Automatic Temperature Compensation and pH Measurement

Some common questions about Automatic Temperature Compensation (ATC) and pH measurement:

1. What does pH ATC do?
2. Should I bother to use ATC for pH? What if I leave the temperature set at 25°C?
3. Will pH ATC adjust the measured sample pH result to the result expected at 25°C?
4. Do I need an ATC probe in order to make a temperature compensated pH measurement?
5. ATC sounds great. Is it perfect?

What does pH ATC do?

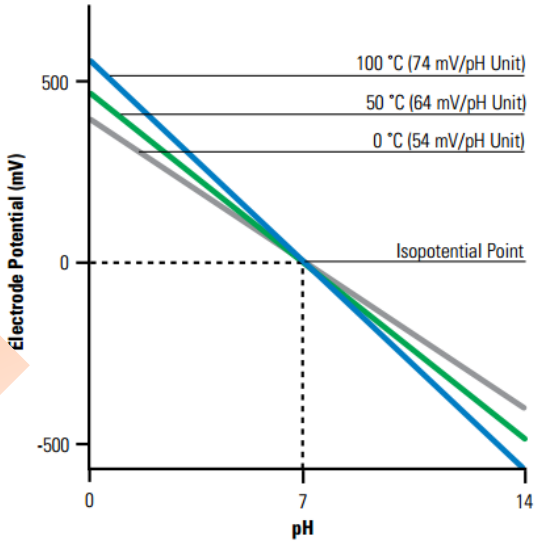
pH ATC improves accuracy and keeps the electrode in calibration regardless of temperature.

- During calibration, ATC reads the true temperature of the buffer and assigns the exact correct value.
- During testing, ATC reads the true temperature of the sample and adjusts the slope to remain in collaboration.

Temp (°C)	pH 10.01
0.0	10.32
5.0	10.25
10.0	10.18
15.0	10.12
20.0	10.06
25.0	10.01
30.0	9.97
35.0	9.93
40.0	9.89
45.0	9.86
50.0	9.83

How pH 10 buffer values vary with temperature. Temperature changes the expected value.

How the electrode slope changes with temperature. This is why pH and temperature are important to measure together.



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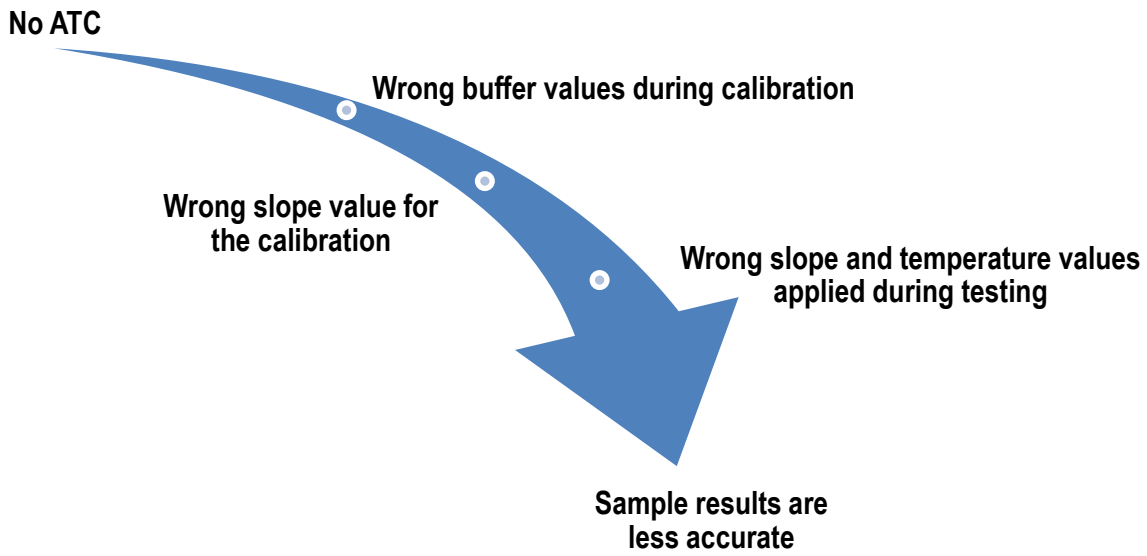
Should I bother to use ATC for pH? What if I leave the temperature set at 25°C?

It is generally worthwhile to use ATC for pH measurements, since it helps improve accuracy and reduces or eliminates the need for strict temperature control of samples or buffers or both. The figure below shows an example of how error is introduced when an ATC is not used during pH testing. If choosing not to temperature compensate, we will need to bring the temperature of the buffers and the samples as close as possible to each other and to the manually set meter temperature (defaults to 25°C).



Will ATC adjust the measured sample pH result to the result expected at 25°C? Does it work like conductivity temperature compensation?

No, ATC does not work like conductivity temperature compensation. We cannot adjust a measured sample pH value at one temperature to an expected sample pH value at another temperature (e.g. 25°C), because we do not know how the pH of a sample varies with temperature. For example, the pH value of a water sample may change rapidly as the result of chemical, physical, or biological processes that are temperature dependent. If we want to know what the pH value of the sample is at a certain temperature, we would have to adjust the sample to that temperature and measure the pH. That is why pH is frequently reported with a temperature measurement. We understand that the pH of a sample is temperature dependent. While ATC does allow us to calibrate accurately and adjust the pH electrode calibration when the temperature changes, ATC can't correct for sample pH/temperature effects, which are unknown.

Do I need an ATC probe in order to make a temperature compensated pH measurement?

No, an ATC probe is not required. Using a Thermo Scientific™ Orion™ Triode™ pH/ATC combination electrode or LogR™ technology meter will also provide automatic temperature compensated pH measurements. Alternatively, temperature can be measured manually for each buffer and solution, and then entered into the meter before recording the pH measurement.

Temperature compensation can be done manually, but it requires the use of a good temperature measurement device and manual entry of temperature for each buffer and sample measured. This will slow down the measurement process and introduce an avenue for error, if the temperature is not entered correctly or measured correctly by the chosen temperature measurement device. An ATC, triode, or LogR meter is quick, easy, and accurate.

ATC sounds great. Is it perfect?

ATC is great, but is not perfect. ATC is based on theoretical assumptions for a perfect, ideal electrode; however, no electrode is perfectly ideal. The better the electrode, the better the ATC works. The farther apart the temperatures of the samples and calibration buffers are, the larger the correction and the more chance for introducing error due to non-ideal behavior. The chart below shows some testing conditions and how they compare for accuracy and convenience.

Overall Score	ATC*	Temperature Adjustment	Adjusted Solution	Temp Range	Accuracy	Convenience
▲▲▲	ATC	calibration performed near the temperature of the samples	Calibration buffers	Adjust within 5-10ºC	+++	+
▲▲	ATC	sample temperatures adjusted to near calibration temperature	Samples	Adjust within 5-10ºC	++	+
▲	ATC	samples and calibration temperatures widely different	None	Widely different	+	++
▲	No ATC	sample temperatures adjusted to same as calibration	Samples	Adjust within 1ºC	++	-
▼	No ATC	no temperature adjustment for samples or calibration	None	Widely different	- -	++

** or Triode (pH/ATC combination electrode) or LogR technology meter*

The best accuracy occurs when a quality electrode (in good working condition) is used, ATC is used, and the sample temperature vs. buffer temperature is not drastically different. Note that ATC is much more accurate than not performing temperature compensation. It is more convenient that adjusting sample and buffer temperatures to the exact same temperature, and it is more convenient than manual temperature compensation.

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