

## Humidifying 100% Outside Air

When air recirculates within a room, there is a lot of flexibility allowed in the selection of a humidifier system. Often simple on/off control will be sufficiently accurate to allow control as close as +-4%RH. Small excursions of the humidifier below or above the set point are usually not noticed. As a result, almost any humidifier system will provide the accuracy of control most usually needed.

However, when the application involves 100% outside air, accuracy and response time of the humidifier selected become absolutely critical. Because the air moves through the room in only one pass, the air must be conditioned to its final humidity level immediately. Any excursions above or below set point will be seen immediately on any recorder. Simply using a modulating controller is not enough - the humidifier selected must be able to accurately and quickly track its output to the demand. Speed of response is essential.

Humidifier Type	Drain/Fill Interruption	Demand Tracking	Response Time	Modulation Range
<b>MC 2000</b> Air/Water Atomizing  Note: competitive air/water systems do NOT share the same features.	Shut down/drain every hour for 30 seconds to clean heads (no shut down on demineralized water). Recovery is instant.	+ -1%	5-10 seconds	0-100% 100:1 turn down
<b>HumiFog</b> Airless Atomizing	None	+ -2%	30-60 seconds	0-100% >100:1 turn down Staging is used to achieve levels of capacity
<b>UltimateSteam</b> Direct Steam	None	+ -1%	15-30 seconds from cold startup. 5-15 seconds when hot.	0-100% Precision depends on the valve.
<b>SD 2000</b> Electrode Steam  HumiSteam Electrode Steam	Drains every 1 to 15 minutes for 5-15 seconds depending on water conductivity. Output falls off during drain. Recovery 1-2 minutes.	+ -5-10%	5-10 minutes on cold startup. 1-5 minutes response to demand.	30-100%
<b>HeaterSteam</b> Element Steam  Note: competitive element steam humidifiers do NOT share the same features.	Drains every 1 to 15 minutes for 5-15 seconds depending on water conductivity. Output remains constant. Recovery 5-10 seconds.	+ -1%	2-5 minutes on cold startup. 10-20 seconds with stand-by mode enabled. 10-20 seconds response to demand.	0-100%
<b>GaSteam</b> Gas-fired Steam	Drains every 1 to 15 minutes for 5-15 seconds depending on water conductivity. Output remains constant. Recovery 30-60 seconds.	+ -3-5%	10-15 minutes on cold startup. 30-60 seconds with stand-by mode enabled. 60-90 seconds response to demand.	25-100%
Evaporative Media	No effect.	+ -10%	1-5 minutes.	50-100%

### NOTES:

1. The MC 2000 and HumiFog are the ONLY systems to achieve 100:1 real time modulating turn down. The nearest competitor is 35:1.
2. The HeaterSteam and GaSteam have an exclusive stand-by preheat mode that competitive units do NOT have and this greatly reduces startup and recovery times.

## Systems of choice for 100% outside air in order of accuracy/response/modulation:

- **MC 2000 Air/Water Atomizing:** With 100:1 modulating turn down, instant on/off, and 0-100% modulation range, the MC 2000 will draw perfect circles on a graph. However, be aware that the evaporative cooling effect could upset the temperature control accuracy if the temperature control system reacts too slowly.
- **HumiFog Airless Atomizing:** Modulation is minimal, but in larger systems a sequential cascade can be used with varying manifold capacities to achieve the required turn down. Best control is about +-2% on 100% outside air applications.
- **HeaterSteam Element Steam:** With 0-100% modulation range, precision SSR control, and stand-by mode, the HeaterSteam will also draw perfect circles on a graph. This is the choice for small applications or where the evaporative cooling effect of the MC 2000 would be disruptive.
- **UltimateSteam Direct Steam:** Accuracy here depends on the precision of the modulating valve. The Siemens valves used by Carel are rated at 100:1 modulating turn down.
- **GaSteam Gas-fired Steam:** With 25-100% modulation, and stand-by mode, the GaSteam can provide good precision for larger areas. However, below 25% modulation, it essentially operates on/off and thereby loses accuracy at the low end of modulation. This is not a good choice for highly accurate requirements.

## Systems to avoid using in 100% outside air applications:

- **SD 2000/HumiSteam Electrode Steam:** Since the water level directly controls the steam output, the normal draining/filling operations are quickly noticed on a humidity graph. Best control is probably +-5% on 100% outside air, if the water supply is stable.
- **Evaporative Media: Forget about precision.** Since water is trickled over a media, there is a terrible lead and lag effect which will cause humidity to undershoot and overshoot by at least +-5-10%. Good as a primary humidifier to maintain minimum levels, but not as a final humidifier where precision control is needed.

## Other considerations when humidifying 100% outside air systems:

- In any humidification system, there is automatically a +-2%RH swing in humidity for every 1°F swing in temperature. Bottom line: if you want +-1%RH control, you need to control temperature to +-0.5°F.
- Make sure that you use fast-acting humidity sensors, like those provided by Carel. Maximum delay should be no more than 60 seconds in still air and 20 seconds in moving air.
- Of course, sensor accuracy must match the requirements for control. A +-3% accurate humidity sensor will not control to +-1%RH.
- Control sensing may be in the supply air or in the room. Room air sensing is best as the readings tend to be a better average of actual room conditions after the supply air has mixed in. Supply air sensing is acceptable, but can lead to some hysteresis in the behavior of the humidifier.
- The humidity must be added where it will be absorbed. Don't try adding humidity to a 45°F air stream when the final requirements are for 72°F and 50%RH. You can't get there from here!

**Any questions?  
Call the experts at Carel.**

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