

# Increase Productivity & Reduce Absenteeism with Humidity Control

## November 15, 2012

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# Today's topics

- Understanding Humidity Control
- Equipment Types
  - Dehumidification
  - Humidification
- Other Considerations
  - Life Cycle Costs

# What is Humidity

- Humidity is a term for the amount of water vapor in the air
- Optimum indoor relative humidity level is 30% to 60%<sup>1</sup>
  - Best range for occupant health is 40% - 50%

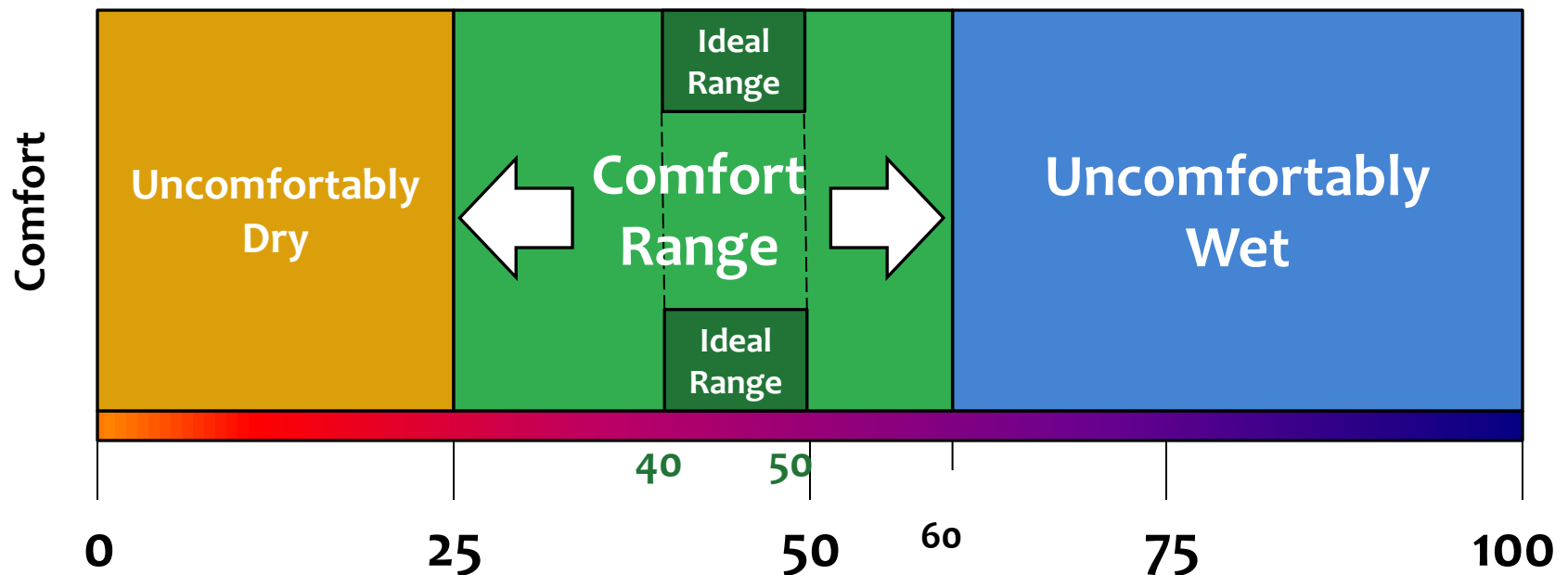
## Humidity

The amount of water vapor in the atmosphere, usually expressed as either absolute humidity or relative humidity

<sup>1</sup> Source: ASHRAE Standard 62-2001, Ventilation for Acceptable Indoor Air Quality

# Relative Humidity (RH) Percentage

- This chart illustrates the RH comfort level for 80% or more of the occupants in a space



# How warm do you feel?

- A person's comfort depends on the direct effect of temperature and humidity. If either are too high or too low they can have a significant effect on comfort level.

**HEAT INDEX TEMPERATURE**

T	125	123	141								
E	120	116	130	148							
M	115	111	120	135	151						
P	110	105	112	123	137	150					
E	100	105	113	123	135	149					
R	95	99	104	110	110	120	132	144			
A	90	85	87	90	93	96	100	106	113	122	
T	85	80	82	84	86	88	90	93	97	102	108
U	80	75	77	78	79	81	82	85	86	88	91
R	75	70	72	73	74	75	76	77	78	79	80
E	70	65	66	67	68	69	70	70	71	71	72
F	10	20	30	40	50	60	70	80	90	100	

**PERCENT RELATIVE HUMIDITY**

Source: National Oceanic & Atmospheric Administration

Typically humidity is too high in the summer and too low in the winter. The Heat Index (HI) or the "Apparent Temperature" is an accurate measure of how hot it really feels when the Relative Humidity (RH) is added to the actual air temperature.

# Humidity Control

- Humidity is a component of indoor air quality
  - Too much or too little moisture equals uncontrolled humidity in the space
- Uncontrolled humidity negatively affects people, buildings and equipment/supplies

# Humidity Control

- Uncontrolled humidity negatively impacts:
  - HVAC systems
  - Energy costs
  - Building structure and systems
  - Furnishings, equipment and supplies
  - Comfort of building occupants
  - Health of building occupants



# High Humidity Impacts

- Heating/Cooling costs
  - Systems work harder and longer to maintain desirable temperature, using more energy and increasing operating costs
- Integrity of building structure and systems
  - Condensation on metal structures contributes to oxidation and early failure
  - Condensation damages windows

# High Humidity Impacts

- Integrity of building structure and systems
  - Excess moisture contributes to growth of damaging mold and mildew
  - Damages furnishings, equipment and supplies
- Comfort of building occupants
  - Excess humidity in Summer makes you feel hot and cold and clammy in winter

# High Humidity Impacts

- Health of building occupants
  - High humidity contributes to growth of disease-causing microbes – bacteria, mold, fungi
  - Contributes to Sick Building Syndrome – aggravating allergies, asthma, etc.

# Low Humidity Impacts

- Integrity of building structure and systems
  - Static electricity impacts computers
  - Too little moisture can dry out wall coverings, floor and ceiling tiles, furniture
- Comfort of building occupants
  - Too little moisture makes occupants feel colder in winter

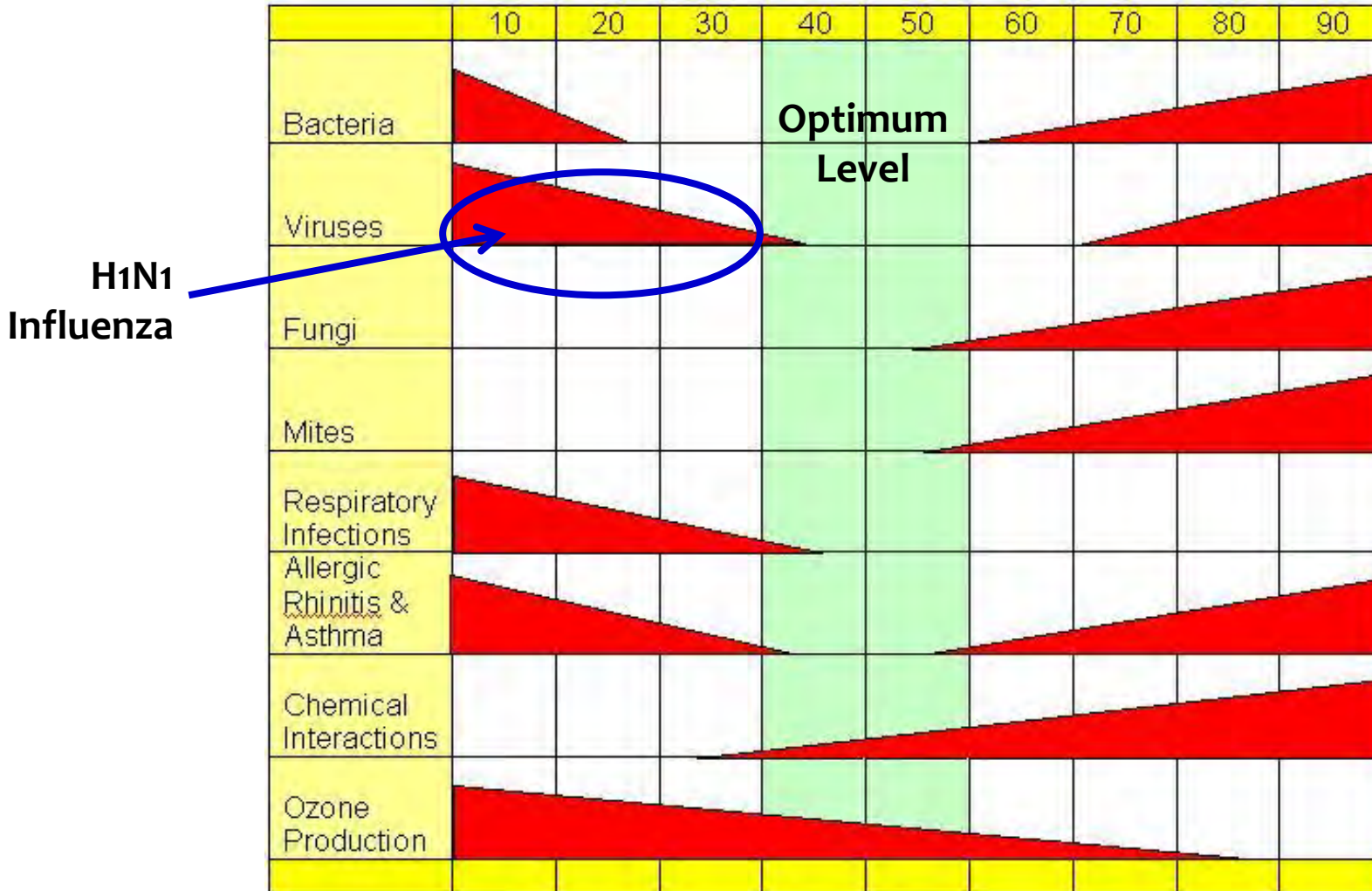
# Low Humidity Impacts

- Health of Building Occupants
  - Low humidity aggravates asthma, allergies and other respiratory-related illnesses
  - Impacts employee productivity and absenteeism
  - Winter dryness causes cracked lips, dry skin, and bloody noses

# Proper Humidity Impacts

- Comfort of building occupants
  - Proper humidity helps control unpleasant odors
  - Proper humidity levels help control growth of bacterial and mold and can reduce the spread of viruses such as influenza
  - People feel more comfortable at proper humidity levels
  - Save Energy required for cooling
  - Helps reduce/eliminate the need for sub-cooling & re-heating – reducing capital costs & energy use

# Health Impact of Uncontrolled Humidity



# Science and Engineering

Please note that the following several slides are meant to be an overview only. It is very difficult to explain and understand psychrometrics

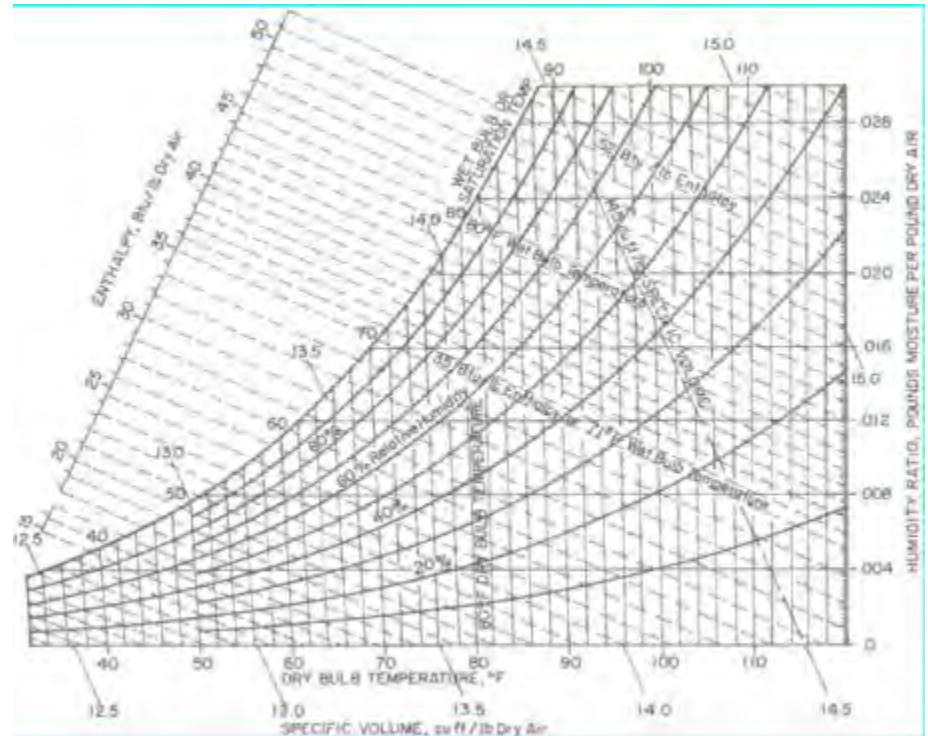
The main point is that too much or too little humidity is not good





# Psychrometric Charts

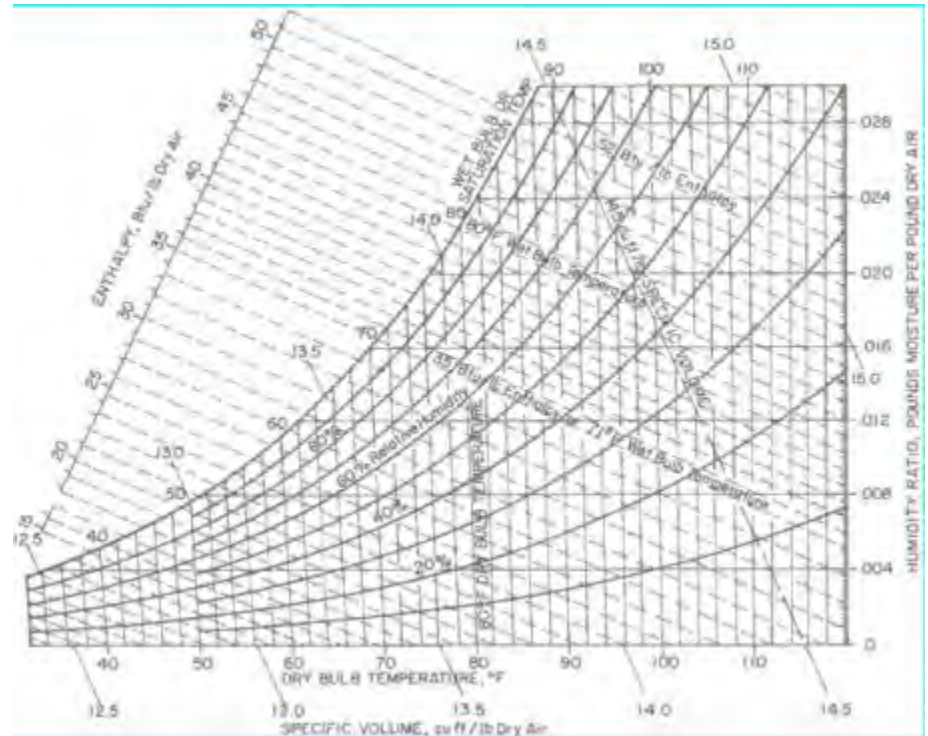
Understanding psychrometric charts helps with visualization of environmental control concepts such as why heated air can hold more moisture, and conversely, how allowing moist air to cool will result in condensation



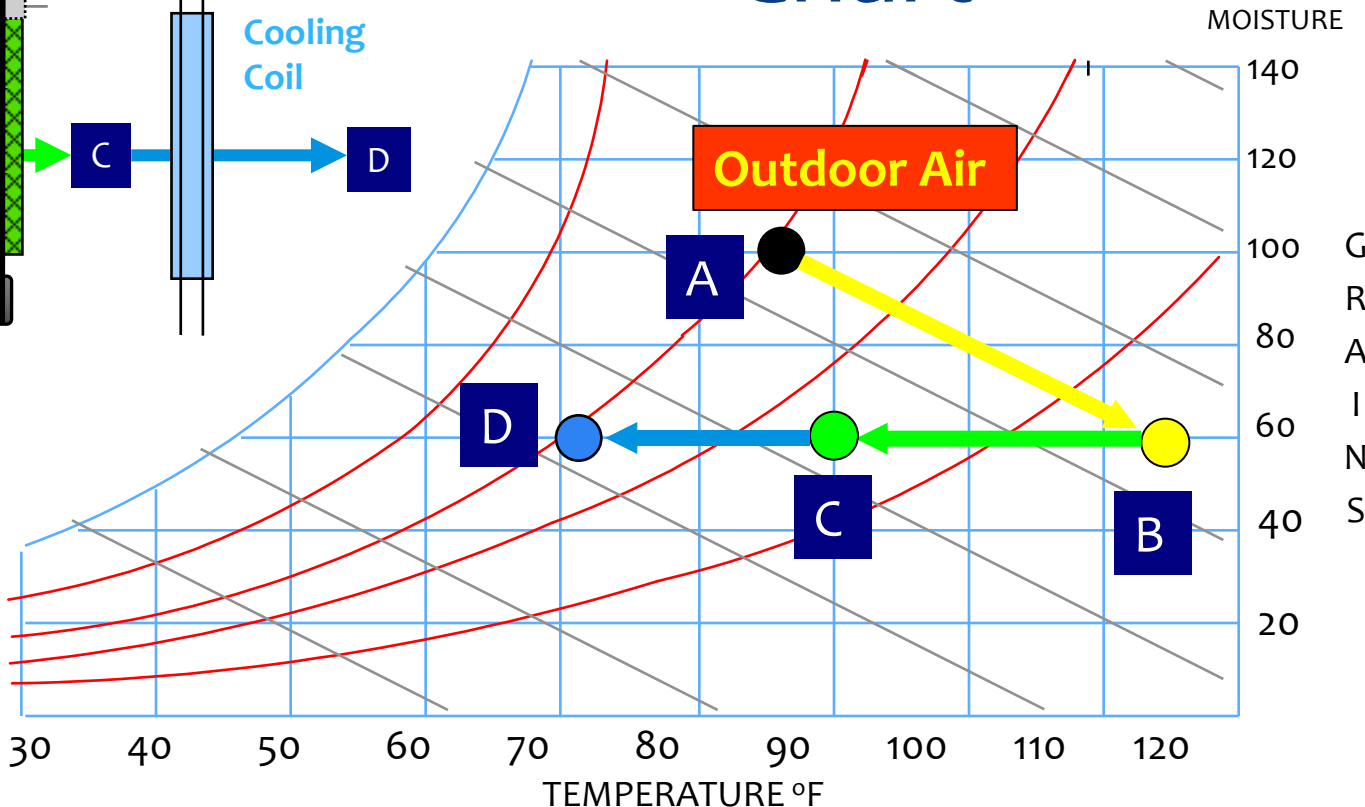
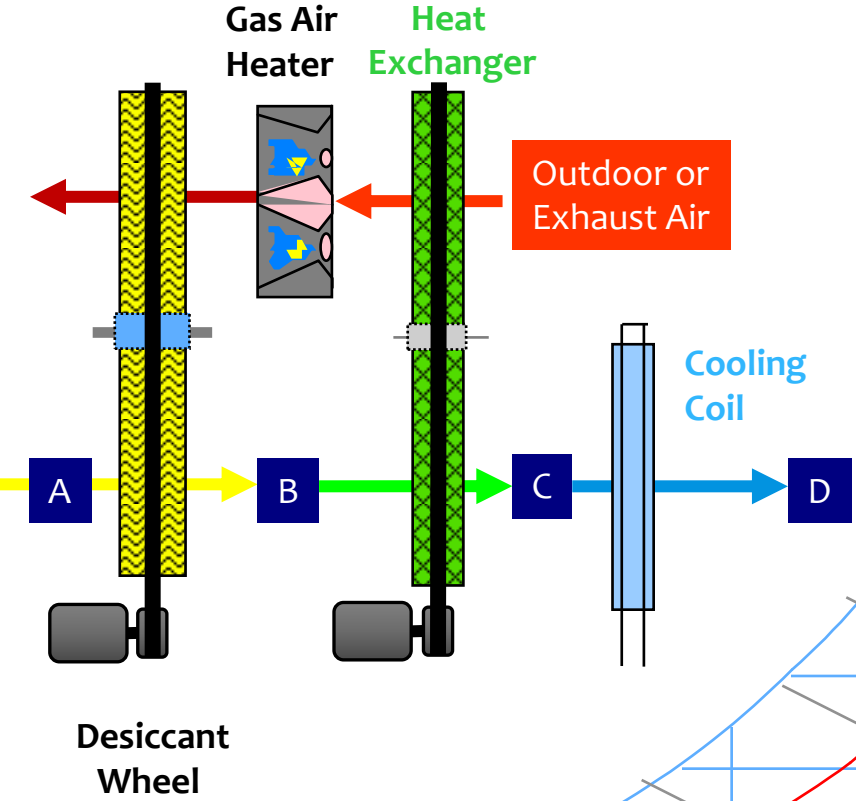
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# Psychrometric Charts

These charts also show the temperature that condensate will form for a given scenario



# How a Desiccant System Works on a Psychrometric Chart



# Measurement

- There are various devices used to measure and regulate humidity
- Humidity measurement uses a psychrometer or hygrometer
- A humidistat is used to regulate the humidity of a building
- These can be analogous to a thermometer and thermostat for temperature control

# Sling Psychrometer

- Incorporates two bulbs – one wet and one dry
  - This is a basic High School chemistry lab experiment
- After a short time, the water on the wet bulb evaporates and at that time, the temperature is measured of each bulb
- The delta between the temperatures is noted **and** the ambient temperature is noted
- Each is used on a chart to find the relative humidity of that temperature and the space

# Psychrometer Types



**Sling Psychrometer**



**Digital Psychrometer**

# Hygrometer



- An instrument used for measuring the moisture content in the environmental air or humidity
- Devices use temperature of condensation, or changes in electrical capacitance or resistance to measure humidity changes.

# Types of Hygrometers

- Metal Coil Type
  - Provides a dial indication of humidity changes
- Hair Tension
  - Uses a human or animal hair under tension
  - The length of the hair changes with humidity and the length change may be magnified by a mechanism and/or indicated on a dial or scale
- Electronic

continued



# Types of Hygrometers

- Electronic
  - Chilled mirror dew point hygrometers – use a chilled mirror and optoelectronic mechanism to detect condensation on the mirror
  - Capacitive humidity sensors, the effect of humidity on the dielectric constant of a polymer or metal oxide material is measured
  - Resistive humidity sensors, the change in electrical resistance of a material due to humidity is measured

continued

# Hygrometers



Metal Coil Type



Hair Tension Type



Chilled Mirror Type



Capacitive Humidity Sensor



Resistive Humidity Sensor

# Everyday Hygrometers



Typically \$5 to \$25 at your local department or hardware store

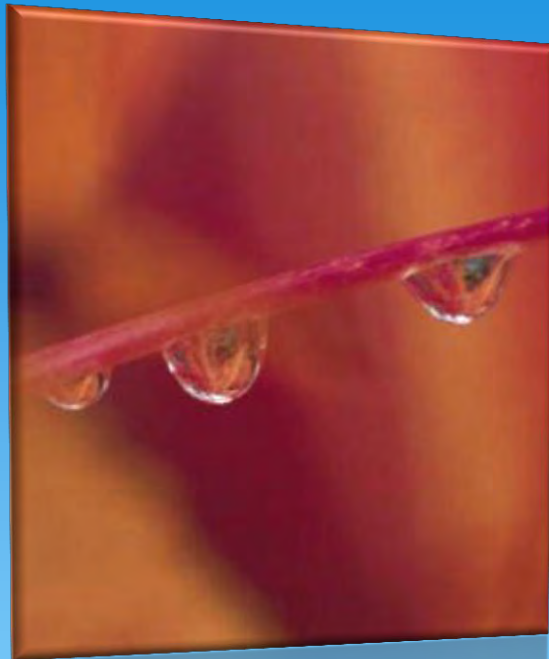
# A last bit of Engineering

- Latent Cooling
  - Cooling the moisture in the air which leads to condensation of moisture on the cooling coils
  - Gas-fired desiccants remove moisture before the cooling coils reducing the latent cooling load

continued

# A last bit of Engineering

- Sensible Cooling
  - Cooling the air itself to reasonable ambient temperature
  - Removal of moisture with desiccant means sensible cooling becomes primary load.
  - Overall reduction in total cooling load.



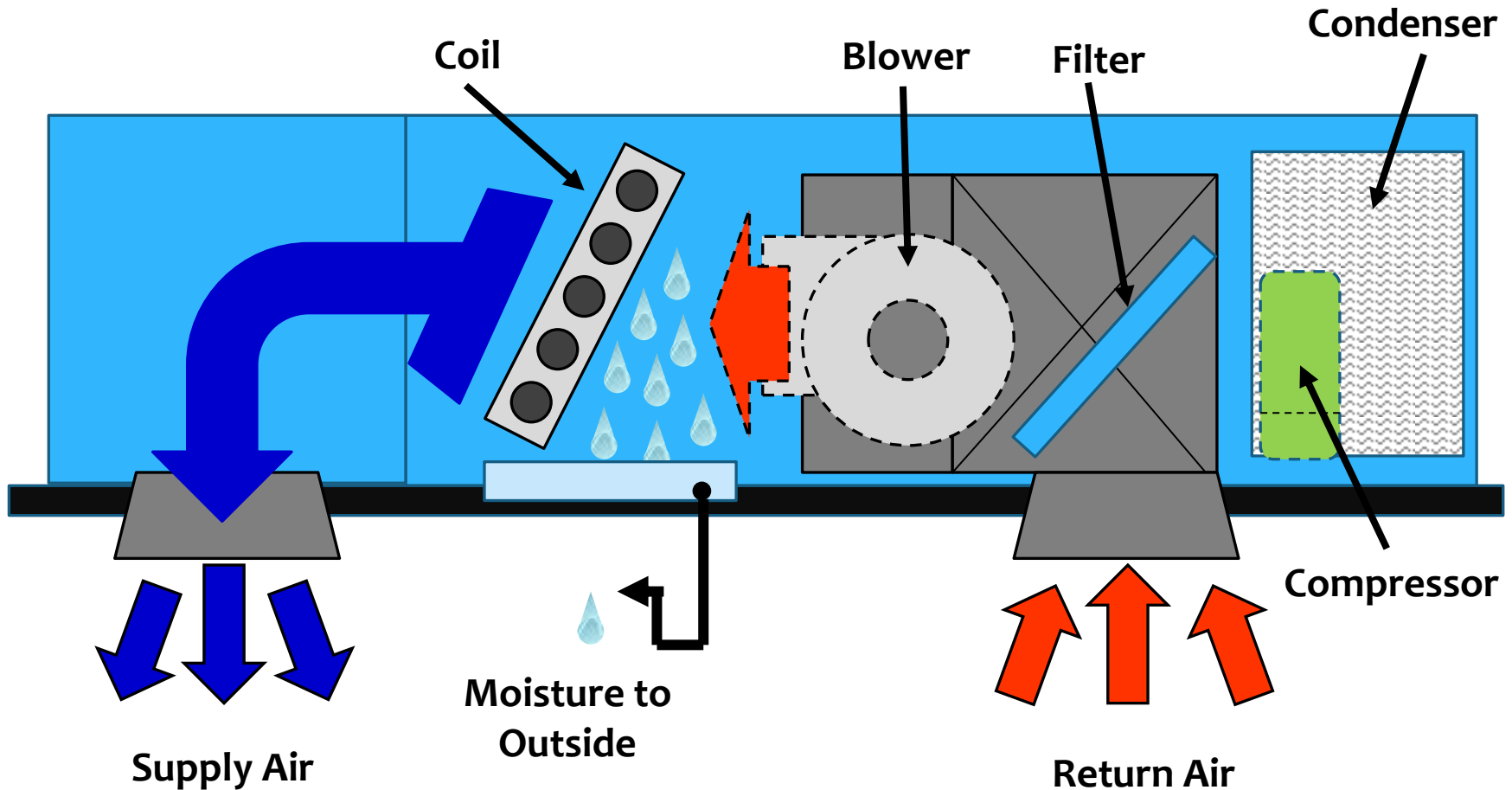
## Available Technologies

Conventional systems  
Dehumidification Equipment  
Humidification Equipment

# Components of Cooling

- Space cooling accomplished by maintaining both components of cooling:
  - Temperature (sensible cooling)
  - Humidity (latent cooling)
- With dry air, it is very easy to regulate temperature

# Drying Air with Conventional HVAC



Moisture in the air stream condenses out naturally as it comes in contact with the cooling coil. The air conditioner works harder and uses more energy, but does dehumidify while operating. Moisture areas are ideal breeding grounds for mold, bacteria, etc.



# Problem with using conventional air conditioning to dehumidify.

- In high humidity climates in the summer, the air conditioner needs to be set at a very low temperature to be able to remove enough humidity – often called ‘**Sub-Cooling**’
- Occupants do not like 50 Degree F air blowing on them or 60 Degree F space conditions, so the system has to ‘**Re-heat**’ the air to an acceptable level and this is done with electric resistance coils or hot water coils

continued

# Problem with using conventional air conditioning to dehumidify

- Sub-Cooling and Re-heating is not very energy efficient, but is a normal practice in commercial buildings.
- Conventional air conditioning
  - Attempts to cool (temperature) and remove moisture (humidity)
  - Compromise = loss of efficiency and/or diminished cooling comfort
  - Wet cooling coils = breeding ground for mold, mildew, etc.
- Gas Fire desiccant systems allow for the separation of de-humidification and cooling

# Desiccant Dehumidification Wheel Type (Dry)

- Natural Gas Desiccant Dehumidification
  - Desiccant dehumidification – assumes responsibility for humidity only
  - Sized from Residential through Industrial
  - Direct gas fired or hot water regeneration



300 cfm – 400 cfm

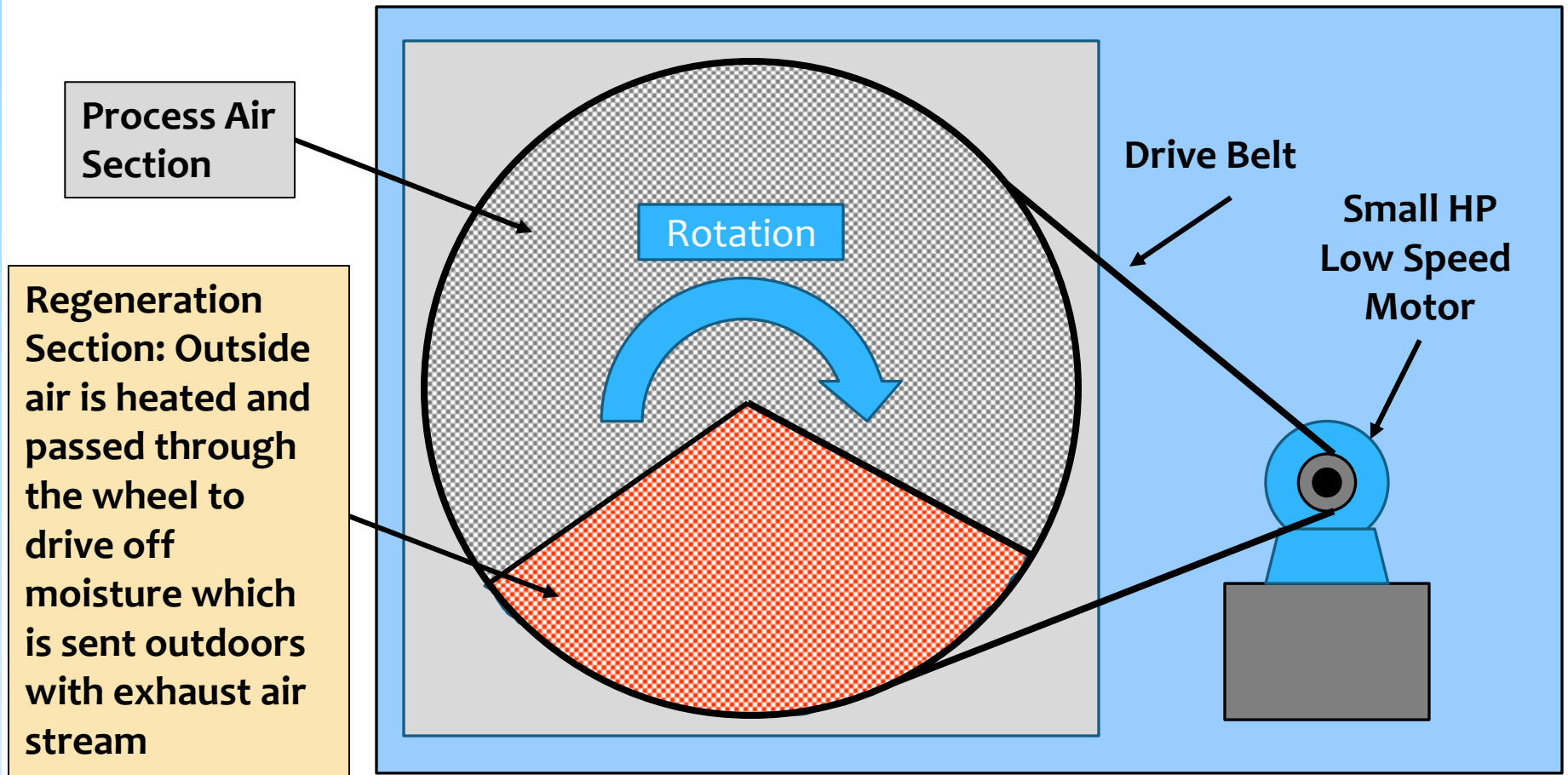


300 cfm – 120,000 cfm

# Basic Desiccant Wheel Process

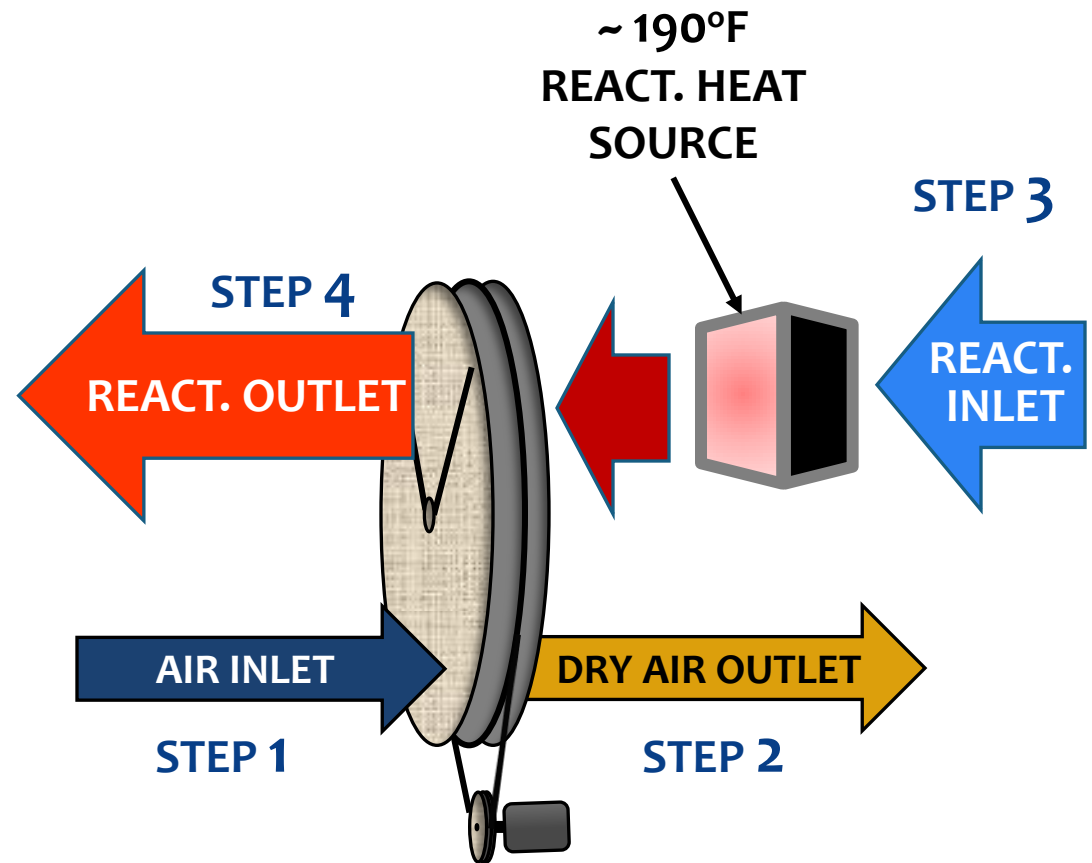
- Porous wheels are coated in a special humidity-absorbing material called a desiccant
  - Often Silica Gel is used as the desiccant
- When exposed to moist air the desiccant absorbs the moisture
- The humidity-saturated section of the wheel is then rotated to a position, where it is "recharged" to drive off the humidity, typically by heating it

# Wheel Technology



# Wheel Type – How It Works

1. Air to be dried
2. Dried air delivered to occupied space
3. Air flow to drive moisture off desiccant wheel
4. Hot, wet air to be exhausted



# Reactivation of Desiccant Wheel

- Heat for reactivation of the wheel is accomplished between 120-190°F
- Available sources
  - Natural gas heater
  - Hot water / steam
  - Electric element
  - Waste heat

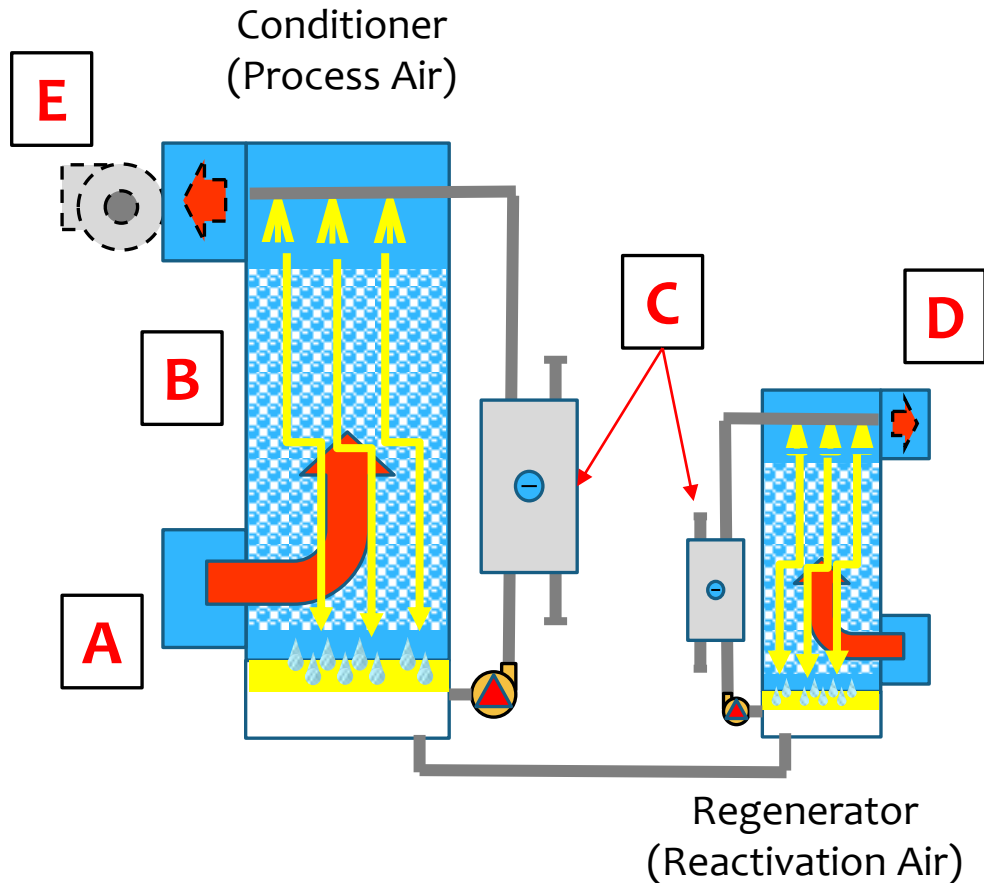
# Liquid Desiccants

- For larger Commercial and Industrial Applications
- Chemical adsorption process
- Size range
  - 1000 CFM to 84,000 CFM





# Liquid Type – How it Works



- A. Air In** – Air to be dried.
- B. Packing Blocks** - Liquid desiccant absorbs moisture
- C. Heat Exchanger** – Gas-fired burner heats the liquid to drive off absorbed moisture
- D. Hot Moist Air Out** – Hot, wet air from liquid exhausted outside
- E. Air Out** – Dried air out

**Produces dry cool air. (Large Commercial and Industrial applications)**

# Advantages of Natural Gas Desiccant Dehumidification

- Reduces growth of disease-causing microbes
- Controls odors, mold and mildew
- Eliminates condensation
- Increases comfort of building occupants
- Prevents damage to furnishings, carpeting, tiles, and other building materials

continued

# Advantages of Natural Gas Desiccant Dehumidification

- Saves energy for heating & cooling – don't have to cool as much in summer or heat as much in winter
- Reduces overall operating costs
- Reduces conventional cooling requirements – *smaller system(s) can be installed*
- Improves efficiency of chillers
- Ensures more precise temperature and humidity control

# Difference between Desiccant Wheels and Liquid Desiccant Systems



**Provides  
warm  
dry air**

**Residential  
through  
industrial sizes**



**Provides  
cool  
dry air**

**Typically large  
commercial and  
industrial sizes**

# Natural Gas Humidifiers

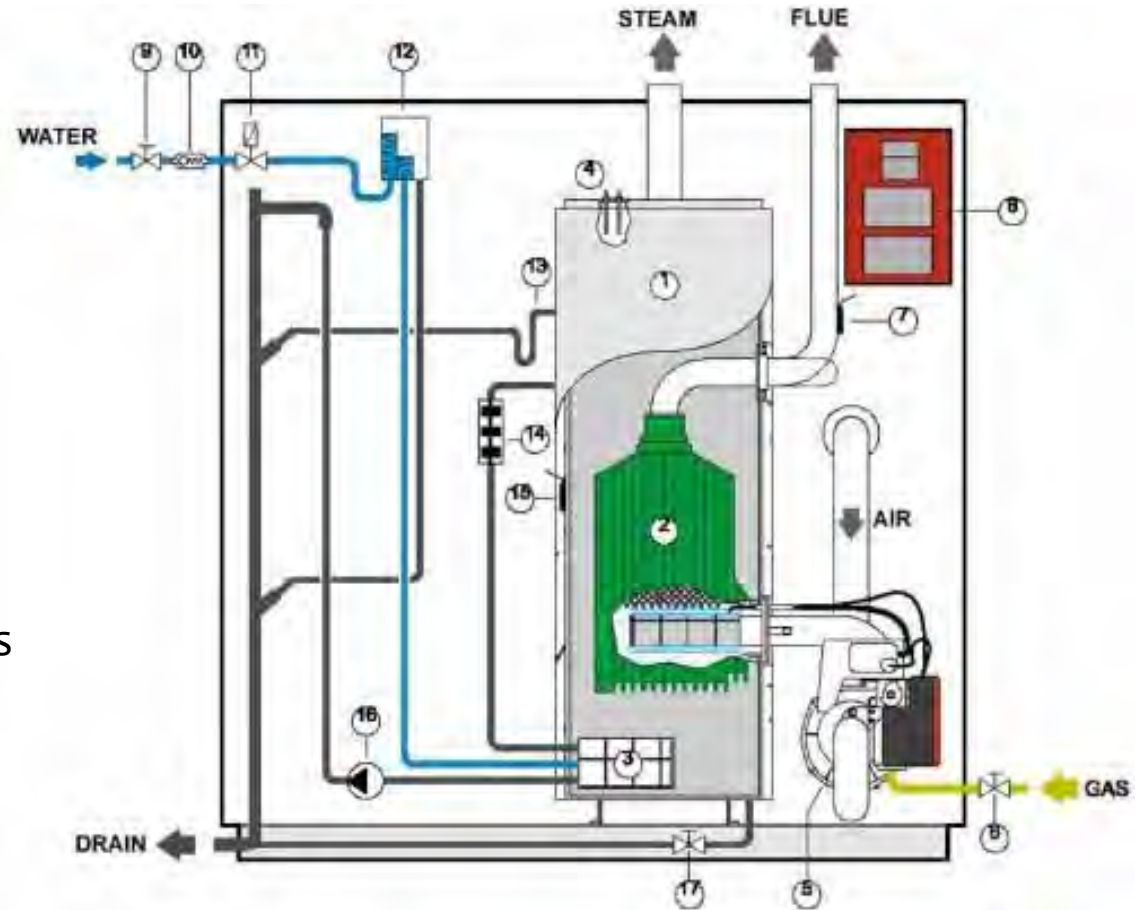
- Natural Gas Humidification
  - Natural gas humidifiers add moisture to dry air
  - Natural gas burners boil water to steam and deliver humidity via air handler or blower
  - Minimizes steam pressure
  - Eliminates boiler chemicals
  - Can be used in conjunction with existing boiler

**Gas Humidifiers are designed to handle scale build up with daily cleaning and purge cycles.**



# Steam Humidifier

1. Stainless steel boiler
2. Aluminum heat exchanger
3. Clean-out cover
4. High level foam probes
5. Forced draft gas burner
6. Gas inlet
7. Flue temperature sensor
8. HumiControl
9. 10. 11. Water inlet assembly
12. Fill cup - conductivity probes
13. Boiler overflows
14. Triple float level control
15. Boiler temperature sensor
16. Drain pump



# Humidification – How It Works

- Humidifier generates steam
- Gas burner fires into heat exchanger
- Heat exchanger submerged in tank of water
- Water heated to steam which is distributed via air handling system or remote blower



Remote  
Blower  
System



Steam Distributor Pipe

# Advantages of Humidification

- Ensures more precise temperature and humidity control
- Reduces incidence of asthma, allergy and related respiratory illnesses brought on by dry air
- Contributes to health and comfort of building occupants
- Reduces employee absenteeism due to illness and increases employee productivity
  - Reduce spread of viruses

continued



# Advantages of Humidification

- Protects expensive equipment, furnishings and supplies
- Eliminates static electricity
- Reduces energy costs
- Cost-effective alternative where no boiler exists

# Manufacturers

- Numerous manufacturers exist for each humidity control technology
- Listed on the following slides are some of the major manufactures by technology type

# Dry Wheel Desiccant Systems

- Bry-Air – [www.bry-air.com](http://www.bry-air.com)
- Concepts and Designs – [www.cdihvac.com](http://www.cdihvac.com)
- Munters – [www.munters.com](http://www.munters.com)
- Novelaire – [www.novelaire.com](http://www.novelaire.com)
- Seasons4 – [www.seasons4.net](http://www.seasons4.net)
- SEMCO – [www.semcohvac.com](http://www.semcohvac.com)
- Stultz-ATS – [www.stultz-ats.com](http://www.stultz-ats.com)



# Liquid Desiccant Systems

- Advantix Systems – [www.advantixsystems.com](http://www.advantixsystems.com)
- AIL Research Inc. – [www.air.com](http://www.air.com)
- Kathabar Dehumidification Systems (KDS) - a Division of Niagara Blower – [www.kathabar.com](http://www.kathabar.com)



# Humidifiers

- Armstrong – [www.armstronginternational.com](http://www.armstronginternational.com)
- Dri-Steem – [www.dristeem.com](http://www.dristeem.com)
- Carel USA – [www.carelusa.com](http://www.carelusa.com)
- Nortec – [www.humidity.com](http://www.humidity.com)
- Pure Humidifier – [www.purehumidifier.com](http://www.purehumidifier.com)



# Other Resource

## [www.gasairconditioning.com](http://www.gasairconditioning.com)

### Gas-Fired Air Conditioning Equipment

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### Desiccant Dehumidification – Wringing Excess Moisture Out of Indoor Air



Maintaining cooler temperatures, whether for comfort, cold storage, quality control of manufacturing processes or other cooling needs, is accomplished by regulating both the temperature (sensible cooling) and the humidity (latent cooling) of the indoor air.

A desiccant dehumidification system assumes responsibility for the humidity component of cooling—usually at least 30% of the total cooling load—allowing the cooling unit to be set for optimal temperature control and enabling the use of a smaller compressor and eliminating excess chiller capacity.

# CenterPoint Energy contacts:

**MN:** Business customers: 612-321-4330 (800-234-5800, ext. 4330)  
Trade Allies: David Poretti 612-321-4386

**AK:** Lance Orton 501-377-4548

**OK:** Robin Slater 580-250-5426

**TX:** Calvin Roberts 713-207-8452

**MS and LA:** Jim Tilley 318-429-4257

Questions ?

