Hull Public Schools
Hull High School
Hull, MA

2020

HVAC System Evaluation

Prepared For:

Hull Public Schools
18 Harborview Road
Hull, MA 02045

Prepared By:

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

September 18, 2020

EXECUTIVE SUMMARY

General

Hull Public Schools engaged BLW Engineers to evaluate the building HVAC system relative to its current operating conditions, re-opening to the building to the public and potential considerations relative to Covid-19. Kenneth R. Beck, PE, Principal-In-Charge, visited each site, reviewed building documentation and prepared the following evaluation.

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 Hull High School is located at 180 Main Street; was constructed in 1957 and was last renovated in 2005. The school comprises approximately 101,780 square feet of educational space.

Hull High School Planned Reopening

The Hull Public Schools plans on the following school re-opening:

- School is to be occupied by 50% of students on Monday/Tuesday, Wednesday will be a disinfection/cleaning day and then occupied by 50% of students on Thursday/Friday.
- Classrooms seating will be reorganized to provide recommended social distancing; typically, classrooms sizes will be typically reduced to 11 occupants (students and a teacher).
- Cafeteria will not be used in normal fashion; there will be three lunch periods and students will be socially distanced.
- Gym will not be used in normal fashion.
- Library room will not be used in normal fashion; it will be used primarily as classroom space.

Recommendations

Based on applicable guidelines (ASHRAE, State of Massachusetts Re-opening Guidelines, Massachusetts Teachers Association, etc.), the Hull High 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" 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; unit ventilators, heating/ventilating units and rooftop 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 (24 hours a day, 7 days a week) 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 by building personal on an intermittent basis.
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 Classroom unit ventilators at maximum outdoor air for ventilation. Based on reduced classroom sizes, the classroom current system can provide more than 32 CFM/occupant for up to 12 occupants which exceeds current code requirements (10 CFM per occupant plus 0.12 CFM/SF), MTA Guidelines and can be supplemented by operable windows.
11. Operate SPED unit ventilators at maximum outdoor air for ventilation. Based on reduced classroom sizes, the classroom current system can provide more than 32 CFM/occupant for up to 7 occupants which exceeds current code requirements (10 CFM per occupant plus 0.12 CFM/SF), MTA Guidelines and can be supplemented by operable windows.
12. Operate Computer Classroom unit ventilators at maximum outdoor air for ventilation. Based on reduced classroom sizes, the classroom current system can provide more than 32 CFM/occupant for up to 12 occupants which exceeds current code requirements (10 CFM per occupant plus 0.12 CFM/SF), MTA Guidelines and can be supplemented by operable windows.
13. Operate Robotics unit ventilator at maximum outdoor air for ventilation. Based on reduced classroom sizes, the classroom current system can provide more than 32 CFM/occupant for up to 12 occupants which exceeds current code requirements (10 CFM per occupant plus 0.12 CFM/SF), MTA Guidelines and can be supplemented by operable windows.
14. Operate CADD unit ventilator at maximum outdoor air for ventilation. Based on reduced classroom sizes, the classroom current system can provide more than 8 CFM/occupant for up to 12 occupants which exceeds current code requirements (10 CFM per occupant plus 0.12 CFM/SF), MTA Guidelines and can be supplemented by operable windows.
15. Operate Wellness unit ventilators at maximum outdoor air for ventilation. Based on reduced classroom sizes, the classroom current system can provide more than 32 CFM/occupant for up to 12 occupants which exceeds current code requirements (10 CFM per occupant plus 0.12 CFM/SF), MTA Guidelines and can be supplemented by operable windows.
16. Operate Band and Choral unit ventilators at maximum outdoor air for ventilation. Based on reduced classroom sizes, the classroom current system can provide more than 32 CFM/occupant for up to 14 occupants which exceeds current code requirements (10 CFM per occupant plus 0.12 CFM/SF), MTA Guidelines and can be supplemented by operable windows.
17. Operate Student Dining unit ventilators at maximum outdoor air for ventilation. Based on reduced classroom sizes, the classroom current system can provide more than 32 CFM/occupant for up to 70 occupants which exceeds current code requirements (7.5CFM per occupant plus 0.18 CFM/SF), MTA Guidelines and can be supplemented by operable windows.

18. Operate Library rooftop unit (RAC-1) at maximum outdoor air for ventilation; the unit has the capability of providing 32 CFM per occupant for 32 occupants.
19. Operate Auditorium rooftop unit (RAC-2) at maximum outdoor air for ventilation; the unit has the capability of providing 32 CFM per occupant for 318 occupants.
20. Operate Curriculum rooftop unit (RAC-1) at maximum outdoor air for ventilation; the unit has the capability of providing 32 CFM per occupant for 9 occupants.
21. Operate Gymnasium heating/ventilating units (HV-1, 2) at maximum outdoor air for ventilation; the unit has the capability of providing 32/CFM per occupant for 234 occupants.
22. Do not occupy the Locker Room and surrounding spaces served by unit ventilators with 100 percent recirculated air.
23. At the commencement of school and until the heating season, the rooftop units, unit ventilators and heating/ventilating units can be run in the "economizer mode" with 100% outdoor air and no recirculation.
24. During the heating season, operate rooftop units, unit ventilators and heating/ventilating units to the level above the ventilation design capacity based on outdoor air temperature and the acceptable indoor air temperature acceptable to the occupant comfort.
25. Eliminate zones that are not occupied to better use outdoor air in occupied areas.
26. Relocate occupants from areas that do not have mechanical ventilation or operable windows.
27. Supplement areas with only operable windows with electric heat and portable HEPA filters.
28. Use operable windows when outdoor air conditions allow.
29. Keep conference room doors open as much as possible or open windows when feasible.
30. Increase regular maintenance of all mechanical heating, ventilating and air conditioning equipment.
31. Do not use free standing fans or operate ceiling destratification fans that provide velocity air flow across one occupant to another.
32. Consider repiping the existing boilers in a correct primary/secondary piping arrangement to extend the life of the boilers.
33. Monitor the heating, ventilating and air conditioning operation of the building on a continual basis.
34. Follow recommendations of holistic view of building recommendations in General Recommendations noted hereinafter.

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 (100 cfm/250 SF) or UV filtration units for unit ventilators, air handling unit or rooftop units with large percentages of recirculation air when operated under 32 CFM per occupant.
2. Install portable humidifiers or retrofit existing equipment with humidifiers for local humidity control should humidity become an issue.
3. Add plug-in type supplemental electric heat as required for increased ventilation requirements through equipment or operable windows.

Notes:

1. 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.
2. These recommendations will have a significant impact on the operating and maintenance related costs of the HVAC systems.
3. The system evaluation is based on the normal operation of the system at the original design parameters without utilizing operable windows or other means of additional ventilation; windows can be opened to provide additional ventilation, but it is not necessary, so long as the space temperature is comfortable to the occupants.

HVAC SYSTEM EVALUATION

The existing building is provided with heating hot water by four gas fired, high efficiency hot water boilers, a two-pipe heating water distribution piping system, unit ventilators, rooftop units, heating/ventilating units, exhaust fans and miscellaneous heating terminal equipment.

The 4 RBI gas fired, high efficiency boilers (1950 MBH gas input each) are located in the mechanical room. The boilers provide heating hot water for the building through the two pipe distribution system through three sets of lead/standby hot water distribution zone pumps with variable speed drives. The boiler room is in nearing the end of its expected operational life and the boiler primary/secondary piping arrangement is piped incorrectly.

The classrooms are provided with unit ventilators and common exhaust fan systems to provide hot water heating, ventilation and exhaust. The unit ventilators are constant volume units that provide 1000 cfm of total supply air and 390 cfm of outdoor air is provided to each classroom. Vertical unit ventilators receive air directly from the outdoors through a sidewall louver. The original ventilation design exceeds current code requirements (Classroom Ventilation = 10 CFM x Occupant + 0.12 CFM x SF or for a typical 1,000 SF classroom with 25 occupants that would be 370 CFM). The common exhaust fan system typically exhausts 390 CFM per classroom. The Classrooms could accommodate up to 12 occupants at 32 cfm/occupant ventilation rate. The Science Prep Rooms are provided with dedicated exhaust fans; the wood shop is provided with a dust collection system.

The Student Dining is provided with four unit ventilators and common exhaust fan systems to provide hot water heating, ventilation and exhaust. The unit ventilators are constant volume units that each provide 1250 cfm of total supply air and 565 cfm of outdoor air for ventilation. Vertical unit ventilators receive air directly from the outdoors through a sidewall louver. The original ventilation design exceeds current code requirements (Ventilation = 7.5 CFM x Occupant + 0.18 CFM x SF). Student Dining could accommodate up to 70 occupants at 32 cfm/occupant ventilation rate.

The Computer Classrooms are provided with unit ventilators, 4-ton air cooled condensing units and common exhaust fan systems to provide hot water heating, ventilation, air conditioning and exhaust. The unit ventilators are constant volume units that provide 1500 cfm of total supply air and 390 cfm of outdoor air is provided to each classroom. Vertical unit ventilators receive air directly from the outdoors through a sidewall louver. The original ventilation design exceeds current code requirements (Classroom

Ventilation = 10 CFM x Occupant + 0.12 CFM x SF or for a typical 1,000 SF classroom with 25 occupants that would be 370 CFM). The common exhaust fan system typically exhausts 390 CFM per classroom. The Computer Classrooms could accommodate up to 12 occupants at 32 cfm/occupant ventilation rate.

The SPED Classroom is provided with a unit ventilator (UV-5), a 2-ton air cooled condensing unit (ACCU-10) and common exhaust fan systems to provide hot water heating, ventilation, air conditioning and exhaust. The unit ventilators are constant volume units that provide 750 cfm of total supply air and 225 cfm of outdoor air is provided to each classroom. Vertical unit ventilators receive air directly from the outdoors through a sidewall louver. The original ventilation design exceeds current code requirements (Classroom Ventilation = 10 CFM x Occupant + 0.12 CFM x SF). The common exhaust fan system typically exhausts 390 CFM per classroom. The SPED Classroom could accommodate up to 7 occupants at 32 cfm/occupant ventilation rate.

The Robotics Room is provided with a unit ventilator (UV-21), a 4-ton air cooled condensing unit (ACCU-5), makeup air unit, welding hood exhaust fan and common exhaust fan systems to provide hot water heating, ventilation, air conditioning and exhaust. The unit ventilator is a constant volume unit that provide 2000 cfm of total supply air and 390 cfm of outdoor air is provided to each classroom. Vertical unit ventilators receive air directly from the outdoors through a sidewall louver. The original ventilation design exceeds current code requirements (Classroom Ventilation = 10 CFM x Occupant + 0.12 CFM x SF or for a typical 1,000 SF classroom with 25 occupants that would be 370 CFM). The common exhaust fan system typically exhausts 390 CFM per classroom. The Computer Classrooms could accommodate up to 12 occupants at 32 cfm/occupant ventilation rate.

The CADD Room is provided with a unit ventilator (UV-22), a 3.5-ton air cooled condensing unit (ACCU-5) and common exhaust fan systems to provide hot water heating, ventilation, air conditioning and exhaust. The unit ventilator is a constant volume unit that provide 1500 cfm of total supply air and 285 cfm of outdoor air is provided to each classroom. Vertical unit ventilators receive air directly from the outdoors through a sidewall louver. The original ventilation design exceeds current code requirements (Classroom Ventilation = 10 CFM x Occupant + 0.12 CFM x SF or for a typical 1,000 SF classroom with 25 occupants that would be 370 CFM). The common exhaust fan system typically exhausts 285 CFM per classroom. The Computer Classrooms could accommodate up to 8 occupants at 32 cfm/occupant ventilation rate.

The Health/Wellness Room are provided with a unit ventilator (UV-24), a 5-ton air cooled condensing unit (ACCU-7) and common exhaust fan systems to provide hot water heating, ventilation, air conditioning and exhaust. The unit ventilator is a constant volume unit that provide 2000 cfm of total supply air and 390 cfm of outdoor air is provided to each classroom. Vertical unit ventilators receive air directly from the outdoors through a sidewall louver. The original ventilation design exceeds current code requirements (Classroom Ventilation = 10 CFM x Occupant + 0.12 CFM x SF or for a typical 1,000 SF classroom with 25 occupants that would be 370 CFM). The common exhaust fan system typically exhausts 390 CFM per classroom. The Computer Classrooms could accommodate up to 12 occupants at 32 cfm/occupant ventilation rate.

The Band and Choral Rooms are provided with two unit ventilators (UV-25, 26) and common exhaust fan systems to provide hot water heating, ventilation and exhaust. The unit ventilators are constant volume units that each provide 750 cfm of total supply air and 225 cfm of outdoor air for ventilation. Vertical unit ventilators receive air directly from the outdoors through a sidewall louver. The original ventilation

design exceeds current code requirements (Classroom Ventilation = 7.5 CFM x Occupant + 0.12 CFM x SF). Student Dining could accommodate up to 14 occupants at 32 cfm/occupant ventilation rate.

The Library served by a variable air volume rooftop unit (RAC-1) through a medium pressure insulated duct system to variable air volume terminal units with hot water reheat coils; from variable air volume terminal units to ceiling supply diffusers. Air is returned to the unit though ceiling register into a low pressure return/exhaust air is duct distribution system. The original design provides 3,640 CFM of total conditioned air supply and 585 CFM of outdoor air for ventilation which exceeds current code requirements (Ventilation = 5 CFM x Occupant + 0.12 CFM x SF). Heating is provided through the variable air volume terminal unit reheat coils interconnected to the hot water distribution piping system and a wall mounted space temperature sensor for each zone. The Library could accommodate up to 32 occupants at 32 cfm/occupant ventilation rate.

The Auditorium is served by a single zone gas heating/DX cooling rooftop unit (RAC-2) with air cooled condensing unit (ACCU-8) to provide heating, ventilating and air conditioning through an insulated duct system to ceiling supply diffusers. Air is returned to the unit though ceiling register into a low pressure return/exhaust air is duct distribution system. The original design provides 10,000 CFM of total conditioned air supply and 6,825 CFM of outdoor air for ventilation which exceeds current code requirements (Ventilation = 5 CFM x Occupant + 0.06 CFM x SF). Heating is provided through the rooftop unit gas furnace and a wall mounted space temperature sensor for each zone. The Auditorium could accommodate up to 318 occupants at 32 cfm/occupant ventilation rate.

The Administrative Offices are served by a variable air volume rooftop unit (RTU-3) through a medium pressure insulated duct system to variable air volume terminal units with hot water reheat coils; from variable air volume terminal units to ceiling supply diffusers. Air is returned to the unit though ceiling register into a low pressure return/exhaust air is duct distribution system. The original design provides 2,365 CFM of total conditioned air supply and 1,035 CFM of outdoor air for ventilation which exceeds current code requirements (Ventilation = 5 CFM x Occupant + 0.06 CFM x SF). The variable air volume dampers are no longer operational, have been fully opened and units operate as reheat coils. Heating is provided through the variable air volume terminal unit reheat coils interconnected to the hot water distribution piping system and a wall mounted space temperature sensor for each zone. The Library could accommodate up to 18 occupants at 32 cfm/occupant ventilation rate.

The Curriculum Room is served by a single zone gas heating/DX cooling rooftop unit (RTU-4) through an insulated duct system to ceiling supply diffusers. Air is returned to the unit though ceiling register into a low pressure return/exhaust air is duct distribution system. The original design provides 2,075 CFM of total conditioned air supply and 295 CFM of outdoor air for ventilation which exceeds current code requirements (Ventilation = 5 CFM x Occupant + 0.06 CFM x SF). Heating is provided through the rooftop unit gas furnace and a wall mounted space temperature sensor for each zone. The Curriculum Room could accommodate up to 9 occupants at 32 cfm/occupant ventilation rate.

The Main Electric Room is served by a single zone DX cooling rooftop unit (RTU-5). The original design provides 2,000 CFM of total conditioned air supply and 0 CFM of outdoor air for ventilation.

The Gym is provided with two heating/ventilating units (HV-1, 2), gravity relief damper and destratification fan to provide hot water heating, ventilation, air conditioning and exhaust. The air handling unit is constant volume units that provide 14,000 cfm of total supply air and 7,500 cfm of

outdoor air for ventilation which exceeds current code requirements (Ventilation = 7.5 CFM x Occupant + 0.06 CFM x SF). Heating is provided through the heating/ventilating unit hot water coil interconnected to the hot water distribution piping system and a wall mounted space temperature sensor. The Gym could accommodate up to 234 occupants at 32 cfm/occupant ventilation rate.

The Boys and Girls Locker Rooms are each provided withfour horizontal heating/ventilating units (HV-3, 4, 5, 6) and exhaust fans to provide heating and exhaust to the locker rooms, toilets, offices, etc. The unit ventilators draw return air from the gymnasium to provide tempered supply air in the locker room areas; the units are not provided with interconnection to the outdoors to provide outdoor air for ventilation.

The Kitchen is provided with a make up air unit (MUA-1) to provide heating and ventilation to the kitchen; the unit was designed to provide 3,500 CFM of outdoor air for makeup air to the kitchen. The kitchen is also provided with a kitchen hood exhaust fan (EF-34) rated for 7,000 CFM of grease hood exhaust and a dishwasher exhaust fan (EF-35) rated for 1,000 CFM of dishwasher hood exhaust.

The Head End Room and Computer Labs is provided with split system air conditioning and operable windows heating, cooling and ventilation. The split system air conditioning consists of an outdoor air cooled condensing interconnected with refrigerant piping to indoor ductless wall mounted units.

Fan coil units with outdoor air connections have been provided for some offices (50 CFM of outdoor air for ventilation or 1 occupant at 32 CFM per occupant), Teachers Room (180 CFM of outdoor air for ventilation or 8 occupants at 32 CFM per occupant) and SPED Room (180 CFM of outdoor air for ventilation or 8 occupants at 32 CFM per occupant). Heating is provided through the unit hot water coil interconnected to the hot water distribution piping system and a wall mounted space temperature sensor.

Theater Arts and Music Offices are not provided with mechanical means of outdoor air for ventilation.

Bathrooms, Janitor's Closets, Storage, Crawlspace, etc. are provided by exhaust registers, exhaust duct distribution system and roof exhaust fans.

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

The building is controlled by electronic controls (Johnson Metasys).

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. Provide MERV13 or higher filters for air handling equipment that recirculate air when equipment has the capacity; however, most existing air handling equipment will not be able to accommodate MERV13 filters without significantly impacting system operation, outdoor air delivery to the space and equipment component failures.

6. 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.
7. 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.
8. 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
9. 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 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.