

Temperature Compensation for pH Meters

Why is there a need for temperature compensation in pH measurements?

1. The Solution Temperature Effect

When temperature changes, the actual pH of the solution being measured changes. This change is not an error caused by the change in temperature. It is the true pH of the solution at the new temperature. Since this is not an error, there is no need to correct or compensate for this temperature effect. To be absolutely correct, document both the pH and temperature of the sample.

2. The pH Electrode Temperature Effect

There is only one major temperature effect in pH measurement that can cause errors in readings. This is the change in the electrode's response (or sensitivity) to pH that results from a change in temperature. It is the only reasonably predictable error due to changes in temperature, and is the only temperature related factor that pH meters with temperature compensation can correct.

This temperature error is very close to 0.003 pH/°C/pH unit away from pH7. In a perfect pH electrode - one that is zeroed at exactly pH 7 - there is no temperature effect on the electrode sensitivity at pH 7 no matter how much the temperature changes. Most pH electrodes are not perfect, but the errors from changes in temperature are still very minute when near pH 7, plus or minus one-tenths of a pH, and can be disregarded. However, the further from pH 7 the solution is and the greater the temperature changes, the greater the measurement error due to changes in the electrode's sensitivity. These errors from changes in electrode sensitivity due to changes in temperature can be corrected by meters with temperature compensation.

There are two variations for temperature compensation:

Automatic: when a meter is able to automatically correct the pH reading for changes in electrode sensitivity by means of a temperature sensor at the tip of a pH electrode.

Manual: where the user must set or enter the solution temperature by means of push buttons or a dial. The meter then corrects the pH readings for changes in the electrode sensitivity.

Temperature compensation eliminates most of the temperature dependent measurement error from the electrode. Further minimization of this error in both temperature compensating and non-temperature compensating pH meters can be made by calibrating the instrument and electrode in pH buffers that are close to the expected measurement values for pH and at (or near) the same temperature as the solution to be measured. This technique also minimizes other temperature related errors which occur in all electrodes but which cannot be predicted or compensated for when temperature changes.

These unpredictable pH measurement errors due to temperature changes are somewhat complex in nature and vary from electrode to electrode. They can result in small but noticeable pH measurement errors. Unfortunately, there is not much that can be done about these in a manner that is economical or practical for most users of pH instruments. Therefore as a practical matter, they are mostly ignored in everyday pH applications.