ENVIRONMENTAL MANAGEMENT QUICK REFERENCE

Temperature (T)

A measure of heat energy expressed in degrees Fahrenheit (F) or Celsius (C). Temperature levels, in combination with RH, govern the rate of chemical decay.

Sustained high temperatures increase the rate of chemical reactions and determine how fast organic materials will decay. In damp conditions, high temperatures can lead to increased biological activity (insects, mold growth).

Vulnerable: For dyes, acetate, nitrate, magnetic media, film, and other plastics 54°F/12°C is high, for leather, rubber, paper and other susceptible materials, 68°F/20°C is high.

Signs of Damage: Shrinkage, sagging, melting, stickiness, fading, embrittlement, and adhesive failure.

Cool temperatures (below 54°F/12°C) slow the rate of chemical decay. Lowering the temperature can improve preservation IF you also maintain a moderate RH (30-50%).

Recommended: Cold temperatures (40°F/4°C) are beneficial for film and photographic collections.

Vulnerable: Polymers found in modern paints and coatings, as well as rubber and plastic objects can be adversely affected by the cold.

Fluctuations: Maintenance of a steady temperature year round is less important than managing high and low temperature extremes. Wide fluctuations in temperature may cause fractures and delamination in vulnerable materials.

Vulnerable: Furniture, ivory, oil paintings, and other composite objects.

Adjusting to Changes in Temperature

Responses to changes in temperature (thermal equilibration) occur relatively quickly—most materials adjust to a change in temperature in a matter of hours. The time needed to adjust is influenced by the amount of exposed surface area and the objects thermal mass.

Relative Humidity (RH)

Represents how saturated the air is with water vapor and determines the amount of water contained within collection materials. RH levels, in combination with temperature, play a significant role in the rate of mechanical decay and the risk of mold growth for susceptible collection materials.

Vulnerable: Hygroscopic organic and some inorganic materials (which absorb and release water depending on the RH of the surrounding air) including paper, parchment, textiles, leather, ivory, and wood.

High RH (generally over 65%) can result in mechanical damage as objects change in response to high levels of moisture. The risk of mold growth increases at 65% RH and above.

Signs of Damage: Warped wood and ivory, buckled paper, softened adhesives, metal corrosion, dye bleed, and an increase in biological activity including mold growth.

Low RH (generally below 25%) can result in mechanical damage as materials react to a loss of moisture.

Signs of Damage: Shrinkage, warping, buckling, embrittlement, cracking, delamination, and loosening of joints.

Fluctuations: Avoiding prolonged periods of high and low RH is more important than maintaining a steady RH year round. Wide and sustained fluctuations in RH increase the rate of mechanical decay as objects absorb and release moisture.

Vulnerable: Composite objects such as furniture and paintings are at risk due to various materials shrinking and swelling at different rates.

Adjusting to Changes in Relative Humidity

Responses to changes in RH (moisture equilibration) occur relatively slowly—most materials adjust to a change in RH in a matter of days or weeks. Variables that determine the time it takes an object to equilibrate include its size, amount of surface exposure, enclosure, and temperature.

Dew Point (DP)

A measure of the absolute amount of water in the air, determines what combinations of T and RH are possible in the storage environment. Change any of these variables and you will have a different environment.

At a constant T, the RH and DP will increase or decrease together.

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At a constant DP, as the T increases, the RH decreases / as the T decreases, the RH increases.

Without humidification (the addition of moisture) or dehumidification (the removal of moisture), the indoor DP is the same as the outdoor DP.

Visit IPI's Dew Point Calculator at:

www.dpcalc.org

Risk Management

Periods of sustained high or low temperature, or of high or low RH have a much more significant impact on material preservation than sudden, temporary spikes or short term fluctuations.

Reduce Mold Risk: Keep excursions above 65% RH to a few days or less, keep summertime dew points as low as possible.

Reduce Chemical Decay: Make it as cool as possible while maintaining RH below 65%, keep summer dew points as low as possible.

Reduce Mechanical Damage: Keep excursions below 20% or above 65% RH short and infrequent, keep winter dew points from being too low and summer dew points from being too high.

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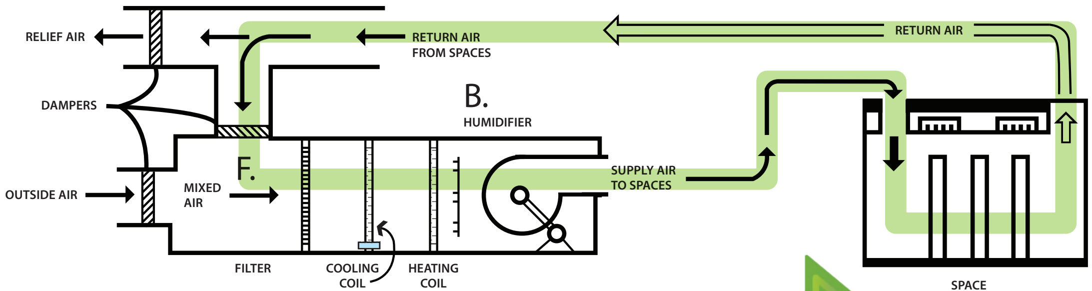
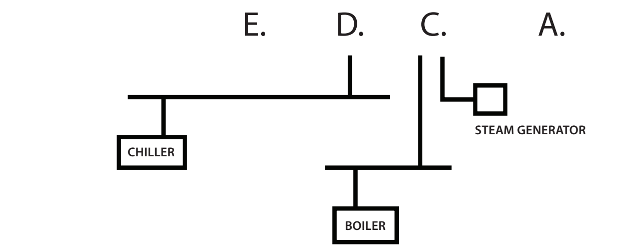
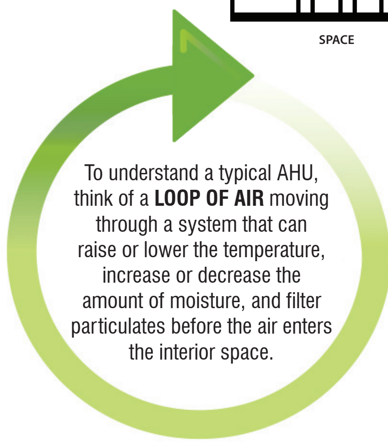
MECHANICAL SYSTEM QUICK REFERENCE

Components of a Typical Air Handling Unit (AHU)







A. **Air Handling Fans** move the loop of air to the spaces through supply air ducts and draws it back in through the return air path. Fans may operate at a constant speed or use variable speed drives that adjust the speed at which the volume of air is exchanged.

B. **Humidifier** injects water vapor into the supply air, usually as steam which is produced by a peripheral ***Steam Generator***, if a sensor in the return air stream detects that the space RH is too low.

C. **Heating Coils** are controlled by a thermostat. The stream of air is warmed as it passes over a heating coil before entering the space. A peripheral ***Boiler*** produces hot water or steam which allows the selected temperature to be achieved. Convectors or radiators may also be used to supply heat.

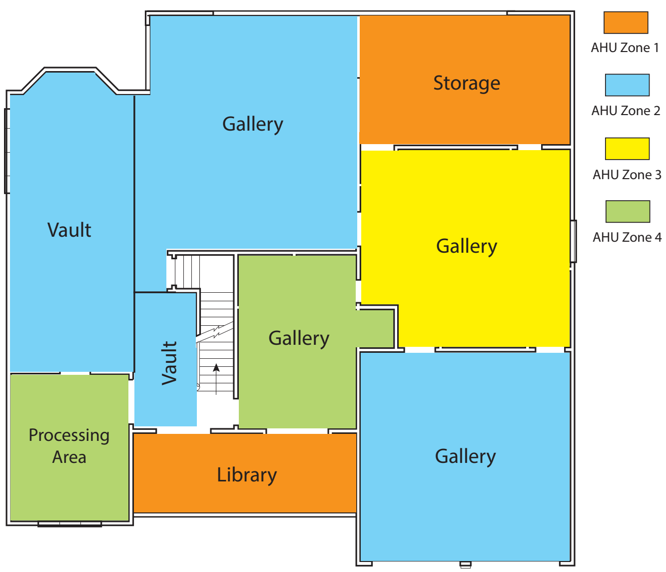
D. **Cooling Coils** – If a sensor in the space detects that the space is too warm, the stream of air passes through a cold coil before being supplied to the space. The coil is cooled by a flow of cold water supplied by a peripheral ***Chiller*** or by the evaporation of a refrigerant provided by a remote compressor/condenser (DX) unit.

E. **Air Filters** remove particulates as all air delivered to spaces passes through one or more filters. Additional filters may be added to remove gaseous components.

F. **Mixed Air** – A portion of the ***Return Air*** from the space is ducted outside through a ***Relief Air Damper*** to make room for the introduction of fresh air through the ***Outside Air Damper***. The outside air is blended with the bulk of the return air in the ***Mixed Air*** chamber.

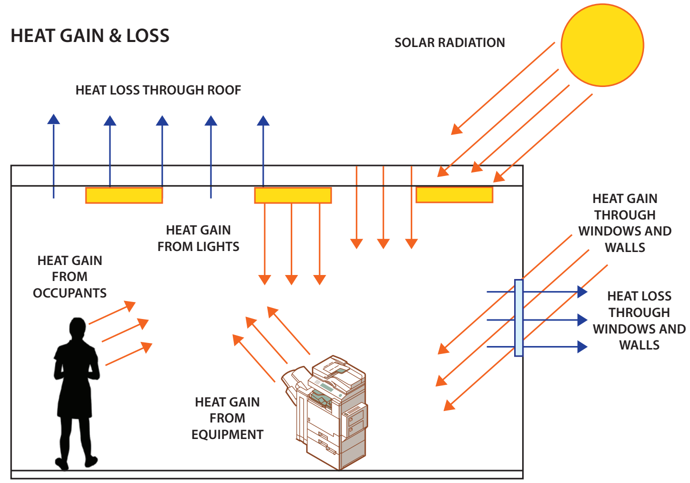
Zone Maps

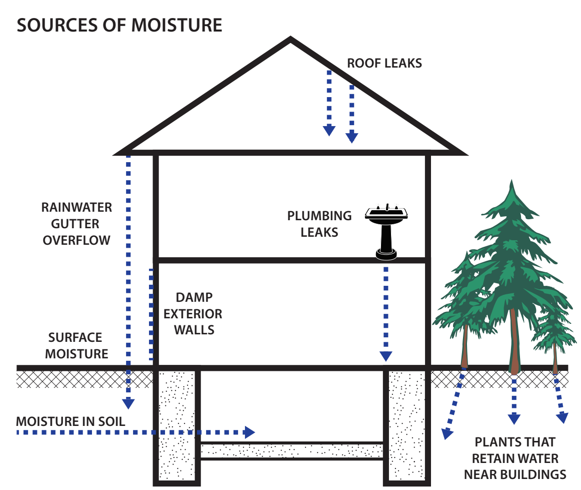
Buildings often have multiple HVAC systems and these systems commonly serve multiple spaces. It is important to document each storage area's HVAC system and all the spaces it serves.



Sources of Heat and Moisture

The building envelope, both above and below grade, plays a role in determining the amount of thermal (heat) or moisture gain or loss that the mechanical system has to deal with.





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