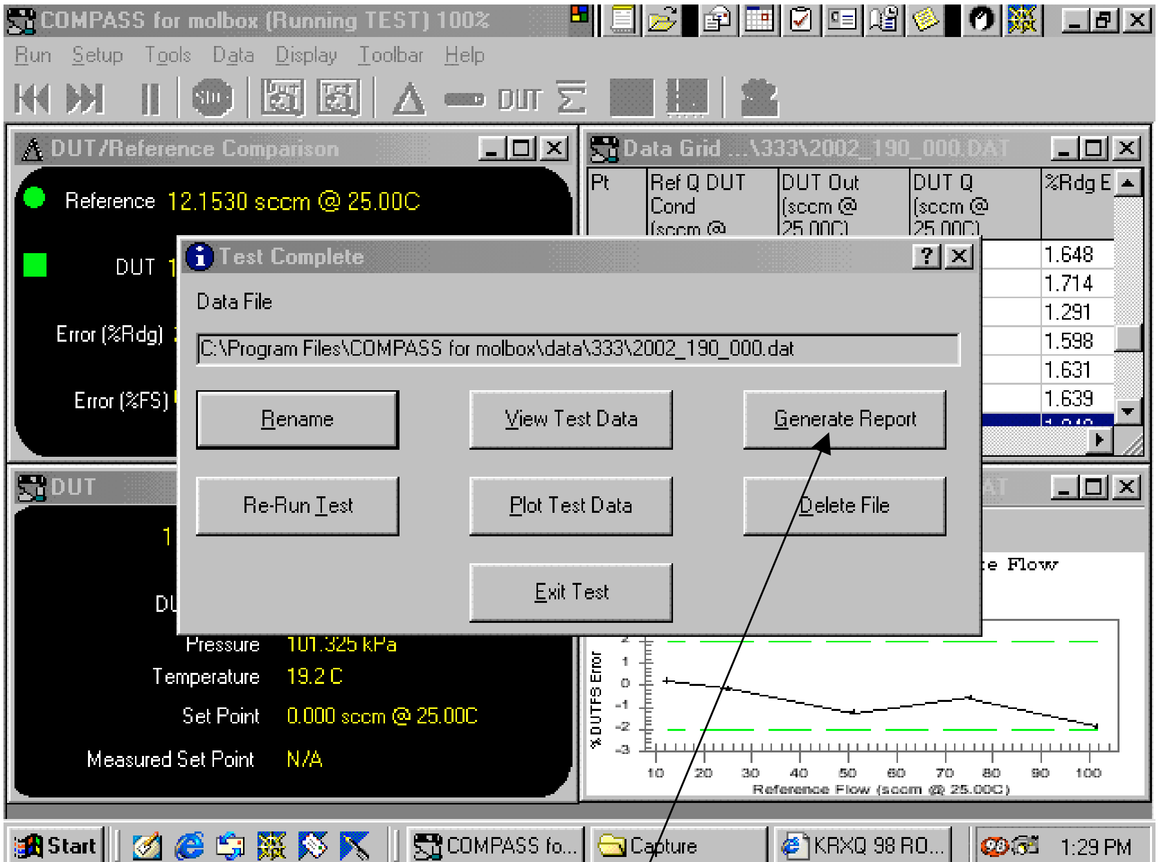


Figure 33 – Generate Report screen

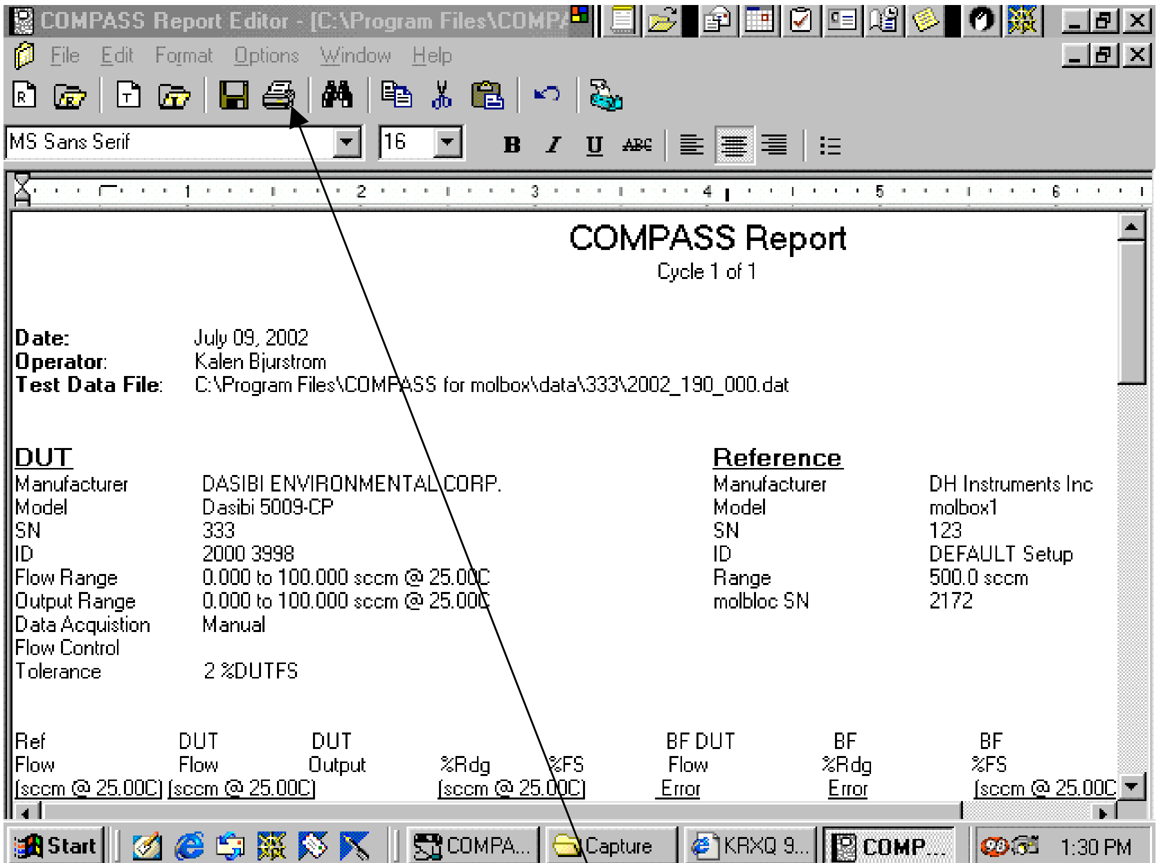


Figure 34 – Print report

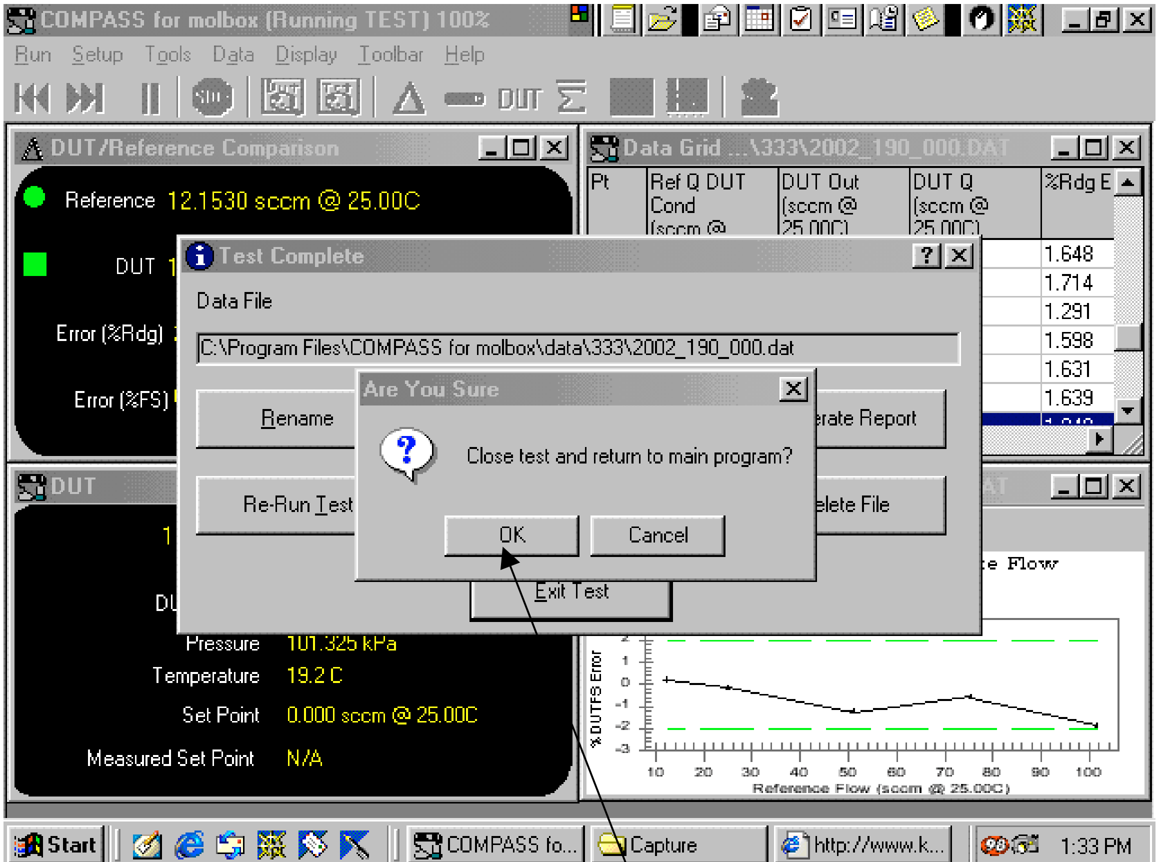


Figure 35 – End test

Molbox/Molbox MFM flow calibtration setup

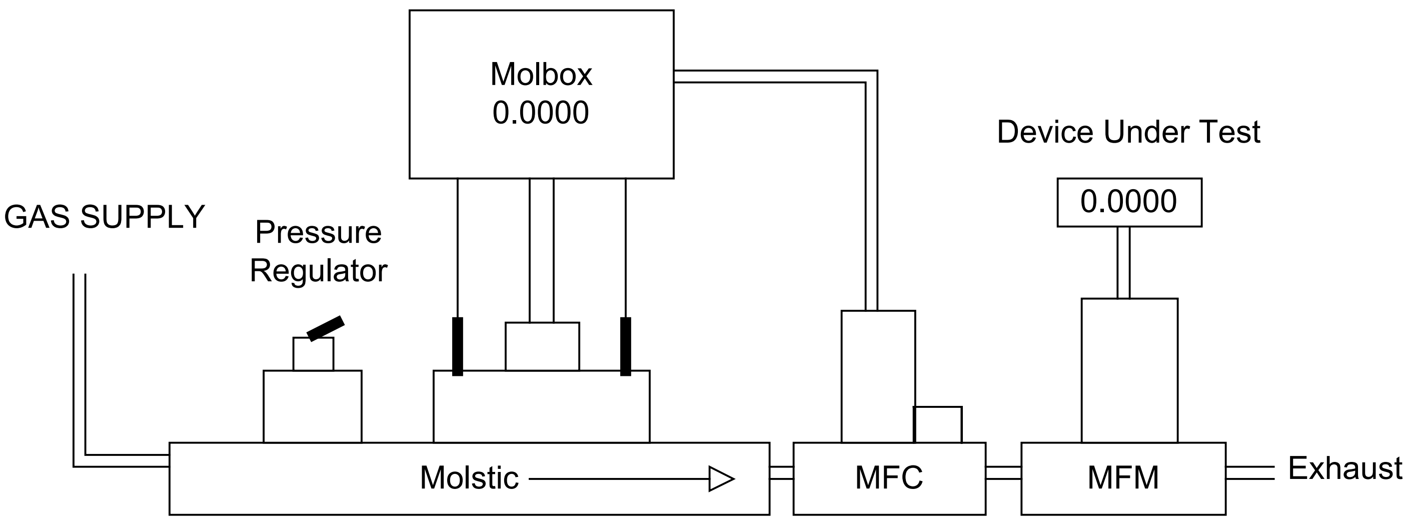


Diagram 1

Molbox/Molbox MFC flow calibtration setup

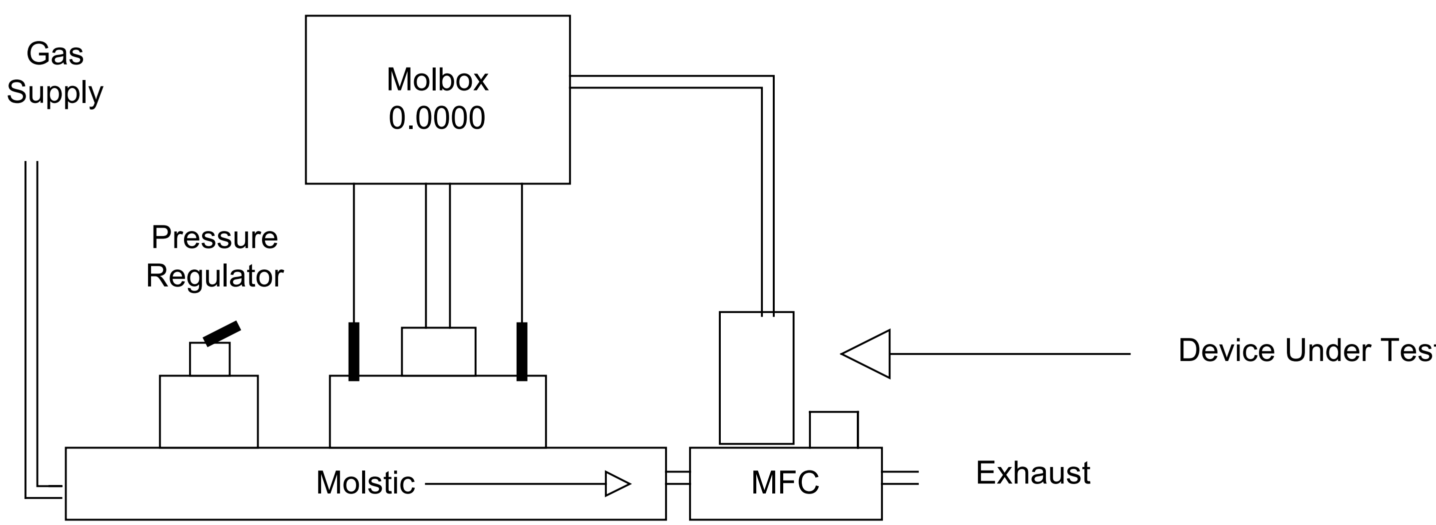


Diagram 2

12. DATA ENTRY INTO THE INSTRUMENT MANAGEMENT SYSTEM

12.1 From a personal computer, load the "Instrument Management System" application and enter calibration data.

12.1.1 Locate and double-click the Instrument Management System icon.

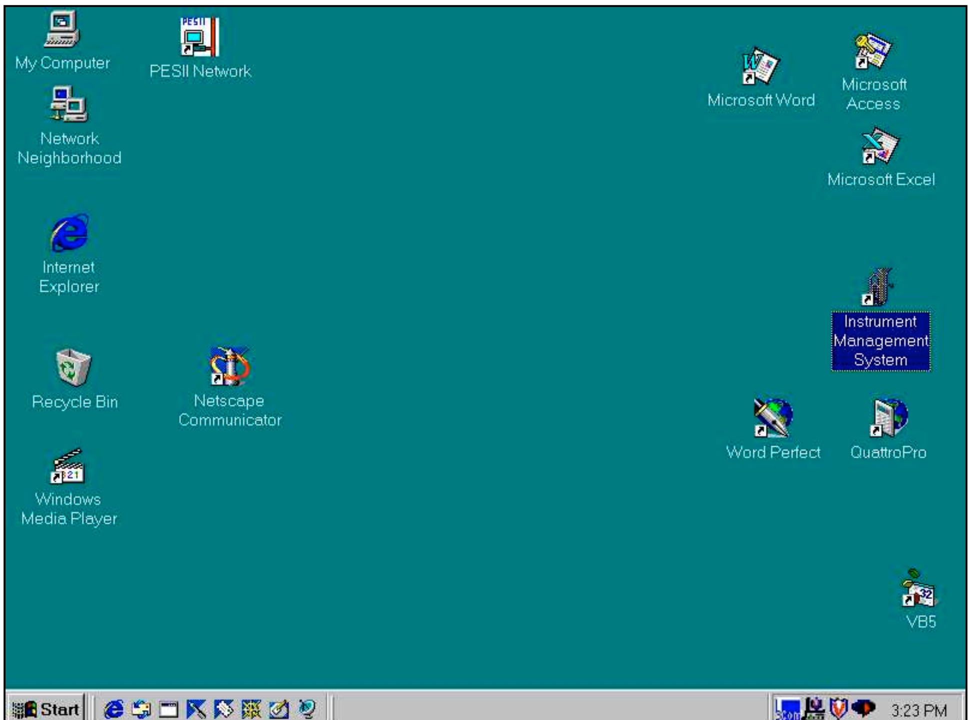


Figure 36

12.1.2 From the main menu of the IMS application, select #10 (Inst. Calibration).

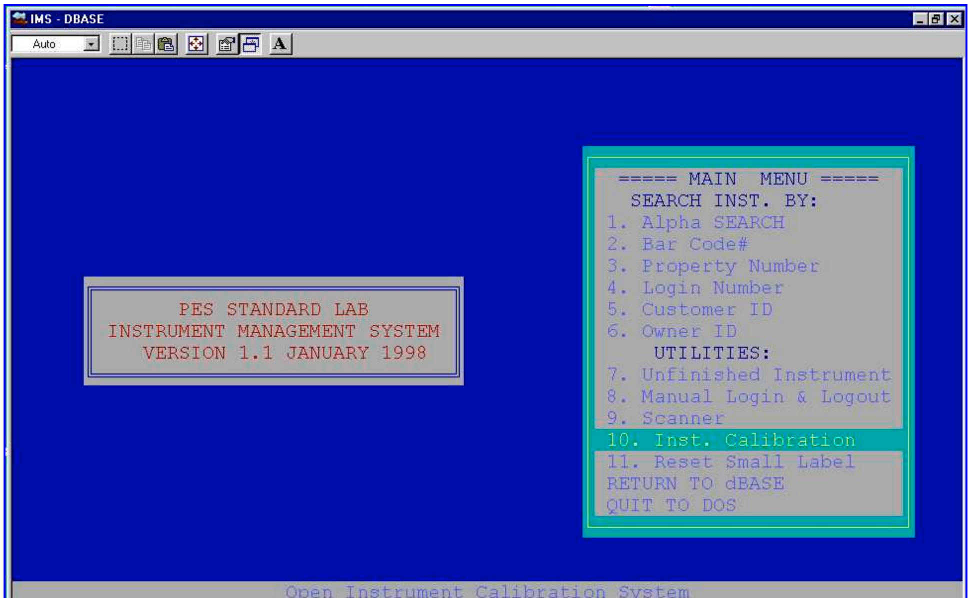


Figure 37

12.1.3 Enter the login number and the calibration date of the guest instrument.

Figure 38

12.1.4 Enter the position number, number of data runs, ambient pressure reading, time correction factor, and which flow calibrator was used.

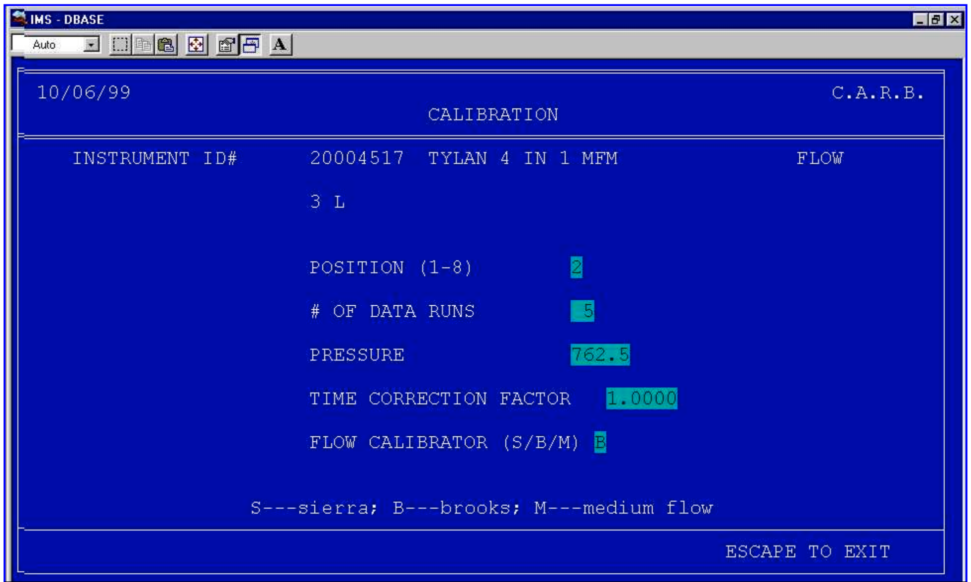


Figure 39

12.1.5 Enter recorded data from the calibration worksheet to the table under the appropriate headings. When the last row of data is entered, a prompt at the bottom of the screen will ask if the entered data is correct. If no is selected, the cursor will go back to the first data entry field to allow re-entry.

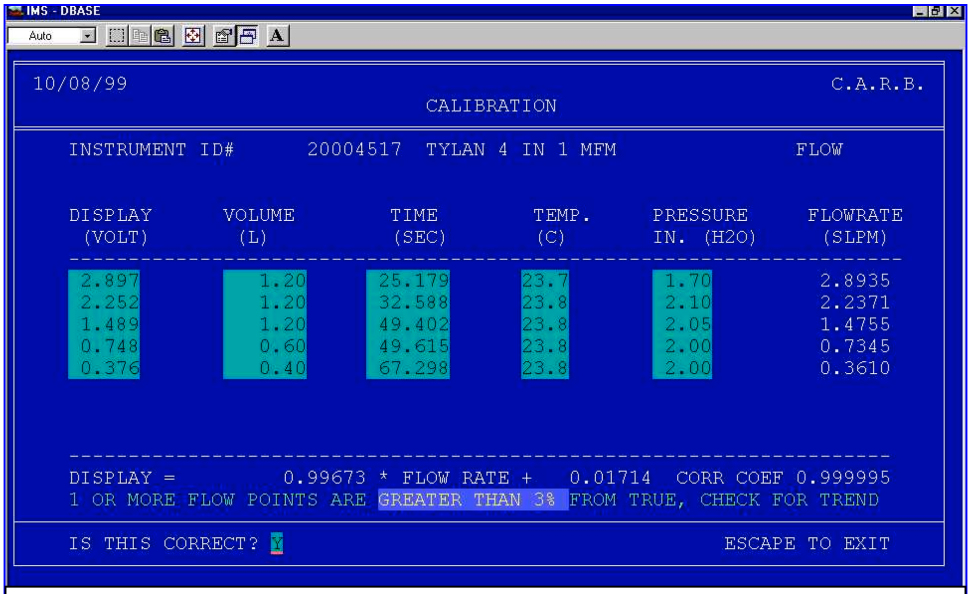


Figure 40

12.1.6 After acknowledging that all entered data is correct, the computer will determine if the results of the calibration comply with calibration criteria. If the results do not comply with criteria, a message alert will notify the user, otherwise you will see the following screen. At this point, print the calibration and the certification. Press escape to exit.

NOTE: This will be the only time you will be able to print calibration results. Raw calibration data are not saved.

Figure 41

13. VERIFICATION CRITERIA

13.1 Primary Flow Standard Verification

13.2 A verification establishes comparability of a standard to a NIST-traceable standard of equal rank.

13.3 Verifications consist of a single multi-point comparison against a primary flow calibrator.

13.3.1 For a verification to be valid, the linear regression of the comparison must comply with the following criteria:

- ✓ correlation coefficient of 0.9999 or greater
- ✓ the slope must be within 5 percent of the expected value
- ✓ the offset must be less than 1 percent from the guest instrument's full scale value

NOTE
The slope or the intercept shall not be used to correct the display readout of the guest Primary flow standard.

14. CERTIFICATION CRITERIA

14.1 A certification requires 4 consecutive assays each performed on different days. This ensures that each assay is performed at a different ambient condition (temperature and barometric pressure) than the previous assay. This practice checks the stability of the guest flow instrument. Each assay must have a linear regression subjected to a correlation coefficient criterion of $\geq$ 0.9999.

14.1.1 A valid certification consists of the following:

- Slope RSD consisting of the latest assay from the current certification process to the three previous assays must be less than 1 percent.

- Intercept RSD consisting of the latest assay from the current certification process to the three previous assays must be less than 1 percent.

- Change from the last assay of the previous certification to the first assay of the current certification process must be less than 1 percent. If this criterion is not met, an additional assay at different ambient conditions must be performed until the RSD criteria for slope and intercept are met.

14.2 After all certification criteria are met, the mean of the slopes and intercepts are used to correct the guest display to the true flow rate at standard conditions (760 mmHg @ 25°C).

14.3 Certified flow transfer standards are traceable to the NIST and carry a certification period of 3 months. Upon request, the certification period may be extended for certain instruments. Historical instrument data must justify such request.

15. CALIBRATION CRITERIA

15.1 A calibration is composed of a single assay which yields a slope and intercept. This slope and intercept are used to correct the display of the guest instrument only if the correlation coefficient is $\geq$ 0.9999.

15.2 Instrument calibrations do not offer NIST traceability.

16. QUALITY CONTROL CRITERIA AND ACTIONS

16.1 Leak Checks

16.1.1 Leak checks are performed on all primary flow standard and the guest instrument before each calibration. Please refer to section 7 if using the Brooks primary flow standard, section 8 if using the Sierra Calbench primary flow standard and, section 11 if using the Molbox/Molbloc flow standard.

16.2 The Sierra Calbench, Brooks, and Molbloc/Molbox flow standards can be compared utilizing the guest instrument's flow characteristics. For guest instruments requiring more than one calibration run, the primary standards are alternately used for each subsequent guest instrument calibration. Using the Brooks calibrator as the reference, the standards are compared using the difference in the guest instruments slope. The calibration runs must occur within seven calendar days of each other. In cases where multiple calibrations from the same seven-day period occur, the mean of the mean differences are used. The Sierra Calbench and Molbloc/Molbox calibrators is expected to be within two standard deviations of the mean difference (determined from historical comparisons) of the Brooks calibrator at all flows. For reference, a control chart is available in the latest quarterly QC Report.

16.2.1 Quality Control Actions

16.2.1.1 Control Limit Violations

16.2.1.2 An exceedance of 2 standard deviations of the mean will trigger a warning. A warning initiates an investigation of the process, but does not stop the process.

16.2.1.3 An exceedance of 3 standard deviations of the mean will trigger an action. This action involves stopping and investigating the process, and review of any data that may have been effected. If warranted, instruments may be recalled from field use for reanalysis.

16.2.1.4 The Molbox control unit is sent back to the manufacturer (DH Instruments, Inc.) annually to have the Reference Pressure Transducers (RPT) and Analog inputs tested and certified.

17. MAINTENANCE

17.1 Both volumetric primary flow standards are cleaned thoroughly once every two months. The Molblocs are purged thoroughly once every two months.

ATTENTION
When servicing either the Brooks or Sierra Calbench primary flow standard, personnel must wear lab coats, full-face shield respirators, and disposable nitrile gloves. The door to the flow room must also be closed and the room ventilation operating.

17.2 Cleaning the Brooks primary flow standard.

17.2.1 Clean the cylinders

17.2.1 .1 Piston and Cylinder Removal

17.2.1.1.1 Remove top cover and protective filter cap.

17.2.1.1.2 Move piston to top of cylinder by actuation.

17.2.1.1.3 Remove piston. Mercury will flow off to sides.

17.2.1.1.4 Remove glass cylinder by sliding up through top.

17.2.1.1.5 Remove mercury from the cylinder trap at the bottom of the cylinder column.

17.2.1.2 Cleaning

DANGER!
Do not use any ammonium based cleaning products to clean the glass tubes. According to the material safety data sheet (MSDS) for mercury, a violent reaction will occur.

17.2.1.2.1 Wipe insides cylinder with a lint free cloth (ie. Kimwipes) soaked with Windex (vinegar solution) wrapped around a wooden rod. Be careful not to scratch the glass.

17.2.1.2.2 Wipe inside of cylinder with a clean, dry, lint-free cloth.

17.2.1.2.3 Clean mercury, dust, and dirt from around the top and bottom of the cylinder supports.

17.2.1.3 Piston and Cylinder Installation

17.2.1.3.1 Grease o-rings with silicone grease.

17.2.1.3.2 Insert cylinder down through top grommet, upper cell, lower cell, and bottom grommet. Rotate cylinder slightly to ensure proper seating of o-ring before allowing the cylinder to bottom out.

17.2.1.3.3 Wipe the outsides of the piston with Windex (vinegar solution) using a lint-free cloth (ie. Kimwipes). Then wipe with a dry, clean, lint-free cloth.

17.2.1.3.4 Insert piston into cylinder and hold so that the groove is just below the top of the cylinder.

17.2.1.3.5 Remove set screw in the center of the piston and pour a few drops of mercury into the hole.

17.2.1.3.6 Replace the setscrew and tighten until groove is completely filled with clean mercury. If not filled, repeat steps 5 and 6 until hole is filled but not overflowing. Be careful not to over-tighten the setscrew.

17.2.1.3.7 Release piston, replace protective filter cap, and top cover.

17.2.1.3.8 Remove front control panel to expose and replace carbon filter (Koby Mercury Adsorber). Replace front control panel.

17.2.1.3.9 Check operation of calibrator.

17.2.1.3.10 Clean up all loose mercury using mercury clean up kit and or mercury vacuum cleaner.

17.3 Cleaning the Sierra Calbench Primary Flow Standard

17.3.1 Cleaning the tubes

17.3.1.1 Small Tube

17.3.1.1.1 Remove the black knobs that secure the hood and flip the hood back.

17.3.1.1.2 Remove the hold down bracket that secures the small transducer in place.

17.3.1.1.3 If the small piston was over-pressured and mercury is present when you remove the sonar, firmly tap the sonar with a side to side motion. Mercury should come out of the sonar transducer. In most instances there is a funnel shaped tube extender located in the sonar transducer, remove it and tap the sonar against the PVC top tube retainer again to remove all traces of mercury.

17.3.1.1.4 Re-install the tube extender in the small sonar transducer. Note: When re-installing the tube extender in the sonar transducer always install it with the I.D. up towards the top of the small tube.

17.3.1.1.5 Contain any mercury that was retrieved from the sonar into a small puddle and vacuum it up using the small hand held pump or syringe supplied in the mercury spill kit.

17.3.1.1.6 Remove the Plexiglas window from the front of the cabinet.

17.3.1.1.7 Loosen the threaded ring nut securing the top of the small tube and pull it down about one foot.

17.3.1.1.8 Carefully turn the small tube clockwise and slowly pull up on the tube for a distance of approximately one-foot. The piston should remain in the cabinet or fall out as you elevate the tube. To avoid damage to the piston, gently push the piston and target towards the back panel of the cabinet using a small acid brush. Clean the piston with a Kimwipe dipped in Windex(vinegar solution) cleaner and let air dry.

17.3.1.1.9 Pull back down on the tube and the O-rings so that the small tube is about five inches over its well.

Using the small acid brush, brush all mercury off the base of the tube. If there is any mercury higher up outside the tube, wipe it off using a small Kimwipe. All visible mercury on the exterior of the small tube should be wiped off inside the cabinet.

17.3.1.1.10 Once the base of the tube has been thoroughly wiped of mercury remove the threaded ring nut and o-ring.

17.3.1.1.11 Carefully remove the small tube by pushing it up and out through the top of the cabinet and clamp vertically to the utility stand. Place a mercury disposal container below the tube. *Never try to pull the small tube out through the front of the cabinet.*

DANGER! *Do not use any ammonium based cleaning products to clean the glass tubes. According to the material safety data sheet (MSDS) for mercury, a violent reaction will occur.*

17.3.1.1.12 Using Windex w/ vinegar cleaner, spray the inside of the tube until the tube becomes concentrated with the solution. The excess solution will drain into the mercury disposal container.

17.3.1.1.13 Prepare the wooden dowel by wrapping and rolling two to four small Kimwipes on one end of the dowel and securing the wipes using masking tape. When finished, it should look like one giant "Q-Tip". Be very conscious of the masking tape becoming uncovered in the tube. If the adhesive of the tape adheres itself to the tube the piston will stick in the tube.

17.3.1.1.14 Using the prepared dowel, scrub the inside of the tube thoroughly. Scrub the inside of the tube for approximately one minute.

17.3.1.1.15 Remove the dowel from the tube and replace the used Kimwipe end with a new one.

17.3.1.1.16 Run the dowel through the inside of the tube with a rotating motion to dry the inside of the tube.

17.3.1.1.17 Remove the dowel from the tube and replace the two wipes again.

17.3.1.1.18 Run the dowel through the inside of the tube once again with a rotating motion to dry the inside of the tube.

17.3.1.1.19 Remove the dowel from the tube and wipe off the outside of the tube so it is also clean and dry. To ensure drying add a five minute wait period before re-installing the tube.

17.3.1.1.20 Now that the tube and piston have been cleaned, contain all the mercury that is not in the small tube well and confine it into a single puddle. Use the vacuum pump or syringe in the mercury spill kit to remove.

17.3.1.1.21 There should now only be mercury in the well of the small tube where the base of the tube is recessed. It is also recommended that the mercury in the well of the small tube also be vacuumed out to avoid splashing of mercury during the tube installation.

17.3.1.1.22 Insert the small tube from the top of the cabinet. When inserting the tube, before the tube reaches the bottom of the cabinet, slip the O-ring over the bottom of the tube and roll it up the length of the tube.

17.3.1.1.23 Proceed to slip the threaded ring nut over the base of the tube and then recess the tube in it well.

17.3.1.1.24 Push down on the tube from the top of the cabinet and roll the o-ring up until about three inches from the bottom of the PVC tube retainer. Grease O-ring with Dow Corning Vacuum Grease and push it into the O-ring groove using the threaded ring nut. (As you push the o-ring up into the groove pull down on the tube so the tube is not pushed up out of its well). Secure the threaded ring so it is finger tight. *Caution: It is possible to break the tube by over-compressing the o-ring.*

17.3.1.1.25 Insert piston into tube and hold piston using forceps or a paper clip so that the groove is below the top of the tube, allowing a mercury seal to form around the piston in the tube.

17.3.1.1.26 Remove the round top sheet metal plate on the top of the piston and with a syringe, dispense a few drops of clean mercury into the hole until the piston groove is completely filled with mercury. Replace the round top sheet metal plate.

17.3.1.1.27 Release the piston and it should fall to the bottom of the tube. *Note: Make* *sure that before the piston is released that there is some air flowing through the tube. This will prevent the mercury seal from breaking as it descends.*

17.3.1.1.28 Replace the sonar transducer over the tube and fasten the sonar transducer with the hold down bracket.

17.3.1.1.29 Force mercury into the well of the small tube to seal the base of the tube. The syringe used to load mercury into the piston can be used for sealing the tube.

17.3.1.1.30 The level of the mercury in the well should be approximately 1/8" from the surface of the PVC tube retainer. If mercury stock is low you may reuse contaminated mercury to seal the base of the tube. Never use contaminated mercury to seal the piston.

17.3.1.1.31 Reposition the Plexiglas window in the cabinet.

17.3.1.1.32 Check for leak free seal (refer to leak check section 8.9).

17.3.1.1.33 Turn off all power to the sonar box. Using a Phillips screwdriver, remove the front bezel from the sonar box and remove the blue top by sliding out.

17.3.1.1.34 Follow the ADJUSTMENT/CALIBRATION procedures in the Calbench manual to guide you through the procedures. A pictorial diagram of the hook-up is shown on page 7. (Reference the Calbench manual chapter 4 Adjustment / Calibration, procedures 4.1 and 4.2). *DO NOT MAKE ANY POTENTIOMETER ADJUSTMENTS WITHOUT CONSULTING SIERRA INSTRUMENTS, INC. FIRST!* Adjustments to this circuit can affect sonar calibration.

17.3.1.1.35 After the sonar transducer has been aligned, tighten the bracket across the sonar with two fastening screws. Tighten the screws until contact and then an additional 45° more to cinch it down. Do not over tighten.

17.3.1.1.36 Install the black knobs that secure the hood and flip the hood back to its original position.

17.3.1.1.37 Dispose of all mercury exposed cleaning materials in appropriate container.

17.3.1.1.38 Remove respirator mask, pair of latex gloves, and goggles.

17.3.1.1.39 Clean respirator mask and goggles using safety equipment wipes.

17.3.1.2 Medium Tube

17.3.1.2.1 Refer to the procedure for cleaning the small tube step 17.3.1.1. Note: Alignment of the medium tube is not necessary.

17.3.1.2.2 Install the black knobs that secure the hood and flip the hood back to its original position.

17.3.1.2.3 Dispose of all mercury exposed cleaning materials such as used Kimwipes and mercury absorbents in a properly labeled airtight container. When this container is full, contact the building's Hazardous Waste Coordinator for disposal.

17.3.1.2.4 Remove respirator mask, pair of latex gloves, and goggles.

17.3.1.2.5 Clean respirator mask and goggles using safety equipment wipes.

17.3.1.3 Large Tube

WARNING

The large tube is heavy and awkward to handle. Do not attempt to remove the large tube from the cabinet without an assistant!

17.3.1.3.3 Follow the cleaning procedure for the small tube steps 17.3.1.1. Exceptions: The large tube is not mounted on a stand. Use a flat and level table to secure tube. Cleaning the inside of the tube is done by simply reaching in and wiping it down using large Kimwipes. Alignment of the large tube is not necessary.

17.3.1.3.4 Install the black knobs that secure the hood and flip the hood back to its original position.

17.3.1.3.5 Dispose of all mercury exposed cleaning materials in appropriate container. Remove respirator mask and goggles using safety equipment wipes.

18. APPENDICES

18.1 Primary Flow Standard Verification Procedure

18.1.1 Connect the guest primary flow standard using the diagram below (figure 42).Refer to step 6 to 6.1.1.2. Connect the Teflon line from the mass flow controller to the input of the two-way valve.

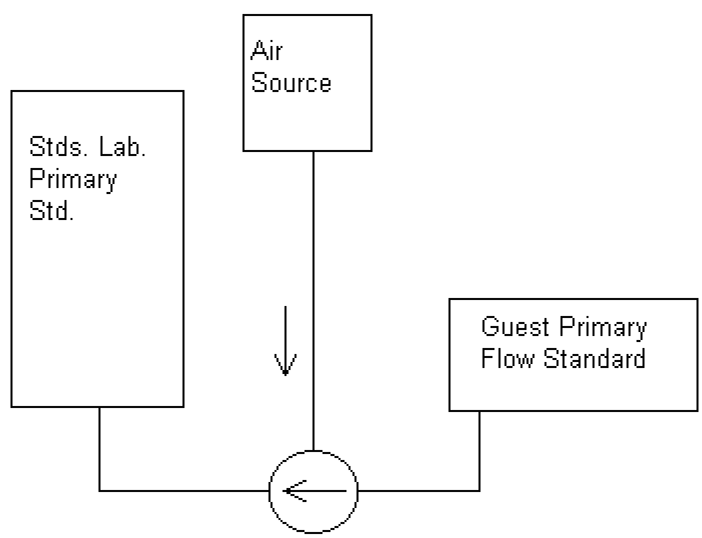


Figure 42

18.1.2 The two vacant outputs are connected to each primary standard respectively.

18.1.3 Turn on the laboratory primary flow standard, the guest primary flow standard, and the mass flow controller and allow each to warm up for 30 minutes.

18.1.4 Prepare work sheet (refer to step 6.3).

18.1.5 Setup up laboratory primary standard. For the Brooks, refer to step 7 to 7.4.1 or the Sierra Calbench, refer to step 8.4 to 8.8.1.

18.1.6 Leak test the laboratory primary flow standard in use. Rotate the two-way valve so that flow is diverted to the laboratory primary flow standard.

- Sierra Calbench (Refer to step 8.9 to 8.9.6)
- Brooks (Refer to 7.6 to 7.10), then monitor the piston for a downward movement which would indicate a leak.

DANGER!

Do not perform leak test on guest primary flow standards. These instruments are not designed to be pressurized and therefore can be damaged and or cause physical injury.

18.1.7 The verification procedure is similar to the calibration procedure with the exception that the guest instrument is also subjected to the same flow point validations as the primary. Refer to the calibration procedure for the Brooks (Step 9) or the Sierra Calbench (Step 10).

18.1.8 When all data has been gathered, use the spreadsheet located in the following path to correct the guest instrument to standard conditions and to determine the slope and intercept of the regression.

Excel Spreadsheet Name: Bubblemeter.XLS
Path: K:\Miscellaneous\Bubble Meter\Bubblemeter.XLS

18.2 Instrument Verification Data Entry (Refer to step 11 to 11.1.3).

18.2.1 Enter the following data:

- Position Number
- Slope
- Intercept
- Correlation Coefficient
- Is this a good run (**T**rue or **F**alse)
- Is this a calibration(**B**) or verification(**V**)
- Send this data to which table: **M**iscellaneous, **O**zone, or **F**low
- Confirm all data entered is correct (**Y**es or **N**o)

Figure 43

18.2.2 After confirmation, the next screen will ask which type of verification report you are generating. Enter "Flow".

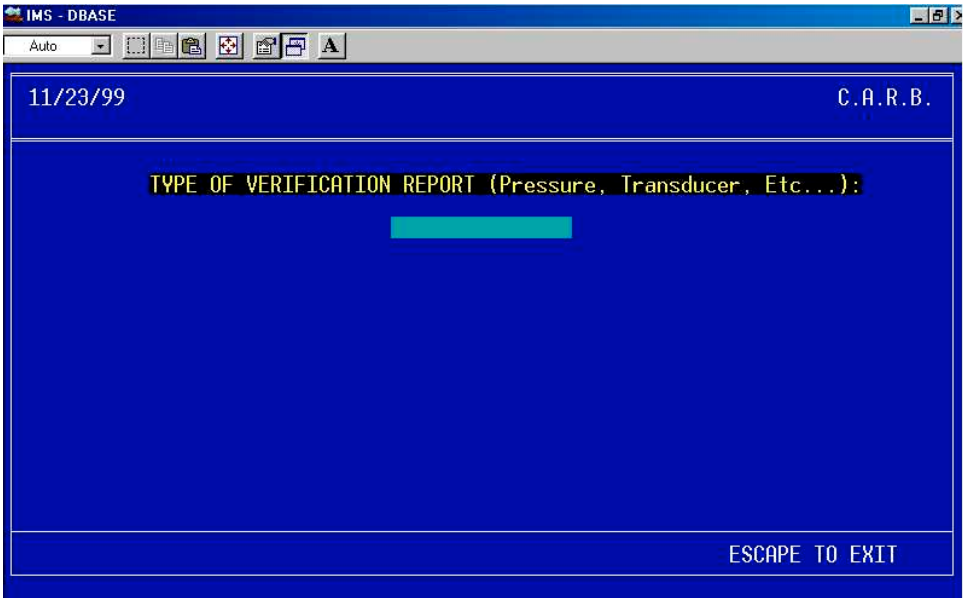


Figure 44

18.2.3 The next screen will ask for a description of the calibration or verification. In the blank field simply type “Verification” and press the **Enter** key.

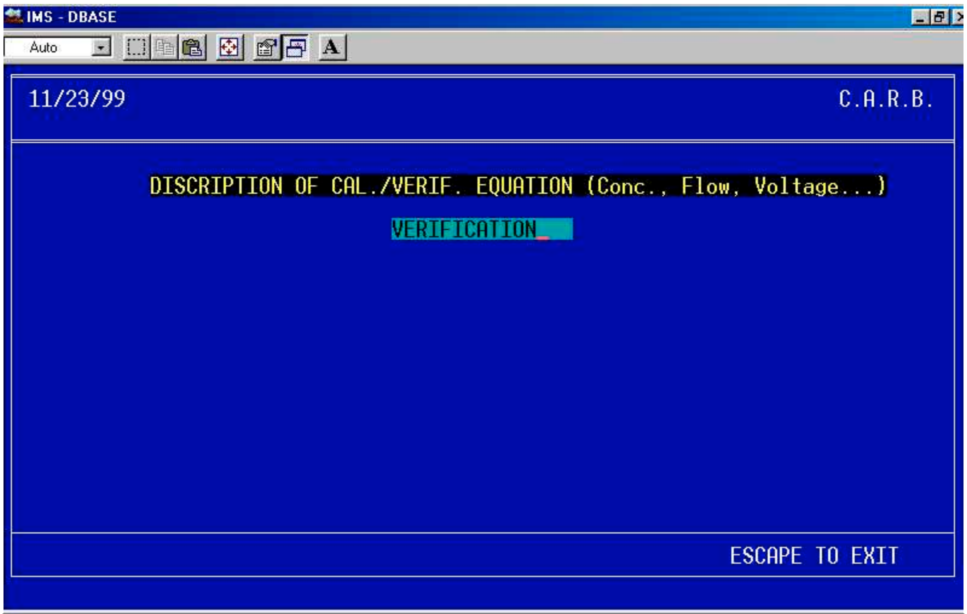


Figure 45

18.2.4 Enter the instrument owner.

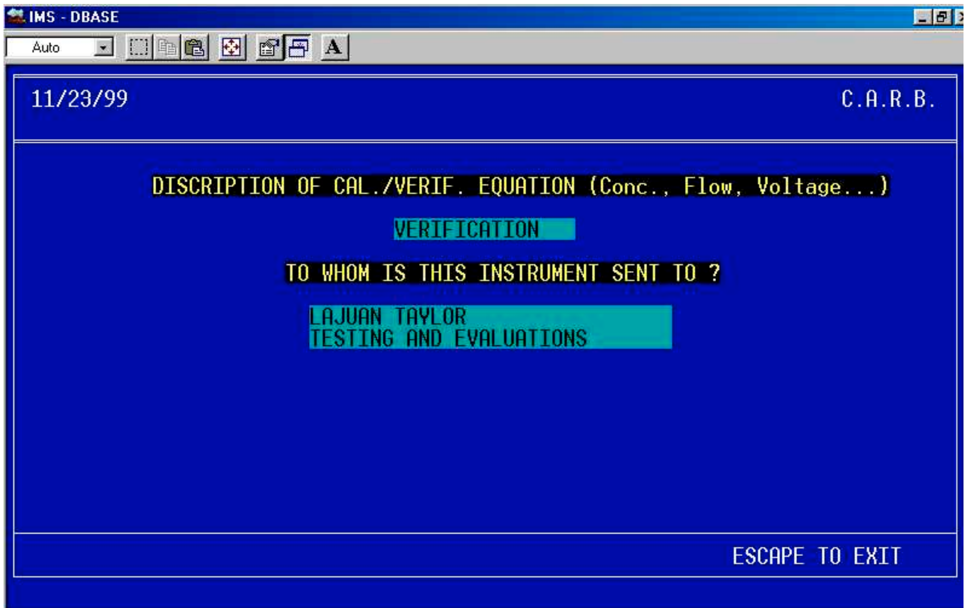


Figure 46

18.2.5 Enter the amount of calibration standards used.

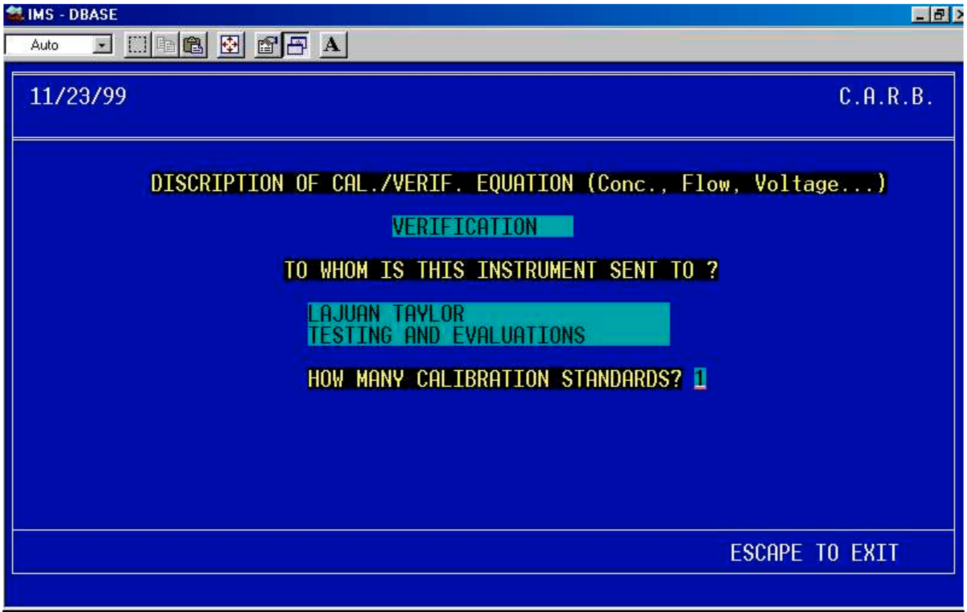


Figure 47

18.2.6 Enter the type of the calibration standard used and its associated barcode number.

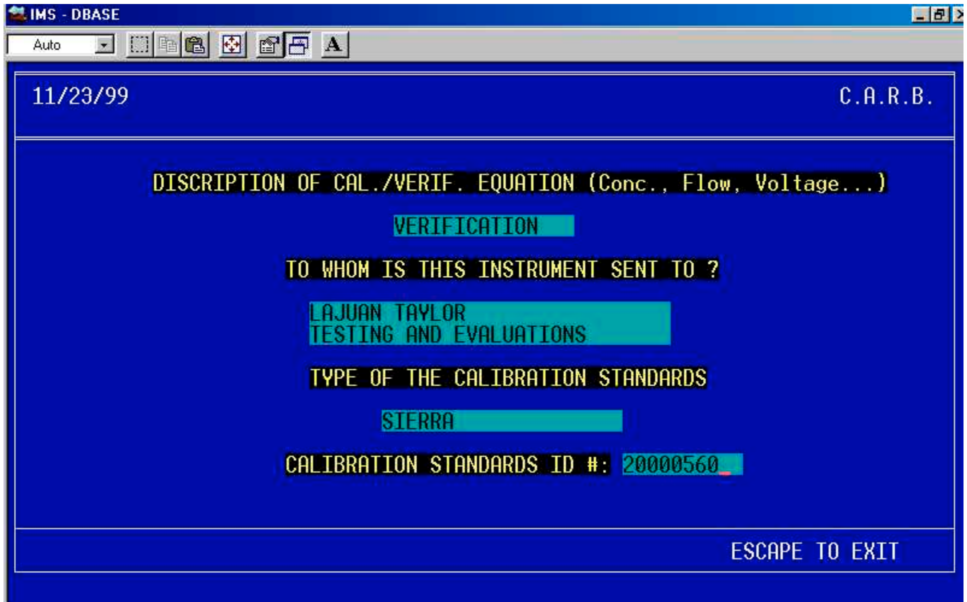


Figure 48

18.2.8 A prompt will ask if you would like to enter more option. Answer yes.

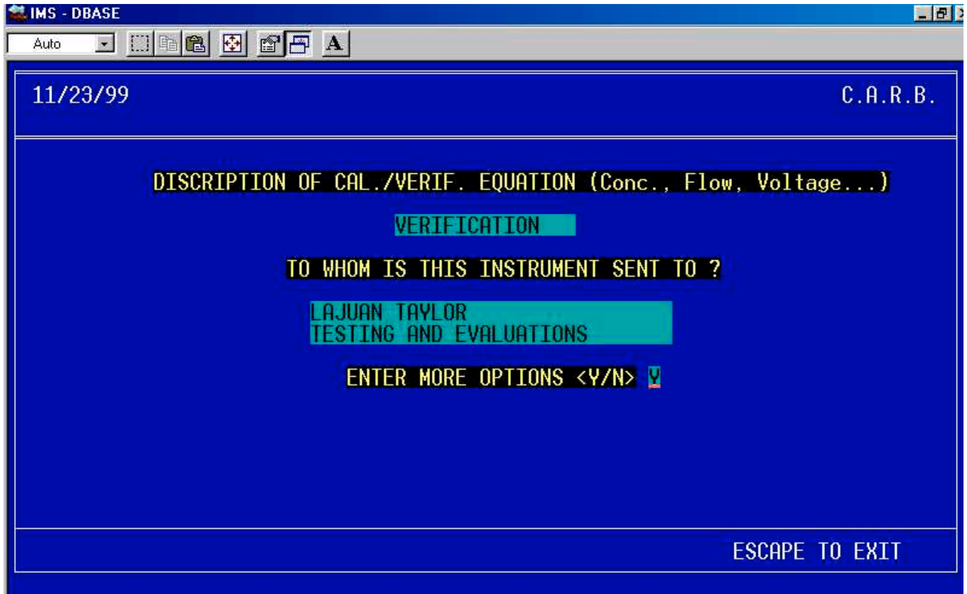


Figure 49

18.2.9 Enter “Flow” in the component field and the flow range in the instrument range field. Press enter to the rest of the fields.

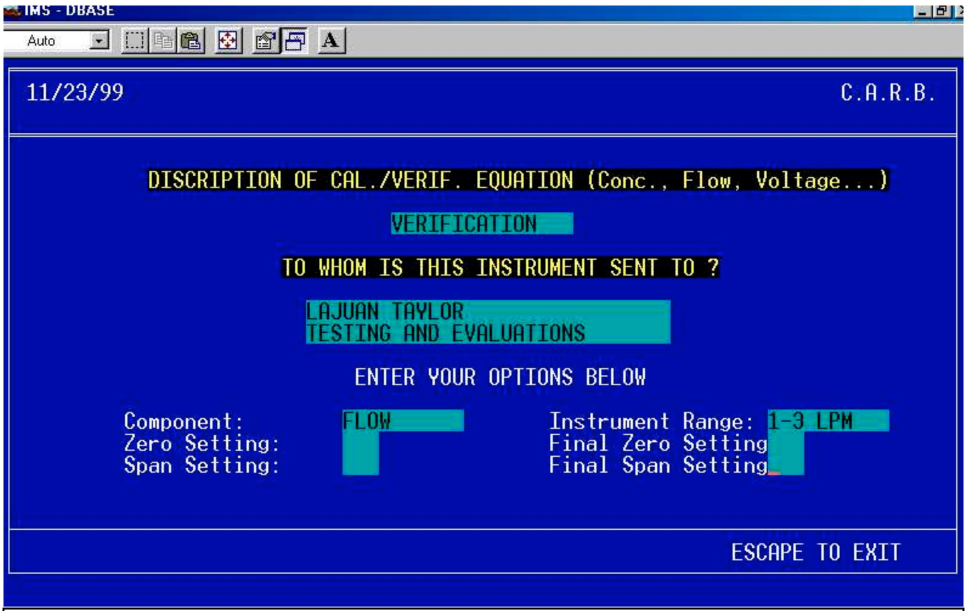


Figure 50

18.2.10 A prompt will ask whether or not you would like to enter comments. If yes is answered, a comment box will be displayed for you to enter your comment.

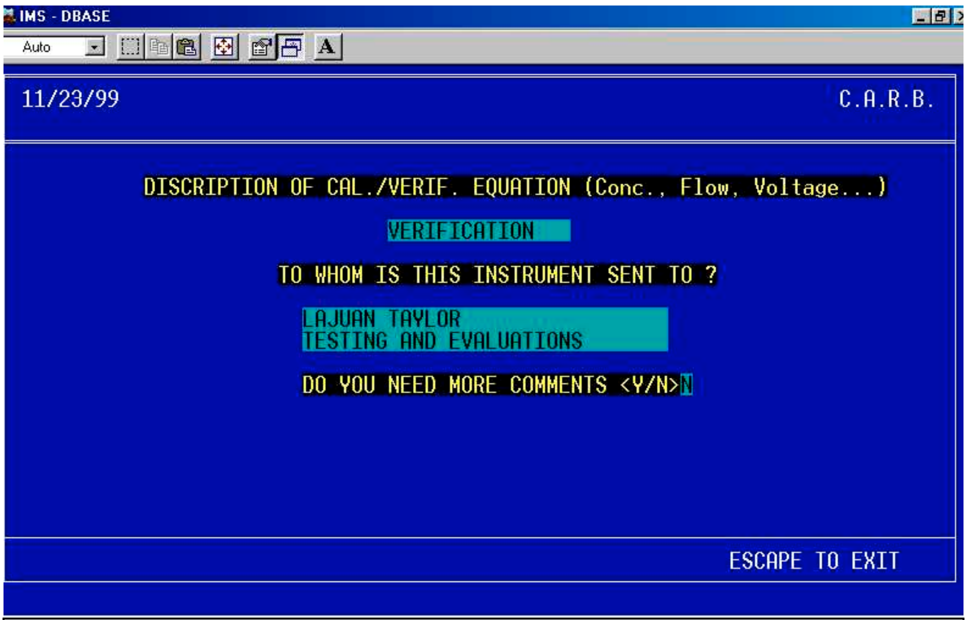


Figure 51

18.2.11 Verify the printer is online so that a report can be printed to it. Press any key to continue.

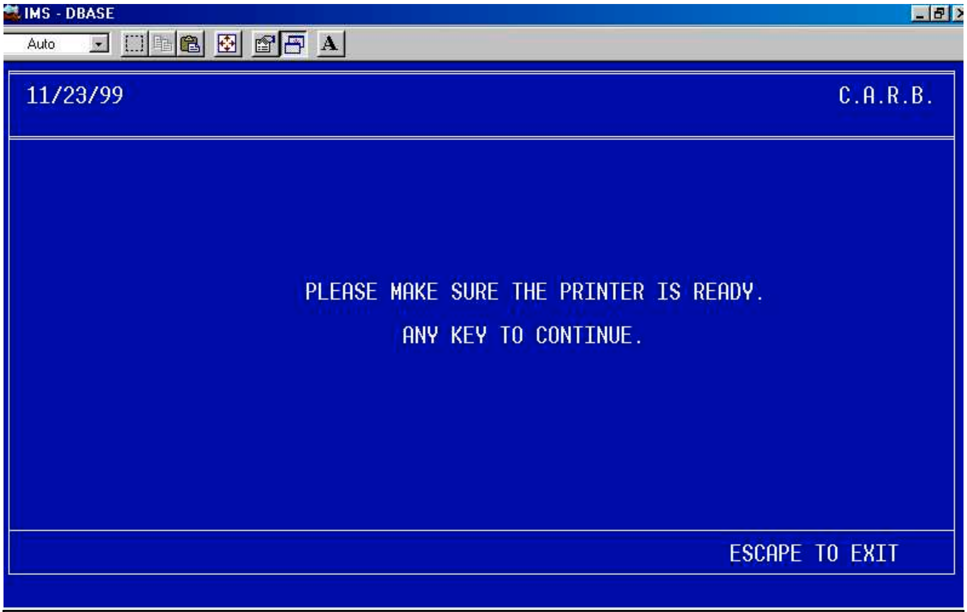


Figure 52

19. HISTORY METHOD

Original version December 14, 1999

Version 2 August 25, 2003

Changes made:

1) incorporated laminar flow element procedure, section 11
2) added Method History, section 19.