The 10 Steps of Humidification Design
Why Humidify?

Winter Outdoor Air
10°F/60%RH = 6 grains

Final Space 70°F
6 grains = 4% RH
Why Humidify?
ASHRAE 20008 Mechanical Systems

<table>
<thead>
<tr>
<th>Decrease in Bar Width</th>
<th>Optimum Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td></td>
</tr>
<tr>
<td>Viruses</td>
<td></td>
</tr>
<tr>
<td>Fungi</td>
<td></td>
</tr>
<tr>
<td>Mites</td>
<td></td>
</tr>
<tr>
<td>Respiratory Infections</td>
<td></td>
</tr>
<tr>
<td>Allergic Rhinitis and Asthma</td>
<td></td>
</tr>
<tr>
<td>Chemical Interactions</td>
<td></td>
</tr>
<tr>
<td>Ozone Production</td>
<td></td>
</tr>
</tbody>
</table>

*INSUFFICIENT DATA ABOVE 50 % R.H.*

Per Cent Relative Humidity

REFERENCE: DR. STERLING
Influenza Virus Transmission Is Dependent on Relative Humidity and Temperature

Anice C. Lowen 1, Samira Mubareka 1, John Steel 1, Peter Palese 1,2

1 Department of Microbiology, Mount Sinai School of Medicine, New York, New York, United States of America, 2 Department of Medicine, Mount Sinai School of Medicine, New York, New York, United States of America.

Using the guinea pig as a model host, we show that aerosol spread of influenza virus is dependent upon both ambient relative humidity and temperature. Twenty experiments performed at relative humidities from 20% to 80% and 5 °C, 20 °C, or 30 °C indicated that both cold and dry conditions favor transmission. The relationship between transmission via aerosols and relative humidity at 20 °C is similar to that previously reported for the stability of influenza viruses (except at high relative humidity, 80%), implying that the effects of humidity act largely at the level of the virus particle. For infected guinea pigs housed at 5 °C, the duration of peak shedding was approximately 40 h longer than that of animals housed at 20 °C; this increased shedding likely accounts for the enhanced transmission seen at 5 °C. To investigate the mechanism permitting prolonged viral growth, expression levels in the upper respiratory tract of several innate immune mediators were determined. Innate responses proved to be comparable between animals housed at 5 °C and 20 °C, suggesting that cold temperature (5 °C) does not impair the innate immune response in this system. Although the seasonal epidemiology of influenza is well characterized, the underlying reasons for predominant wintertime spread are not clear. We provide direct, experimental evidence to support the role of weather conditions in the dynamics of influenza and thereby address a long-standing question fundamental to the understanding of influenza epidemiology and evolution.

Introduction

Influenza A virus, of the family Orthomyxoviridae, carries an RNA genome consisting of eight segments of negative-stranded RNA. This genome encodes one or two non-structural proteins and nine structural proteins, which, together with a host cell-derived lipid envelope, comprise experiments performed in the winter months yielded a transmission rate of 58.2%; in contrast, a rate of only 34.1% was observed in the summer months [10]. While these data suggested that the seasonal influences acting on humans also affect laboratory mice, no mechanism to explain the observations was identified.

Why Humidify?
A HISTORIC CHANGE IN THE OPERATING ROOM ENVIRONMENT
The National Standard for Establishing Relative Humidity in Operating Rooms Has Been Reduced to 20%

Over the years, relative humidity levels have been a source of continued debate in the health care community. In an effort to debunk an age-old requirement, the ASHRAE Standard 170, Ventilation of Health Care Facilities Standing Committee applied science, a literature search and research to this subject and recently issued a formal Addendum "id." which becomes effective immediately. ASHRAE 170 has been incorporated into the 2010 FGI Guidelines for Design and Construction of Health Care Facilities. The publication of this addendum stresses the aspects of relative humidity in operating rooms in terms of clinical outcomes, comfort, and engineering concepts.

Attend this ASHE/FGI educational event:
The Role of Humidity in Operating Rooms - Demystifying the Myth
June 8, 2010

This program has been designed to provide you with accurate information on the real issues surrounding humidity levels in the operating room environment. Input from AORN, APIC, CDC, NIOSH, and ASHRAE was instrumental in designing the program content. As a result of participation, you will be able to:

- Explain the rationale behind this significant change to ASHRAE 170 and the Guidelines.
- Prepare health care organizations to implement the lower humidity levels in operating rooms.
- Discuss the effect humidity levels have on surgical site infections, patient outcomes, and comfort.
- Provide health care professionals with well-balanced, pertinent information on the new national standards for humidity in short-stay patient care areas, which includes the operating room.
Step 1: Select Humidifier Type
Two Humidifier Types

- Isothermal – energy for change of state from boiler
- Adiabatic – energy for change of state from air stream
Isothermal

- Steam from low pressure boiler
- Electric Resistant
- Electrode
- Gas Heat Exchanger
- Steam Heat Exchanger
Steam Jacketed Humidifiers
Non-Jacketed Short Absorption
Electric Resistant Heater
Electrode Type Humidifier
Steam Heat Exchanger
Gas Humidifier Energy Savings
12 Cents per kWhr

ENERGY-CALC™
DRI-STEEM's Energy Savings Calculator

This worksheet will help you quickly estimate your energy savings from using gas humidification instead of electric. In many locations, the savings are significant enough that you can replace your old electric units with new GTS™ gas humidifiers from DRI-STEEM -- and let the energy savings pay for the cost!

To find your energy savings estimate¹, simply select the appropriate information from the pull-down menus and let ENERGY-CALC do the rest! Click on the "Energy Savings Calculations" worksheet tab (located below) for details after selections are made. If you are interested in financing a humidifier purchase, click on the "Finance Estimates" worksheet tab below.

1. Select the city nearest you. Choose are arranged in alphabetical order by city.  

2. Select your NATURAL GAS utility rate ($/1000 cu ft). Rates can vary greatly. It is best to use the actual rate for your area if you know it. For reference, United States Energy Information Administration data² provides the following overall average natural gas rates for: 

   New York:
   Industrial State Avg. ($/1000 cu ft) 6.5
   Commercial State Avg. ($/1000 cu ft) 8.5

3. Select your ELECTRIC utility rate (cents/kWh). Rates can vary greatly. It is best to use the actual rate for your area if you know it. For reference, United States Energy Information Administration data² provides the following overall average electric rates for: 

   New York:
   Industrial State Avg. (cents/kWh)  12
   Commercial State Avg. (cents/kWh)  11.3

4. Select the total air handler(s) cfm for the areas to be humidified. 

5. Select the % of outdoor air that is provided to the air handler(s). 

   100%

6. Select the desired temperature (°F) in the area to be humidified. 

   70°F

7. Select the desired RH in the area to be humidified. 

   40%

8. Select the number of hours per week the humidifier will be allowed to operate to maintain set point. 

   168 Hrs/Wk

Based on the information you selected, the estimated annual load for this application in lb/yr is: 321634

Based on the information you selected, the estimated electric cost per year to humidify this space is: $13,842

Based on the information you selected, the estimated natural gas cost per year to humidify this space is: $4,286

Estimated design load (lb/hr): 136  
Typical humidifier selection: 1 GTS 200

Estimated Annual Energy Savings with Gas Humidification: $9,246

(Additional savings may result if the selected electric rate chosen above does not include demand charges.)
Steam piping

GTS humidifier in outdoor enclosure

Electrical connections

Gas piping

Flue

Curb

Drain piping

Water piping

Vapor-logica keypad shown with optional cable length. Keypad ships standard with 5' (1.5 m) of cable
Adiabatic

- Significant temperature drop
- Longer absorption distance
- RO water required
Step 2:

Determine Humidification Load
Step 2: Determine Humidification Load

- Mechanical with constant amount of outside air
- Economizer changes amount of outside air to utilize free cooling
Mechanical Calculation
<table>
<thead>
<tr>
<th>Tag</th>
<th>Qty</th>
<th>Entering DB/RH</th>
<th>Leaving DB/RH</th>
<th>Load</th>
<th>Model</th>
<th>Abs</th>
<th>Dispersion</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>1</td>
<td>0 °F / 70 (%)</td>
<td></td>
<td>157.64 lbs/hr</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Edit Humidifier Load Calculation: H-1**

- **Calculation Method**: Calculate
- **Air Intake Method**: Mechanical
- **Total Air Volume (CFM)**: 25000
- **Entering Outside Air (%)**: 25
- **Load (lbs/hr)**: 157.64

[Buttons: Cancel, Save As Default, Back, Save]
Economizer Calculation
Economizer
Step 2: Determine Humidification Load

- Accurate humidification load must include condensate loss and steam jacket requirement
Steam Jacket Impact on Load Calculation
Dispersion Panel Condensate Impact on Load Calculation
Step 3: Determine Absorption Requirement
Steam Absorption in Duct
Steam Absorption in AHU
Determine Absorption Requirement

- Temperature
- Velocity
- Fan/Air flow characteristics
Determine Absorption Requirement

- Effect of AHU or duct temperature on steam absorption distance
The leaving duct RH cannot be greater than 90% to prevent saturation. A possible solution is to raise the duct temperature and/or increase total air volume.
Determine Absorption Requirement

- Isothermal 250-3000 fpm
- Adiabatic 250-750 fpm
Bypass Under Dispersion Panel
### Steam Injection Selection

- **Type of Dispersion**: AHU
- **Mounting Location**: Coil
- **Coil Dimensions (inches)**:
  - **Width**: 84
  - **Height**: 84
- **Leaving Duct Temp (°F)**: 55
- **Absorp. Distance (inches)**: 36
- **Insulated Tube(s)**: Off
- **Steam Pressure (psi)**: 12
- **Airflow**: Horizontal
- **Header**: Inside AHU
- **Steam Trap**: Inside AHU
- **Use**: One Valve, 100%

### Load
- **Load (lbs/hr)**: 769.51
- **Air Volume (CFM)**: 25000.00
- **Humidified Air Volume**: 25000.00
- **Air Velocity (ft/min)**: 510.20
- **Entering Duct RH (%)**: 11
- **Leaving Duct RH (%)**: 83
- **Actual RH (%)**: 50

### Table

<table>
<thead>
<tr>
<th>Model</th>
<th>Qty</th>
<th>Abs.</th>
<th>Tubes</th>
<th>O.C.</th>
<th>Valve</th>
<th>Cv</th>
<th>Cap</th>
<th>Valve</th>
<th>Cv</th>
<th>Cap</th>
<th>Max Cap</th>
<th>Load + Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULTRA-SORB LH</td>
<td>1</td>
<td>18</td>
<td>-</td>
<td>3</td>
<td>1 1/2</td>
<td>28</td>
<td>1104</td>
<td>-</td>
<td>0.00</td>
<td>1104</td>
<td>861.92</td>
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<tr>
<td>ULTRA-SORB LH</td>
<td>1</td>
<td>35</td>
<td>-</td>
<td>6</td>
<td>1 1/2</td>
<td>28</td>
<td>1104</td>
<td>-</td>
<td>0.00</td>
<td>1104</td>
<td>805.54</td>
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<tr>
<td>ULTRA-SORB LV</td>
<td>1</td>
<td>18</td>
<td>-</td>
<td>3</td>
<td>1 1/2</td>
<td>28</td>
<td>1104</td>
<td>-</td>
<td>0.00</td>
<td>1104</td>
<td>865.47</td>
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<td>ULTRA-SORB LV</td>
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<td>-</td>
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<td>1 1/2</td>
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<td>-</td>
<td>0.00</td>
<td>1104</td>
<td>808.31</td>
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<tr>
<td>ULTRA-SORB XV</td>
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<td>18</td>
<td>-</td>
<td>3</td>
<td>1 1/4</td>
<td>20</td>
<td>788</td>
<td>-</td>
<td>0.00</td>
<td>788</td>
<td>813.76</td>
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</tbody>
</table>
The leaving duct RH cannot be greater than 90% to prevent saturation. A possible solution is to raise the duct temperature and/or increase total air volume.
### Suggested Schedule Format

**Project Name:** CUSTOM AIR

<table>
<thead>
<tr>
<th>Tag</th>
<th>Qty</th>
<th>Multi</th>
<th>Humidifier Model</th>
<th>Load (lbs/hr)</th>
<th>Air Volume (CFM)</th>
<th>Volts/Phase/ Amp (Each)</th>
<th>Control Input Signal</th>
<th>Dispersion Model</th>
<th>Absorp. Dist. (inches)</th>
<th>Entering Conditions Dry Bulb/RH</th>
<th>Leaving Conditions Dry Bulb/RH</th>
<th>Duct Area WxH (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1</td>
<td>1</td>
<td>1</td>
<td>(1)NM-8</td>
<td>20.33</td>
<td>3000.00</td>
<td>480 / Three / 14.4</td>
<td>DRI-STEEM</td>
<td>(1)RAPID-SORB</td>
<td>0</td>
<td>71.4°F / 31%</td>
<td>72.0°F / 40%</td>
<td>20 x 20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heat Gain from Assembly</th>
<th>Heat Gain from Steam</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.22°F</td>
<td>0.40°F</td>
</tr>
</tbody>
</table>
Step 4:

Chemically Treated Steam
Step 3: Determine if Chemically Treated Steam is Acceptable?

- Steam boilers with condensate return must protect piping with dangerous chemicals Sodium Sulfite, Sodium Hydroxide, Sodium Gluconate
- Chemicals in steam used for humidification will enter AHU air stream
- Scrutinize use in hospitals or museums
5.10 Humidification and Water Treatment

Humidifiers and Direct Evaporative Coolers: Make-up water for direct evaporation humidifiers and direct evaporative coolers, or other water spray systems shall originate directly from a potable source that has equal or better water quality with respect to both chemical and microbial contaminants. Humidifiers shall be designed so that microbicidal chemicals and water treatment additives are not emitted in ventilation air. All components of humidification equipment shall be stainless steel. Air washer systems are not permitted for cooling.

Humidification shall be limited to building areas requiring special conditions. Courtrooms with wall coverings of wood shall be provided with humidification. General office space shall not be humidified unless severe winter conditions are likely to cause indoor relative humidity to fall below 30 percent. Where humidification is necessary, atomized hot water, clean steam or ultrasound may be used and shall be generated by electronic or steam-to-steam generators. To avoid the potential for over saturation and condensation at low load, the total humidification load shall be divided between multiple, independently-modulated units. Single-unit humidifiers are not acceptable. When steam is required during summer seasons for humidification or sterilization, a separate clean steam generator shall be provided and sized for the seasonal load. Humidifiers shall be centered on the air stream to prevent stagnation of the moist air. All associated equipment and piping shall be stainless steel. Humidification system shall have microprocessor controls and the capability to connect to building automation systems.

Water Treatment: The water treatment for all hydronic systems, including humidification systems, shall be designed by a qualified specialist. The design system shall address the three aspects of water treatment: biological growth, dissolved solids and scaling, and corrosion protection. The performance of the water treatment systems shall produce, as a minimum, the following characteristics: hardness: 0.00 iron content: 0.00 dissolved solids: 1,500 to 1,750 ppm silica: 610 ppm or less; and a pH of 10.5 or above. The system shall operate with an injection pump transferring chemicals from solution tanks as required to maintain the conditions described. The chemical feed systems shall have self-contained microprocessor controls capable of connecting to and interfacing with a Direct Digital Control (DDC) Building Automation System. The methods used to treat the systems’ make-up water shall have prior success in existing facilities on the same municipal water supply and follow the guidelines outlined in ASHRAE Applications Handbook.
Humidification and Dehumidification Equipment

- Potable water rather than boiler water should be used as a source of steam to avoid contaminating the indoor air with boiler treatment chemicals.
- Wet surfaces should be properly drained and periodically treated as necessary to prevent microbial growth.
- Duct linings should not be allowed to become moist from water spray.

Outdoor Air Dampers

Screens and grilles can become obstructed. Remove obstructions, check connections, and otherwise insure that dampers are operating to bring in sufficient outdoor air to meet design-level requirements under all operating conditions.

Air Filters

- Use filters to remove particles from the air stream.
- Filters should be replaced on a regular basis, on the basis of pressure drop across the filter, or on a scheduled basis.
- Fans should be shut off when changing the filter to prevent contamination of the air.
- Filters should fit tightly in the filter housing.
- Low efficiency filters (ASHRAE Dust Spot rating of 10%-20%), if loaded to excess, will become deformed and even "blow out", leading to clogged coils, dirty ducts, reduced indoor air quality and greater energy use.
- Higher efficiency filters are often recommended as a cost-effective means of improving IAQ performance while minimizing energy consumption. Filtration efficiency should be matched to equipment capabilities and expected airflows.

Ducts

A small amount of dust on duct surfaces is normal. Parts of the duct susceptible to contamination include areas with restricted airflow, duct lining, or areas of moisture or condensation. Problems with biological pollutants can be prevented by:

- Minimizing dust and dirt build-up (especially during construction or renovation)
- Promptly repairing leaks and water damage
- Keeping system components dry that should be dry
- Cleaning components such as coils and drip pans
- Good filter maintenance
- Good housekeeping in occupied spaces

Duct leakage can cause or exacerbate air quality problems and waste energy. Sealed duct systems with a leakage rate of less than 3% will usually have a superior life cycle cost analysis and reduce problems associated with leaky ductwork. Common problems include:

- Leaks around loose fitting joints
- Leaks around light Troffer-type diffusers at the diffuser light fixture interface when installed in the return plenum
- Leaks in return ducts in unconditioned spaces or underground can draw contaminants from these spaces into the supply air system

Exhaust Systems

In general, slightly more outdoor air should be brought into the building than the exhaust air and relief air of the HVAC system. This will insure that the building remains under slight positive pressure.

- Exhaust intakes should be located as close to the source as possible.
- Fan should draw sufficient air to keep the room in which the exhaust is located under negative pressure relative to the surrounding spaces, including wall penetrations outside of the HVAC system.
VA Standard

STANDARDS SERVICE • Facilities Quality Management

ISSUE:

Background:

VA criteria allow use of direct steam from its boiler plants, a ready and reliable source of steam. However, there has been some concern expressed in the industry because of the chemicals used to treat boiler water.

Discussion:

VA’s DASO (Designated Agency Safety and Health Official) issued a memorandum dated October 4, 1999, communicating position on its Hazard Communication Standard for airborne and aqueous release chemicals from steam injection humidifiers. OSHA classified these chemicals as consumer products under 29CFR 1910.1200 (b) (6) (vii). Therefore, DASHO determined notification of VA humidification was not required and special notification of building occupants of the presence of these chemicals was not required by OSHA. However, the memo recommends that for new construction, humidification systems that do not require the use of the facility’s boiler water should be considered. The following table shows comparisons of various types of steam humidifiers.

<table>
<thead>
<tr>
<th>Humidifier Type</th>
<th>Initial Cost</th>
<th>Energy Cost</th>
<th>Maintenance Frequency</th>
<th>Life Cycle Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Steam</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Steam Steam</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Steam Steam</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Steam Steam (w/ Type)</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Steam Steam (w/ Element)</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Steam Steam (w/ Ionic)</td>
<td>6</td>
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<td>6</td>
</tr>
<tr>
<td>Steam Steam (w/ Ionic)</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

The table is based on an article published in the NEMS dated February 24, 1996.

Ranking: 1 = Excellent, 2 = Very good, 3 = Good, 4 = Fair, and 5 = Poor

Recommendation:

1. Follow VA criteria. For new construction consider humidification systems that do not require use of facility’s boiler steam as recommended by DASHO.

For Additional Information:

Contact XXXXX at 202-565-5032 in the Standards Service (187C).

13 January 1999
FM-187C-095

DRISTEEM
Humidifiers

within the duct. For proper psychrometric calculations, refer to Chapter 6 of the 2005 ASHRAE Handbook—Fundamentals. Because these humidifiers inject steam from a central boiler source directly into the space or distribution duct, boiler treatment chemicals discharged into the air system may compromise indoor air quality. Chemicals should be checked for safety, and care should be taken to avoid contamination from the water or steam supplies.
Steam Heat Exchanger
Caution: Limit One Per AHU
Step 5:

Condensate Management
Non-Jacketed Rapid Absorption
Step 4: Condensate Management

- Reduce atmospheric condensate
Insulated Tubes
High-efficiency Dispersion Tube Payback Estimator
Rev V1.3.11

To estimate payback by investing in DRI-STEEM High-efficiency dispersion tubes, enter the appropriate information in the drop-down boxes. Additional parameters located on the "Config" tab.

To analyze the investment based on run hours other than estimated from the TMY2 data, manually select run hours in the bottom drop-down box. Manual results are shown on the bottom right.

Notes:
- Accumulates water, cooling and vaporization expenses associated with humidifying ventilation air only.
- Minimum modulation rate - fixed 6%
- Color bars become highlighted potential issues. Verify entry and disregard highlight if entered correct for your application.
- For proper calculation, verify that steam capacity, number of tubes, airflow, temperatures and dimensions are accurate.

Prepared for: Bellevue Hospital NYU Brain

Unit serial #: 1103290

Estimated Insulation Option Payback

Based on TMY2 data using 3985 run hours:

<table>
<thead>
<tr>
<th>Item</th>
<th>Electric</th>
<th>Gas</th>
<th>District Steam</th>
</tr>
</thead>
<tbody>
<tr>
<td>$9,452 Per Year</td>
<td>0.37 Years</td>
<td>$9,488 Per Year</td>
<td></td>
</tr>
<tr>
<td>$6,289 Per Year</td>
<td>0.67 Years</td>
<td>$5,309 Per Year</td>
<td></td>
</tr>
<tr>
<td>$8,370 Per Year</td>
<td>0.56 Years</td>
<td>$6,394 Per Year</td>
<td></td>
</tr>
</tbody>
</table>

$56,658 Gallons/yr saved! $2,271 Per Year
54 lbs steam & 63,022 btu/hr saved!

Electric = 93,353 lbs CO₂/yr
Gas = 28,683 lbs CO₂/yr

Reductions

Tube induced duct heat gain: 1.1 °F Insulated
3.4 °F Uninsulated

Approximate Insulation Option Price (includes optional cost) $3,568
Various Methods To Reduce Condensate and Heat Gain
Performance Differences

**Table 4-1: Insulation \( k \) factors and \( R \) values**

<table>
<thead>
<tr>
<th>Insulation</th>
<th>Thickness</th>
<th>( k ) factor</th>
<th>( R ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal insulating coating</td>
<td>0.0025 (0.030(&quot;))</td>
<td>0.0561</td>
<td>0.045</td>
</tr>
<tr>
<td>Stainless-steel-shielded air gap</td>
<td>0 to 0.0208 (0(&quot;) to 0.25(&quot;))</td>
<td>0.108 (average)</td>
<td>0.16 (average)</td>
</tr>
<tr>
<td>PVDF insulation</td>
<td>0.0104 (0.125(&quot;))</td>
<td>0.0185</td>
<td>0.56</td>
</tr>
</tbody>
</table>
Condensate Management

- No atmospheric condensate-return to LPR
Steam Injection Humidifiers
End View Cut-Away
Step 6:

Define Control Requirement
Step 6: Define Humidifier Accuracy

- Based on air changes per hour and RH accuracy requirement
- Standard humidifier will maintain +/- 3% with 2-10 air changes per hour
Humidifier Accuracy

- +/- 1% accuracy with high number of air changes is possible with:
  - Pressurized steam controlled by steam valve with adequate turndown
  - Resistive electric humidifier with DI/RO water and SSR controller - NOT ELECTRODE TYPE
Define Humidifier Accuracy

- DI/RO makeup water
- Eliminates interruption of boiling due to large amount of cold make up water
- Eliminates unscheduled maintenance or unit failure due to Calcium and Magnesium accumulation
Step 7:

Make Up Water
Determine Water Source

- Will there be maintenance
Impact of Make Up Water
Impact of Make Up Water
Determine Water Source

- Anti-Foaming
- Ionic beds
- Softened water
- Skimmer + periodic drain
Ionic Bed Maintenance

3) Ionic Bed Inspection
Remove and inspect one of the ionic beds and inspect the drain screen at the bottom of the tank. If it does not appear to be saturated with mineral deposit (a full bed will weigh 2.5 pounds dry) and if the drain screen is clear, you have two options.

a) **Reset the existing service life counter.** In which case the unit will need to be thoroughly checked at the next service life. To reset the service life: hold the “RESET” button in (to the left) for 20 seconds until the front panel LED’s illuminate than all go off (except the power LED). Proceed with Step 4.

b) **Change the service life settings** (see bed life adjustment procedure at the end of this document).

4) Ionic Bed Replacement
If the beds are saturated (a full bed will weigh 2.5 pounds dry) remove all of them. Remove any large pieces of scale from the tank. Scraping the tank is advised.

a) Chemically clean the unit with Rite-Qwik.
   i) Pour one gallon of Rite-Qwik into tank followed by one gallon of fresh water.
   The HC-4500 model requires 2 gallons of Rite-Qwik and 2 gallons of water.
Determine Water Source

- Softened water for cylinder life
Determine Water Source

- DI makeup water system must be properly maintained by end user or system will generate Chlorides
Control System Consideration
Step 8: Control System Consideration

- Sensor placement
- VAV
- Primary/secondary
- Heat Gain from Humidifier Dispersion
- PID Loop/Modulating Duct High Limit
- Window dew point control
Sensor Placement

- Return Air for space monitoring
- Caution with high temp supply duct
Variable Air Volume

- Impacts ability to deliver humidified air at terminal unit
- Impacts ability to introduce moisture in AHU air stream
Variable Air Volume
Primary and Secondary/Trim System

- Often hospitals with diverse zones served by single AHU
Primary and Secondary/Trim
Primary and Secondary/Trim

- Interlock secondary trim humidifiers with reheat coils
Heat Gain from Dispersion

<table>
<thead>
<tr>
<th>Project Name: PLYMOUTH STATE RECITAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quote Date: 08.22.2010</td>
</tr>
<tr>
<td>Unit of Measure: Inch-Pound</td>
</tr>
<tr>
<td>Humidifier Tag: 4164 CPM GA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System Quantity</th>
<th>Calculation Method</th>
<th>Mechanical Airflow (CFM)</th>
<th>4865.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation (ft)</td>
<td>Desired Dry Bulb (°F)</td>
<td>70.0</td>
<td>Entering Outside Air (%)</td>
</tr>
<tr>
<td>Entering RH (%)</td>
<td>Desired RH (%)</td>
<td>25</td>
<td>Load (lbs/hr)</td>
</tr>
<tr>
<td>Actual RH (%)</td>
<td>Load Plus Loss (lbs/hr)</td>
<td>112.07</td>
<td></td>
</tr>
</tbody>
</table>

(All Values are per unit, unless otherwise noted)

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Electric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Type</td>
<td>Potable</td>
</tr>
<tr>
<td>Total Humidifier Capacity (lbs/hr)</td>
<td>135.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Multi</th>
<th>Qty.</th>
<th>Volts/Phase/Amp (Each)</th>
<th>Humidifier Outlet Type</th>
<th>Dia. (Inches)</th>
<th>Qty.</th>
<th>Size (inches) W x H x L</th>
<th>Stages</th>
<th>kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLC 48-3</td>
<td>1</td>
<td>208/3</td>
<td>132.2</td>
<td>Hose</td>
<td>1 1/2</td>
<td>3 x 22.00 x 8.88 x 8.88</td>
<td>3</td>
<td>46.0</td>
<td></td>
</tr>
</tbody>
</table>

Selected Humidifier Options:
- Type of Water: Potable
- CRANE-HOOKER
- CRANE-HOOKER, Wall Mount
- Evaporating Chamber Insulation
- Trace Water Hangers

Selected Control Options:
- VAPOR-LOGIC-4
- Type of Control: Modulating
- Time Proportioning
- Modulating: DRI-STEEM
- Temperature: Room
- Humidistat, On-Off High Limit, Dust
- Airflow Proving Switch Pressure

Humidifier Notes:
Minimum water conductivity of 2 grams/cm² (100 µS/cm)
Power block maximum wire connection size of 2/0 gauge

<table>
<thead>
<tr>
<th>Dispersion Inlet</th>
<th>Face Dimensions (inches)</th>
<th>Overall Dimensions (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Diameter (Inches)</td>
<td>Position</td>
</tr>
<tr>
<td>Hose</td>
<td>1 1/2</td>
<td>B3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Qty.</th>
<th>Header Size (inches)</th>
<th>Tube Center (inches)</th>
<th>Condensate Position</th>
<th>Position #1</th>
<th>Position #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULTRA-CORE LV</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>NA</td>
<td>01</td>
<td>07</td>
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Duct Conditions

<table>
<thead>
<tr>
<th>Absorption Dist. (inches)</th>
<th>Airflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Horizontal</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Duct Width (inches)</th>
<th>Air Velocity (feet/min)</th>
<th>Duct Height (inches)</th>
<th>Airflow Pressure Drop (in)</th>
<th>Enterent Dust Temp (°F)</th>
<th>Entering RH (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45.5</td>
<td>180</td>
<td>27</td>
<td>0.005</td>
<td>45.5</td>
<td>18</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Header Location</th>
<th>Outside Dust</th>
<th>Heat Gain Assembly (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Dust</td>
<td>21.5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water Seal Location</th>
<th>Outside Dust</th>
<th>Heat Gain Steam (°F)</th>
<th>Load Plus Loss (lbs/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Dust</td>
<td>13.3</td>
<td></td>
<td>112.07</td>
</tr>
</tbody>
</table>

Selected Dispersion Options:
- Casing: Galvanized Steel
- Insulated Tubing
Step 9:

Humidifier Tank Location
Step 9: Determine Humidifier Placement

- Access for maintenance
- Floor vs. Ceiling
Maximum 100 ft. with proper steam supply sizing
Consider condensate from tank & dispersion
Step 10:

Review Building Construction
Step 10: Review Building Construction

- Vapor barrier
- Windows
- Roof decking
- Dock doors
Vapor Barrier
Thank You