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# DAQ-13-006.1 Standard Operating Procedure (SOP) for Field Barometer Certification Electronics and Calibration Branch (ECB) Responsibilities



### 1.0 Approval Sign-Off Sheet

I certify that I have read and approve of the contents of the Standard Operating Procedure (SOP) for Field Barometer Certification Electronics and Calibration Branch (ECB) Responsibilities written here with an effective date of September 20, 2022.

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#### Disclaimer:

This document, and any revision hereto, is intended solely as a reference guide to assist individuals in the certification of barometers used in the North Carolina Division of Air Quality's Ambient Monitoring Program.

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## 2.0 Scope, Purpose, and ECB Responsibilities

This document is designed for the Electronics and Calibration Branch (ECB) Technicians responsible for certifying and calibrating Druck Model DPI 705 digital barometers. The barometers are used for but not limited to audits, calibrations, verifications, and testing of ambient monitoring equipment in field or laboratory conditions. This document shall provide procedures used to achieve uniformity and ensure highly accurate ambient barometric pressure measurements.

**Note:** Use the Druck DPI 705/DPI IS Series user manual K0214 in conjunction with this SOP to get an in-depth understanding of the unit.

## 3.0 Instrument Description

The Druck DPI 705 is a digital pressure indicator that uses a micro-machined silicon transducer to produce a pressure reading in units of pressure measurement. These pressure indicators also known as “barometers or field barometers” are used to:

- 1) verify the accuracy of barometric sensors and
- 2) calculate flow rates when using “Flow Transfer Standards (FTS).

The Mensor Model # 14500C is the Lab Standard (LS) electronic barometer and is located and maintained by the ECB. The LS barometer will be recertified at least annually by the manufacturer or some other National Institute of Standards and Technology (NIST) certified agency. Any other Mensor Model 14500C barometer can be used as a secondary LS if it is referenced to the primary LS. The procedure outlined below is designed to establish NIST traceability for these field barometers.

## 4.0 Site Check

This section is reserved. Site checks do not apply to instruments housed at the ECB.

## 5.0 Detailed Procedure

### 5.1. Equipment and Materials List

The equipment and materials used to certify barometers include:

- A pressure manifold with three (3) connecting ports plus an on/off valve that vents to the atmosphere;
- A NIST traceable barometric LS;
- Hand pumps and valve system for creating negative/positive pressures in the manifold; and
- E-log/ Certification of Verification/Calibration Form (see Appendix A for examples)

### 5.2. Procedure(s):

There are three major steps to follow:

- 1) Initial “confidence” check or as found check;
- 2) Recertification (verification only); and
- 3) Calibration (adjustments are made).

If a unit passes the criteria for the initial confidence check, it will proceed to the recertification. If the unit fails the criteria for initial confidence check or the recertification, it will proceed to the calibration step. If the unit fails the calibration step, it will be returned to the manufacturer for service.

### 5.3. Initial Confidence Check (including a leak check)

Follow the steps below to complete the initial confidence check including a leak check:

- Inspect the barometer to make sure it is in proper working order; replace or repair as needed. (Check for low battery if so equipped.)
- All barometers are referred to by their model number, serial number and unique ECB assigned unit number.
- Enter date, time, the LS Serial number, the barometer's unique ECB number, and the barometer's region of origin on to the ECB Barometer e-log (Appendix A). Pay special attention to the expiration date. If the LS has expired stop the test and find a LS that has not expired. The e-log should give indication of an expired LS by the cell turning red.
- Perform a leak test: **Press the LEAK** key 3 times.
- The symbol flashes on the display with the number 60.
- To start the leak test, **press the LEAK** key again.
- The instrument counts down 60 seconds displaying the leakage at the end of the 60 second period.
- **Press the LEAK** key at any time during the leak test to quit and return to normal measurement. Retry the leak test a second time if the instrument fails the first test. Make notes in the comments and return the unit to the factory for repair if the leak cannot be determined after several attempts.

### 5.4. Setup the Test:

Follow the steps below to setup the test:

- Using rubber tubing, connect the barometer, LS and the vacuum and pressure pumps to the ports on the manifold.
- Set the units to read in millimeters of mercury (mm Hg) in both the LS and the device under testing (DUT) barometer being tested. If needed, see user manuals to navigate setting units.

### 5.5. Perform the "Confidence" Barometric Test:

Follow the steps below to perform the confidence barometric test:

- Perform a brief "confidence test" at **atmospheric pressure** (see 5.10 Final Ambient Check for instructions), at a low pressure of **650 mm Hg** (see 5.8 Perform the "Low Pressure" or ZERO calibration for instructions) and a high pressure of **800 mm Hg** (see 5.9 Perform the "High Pressure" or full-scale calibration for instructions) to show that the unit is responding accordingly. Record the readings of the unit at each pressure against the readings of the ECB NIST certified reference (Lab Standard, LS).
- At each pressure, ensure that the readings are stable for approximately 5 seconds; (Note: the LS can fluctuate with ambient changes in the lab atmosphere such as doors opening, or the ventilation system turning on or off).

- Record the ambient pressure readings for both the LS and Druck being tested.
- The elog will compute the difference as  $\pm$  mm Hg.
- If the differences are 5 mm Hg or less, proceed to the recertification step. If not, proceed to the calibration step.

### 5.6. Recertification (as left)

**Note:** Recertification is to be performed at atmospheric pressure only.

Follow the steps below to perform the recertification:

- At this point the Druck and LS should be connected to the manifold. Ensure that the manifold vent valve is open and vented to the atmosphere. Do not move or touch the hand pump or tubing during this acclimation or the test period.
- Ensure the LS output is stable for approximately 5 seconds;(Note: the LS can fluctuate with ambient changes in the lab atmosphere such as doors opening, or the ventilation system turning on or off).
- Record the pressure readings for both the LS and Druck being tested.
- If the difference is  $\pm$  5 mm Hg or less enter "Yes" for passing recertification. If the difference is greater than  $\pm$  5 mm Hg enter "No" for failing the recertification.
- If the unit "Fails" it must be recalibrated by the ECB. Proceed to the CALIBRATION procedure below. If the unit "Passes", go to appendix A Setting up MS Word to Print Certification of Validation/Calibration and follow the instructions to print certifications.

### 5.7. Initiate Calibration

Follow the steps below to perform the calibration:

- Ensure that the LS is set to read mm Hg. If the Druck does not read in mm Hg, **simultaneously press, and hold LEAK and ON/OFF keys** to see OFF displayed momentarily and then release both keys. Then set Druck to display mm Hg.
- On the Druck, **simultaneously press and hold EQUALS, TARE and UNITS keys to see CAL** displayed then release all keys. **Push the TARE key** to see the PIN# "1111" displayed. Use the EQUALS and LEAK keys to set the PIN# to "4321". **Push the TARE key** and see "2ErO" (zero) displayed. This indicates that the **Druck is in the calibrate mode.**
- Connect the Druck, LS and vacuum hand pump to the manifold. Ensure that the manifold vent valve is closed.

### 5.8. Perform the "Low Pressure" or ZERO calibration

Follow the steps below to perform the low pressure calibration:

- Use the vacuum hand pump to SLOWLY evacuate the manifold until the LS indicates 650.0 mm Hg. It may be necessary to slightly overshoot the 650 and use the pump vernier adjustment to bring the pressure to exactly 650.0.
- Ensure the LS output is stable for 5 seconds. Do not move or touch the hand pump or tubing during this acclimation or the test period.
- **Push the TARE key once**, wait 5 seconds and see "0.0" displayed.

- Use the EQUALS and UNITS keys to change the Druck display to read 650.0 exactly.
- **Press TARE** and see F5 (full scale) displayed. Release the vacuum and ensure the manifold valve is closed for the “High Pressure” calibration.

### 5.9. Perform the "High Pressure" or full-scale calibration

Follow the steps below to perform the high pressure calibration:

- Use the pressure hand pump to SLOWLY pressurize the manifold until the LS indicates: 800.0 mm Hg. It may be necessary to slightly overshoot the 800 and use the pump vernier adjustment to bring the pressure to exactly 800.0.
- Ensure the LS output is stable for 5 seconds. Do not move or touch the hand pump or tubing during this acclimation or the test period.
- **Push the TARE key once**, wait 5 seconds and see “1551.x” displayed.
- Use the EQUALS and UNITS keys to change the Druck display to read 800.0 exactly.
- **Press TARE and listen for three beeps** to indicate calibration is complete.
- Return the manifold to ambient pressure by slowly releasing the pressure and perform a check at ambient pressure.

### 5.10. Final Ambient Check

Follow the steps below to perform the final ambient check:

- At this point, the Druck and LS should be connected to the manifold. Ensure that the manifold vent valve is open and vented to the atmosphere. Do not move or touch the hand pump or tubing during this acclimation or the test period.
- Ensure the LS output is stable for approximately 5 seconds; (Note: the LS can fluctuate with ambient changes in the lab atmosphere such as doors opening, or the ventilation system turning on or off).
- If the difference between the two ambient pressure readings is greater than  $\pm 5$  mm Hg, repeat the calibration. If the difference is still greater than  $\pm 5$  mm Hg, the unit must be return to the factory for repair. If the difference is within  $\pm 5$  mm Hg, the calibration is complete, go to appendix A Setting up MS Word to Print Certification of Validation/Calibration and follow the instructions to print certifications.
- On the Druck, **simultaneously press and hold LEAK and ON/OFF keys**, see OFF displayed momentarily, and then release the keys. **Simultaneously press and hold EQUALS, TARE and UNITS keys** to see CAL displayed then release all keys. **Push the TARE key** to see the PIN# “1111” displayed. This will ensure that access to the calibration function has been denied.

## 6.0 Data Review

Self/Level 1 Barometer E-Log Entry Review (Primary ECB Technician)

Review the Barometer e-log for completeness and accuracy. Initial and date the e-log entry to indicate a level 1 review has occurred and submit the e-log for secondary, level 2 peer review. It is the responsibility of the primary, level 1, operator to find a suitable reviewer in a timely manner.

## Peer/Level 2 Barometer E-log Data Review

Review the Barometer e-log entry for completeness and accuracy. Make any corrections necessary by putting a line through the error (Right click cell choose format, effects, and strikethrough), initialing and dating (right click cell and choose new note enter initials and date). Write the correction in the new note box or comments section. Initial and date the logbook to indicate a level 2 peer review has occurred. Review certificates of verification/calibration and associated e-logs.

### 7.0 File Management

The primary types of files associated with the Druck 705 barometer include but are not limited to: certificates of calibration, testing e-logs and procurement documentation. These documents are maintained on the P: Drive at P:\Ambient\ECB\NIST.

#### 7.1. Original Certificates of Calibration

The original certificate of calibration that come with the units and annual certifications are kept on file at ECB. Scanned copies of these certificates are saved on the P drive at P:\Ambient\ECB\NIST.

### 8.0 File Quality Assurance and Data Handling

The primary types of files associated with the Druck 705 barometer include but not limited to: certificates of calibration and testing e-logs. They are maintained on the P: Drive at P:\Ambient\ECB\NIST.

### 9.0 Troubleshooting/Maintenance/Repairs/Cleaning

Return the instrument to the factory for any repairs, it cannot be repaired on-site. Clean the instrument case with a moist, lint-free cloth and weak detergent as needed.

### 10.0 Revision History

Revision 0 – Travis Funderburk, 13 Sept. 2022

### 11.0 References

Section 2.3.3 Certification and Accuracy Check of Field Barometers and Thermometers (Performed by the Electronics and Calibration Branch) Rev. 7 November 1, 2011

Druck DPI 705/DPI 705 IS Series Digital Pressure Indicator User Manual K0214

Method 2.12, Section 4.2.2

12.0 Appendix  
Appendix A – Example of Certificate of Verification/Calibration

## CERTIFICATION OF VERIFICATION/CALIBRATION

This certifies that barometer Druck 705 No.74523 for the FRO  
has successfully been verified or calibrated according to the DAQ-13-006.1 on  
8/19/2022. The unit will be due for recertification on or before 8/19/2023.

Test: Lab Standard (LS) S/N: 121314 Exp. 1/8/2023 vs Device under Testing (DUT)  
Druck 705 74523.

TEST DATA (mmHg)	LS	DUT
As Found Test Point	790	785
Test Point 1	650	655
Test Point 2	860	864
As Left Final Test point	752	756
*Correction or offset	-1.00	
Recertification Passed	Yes	

\*Adding the correction or offset value to your final reading  
increases the accuracy of the measurement.



ECB Technician, MM

8/19/2022

File Home Insert Draw Page Layout Formulas

Cut Copy Paste Format Painter

Calibri B I U

Clipboard Font Alignment

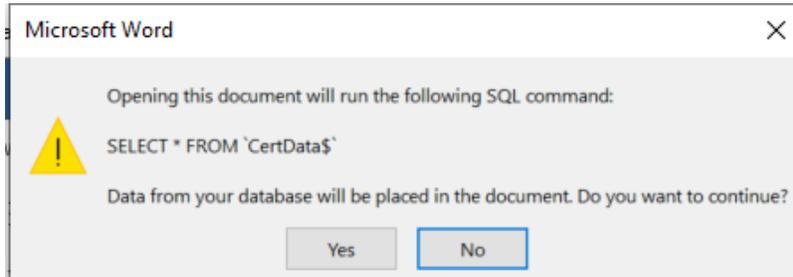
B24 758

Fill in only the white cells, other cells have formulas, or they are used as a reference.

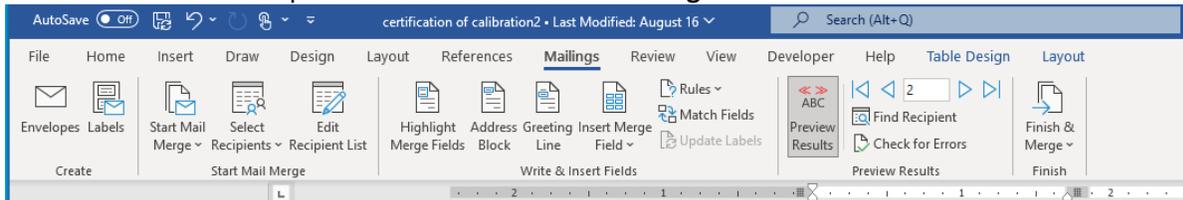
	A	B	C	D	E	F	G
1	Test Date	8/9/2022	8/9/2022	8/19/2022	8/29/2022	8/9/2022	8/9/2022
2	Test Time	17:00	17:30	16:45	16:45	16:45	16:45
3	Technician	MM	MM	MM	MM	MM	MM
4	DUT ECB #	77856	77856	74523	99582	1	1
5	Model/Serial	Druck 705					
6	DUT Region	FRO	FRO	FRO	FRO	FRO	FRO
7	Lab Standard S/N	1234	1234	1234	1234	1234	1234
8	LS Check Exp. Date	1/8/2023	1/8/2023	1/8/2023	1/8/2023	1/8/2023	1/8/2023
9	<b>Test</b>						
10	Test units are in mmHg						
11	<b>Initial Amb. (as Found)</b>						
12	LabStd	757	790	790	790	790	790
13	DUT	755	785	785	785	785	785
14	Delta(+/-5.0)	2	5	5	5	5	5
15	<b>Low: 650 mm Hg</b>						
16	LabStd	655	655	650	650	650	650
17	DUT	655	655	655	655	655	655
18	Delta(+/-5.0)	0	0	-5	-5	-5	-5
19	<b>High: 800 mm Hg</b>						
20	LabStd	800	868	860	860	860	860
21	DUT	801	864	864	864	864	864
22	Delta(+/-5.0)	-1	4	-4	-4	-4	-4
23	<b>Final Amb. (as Left)</b>						
24	LabStd	758	756	752	752	752	752
25	DUT	757	756	756	756	756	756
26	Delta(+/-5.0)	1	0	-4	-4	-4	-4
27	<b>Comments</b>						
28	Enter comments as needed						
29	<b>Recertification Passed</b>	Yes	Yes	Yes	Yes	Yes	Yes
30	<b>New Exp. Date</b>	8/9/2023	8/9/2023	8/19/2023	8/29/2023	8/9/2023	8/9/2023
31	For Field Use: Correction factor in mm Hg	1.00	1.70	-1.30	-1.30	-1.30	-1.30
32	<b>Perform Calibration</b>						
33	See 4.7 in the SOP	No	No	No	No	No	No
34	If performing a calibration, run the same test points again and enter data in the adjacent column.						

### Setting up MS Word to Print Certification of Validation/Calibration

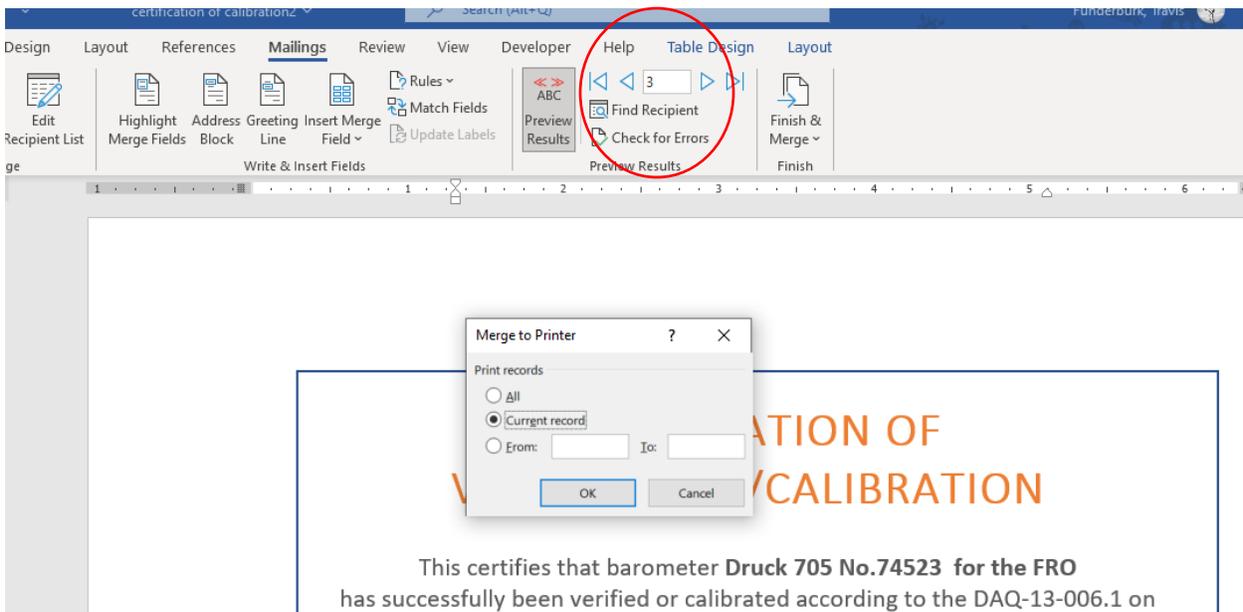
Open the word document named “certification of calibration,” a popup box will appear as below, click “Yes” this will connect to the data in the elog to the certification form.



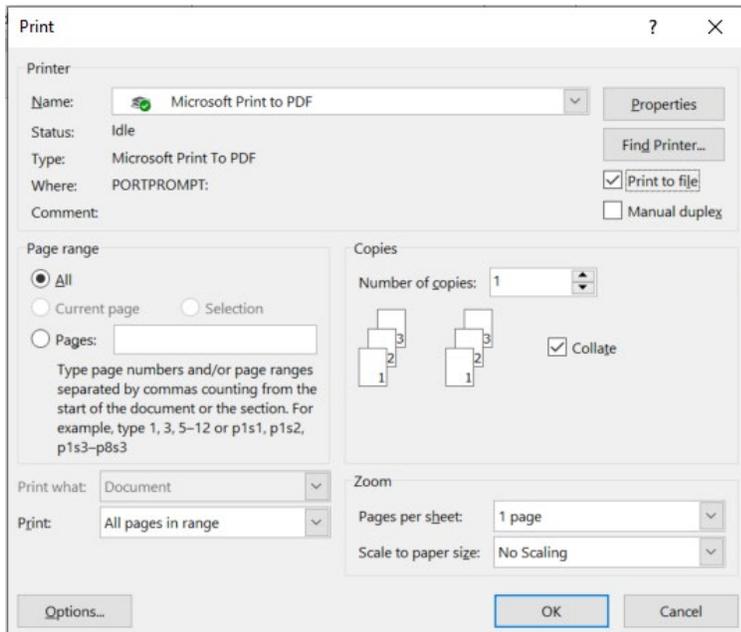
After this document is opened click on the ribbon “Mailing.”



On the ribbon, scroll to or enter the record you want to print. Select **current record** and press **OK**. Note: If you cannot remember the record number, it is located on the first row of the barometer elog.



In the print window select **Microsoft Print to PDF** and check **print to file** and click **OK**. **Save the file to P:\Ambient\ECB\NIST Certification Devices\Certification2022\Handheld Barometers (Druck)**. Note: the file name will change with the year. Name the file Druck\_D904\_mmddyyyy. See example of a certification done on May 17, 2022. Druck\_D904\_05172022. Print a hard copy of the file and attach it inside the unit case for delivery to the region or lab.



## Appendix B: Acronym Glossary

° C – degrees Celsius  
ECB – Electronics and Calibration Branch  
e-log – electronic logbook  
FS – full scale  
FTS – flow transfer standard  
i/d – inner diameter  
IBEAM – Internet-Based Enterprise Application Management  
lb. in – pounds per square inch  
LS – Lab Standard  
mm - millimeters  
mm Hg – millimeters of mercury  
NEMA – National Electrical Manufacturer Association  
NIST - National Institute of Standards and Technology  
Nm – Newtons per square meter  
NPT – National Pipe Taper  
o/d – outer diameter  
± - plus or minus  
psi – pounds per square inch  
SOP - Standard operating procedure  
 $\mu\text{g}/\text{m}^3$  – micrograms per cubic meter  
V - volts