



RESET

PRINT



Efficient HVAC Operation during a Pandemic

Self-evaluation Tool and Guide

Natural Resources Canada has developed this voluntary, self-assessment Tool to provide feedback on the impact of your HVAC strategies during and after pandemics. It highlights key areas and best practices for efficient HVAC operation during these times and help your operations team to respond with greater confidence.



Please Note

This voluntary, self assessment tool has been tested with a variety of property managers and operations staff. The objective is to share reputable advice on the critical HVAC elements in response to the pandemic period while optimizing energy use in a commercial office, based on recognized sources. However, this tool is not intended to guarantee that an HVAC system will prevent the spread of disease or virus.

This tool is provided free of charge for you on the NRCan website, but data entered WILL NOT be retained by NRCan. We also welcome your comments, which you may send to:

COMMENTS ARE WELCOME:

nrcan.buildings-batiments.nrcan@canada.ca

Please include "Comments on the HVAC assessment tool" in the subject.

DISCLAIMER

Please note that ongoing research is being conducted on the impact of the COVID-19 pandemic as it relates to HVAC requirements, including ventilation, filtration, and relative humidity. The transmission of the disease is not yet fully understood. NRCan is not qualified to provide guidance on potential health effects of HVAC configurations.

This tool reflects NRCan's best understanding of possible HVAC configurations, as of its release date of March 12, 2021. Please seek additional input from your provincial and/or local health care officials.



Introduction

The COVID-19 pandemic caught everyone off guard and introduced the need of a "New Norm" on a global scale. This new norm extends to the operation of heating, ventilation and air conditioning (HVAC) systems in commercial buildings and institutional.

The purpose of this voluntary self-assessment tool is to provide feedback on the energy efficiency impact of your HVAC strategies. More specifically, the following assessment and guidance will:

1. Emphasize the Existing Building Commissioning (EBCx) approach and its application to help owners undertake HVAC operation changes. NRCan's 4-phase EBCx process can often achieve savings of 10 to 15%, as well as other non-energy benefits.
2. Highlight where HVAC operation can be improved to meet energy efficiency best practices without compromising current pandemic HVAC operations guidelines.
3. Provide resources and references that can help guide you in determining an enhanced HVAC operations strategy and plan during a pandemic.

“The greatest danger in times of turbulence is not the turbulence; it is to act with yesterday’s logic”

Peter Drucker

Since each building and HVAC system are unique, with their unique requirements, the tool cannot recommend specific operating parameters. Instead, the tool is based on a series of 10 questions that focus on the most important elements to consider for the efficient operation of HVAC systems during a pandemic. These elements were taken from recognized resources in the HVAC industry as well as the best practices recommended by these organizations.

This tool is focused on commercial offices but can be used with caution for other facilities that have similar occupancy. For sectors that have very specific sanitary requirements, such as the Health Care Sector, additional considerations are naturally required. Each question has a brief reference or additional resource to help provide context. Space is also provided to comment on the respective response.



General Information

This assessment tool should be completed with management and operations to achieve the best result. The additional advantage is obtaining mutual support and an appreciation of the issues from a better understanding of the HVAC system, operation, and maintenance

Property	<input type="text"/>
Location	<input type="text"/>
Prepared for	<input type="text"/>
Prepared by	<input type="text"/>
Date (yyyy-mm-dd)	<input type="text"/>

Brief Building Description

Example: This 2002 five story commercial office has the original BAS, constant volume HVAC systems and continues to operate as originally intended but with increased occupancy and extended hour: 7 am to 7 pm M-F and on request for weekends and holidays.

Pre-pandemic Building Annual Energy Intensity: GJ/m²

Current Building Annual Energy Intensity: GJ/m²

HVAC System Description

Floor area m²



General Information

SUGGESTED APPROACH IN COMPLETING THE HVAC SELF-ASSESSMENT TOOL

1. The time required to complete this tool is estimated at 30 minutes. Make sure to involve both operations and building management staff when completing the tool, either on site or virtually. Regardless of the method chosen, it remains important to have both managers and operating staff in order to have the different points of view concerning the operation of the building.
2. Review the Current Facility Requirements (CFR), an example is provided in Appendix A. During a process of optimizing the operation of HVAC systems, performance targets are required. These should be clearly specified in a CFR document, which takes into account pandemic requirements. Such a document is often little known, although it is essential in an optimization process.
3. Use the 'Comment' space to make notes: Each question includes a space to make a comment. This is extremely helpful when deciding on next steps or reviewing the response with others.



Example Question and Response

Q

“Questions about the characteristics of the system will be posed ”

- 0 pts** If none of the suggested changes are made, 0 pts.
- 5 pts** If some of the suggested changes are made, 5 pts.
- 10 pts** If all of the suggested changes have been made, 10 pts.

Comment: Comments provide an excellent opportunity to understand the system and the reason for selecting the respective answer. Comments also allow limitations or conditions to be defined for specific instances.

OPERATIONAL PARAMETERS



Filtration

Q1

“Have mixed air filters used in your air handling units been modified?”

- 0 pts** No changes have been made to the filters.
- 5 pts** Filters have been upgraded to MERV 13 or more without an estimate on the impact.
- 10 pts** Filters have been upgraded to MERV 13 or more with complete evaluation of its impact on airflow and energy consumption.

Comment:



Filtration

ASHRAE is currently recommending a minimum of MERV 13 for filters in mixed air systems with MERV-14 being preferred. Filters for 100% outside air system typically do not need to be upgraded unless exhaust air re-entrainment is identified. Filters on zone-level systems, such as fan-coils and heat pumps should be increased as much as the equipment will allow.

For more information, please refer to the ASHRAE position document on aerosols: https://www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf

FILTERS MERV LEVELS

Standard 52.5 Minimum Efficiency Reporting Value	Dust Spot Efficiency	Arrestance	Typical Controlled Contaminant	Typical Applications and Limitations	Typical Air Filter/Cleaner Type
20	n/a	n/a		Cleanrooms Radioactive	>99.999% eff. On .10-.20 pm
19	n/a	n/a	< 0.30 pm particle size Virus	Materials Pharmaceutical	Particles Particles Particulates
18	n/a	n/a	(unattached) Carbon Dust	Man.	>99.97% eff. On .30 pm Particles
17	n/a	n/a	All Combustion smoke	Carcinogenetic Materials	
16	n/a	n/a	.30-1.0 pm Particle Size	General Surgery	Bag Filter- Nonsupported microfibre fiberglass or
15	>95%	n/a	All Bacteria	Hospital Inpatient Care	synthetic media, 12-36 in. deep, 6-12 pockets
14	90-95%	>98%	Most Tobacco Smoke	Smoking Lounges	Box Filter- Rigid Style Cartridge Filters 6 to 12"
13	89-90%	>98%	Proplet Nucli (Sneeze)	Superior Commercial Buildings	deep m ay use lofted or paper media.
8	30-35%	>90%	3.0-10.0 pm Particle Size	Commercial Buildings	Pleated Filters- Disposable, extended surface area, thick with cotton-polyester blend media, cardboard frame
			Mold Spores		



Filtration

Q2

Was the filter maintenance and filter rack inspection schedule modified?

- 0 pts** No changes were made to the racks and filter installation have not been verified more than quarterly.
- 5 pts** Filters are inspected monthly, racks are not part of the routine maintenance.
- 10 pts** Filters are checked at least monthly to minimize pressure drop and changed based on pressure differential. Racks are inspected to eliminate gaps.

Comment:



Guide

Even small gaps around filters or the filter rack can drastically reduce the effective efficiency of your filters. A single cm gap between MERV 13 filters reduces their effectiveness to that of MERV 8. Filter can be taped together to drastically reduce bypass and gaps between the rack and air handler can be sealed.



Example of filter rack assembly allowing significant air flow bypass



Outside Air

Q3

Has the occupied period minimum outside air flow been modified?

- 0 pts** No changes.
- 5 pts** Outside air flows have been increased to meet the most recent ASHRAE 62.1 standard or applicable code, (whichever provides the greatest flow.) but the impact on energy consumption has not been quantified.
- 10 pts** Outside air flows have been maximized based on system type, installed filtration levels and practical constraints using an EBCx or equivalent approach.

Comment:



Guide

The increase in outdoor air flow is an important factor in adapting the HVAC system for pandemic operations. This increase must be done while ensuring adequate operation of the system. Specifically, by evaluating the ability of the system to heat, cool and humidify additional outside air (OA). The increase in outdoor air flow should not be done without appropriate assessment of its consequences. Combining improved filtration efficiency (higher MERV) may allow using lower OA flow rates in some systems. The increase in flow should always be considered in combination with the changes to the filter system. Some models exist to demonstrate the impact of filtration and outdoor air, including that of the National Institute of Science and Technology (NIST), visit this [page](#).



Percent damper opening is not a good measure of percentage of outside air flow since damper opening and flow do not vary linearly



Outside Air

Q4

Have un-occupied ventilation schedules been modified?

- 0 pts** No change compared to pre-pandemic conditions.
- 5 pts** All systems run 24/7 with outside air regardless of Current Facility Requirements (CFR) or energy impact.
- 10 pts** Schedules have been adapted to meet the CFR and the required pre- and post-OA purges as recommended by ASHRAE using an EBCx or equivalent approach.

Comment:



Guide

ASHRAE recommends performing a pre-occupancy and post-occupancy purge resulting in a total of 3 changes of outside air for each purge. To this end, it is therefore important to know the outdoor air flow of each air handling unit and the volume of spaces served by each unit. For more details, see [this document](#).

Calculator: Air Changes Per Hour

$$ACH = \frac{\text{Airflow (CFM)} \times 60}{\text{Area (ft}^2\text{)} \times \text{Height (ft)}}$$

ACH = Air Changes per Hour **CFM** = Cubic Feet per Minute



Outside Air

Q5

Has the operation of Demand Control Ventilation and Outside Air Heat Recovery been modified?

- 0 pts** Either DCV or HR systems are being used without modifications compared to pre-pandemic conditions.
- 5 pts** DCV systems are disabled and all HR systems have stopped.
- 10 pts** DCV systems are disabled and HR systems have been evaluated based on ASHRAE's guidelines and stopped where required or there is no HR or DCV.

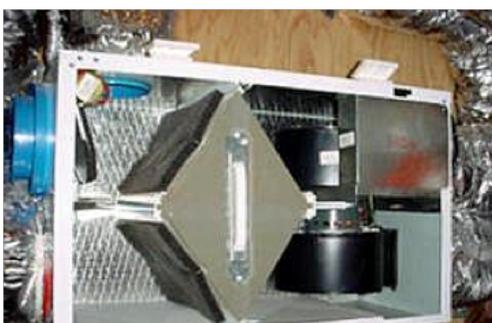
Comment:



Guide

ASHRAE has specific guidance for using air-side heat recovery systems during pandemic conditions. The guidance is provided in the **this document**. It shows that systematically stopping all heat recovery systems is not the most appropriate procedure. Each system must be considered based on its configuration and the ASHRAE document guidelines should be followed when determining if the heat recovery system should be stopped.

For demand control ventilation, the following ASHRAE document "Guidance for Building Operations During the COVID-19 Pandemic", ASHRAE Journal, May 2020 states that such system should be disabled and this position is also restated in the **ASHRAE guidance**.





Humidification

Q6

Have humidification adjustments been made?

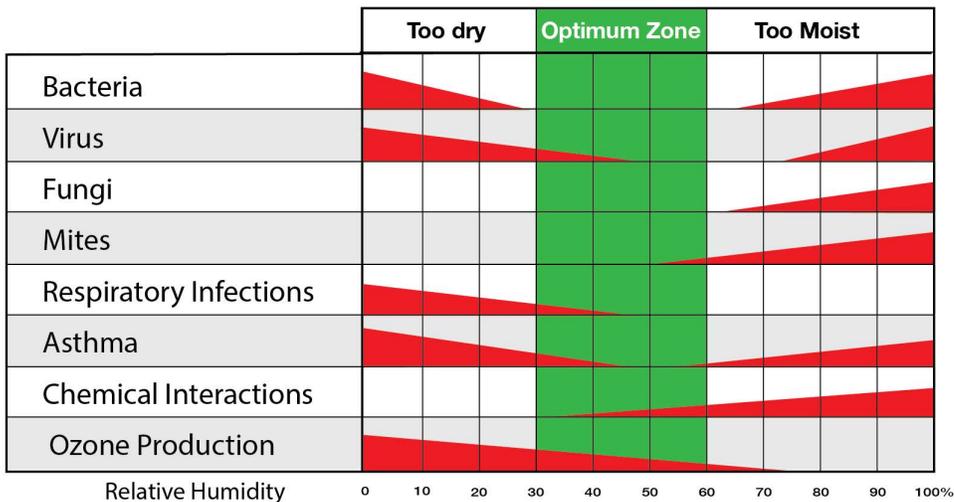
- 0 pts** Humidification is provided using pre-pandemic set points.
- 5 pts** Set points were increased without consideration on the impact on the thermal envelope or energy consumption.
- 10 pts** Humidification set points are increased to meet recommended values within practical constraints using an EBCx or equivalent approach or there is no humidification.

Comment:



Guide

ASHRAE is currently suggesting adjusting the humidification set points between 40 to 60%. It is important to note that ASHRAE also acknowledges that this is not necessarily practical for all building types, especially in colder climates. Prior to increasing set points, an evaluation of the potential impact on the building envelope should be done as well as the impact on any increase in outside air flows.



Source: ASHRAE, American society of heating, Refrigeration and Air-Conditioning Engineers. A decrease in the bar height indicates a decrease in effect.



Maintenance

Q7

Have the Preventive Maintenance (PM) procedures for air handling units been modified?

- 0 pts No change to the PM program, including filters.
- 3 pts An in-house review of the PM procedures and schedule has been done. Modifications were implemented to account for the new operating practices, such as filter type.
- 7 pts In-house review performed as per previous point but also taking into consideration ASHRAE's recommendation on maintenance during pandemic condition as well as the new operating practices.
- 10 pts Full review of the PM program as per the previous point complete with inspection and testing of the air handling units, like an EBCx approach.

Comment:



Guide

Proper operation is essential. CDC suggests, as a minimum, the use of the ASHRAE Standard: “Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems”. Specific items to be verified include proper operation of washroom exhaust fan to maintain these spaces in negative pressure, proper operation of outside air dampers, and adequate schedule for filter replacement.

In addition, ASHRAE presents specific instructions on personal protective equipment during maintenance of air handling units. For more details, see [this link](#).





Operation

Q8

Current Facility Requirements (CFR)

CFR defines the operating parameters and can provide targets to optimize operations

- 0 pts** Facility has no documented CFR.
- 5 pts** An informal discussion on the changes to the building CFR was done with the operating team but not formalized.
- 10 pts** A formal review of the CFR has been done and the operating team has been trained on how it should be implemented.

Comment:



Guide

Current Facility Requirements (CFR) is a document that details the operating requirements of an existing facility and the expectations of how it should be used. CFR defines the operating parameters and can provide targets to optimize operations during the pandemic period. The CFR requires management approval in cooperation with operations. For a sample CFR refer to Appendix A.



Existing Building Recommissioning

Q9

Existing Building Commissioning (EBCx)

EBCx provides a proven and systematic approach to meet the CFR for the pandemic period.

- 0 pts** EBCx has not been considered or has not been done recently (within 5 years).
- 5 pts** An in-house system review and inspection has recently been by performed by the operating team.
- 10 pts** A formal EBCx has recently been performed complete with preparing a formal CFR.

Comment:



Guide

EBCx is a systematic process to improve an existing building's performance. As such it is perfectly suited to ensure that a building's operation is adapted to new operating procedures such as those that may be implemented during a pandemic. It provides a thorough, systems approach-based evaluation to identify problems and integration issues. It can thus identify savings opportunities while implementing the pandemic-related operational changes. The main objective of EBCx is to determine low cost/no cost operational improvements that can be made to the building while still meeting the CFR. NRCan provides a free **pre-screening tool**.



Training and Communication

Q10

Was a Training and Communication plan prepared for the revised HVAC system operation?

- 0 pts** No formal training has been provided on HVAC operations.
- 5 pts** Management has advised Operators on the new operations but without formal training.
- 10 pts** Formal training was provided to the O&M personnel, and a documented HVAC response strategy is available. Tenants are informed of the HVAC response strategy.

Comment:



Guide

Management and Operations must be united in understanding the HVAC response to the pandemic in order to assure occupants and tenants that best practices are being followed which will allow that level of assurance needed to feel secure.



FINAL SCORE AND SUGGESTIONS

Potential improvement index for the changes made to your HVAC operation due to the pandemic
(Add scores for questions 1 to 10)

Total score	Improvement Possibility
0 - 50	Only minor changes were made and a revision of the operation should be considered taking into account the energy impact.
50 - 75	Significant changes have been made but energy efficiency has not been optimized and the potential is significant.
Over 75	Significant changes have been made and energy efficiency has been optimized and the additional potential is modest.

Total score

Comment



Typical Next Steps

Each property will have their own next steps. This space is set aside to help initiate action. Here are some examples:

- a) Develop a HVAC strategy so that all team members understand the issues and their importance.
- b) Document and discuss the HVAC strategy with members of the operations and management team so that they are prepared to implement them adequately.

What are your next steps?

Steps	Improvement Possibility
1	
2	
3	



Final Thoughts and Resources

Through the review of this tool, your next steps may be to review low scoring questions and associated references to help develop an enhanced HVAC operations strategy and plan with consideration for each building's specific requirement and configuration.

Additional next steps could include exploring approaches such as those found in the Existing Building Commissioning (EBCx) process that lead to optimized building operations in key areas of indoor air quality, comfort, and energy savings.

As we continue to learn and evaluate options, the ability to optimize HVAC operation, in accordance with recommended best practices, will increase. As you remain engaged and proactive in providing the highest level of care by keeping informed and searching for "tomorrow's logic", we trust this tool and guide will also be of assistance.

ASHRAE, Fitwell, CDC and other organization acknowledge that adherence to best practices can not eliminate the risk from COVID-19 or other airborne diseases. Similar to HVAC resources there are resources from health authorities for safe operations, such as Health Canada that should be consulted: <https://www.canada.ca/en/health-canada.html>.

Natural Resources Canada provides EBCx and additional information free-of-charge and online: NRCan EBCx.

BOMA Canada has been very proactive and developed this 66-page guide: Pathway back to Work; <http://bomacanada.ca/pathway-back-to-work>.

Your feedback and suggestions to improve the tool Feedback and suggestions to improve the tool are welcome!

Please contact: nrcan.buildings-batiments.nrcan@canada.ca . Please include "HVAC Assessment Tool feedback" in the Subject line of the email.

ACKNOWLEDGEMENTS

Natural Resources Canada would like to thank the following organizations for their assistance during the development of the tool:

Energy@Work Inc., Technosim, and the numerous organizations that have provided comments guidance and improvement suggestions.

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Appendix B: Sample Current Facility Requirements (CFR)

Objective of the CFR:

To help management and operations agree and document space requirements, typically based on lease requirements or special provisions defined by the owner

Section 1.0: Building Information and Purposes		
1.1 Building Information		
Property	Building 123	
Contact (s)	xxx@gmail.com	XXX
Date	14-Nov-20	
Comments	XXX met with operations and management on November 14th.	
	Purpose was to enable NRCan's Assessment Tool to be completed.	
1.2 CFR's Purposes:		
1	To determine "Non-Routine" energy adjustments for ventilation, filtration, disinfection, etc.	
2	To document industry HVAC best practices based on advice from ASHRAE, Fitwell, etc.	
3	To ensure operations have clear and approved directions on HVAC objectives	
4	To provide confidence than an 'approved' & appropriate response is in place	

Section 2.0: Original HVAC Requirements

#	Requirement	Typical for the Building a	Special Spaces	Notes
1	Filtration	MERV 8 Mixed Air		
		MERV-10 100% outside air systems		
2	Humidity			
	Winter	N/A		
	Summer	N/A		
	Holidays	N/A		
3	Temperature			
	Winter	20°C (68°F) < T < 24°C (75°F)		
	Summer	23°C (73°F) < T < 26°C (79°F)		
4	Ventilation	N/A		
5	Disinfection	N/A		
6	Operating Hours			
	Monday to Friday	7 am to 7 pm		
	Saturday	On request only		
	Sunday	On request only		
	Holidays	On request only		
7	Operation Practice	Monthly Inspection		
8	Pressure	(+) 0.01 kPa diff. pres. between building interior and outside environment		
9	Noise	55-60 dB from outdoor ambient noise		
10	Light level	300 Lux at task surface		
11	CO ₂ Levels	700 ppm above ambient		
12	Other	None		

Section 3.0: New Requirements

#	Requirement	Typical for the Building a	Special Spaces	Notes
1	Filtration	MERV-10 100% outside air systems		
		Upgrade to MERV 13 in Mixed Air		
2	Humidity			
	Winter	30% to 35%		This will depend on building envelope
	Summer	40% to 50%		
	Holidays	N/A		
3	Temperature			
	Winter	20°C (68°F) < T < 24°C (75°F)		
	Summer	23°C (73°F) < T < 26°C (79°F)		
4	Ventilation	Meet ASHRAE 62.1 (2013)		Excluding DCV
5	Disinfection	N/A		
6	Operating Hours			
	Monday to Friday	5 am to 9 pm		3 air change purge
	Saturday	8 am to 4 pm		New Hours
	Sunday	On request only		
	Holidays	On request only		
7	Operational Practices	Weekly Inspection		Refer to operational procedures
8	Pressure	(+) 0.01 kPa diff. pres. between building interior and outside environment		
9	Noise	55-60 dB from outdoor ambient noise		
10	Light level	300 Lux at task surface		
11	CO ₂ Levels	DCV not to be used during a pandemic		
12	Other	Refer to Operational procedures		

Section 4.0: Check Energy Impacts

#	Requirement	Impact	Comment
1	Filtration	Increase in filtration level	Additional electricity of xx kWh
2	Humidity	Increased Humidity	Additional electricity of xx kWh
3	Temperature	No impact to energy use	
4	Ventilation	Increase in Energy Use	Additional electricity of xx kWh and m ³
5	Disinfection	No impact to Energy Use	
6	Operating Hours	Increase in Energy Use	Additional electricity of xx kWh and m ³
7	Operation Practice	No impact to energy use	
8	Pressure	No impact to energy use	
9	Noise	No impact to energy use	
10	Light level	No impact to energy use	
11	CO ₂ Levels	No impact to energy use	
12	Other	No impact to energy use	

Section 5.0: Background and References

CFR will vary for each building and depending on space requirements but typically include:

Temperature	
Humidity set points	
Operating Hours	
Filtration	
Ventilation	
Noise and/or Vibration	
Operational Practices	
Specialty Needs	Ventilation based on Air Changes (AC)
	Disinfection in HVAC systems

Helpful resources to properly evaluate the impacts of changes to the CFR

i)	Existing building commissioning for energy using systems	CSA Z5001:20, Aug. 2020
ii)	NRCAN EBCx Guide	Refer to Page 113



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