Nashoba Regional Schools
Florence Sawyer School
Bolton, MA

2020

HVAC System Evaluation

Prepared For:

Nashoba Regional School District
50 Mechanic Street
Bolton, MA 01749

Prepared By:

BLW Engineers, Inc.
311 Great Road
Post Office Box 1551
Littleton, MA 01460

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EXECUTIVE SUMMARY

General

The Nashoba Regional School District engaged BLW Engineers to evaluate the HVAC systems serving these buildings relative to their current operating conditions, re-opening of the building to the public and potential considerations related to Covid-19.

While at the site, BLW Engineers met with the facilities operator who reported the HVAC systems receives regular preventative maintenance which includes filter replacement, grease motors and bearings, replace fan belts and verify damper and valve operation.

The Florence Sawyer Elementary School is located at 100 Mechanic Street in Bolton. The school comprises approximately 139,000 square feet of educational space with enrollment of approximately 720 students. The building was originally constructed in 1997, with most of the HVAC systems and equipment having been installed at that time.

Florence Sawyer Elementary School Planned Reopening

The Nashoba Regional School District plans on the following school re-opening for the Florence Sawyer Elementary School:

- School is to be occupied by students and teachers in the hybrid model with 50% occupation Monday/Tuesday; Wednesday disinfection/cleaning; 50% occupation Thursday/Friday; Saturday disinfection/cleaning.
- Classrooms seating will be reorganized to provide recommended social distancing.
- Cafeteria will not be used in normal fashion; students will eat lunches at their desk.
- Gym will not be used in normal fashion.
- Library and Auditorium will not be used in normal fashion; they will be used primarily as classroom space.

Recommendations

Based on applicable guidelines (ASHRAE, State of Massachusetts Re-opening Guidelines, Massachusetts Teachers Association, etc.), the Florence Sawyer Elementary School is safe to occupy and should consider the following best practice operation of the current HVAC system in an effort to provide an environment to best protect the occupants and visitors to the building during the pandemic:

Tier 1 Recommendations: Tier 1 recommendations are immediate revisions to system operation prior to start of classroom and until the start of the heating season.

1. Create an "Epidemic Mode" Building Management System sequence of operation that can be turned on, shut down or override, if needed, by manual selection of the operator.
2. Replace the unit filters with the best filters available that will not impact the heating capacity of the units and develop a filter replacement plan; the existing rooftop units and air handling units will not be able to accommodate MERV13 filters without significantly impacting system operation, outdoor air delivery to the space and equipment component failures.

3. Filter upgrades will require more frequent changes due to pressure drop of filter and particulates that “dirty” the filters.
4. Continued operation of heating and cooling systems is recommended.
5. Operate toilet exhaust fans 24 hours a day, 7 days a week.; other fans shall operate two hours prior and two hours post occupied hours.
6. Monitor Carbon Dioxide (CO2) levels in occupied areas of the building.
7. Should building exhaust exit building through sidewall louvers subject to pedestrian traffic, provide warning signs and consider diverting or rearranging the exhaust air discharge locations so that they would pose no opportunity to cause harm.
8. Operate the building in occupied mode with mechanical ventilation prior and two hours post occupied hours; where mechanical ventilation and exhaust are not currently provided, utilize operable windows.
9. Operate the building in the occupied mode during disinfection and cleaning operations.
10. Operate building air handling equipment with highest percentage of outdoor air possible without adversely affecting the occupied environment; outdoor air percentage will be dependent on outdoor air temperature and allowable indoor air temperatures above/below normal operation.
11. Operate Classroom unit ventilators with ventilation as originally designed. Based on reduced classroom sizes, the classroom current system can provide more than 25 CFM/occupant which exceeds current code requirements (10 CFM per occupant plus 0.12 CFM/SF) and can be supplemented by operable windows.
12. Operate Classroom heating/ventilating unit (HV-1) with ventilation as originally designed. Based on reduced classroom sizes, the classroom current system can provide more than 30 CFM/occupant which exceeds current code requirements (10 CFM per occupant plus 0.12 CFM/SF) and can be supplemented by operable windows.
13. Computer Lab unit ventilators are not provided with any outdoor air for ventilation; the space should not be occupied unless windows are open, supplemental heat and HEPA filtration is provided to the space.
14. Operate Media air handling unit (AHU-1) at maximum design air flow; the unit has the capability of providing 20/CFM per occupant for 48 occupants.
15. Operate interior room air handling unit (AHU-2) at maximum design air flow; the unit did not have any data on the outdoor for ventilation design and should have balancing measurements taken to determine space occupancy based on the unit’s capability of providing 20/CFM per occupant.
16. Operate interior room air handling unit (AHU-3) at maximum design air flow; the unit did not have any data on the outdoor for ventilation design and should have balancing measurements taken to determine space occupancy based on the unit’s capability of providing 20/CFM per occupant.
17. Operate Auditorium air handling unit (AHU-4) at maximum design air flow; the unit did not have any data on the outdoor for ventilation design and should have balancing measurements taken to determine space occupancy based on the unit’s capability of providing 20/CFM per occupant.
18. Operate Gymnasium air handling unit (AHU-5) at maximum design air flow; the unit has the capability of providing 20/CFM per occupant for 206 occupants.
19. Operate Cafeteria air handling unit (AHU-6) and the four unit ventilators at maximum design air flow; the unit has the capability of providing 20/CFM per occupant for 225 occupants.
20. Operate Administration air handling unit (AHU-7) at maximum design air flow; the unit has the capability of providing 20/CFM per occupant for 32 occupants.

21. At the commencement of school and until the heating season and when outdoor air temperature conditions allow, the air handling equipment can be operated with recirculated air can be run in the “economizer mode” with 100% outdoor air and no recirculation.
22. Reset discharge air setpoint as high as possible for variable air volume systems to encourage variable air volume dampers to maximized outdoor air into the building.
23. Disable any CO2 demand control ventilation sequences of operation and occupancy setback controls; operate units at maximum outdoor air capacity.
24. Eliminate outdoor air to zones that are not occupied to better use in occupied areas.
25. Relocate occupants from areas that do not have mechanical ventilation or operable windows.
26. Use operable windows when outdoor air conditions allow.
27. Keep conference room doors open as much as possible or open windows when feasible.
28. Increase regular maintenance of all mechanical heating, ventilating and air conditioning equipment.
29. Monitor the heating, ventilating and air conditioning operation of the building on a continual basis.
30. Follow recommendations of holistic view of building recommendations in General Recommendations.

Tier 2 Recommendations: Tier 2 recommendations are supplemental revisions/additions to the existing systems that may be required for the heating season when systems will need to utilize recirculated air to maintain space temperature setpoints.

1. Provide additional filtration with portable HEPA filter units or UV filtration units for areas that might have multiple occupants served by units that utilize recirculated air.
2. Install portable humidifiers or retrofit existing heating/ventilating equipment with humidifiers for local humidity control.
3. Add plug-in type supplemental electric heat as required for increased ventilation requirements.
4. Apply and use outdoor air quality sensors or reliable web-based data for outdoor pollution information as part of the new ventilation operation.
5. Consider UV decontamination lights on highly touched surfaces.

Notes:

1. While there is ventilation air and return air associated with each classroom unit ventilator, the units only recirculate air within each classroom and do not recirculate air between classrooms. The ventilation and exhaust systems for the typical classroom is continuous and separate.
2. While there is ventilation air and return air associated with Gym, Cafeteria, Media Center and Auditorium air handling units, the units only recirculate air within each space and do not recirculate air between other spaces.
3. These recommendations are based on guidance provided by applicable agencies and publications for best practices for protection of occupants and visitors to the building but do not provide absolute protection from the pandemic.
4. These recommendations will have a significant impact on the operating and maintenance related costs of the HVAC systems.

HVAC SYSTEM EVALUATION

Existing Conditions

The majority of the heating for the buildings is provided through a hydronic system consisting of a two-pipe distribution that is fed from two propane-fired, condensing boilers and variable speed circulation pumps. The distribution piping supplies unit ventilators (UV), indoor air handling units (AHU), unit heaters (UH) and various smaller convective heaters throughout the building. The typical air handling unit consists of a supply fan, a hot water heating coil, a return/exhaust fan, damper section and filter-mixing box. Cooling is provided to the Media Labs, Auditorium and Administrative offices through packed, direct expansion (DX) cooling systems integral to the air handling units or through split DX condensers paired with cooling coils in the unit ventilator.

The classrooms in this building are served by floor mounted unit ventilators and general exhaust fans which provide constant ventilation and air exchange throughout the spaces during occupied hours. The UV's draw ventilation air through a directly connected wall louver, the air is mixed with return air from the space, is filtered then heated to maintain space temperature. The UV's are designed for a total supply airflow of 875 CFM and ventilation air flow of 375 CFM, with capacity of 38 MBH heating. The UV's are controlled through the building energy management system and are reportedly capable of operating with 100% ventilation air under appropriate weather conditions. Exhaust air is drawn from each space at ceiling registers and discharges through roof mounted exhaust fans which operate on a scheduled basis. The typical classroom is provided a ventilation airflow of 375 CFM and is continuously exhausted at a rate of 375 CFM. The original ventilation design appears to meet current code requirements, which would be 360 CFM for such a classroom size (Ventilation = 10 CFM x 27 Occupants + 0.12 CFM x 750 SF).

The air handling unit AHU-1 is located on the roof and provides ventilation and conditioned supply air through a system of supply and return distribution ductwork and duct mounted hydronic heating coils to the Media center on the second floor. The space is also served by perimeter fin-tube radiation. The air handling unit operates at a constant air volume and discharge temperature is controlled to maintain space temperature based on local thermostat/sensor. The design documents indicate that AHU-1 is 21% outdoor air with a maximum supply air flow of 4,580 CFM, corresponding maximum ventilation air flow of 975 CFM and a maximum return air flow of 3,605 CFM. This unit was designed with capacity for 150 MBH total cooling and a total static pressure capacity of 4.0" w.c. through the supply fan with 60% efficient filters. The associated duct heating coils have a combined capacity of 75 MBH. New filters have recently been installed on these units and are reported to be MERV 10 (~50% efficiency). The design ventilation air flow to the computer lab and media center does not appear to meet current code requirements (Ventilation = [10 CFM x 0.025 Occupants/SF + 0.12 CFM] x SF) for the approximately total floor area of 3,400 SF.

The Computer Lab on the second floor is served by two ducted unit ventilators with split DX cooling coils and associated condensing units on the roof, as well as perimeter fin tube radiation. The UV's are recirculation only, heating and cooling the supply air as necessary to maintain space temperature. The UV's are each designed for a total supply airflow of 850 CFM with capacity for 10 MBH of heating and 21 MBH of total cooling; the UV's are controlled through the building energy management system. The perimeter fin-tube has a total heating capacity of 12 MBH. The space relies on operable windows for natural.

The air handling unit AHU-2 is located on the roof, providing ventilation and heated supply air through a system of supply and return distribution ductwork and duct mounted hydronic heating coils to the corridors and small interior rooms on the eastern portion of the first and second floors. The air handling unit operates at a constant air volume and discharge temperature is controlled to maintain space temperature based on local thermostat/sensor. The design documents a maximum supply air flow of 1,665 CFM for AHU-2 but do not include outdoor air flow data. This unit was designed with a total static pressure capacity of 4.0” w.c. through the supply fan and the associated duct heating coils have a combined capacity of 127 MBH. New filters have recently been installed on these units and are reported to be MERV 10 (~50% efficiency). The current code requirement for ventilation air flow to the corridors and associated interior rooms would be 380 CFM (Ventilation = 10 CFM x # Occupants + 0.06 CFM x SF) for the approximately total floor area of 5,400 SF which would correspond to 23% of the total supply airflow.

The air handling unit AHU-3 is located on the roof, providing ventilation and heated supply air through a system of supply and return distribution ductwork and duct mounted hydronic heating coils to the corridors and small interior rooms on the western portion of the first and second floors. The air handling unit operates at a constant air volume and discharge temperature is controlled to maintain space temperature based on local thermostat/sensor. The design documents a maximum supply air flow of 1,755 CFM for AHU-3 but do not include outdoor air flow data. This unit was designed with a total static pressure capacity of 4.0” w.c. through the supply fan and the associated duct heating coils have a combined capacity of 132 MBH. New filters have recently been installed on these units and are reported to be MERV 10 (~50% efficiency). The current code requirement for ventilation air flow to the corridors and associated interior rooms would be 380 CFM (Ventilation = 10 CFM x # Occupants + 0.06 CFM x SF) for the approximately total floor area of 5,400 SF which would correspond to 22% of the total supply airflow.

The air handling unit AHU-4 is located on the roof, providing ventilation and heated supply air through a system of supply and return distribution ductwork and duct mounted hydronic heating coils to the Auditorium. The air handling unit operates at a constant air volume and discharge temperature is controlled to maintain space temperature based on local thermostat/sensor. The design documents a maximum supply air flow of 6,000 CFM for AHU-4 but do not include outdoor air flow data. This unit was designed with a total static pressure capacity of 4.0” w.c. through the supply fan and the associated duct heating coils have a combined capacity of 261 MBH. New filters have recently been installed on these units and are reported to be MERV 10 (~50% efficiency). The original ventilation design appears to meet current code requirements, which would be 4,050 CFM for the approximate total floor area of 5,000 SF (Ventilation = [5 CFM x 0.15 Occupants/SF + 0.06 CFM/SF] x SF).

The air handling unit AHU-5 is located on the roof, providing ventilation and heated supply air through a system of supply and return distribution ductwork and duct mounted hydronic heating coils to the Gymnasium. The air handling unit operates at a constant air volume and discharge temperature is controlled to maintain space temperature based on local thermostat/sensor. The design documents indicate a maximum supply air flow of 8,250 CFM for AHU-4, a normal ventilation air flow of 4,125 CFM and a full economizer air flow of 8,250 CFM. This unit was designed with capacity for 330 MBH of total cooling, a total static pressure capacity of 4.0” w.c. through the supply fan and the associated duct heating coils have a combined capacity of 314 MBH. New filters have recently been installed on these units and are reported to be MERV 10 (~50% efficiency). The current code requirement for ventilation air flow to the Auditorium will vary based on the proportion of play area and spectator area, with an even proportioning the ventilation air flow would be 5500 CFM for the approximately total floor area of 7,400 SF which would correspond to 92% of the total supply airflow.

The air handling unit AHU-6 is located on the lower roof, providing ventilation and heated supply air through a system of supply distribution ductwork and duct mounted hydronic heating coils to the Cafeteria. The cafeteria is also served by four unit ventilators and the space acts to provide make-up air for the three separate exhaust fans serving the adjacent kitchen area. The air handling unit appears to be designed for 100% outdoor air flow, operates at a constant air volume with discharge temperature controlled to maintain space temperature based on local thermostat/sensor and is reported to be interlocked with the kitchen hood exhaust. The design documents indicate a maximum supply air flow of 1,500 CFM for AHU-6, a total static pressure capacity of 4.0" w.c. through the supply fan and the associated duct heating coil has a capacity of 114 MBH. New filters have recently been installed on these units and are reported to be MERV 10 (~50% efficiency). The floor mounted UV's draw ventilation air through a directly connected wall louver, the air is mixed with return air from the space, is filtered then heated to maintain space temperature. The UV's are each designed for a total supply airflow of 1,500 CFM and ventilation air flow of 750 CFM, with 68 MBH of heating capacity. The UV's are controlled through the building energy management system and are reportedly capable of operating with 100% ventilation air under appropriate weather conditions. Exhaust air is drawn from the kitchen hood, dishwasher hood and ceiling registers in the staff restrooms at a total rate of 5,290 CFM and discharges through roof mounted exhaust fans. The total original ventilation design of 4,500 CFM appears to exceed current code requirements, which would be 4,020 CFM for the approximate total floor area of 5,700 SF (Ventilation = [7.5 CFM x 0.07 Occupants/SF + 0.18 CFM/SF] x SF). The design ventilation airflow is also approximately 85% of the total exhaust airflow and will allow for the kitchen area to remain at a negative pressure relative to the cafeteria and other neighboring spaces during use.

The air handling unit AHU-7 is located on the roof and provides ventilation and conditioned supply air through a system of supply and return distribution ductwork and duct mounted hydronic heating coils to the Administration Offices on the first floor. The air handling unit operates at a constant air volume and discharge temperature is controlled to maintain space temperature based on local thermostat/sensor. The unit nameplate data indicate that AHU-7 has a maximum supply air flow of 3,000 CFM and design documents indicate a maximum ventilation air flow of 640 CFM. This unit has a capacity for 90 MBH total cooling and an external static pressure capacity of 0.5" w.c. through the supply fan with 60% efficient filters. The associated duct heating coil has a capacity of 54 MBH. New filters have recently been installed on these units and are reported to be MERV 10 (~50% efficiency). The design ventilation air flow to the administrative office and meeting areas appears to meet current code requirements, which would be 550 CFM (Office Ventilation = [5 CFM x 0.005 Occupants/SF + 0.06 CFM] x SF, Meeting Ventilation = [5 CFM x 0.05 Occupants/SF + 0.06 CFM] x SF) for the approximately total floor area of 3,200 SF.

Bathrooms, Janitor's Closets, Storage, etc. are exhausted through registers and ductwork connected to roof mounted exhaust fans. Bathrooms are provided with hot water heating terminal equipment.

Specialty exhaust systems have been provided for the Science Rooms, Art Room and Storage.

The electric room has been provided with heat dissipation systems including an exhaust fan, a gravity intake with motor operated damper and a temperature sensor to maintain a maximum space temperature.

Miscellaneous spaces have been provided with hot water terminal equipment interconnected with the hot water distribution piping system.

The building is monitored and operated electronically by a system of direct digital controls (DDC).

GENERAL PUBLICATION RECOMMENDATIONS

Publications referenced include ASHRAE and State of Massachusetts Re-opening Guidelines for schools.

Operating school buildings under epidemic conditions requires a holistic framework during the crisis and the restoration to potentially a new "normal" after the public health emergency has ended. Considerations include:

- Review of current operational practices
- Holistic view for owner/operator

Review of current operational practices

- Modes of operation of HVAC systems
    - sequences of operations
    - set points
    - schedules
- Verification that equipment and systems are properly functioning and have the enhanced capabilities to address public health considerations, with a focus building air circulating systems.
- Understanding that infected people who are asymptomatic may enter buildings, increasing the likelihood of the spread of virus through air systems to other occupants.

Holistic view for owner/operator

Owners and operators should take a holistic view of their buildings and:

1. Develop a pandemic preparedness plan
2. Review indoor and outdoor environment
3. Review the space types
4. Operate and maintain HVAC
    - Air-Conditioning and Ventilation systems
    - Exhaust systems
5. Check Elevator Control
6. Check BAS and Access Control Systems

Develop a Pandemic Preparedness Plan

Consider these possible goals:

- Reduce the spread of infection among building occupants,
- Maintain HVAC and Building Service Systems in safe and healthy conditions,
- Minimize impact on building occupants and visitors,

- Communicate risks and precautions being taken with occupants transparently
- Implement measures that help make occupants feel secure:
    - Require occupants, visitors and maintenance personnel to wear appropriate PPE per CDC,
    - Screen, monitor and control the circulation of occupants and guests to help avoid transmission of disease,
    - Increase frequency for surface disinfection on frequently touched surfaces, such as door handles, handrails, door bells and elevator buttons.

Ensure continuity of supply chains and have backup plans.

- Identify your critical suppliers, e.g. filters, cleaners, disinfectants, parts, PPE, etc.,
- Identify vendors who could negatively affect your operation if they fail to deliver,
- Review current service provider agreements to see if alternate suppliers can be engaged in the event of a supply disruption, for example, equipment service providers, and understand contract limitations and restrictions on using alternative providers,
- Ask critical suppliers to share their pandemic plans:
    - What does their plan include?
    - Have they tested their plan? When was it updated?
    - Set boundaries with suppliers – ask that they do not send staff who may be showing signs of illness to your property.

Review contract agreements:

- Review contract agreements: Review contracts with service providers, utilities, and suppliers to determine what rights and remedies they have because of disruptions due to unforeseeable circumstances that prevent fulfillment of a contract.

Establish a communication protocol and continuity of operations plan:

- Identify key contacts and publish normal and emergency contact information,
- Document the chain of command and communication requirements, and provide instructions and outline expectations for how all responses are to be documented and what records shall be maintained and distributed.

Provide staff with:

- PPE per CDC and OSHA requirements,
- Training on the proper use and disposal of PPE and waste,
- Training on infection prevention and control measures,
- Cross training to ensure critical building functions are maintained in an emergency, and
- Instruction to staff to stay at home if they are feeling sick.

Check with insurance providers to determine whether there are special measures that can be taken to preserve coverage or lower premiums.

Next Steps:

1. Notify staff, tenants and visitors about the plan
2. Follow all local, state and federal executive orders, statutes, regulations, guidelines, restrictions and limitations on use, occupancy and separation
3. Follow OSHA Guidelines, especially the portion in the guide regarding filter and outside air.
4. Ensure that custodial staff and service providers job descriptions includes performing proper cleaning procedures based EPA and CDC guidance using approved products and methods:
    - Disinfect high touch areas of HVAC and other Building Service systems such as on/off switches, and thermostats;
    - Consider UV light disinfection devices of high touch counters in public spaces.
    - Disinfect interiors of refrigerated devices, such as refrigerators, coolers and vending machines where the virus can survive for potentially long periods of time.
5. Consider installing a thermal camera at building entrances to help screen visitors for elevated body temperatures. Note that that infected individuals may show no signs of being ill, including having no fever, and can be responsible for much of the transmission. In such cases, thermal imaging may not be effective.
6. Provide MERV13 or higher filters for air handling equipment that recirculate air when equipment has the capacity.
7. The HVAC systems that are physical or capacity limited for better filtration and UV decontamination systems in the return airstream, consider installing portable filtration and air cleaning devices such as UVGI (Ultraviolet Germicidal Irradiation), especially if seniors or anyone with other health issues or compromised immune systems may be located, or, in mission critical areas where required.
8. Provide automatic hand sanitizer dispensers in the high touch areas and other common areas, including spaces where equipment where frequent maintenance is required, and ensure dispensers are serviced often and remain operational.
9. Post signage in prominent locations that contain information and instructions to educate and remind staff about proper procedures to maintain personal protection while cleaning, replacing filters and moving or using other equipment that maybe contaminated
10. Consider providing antimicrobial door mats at high traffic entrances to the building.
11. Institute additional cleaning procedures to ensure proper disinfection of bathrooms, kitchens and common areas. Educate cleaning and maintenance staff on proper personal protection and PPE use including following OSHA worker exposure guidelines.

Review Indoor and Outdoor Environment

- Maintain dry bulb temperatures within the comfort ranges indicated in ANSI/ASHRAE Standard 55-2017
- Maintain relative humidity between 40% and 60% through the use of the air conditioning systems.

In Cold Climates
i. HVAC systems with no humidification may not achieve the minimum humidity indicated, ii. Observe building assemblies and finishes frequently for condensation when indoor dew points

In Cold Climates
rise above the surface temperatures of the assemblies and finishes, iii. Excessive humidity may lead to condensation, indoor mold growth, and degradation of indoor air quality.

Review the space types

Conference Rooms	Keep doors to be opened to promote good ventilation where possible. If doors must be closed, consider local air filtration and cleaning devices and appliances such as portable air filters, or provide local exhaust fans discharging directly to the outside to improve ventilation.
Pantries/Storage Rooms	Provide local exhaust, or portable air filtration and cleaning appliances, especially if refrigerators, or similar appliances, are presented.
Public/Large Assembly Spaces	Where there can be a large assembly of people, consider air treatment, e.g. upper-room UVGI lamps.

Operate and maintain the HVAC system

Building owners and service professionals should follow the requirements of ASHRAE Standard 180-2018, Standard Practice for the Inspection and Maintenance of Commercial HVAC Systems which has tables to show the typical maintenance required for equipment that has been in operation. Consider PPE when maintaining ventilation materials including filters, condensate. Consult additional guidance before duct cleaning. Check specifically:

- Dampers, filter, and economizers seals and frames are intact and clean, are functional and are responding to control signals. MERV13 or higher filters are required for capture of airborne viruses; however, most existing equipment will not be able to support the associated pressure drop of these filters and equipment should be provided with only the highest MERV rating that does not affect the heating and cooling capacity of the units.
- Zone and air temperature are calibrated and accurately reporting environmental conditions to the BAS or local controllers.
- Exhaust fans are functional and venting to the outdoors.
- Check outside air intake regularly for any potential risk such as exhaust nearby and provide proper clearance if assessible by pedestrians, etc.

Operate and maintain the HVAC system – Air conditioning and ventilation systems

- Continued operation of all systems is recommended.
- For offices with fan coil units, open windows 2 hours before and after occupied periods.

Centralized and floor-by-floor Variable Air Volume (VAV) systems: General information

- For central or floor-by-floor VAV systems that have the capacity to operate with 100% outside air, such as an economizer cycle, close return air dampers and open outdoor air dampers to 100% or to the maximum setting that the HVAC system can accommodate and still maintain acceptable indoor conditions.
- If there are heating and cooling coils to temper the air, it can provide comfort and eliminate recirculation (in the mild weather seasons this will have smaller impacts to energy consumption, thermal comfort, or humidity control, however, using 100% outside can be more difficult in extreme weather conditions).
- Considerations also should be given in areas with dry outside air that may lower the relative humidity to below 40%.
- Prioritize increasing outside air over humidity (see concerns about operating at indoor humidity outside the range of 40%-60%).

Centralized and floor-by-floor Variable Air Volume (VAV) systems: Floor-by-floor

- In floor-by-floor VAV systems that have only minimum outside air damper positions or openings, open outside air damper to its maximum position (the same cautions and concerns stated above apply).
- If outside air is supplied centrally from outside air handling units (typically at mechanical levels) to all floors, and there are unoccupied tenant floors, divert the outside air to the occupied floors.
- Consider changing the floor level VAV air handling units' discharge air temperature setpoint the maximum (typically no higher than 60º F).
- This will cause VAV terminal units (boxes) to open to try and satisfy space cooling loads which will increase the number of air changes in the space being served.

Centralized and floor-by-floor Variable Air Volume (VAV) systems: Cooling coils

- Cooling coils, heating coils and condensate drain pans inside air handling equipment can become contaminated.
- Therefore, consider adding UVGI for coil surface and drain pan disinfection are encouraged as it will reduce the needs and frequency for in-person coil surface disinfection.
- These devices and systems should be monitored often and regular and emergency maintenances should continue.
- Provide PPE protection for building operators, maintenance technicians and anyone else who must inspect or come in contact with the device or equipment.

Centralized and floor-by-floor Variable Air Volume (VAV) systems: Operable windows

- In buildings with operable windows, when outside air thermal and humidity conditions and outdoor air quality are acceptable, open windows where appropriate during occupied hours.
- Disabling the interlock between opening windows and air conditioning system lockout or shut down if this feature is provided for in the Building Automation System.
- Monitor indoor spaces for possible contaminants entering through the windows such as toilets exhaust located nearby or for windows accessible to public and high traffic on adjacent streets and walkways.
- Exposure to seasonal and other outdoor allergens (pollen and mold spores) may occur with windows opened.
- Special ductwork cleaning, or, changing filters more often than normal is not necessary.

Domestic Heating Water systems:

- Keep heating water systems circulating and maintain temperatures above 140°F to avoid microbial incursion. Do not let water temperature to drop below 120°F.

Operate and maintain the HVAC system - Exhaust systems

- Exhaust system for toilets should run 24/7. Do not open operable windows in toilets.
- Other exhaust systems should continue to run as normal. Run exhaust systems 2 hours before and after occupied periods.
- If there are exhaust outlets located in pedestrian areas outside, provide warning signs and consider diverting or rearranging the exhaust air discharge locations so that they would pose no opportunity to cause harm.

Elevator Control

1. Turn on elevator cab (lift) ventilation fans, where possible
2. Encourage occupants to take stairs, where possible, especially when elevator lobbies are crowded.
3. Allow elevators to run at high speed to minimize time in elevator.
4. Close elevator lobby vestibule doors, if available.
5. Consider local air treatment devices in frequently used lifts.

Building Automation System and Access Control System Programming

Building Automation Systems:

- Automate the control sequences in this document as a "Epidemic Mode" operation that can be turned on, shut down or override, if needed, by manual selection of the operator.
- Provide remote access to staff and trusted service providers who are responsible for operating and maintain Building Automation Systems, security, access control, information technology, fire alarm and life safety systems. Have written procedures and test remote access and secure access levels and permissions for all individuals prior to an emergency, if possible.

Access Control Systems:

- Post signage and communicate to tenants, and post visitors' procedures for entering and leaving the building that will minimize the time spent in public spaces.
- Use touchless assess control system if available and where possible.
- Require and enforce social distancing within public and shared spaces using signage.
- Ensure that workspaces are situated to accommodate social distancing recommendations.