

## 1. OBJECTIVE

pH varies with temperature. The 10F-20F change that most cooling towers experience does not have any practical effect on pH control and resulting water treatment chemistry.

However there are systems where temperature will significantly effect pH measurement. This application note details those applications where thermal effect causes water treatment operational problems.

### **pH Measurement & Control Troubleshooting**

See Aquatrac's Technical Service Manual Section 2.4; available at [www.aquatrac.com](http://www.aquatrac.com).  
Select **Manuals & Product Info** – Scroll to Product **Smart Flex**  
and then select **FLX-AS\_Techman**

## 2. THERMAL EFFECTS

A 36F temperature increase at the pH sensor changes the measured pH from +0.01 pH to +0.11 pH as tower pH control setpoint varies from 7.5 to 9.0.

This error is comparable to the swing in pH that occurs during ON/OFF pH control due to the time delay between feed point and pH measurement.

At pH 7, thermal correction is not required. Cooling towers which operate close to pH 7 would typically not experience any measurable thermal effect. Using thermal compensation of pH at sites which operate in the pH 7.5 to 8.5 range, adds complexity, complicates calibration & reduces overall system reliability. See Section 3. **pH vs Temperature**.

As the temperature decreases, the impedance of the pH sensor increases and the sensor becomes more noise sensitive. Sensor response time increases. Below 50F, this effect starts to be significant; sensor cable routing and length becomes critical. The measured pH may not track and appear to drift.

Chilled loops and systems which switch to free cooling in the winter months will both see water temperatures below 50F. See Section 4. for **Low Temperature Options**.

### 3. pH vs Temperature

#### pH Measurement\*

pH	10C 50F	20C 68F	30C 86F	40C 104F	50C 122F	Notes
6.0	6.07	6.01	5.98	5.94	5.84	
6.5	6.52	6.51	6.49	6.47	6.45	
7.0	7.00	7.00	7.00	7.00	7.00	No thermal effect
7.5	7.46	7.49	7.51	7.53	7.55	
8.0	7.92	7.99	8.02	8.06	8.16	Typical Cooling Tower
8.5	8.38	8.48	8.53	8.58	8.75	
9.0	8.84	8.98	9.04	9.11	9.18	

\*Using factory default controller **GAIN=0.017 & OFFSET=7.0**, rounded to 2 digits of resolution  
Actual measured pH will vary with sensor age and cooling water composition.

### 4. Low Temperature Options

The increasing impedance of pH sensors at temperatures less than 50F requires care in routing the sensor cable. Coil the excess pH sensor cable at the sensor and not in the controller enclosure. When routing the sensor cable within the enclosure, cross AC power cabling at right angles and do not bundle sensors cabling with AC power cabling.

Aquatrac uses low impedance glass in its blue, ½” diameter **A261100** pH sensor to lessen the effect of low temperatures. For continuous operation between 40F & 50F, use an amplified pH sensor, Aquatrac Part# **SXT-GXP**. This sensor has a battery powered buffer amplifier built into the end of sensor.