



QUALITY MANAGEMENT BRANCH

STANDARD OPERATING PROCEDURES

FOR

VERIFICATION AND CALIBRATION OF
PRESSURE DEVICES

Standards Laboratory SOP 007

Version 1

MONITORING AND LABORATORY DIVISION

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Standard Operating Procedures (SOP) Approval

Title: Verification and Calibration of Pressure Devices
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4.21.15

DATE

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Michael Miguel, Chief
Quality Management Branch

4/21/15

DATE

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1.0 Introduction

This procedure will provide National Institute of Standards and Technology (NIST) traceable verifications and calibrations for pressure devices. Pressure values from 0 to 200 kilopascals (kPa), or 30 pounds per square inch (psi) absolute and 0 ± 100 kPa (15 psi) gauge can be evaluated. Hand-held digital pressure meters and mechanical gauges are acceptable for verification or calibration.

2.0 Regulatory Requirements

U.S. Environmental Protection Agency (U.S. EPA) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Monitoring.

3.0 Summary of Method

A candidate pressure device is compared against a reference standard at five different points spread evenly throughout the instrument's range.

If an adequate coefficient of determination ($R^2 \geq 0.9999$) is developed from comparing the candidate device to the reference standard, a verification report is issued and no adjustments or corrections are needed before using the data from the display of the candidate device. The correction equation can be used to improve the accuracy of the readings.

If an $R^2 \geq 0.999$ is developed from comparing the candidate device to the reference standard, a calibration correction equation is provided. It is highly recommended that the user use the correction equation to improve the accuracy of the display reading.

If the candidate pressure device is unable to meet the verification criteria or calibration criteria, a re-test is performed to confirm the failure. If the failure is confirmed, the candidate device is returned to the customer for repair or replacement.

4.0 Summary of Changes to Previous Version

Not Applicable

5.0 Definitions

- Calibration – establishes a correction formula to be used to adjust or correct the display of the candidate instrument to a NIST traceable value.
- Verification – establishes comparability of a candidate instrument to a NIST traceable value. The output of candidate instrument display does not have to be corrected.

6.0 Personnel Qualifications

Before new personnel perform this procedure, one or more weeks of training from Standards Laboratory staff is required. Subsequent to this, new personnel need to be able to demonstrate competency in performing this procedure without any assistance.

7.0 Health and Safety

Adhere to manufacturer's input pressure limits (10 to 15 psi) when operating this equipment.

8.0 Cautions

Do not apply more than 15 psi to the "Air Supply" port of the PPC3 pressure controller. Over pressurizing can damage the pressure controller.

9.0 Interferences

Avoid kinked or bent tubing to prevent compromising accurate pressure readings.

10.0 Equipment and Supplies

- Fluke PPC3 Pressure Controller/Calibrator
- Clean air supply
- Vacuum Pump
- 1/8" ID (inside diameter) 1/4" OD (outside diameter) flexible tubing.
- Laptop computer with Compass software installed

11.0 Five Point Verification/Calibration Procedure

11.1 Power on the PPC3 Pressure Controller/Calibration. See Figure 1.

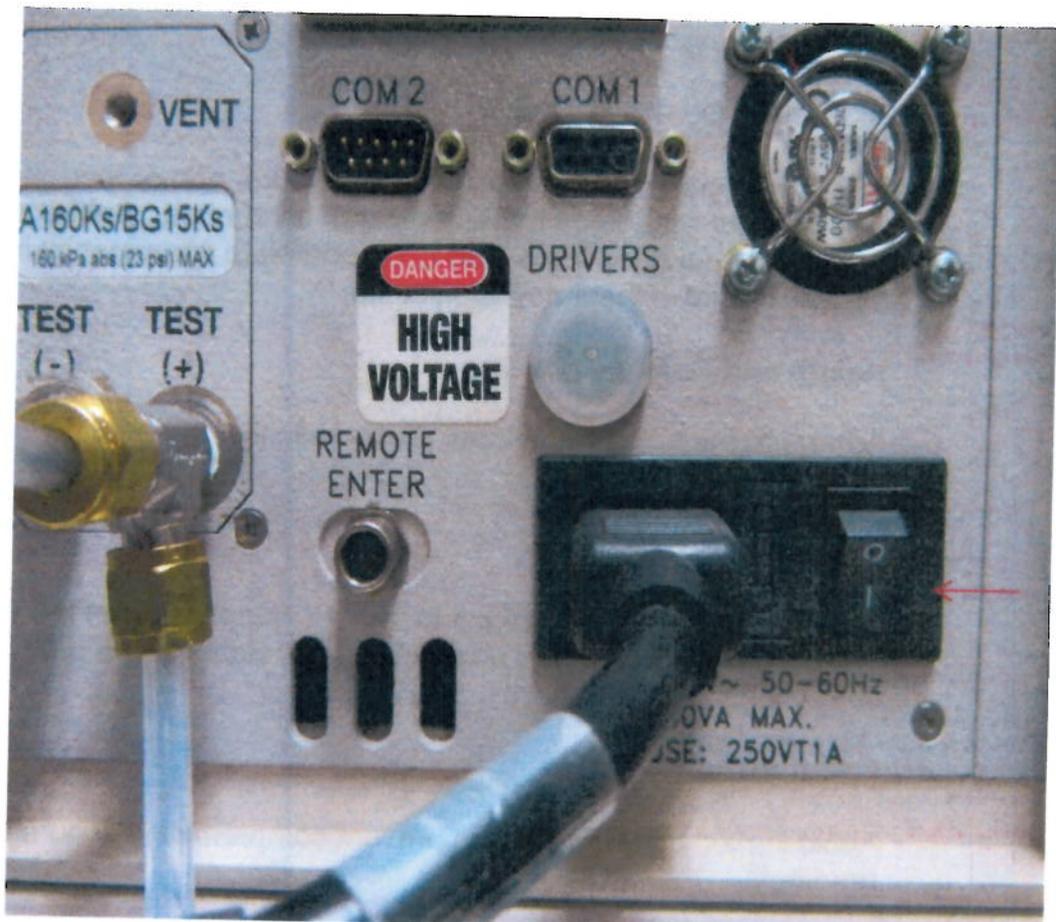


Figure 1

- 11.2 Apply 10 psi of clean dry air to the “Supply” port of the PPC3 Pressure Controller/Calibration. Do not apply more than 15 psi to the “Supply” port. The clean dry air supply is located between the two work benches located in the flow room. See Figure 2.



Figure 2

- 11.3 Connect the vacuum line from the vacuum pump to the “Exhaust” port of the reference pressure controller. See Figure 3.

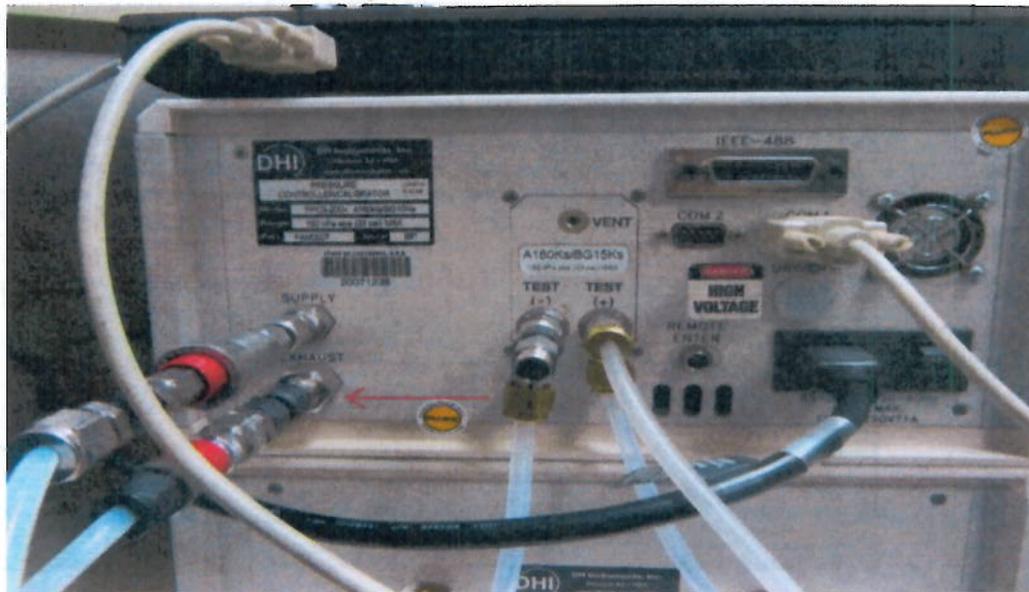


Figure 3

- 11.4 Connect the serial cable from the laptop serial port to the "COM1" port of the reference pressure controller. See Figure 4.



Figure 4

- 11.5 From the laptop computer, double-click on the "DASPS" icon. See Figure 5. The laptop is located in staff's cubical area.



Figure 5

11.6 Double-Click on the “Standards Laboratory” folder. See Figure 6.

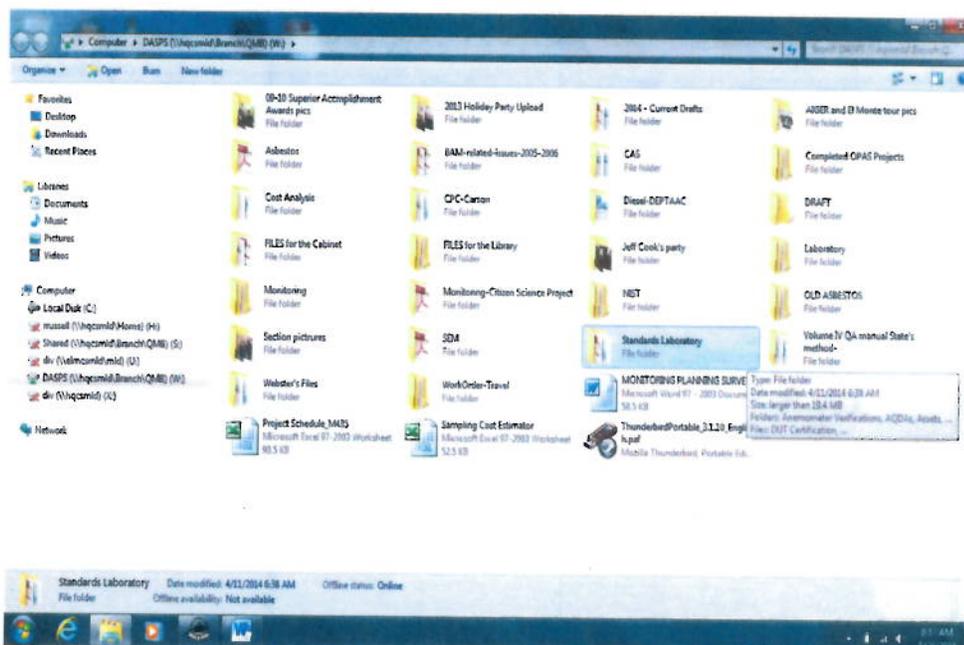


Figure 6

11.7 Double-Click on the “Calibration Forms” folder. See Figure 7.

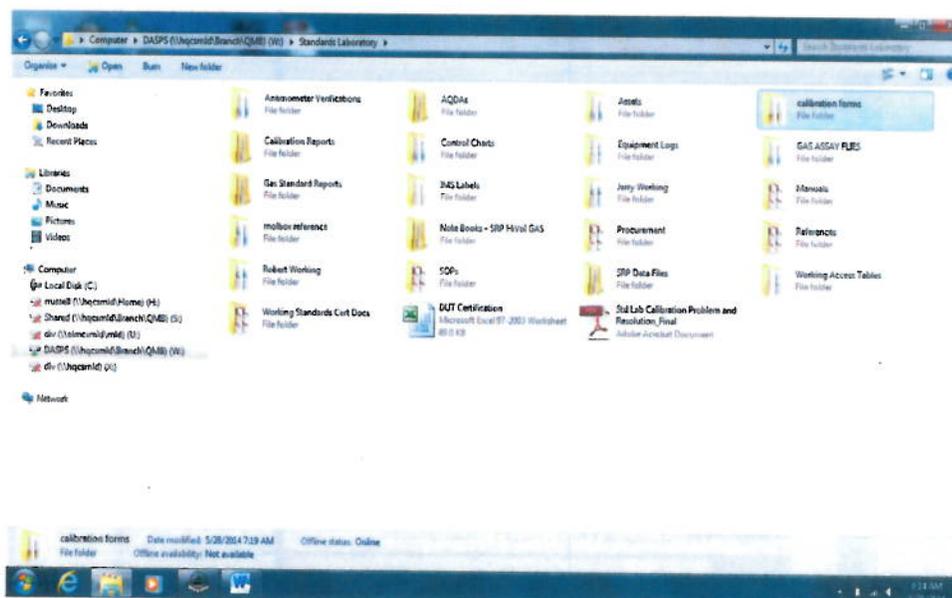


Figure 7

11.8 Double-Click on the “Misc Cal “workbook. See Figure 8.

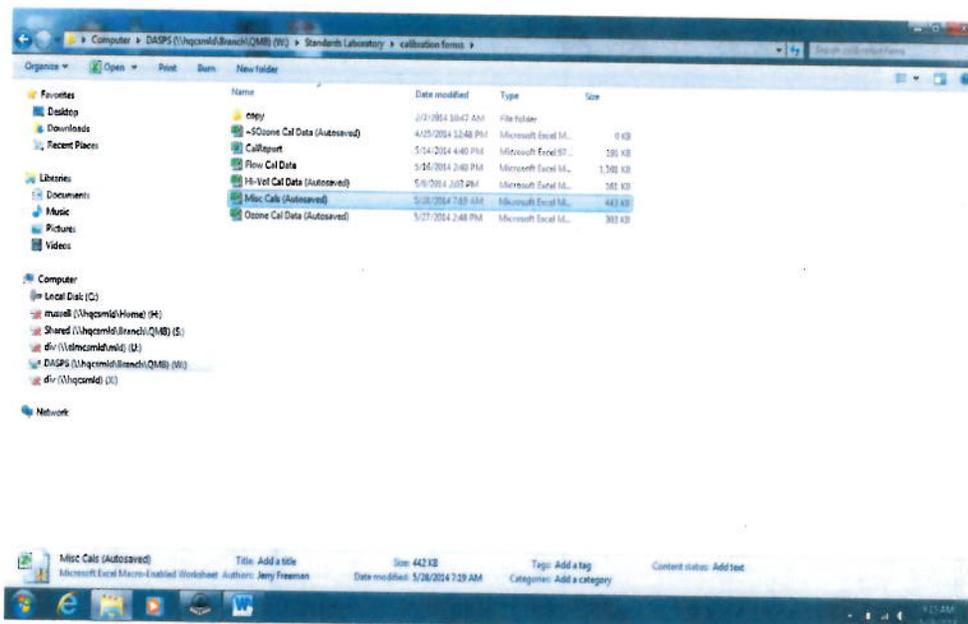


Figure 8

11.9 Select the “Login” worksheet. Enter the “Instrument ID” number. Click on the “Collect Customer Information” button. See Figure 9.

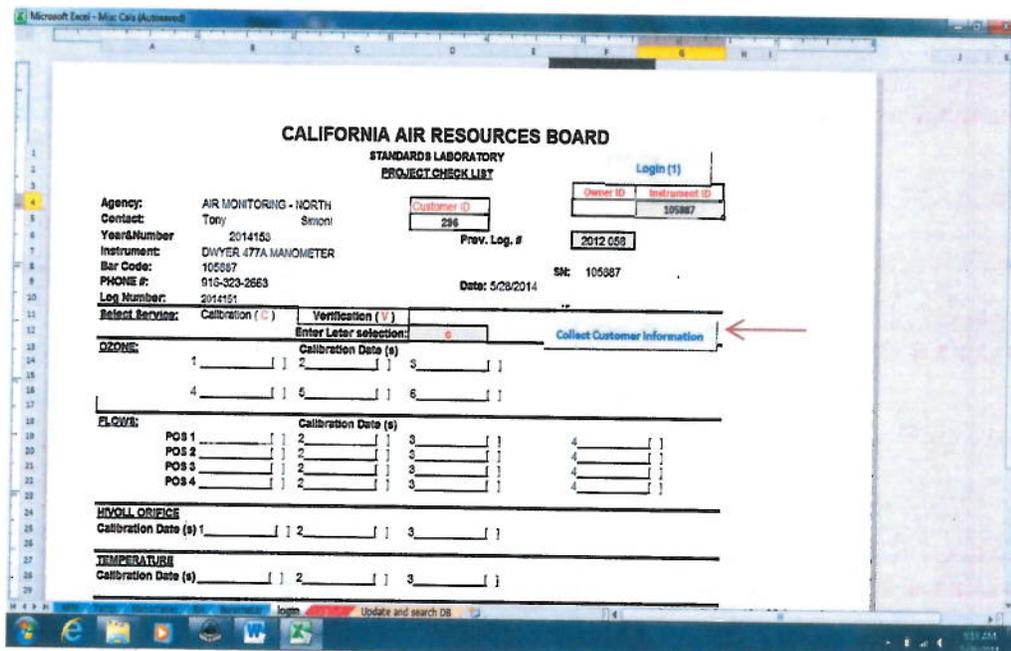


Figure 9

11.10 Select the “Manometer” worksheet. Enter the appropriate information into the “Cal. Date:” “Component,” and “Instrument Range” cells. See Figure 10.

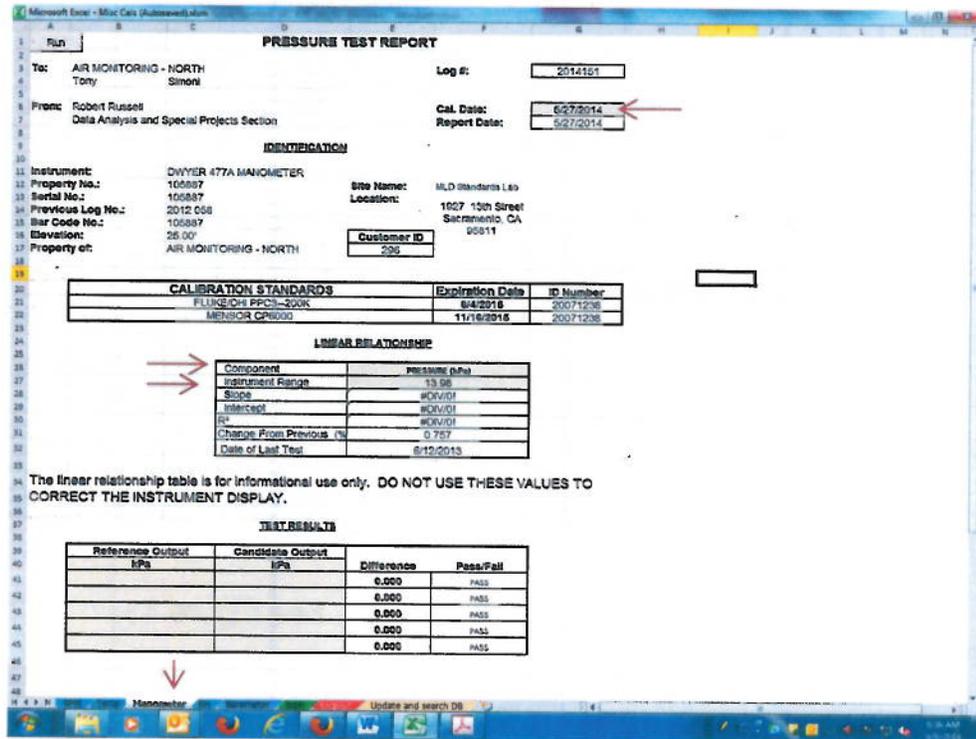


Figure 10

11.11 From the desktop double-click on the “COMPASS” icon. See Figure 11.



Figure 11

- 11.12 Click on the “RUN” dropdown menu and select “Run Test Definition.”
See Figure 12.

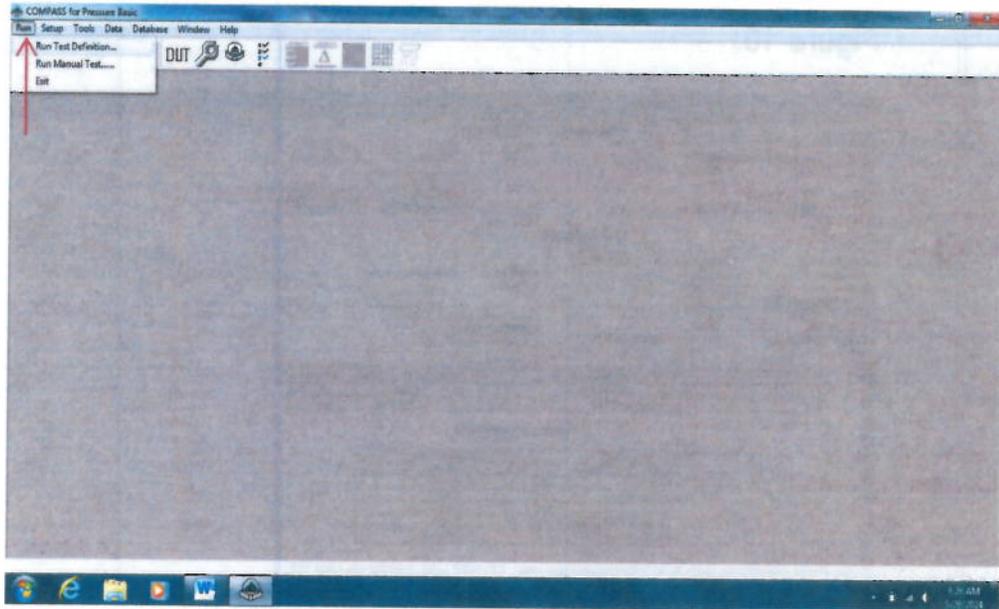


Figure 12

- 11.13 Select the “Test Pressure Unit” (kPa). See Figure 13.

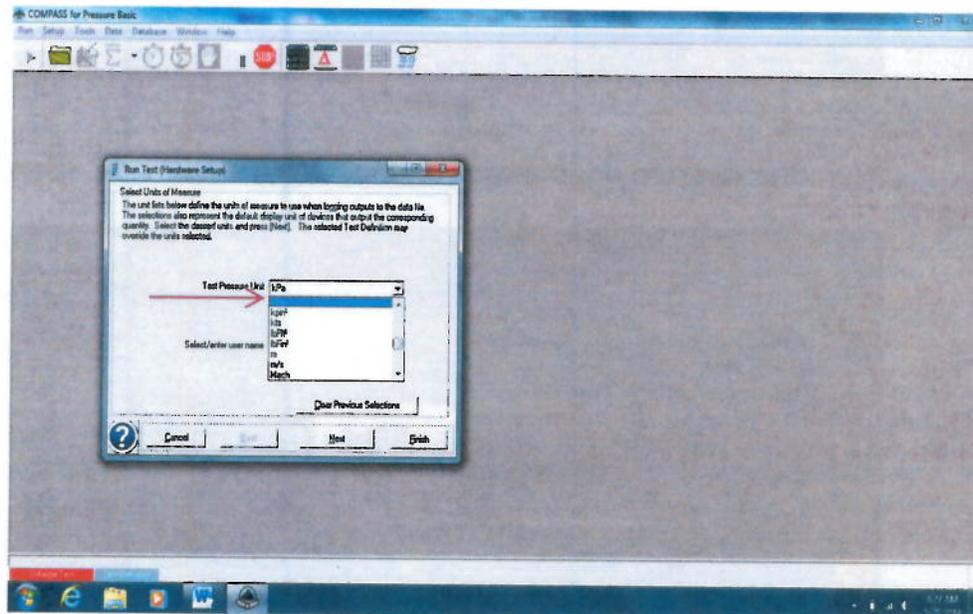


Figure 13

11.14 Enter the user name, and then click on the “Next” button. See Figure 14.

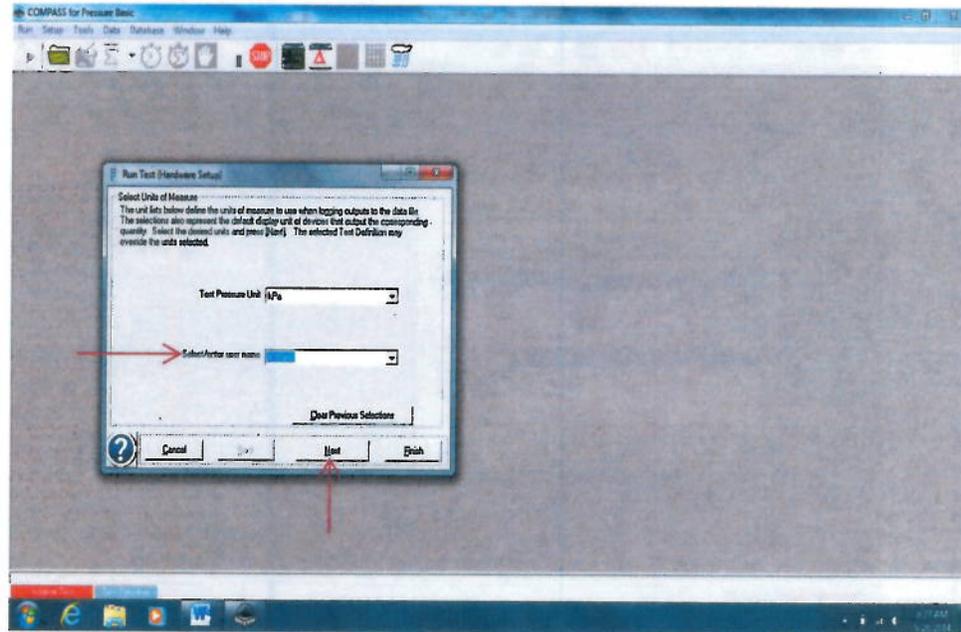


Figure 14

11.15 Click on the “Search” (1) button then enter the Instrument ID number (2). Click on the “OK” button (3). Click on the “Next” button (4).

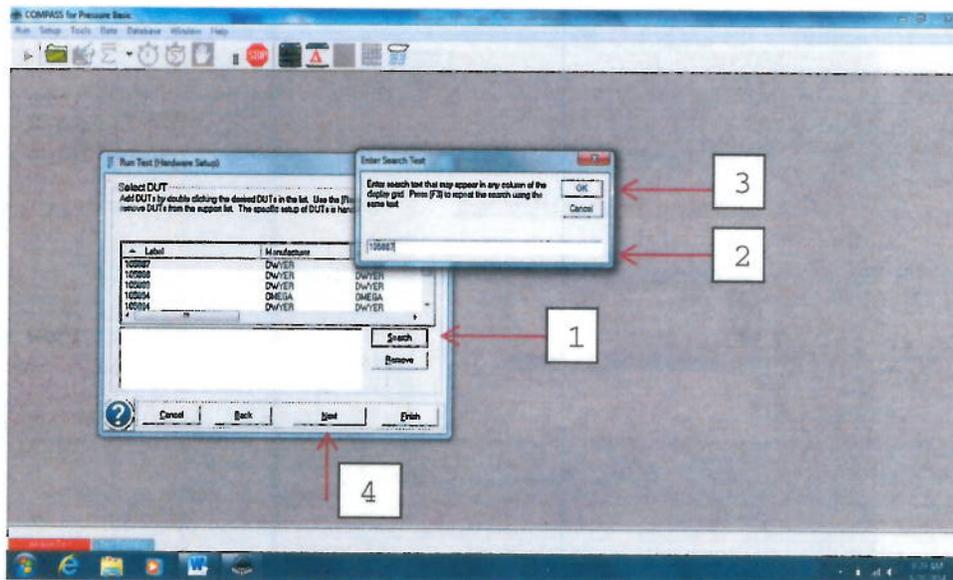


Figure 15

11.16 Double-Click on the highlighted “DUT” (device under test). See Figure 16.

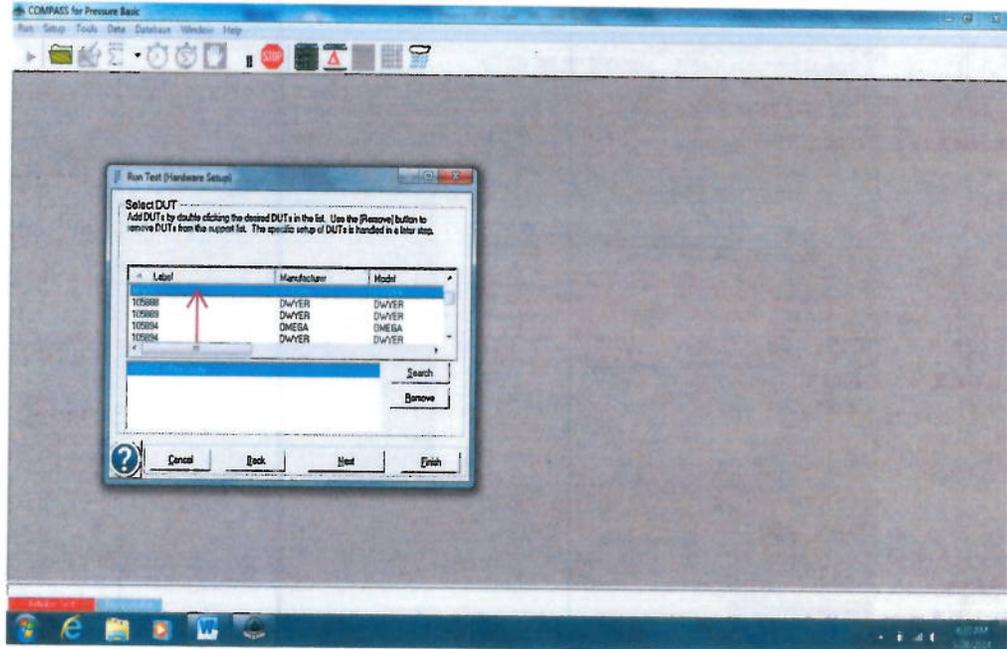


Figure 16

11.17 Click on the “Next” button. See Figure 17.

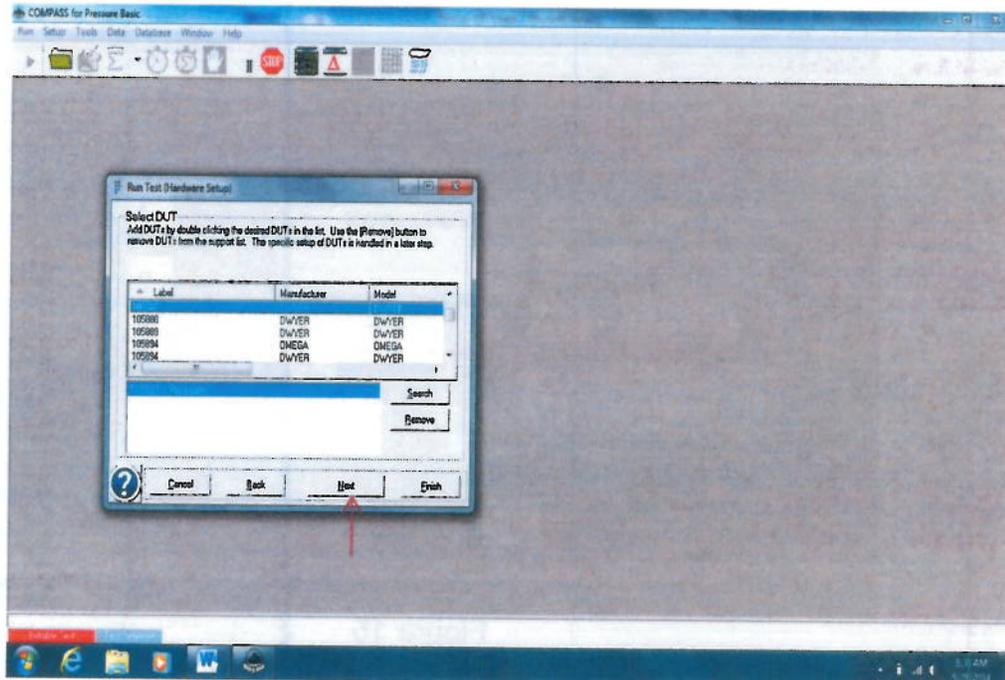


Figure 17

- 11.18 The window allows you to verify the hardware setup. This information does not change. Click on the “Next” button. See Figure 18.

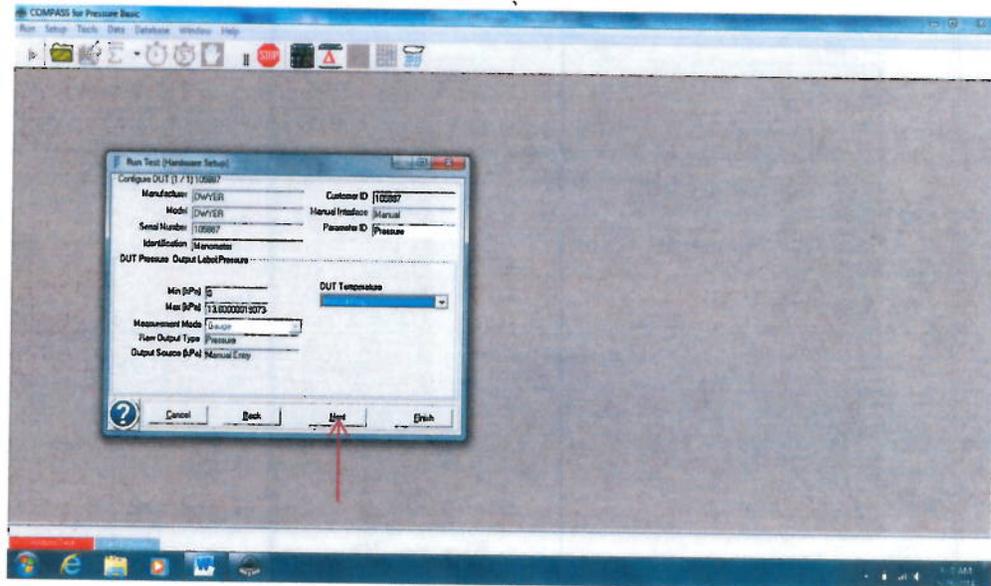


Figure 18

- 11.19 Double-Click on the “Test Definition,” then click on the “Next” button. See Figure 19.

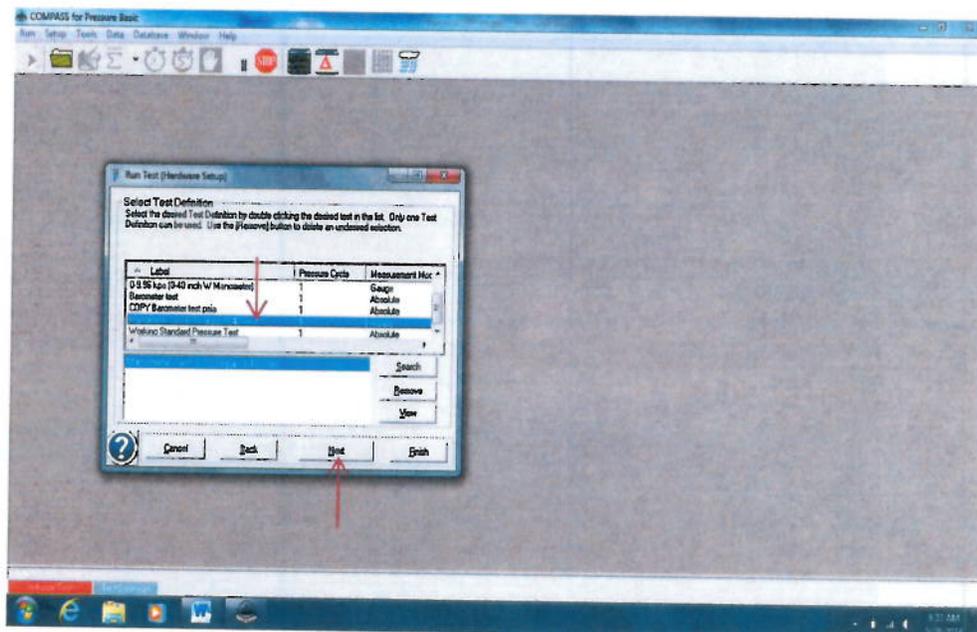


Figure 19

11.20 This window is for information only. Click on the “Next” button.
See Figure 20.

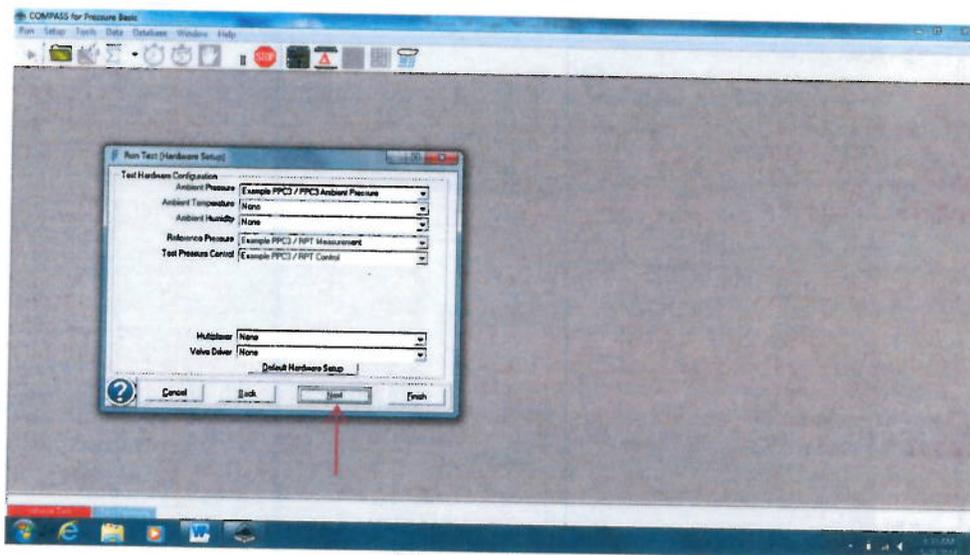


Figure 20

11.21 This window is for information only. Click on the “Next” button.
See Figure 21.

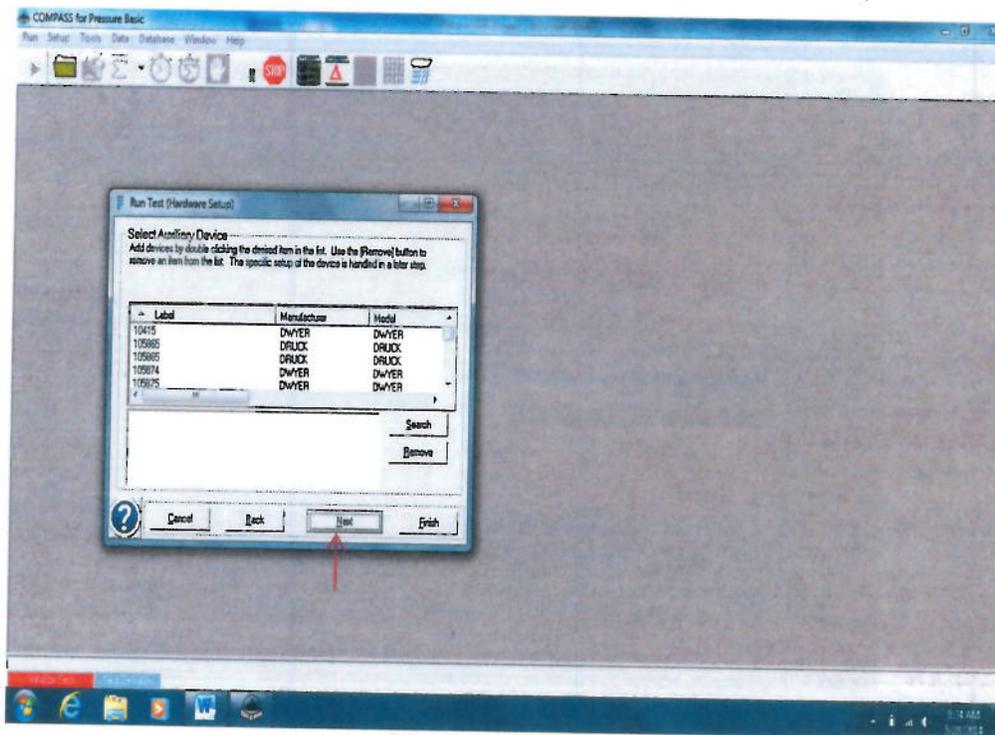


Figure 21

11.22 Turn on vacuum pump. See Figure 22.

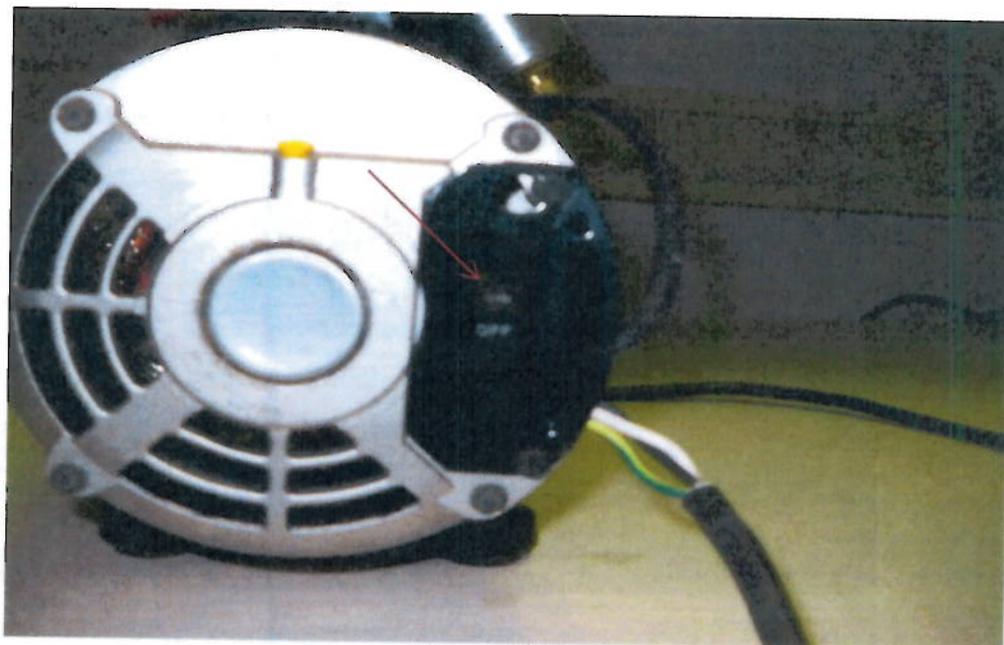


Figure 22

11.23 Click on the “Load Setting” (1) button. It will take a few seconds for Compass to load the setting. Click on the “Finish” (2) button.

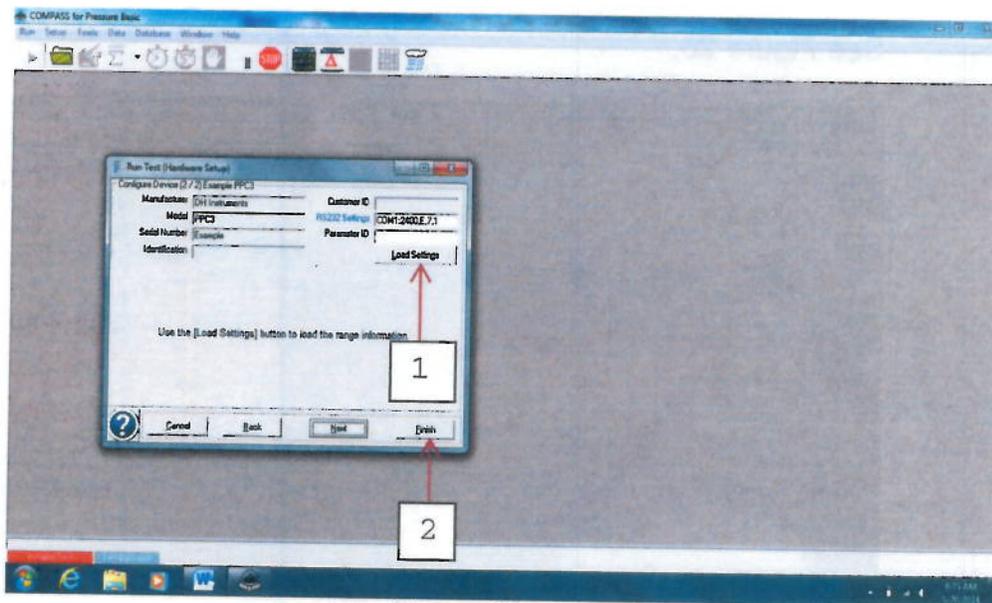


Figure 23

- 11.24 The Compass software will drive the pressure controller to the first set point. (The five points are already pre-programmed into the Compass software for each pressure device type.) When the reference standard reading becomes stable, the following window will pop-up. See Figure 24.

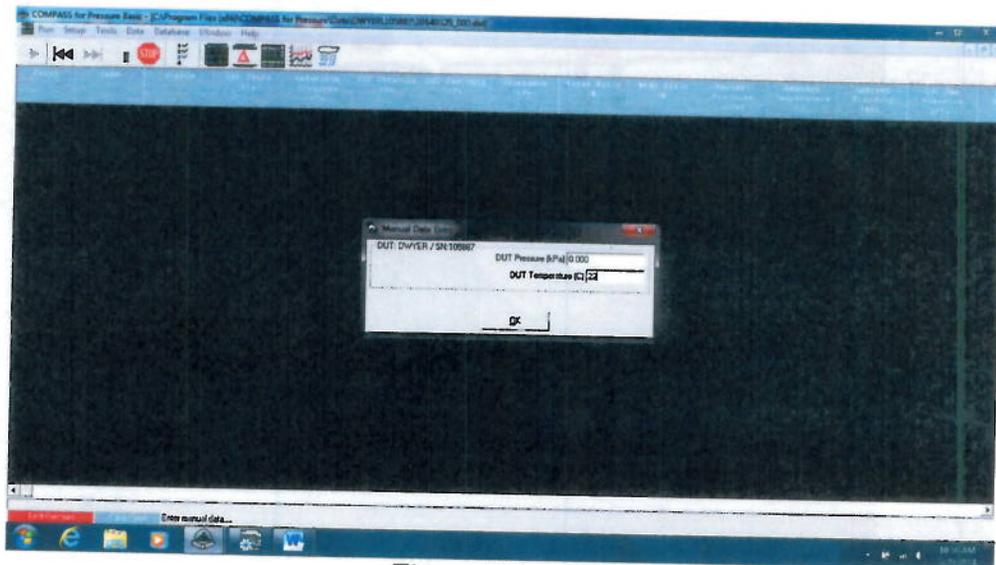


Figure 24

- 11.25 Enter the candidate display reading into the "DUT Pressure (kPa)" text box. See Figure 25. Enter the laboratory temperature from the digital meter located on the workbench into the "DUT Temperature (C)" text box. See Figure 26.

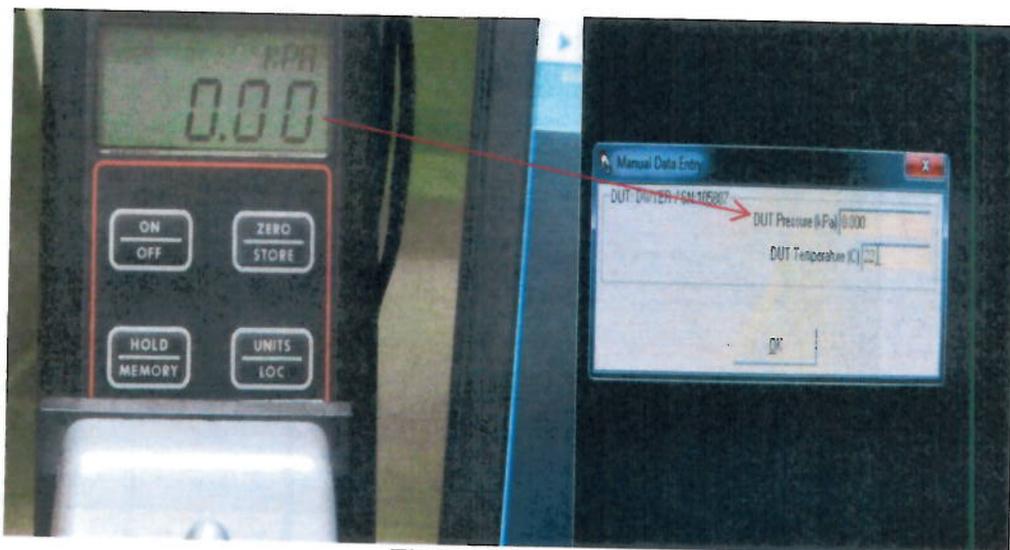


Figure 25

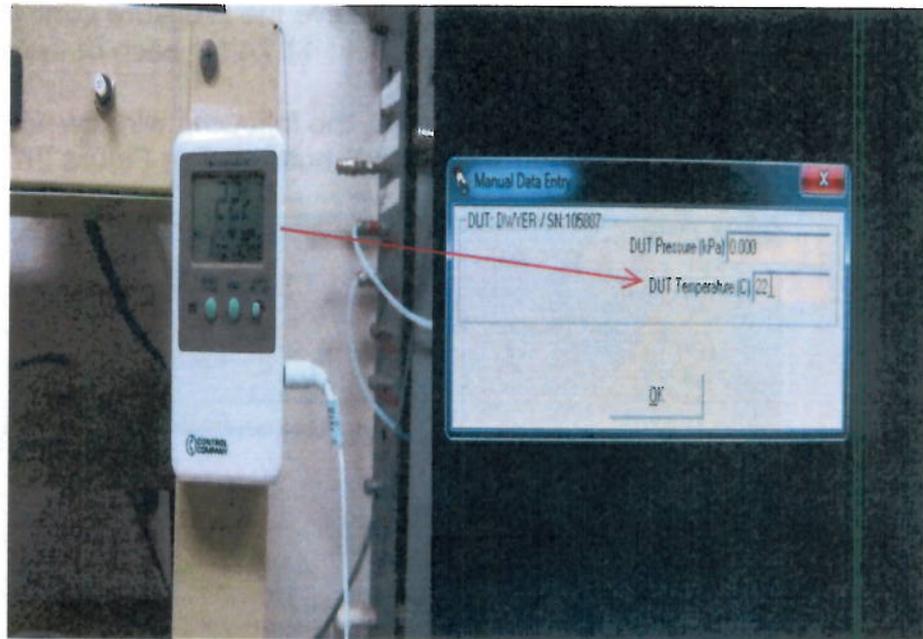


Figure 26

11.26 Click on the "OK" button. See Figure 27.

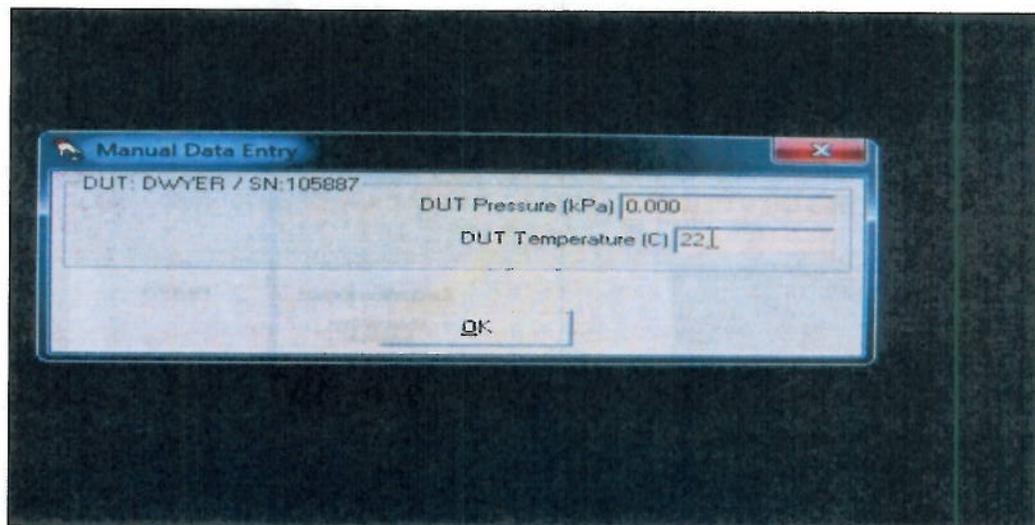


Figure 27

- 11.27 The COMPASS software will drive the pressure controller to a total of five points. Repeat steps 11.23 and 11.24 for each of the set points.
- 11.28 After the last point is entered, the following window will appear: Click on the “Generate Report” button. See Figure 28.

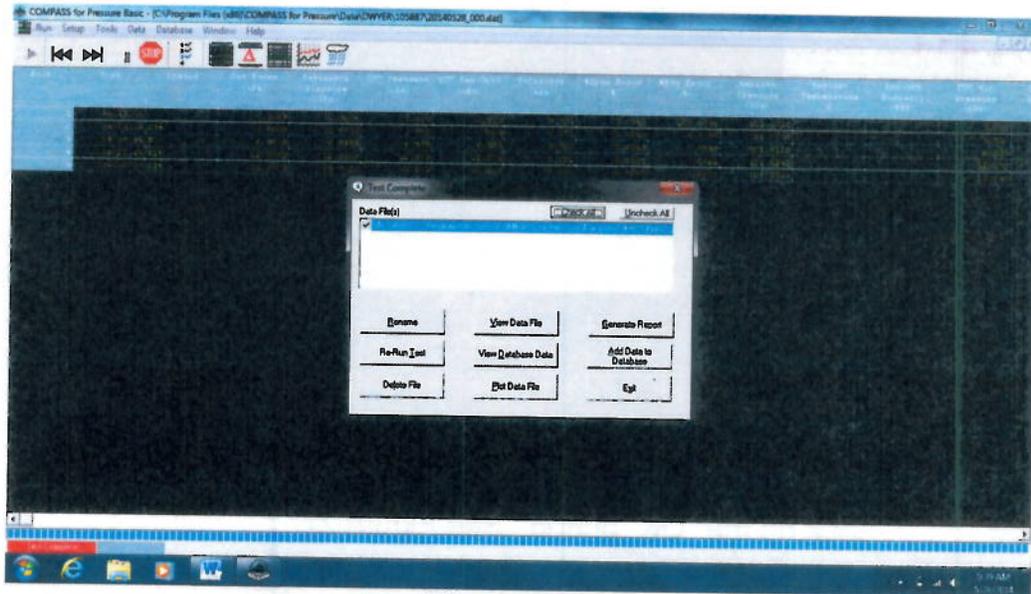


Figure 28

- 11.29 Print the report. See Figure 29.

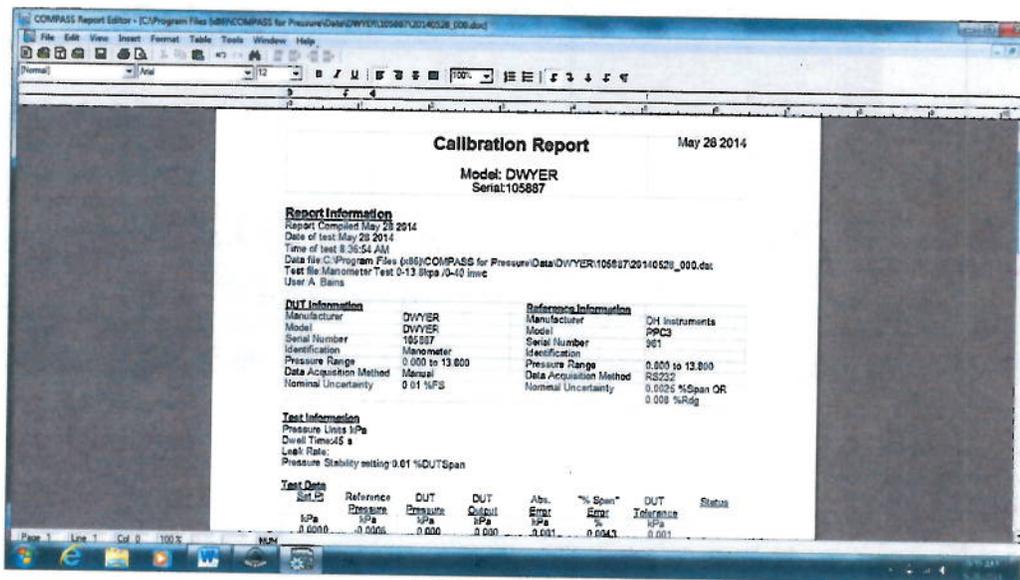


Figure 29

11.30

Transfer the Compass test results (Figure 30) to the "Manometer" worksheet (Figure 31) opened in step 11.8.

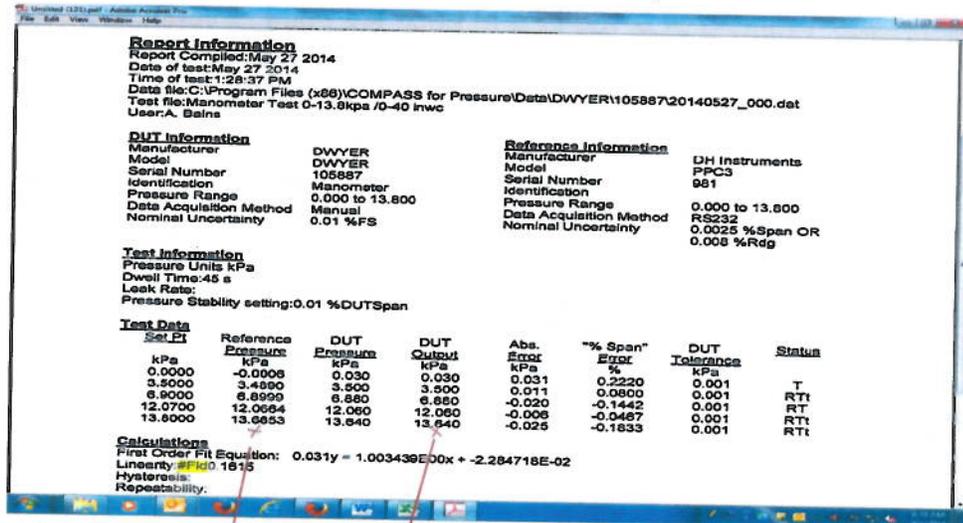


Figure 30

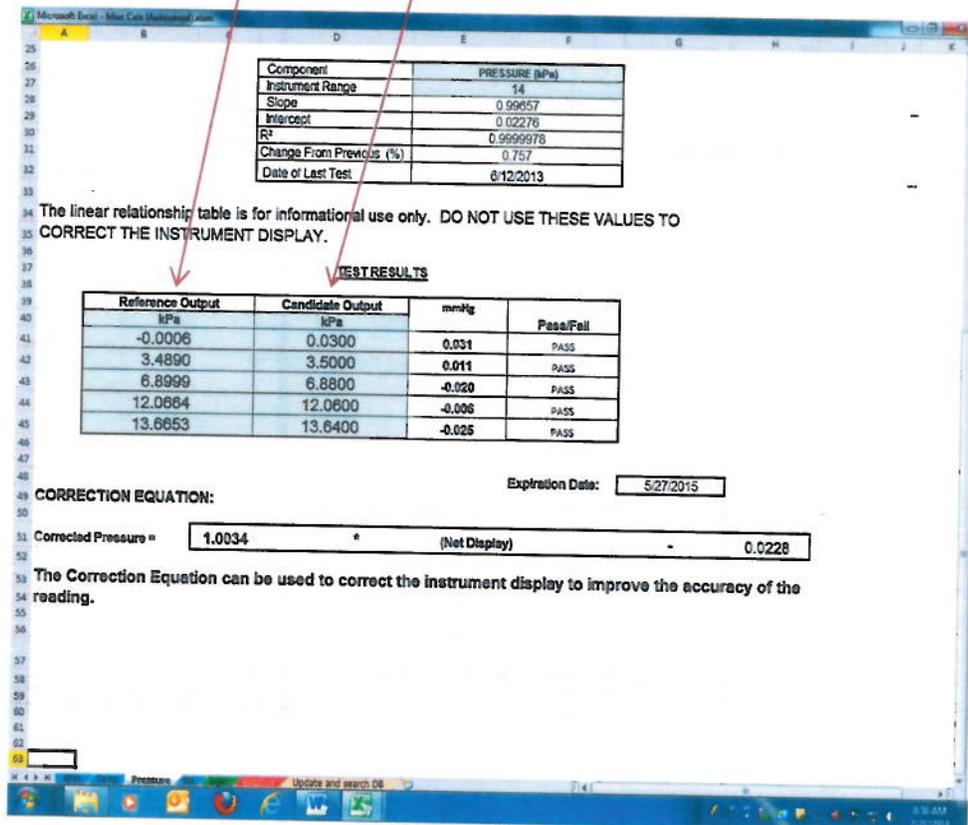


Figure 31

12.0 Verification/Calibration Report Generation

12.1 If the difference between the reference standard and the candidate device is < 1 mmHg or 0.133 kPa at each set point, a verification/calibration report can be issued for the candidate pressure device. If the R^2 value is ≥ 0.999 , the correction equation can be applied to the candidate's display to correct the pressure reading. See Figure 31. If the R^2 value is < 0.999 , the candidate failed the test. A retest is performed to confirm the failure. If the failure is validated, inform the customer of the failure and proceed with a Standard Failure Notification report.

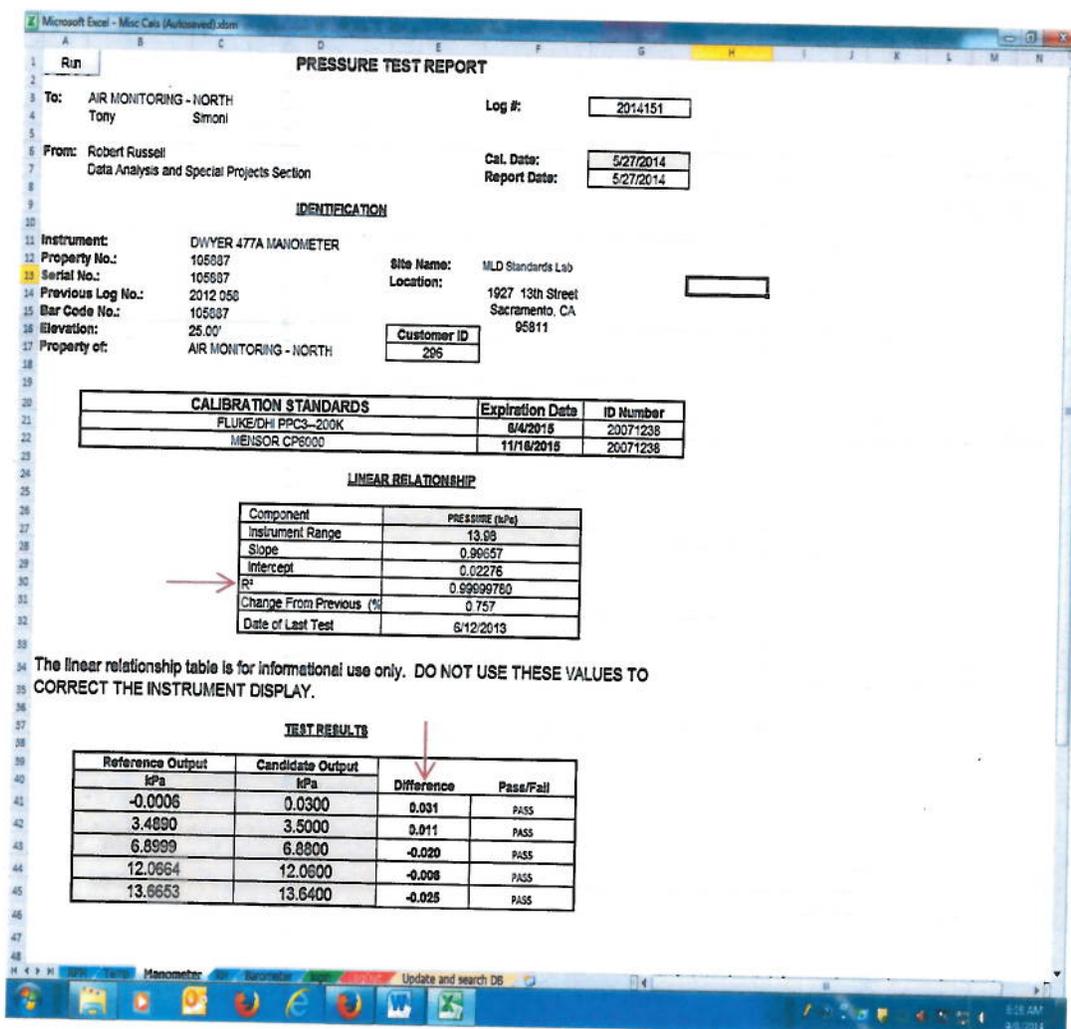


Figure 32

12.2 Click on the “RUN” button once. Clicking on the “RUN” button will save the test data. See Figure 33.

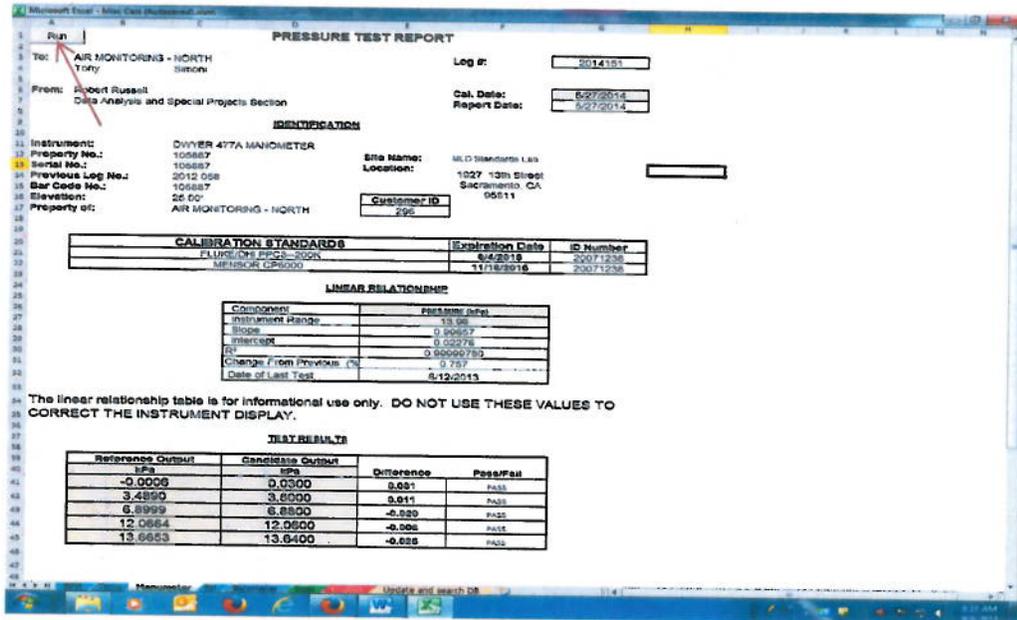


Figure 33

12.3 Print a copy of the “PRESSURE TEST REPORT” (Figure 33) and the Compass calibration data report (Figure 34). When you exit the Compass program it will ask you if you want to save the Compass calibration data report. Click on the “yes” button.

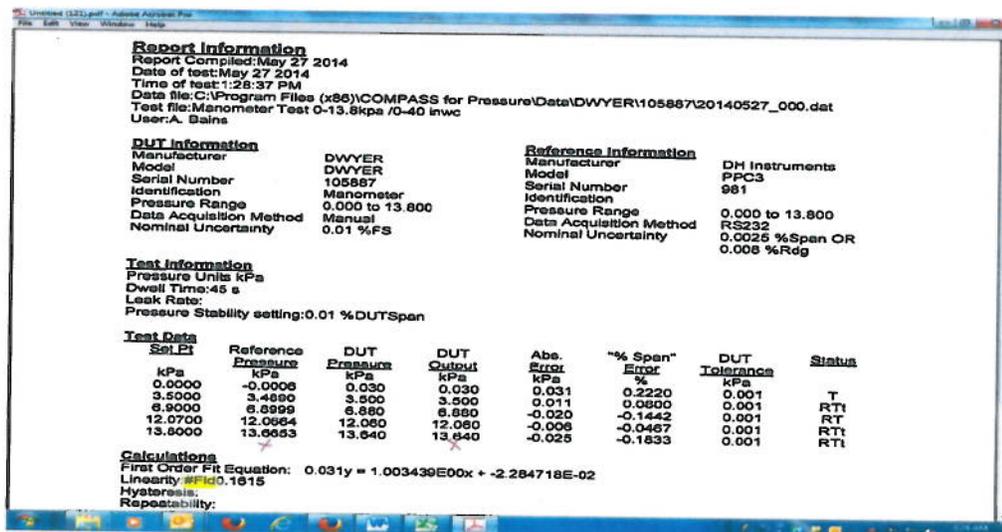


Figure 34

12.4 Have a peer review the documents for accuracy and completeness. After the reports have been signed by the reviewer, make a copy of the "PRESSURE TEST REPORT." Place the copy with the candidate's pressure standard and file the original along with the Compass "Calibration Report" inside the customer's login folder. Create an electronic copy by scanning the Compass "Calibration Report" and "PRESSURE TEST REPORT" report. Save as PDF files in the following location: W:\Standards Laboratory\Calibration Reports.

13.0 **Quality Control**

The Fluke PPC3 reference standard is crossed checked against the Mensor model CP600 backup pressure calibration standard every 6 months. The slope and intercept results are tracked in a control chart. If the mean of either the slope or the intercept varies more than 2 standard deviations, an investigation is done to determine what caused the variance.

The Fluke PPC3 and Mensor CP600 pressure calibration standards are sent to a qualified vendor for a NIST traceable calibration bi-annually.

14.0 **Troubleshooting**

Refer to the Pressure Controller/Calibrator Operation and Maintenance Manual if you suspect that the instrument is not operating properly.

15.0 **References**

- U.S. EPA Quality Assurance Handbook Volume II, Sec.12.
- Pressure Controller/Calibrator Operation and Maintenance Manual Operator's Manual
- U.S. EPA Quality Assurance Handbook Volume IV: Meteorological Measurements
- U.S. EPA Quality Assurance Guidance Document 2.12 (Monitoring PM_{2.5} in Ambient Air Using Designed Reference or Class I Equivalent Methods)