



Parameter's Approach to Relative Humidity Control and Calibrations

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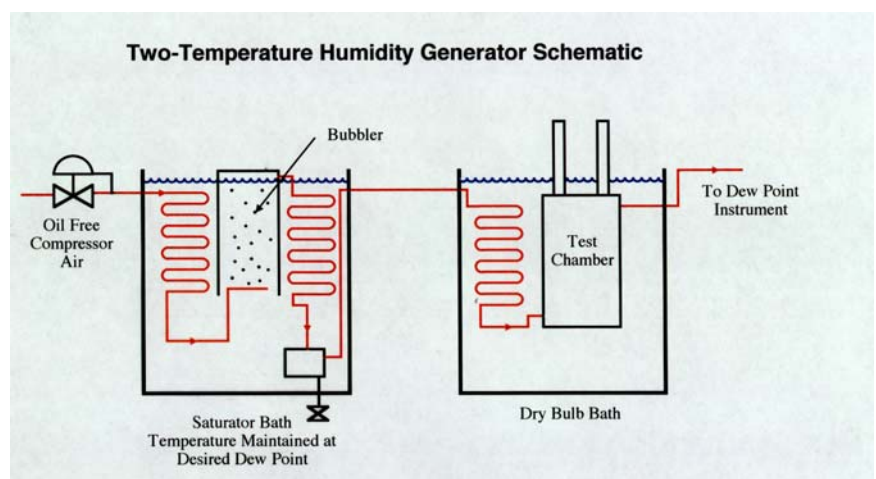
Parameter Generation and Control (Parameter) has specialized in the manufacturing of equipment to provide precise relative humidity and temperature control in rooms, reach-in chambers, and existing structures since 1977. Parameter utilizes the “two-temperature” method as our standard control process.

There are several commercial methods of humidity control that include:

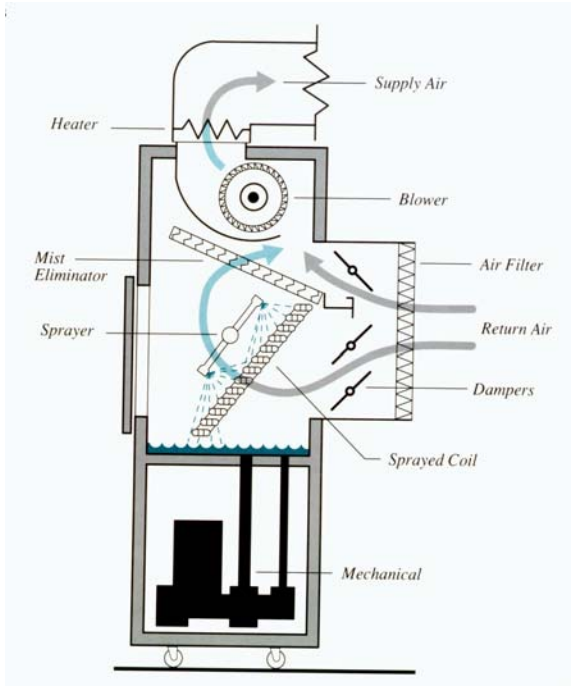
- Two-Pressure Method (Calibration)
- Two-Temperature Method (PGC)
- Steam Injection / DX Dehumidification (Common commercial method)
- Mixed Stream Method (Calibration)
- Desiccant Dryer Method

Each of these methods is useful depending on the specific requirement. Size of the area to be conditioned, range of temperature / dew point required, and accuracy / control requirements are some of the factors that would determine the most suitable process for a specific application.

In its simplest form, the two-temperature method circulates an air stream through a precise temperature controlled saturator (water spray or



bubble column). The air becomes saturated at the temperature of the water. When leaving the saturator, the air travels through a mist elimination device to insure liquid water does not go beyond the saturator. The air is then reheated to the desired dry bulb temperature. The temperature of the saturator would equal the dew point temperature. RH is calculated from the dew point and dry bulb temperatures (two temperature method).



In theory, this is a very simple primary method to control relative humidity. In practice, PGC cannot utilize this as a primary method because of the difficulty in actually achieving saturation in the saturator. It is also not practical if there are changing loads within the conditioned space, such as equipment, people, or ambient temperature changes around the chamber. In a Parameter System, the volume of the air flow required for maintaining room or chamber uniformity prevents the process air from reaching actual saturation in the saturator. The air circulating through the saturator does not cool down to the same temperature as the water temperature.

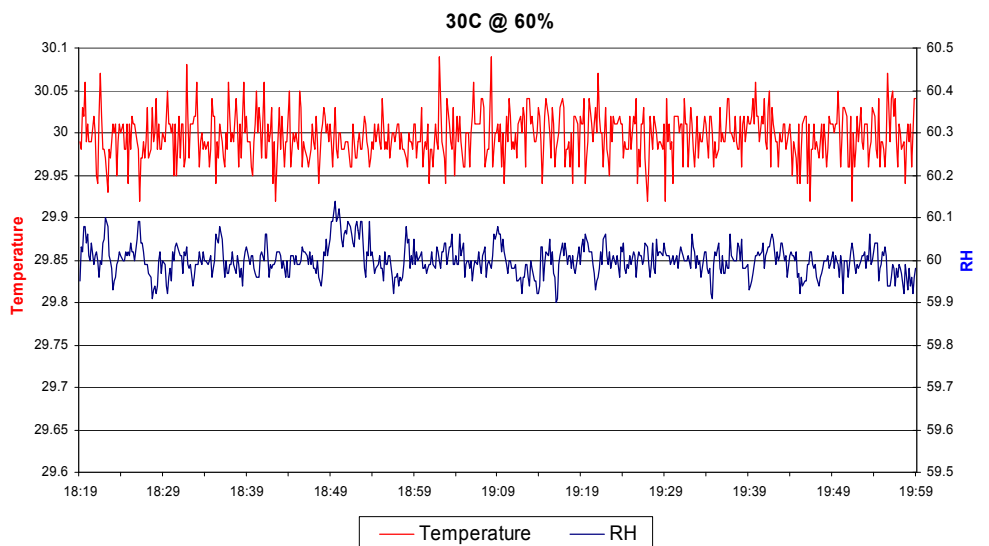
In a closed loop system utilizing a PGC conditioner with no internal loads, there is approximately 0.1°C per degree difference of dew point and dry bulb temperature.

For example, if maintaining 25°C at 60% (dew point of 14°C) there is an 11°C difference between dry bulb

temperature and dew point that would require a 1.1° off set to water spray temperature. The approximate water spray temperature to maintain 25°C at 60% is 12.9°C.

Since air does not reach exact saturation in the PGC saturator, our method of control is not a primary standard. The accuracy of the control point will depend on the accuracy of humidity control sensor. Saturator temperature is automatically adjusted by the output of the humidity sensor to maintain the desire relative humidity. If the actual humidity is lower than set point, the saturator temperature will rise to increase the dew point temperature and RH. Adjusting the saturator temperature down will lower dew point and RH control point.

Although Parameter does not utilize this method as a primary generator, the “two-temperature” methods provides a very stable humidity control of ±0.2 to 0.5% even in high velocities of air up to 15,000 cubic feet per minute (425 cubic meters per minute). PGC utilizes this process for controlled areas of 2 cubic feet (57



liters) up to 45,000 cubic feet (1,275 cubic meters).

The humidity uniformity of most chambers and rooms is temperature dependent with the exception of rooms that have a latent heat load. If the circulated air has a constant dew point, changes in air temperature dramatically affect relative humidity uniformity. Temperature uniformity is driven by internal heat load, external heat load (transmission through the walls), air velocity, and air distribution. Since the “two temperature” control method allows Parameter to move large volumes of controlled air, temperature uniformity is easier to achieve. The chart below illustrates the effect of velocity on uniformity.

**12 x 12 foot room
with 900 watt load**

Supply Air	Air Changes per Hour	Return Air
23°C at 50%	15 (300 CFM)	28°C at 37%
23°C at 50%	30 (600 CFM)	26°C at 43%
23°C at 50%	60 (1200 CFM)	24°C at 48%

The “two-temperature” approach is also useful in calibration when relatively large chambers are required for either quantity of probes or physical size of sensors such as hygrometers. Parameter will provide a precise control and tight uniformity, but the calibration chamber will require a precise humidity standard to provide the accuracy of the readings. A chilled mirror hygrometer or precise psychrometer is generally used to provide the humidity reading. The humidity standard can be utilized as the control probe or just as a monitoring standard.

Parameter's standard control sensor is a digital probe supplied by Rotronic. Parameter's controller is equipped with a single-line serial data input port developed specifically to communicate with the Rotronic probe and allows direct digital input from the sensor. Since the data is already in digital format the controller does not corrupt the data in any way allowing the temperature / RH probe to be calibrated off-site against a traceable reference standard, then re-installed in the chamber while retaining traceability. This feature reduces down-time and cost associated with standard humidity calibrations.

Limitations to the Parameter “two temperature” approach include:

- Range – dew point must be above freezing or a desiccant dryer must be incorporated into the control scheme.
- Ramp Rates – larger saturator water volumes stabilize control but increase the time to ramp dew points.
- Requires a humidity sensor.
- Is not a primary standard.

The “two temperature” approach to humidity control an excellent solution for larger volume control requirements. Accuracy is sensor dependent, but the approach allows for exceptional control and uniformity specifications.