Calibrating an AMT pH Sensor for a NXIC-ADC

INTRODUCTION:

The AMT pH sensor integrated with a NXIC-ADC is configured and calibrated at Teledyne RD Instruments prior to shipment. **For greatest accuracy, proper calibration of the pH sensor is essential.** Please refer to the AMT pH sensor technical manual for calibration guidelines. The following procedure will explain how to calibrate the sensor using Teledyne RD Instruments CTDPro software. Be sure to use CTDPro v2.39 or greater,

CALIBRATING THE AMT PH SENSOR:

Each sensor is supplied with a wetting cap filled with 3 mol/l KCl. Ensure that the wetting cap is in place when not in use. This prevents drying out as well as damage to the electrodes. If the membrane has dried out, soak the pH electrode in a neutral buffer solution, or preferably, soak in a potassium chloride solution (3 mol/l) for 24 hours.

When ready to calibrate remove the wetting cap and soak in a neutral buffer solution for 10 minutes. Calibration requires the standard 4,7 and 10 pH buffer solutions. For best results make sure the temperatures are the same for all three buffers as the pH of the buffers change with temperature. The ideal temperature is 20 degrees C

1. Open CTDPro.
2. Select CTD / Communications / Find CTD
3. Select Sensors and select “Calibrate”.
4. Place the sensor in buffer solution pH = 7
5. In the “Sensor” selection window select “pH”. Enter the value of the buffer solution (7.00) in the “Standard” field.
6. The numbers on the Y axis and in the sensor column represent the value calculated from the sensor voltage output without the offset and slope coefficients and do not represent the actual pH being measured. The X axis represents time.

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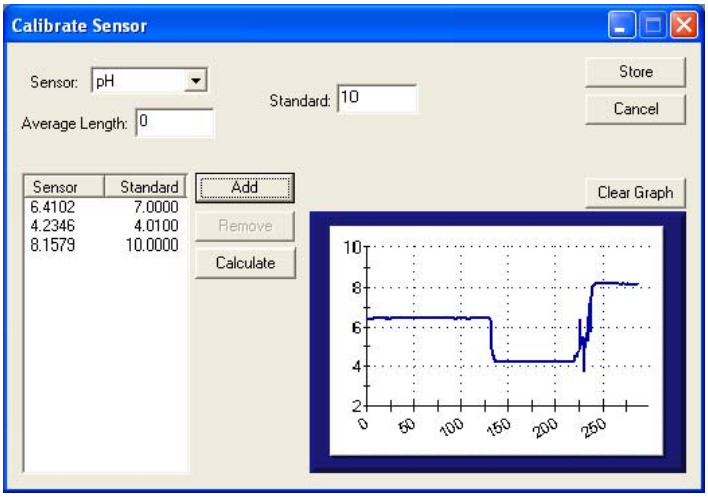
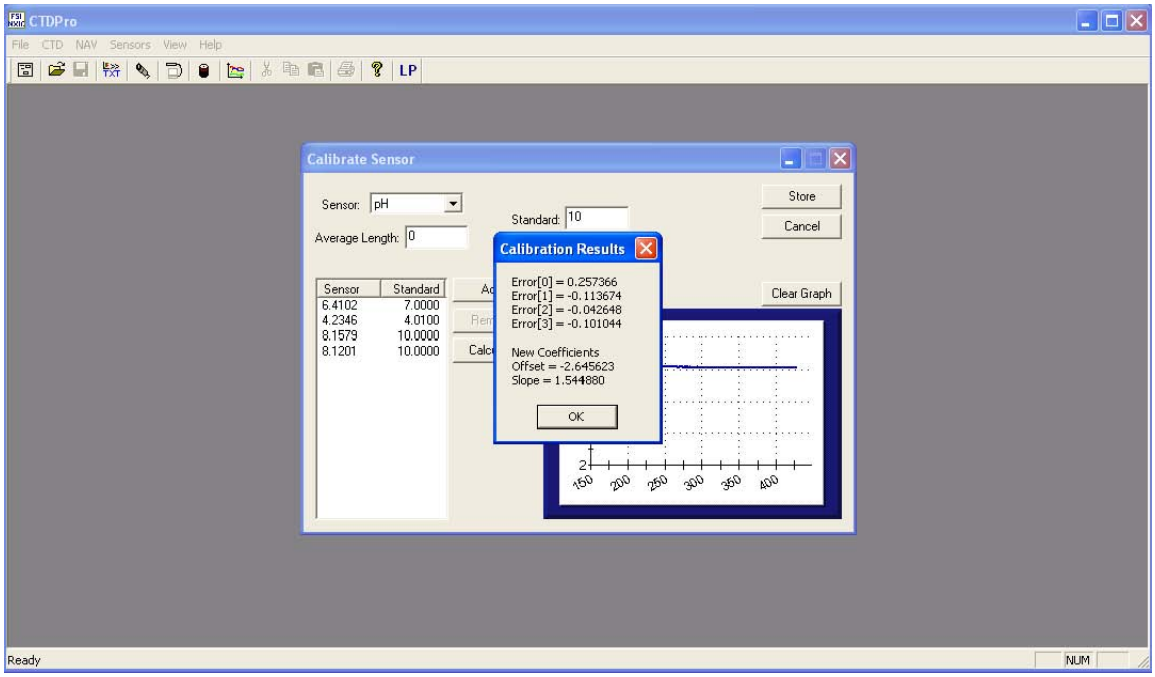


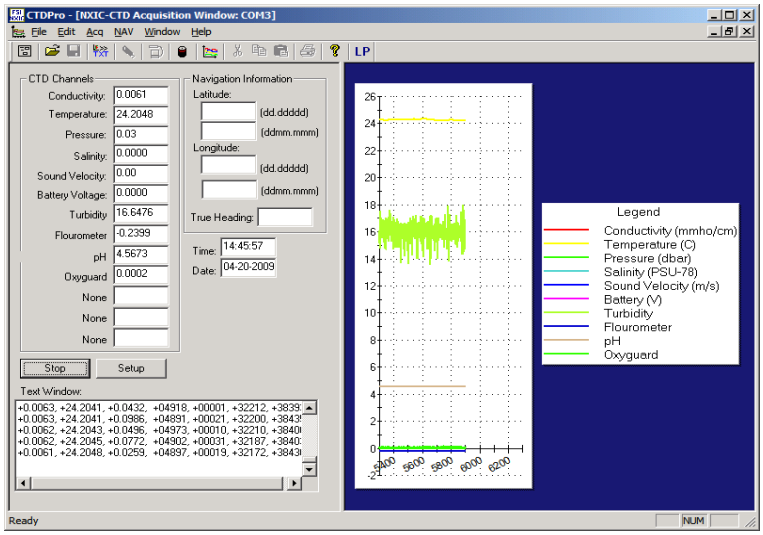
Click the "Add" button in the "Calibrate Sensor" window to add the sensor and standard data to the table. Multiple data points are taken by clicking "Add" multiple times and they will be averaged when calculated. At least three readings should be made for each buffer solution. If an error is made during the entry of data, the remove button will erase the data entry. Allow the data to stabilize as much as possible before selecting the add button.

7. Next place the sensor in buffer solution pH = 4. Enter the value of the buffer solution in the "Standard" field.
8. Wait for the reading to stabilize. Click the "Add" button to add the sensor and standard data to the table. Multiple data points can be taken by clicking "Add" multiple times and they will be averaged when calculated. At least three readings should be made for each buffer solution. If an error is made during the entry of data, the remove button will erase the data entry. Allow the data to stabilize as much as possible before selecting the add button.
9. Repeat this procedure using buffer solution of pH=10.
10. When the points have been sampled and graphed select the calculate button to display the error percentages and calibration coefficients.
11. The Calibration Results display will appear as an overlay on the "Calibrate Sensor" window.



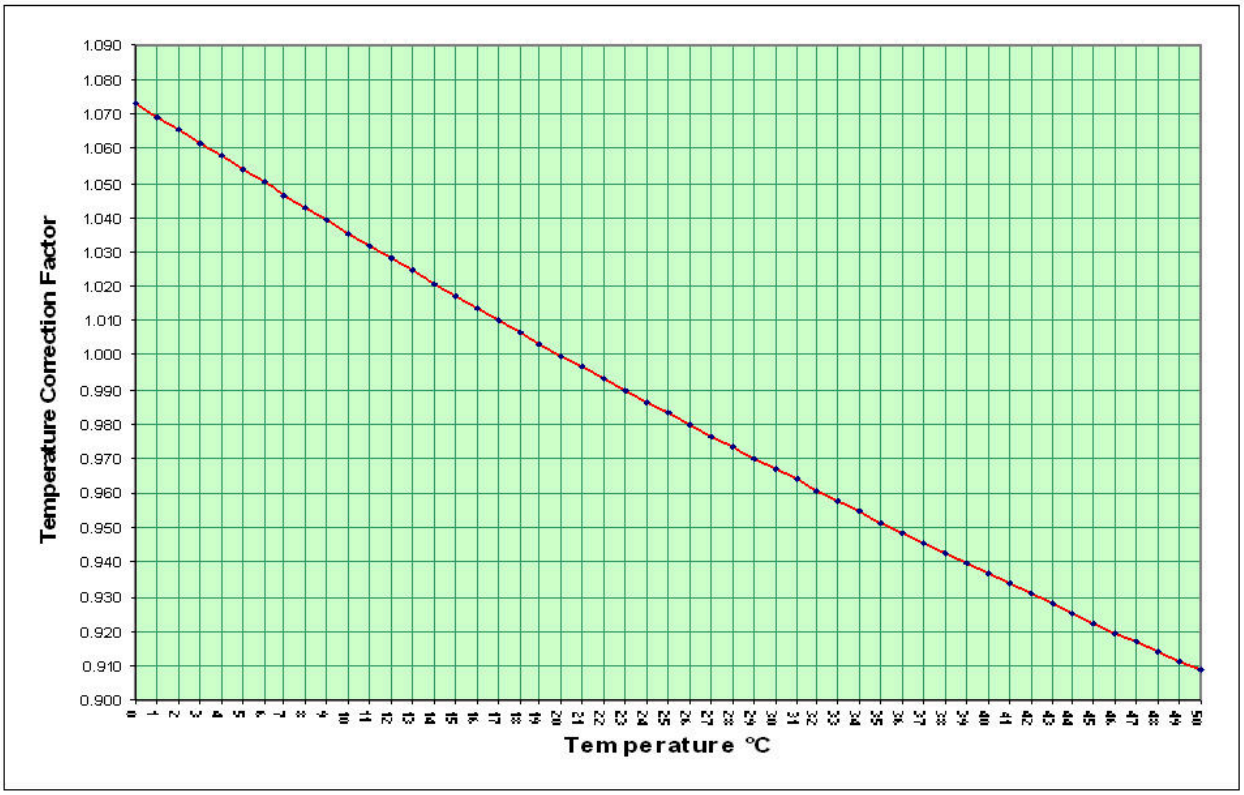
12. Click “OK” in the ‘Calibration Results” window. Click “Store” to write the calibration coefficients into the NXIC CTD.

(Note: Calibration accuracy can be verified by selecting “CTD” from the main menu and then selecting “Acquisition” and then clicking “Start”. The calibrated pH readings will be displayed based on what the pH sensor is currently immersed in.)



POST-PROCESSING FOR TEMPERATURE COMPENSATION

The instrument does not apply temperature compensation for pH values. The temperature dependency is small and affects the slope of the linear equation. The compensation factor for temperature @20°C is 1, so if the deployment temperature is near 20°C it may be ignored, depending on your requirements. If temperature correction is required, then one approach is to calibrate at the target temperature, if the target temperature is known. Note that pH buffer solutions change pH with temperature so the calibration values would have to be adjusted accordingly.



1. Correction Factor over Temperature

Another and simpler approach is to apply the temperature correction after the data is exported. Each exported data record contains both temperature and pH so the data can be imported into another application such as MATLAB or Excel, and the following equation applied:

$$pH_{tcomp} = f(T) \times (pH - 7) + 7$$

$$Where:$$

$$f(T) = A_0 + A_1 \times T + A_2 \times T^2$$

and

$$A_0 = 1.0732$$

$$A_1 = -3.9093 \times 10^{-3}$$

$$A_2 = 1.2333 \times 10^{-5}$$

These values are taken from the AMT calibration data sheet supplied with the sensor and are subject to change. Consult the data sheet that came with the specific sensor to verify the values.

SENSOR CARE:

1. As the membrane ages the readings will become slower and the slope will gradually decrease.
2. Temperature extremes or rapid temperature changes can stress the sensor and reduce its service lifetime.
3. Always keep the membrane moist by keeping the wetting cap on when not in use.

SENSOR STORAGE

1. Always keep the membrane moist by keeping the wetting cap on when not in use.
2. Store the sensor horizontally or upright with the membrane at the bottom.
3. Do not store the sensor in distilled water!

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