BALA

**CITY OF NEW BEDFORD SCHOOLS**

**HVAC SYSTEM ASSESSMENT REPORT FOR NORMANDIN MIDDLE SCHOOL RE-OPENING**

A. General:

1. The purpose of this report is to provide an overview of the potential measures that may be applied to the building HVAC systems and spaces to make a safer environment for students, teachers and staff to return to school this year. The diversity of space types and systems require several different solutions and strategies to be considered to improve the interior environment.

2. This report does not make recommendations on occupant density, reconfiguration of spaces, cleaning procedures, or implementation of touch-free procedures. The School is urged to seek guidance from the state on these and other issues.

3. This report does not make any certification, determination nor render any opinion, as to whether the building reviewed within this assessment is safe to reoccupy or not. Determination to reoccupy the building is the sole purview of the Superintendent of Schools for the City of New Bedford.

4. Buildings included within this report are:

   a. Normandin Middle School; visited on 9/3/2020; 10:30 AM. Normandin School delegate present during site tour: Mr. Mark Sousa.

B. Potential Strategies:

1. Enhanced Filtration:

   a. The ability to add higher efficiency filters in air systems can provide some level of protection, however most systems are limited. The thickness of the existing filter systems is one factor that can limit the level of efficiency that can be achieved. Another consideration is that higher efficiency filtration typically has a higher pressure drop when compared to the same air flow.

   b. Where filters are limited to 2-inch thickness, a filter efficiency rating of MERV 8 is typically used. The highest efficiency level that can be achieved with 2-inch filters is MERV 13, but these filters must be stored in a dry location to maintain their effectiveness. Filters with a MERV 13 rating can capture up to 75% of aerosolized virus particles.

   c. Where systems have 12-inch cartridge or bag filters, efficiencies of at least MERV 16 may be possible. These filters can capture up to 95% of viruses carried by aerosols.

   d. The high pressure drop associated with higher efficiency filters will cause a reduction in the air handling system air flow capacity. This may not be significant for larger systems but can be noticeable on smaller systems. Variable air volume systems can overcome this additional loss to some degree, but the peak capacity will still be somewhat limited.

   e. HEPA filters would offer even more protection, but they come with an even higher pressure drop and they typically require twice the filter area.

f. It is recommended that appropriate precautions be taken when dirty filters are removed from the systems, since active viruses may be present.

2. UV-C Irradiation:

a. Ultraviolet germicidal irradiation (UVGI) using UV-C lamps is one strategy that can be applied to kill viruses in the air stream. These systems may be applied in-duct or inside air handling units. Other systems are available for treatment at the space level, but these are not viewed as a primary method for UV-C application.

b. Prior to the advent of the pandemic, UV-C systems had typically been applied as a treatment for irradiating coils in air handling units to eliminate microbial growth that causes a biofilm to develop which leads to reduced coil efficiency. As a result, many companies have not fully developed and tested in-duct applications. Companies that provide fully developed commercial solutions should be considered over companies that specialize in residential solutions.

c. Properly designed systems can be installed in the supply ductwork where sufficient straight ductwork exists. Systems can also be installed inside air handling units where space permits.

d. In-duct systems require high intensity UV lamps to be effective due to the limited amount of exposure time as air flows through the system.

e. UV lamp life is typically about 19,000 hours or two years. Depending on the hours of use the lamps may last longer, but their effectiveness will degrade over time which should be monitored.

f. UV-C systems should be interlocked to deenergize when the air system is shut down.

g. In-duct UV-C systems become less useful when the respective system is operating in economizer mode since larger amounts of outside air means less recirculated air. Consider de-activating economizer mode when the UV-C system is in operation.

3. Bipolar Ionization:

a. The application of bipolar ionization (BPI) is more developed for in-duct applications and provides an effective means for deactivating airborne viruses by attraction to positive and negative ions which then aggregate into larger particulates in the air and are then either filtered out or drop out of the airstream. In-duct installations for BPI have little restrictions.

b. BPI systems utilize needlepoint ionization or ionization tubes. Like UV-C lamps, ionization tubes have a useful operating life of approximately two years depending on conditions and will therefore need to be replaced periodically. Needlepoint systems also require regular maintenance to clean the elements.

c. In-duct BPI systems should be installed in the supply air duct to deliver the ionized molecules to the occupied space where they can interact with the room air.

d. BPI systems are not reduced in effectiveness when the respective system is operating in economizer mode since it is acting downstream in the space. Therefore, systems with economizer outside air control can continue to benefit from the free cooling as well as the higher amount of outside air.

e. As with UV-C systems, BPI systems should be interlocked to deenergize when the air system is shut down. An airflow switch may be used for this purpose.

f. BPI systems are also available for small air systems such as fan coil units, unit ventilators, ductless split units. These systems can be installed on the fan housing near the air inlet inside the unit.

4. Control Strategies:

a. Control strategies can be used to help reduce the level of virus concentration in occupied spaces. These strategies can include the following: Pre-occupancy and post-occupancy flush-out, extended hours of system operation, override of variable air volume controls, override of demand ventilation controls.

b. In addition to supply air and ventilation air strategies, exhaust systems can also help to reduce the level of virus contamination in spaces. Setting toilet room exhaust systems to operate continuously should be considered, since these spaces can potentially be a source for high contamination. Hands-free faucets and toilet fixtures should also be considered.

c. Classroom exhaust systems can be set to run continuously or at least operate for extended hours before and after occupancy to help flush the space. This should be done in conjunction with the operation of ventilation systems that deliver a corresponding amount of outside air to prevent negative pressurization and associated problems.

5. Other Strategies:

a. Increasing the minimum outside airflow settings for air handling systems would generally be limited to a 10% to 30% increase at the expense of higher energy use and a reduction in system capacity available for space cooling. Increasing minimum outside air settings only provides a marginal improvement at the space level. Where other technology-based solutions are applied, there would be little reason to increase outside air flow.

b. Controlling pressure relationships between spaces can provide a small measure of protection but would require a detailed evaluation to determine if there is an overall benefit.

C. Strategies for Various System Types:

1. Mixed/Recirculation Air Systems:

a. These systems typically provide supply air to multiple spaces using ductwork. A portion of the supply air includes outside air that is mixed with return air in the air handling unit before it is delivered to the space. These systems may also provide economizer cooling using up to 100% outside air when ambient conditions permit. Since these systems recycle air and serve multiple spaces, they provide an opportunity to apply centralized solutions. Rooftop units fall into the category or mixed air systems.

b. Provide enhanced filtration wherever possible. Since these systems at the school have 2-inch filters, MERV 13 filters should be considered. Note that these filters will collect more particulates and may tend to load up quicker than low efficiency filters. Therefore, more frequent filter changes should be planned.

c. Bipolar ionization systems should generally be considered over UV-C systems. These can be readily applied to all different system sizes with little restrictions.

d. Consider extended hours of operation after occupancy to further reduce airborne concentrations, especially where bipolar ionization is applied. Up to four hours of extended operation should be considered.

D. Normandin Middle School, HVAC systems description (based upon room type):

1. Typically, all classrooms are served by unit ventilators (sill mounted or ceiling recessed) which utilize exterior louvers to bring in fresh, outside air, to the classroom. Classrooms are also provided with finned tube radiation that spans the exterior walls. All classrooms utilize operable windows. The unit ventilators utilize 1-inch thick, Merv7 or 8, filtration. Additionally all classrooms are provided with one exhaust grille to extract air from the room to maintain neutral pressurization to the adjacent corridor.


**Picture #1: Typical Classroom with sill mounted Unit Vent**


**Picture #2: Typical Classroom with ceiling recessed Unit Vent**

2. Corridors are provided with no means of ducted or natural ventilation (outside air). The only HVAC system that was readily apparent were wall mounted cabinet unit heaters which simply recirculate air within the space for heating purposes.

3. The Library and Administrative offices are served by DX-rooftop units, that deliver tempered and filtered air via a ducted system to the building. Based upon observation of the rooftop units the reviewing engineer believes the RTUs employ MERV7 or 8 filters. Additionally the library is provided with finned tube radiation for use during the heating season.

**Picture #3: Library**

**Picture #4: Typical RTU filtration**

4. The combination Cafeteria / Auditorium is served by rooftop units that provide heated and filtered air to the space via a ducted distribution system.

**Picture #5: Cafeteria / Auditorium**

5. The Gymnasium is served by similar rooftop units as the Cafeteria / Auditorium.

6. Additional air moving units were found on the roof of the building. Reviewing engineer was unable to ascertain the spaces being served by these units. These units appear to be energy recovery devices that may be providing untampered, but filtered, outside air to any one of the following spaces: Gymnasium, Café / Auditorium.

**Picture #6: Typical Energy Recovery Unit**

E. COVID Mitigation Measures to implement:

1. Classrooms with unit ventilators are recommended to apply strategies above for Unit Ventilators. In addition, the unit ventilators, classroom exhaust fans and transfer fans are recommended to run for extended hours.

2. The corridor/ lobby space does not appear to have any ventilation system. It is recommended that an energy recovery ventilator (ERV) be installed to provide the code required ventilation air or greater to offset any exhaust systems in the building with makeup air. A BPI unit is recommended to be provided in the supply air from the ERV and the unit is recommended to include 4-inch MERV 13 filters if possible, or 2-inch MERV 13 at a minimum.

3. All ducted Rooftop units and Energy recovery units serving the building are recommended to apply the strategies above for enhanced ventilation, UV-C radiation within the rooftop unit DX cooling section only, bipolar ionization within the supply ductwork, pre and post occupancy flush-out, recalibration of existing outside air control damper, and increase of air filtration. Additionally, all exhaust fans are recommended to utilize enhanced ventilation and pre / post occupancy flush-out control strategies.