Meet USP<645> Water Conductivity Requirements and European Pharmacopoeia 2.2.38 Conductivity Test for USP & EP Purified Water and Water for Injection using Thornton Instruments

Specification:	USP <645> Requirement	Thornton MAX	Thornton 200 Series
Conductivity Sensor and Cell Constant Accuracy	Verify cell constant within ±2% using a reference solution, e.g. ASTM D1125 solution D (146.9 µS/cm) or other certified reference solution.	Calibration of all sensors supplied by Thornton exceeds USP <645> requirements ±1%. Certificate is provided.	Calibration of all sensors supplied by Thornton exceeds USP <645> requirements ±1%. Certificate is provided.
Conductivity Meter Calibration	NIST traceable 0.1% precision resistors in place of sensor	• Smart Calibration • NIST traceable to 0.05% • Verification & Calibration for resistance & temperature • Recertification	• User Calibration • NIST traceable to 0.08% • Verification & calibration for resistance & temperature • Recertification
Instrument resolution	0.1µS/cm	0.001µS/cm	0.001µS/cm
Instrument accuracy @ 1.3 µS/cm	0.1µS/cm	(±0.3%) ±0.004µS/cm	(±0.5%) ±0.007µS/cm
Temperature compensation	Must be read uncompensated	Uncompensated & compensated	Uncompensated & compensated
Instrument dynamic range	10^2	10^6	10^4

Thornton Inc. develops, manufactures and markets process control instrumentation to measure and monitor various parameters used to control pure and ultrapure water systems such as resistivity, conductivity, TOC, dissolved oxygen, flow, pressure, tank level, pH, ORP and temperature. Thornton is the recognized industry leader in the measurement of resistivity and conductivity, particularly in pure water. The ASTM "Standard Test Methods for Electrical Conductivity and Resistivity of Water" (D1125) was revised in 1995 based specifically on papers and recommendations from Thornton Inc. Thornton has been the principal consultant for conductivity to the USP and the Water Quality Committee of the Pharmaceutical Research and Manufacturers of America, and a staff associate is the Chairperson of the USP Pharmaceutical Water Expert Committee.

ML0076 04/02

Quick Guide to USP Pharmaceutical Water Conductivity Requirements

Stage 1: Conductivity vs. Temperature Tables
Stage 2: Conductivity Limit
Stage 3: Conductivity vs. pH Tables

USP requirements since November 15, 1996 and EP requirements since July 2000

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USP <645> Goals

Fundamental Goals of the changes to USP Purified Water and WFI

- Maintain/Improve existing water quality
- Improve the reliability of the testing (using modern instrumentation)
- Reduce the number of tests
- Make allowances for on-line, in-line testing

The Three-Stage Philosophy

Stage 1: In-line Test:
A non-temperature compensated conductivity measurement corresponding to a measured temperature. If the conductivity does not exceed 1.3µS/cm @ 25°C (or tabulated values in Table A), the test is complete. If not, go to Stage 2.

Stage 2: Lab Test:
Equilibrate a water sample with air. If the conductivity does not exceed 2.1µS/cm at 25°C, the test is complete. If not, go to Stage 3.

Stage 3: Lab Test:
Add saturated KCl to the previous sample and measure the pH. If the conductivity does not exceed the allowable level of conductivity (measured in Stage 2) at that pH, based on Table B, the test is complete. If the conductivity exceeds that limit, the water test fails.

Advantages of on-line testing Stage 1:

- Real-time process information for conductivity and temperature.
- Immediate alarms and options.
- Data may be logged, providing water history.
- Easier and cost effective.
- Eliminates sample collection, handling and transportation errors.
- In addition, temperature-compensated conductivity remains an excellent technique to observe water quality changes.

What is USP and how does it affect me?

USP <645> was published on September 15, 1996, became mandatory on November 15, 1996 and is continued in subsequent revisions.

Recommendations of the Water Quality Committee (WQC) of the Pharmaceutical Research and Manufacturers of America (PhRMA formerly PMA) comprising leaders from major pharmaceutical companies were accepted to update antiquated testing standards for pharmaceutical waters such as USP Purified and Water For Injection (WFI). According to the WQC:... *"The existing USP monograph test for chloride, sulfate, calcium, ammonia and carbon dioxide were introduced into the USP in 1890 or before and may no longer be appropriate with regard to test methodology. While USP water monograph test methodologies for inorganic ions traditionally have been wet chemical methods, which are inexpensive and require little technical skill to perform, such attributes are offset by the qualitative and subjective nature of the antiquated tests....the WQC of PMA proposes to replace them with a conductivity measurement."*

Stimuli to the Revision Process, Pharmacopeial Forum November/December 1991.

Table A
Stage 1 Conductivity Limits as a Function of Temperature

Temperature (°C)	Stage 1 Conductivity Limit (µS/cm)
0	0.6
5	0.8
10	0.9
15	1.0
20	1.1
25	1.3
30	1.4
35	1.5
40	1.7
45	1.8
50	1.9
55	2.1
60	2.2
65	2.4
70	2.5
75	2.7
80	2.7
85	2.7
90	2.7
95	2.9
100	3.1

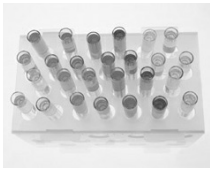

Table B
Stage 3 Conductivity Limits as a Function of pH

pH	Stage 3 Conductivity Limit (µS/cm)
5.0	4.7
5.1	4.1
5.2	3.6
5.3	3.3
5.4	3.0
5.5	2.8
5.6	2.6
5.7	2.5
5.8	2.4
5.9	2.4
6.0	2.4
6.1	2.4
6.2	2.5
6.3	2.4
6.4	2.3
6.5	2.2
6.6	2.1
6.7	2.6
6.8	3.1
6.9	3.8
7.0	4.6

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