ENERGY-SAVING STRATEGIES: SEASONAL SET POINTS

Goal: To use appropriate seasonal temperature and relative humidity settings to improve the preservation environment and reduce energy impacts.

Advantages	Disadvantages
Often simple mechanical control	Potential to forget to reset equipment to next seasonal operation
Potential to seasonally improve environmental conditions for collection	Seasonal decreases in temperature may increase human comfort complaints
Cumulative energy savings over the seasons	Potential for significant fluctuation in poorly insulated buildings

Description of Potential

Many institutions utilize set point changes as a way to create the most efficient and beneficial preservation environment on a seasonal basis. AHU zones that have traditionally maintained constant set point conditions throughout the year may be missing opportunities to both reduce energy consumption and improve preservation conditions. Research has helped define safe ranges of RH for many collection materials; that data, combined with the knowledge that cooler temperatures slow the rate of chemical decay for organic materials can allow institutions in seasonal climates to take better advantage of natural outdoor weather conditions.

Seasonal set point controls typically work in two ways. Space RH set points in hot and humid seasons may be adjusted slightly higher – to 55-60% RH maximum depending on the collection needs and risks – to reduce energy consumption on dehumidification with minimal impact on the overall preservation risk. In climates with seasonally cool and dry outdoor conditions, interior temperature set points are lowered, reducing energy consumption for heating and humidifying (lower temperatures typically help keep the RH higher), and sometimes significantly improving preservation quality. These lower set points are usually instituted in the middle or end of the fall season and then raised to summer set points in early to mid spring (in the case of a mid-Atlantic environment).

The intention of the set point change is primarily to improve the preservation environment; energy savings are an additional benefit and may not be as immediately pronounced as with other strategies. When utilizing set point changes during both hot and cool seasons, summer set points may result in slightly higher rates of chemical decay, but these are typically offset by using corresponding winter set point changes to improve chemical decay rates. The end result is often a similar to slightly increased overall preservation quality maintained at lower energy costs due to more appropriate energy allocation. Institutions may also choose to apply any winter energy savings achieved to their summer operation, and work to improve summer dehumidification and preservation quality.

Lowering interior temperatures during cooler months does not mean increasing the amount of outside air. The use of more outside air could result in a lower temperature than normal at the heating coil, causing the coil to use more energy to reach the set point condition. Another potential side effect of too much outside air in the winter is a lower than normal dew point temperature, which may cause humidifiers on the system to operate more frequently. If there is no humidification, the low dew point could result in dangerously low relative humidity levels for the collection.

For winter set point adjustment, the intention is to use less heating on the supply air to produce a cooler temperature. In this scenario the return air is brought back into the system slightly cooler than the supply air due to presumed heat loss from the space. This air combines with minimal outside air and the condition of this mixed air is likely slightly cooler than the return air. When this mixed air reaches the heating coil, the air is heated to the new supply air temperature seasonal set point. The lower the desired space temperature the less work the heating coil needs to perform to achieve it. Note that this strategy may not work for zones that are completely interior to a building, with no exterior exposure or heat loss.

Using set point changes in occupied spaces can be tricky. People become accustomed to warm space temperatures and tend to notice temperature drops of even a few degrees. Some occupants are satisfied in warm spaces around 70°F and others can be comfortable in temperatures as low as 65°F. If the team is proposing experimentation in occupied spaces, work closely with staff in the zone to determine appropriate tests and compromises between human comfort, preservation goals, and energy benefits.

Requirements

- Automated control of mechanical system is preferable
- Ability to program system operation
- Knowledge of temperature and RH limits of vulnerable collection materials
- Data logging within the mechanical system (if you want to quantify energy savings)
- Data logging in the collection space (to monitor the storage environment for improvement in conditions or any potential risk)

Critical Data Points

- Preservation
    - Space data from each space affected by the system during seasonal changes
    - Identification and monitoring of potential microclimate areas that may fluctuate differently than the rest of the space (especially near doors, windows, or anywhere that outside air may infiltrate)
- Energy
    - Data from each location in the system where a component can mechanically work on the air:
        - Return air
        - Mixed air
        - Pre-heated air
        - Cooled air

- Heated/supply air
- Fan amps
- Downstream reheats
- Others (as needed)

Pre-Testing

- Use Dew Point Calculator to evaluate the temperature and relative humidity conditions you intend to use
    - Analyze dew point graphs for the selected space over time in eClimateNotebook to determine the expected dew point. Use this dew point with the selected temperature to find the potential relative humidity for the space.
- Verify the date when the system typically switches from cooling to heating mode with your facilities representative
- Consider space occupancy and determine whether two different set points need to be used (one temperature for operating hours and a lower temperature for after work hours)

System Notes

1. Be sure to set start and end dates for the seasonal changes. Data in eClimateNotebook (www.eClimateNotebook.com) can be used to identify the seasonal swing points.
2. Verify the type of system that serves your space. If the AHU operates as a subcool/reheat arrangement, be careful of the misconception that turning the temperature up in the summertime in a space means you are using less energy. With sub-cool and reheat systems, turning the heat up in the summer will use more energy.

Selection Criteria/Variables That Impact Potential

- Outdoor Climate
    - Take advantage of cooler outside temperatures by employing passive methods to let the space temperature drop naturally
    - Consider relaxing RH set points to safe upper limits (55-60% RH for many collections) during dehumidification operation to allow for reduced dehumidification, or cooler temperature set points to reduce the rate of chemical decay
- Building Envelope
    - Infiltration of outside air near doors, windows, open plenum returns, stairwells, etc. may produce microclimates causing the temperature in some areas to drop lower than desired and could impact relative humidity levels.

- Occupancy
    - Comfort complaints may result from any set point change
        - Complaints to facility managers may result in set point adjustments
        - Test results may be skewed if facility mangers or staff members alter space temperatures due to comfort complaints
- Space Load
    - Ensure that staff are not using independent space heaters that may provide false readings or add extra heat to the space
- Power
    - Verify that in the event of a power outage the set points will return to the desired seasonal settings and not revert to the original space set points

PREPARATION

- Complete documentation, data gathering, and analysis steps for the system/spaces in question
- Use the selection criteria above to review whether the system/space is a good candidate for seasonal set points
- Confirm that appropriate data gathering capabilities are deployed, determine who will pull and check data, and how often. The frequency of data pulls and analysis is up to the institution and is based on staff scheduling and the level of risk management desired for a particular collection space. Common approaches include:
    - A daily walk-through of the space to be sure that set points are being held
    - Weekly data pulls from loggers to analyze data
- Determine test parameters
    - Occupied space seasonal set point changes
        - Occupied spaces are limited in the amount they can be cooled due to use. Set points should be selected that consider human comfort as well as collection risks.
        - Spaces that are accessed often but not staffed can use cooler temperatures, however the comfort of the individuals that may access the space should be considered. Coats or sweaters may be provided for those who need to work in the collection.
    - Unoccupied space seasonal set point changes
        - Unoccupied spaces benefit from the ability to lower the temperature significantly compared to occupied spaces. When evaluating unoccupied spaces the most significant factors may be the relative humidity level or the frequency of use.
    - Be sure that the temperature you are using produces a safe relative humidity

- Length of seasonal set point test
    - Set a start and end date for the test period.
        - Seasonal set points are usually introduced in mid to late fall and the summer set points are reinstated in early to mid spring.
    - Typically an initial test should be allowed to run for two weeks. Environments can respond differently based on outdoor weather conditions and two weeks is a reasonable compromise between gathering a representative sample set for a season and limiting any long-term risk.
- Communicate the set point changes to collections and facilities staff responsible for managing the areas involved.
    - Discuss the potential impact on human comfort in the space
        - If the set point changes will occur in occupied spaces be sure all staff are aware of the changes and that they can plan accordingly
        - Be sure staff do not use alternative methods of heating during the testing period
        - Set up a communication structure during the test period for any environmental complaints or work-orders associated with comfort or temperature complaints
    - Finalize a start and end date for the test period and make sure they with departmental needs

ON TEST START DATE

- Facilities staff should physically confirm that the system has switched over to the seasonal set points
- Facilities staff should notify team members that the testing has begun
- Collections staff should notify other staff members that testing has begun

DURING THE TEST PERIOD

- Facilities staff should be sure to forward any comfort complaint calls to the facilities team representative
- Collections staff should conduct daily walk-throughs of test space and check space dataloggers for deviation from the desired temperature and relative humidity
- Follow schedule for data retrieval from space and mechanical systems
- Facilities staff should conduct regular checks of BMS for alterations in system operation
- First data retrieval as per test schedule
    - Look for evidence of set point change in data from both the space and mechanical system dataloggers
        - If seasonal set points do not appear to be employed, work with facilities staff and/or controls technicians to find and resolve the problem

        - Evaluate results of test set points
- If the results of the initial test are acceptable, continue the seasonal set points protocol until the end date

AT THE END OF THE TEST PERIOD

- Conduct a final walk-through of systems and spaces
- Retrieve and upload data from space and mechanical system dataloggers
- Conduct final analysis of the test data as a team
- Meet with collections and facilities staff that manage the area to discuss any observations on their part during the test period and communicate the results of the final data analysis to them
- Results of analysis will determine the next step:
    - If test results were favorable
        - Continue using the conditions through the season
    - If test results were not favorable
        - Consider altering the test in some manner (raising/lowering the desired temperature) to achieve more acceptable results
- If testing of all strategies for that AHU is complete, remove mechanical system dataloggers and reset them to be used in experimentation for other systems
- Compile, quantify, and report test results to appropriate administrative staff

Once a team has determined a seasonal set point procedure, settled on a schedule to follow, and the set points to use, the process enters the implementation/maintenance phase. At this point, the team should be satisfied that they have tested the potential variants of temperature and relative humidity set points allowable, and have chosen the best operation for the needs of both preservation and energy savings.

Implementation/Maintenance

- If the team has determined that using seasonal set points is desirable be sure to have solid start and end dates for the use of seasonal set points that are agreed upon before implementation
- If possible, add set points to the schedule for the AHU, both in programming and in any written documentation
- Be sure to add the set point changes to the facility calendar and the collections calendar as a reminder to verify the implementation of winter set points and return to summer set points

Evaluating Test Results

SPACE DATA

- Look for variations that correspond to the seasons.
    - Temperatures in spaces should be lower during the time of year when it is cooler outside than when it is warmer outside. Having a few anomalous days should not be an issue, but the set points should correspond closely with outside conditions to maximize effectiveness.
    - Temperature set points should be appropriate so that do not result in relative humidity issues (i.e. the temperature in the summer may have to be higher than in the winter to keep the relative humidity artificially low).

MECHANICAL SYSTEM DATA

- Use the supply air dataloggers to see that the spaces are receiving the desired conditions.
- In a sub-cool/reheat system, the heated air and humidified air dataloggers should be doing less work than previously during the winter.

REMINDERS FOR MAXIMIZING EFFECTIVENESS

Be sure to fully inform staff:

- Not to adjust the temperature due to comfort issues in occupied spaces
- To dress for lower temperatures in unoccupied spaces