



**Applications Tip of the Week
Conductivity Temperature Compensation**

Q: Why is temperature compensation offered on conductivity meters?

A: Temperature compensation choices arise because the conductivity reading of a solution varies with temperature. Therefore, when taking conductivity measurements, it is common to account for temperature effects in some manner.

To account for temperature effects, choices include:

- ◆ document and report the temperature at which the readings are taken; or
- ◆ adjust the sample temperature to a reference temperature, for example 20 or 25° are common reference temperatures; or
- ◆ apply a temperature compensation to calculate the expected conductivity of the solution at the desired reference temperature.

Q: What are the various temperature compensation choices on a conductivity meter?

A: In general, there are three main types of temperature compensation choices as follows:

1. no temperature compensation
2. linear temperature compensation
3. non-linear temperature compensation

Compensation Type	Description	Examples	Notes
None	Compensation is off or set to 0%	1) when required by method to use non-compensated readings such as purified water by EP or USP; 2) when the temp comp factor is not known.	EP mode = temp comp is off, warning is given when conductivity exceeds the allowed value for that temperature per the EP or USP purified water protocol.
Linear	A constant % correction factor (coefficient) is applied for every °C change in temperature	For solutions of known temperature dependence, e.g., salts, acids, bases, sugar.	Typical default linear coefficient is 2.1%, which is suitable for salt (NaCl) solutions.
Non-linear	A non-constant correction factor applied to pure water which varies depending on temperature	For pure waters, when temperature compensation is required or allowed by method.	Variations include: 1) a natural or air-equilibrated pure water, and 2) an ultra pure or degassed water.

Q: How do I choose a temperature compensation mode on an Orion Star or Orion Star A meter?

A: The choice of temperature compensation modes depends on the method you are following, the sample you are testing, the temperature at which you are testing, and the meter you are using.

Below is a brief description of setup options for temperature compensation and when they might be applied*.

◆ **Off – No temperature compensation.**

- This mode is non-temperature compensated. Use when: required by your method; the temperature coefficient is not known; or you will measure the conductivity at the reference temperature. Examples include field testing of waters, any in-situ testing, pure water readings, or readings taken at a controlled temperature that matches the reference temperature.

◆ **EP - European Pharmacopoeia**

- This mode is non-temperature compensated and complies with EP and United States Pharmacopoeia (USP) methods for conductivity of pure water samples. The EP mode includes warning limits that will display when your pure water exceeds the acceptable reading for that temperature per EP or USP requirements.

◆ **Lin - Linear (% Coefficient)**

- This mode is for temperature compensated readings on samples for which the temperature coefficient is known and is linear. Examples include:

<u>Sample</u>	<u>% per °C from 25C</u>
▪ Salt solution (sodium chloride)	2.12%
▪ 5% NaOH (sodium hydroxide)	1.72%
▪ Dilute ammonia solution	1.88%
▪ 10% HCl (hydrochloric acid)	1.32%
▪ 5% sulfuric acid	0.96%
▪ 98% sulfuric acid	2.84%
▪ Sugar syrup	5.64%
▪ 10% KCl (potassium chloride)	1.88%

◆ **nLFn or nLF - Non-Linear Natural (Air Equilibrated) Pure Water**

- This mode is for temperature compensated readings of low conductivity waters that are in equilibrium with the carbon dioxide in air, such as pure waters reading near 1 µS/cm at 25C and natural waters having a composition comparable to natural ground, well, or surface waters.

◆ **nLFu - Non-Linear Ultra Pure Water (Degassed)**

- This mode is for temperature compensated readings of ultra pure water that contains no air and no carbon dioxide, such as ultra pure water (18 megohms resistance or higher) directly from the source without aeration.

Additional Notes

- ◆ When reporting results, report the temperature measurement along with the conductivity reading. Report either the temperature at which the sample was measured or the reference temperature to which it was compensated.
- ◆ If testing exactly at the reference temperature (e.g., using a water bath to control temperature), temperature compensation is not required.

* Not all temperature compensation options are available on every meter. See the meter specifications to determine which options are available with your meter.