Shawsheen Valley Regional Technical High School

Billerica, MA

2020

HVAC System Evaluation

Prepared For:

Shawsheen Valley Regional
Vocational Technical School District
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HVAC SYSTEM EVALUATION

General

Shawsheen Valley Regional Vocational Technical School 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.

Existing Conditions

BLW visited the school to review the existing systems and has confirmed that the existing drawings appear to match the systems as designed and appear to be operating as designed.

The existing building is provided with heating hot water by gas fired boilers, a two-pipe heating water distribution piping system, unit ventilators, heating/ventilating units, roof top units, exhaust fans, split system air conditioning unit and miscellaneous heating terminal equipment.

The gas fired high efficiency boilers are located in the mechanical room. The boilers provide heating hot water for the building through the two-pipe distribution system through lead/standby hot water distribution pumps. The boiler room is in good operating condition.

Classrooms are conditioned with unit ventilators and roof top units.
The **classrooms** that are conditioned with unit ventilators typically supplies a total of 1,200 CFM of air with 375 CFM of the total air being ventilation air. The conditioned air is heated with a hot water coil that is interconnected to the hot water distribution system. Unit ventilators provided with enough static pressure to accommodate MERV13 filters.

RTU-6, RTU-9 & RTU-16 located on the roof, supplies a total of 22,950 CFM of air with 3,050 CFM of the total air being ventilation air to the **classrooms** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system or gas fired furnace and cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. Roof top units have enough static pressure to accommodate MERV13 filters.

The current code ventilation requirements are as follows – (Current Code Classroom Ventilation = 10 CFM x Occupant + 0.12 CFM x SF or for a typical 800 square foot classroom with 20 occupants that would be 296 CFM).

H&V-8 located in the mechanical room supplies of 15,500 CFM of air with 6,750 CFM of the total air being ventilation air to the **gymnasium** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. Heating and ventilation unit have enough static pressure to accommodate MERV13 filters. The current code ventilation requirements are as follows - (Current Code Ventilation = 10 CFM x Occupant + 0.12 CFM x SF).

RTU-23 located on the roof, supplies a total of 11,000 CFM of air with 3,000 CFM of the total air being ventilation air to the **library** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system and is cooled with packaged DX cooling.

Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. Space temperature is controlled with several VAV with hot water reheats; The heating/ventilating unit is provided with heating with a hot water heating coil interconnected to the hot water distribution piping system. The roof top unit has enough static pressure to accommodate MERV13 filters. The current code ventilation requirements are as follows - (Current Code Ventilation = 10 CFM x Occupant + 0.12 CFM x SF).

AHU-3 located on the roof, supplies a total of 6,000 CFM of air with 1,000 CFM of the total air being ventilation air to the **auditorium** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system and is cooled with a chilled water coil that is interconnected to the chilled water distribution system and cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters. The current code ventilation requirements are as follows - (Current Code Ventilation = 5 CFM x Occupant + 0.06 CFM x SF).

RTU-20 and RTU-21 located on the roof, supplies a total of 16,000 CFM of air with 3.200 CFM of the total air being ventilation air to the **cafeteria** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return air ductwork distribution system. The roof top units have enough static pressure to accommodate MERV13 filters. The current code ventilation requirements are as follows - (Current Code Ventilation = 10 CFM x Occupant + 0.12 CFM x SF).

RTU-19 located on the roof, supplies a total of 5,130 CFM of air with 500 CFM of the total air being ventilation air to the **administration** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. Space temperature is controlled with VAV boxes with hot water reheats; The heating/ventilating unit is provided with heating with a hot water heating coil interconnected to the hot water distribution piping system. The roof top unit has enough static pressure to accommodate MERV13 filters.

RTU-1 located on the roof, supplies a total of 12,970 CFM of air with 1,300 CFM of the total air being ventilation air to the **graphic arts classroom** and its support spaces. The supply air is heated with a gas furnace and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters.

RTU-2 located on the roof, supplies a total of 10,490 CFM of air with 1,050 CFM of the total air being ventilation air to the **data processing classroom** and its support spaces. The supply air is heated with a gas fired furnace and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters.

RTU-10 located on the roof, supplies a total of 5,600 CFM of air with 560 CFM of the total air being ventilation air to the **business technology classroom** and its support spaces. The supply air is heated with a gas fired furnace and is cooled with packaged DX cooling. Conditioned air is distributed

throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters.

RTU-12 located on the roof, supplies a total of 5,800 CFM of air with 1,000 CFM of the total air being ventilation air to the **masonry classroom** and its support spaces. The supply air is heated with a gas fired furnace and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters.

RTU-14 and 15 located on the roof, supplies a total of 9,000 CFM of air with 1,000 CFM of the total air being ventilation air to the **electric and plumbing classroom** and its support spaces. The supply air is heated with a gas fired furnace and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters.

RTU-17 located on the roof, supplies a total of 5,000 CFM of air with 1,000 CFM of the total air being ventilation air to the **diesel shop classroom** and its support spaces. The supply air is heated with a gas fired furnace and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters.

RTU-22 located on the roof, supplies a total of 11,000 CFM of air with 3,000 CFM of the total air being ventilation air to the **pool** and its support spaces. The supply air is heated with a gas fired furnace and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters.

RTU-25 located on the roof, supplies a total of 6,000 CFM of air with 500 CFM of the total air being ventilation air to the **back stage area**. The supply air is heated with a gas fired furnace and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters.

RTU-26 located on the roof, supplies a total of 3,000 CFM of air with 500 CFM of the total air being ventilation air to the **dining room**. The supply air is heated with a gas fired furnace and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters.

RTU-27 located on the roof, supplies a total of 2,000 CFM of air with 430 CFM of the total air being ventilation air to the **staff dining**. The supply air is heated with a gas fired furnace and is cooled with packaged DX cooling. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. The roof top unit has enough static pressure to accommodate MERV13 filters.

H&V-1, H&V-2 and H&V-3 located in the mechanical room supplies of 21,600 CFM of air with 4,800 CFM of the total air being ventilation air to the **auto shop area** and its support spaces. The supply air is

heated with a hot water coil that is interconnected to the hot water distribution system. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. Heating and ventilation unit have enough static pressure to accommodate MERV13 filters.

H&V-4 located in the mechanical room supplies of 7,000 CFM of air with 1,000 CFM of the total air being ventilation air to the **welding shop area** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. Heating and ventilation unit have enough static pressure to accommodate MERV13 filters.

H&V-5 located in the mechanical room supplies of 6,000 CFM of air with 1,000 CFM of the total air being ventilation air to the **machine shop area** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. Heating and ventilation unit have enough static pressure to accommodate MERV13 filters.

H&V-6 located in the mechanical room supplies of 3,000 CFM of air with 1,500 CFM of the total air being ventilation air to the **electrical shop area** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. Heating and ventilation unit have enough static pressure to accommodate MERV13 filters.

H&V-7 located in the mechanical room supplies of 3,000 CFM of air with 1,500 CFM of the total air being ventilation air to the **electronics shop area** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. Heating and ventilation unit have enough static pressure to accommodate MERV13 filters.

H&V-10, H&V-11 and H&V 12 located in the mechanical room supplies of 26,750 CFM of air with 22,50 CFM of the total air being ventilation air to the **kitchen area** and its support spaces. The supply air is heated with a hot water coil that is interconnected to the hot water distribution system. Conditioned air is distributed throughout the space with a supply and return ductwork distribution system. Heating and ventilation unit have enough static pressure to accommodate MERV13 filters.

The Kitchen is provided with a Kitchen Hood Exhaust and general exhaust systems.

Hallways are typically ventilated through the heating/ventilating unit that serves the space in the immediate area; vestibules are provided with hot water cabinet unit heaters.

Bathrooms, Janitor's Closets, Storage, 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 mostly pneumatic controls with some electronic controls for energy conservation measures (building occupied/unoccupied operation, boilers, variable speed pumps, etc.).

General Recommendations

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. The unit ventilators, heating/ventilating unit and air handling unit systems 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.
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. Consider providing antimicrobial door mats at high traffic entrances to the building.
10. 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 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; where existing equipment will not be able to support the associated pressure drop of these filters, the 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 spaces without mechanical ventilation, open windows 2 hours before and after occupied periods.

Centralized Heating/Ventilating Unit Systems: General information

- For central rooftop or air handling 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 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 Heating/Ventilating Unit 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 "Continuous Occupied 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

Conclusions

Based on applicable guidelines, the Shawsheen Valley Technical High School 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:

1. Create a "Continuous Occupied 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 and heating/ventilating 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. Continued operation of heating and cooling systems is recommended.
4. 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.
5. Provide warning signs and consider diverting or rearranging the exhaust air discharge locations so that they would pose no opportunity to cause harm.
6. Where mechanical ventilation and exhaust are not currently provided, utilize operable windows.
7. Eliminate outdoor air to zones that are not occupied to better use in occupied areas.
8. Relocate occupants from areas that do not have mechanical ventilation or operable windows.
9. Use operable windows when outdoor air conditions allow.
10. Keep conference room doors open as much as possible or open windows when feasible.
11. Increase regular maintenance of all mechanical heating, ventilating and air conditioning equipment.
12. Monitor the heating, ventilating and air conditioning operation of the building on a continual basis.
13. Follow recommendations of holistic view of building recommendations in General Recommendations.

Tier 2 Recommendations:

1. Provide additional filtration with portable HEPA filter units or UV filtration units for heating/ventilating units with large percentages of recirculation air that may be used as classrooms (Library, Multipurpose Room, etc.).
2. Add plug-in type supplemental electric heat as required for increased ventilation requirements through equipment or operable windows.
3. Apply and use outdoor air quality sensors or reliable web-based data for outdoor pollution information as part of the new ventilation operation.
4. Consider adding UV decontamination in return airstream for heating/ventilating units for Gymnasium, Mulit-Purpose Room, Cafeteria and Library.
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.
2. While there is ventilation air and return air associated with heating/ventilation units for the Gymnasium, Cafeteria and Library 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.