

# Recommendations for HVAC and Domestic Water Systems when Re-Opening Facilities after Periods of COVID-19 Dormancy

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Pathogens, like COVID-19, that cause infectious disease are transmitted from primary hosts to secondary hosts by several different routes, including as bioaerosols. Within buildings, pathogen spread can be impacted by airflow patterns. Thus, operating HVAC equipment can impact pathogen transmission. Ventilation and filtration provided by HVAC equipment can help reduce airborne concentrations of bioaerosols. This document offers recommended operational and maintenance practices through which HVAC systems can help decrease building occupants' exposure to infectious bioaerosols.

In light of available information and accepted industry practices, the COVID-19 task force members of the Detroit and Western Michigan Chapters of ASHRAE have used their best efforts in the development of these recommendations for the benefit of building owners, managers, and occupants in Michigan. However, we do not guarantee, verify, or assure that the safety or performance of any products, components, or systems, tested, installed, or operated in accordance with these recommendations will be free from risk.

Information on COVID-19 is emerging and rapidly evolving. The suggestions in this document should be considered along with the specific characteristics and requirements of your building as well as all owner and occupant criteria, and all Executive Orders from the Michigan Office of the Governor.

## General Recommended Actions for All Equipment and Systems

- Review your current facility or building systems manual, sequences of operation, and setpoints.
- Document all changes to the existing operating protocols.
- Establish a date to review temporary procedures and return to normal operations.
- Verify that all facility operators and management personnel are aware of all changes in operating procedures and have received appropriate training.
- Advise building occupants that temporary changes are in effect, that the building may slightly less comfortable, and that they should (1) advise building operating staff of any issues or concerns, (2) dress appropriately, and (3) not use ceiling fans, personal fans, or space heaters with internal fans.
- Monitor, track, and if possible, trend impacts of temporary operating procedures.
- At the appointed time, review impacts of temporary procedures and determine whether to return to previous protocols & setpoints.
- Document any additional changes in operating protocols & setpoints and communicate them to the building operations team.
- For additional guidance, see:
  - ASHRAE Position Document on Airborne Infectious Aerosols
  - ASHRAE Standard 180: Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems
  - ASHRAE Standard 62.1: Ventilation for Acceptable Indoor Air Quality
  - ASHRAE Standard 55: Thermal Environmental Conditions for Human Occupancy
  - ASHRAE Standard 188: Legionellosis: Risk Management for Building Water Systems
  - ASHRAE Guideline 12: Managing the Risk of Legionellosis Associated with Building Water Systems
  - ASHRAE Guideline 29: Guideline for the Risk Management of Public Health and Safety in Buildings
  - "Developing a Water Management Program to Reduce Legionella Growth & Spread in Buildings" by the U.S. CDC
  - NSF Protocol P453: Cooling Tower Water Systems – Treatment, Operation, and Maintenance to Prevent Legionellosis
  - CTI Guideline 159: Practices to Reduce the Risk of Legionellosis from Evaporative Heat Rejection Equipment Systems
- For assistance, consult your local engineer specializing in HVAC and/or water systems, water treatment specialist, and/or equipment manufacturer's representative.

### Acronyms:

HVAC- Heating Ventilating and Air-Conditioning

IAQ- Indoor Air Quality

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Equipment or Component	Recommended Actions <sup>1,2,3</sup>	Notes of Caution
Building Water Service, Piping and Plumbing Fixtures	<p><u>At least 4 days prior to re-opening:</u></p> <ul style="list-style-type: none"> <li>• Check with your local water utility to obtain the chlorine level that should be present in your water.</li> <li>• If you do not have them already, purchase a chlorine test kit and thermometer.</li> </ul> <p><u>Flush all mains, branch piping, and fixtures.</u></p> <ol style="list-style-type: none"> <li>1 Turn OFF water heater because heat dissipates chlorine.</li> <li>2 Starting with the fixtures nearest the building's water service entrance, cover fixture to avoid water spraying into the air.</li> <li>3 Run cold water through all fixtures in succession until water is clear and roughly the same temperature as the building entering water. Flush toilets at least 5 times and until water is clear.</li> <li>4 Run "hot" water through all fixtures in succession until water is clear and roughly the same temperature as the building entering water.</li> <li>5 Flush entire volume of storage water heater at least 2 times and until water is clear.</li> <li>6 Turn water heater back ON.</li> </ol> <p><u>Check level of free chlorine in the water.</u></p> <p>The chlorine level at the first fixture should be equal to the utility level. If you were not able to get a utility level, assume 1 part per million (ppm). The level at the last fixture should be approximately 1/2 the utility level. If you were not able to get a utility level, assume 0.5 ppm.</p> <ol style="list-style-type: none"> <li>1 Obtain water sample at the first and last fixtures.</li> <li>2 Test water samples for residual free chlorine.</li> <li>3 If first fixture free chlorine level is less than the utility level or the assumed level of 1 ppm, flush entire volume of service pipe with water at a flowrate of approximately 3 ft/sec.</li> <li>4 If last fixture free chlorine level is less than 1/2 the utility level or the assumed level of 0.5 ppm, flush entire volume of service pipe with water at a flowrate of approximately 3 ft/sec.</li> <li>5 Repeat as needed until residual free chlorine level equals the utility level or 1 ppm at first fixture and approximately 1/2 the utility level or 0.5 ppm at the last fixture.</li> </ol>	<p>Fixtures other than toilers and storage water heaters should be flushed at a flowrates of 2 gpm for at least 3 minutes with both hot and cold water.</p> <p>For additional guidance, see ASHRAE Standard 188: Legionellosis: Risk Management for Building Water Systems.</p> <p>Private wells serving buildings should be chlorinated. For guidance on how to chlorinate a well, visit <a href="http://www.cdc.gov/disasters/wellsdisinfect">www.cdc.gov/disasters/wellsdisinfect</a>.</p>

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Building Water Service, Piping and Plumbing Fixtures (continued)	<p><u>Healthcare and Other Large Facilities</u></p> <p>For large facilities and those related to healthcare, it is further recommended that water samples also be tested for the presence of Legionella bacteria. Allow 5 - 7 days for testing and any necessary remediation. If the bacteria are present,</p> <ol style="list-style-type: none"> <li>1 Increase water heater temperature setpoint.</li> <li>2 Repeat the flush.</li> <li>3 Re-test for the presence of the bacteria.</li> <li>4 If the bacteria are still present, contact your water treatment specialist or utility.</li> </ol>	
Ice Machines	<ul style="list-style-type: none"> <li>• Empty machine.</li> <li>• Clean and disinfect waterway and ice bin properly, as needed.</li> <li>• Detach supply pipe from filter and flush for 3 minutes.</li> <li>• Test for chlorine residuals. (See Building Water Service).</li> <li>• Flush and disinfect all flexible piping and filter cartridge containers properly, as needed.</li> <li>• Replace filters.</li> </ul>	<p>Make and dispose of at least 2 batches of ice before returning the machine to service.</p> <p>For additional guidance, see ASHRAE Standard 188: Legionellosis: Risk Management for Building Water Systems.</p>
Drinking Fountains	<ul style="list-style-type: none"> <li>• <b>Disable in accordance with Governor's Executive Order 2020-91</b></li> </ul> <p><u>When permitted by successive Executive Order to resume fountain operations:</u></p> <ul style="list-style-type: none"> <li>• Clean and disinfect waterway properly, as needed.</li> <li>• Replace in-line filter and flush for 3 minutes.</li> <li>• Test for chlorine residuals. (See Building Water Service).</li> </ul>	<p>For additional guidance, see ASHRAE Standard 188: Legionellosis: Risk Management for Building Water Systems.</p>
Water Coolers	<ul style="list-style-type: none"> <li>• Dispose of existing water bottle.</li> <li>• Clean and disinfect drip tray and faucets properly, as needed.</li> <li>• Install new water bottle.</li> <li>• Flush each faucet for 3 minutes.</li> </ul>	<p>For additional guidance, see ASHRAE Standard 188: Legionellosis: Risk Management for Building Water Systems.</p>
Cooling Towers and Other Evaporative-Cooled Equipment	<p><u>After water system flush (See Building Water Service):</u></p> <ul style="list-style-type: none"> <li>• Check for and remove accumulated dirt and debris, particularly in basin.</li> <li>• Check that basin is draining properly.</li> <li>• Check controllers, sensors, switches, fill media, and fans for proper operation.</li> <li>• Repair or replace damaged or non-working components.</li> <li>• Clean and disinfect fans, fan housings, fill media, and basin properly, as needed.</li> <li>• Check chemical injector system. Clean as necessary.</li> <li>• Test water chemistry. Treat water as needed.</li> </ul>	<p>For additional guidance, see ASHRAE Standard 188: Legionellosis: Risk Management for Building Water Systems and CTI Guideline 159: Practices to Reduce the Risk of Legionellosis in Evaporative Heat Rejection Equipment Systems.</p>

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Chillers	<ul style="list-style-type: none"> <li>• Test water system chemistry. Treat as needed.</li> <li>• Perform manufacturer's prestart-up checks.</li> <li>• Repair or replace any damaged or non-working controls or components.</li> <li>• Perform manufacturer's start-up procedure.</li> </ul>	For water cooled chillers, ensure cooling tower water has the proper chemistry, volume, and temperature (in accordance with manufacturer recommendations) prior to chiller start-up.
HVAC Controls	<ul style="list-style-type: none"> <li>• Check for proper operation. Check setpoints. Retrocommission as needed.</li> <li>• Check with manufacturer for any software updates. Update software as needed.</li> <li>• Measure space percent relative humidity (RH).</li> </ul> <p><u>Air-side Building Flush:</u></p> <ul style="list-style-type: none"> <li>• Run air-handling units and other air-side equipment in 100% outside air mode for at least 4 hours.</li> <li>• For VAV systems, temporarily raise discharge air temperature setpoint to 75°F to ensure all VAV boxes fully open.</li> <li>• If 100% outside air is not practical, run equipment long enough to achieve approximately 4 to 8 complete air changes, as needed.</li> <li>• If HVAC equipment has limited outside air capability, open windows or doors and use temporary exhaust fans to flush the facility.</li> <li>• Monitor controls and trend thermal setpoints to confirm proper operation.</li> </ul>	<p>Houses of worship and other spaces with single pane windows may not tolerate higher relative humidity. Consult an engineer proficient in HVAC and IAQ before increasing RH above existing setpoints.</p> <p>Check with controls manufacturer that updates are backward compatible.</p> <p>Use caution with unattended open windows and doors that occupant safety and health are not compromised.</p>
Air Handling Units (AHU), Rooftop Units (RTU), Air-side Economizers, Window Air-Conditioners, Packaged Terminal Units, Unit Ventilators, Fan-Coils, Furnaces & Other Air Distributing Equipment	<ul style="list-style-type: none"> <li>• Check controls, including sensors and switches, for proper operation.</li> <li>• Repair or replace any non-working sensors, switches, or controllers.</li> <li>• Check setpoints. Retrocommission as needed.</li> <li>• Check casing interior for accumulation of debris.</li> <li>• Clean and disinfect casing interior walls, ceiling and floors properly, as needed.</li> </ul> <p><u>Cooling Season:</u></p> <ul style="list-style-type: none"> <li>• Increase minimum outside air volume to as high as is practical.</li> <li>• Disable demand-controlled ventilation.</li> <li>• If practical, in order to better distribute air when facility is not fully occupied, increase discharge air temperature to 62°F (while maintaining relative humidity at less than 60% RH).</li> </ul>	<p>When facility is fully occupied, do NOT increase discharge air temperature because it will increase air circulation and energy costs.</p> <p>Verify that ductwork and humidification equipment can accommodate a relative humidity above 40% RH. If not, consider in-space humidifiers for heating season operation. If RH setpoint is increased, upgrade in-duct controls to an air-proving switch to prevent steam generation when duct RH levels are high or airflow is low, and a modulating high limit controller to prevent short-cycling.</p>

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Air Handling & Distribution Equipment (continued)	<p><u>Heating Season:</u></p> <ul style="list-style-type: none"> <li>• If practical, maintain space relative humidity above 40% RH (approximately 80% RH in the duct).</li> <li>• For air-side economizers, lower the outside air temperature at which the unit switches from 100% outside air to minimum outside air with mechanical cooling.</li> </ul>	Houses of worship and other spaces with single pane windows may not tolerate higher relative humidity. Consult an engineer proficient in HVAC and IAQ before increasing RH above existing setpoints.
Air Filters	<ul style="list-style-type: none"> <li>• Check that filters are new or recently changed, and dry.</li> <li>• Check that filters fit tightly in filter racks with no gaps.</li> <li>• Repair or replace any damaged racks.</li> <li>• If replacing filters, select new filters with the highest MERV Rating that have a pressure drop similar to the existing system.</li> <li>• If possible, consider upgrading filters to a MERV Rating of 13 or 14 under the guidance of an engineer. If not possible, consider in-space filtration.</li> </ul>	Filters increase system pressure, impacting airflow and comfort. Do <b>NOT</b> install filters of higher pressure drop than your system is designed to handle without guidance from an engineer proficient in HVAC and IAQ.  Double-bag and properly dispose of removed filters.
Ultraviolet Germicidal Irradiation (UVGI), Ionizers, & Other Electric Air Filtration	<ul style="list-style-type: none"> <li>• Check lamps, controllers, and sensors for proper operation.</li> <li>• Repair or replace any damaged or non-working components.</li> <li>• Check for accumulated dirt. Clean lamps and filters as needed.</li> <li>• If the facility does not currently use this technology, consider adding it with the guidance of an engineer.</li> </ul>	Potential code impacts. Do <b>NOT</b> use these devices to reduce the amount of fresh outside air brought into the building without guidance from an engineer proficient in HVAC, IAQ, and code requirements.
Drain Pans & Condensate Pumps	<ul style="list-style-type: none"> <li>• Check that pans are dry and draining properly.</li> <li>• Check traps. Prime (refill) as needed.</li> <li>• Repair or replace any non-working traps or clogged drains.</li> <li>• Clean condensate pump. Clean and disinfect pans properly, as needed.</li> </ul>	
Coils	<ul style="list-style-type: none"> <li>• Check for evidence of leaks, moisture carryover, or biological growth.</li> <li>• Repair or replace any damaged or non-working coils.</li> <li>• Clean and disinfect coils properly, as needed.</li> </ul>	
Supply, Return, General Exhaust, and Toilet Exhaust Fans	<ul style="list-style-type: none"> <li>• Check for proper operation.</li> <li>• Repair or replace and non-working fans, fan controllers, or motors.</li> <li>• Clean and disinfect fan and housing properly, as needed.</li> </ul>	In toilet rooms, check that floor traps are properly primed (filled), and disable electric hand dryers..
Dampers & Louvers	<ul style="list-style-type: none"> <li>• Visually inspect for moisture accumulation.</li> <li>• Clean and disinfect dampers and louvers properly, as needed.</li> <li>• Check linkages and actuators for proper operation.</li> <li>• Repair or replace any non-working linkages or actuators.</li> </ul>	

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Air-to Air Energy Recovery Wheels	<ul style="list-style-type: none"> <li>• Check equipment, controls, and sensors for proper operation.</li> <li>• Repair or replace any non-working or damaged components.</li> <li>• Clean and disinfect air-side components properly, as needed.</li> </ul>	If proper pressure differential is not maintained, a leakage of contaminated air to supply air may result. Consider temporarily not operating this equipment.
Humidifiers and Dehumidifiers	<ul style="list-style-type: none"> <li>• Check controls, steam traps, pumps, dispersion tubes, and strainers for proper operation.</li> <li>• Repair or replace non-working or damaged devices or components.</li> <li>• Check setpoints. Retrocommission as needed.</li> <li>• If possible without causing moisture problems, maintain relative humidity of 40% RH - 60% RH. Verify that system ductwork and humidification equipment can accommodate a relative humidity above 40% RH. If not, consider in-space humidifiers for heating season operation.</li> <li>• Adjustments to setpoints can impact the steam humidifier's required absorption distance. If the distance becomes too long, consider raising the supply air temperature to allow the air to absorb moisture more quickly.</li> </ul>	<p>Raising the space RH can result in a dew point temperature higher than the inside surface temperature of windows and other surfaces causing condensation to form. This is particularly a concern for houses of worship and other spaces with single pane windows. Consult an engineer proficient in HVAC and IAQ before increasing RH above existing setpoints.</p> <p>If RH setpoint is increased, upgrade in-duct controls to an air-proving switch to prevent steam generation when duct RH levels are high or airflow is low, and a modulating high limit controller to prevent short-cycling.</p>
Ductwork	<ul style="list-style-type: none"> <li>• Visually inspect exposed ductwork for insulation &amp; vapor barrier integrity.</li> <li>• Repair or replace any damaged insulation.</li> <li>• Visually inspect ductwork connections.</li> <li>• Check that duct interior is dry.</li> <li>• Clean and disinfect duct interior, properly as needed.</li> </ul>	
VAV Boxes	<ul style="list-style-type: none"> <li>• Check controls, including sensors and switches, for proper operation.</li> <li>• Repair or replace any non-working controls or components.</li> <li>• Check casing interior for accumulation of dirt or biological growth.</li> <li>• Clean and disinfect casing interior, fans &amp; fan housings, and coils properly, as needed.</li> </ul>	
Grilles, Registers, and Diffusers	<ul style="list-style-type: none"> <li>• Clean and disinfect properly, as needed.</li> <li>• Check for proper register operation.</li> <li>• Repair or replace any non-working or damaged devices.</li> </ul>	

1 This document is published by the Detroit and Western Michigan Chapters of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). It does not present official positions of the Society. ASHRAE chapters may not act for the Society and the information presented here has not had Society review. To learn more about ASHRAE activities on an international level, visit [www.ashrae.org](http://www.ashrae.org).

2 Appropriate personal protective equipment (PPE) should be worn when performing all system and equipment inspections, maintenance, repairs, and alterations.

3 All products, solutions and chemicals used to clean or disinfect equipment should be in accordance with equipment manufacturers' recommendations.

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