

Energy Savings Plus Health: Indoor Air Quality Guidelines for Multifamily Building Upgrades



How to protect public health, save energy and reduce climate change impacts — all at the same time

These Energy Savings Plus Health: Indoor Air Quality Guidelines for Multifamily Building Upgrades are part of EPA's approach to addressing three of our most pressing environmental and public health priorities: reducing asthma and other health disparities, our reliance on fossil fuels, and climate change impacts.

These guidelines will be a valuable tool in helping to ensure the health, comfort and safety of the many Americans living in multifamily buildings. More than 80 million Americans, about 25 percent of the U.S. population, live in multi-unit homes. About one-quarter of these residents live below the poverty line and a large percentage of residents of affordable housing are children, the elderly or disabled. These groups are the most vulnerable, and they are disproportionately impacted by diseases like asthma and commonly exposed to serious health risks from secondhand tobacco smoke, usually at home.

Heating and cooling buildings uses a lot of energy — about 43 percent of all energy use in the United States! Producing this energy requires us to burn fossil fuels like coal and oil, which contributes to air pollution and generates large amounts of greenhouse gases that contribute to climate change.

Improving the energy efficiency of buildings usually involves tightening the buildings through air sealing and other weatherization techniques to reduce the escape of air that we have just spent money to heat or cool. That's a very good thing. However, as buildings are renovated or repairs are made to save energy or increase comfort, indoor air quality problems can be created or exacerbated. Indoor pollutants like radon, mold, particles and chemicals from a variety of sources can build up to unhealthy levels unless pollutant sources, ventilation and moisture are carefully managed. Pollutants like tobacco smoke can easily migrate from one unit to another in multi-unit buildings, and lead and asbestos, which may be disturbed during renovations or retrofits, remain serious health risks in older buildings.

Protecting indoor air quality and occupant health while saving energy and money during building retrofits isn't very hard to do, but it does require teamwork, planning and commitment from everyone involved in building upgrades. Most importantly, if we do it right, we'll protect public health, reduce our reliance on fossil fuels and reduce climate change impacts all at the same time.

The guidance on these pages can help ensure that energy efficiency upgrades and other building renovations accomplish what they set out to do: provide safe, healthy, comfortable and energy efficient homes for all of us. Read it. Use it. Together, we can build a better future.



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Section 1

Introduction



Section 1: Introduction

Purpose and Scope

Millions of American homes, including dwelling units in multifamily residential buildings, will be retrofitted in the coming years to renovate their existing structure, improve energy efficiency, improve long-term durability and ensure good indoor air quality (IAQ). Some upgrade activities, however, might negatively affect IAQ if the appropriate building assessment is not made before work begins and issues that can compromise IAQ are not identified and properly addressed. The U.S. Environmental Protection Agency (EPA) developed this document, **Energy Savings Plus Health: Indoor Air Quality Guidelines for Multifamily Building Upgrades**, to provide practical guidance to ensure healthy indoor environments during multifamily residential building upgrades, retrofits and renovations (including energy upgrades), and to maintain the building upgrades after dwelling units are reoccupied.

In 2011, EPA released [Healthy Indoor Environment Protocols for Home Energy Upgrades](#) (EPA document # 402/K-11/003), which applies primarily to existing single-family homes and, to a much lesser degree, existing multifamily low-rise residential buildings of three stories or less. The opportunities and challenges to maintain or improve IAQ while upgrading single-family homes often differ from those encountered in multifamily residential buildings, where spaces, equipment and decision-making are often shared and, in the case of leased space, dependent on the building owner/developer. In addition, some multifamily residential buildings are classified as mixed-use where the buildings can contain, for example, retail spaces, parking garages, conference/meeting rooms, offices, health clubs/aerobic rooms, and beauty/nail salons, in addition to dwelling units. Mixed-use spaces often present challenges generally not found in single-family homes, including different sources of pollutants and activities that generate a broader range of indoor pollutants.

This Guide applies to multifamily residential buildings containing at least five residential dwelling units that share one or more building systems. Each multifamily dwelling unit typically shares at least a floor or a ceiling and one or more walls with other dwelling units. Multifamily residential buildings can range from low-rise to high-rise buildings. A low-rise multifamily residential building is a structure of up to three stories, a mid-rise multifamily residential building has four or five stories, and a high-rise multifamily residential building has six stories or more. This document provides guidance for conducting multifamily building assessments and identifying common IAQ and safety

concerns, and can help improve the quality of multifamily residential building upgrade projects.

Given the unique complexities of multifamily residential buildings, this Guide differs from EPA's protocols for single-family homes. For example, the following issues can be significantly different in, or unique to, multifamily residential buildings:

- Environmental Tobacco Smoke
- Garage Air Pollutants
- Pests
- Radon
- Heating, Ventilation and Air Conditioning Equipment
- Compartmentalization to Prevent Odor or Unwanted Air Transfer
- Local Exhaust
- Mechanical Ventilation Systems for Individual Dwelling Units
- Mechanical Ventilation Systems for Multiple Dwelling Units
- Natural (Not Fan-Powered) Ventilation Systems
- Multifamily Building Safety
- Protecting IAQ During Construction
- Operations and Maintenance Staff Training
- Occupant Education

This Guide is intended for use during multifamily residential building upgrades, renovations and remodeling, including energy efficiency upgrades. The intended audience includes rehabilitation professionals, contractors and others involved with renovation and remodeling efforts, including energy-focused residential retrofits. The Guide also can be adopted or used by federal, state, tribal and local weatherization assistance programs; federally funded housing programs; industry standards organizations; private sector home performance organizations; and other contracting organizations. EPA developed this voluntary Guide in coordination with the U.S. Department of Energy (DOE) [Standard Work Specifications for Multi-Family Home Energy Upgrades](#).

Programs and contractors undertaking building upgrades are encouraged to coordinate their activities with local health and housing resources for multifamily residential buildings to provide building owners, property managers and occupants the support they may need.

This document does not do any of the following:

1. Set new EPA regulatory requirements or in any way modify or supersede existing EPA regulatory requirements.
2. Provide guidance on diagnosing occupant health problems or building-related illness.
3. Address emerging issues that have not been linked to adverse health effects.
4. Make training or training documents unnecessary.
5. Provide detailed implementation guidance on how to achieve each recommendation in all situations.
6. Identify funding availability or which programmatic funding sources should be used.
7. Provide guidance for prioritizing building-specific projects during the upgrade process.

Portions of this Guide summarize certain regulatory requirements, but the requirements themselves, not the summaries in this Guide, govern.

Important Basic Considerations for Protecting IAQ During Building Upgrades

Several energy retrofit and building upgrade activities can cause or aggravate IAQ problems as described in detail throughout this publication; however, these important basic considerations must always be kept in mind:

- **Occupants' and workers' exposure to airborne contaminants generated during and after building upgrade activities should be minimized.**

Building upgrades can disturb existing contaminants known to cause health problems. Some of these contaminants have specific regulatory requirements (e.g., asbestos, lead) that must be followed.

- **Reducing air leakage across the building envelope should not be performed without ensuring that there will be adequate venting of combustion appliances and outdoor air ventilation to dilute and remove pollutants from within the building after the project is completed.**

Modifications that increase the airtightness of a building's envelope increase the potential for elevated levels of contaminants indoors. Care must always be taken to ensure that these activities do not cause improper venting of combustion appliances and increase occupant exposure to combustion by-products, including carbon monoxide; introduce increased indoor exposures to other pollutants; or introduce or exacerbate moisture and mold problems within the building.

How This Guide Is Organized

This Guide covers 24 priority issues, and each priority issue includes three sections.

1. **Assessment Protocols:** Measures to identify and evaluate potential IAQ and safety concerns in multifamily residential buildings undergoing upgrade activities. The assessments should be performed in all common areas of the building and in as many dwelling units as possible.
2. **Minimum Actions:** Critical actions intended to correct deficiencies identified during the assessments, incorporate minimum IAQ protections, and ensure that work does not cause or worsen IAQ or safety problems for occupants or workers (i.e., "Do No Harm"). EPA recommends these protections for all building upgrade projects.

Some of the **Minimum Actions** identified overlap with regulatory requirements but not all regulatory requirements are listed; others are recommendations for additional steps to protect and improve IAQ during building upgrades. Applicable regulatory requirements must be followed, and the regulations, not the summaries in this Guide, establish the applicable requirements. Recommended additional steps are not mandatory from a regulatory standpoint.

3. **Expanded Actions:** Additional actions to promote healthy indoor environments that can be taken during many building upgrade projects. EPA recommends considering these improvements when feasible and sufficient resources exist.

The **Assessment Protocols**, **Minimum Actions** and **Expanded Actions** are designed to incorporate good IAQ practices into a variety of multifamily residential building upgrade projects. To be effective, the recommended assessments and actions should be built into the very earliest stages of project conceptualization and design. Working as a team, building upgrade contractors, building owners and property managers can use the guidelines to better understand the interrelationships between building upgrades, including energy efficiency upgrades and IAQ goals. They also can use the guidelines to identify opportunities to protect and promote healthy indoor environments during typical building operations, maintenance and energy management tasks. Due to the wide variety in multifamily residential building designs and the magnitude in scopes of building upgrade projects, there can be variability in how this Guide is used. For example, a small project focused only on window upgrades would refer to a small subset of priority issues in the Guide, while a larger, more extensive renovation could refer to the majority of priority issues.

These actions often refer to national standards, model codes and guidelines; however, work must be conducted in compliance with state and local requirements as well. All equipment removed should be disposed of properly to prevent it from being reinstalled or used elsewhere.

Relevant reference documents for each priority issue are provided in an abbreviated format. More detailed information can be found in **Appendix D: References**.

The following icons are used in this Guide:



Indicates an issue that references **Appendix A: Worker Protection** for recommended actions and additional resources to minimize health and safety risks for workers performing the building upgrades.



Indicates an issue that references **Appendix B: Property Management and Occupant Education** for additional information and resources on important property management and occupant education considerations related to the building upgrades. These considerations are important to ensure that property managers and building occupants do their part to maintain a healthy indoor environment before, during and after the building upgrade is complete.

Examples of multifamily residential building upgrade projects are identified in Table 1, accompanied by descriptions of the IAQ/health risks and opportunities that may be encountered, and the potentially applicable priority issues of this Guide. The Master Verification Checklist in **Appendix E** can be used to track progress and verify that the applicable assessments, minimum actions and expanded actions have been performed.

Table 1: Examples of Multifamily Residential Building Upgrade Projects

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
LIGHTING		
<p>Lighting Upgrades</p> <ul style="list-style-type: none"> De-lamping: Removing unnecessary light bulbs/fixtures to save energy Re-lamping: Replacing lighting components and fixtures Upgrading ballasts Other modifications or upgrades (e.g., occupancy sensors) 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> Asbestos-containing material, lead paint or polychlorinated biphenyls (PCBs) may be disturbed during lighting replacement. PCBs may be present in older fluorescent light ballasts that are not labeled “No PCBs” or “electronic.” Mercury vapor or mercury-containing powder from broken fluorescent bulbs or improper use of drum-top crushers may be present. Lighting upgrades likely will reduce sensible heat loads, which may affect moisture removal performance of HVAC systems. <p>Opportunities:</p> <ul style="list-style-type: none"> Remove and replace old fixtures containing hazardous materials with those that contain less hazardous materials. Properly dispose of lamps containing mercury and fixtures containing PCBs. 	<ul style="list-style-type: none"> 2.0 Asbestos 3.0 Lead 4.0 PCBs 10.0 Building Products/Materials Emissions 17.0 HVAC Equipment 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
BUILDING ENVELOPE		
<p>Roof and Ceiling Assemblies</p> <ul style="list-style-type: none"> • Repairing or replacing the roof • Upgrading roof and ceiling insulation • Upgrading moisture protection • Upgrading air sealing 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material, lead paint, PCBs or mold may be disturbed. • Installing spray polyurethane foam (SPF) may generate indoor contaminants. • Moisture may be trapped behind spray foam insulation when installed under a low pitch wooden roof deck, creating the potential for hidden, structural roof damage and mold. • Moisture may be trapped in insulation installed adjacent to drainage planes, vapor barriers or roof membranes. • Sealing the building envelope may increase levels of indoor contaminants, including radon, combustion by-products, moisture and mold, and volatile organic compounds (VOCs). Adequate ventilation must be provided to dilute and remove indoor pollutants. Radon mitigation systems may become necessary. <p>Opportunities:</p> <ul style="list-style-type: none"> • Control for moisture by selecting moisture-resistant insulation, properly installing insulation materials, and ensuring surfaces and assemblies with condensation potential are properly sealed and insulated to avoid dew-point conditions. • Seal unwanted openings and leaks in the building envelope to reduce air infiltration and conditions conducive to pest entry. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 17.0 HVAC Equipment 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety
<p>Wall Assemblies</p> <ul style="list-style-type: none"> • Repairing and sealing wall penetrations • Upgrading wall insulation • Replacing windows • Adding window film covering • Repairing windows • Sealing windows 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material, lead paint, PCBs or mold may be disturbed. • Installing spray-polyurethane foam may generate indoor contaminants. • Sealing the building envelope may increase levels of indoor contaminants, including radon, combustion by-products, moisture and mold, and VOCs. Adequate ventilation must be provided to dilute and remove indoor pollutants. Radon mitigation systems may become necessary. <p>Opportunities:</p> <ul style="list-style-type: none"> • Control moisture and condensation potential on surfaces, install moisture-resistant insulation, and ensure proper exterior drainage and water management (e.g., include header and panned windowsill flashing during window replacement). • Seal unwanted openings and leaks in the building envelope to reduce infiltration and conditions conducive to pest entry. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
<p>Concrete Floor Sealing</p> <ul style="list-style-type: none"> • Repairing and sealing floor penetrations • Sealing cracks and joints in floors • Applying floor sealer/ paint 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material, lead paint, PCBs or mold may be disturbed. • Sealing the building envelope may increase levels of indoor contaminants, including radon, combustion by-products, moisture and mold, and VOCs. Adequate ventilation must be provided to dilute and remove indoor pollutants. <p>Opportunities:</p> <ul style="list-style-type: none"> • Understand and appropriately manage moisture emission rates and select sealants/adhesives with low-VOC or no-VOC content/emissions. • Reduce infiltration and conditions conducive to pest entry. • Seal cracks and joints in floors, which may be an integral part of a radon mitigation system. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety
<p>Moisture Barrier for Ground-Level Slabs, Basement and Crawlspace Floors</p> <ul style="list-style-type: none"> • Adding new moisture barriers • Modifying or repairing existing moisture barriers 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material, lead paint, PCBs or mold may be disturbed. • Uncovered dirt floor may contribute to excessive moisture migration into the building. • Installing carpet or floor tile over concrete floor that has a persistent condensation or water pooling problem will likely lead to mold growth. • An existing moisture barrier also may be an integral part of a radon mitigation system or other belowground contaminant mitigation measures and should not be disturbed. • Uncovered dirt floors may introduce pest populations and will promote rodent habitats. <p>Opportunities:</p> <ul style="list-style-type: none"> • Provide sealed moisture barrier over dirt foundation floors. • Provide moisture barrier beneath concrete slabs. • Select sealants/adhesives with low-VOC or no-VOC content/emissions. • Select exposed poly films with proper flame and smoke ratings. • Incorporate other radon mitigation and belowground contaminant mitigation measures as needed. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
HEATING, VENTILATION AND AIR CONDITIONING (HVAC) SYSTEMS		
<p>Ducts, Fan Coils and Unit Ventilators</p> <ul style="list-style-type: none"> • Adding or replacing ducts • Sealing and insulating air ducts • Altering or cleaning fan coil and unit ventilators 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material, lead paint, mold or other debris may be disturbed during duct installation, sealing or replacement. • Improper condensate drainage can present an opportunity for bacterial or mold growth in units with cooling coils. • Humid climates may require additional dehumidification when the outdoor air supply is increased. • Ductwork that is not properly sealed and insulated can lead to condensation problems if it passes through unconditioned spaces. • Improper modifications to HVAC systems can cause unbalanced flows and pressures that can lead to increased intrusion of moisture, radon and other belowground contaminants. • Excessive moisture promotes pest infestation. • Ventilation systems may be contaminated with PCBs if PCBs have migrated via indoor air from caulk and/or lighting ballasts that contain PCBs. • Noisy ventilation systems may be turned off by occupants, which will negatively affect ventilation. <p>Opportunities:</p> <ul style="list-style-type: none"> • Contain and do not disturb areas of significant mold contamination until these areas can be remediated. • Reduce entry of airborne contaminants into the building; maintain interior humidity levels. • Select low-VOC and formaldehyde-free products. • Provide sealed and energy-efficient ducts. • Provide proper ventilation; properly balanced HVAC systems can maintain positive pressurization indoors to reduce intrusion of moist air into the building envelope and interior zones and belowground contaminants and radon into the building. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 13.0 Ozone from Indoor Sources 17.0 HVAC Equipment 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
<p>Outdoor Air Ventilation (upgrades or modifications)</p> <ul style="list-style-type: none"> Outdoor air intakes and controls Filtration of outdoor ventilation air and make-up air Local exhaust for indoor areas with strong sources of pollutants Additional dehumidification, as needed for humid climates 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> Asbestos-containing material, lead paint or PCBs may be disturbed during wall, roof or ceiling penetrations. Some locations may have strong outdoor pollutant sources in the proximity of outdoor air intakes. Smoking near outdoor air ventilation intakes can increase indoor exposure to environmental tobacco smoke. Humid climates may require additional dehumidification when the outdoor air supply is increased. Excessive moisture promotes pest infestation. Noisy ventilation systems may be turned off by occupants, which will negatively affect ventilation. <p>Opportunities:</p> <ul style="list-style-type: none"> Ensure that outdoor air controls are working properly, while controlling for moisture. Ensure the proper location of outdoor air intakes. Ensure that all occupied spaces are provided with adequate outdoor air ventilation. Ensure any filter status pressure sensors and switches are calibrated regularly. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 14.0 Environmental Tobacco Smoke 17.0 HVAC Equipment 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety
<p>Heating and Cooling Systems</p> <ul style="list-style-type: none"> Boiler replacement Steam trap replacement or maintenance Pipe modifications: Converting from one-pipe to two-pipe steam systems OR Converting from two-pipe to four-pipe heating and cooling systems System modifications: Converting from steam to hot-water systems Control valves: Maintenance and additions Combustion equipment replacement Air conditioning system replacement Additional dehumidification, as needed for humid climates 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> Asbestos-containing material, lead paint, PCBs or mold may be disturbed during system or component replacement. Improperly vented combustion gases and occupant exposure to carbon monoxide are potential risks. Moisture or mold may be present when the HVAC system is turned off for extended periods. Poor humidity control during cooling system operation can result in mold growth and present opportunities for pest infestations. Inadequate humidifier maintenance can lead to microbiological problems. <p>Opportunities:</p> <ul style="list-style-type: none"> Properly vent combustion gases and ensure that mechanical rooms with combustion equipment have adequate make-up air and ventilation. Install and maintain carbon monoxide detection and warning equipment. Ensure that combustion equipment and boilers are installed correctly and that make-up air registers are not blocked. Ensure that air conditioning systems are properly sized and controlled to avoid humidity and moisture issues. Ensure that well-maintained humidification equipment and controls are in place to promote occupant comfort and health during the heating season, as needed. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 13.0 Ozone from Indoor Sources 17.0 HVAC Equipment 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
<p>HVAC Controls to Monitor/Maintain IAQ (upgrades or modifications)</p> <ul style="list-style-type: none"> • Temperature and humidity controls: Installation, replacement and/or calibration • Controls for outdoor air ventilation and exhaust airflow rates • Air filtration pressure sensors • Occupancy sensors 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material or lead paint may be disturbed during wall or ceiling penetrations. • Mercury from removal of old mercury bulb thermostats may present a risk. • Sensors that are not regularly calibrated may lead to IAQ problems. • Poor humidity control during cooling system operation can result in mold growth and present opportunities for pest infestations. • Inadequate operation and maintenance of humidifier controls can lead to microbiological problems. • Improper HVAC controls can cause unbalanced flows and pressures that can lead to increased intrusion of moisture, radon and other belowground contaminants. • Improperly vented combustion gases; occupant exposure to carbon monoxide. <p>Opportunities:</p> <ul style="list-style-type: none"> • Control moisture to avoid mold growth and pest infestations, and optimize occupant comfort. • Monitor and maintain outdoor and exhaust airflow rates. • Install and maintain carbon monoxide detection and warning equipment. • Properly dispose of mercury-containing thermostats. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 17.0 HVAC Equipment 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety
<p>Hydronic Systems (upgrades or modifications)</p> <ul style="list-style-type: none"> • Chilled water system optimization • Pipe insulation upgrades (chilled water, hot water, steam piping) • Hydronic or steam piping system changes • Cooling tower upgrades 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material, lead paint or mold may be disturbed during system or component replacement. • Moisture accumulation on cold surfaces can lead to mold growth and pest infestations. • Legionella bacteria can grow in stagnant water, including hot water tanks. • Poor maintenance of cooling tower may allow Legionella bacteria to grow, causing potential risk to maintenance personnel and occupants. <p>Opportunities:</p> <ul style="list-style-type: none"> • Control moisture to prevent mold growth and pest infestations and optimize occupant comfort. • Manage building water systems and cooling towers to minimize bacterial growth. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 17.0 HVAC Equipment 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

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MATERIALS SELECTION AND REPLACEMENT		
<p>Adhesives and Sealants</p> <ul style="list-style-type: none"> • Application of materials used during energy upgrades for air sealing • Application of materials used for adhering and fastening components 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material, lead paint or PCBs may be disturbed when removing previously installed adhesives or sealants. • Weatherization and air sealing can reduce air exchange rates and result in elevated levels of contaminants indoors if there is inadequate ventilation. <p>Opportunities:</p> <ul style="list-style-type: none"> • Always select sealants and adhesives for indoor use with low-VOC or no-VOC content/emissions. • Select outdoor sealants for long life to keep out water and, when possible, with low-VOC or no-VOC content/emissions. • Ensure adequate outdoor air ventilation after weatherization and air sealing. 	<ul style="list-style-type: none"> 2.0 Asbestos 3.0 Lead 4.0 PCBs 10.0 Building Products/Materials Emissions 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety
<p>Carpet and Flooring</p> <ul style="list-style-type: none"> • Replacing existing carpet • Installing new carpet over uncarpeted areas • Replacing or repairing existing floor tiles • Installing new flooring over existing floor surfaces 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material (many floor tiles in older buildings were made of asbestos), lead paint, mold or large quantities of dust may be disturbed. • Carpet and flooring may be contaminated with PCBs if PCBs have migrated via indoor air from caulk and/or lighting ballasts that contain PCBs. <p>Opportunities:</p> <ul style="list-style-type: none"> • Isolate the work area to reduce dust migration caused by carpet and flooring removal. • Select low-VOC materials, including carpets, resilient flooring, adhesives and sealants. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 9.0 Tracked-In Pollutants 10.0 Building Products/Materials Emissions 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety
<p>Painting</p> <ul style="list-style-type: none"> • Removing old deteriorated paint (scraping and sanding) • Repainting existing surfaces • Painting new surfaces 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material, lead paint or PCBs may be disturbed. • Indoor surfaces may be contaminated with PCBs if PCBs have migrated via indoor air from caulk and/or lighting ballasts that contain PCBs. <p>Opportunities:</p> <ul style="list-style-type: none"> • Select paint with low-VOC or no-VOC content/emissions and do not conduct dry sanding without rigorous containment. 	<ul style="list-style-type: none"> 2.0 Asbestos 3.0 Lead 4.0 PCBs 10.0 Building Products/Materials Emissions 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
<p>Suspended Ceilings</p> <ul style="list-style-type: none"> • Repairing or replacing existing ceiling tiles • Installing new ceilings 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material (including vermiculite insulation), fiberglass, mineral wool or other insulation materials may be disturbed. • Ceiling tiles may be contaminated with lead paint or lead paint particles. • Removal of ceiling tiles may expose pest infestations. • Ceiling tiles may have water damage and/or mold growth. • Ceiling materials may be contaminated with PCBs if PCBs have migrated from older, leaking lighting ballasts that contain PCBs. <p>Opportunities:</p> <ul style="list-style-type: none"> • Select low-emission materials, such as formaldehyde-free ceiling tiles. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 8.0 Pests 10.0 Building Products/Materials Emissions 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety
OPERATION AND MAINTENANCE		
<p>Systems Operation and Maintenance</p> <ul style="list-style-type: none"> • Check control systems and devices for evidence of improper operation on a regular schedule (e.g., semiannually) and take corrective actions • Calibrate and periodically recalibrate sensors (e.g., temperature, humidity) • Perform cooling unit drain pan maintenance • Replace filters • Clean supply diffusers, return registers and outside air intakes • Keep unit ventilators and other duct openings clear of obstructions • Perform regular system operational checks • Check occupancy sensors 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material, lead paint, PCBs or mold may be disturbed. • Deferred maintenance can lead to system degradation and IAQ problems. • Improperly maintained and uncalibrated sensors can lead to poor system performance and IAQ problems. • Poor air filtration and maintenance can lead to clogged coils and a need for expensive cleaning that can be avoided with proper maintenance. • Inadequate drain pan design or maintenance can lead to microbial contamination. • Inadequately maintained combustion equipment can result in improperly vented combustion gases and occupant exposure to carbon monoxide. <p>Opportunities:</p> <ul style="list-style-type: none"> • Ensure the proper operation and venting of combustion appliances. • Install and maintain carbon monoxide detection and warning equipment. • Control for moisture by maintaining humidity levels. • Ensure that particle removal filtration systems are operating properly. • Repair or adjust drain pans to drain completely. • Ensure that occupancy sensors are operating properly. • Implement a scheduled inspection and calibration/recalibration program (e.g., semiannually) for measurement sensors, paying special attention to the systems that are intended to supply outdoor air ventilation. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 13.0 Ozone From Indoor Sources 17.0 HVAC Equipment 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
<p>Building Operations and Maintenance</p> <ul style="list-style-type: none"> • Deep extraction steam or hot water carpet cleaning • Pest control • Custodial operations 	<p>IAQ/Health Risks:</p> <ul style="list-style-type: none"> • Asbestos-containing material, lead paint, PCBs or mold may be disturbed. • Cleaning chemicals and pesticides may aggravate allergies and asthma. • Mold and moisture problems may occur if carpets do not dry quickly after spills or carpet cleaning. • Smoking near outdoor air ventilation intakes can increase indoor exposure to environmental tobacco smoke. • Vehicle idling near outdoor air intakes can increase indoor exposure to vehicle exhaust contaminants. <p>Opportunities:</p> <ul style="list-style-type: none"> • Minimize chemical exposure to occupants and staff by using the least toxic materials. • Reduce cleaning product use through better use of cleaning equipment and cleaning process improvements. • Minimize exposure to pesticides through integrated pest management tactics. • Always plan for thorough drying of carpets if steam or wet methods are used, especially during humid weather. • Provide walk-off mats to reduce track-in of pollutants. • Ensure that the building has a policy on tobacco use. • Periodically retest areas of the building that have been mitigated for radon. 	<ul style="list-style-type: none"> 1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 9.0 Tracked-In Pollutants 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 13.0 Ozone from Indoor Sources 14.0 Environmental Tobacco Smoke 17.0 HVAC Equipment 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Section 2

Assessment Protocols and Recommended Actions



Section 2: Assessment Protocols and Recommended Actions

Contaminants and Sources

PRIORITY ISSUE 1.0 MOISTURE CONTROL AND MOLD		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 1.1 Inspect for Moisture Problems and Document Results</p> <p>Inspect the interior and exterior of the building and the building's mechanical systems for evidence of moisture problems. Examples of moisture and mold problems include the following:</p> <ul style="list-style-type: none"> • Water damage or stains (e.g., on walls, ceilings or floor coverings) • Foundation cracks that leak water • Signs of seepage or wicking (e.g., efflorescence, peeling paint, delaminating materials) • Visible mold growth • Mold growth in ductwork and plenums • Wet or damp spots • Musty odor • Groundwater, surface water and rainwater intrusion • Plumbing leaks • Leakage through penetrations in the building envelope (e.g., utility entry points) • Condensation or moisture damage on and around windows • Other condensation (consider surface temperature, relative humidity and dew point temperature when evaluating the potential for condensation problems) <p>Document the extent and location of the problems and the proposed repairs.</p>	<p>MA 1.1 Repair Moisture Problems</p> <p> Repair moisture problems identified during the assessments (e.g., plumbing leaks; rain leaks, including leaks around windows and flashing; roof leaks; foundation leaks). It is important to correct a moisture problem at its source.</p> <p>MA 1.2 Conduct Required Mold Remediation</p> <p> Conduct any required mold remediation following professional guidance, such as EPA's Mold Remediation in Schools and Commercial Buildings guide and Institute of Inspection, Cleaning and Restoration Certification (IICRC) Mold Remediation Standard S520. Do not disturb mold growth without following professional guidelines.</p> <p>MA 1.3 Address Standing Water Problems</p> <p>Address standing water problems (e.g., surface water pooling near the foundation, water that does not drain from flat roofs and gutters). Ensure that there is adequate slope and drainage away from the building. Correct standing water problems near foundations and crawlspaces before insulating and weatherizing.</p> <p>MA 1.4 Manage Rainwater</p> <p>Manage rainwater in assemblies that are included in the scope of work (e.g., using drainage planes and flashings). Ensure that there is adequate slope and drainage away from the building, particularly for downspouts that carry rainwater from the roof.</p> <p>MA 1.5 Ensure Proper HVAC Condensate Drainage</p> <p>Ensure that condensate collects in drain pans under cooling coils and exits via a deep seal trap. Standing water will accumulate if the drain pan system has not been designed to drain completely under all operating conditions (sloped toward the drain and properly trapped). It is important to verify that condensate lines are properly trapped and charged with liquid.</p>	<p>EA 1.1 Retrofit Crawlspaces</p> <p>Where permitted by building codes, retrofit crawlspaces so that they are sealed, insulated, ventilated with conditioned air, properly drained and waterproofed (see EPA's Moisture Control Guidance for Building Design, Construction and Maintenance, and the 2012 International Building Code, Section 1203.3.2). Install a high capacity, energy-efficient dehumidifier in the crawlspace if the climate conditions warrant.</p> <p>EA 1.2 Perform Additional Mold Remediation Activities</p> <p>Perform additional activities, beyond those required for the building upgrade project, to remediate any observed mold growth. Follow EPA or other professional guidance.</p>



See Appendix A: Worker Protection



Appendix B: Property Management and Occupant Education

PRIORITY ISSUE 1.0 MOISTURE CONTROL AND MOLD (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>Notes:</p> <p>(1) Be aware of all rainwater drainage systems to ensure that all are functioning properly. In some older brick buildings, gutters may be found between brick and drywall/plaster.</p> <p>(2) If the assessments reveal that an atmospherically vented combustion device is causing an indoor humidity problem, it should be repaired in accordance with the guidance provided in Priority Issue 11.0 Vented Combustion Appliances.</p> <p>(3) Conduct assessments for all common areas and as many dwelling units as possible that are associated with the building upgrade.</p> <p>AP 1.2 Determine Whether Mold Remediation is Required</p> <p>Determine whether the project requires mold remediation and additional moisture control measures (e.g., as determined during a Weatherization Assistance Program audit). Remember to identify the sources of moisture problems. Isolate and contain areas of significant mold contamination until these areas can be remediated (see MA 1.2; see EPA Mold Remediation in Schools and Commercial Buildings guide and IICRC Mold Remediation Standard S520 for additional information).</p> <p>AP 1.3 Identify Moisture Problems to Address/Repair Before Building Upgrades</p> <p>Document which moisture problems will be addressed as part of the building upgrade project and which must be repaired by the building owner, property manager, or another contractor before the building upgrades are performed.</p> <p> The assessments also may reveal moisture problems that fall outside the scope of work for the upgrade project (e.g., condensation or insulation problems) that should be communicated to the building owner or property manager.</p>	<p>MA 1.6 Prevent Condensation in the Building Enclosure</p> <p>Air seal the enclosure and manage air pressure relationships.</p> <p>Note:</p> <p><i>Air sealing the interface between the ceiling and attic also prevents ice dams on roofs in cold, snowy climates.</i></p> <p>Manage water vapor flow and condensing surface temperatures to avoid dew point conditions within the thermal envelope, on interior walls, or on other surfaces inside the building where the surface temperature is expected to fall below the surrounding dew point temperature. This is achieved by selection of materials with an appropriate combination of thermal insulation and vapor permeability. Strictly follow all building codes for vapor retarder placement.</p> <p>Ensure that all piping, valves and ductwork with condensation potential are adequately insulated to reduce moisture problems. Perform a quality control review of insulation after it is installed to ensure that all surfaces are covered with airtight, vapor-impermeable insulation, including surfaces that will pass through unconditioned spaces.</p> <p> Control indoor humidity sources:</p> <ul style="list-style-type: none"> • Ensure existing bath and kitchen exhaust fans are operating properly and vented directly to the outdoors. • Ensure clothes dryers exhaust directly to the outdoors (in both dwelling units and common laundry rooms). Condensing clothes dryers piped to a drain are exempt. • Cover earthen floors in basements and crawlspaces with sealed vapor barriers and seal sump covers. • Ensure proper crawlspace ventilation that meets applicable building codes (e.g., ventilation openings through foundation walls per the 2012 International Building Code, Section 1203.3). • Ensure proper attic ventilation that meets applicable building codes (e.g., cross ventilation per the 2012 International Building Code Section 1203.2). <p>MA 1.7 Use HVAC Systems to Manage Moisture</p> <p>Use HVAC systems to manage moisture inside the building:</p> <ul style="list-style-type: none"> • Ensure proper sizing when specifying new or replacement air conditioning systems. Base calculations on post-upgrade project conditions. Use the Air Conditioning Contractors of America (ACCA) Manual J for low-rise residential applications, ACCA Manual N for commercial applications, the ASHRAE Load Calculation Applications Manual, ASHRAE Standard 183, or ASHRAE Handbooks for HVAC load calculations. Use ACCA Manual S or ASHRAE Handbooks for equipment selection. • If it is not possible to maintain the indoor relative humidity below 60%, evaluate whether the air conditioning system has an oversized design-sensible capacity or an undersized design-latent capacity. 	



PRIORITY ISSUE 1.0 MOISTURE CONTROL AND MOLD (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 1.4 Identify Moisture Problems That May Prevent Other Building Upgrades</p> <p>If there are significant moisture problems that cannot be addressed, do not install building upgrades that will reduce the building's air infiltration rate. Instances where this may be the case include buildings that have significant condensation or humidity problems, such as condensation on multiple windows, condensation in attics, or significant moisture or mold problems that are beyond the scope of the remedies under Minimum Actions.</p>	<ul style="list-style-type: none"> • Install dehumidifiers in humid climates to avoid moisture problems if individual air conditioning systems serving each dwelling unit cannot effectively control relative humidity below 60% under partial cooling load conditions. • Remove unvented combustion space heaters. <p>MA 1.8 Use Nonporous Materials in Moisture Prone Areas</p> <p>Use moisture-resistant materials in areas likely to become wetted frequently. If possible, use seamless and slip-resistant materials.</p> <p>Note:</p> <p><i>Floor-covering manufacturers specify the maximum water vapor emission rate of concrete over which coverings such as tile and carpet can be installed. Installing a covering on concrete that exceeds the maximum emission rate may cause the covering to fail, promote mold growth, and void the manufacturer's warranty. It is recommended that the water vapor emission rate of a floor be measured before coverings are installed (even when the installation occurs long after the building was constructed).</i></p> <p>MA 1.9 Control Moisture During Roofing Modifications</p> <p>Take precautions to control moisture during roofing modifications. For example:</p> <ul style="list-style-type: none"> • Protect open roof areas from rain during construction. • Design and construct roofing systems and flashing details to ensure proper moisture barriers. • Repair roof leaks before air sealing or insulating the attic. <p>MA 1.10 Protect On-Site Materials From Moisture</p> <p>Protect materials on-site from moisture damage. Do not install materials that show visible signs of biological growth resulting from the presence of moisture. Store and install all building products, systems and components in strict accordance with the manufacturers' printed instructions.</p>	

References for Priority Issue 1.0 Moisture Control and Mold:

[ACCA: Manual J Residential Load Calculation](#)
[ACCA: Manual N Commercial Load Calculation](#)
[ACCA: Manual S Residential Equipment Selection](#)
[ASHRAE/ACCA Standard 183-2007 \(RA 2014\)](#)
[ASHRAE: Load Calculation Applications Manual](#)
[ASHRAE: ASHRAE Handbook – Fundamentals](#)
[ASHRAE: ASHRAE Handbook – HVAC Systems and Equipment](#)
[CDC-NIOSH: Dampness and Mold Assessment Tool](#)
[DOE: Standard Work Specifications for Multi-Family Home Energy Upgrades](#)
[EPA: Moisture Control Guidance for Building Design, Construction and Maintenance](#)
[EPA: Mold Remediation in Schools and Commercial Buildings](#)
[IICRC: S520 Standard and Reference Guide for Professional Mold Remediation](#)
[International Code Council: International Building Code, 2012 Edition, Chapter 12 Sections 1203.2 and 1203.3](#)

PRIORITY ISSUE 2.0 ASBESTOS

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 2.1 Determine Potential Asbestos Hazards</p> <p>Consider the age of the structure; older multifamily residential buildings in particular may have asbestos insulation or other asbestos-containing material (ACM). Although the production and use of asbestos has declined, some building materials may still contain asbestos.</p> <p>Check to see if any replacement materials you intend to install might contain asbestos by reading the product labels, calling the manufacturer or asking the retailer to provide you with the Material Safety Data Sheet (MSDS) for the product(s) in question.</p> <p>Complete all assessments for ACM prior to initiating building upgrade tasks that have the potential to disturb ACM (e.g., blower door testing that often is performed during weatherization upgrades, see MA 2.4).</p> <p>Notes: Possible sources of asbestos include the following:</p> <ul style="list-style-type: none"> • Insulation in attics and attic-like spaces (e.g., vermiculite) • Wall insulation (e.g., vermiculite, insulation blocks) • Hot water and steam pipes coated with asbestos material or covered with an asbestos blanket or tape • Oil and coal furnaces and door gaskets with asbestos insulation • Vinyl flooring (including 9"-by-9" or 12"-by-12" floor tiles, vinyl sheet flooring, and the mastics and other adhesives used to secure the flooring) • Cement sheet, millboard, and paper used as insulation around furnaces and wood- or coal-burning appliances • Soundproofing or decorative surface materials sprayed on walls or ceilings, including popcorn ceilings • Patching, joint compounds and textured paints on walls and ceilings • Roofing, shingles and siding (including cement or adhesives) • Artificial ashes and embers (used in gas-fired fireplaces) • Transite (cement and asbestos) pipe in water distribution and drainage systems, HVAC ducts, combustion vents or transite flues 	<p>MA 2.1 Address ACM During Building Upgrades and Use Accredited Personnel for Abatement or Repair</p> <p> Suspected ACM in good condition can be managed in place, but take caution not to disturb it. If suspected ACM is damaged (e.g., unraveling, frayed or breaking apart), immediately isolate the area(s) and consult a trained and accredited asbestos professional to determine what corrective measures should be taken. Trained and accredited asbestos professionals must separate the work area in question from occupied portions of the building using appropriate containment practices. For suspected ACM that must be disturbed as part of the project, contact an accredited and properly trained asbestos professional for abatement or repair, in accordance with federal, state and local requirements. Only a trained and accredited asbestos professional may abate, repair or remove ACM. Contact your state asbestos regulatory agency for information on how to find an accredited asbestos professional.</p> <p>Note: Typically, trained and accredited professionals can repair asbestos by –</p> <ul style="list-style-type: none"> • <i>Sealing or Encapsulating:</i> Treating the material with a sealant that binds the asbestos fibers together or coats the material so fibers are not released. Pipe, furnace and boiler insulation often can be repaired in this manner. • <i>Covering or Enclosing:</i> Placing a protective layer over or around the ACM to prevent release of fibers. Exposed insulated piping may be covered with a protective wrap or jacket. • <i>Removing:</i> Removing ACM may be advantageous when performing building upgrades or making major changes to a building that will disturb ACM or if ACM is damaged extensively and cannot be otherwise repaired (by covering, enclosing, sealing or encapsulating). <p>MA 2.2 Precautions for Working Around ACM</p> <p>When working around ACM, do not:</p> <ul style="list-style-type: none"> • Dust, sweep or vacuum ACM debris. • Saw, sand, scrape or drill holes in the material. • Use abrasive pads or brushes to strip materials. 	<p>This cell is intentionally blank.</p>



See Appendix A: Worker Protection

PRIORITY ISSUE 2.0 ASBESTOS (continued)		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<ul style="list-style-type: none"> Plaster that is old enough to potentially contain asbestos <p>The EPA vermiculite website referenced below includes photos to aid in the identification of vermiculite insulation.</p> <p>AP 2.2 Contact a Trained and Accredited Asbestos Professional if Unsure Whether Material Contains Asbestos</p> <p>Generally, it is not possible to tell if a material contains asbestos unless it is labeled. The only way to be sure whether a material contains asbestos is to have it tested by a qualified laboratory. EPA recommends testing suspect materials only if they are damaged (fraying, crumbling) or if a planned building upgrade would disturb the suspect material. If unsure whether material contains asbestos, contact a trained and accredited asbestos professional to assess, sample and test the material, as needed. Notify the building owner and/or property manager of any ACM identified during the assessments.</p>	<p>MA 2.3 Ensure Insulation is Asbestos-Free Before Disturbing</p> <p>Do not remove or disturb insulation that looks like vermiculite (e.g., attic or wall insulation). Because confirming whether vermiculite contains asbestos by testing is unreliable, EPA recommends assuming it contains asbestos and managing accordingly. Specifically, EPA recommends the following precautions:</p> <ul style="list-style-type: none"> Leave vermiculite insulation undisturbed in attics or walls. Do not store boxes or other items in an attic if it contains vermiculite insulation. Hire a professional asbestos contractor if there are plans to remodel or conduct renovations that would disturb vermiculite in attics or walls to make sure that the material is safely handled and/or removed. <p>MA 2.4 Conduct Asbestos Abatement Before Blower Door Testing and Air Duct Testing</p> <p>Any asbestos abatement or repair work should be completed by properly trained and accredited professionals prior to blower door testing and air duct testing. Exercise appropriate caution when conducting blower door testing where friable asbestos or vermiculite attic insulation is present to avoid drawing asbestos fibers into the living space (i.e., use positively pressurized blower door testing and do not blow air on or over friable asbestos materials). Do not conduct air leakage tests (e.g., duct blaster tests) on ductwork that contains asbestos insulation.</p> <p>Note:</p> <p> <i>Appropriate identification of ACM is necessary to ensure the continued safety of the occupants and the safety of workers, who may not be aware of asbestos hazards. If ACM may be disturbed during a planned project, a properly trained and accredited asbestos professional should conduct an initial assessment to determine potential worker exposures and required exposure controls.</i></p> <p> <i>Asbestos awareness training is recommended for building upgrade workers, especially work planners and crew chiefs.</i></p>	<p>This cell is intentionally blank.</p>

References for Priority Issue 2.0 Asbestos:

- Building Performance Institute (BPI): [Technical Standards for the Heating Professional](#)
- EPA: [Asbestos](#)
- EPA: [Asbestos in the Home: A Homeowner's Guide](#)
- EPA: [Asbestos NESHAP](#)
- EPA: [Monitoring Asbestos-Containing Material \(ACM\)](#)
- EPA: [Protect Your Family from Asbestos-Contaminated Vermiculite Insulation](#)
- EPA: [State Asbestos Contacts](#)
- National Institute of Standards and Technology (NIST): [National Voluntary Laboratory Accreditation Program \(NVLAP\) Asbestos Fiber Analysis LAP](#)
- Occupational Safety and Health Administration (OSHA): [Asbestos](#)
- OSHA: [Asbestos, Construction](#)

 See Appendix A: Worker Protection

PRIORITY ISSUE 3.0 LEAD

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 3.1 Determine Whether There is Lead-Based Paint</p> <p>Assume there is lead-based paint in multifamily residential buildings built before 1978 unless testing shows otherwise. Recognize, however, that lead-based paint may be present in any building.</p> <p>Note:</p> <p><i>EPA's Lead Renovation, Repair and Painting Rule (RRP Rule) requires that firms performing renovation, repair and painting projects that disturb lead-based paint in homes built before 1978 (including many of the projects envisioned in this document) have their firm certified by EPA (or an EPA-authorized state), use certified renovators who are trained by EPA-accredited training providers, and follow specific lead-safe work practices.</i></p> <p>If unsure whether there is lead-based paint, consider one of the following options:</p> <ul style="list-style-type: none"> • Hire an RRP-certified contractor to test for lead using an EPA-recognized test kit (available at hardware stores). The certified contractor has been directed to follow specific instructions to get accurate results. Note that testing performed by uncertified people, including landlords or property managers, is not sufficient. To learn more about EPA-recognized test kits, visit the EPA Lead Test Kits Web page. • Hire a certified professional to check for lead-based paint. A certified inspector or risk assessor can conduct an inspection to determine whether a home or a portion of a home has lead-based paint and where it is located. • For help finding a certified risk assessor, inspector or RRP contractor, call the National Lead Information Center at 1-800-424-LEAD (5323). 	<p>MA 3.1 Comply with EPA's Lead RRP Rule if Disturbing More Than 6 Square Feet of Interior or 20 Square Feet of Exterior Painted Surfaces</p> <p>Among the rule's key elements are the following:</p> <ul style="list-style-type: none"> • Use a trained and certified renovator employed by a lead-safe certified firm. • Follow lead-safe work practices. • Contain the work area to avoid occupant exposure. • Minimize lead dust and leave no dust or debris behind. • Achieve visual post-cleaning criteria. • Comply with state and local lead-related regulations, which may be applicable to lead hazard reduction activities and may require additional certified personnel. <p>Note:</p> <p>  <i>This is not a complete summary of the regulatory requirements. The intent of this Guide is to promote the most health-protective steps that are feasible and practical. The minimum action recommended in this Guide is to comply with whatever the most current version of the RRP Program Rule prescribes and with all local and state regulations that may apply.</i></p> <p>MA 3.2 Inform Maintenance Staff on Requirements for Lead-Safe Work Practices</p> <p>Inform maintenance staff that if they will be disturbing lead paint, they must be trained and certified under EPA's RRP program for lead-safe work practices. This includes ensuring the information distribution requirements of EPA's RRP program are met. See Small Entity Compliance Guide to Renovate Right: EPA's Lead-Based Paint Renovation, Repair, and Painting Program.</p>	<p>EA 3.1 Comply with Expanded Requirements Including HUD's Lead-Safe Rehabilitation Practices and EPA Lead Hazard Standards</p> <ul style="list-style-type: none"> • Follow the U.S. Department of Housing and Urban Development (HUD) lead-safe rehabilitation practices. In addition to EPA's RRP Rule, these HUD practices include: <ul style="list-style-type: none"> ◦ Lowered thresholds for interior painted surface area, from 6 square feet to 2 square feet. ◦ Requirements for repair of painted surfaces that are disturbed when using lead-safe work practices. •   Ensure that EPA lead hazard standards are met, including requirements for no deteriorated paint and for meeting lead dust clearance testing standards. Dust testing must be done by an EPA- or state-certified inspector or risk assessor. If the job affects an outdoor area, ensure that EPA soil hazard standards also are met. <p>Note:</p> <p><i>Lead dust clearance testing includes measuring for lead dust on floors, windowsills and window troughs. See EPA Hazard Standards for Lead in Paint, Dust and Soil (TSCA Section 403).</i></p> <p>EA 3.2 Replace Windows Containing Lead-Based Paint</p> <p>Replace windows that test positive for lead-based paint, complying with EPA's RRP Rule and other regulations that may be applicable to lead hazard reduction activities.</p>



See Appendix A: Worker Protection



Appendix B: Property Management and Occupant Education

PRIORITY ISSUE 3.0 LEAD (continued)		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<ul style="list-style-type: none"> Notify the building owner and/or property manager of any lead-based paint identified during the assessments. <p>Note: <i>The lead-safe work practices (see Minimum Actions and Expanded Actions) apply unless paint is tested and found NOT to be lead-based.</i></p> <p>AP 3.2 Determine Area of Paint That Will be Disturbed</p> <p>Determine whether any suspected lead-based paint will be disturbed by the project and, if so, the size of the lead-based paint area that will be disturbed.</p>		<p>EA 3.3 Ensure All Paint Used in the Future Is Lead-Free</p> <p>Some coatings are exempt from lead-containing paint regulations. These include coatings for industrial equipment and those used for building and equipment maintenance coatings. Recommend the building owner and property manager ensure that all future paint applications in the building are lead-free. See the Consumer Product Safety Commission's (CPSC) Lead in Paint: Overview and Product-Specific FAQs.</p>

References for Priority Issue 3.0 Lead:

CPSC: [Lead in Paint: Overview and Product-Specific FAQs](#)
 EPA: [Lead Test Kits](#)
 EPA: [Hazard Standards for Lead in Paint, Dust and Soil \(TSCA Section 403\)](#)
 EPA: [Lead](#)
 EPA: [Lead: Details on Certification Requirements for Firms](#)
 EPA: [Locate an RRP Training Class or Provider in Your Area](#)
 EPA: [Locate Certified Inspection, Risk Assessment, and Abatement Firms](#)
 EPA: [Renovation, Repair and Painting Program](#)
 EPA: [Small Entity Compliance Guide To Renovate Right: EPA's Lead-Based Paint Renovation, Repair, and Painting Program](#)
 EPA: [Steps to Lead Safe Renovation, Repair and Painting](#)
 HUD: [The Lead-Safe Housing Rule](#)
 OSHA: [Lead](#)

PRIORITY ISSUE 4.0 POLYCHLORINATED BIPHENYLS (PCBs)		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 4.1 Determine Whether Fluorescent Light Ballasts Containing PCBs Are Present</p> <p>Some multifamily residential buildings may contain fluorescent light fixtures with ballasts manufactured before 1979 that contain PCBs. Ballasts manufactured between July 1, 1978 and July 1, 1998 that do not contain PCBs were required to be labeled “No PCBs.” Newer fluorescent lighting typically uses electronic ballasts that do not contain PCBs and should be clearly marked as electronic.</p> <p>If fluorescent light ballasts do not have the statement “No PCBs” or are not marked as electronic, assume that the ballasts contain PCBs or contact the manufacturer to determine whether the ballasts contain PCBs. If the manufacturer is not sure whether the ballasts contain PCBs, assume that they do.</p> <p>AP 4.2 Assess Caulk That Will Be Disturbed</p> <p>Assess whether caulk will be disturbed during the building upgrade activities. Consider the age of the structure, since buildings built or renovated between 1950 and 1979 may be more likely to contain PCBs in caulk. Typical locations include around windows, door frames, masonry columns and other masonry materials.</p> <p>Note:</p> <p><i>PCBs were not added to caulk after 1979; however, caulk containing PCBs manufactured before 1979 could have been used in buildings after that time.</i></p>	<p> MA 4.1 Replace PCB-Containing Fluorescent Light Ballasts</p> <p>Whether PCBs are confirmed or assumed to be present, new lighting fixtures can be used to replace the existing fixtures. PCB-containing fluorescent light ballasts that are leaking must be replaced and properly disposed of pursuant to EPA regulations, as described in 40 CFR Part 761 Subpart D. Any oil and stains leaked from PCB-containing ballasts also must be properly cleaned up or disposed of in accordance with the PCB decontamination or disposal regulations. EPA recommends that non-leaking PCB-containing fluorescent light ballasts also be replaced because of their increased likelihood to fail and leak and because of the increased energy efficiency of new ballasts.</p> <p> MA 4.2 Address Caulk Potentially Containing PCBs When It Will be Disturbed During Building Upgrades</p> <p>If PCBs are potentially present in caulk and the caulk will be disturbed during the building upgrades (e.g., window or door replacement, improved weatherization sealing), take steps to minimize exposure. For more information, go to Polychlorinated Biphenyls (PCBs) in Building Materials.</p> <p> MA 4.3 Properly Dispose of PCB-Containing Light Ballasts, Caulk and Other Materials</p> <p>When removing PCB-containing light ballasts, caulk and other materials contaminated by PCBs, specific notification, packing, reporting, storage, transportation and disposal requirements apply, see 40 CFR Part 761. Ensure that waste management also meets local and state requirements. Document and store copies of all test results. Include documentation of all sampling locations and disposal measures, including disposal companies used and final destination of waste materials.</p> <p>EPA Regional PCB Coordinators are a resource for all PCB issues.</p> <p>Note:</p> <p><i>Fluorescent light bulbs contain small amounts of mercury. Ensure that the bulbs are handled properly to avoid breakage and the release of contaminants. More information on fluorescent bulb disposal requirements may be obtained from your state solid and hazardous waste agencies. See Priority Issue 23.0 Protecting IAQ During Construction for more information on limiting exposure to mercury.</i></p>	<p>This cell is intentionally blank.</p>

References for Priority Issue 4.0 Polychlorinated Biphenyls (PCBs):

EPA: [Polychlorinated Biphenyls \(PCBs\) in Building Materials](#)
EPA: [PCB-Containing Fluorescent Light Ballasts \(FLBs\) in School Buildings](#)
EPA: [Polychlorinated Biphenyls \(PCBs\)](#)
EPA: [Polychlorinated Biphenyls \(PCBs\) Manufacturing, Processing, Distribution in Commerce, And Use Prohibitions, 40 CFR Part 761 Subpart D—Storage and Disposal](#)
EPA: [Recycling Mercury-Containing Light Bulbs \(Lamps\)](#)
EPA: [Regional PCB Contacts](#)
EPA: [Steps to Safe Renovation and Abatement of Buildings That Have PCB-Containing Caulk](#)

 See Appendix A: Worker Protection

PRIORITY ISSUE 5.0 RADON

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 5.1 Select a Radon-Testing Professional</p> <p>Qualified measurement professionals are individuals who have demonstrated a minimum degree of appropriate technical knowledge and skills specific to radon testing in large buildings (1) as required by a state licensing or certification program, as applicable, or (2) as established in certification requirements of the National Radon Proficiency Program or the National Radon Safety Board.</p> <p>Those who wish to perform their own radon testing may learn more about obtaining a radon test kit at EPA's Where Can I Get a Radon Test Kit? website.</p> <p>AP 5.2 Test Either (1) Both Pre- and Post-Upgrade Work or (2) Only Post-Upgrade Work</p> <p>Follow sampling guidance in American Association of Radon Scientists & Technologists (AARST) Protocol for Conducting Radon and Radon Decay Product Measurements in Multifamily Buildings, MAMF-2012, summarized below.</p> <ul style="list-style-type: none"> • Sample all dwelling units in contact with the ground. • Sample all common areas and office spaces in contact with the ground. • Sample nonresidential rooms or areas (e.g., utility rooms, storage rooms, and maintenance rooms) in contact with the ground that: <ul style="list-style-type: none"> o Can be occupied with little or no modification. o Are occupied more than 4 hours a day. o Have air communication with areas that can be occupied (e.g., via pathways such as stairwells, air-handling equipment, elevator shafts). • Sample 10% of dwelling units on each higher floor or, if 10% is less than one unit, sample at least one dwelling unit on each higher floor. 	<p>MA 5.1 Take Precautionary Measures Before Completing Energy Efficiency Upgrade Activities</p> <p>Before completing upgrade activities, take precautionary measures listed in the first column of Table 2: Radon Testing Options and Reduction Strategies, depending on pre-work radon test results.</p> <p>MA 5.2 Follow Minimum Actions in Table 2 According To Post-Work Radon Test Results</p> <p>After work is complete, follow the appropriate Minimum Actions outlined in Table 2: Radon Testing Options and Reduction Strategies, depending on post-work radon test results. If more than one sample was taken in a dwelling unit or nonresidential room, average the results for that specific location. Do not average results across dwelling units or building levels.</p> <p>When the pre-work radon level is > 2 pCi/L, complete precautionary foundation air sealing strategies:</p> <ul style="list-style-type: none"> • Cover exposed earthen floors in basements and crawlspaces according to Section 1.2 of EPA's Indoor airPLUS Construction Specifications. • Air seal sumps (e.g., install an airtight sump cover) in such a way that water can drain from above and below the sump cover. • Install airtight drain fittings (e.g., trap or flange system) in foundation floor drains. • Seal and caulk penetrations, openings or cracks in below-grade walls and floors that contact the ground with a sealant that meets the requirements of ASTM C920-14a. <p>Note:</p> <p><i>These foundation air sealing strategies also are important elements of radon mitigation according to AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.</i></p>	<p>EA 5.1 Follow Expanded Actions Listed in Table 2 According To Post-Work Radon Test Results</p> <p>See Table 2: Radon Testing Options and Reduction Strategies for Expanded Actions to reduce radon exposure.</p> <ul style="list-style-type: none"> • Mitigate according to AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014. • If the post-work radon level is between 2 and 4 pCi/L, the building owner and/or property manager may refer to EPA's Citizen's Guide to Radon.

PRIORITY ISSUE 5.0 RADON

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>Note: <i>Testing on every floor is necessary to (1) assess whether radon from a ground-contact source is travelling upwards through the building via a chase, shaft or other pathway; and (2) assess whether there are building materials that emit radon. In higher floors where only one dwelling unit is tested, it can be useful to test a dwelling unit adjacent to potential radon pathways such as a stairwell or elevator shaft.</i></p>	<p>If radon levels increase from less than 4 pCi/L to 4 pCi/L or higher, complete radon mitigation consistent with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014. Long-term (90-day) samples should be used to confirm post-upgrade results. Follow the same mitigation approach if no pre-work levels were taken and the post-work radon level is ≥ 4 pCi/L.</p> <p>MA 5.3 Notify the Building Owner/Property Manager About Radon-Reduction Measures</p> <p>Notify the building owner and/or property manager about the test results and radon-reduction measures that were implemented. Inform the building owner and/or property manager that the radon testing protocols were completed to ensure that the building upgrade work did not introduce indoor radon problems, but the protocols did not necessarily mitigate a prior radon problem in the building. Advise the building owner and/or property manager to perform periodic retesting in areas of the building that have been mitigated for radon. Encourage the building owner and/or property manager to provide occupants with information about radon testing results and mitigation/ risk-reduction measures. Owners should consult EPA's A Citizen's Guide to Radon for more information about radon risk and mitigation strategies.</p>	

Table 2: Radon Testing Options and Reduction Strategies¹

Pre-Work Test Result and Precautionary Measures	Post-Work Test Result	Minimum Actions	Expanded Actions
< 2 pCi/L <i>Consider precautionary radon-reduction actions as part of building upgrade work, especially covering exposed earth, air sealing open sumps, and ensuring floor drains have traps and that the traps are not dry.</i>	< 2 pCi/L	No further minimum action.	
	> 2 and < 4 pCi/L	Complete foundation air sealing strategies.	For post-work radon levels between 2 and 4 pCi/L, refer the building owner/property manager to EPA's A Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.
	≥ 4 pCi/L	Mitigate in accordance with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.	
> 2 and < 4 pCi/L <i>Take precautionary radon-reduction actions: complete foundation air sealing strategies as part of building upgrade work.</i>	< 4 pCi/L and NOT higher than pre-work level.	No further minimum action.	For post-work radon levels between 2 and 4 pCi/L, refer building owner/property manager to EPA's A Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.
	< 4 pCi/L AND higher than pre-work level.	Verify that foundation air sealing strategies were completed appropriately and correct deficiencies.	For post-work radon levels between 2 and 4 pCi/L, refer building owner/property manager to EPA's A Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.
	≥ 4 pCi/L	Mitigate in accordance with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.	
≥ 4 pCi/L <i>Complete all foundation air sealing strategies as part of building upgrade work.</i>	< 4 pCi/L	No further minimum action.	For post-work radon levels between 2 and 4 pCi/L, refer building owner/property manager to EPA's A Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.
	≥ 4 pCi/L	Refer building owner to EPA's A Citizen's Guide to Radon and recommend radon mitigation in accordance with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.	Mitigate in accordance with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.
No Pre-Work Test <i>Consider precautionary radon-reduction actions as part of building upgrade work, especially covering exposed earth, air sealing open sumps, and ensuring floor drains have traps and that the traps are not dry.</i>	< 4 pCi/L	No further minimum action.	For post-work radon levels between 2 and 4 pCi/L, refer building owner/property manager to EPA's A Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.
	≥ 4 pCi/L	Mitigate in accordance with AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.	

References for Priority Issue 5.0 Radon:

- [AARST: Protocol for Conducting Radon and Radon Decay Product Measurements in Multifamily Buildings, ANSI/AARST MAMF-2012](#)
- [AARST: Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014](#)
- [ASTM: C920-14a Standard Specification for Elastomeric Joint Sealants](#)
- [EPA: A Citizen's Guide to Radon](#)
- [EPA: Consumer's Guide to Radon Reduction](#)
- [EPA: Indoor airPLUS Construction Specifications](#)
- [EPA: Map of Radon Zones Including State Radon Information and Contacts](#)
- [EPA: Where Can I Get a Radon Test Kit?](#)

1. **Note:** If the building upgrade involves installation of insulation that moves the thermal boundary to the roof, making the attic a conditioned space, take precautions to ensure that any active radon mitigation system does not result in radon levels that are equal to or greater than 4 pCi/L in the attic.

PRIORITY ISSUE 6.0 BELOWGROUND CONTAMINANTS (EXCEPT RADON)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 6.1 Evaluate Potential Sources and Odors Perform a walkthrough inspection and visually evaluate potential sources and check for gasoline, sewer gas, or fuel oil odors. Pay particular attention to ground-contact spaces, mechanical rooms, and areas with drain, waste and vent piping.</p> <p>AP 6.2 Evaluate the Sewer Vent System Visually evaluate the integrity of the sewer vent system (e.g., ensure drain traps have water in them, inspect drain lines for breaks or leaks, check for apparent blockages), particularly if there is sewer gas odor in the building (e.g., during the initial assessment or a fan depressurization test).</p> <p>AP 6.3 Take Proper Actions if the Odor Source Cannot be Identified If an odor is detected but its source cannot be identified, and the building is in a known area of contamination, notify local or state authorities and/or pursue additional assessments before continuing project work.</p> <p>AP 6.4 Conduct Further Assessment if Contamination is Suspected If soil or groundwater contamination is suspected on or near the building site (e.g., former industrial site), volatile contaminants or breakdown products may pose an IAQ risk through soil gas intrusion. In such cases, EPA recommends further assessment before air sealing. Consult your state or tribal voluntary Brownfields cleanup program or environmental regulatory agency for information on the risks of vapor intrusion in your area. ASTM E2600 describes a tiered approach for screening properties for vapor intrusion and Table X5.1 of the standard provides a list of state vapor-intrusion guidance websites.</p> <p>Note: <i>A records search of the property and surrounding areas may provide information regarding past uses and spill reports.</i></p>	<p>MA 6.1 Repair Unattached Sewer Vent System Components Repair or replace failed or unattached sewer vent system components before proceeding with building upgrade projects.</p> <p>MA 6.2 Address Drain Traps Prone to Drying Out If the assessments reveal sewer gas odors from drain traps that are dry because of infrequent use, develop a maintenance plan to periodically add water to the traps to maintain a seal against sewer gases. Consider installing inline drain trap seals on floor drains prone to drying out.</p> <p>Note: <i>Because of their continuous usage, drain traps in sinks, toilets and drinking fountains seldom are a problem. Usually it is a floor drain in an obscure location, such as a mechanical room or a maintenance closet. Dry drain traps in mechanical rooms are especially problematic because mechanical rooms often contain heating, cooling and ventilation systems that can quickly spread the gases and odors to other parts of the building. Unitary equipment (e.g., heat pumps) can have dry drain traps, which often results in the undesirable odors being limited to one room.</i></p> <p>MA 6.3 Mitigate Soil Gas Vapor Intrusion If soil gas vapor intrusion is confirmed during the assessments, mitigate in compliance with state or local standards. Table X5.1 of ASTM E2600 provides a list of state vapor intrusion guidance websites. If there are no state or local standards for your area, follow the EPA guidance referenced below for vapor intrusion evaluation and mitigation.</p> <p>Note: <i>The causes or sources of contaminants must be identified and corrected before air sealing or other building upgrade actions are performed to ensure the problem is not exacerbated.</i></p>	<p>EA 6.1 Install Floor Drain Seals to Untrapped Floor Drains If there are untrapped floor drains, install inline floor drain seals to provide protection against sewer gases.</p> <p>EA 6.2 Install Automatic Drain Trap Primers Install automatic drain trap primers, available from several major manufacturers, in drain traps that are susceptible to drying out to ensure that a small amount of water is periodically delivered to the trap.</p> <p>EA 6.3 Take Proper Measures for Brownfields Sites During New Construction or Building Expansion Projects located on Brownfields sites (as classified by a federal, state or local government agency) involving new construction or expansion of a ground-level foundation should include features to prevent migration of soil-gas contaminants into occupied spaces, as described in the ASHRAE Indoor Air Quality Guide, Strategy 3.4.</p>

References for Priority Issue 6.0 Belowground Contaminants (Except Radon):

- ASHRAE: Indoor Air Quality Guide, Strategy 3.4
- ASTM: E2600-15 Standard Guide for Vapor Encroachment Screening on Property Involved in Real Estate Transactions
- EPA: Building Air Quality Action Plan, Step 2: Develop an IAQ Profile of Your Building, Part 2: Conduct a Walkthrough
- EPA: Engineering Issue. Indoor Vapor Intrusion Mitigation Approaches
- EPA: IAQ Design Tools for Schools. Preventing the Entry of Pollutants from Outside the Building. Drain Traps
- EPA: Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air
- EPA: Vapor Intrusion

PRIORITY ISSUE 7.0 GARAGE AIR POLLUTANTS

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 7.1 Identify Location and Configuration of Attached Garages Identify whether the building has any attached garages. Underground or tucked-under garages, with or without openings to the outdoors, should be considered as attached garages. An attached carport not open to the outside on at least two sides also should be considered an attached garage.</p> <p>AP 7.2 Check for HVAC Systems Inside Garage Identify whether HVAC components (such as air-handling equipment and ductwork) serving occupied spaces are inside the envelope of the attached garage(s).</p> <p>AP 7.3 Locate Air Leaks Using ASTM E1186-03 (2009), identify all air leaks between the attached garage(s) and occupied spaces that share a surface with the garage.</p> <p>AP 7.4 Determine Presence of Combustion Engines Identify whether any combustion engines other than automobiles and trucks are operated in the attached garage(s).</p>	<p>MA 7.1 Eliminate or Minimize Unwanted Air Transfer to Dwelling Units Via Mechanical Equipment and Ductwork Do not install in a garage new HVAC equipment or ductwork that serves occupied spaces. For existing air-handling equipment and ductwork that serves occupied spaces and is located in a garage:</p> <ul style="list-style-type: none"> • Air seal all ductwork and fittings. Seal seams, plenums and ductwork with tape and mastic systems that meet the applicable requirements of UL 181A or UL 181B, or gasket systems. • Seal gaps around ductwork, pipes and cables that penetrate the common walls, floors and ceilings separating occupied spaces from garages. • Because existing air handler cabinets are likely to have high leakage rates, seal access panel edges with tape to allow future servicing and permanently seal all other cabinet openings. • Disconnect and remove supply diffusers and return grilles in the garage that connect to ductwork and air handlers serving occupied spaces; close with end caps and air seal the gaps. • If the air handler is part of a natural or induced draft furnace, replace the furnace with a power vent or sealed combustion appliance or provide all combustion air from the outdoors according to ANSI Z223.1/ NFPA 54 National Fuel Gas Code or the 2012 International Fuel Gas Code. In low-rise buildings, place combustion air openings in a vented attic, where possible. <p>Note: <i>Cold climate combustion air louvers directed to the outdoors may require interlocked mechanical dampers to prevent pipe freezing.</i></p>	<p>EA 7.1 Remove Air-Handling Equipment from Garages Relocate air-handling equipment that serves occupied spaces from the garage to an area within conditioned space.</p> <p>EA 7.2 Perform Additional Efforts to Compartmentalize Garages from Occupied Spaces</p> <ul style="list-style-type: none"> • Where concrete block or other air-permeable material is in place between a garage and conditioned space, provide an air barrier membrane or coating on the garage side of common surfaces to occupied space. • Construct a vestibule at doorways leading from the garage into the occupied portions of the building and exhaust vent the vestibule to the outdoors. • Enhance the effectiveness of the garage exhaust system. Consider designing the garage exhaust system so that a portion of the exhaust is used to depressurize common walls, floors, and ceilings that separate the garage from occupied space. <p>Note: <i>When sealing, the air barrier assembly must have been evaluated by the Air Barrier Association of America (ABAA) and installed according to manufacturer specifications. Fire rated assemblies must be sealed using approved fire-rated materials. The fire rating requirements supersede the ABAA evaluation requirement.</i></p> <p>EA 7.3 Recommend Removal of Combustion Engine-Operated Equipment inside the Garage Advise the building owner or property manager to remove all combustion engine-operated equipment (except automobiles and trucks) from inside the garage, where feasible.</p>

PRIORITY ISSUE 7.0 GARAGE AIR POLLUTANTS (continued)		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
	<p>MA 7.2 Compartmentalize Garage from Occupied Spaces:</p> <p>Isolate the garage from adjacent occupied spaces. For large openings, use sealed gypsum wall board in conformance with the 2012 International Building Code requirements for fire and smoke separation (i.e., at least ½” thick on the walls and at least ¾” thick on the ceiling separating the garage and the occupied spaces above). Tightly seal all penetrations, including electrical, plumbing and duct penetrations through common walls, floors and ceilings separating occupied spaces from garages.</p> <ul style="list-style-type: none"> • In occupied conditioned spaces above the garage, seal all connecting floor and ceiling joist bays. • In occupied conditioned spaces next to the garage, apply weather stripping to all doors, and seal all cracks at or between the mud sill, rim joists, subfloors and/or the bottom of gypsum board. • Ensure a carbon monoxide alarm is installed in every room that shares a floor, ceiling or wall with the garage. <p>If possible, include a vestibule that provides an airlock between the garage and adjacent occupiable spaces, or provide self-closing gasketed doors with deck-to-deck partitions or a hard lid ceiling.</p> <p>Note:</p> <p><i>When air sealing, the air barrier assembly must have been evaluated by the ABAA and installed according to manufacturer specifications. Fire-rated assemblies must be sealed using approved fire-rated materials. The fire rating requirements supersede the ABAA evaluation requirement.</i></p> <p>Provide an exhaust fan in the garage, vented directly to the outdoors. The exhaust rate shall be at least 0.75 cubic feet per minute (cfm) per square foot of garage floor area, with no air recirculation, provided continuously. Add gaskets to any doors or ports that allow access for exhaust fan servicing.</p> <p>Exception:</p> <p><i>Garages that meet the requirements for open parking garages, as defined by 2012 International Building Code, Section 406.5.2 Openings.</i></p> <p>Advise the building owner or property manager that the use of engine-operated equipment other than automobiles or trucks in the garage may generate pollutants that can negatively affect occupied spaces.</p>	

References for Priority Issue 7.0 Garage Air Pollutants:

ABAA: Air Barrier Materials, Components, Assemblies & Systems
ANSI Z223.1/NFPA 54: National Fuel Gas Code
ASTM E1186-03 (2009): Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
DOE: Standard Work Specifications for Multi-Family Home Energy Upgrades, Sections 3.1501.2, 3.1502.1 and 3.1502.2
International Code Council: International Building Code, 2012 Edition, Section 406.5.2
International Code Council: International Fuel Gas Code, 2012 Edition
UL: Fire-Resistance and Smoke Protection
UL 181A: Standard for Closure Systems for Use With Rigid Air Ducts
UL 181B: Standard for Closure Systems for Use With Flexible Air Ducts and Air Connectors

PRIORITY ISSUE 8.0 PESTS

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 8.1 Identify Potential Pests and Integrated Pest Management (IPM) Resources</p> <p>Identify pests likely to colonize the building based on project location. Identify and acquire resources to assist with implementing IPM (e.g., state/county extension, publications and online resources, nongovernmental organizations, pest management professionals with expertise in IPM), including the proper identification of pests.</p> <p>AP 8.2 Identify Evidence of Pests</p> <p>Identify evidence of pests (e.g., rodents, squirrels, termites, birds, bats, cockroaches) in common areas and dwelling units. Note the location and identify pest-contaminated materials. Determine whether pesticides (rodenticides, insecticides, fungicides) presently are being used. See Minimum Action 8.1 for minimum actions to address pest infestations.</p> <p>Notes:</p> <p>(1) <i>Areas that have a significant potential for pest infestations include attics, basements, crawlspaces, and around chimneys, mechanical stacks and plumbing cleanouts.</i></p> <p>(2) <i>Termites and some other types of pest infestations often are an indication of moisture problems. See Priority Issue 1.0 Moisture Control and Mold for diagnosing moisture problems.</i></p> <p>AP 8.3 Assess Whether the Building Has an IPM Plan</p> <p>Consult with building management to determine whether the building has an IPM plan or other pest management plan and the degree to which the plan is being followed.</p>	<p>MA 8.1 Mitigate Pest Infestations</p> <p> If there is indication of current or past infestations within the building, seek assistance from a professional who ensures IPM practices with their pest management services (some examples may include GreenPro, Green Shield, or equivalently trained IPM professionals).</p> <p>Do not begin work in pest-infested zones until infested materials are properly removed. In some cases, professional assistance may be needed to remove infested materials.</p> <p>Note:</p> <p><i>Many states require pest management professionals to be licensed.</i></p> <p>MA 8.2 Reduce Potential for Pest Entry</p> <p>Block, seal and eliminate pest entry points around the building envelope. Examples include gaps around doors and windows, between the foundation and the upper portion of the building, and around utility pipes, conduits or wires.</p> <p>MA 8.3 Patch Openings to Eliminate Rodent Pathways</p> <p>In areas with evidence of rodent infestation, patch and seal exterior holes that are larger than ¼” by ⅜” with pest-resistant materials (e.g., copper mesh, hardware cloth, sheet metal, concrete) before applying weatherization materials that may be susceptible to gnawing by rodents (e.g., caulk or foam).</p> <p>MA 8.4 Block Pest Movement Through Building</p> <p>Reduce risk of pest dispersal throughout the building by sealing and blocking passageways that pests can use to move freely to obtain food, water and harborage. This includes gaps around floor and ceiling joists; penetrations in walls, floors and ceilings; and openings around shafts and chutes.</p> <p>MA 8.5 Protect Outdoor Air Intakes and Exhausts</p> <p>Protect air intakes from bird and pest entry (e.g., cover openings with corrosion-resistant ½”-screen or galvanized mesh). Similarly, protect exhaust vents from rodent, bird and pest entry (e.g., cover openings with louvers). Avoid creating conditions that can clog exhaust vents.</p> <p>Advise the property manager to regularly inspect, clean and repair screens or louvers over air intakes and exhausts (e.g., at least semi-annually or when replacing HVAC filters). Make sure that rooftop air handlers, including exhaust fans, are air sealed to their roof curbs to prevent pest entry.</p> <p>MA 8.6 Do Not Disturb Existing Pest Protections</p> <p>Do not disturb or eliminate any building-related materials that are in place to exclude pests. If temporary disruption is necessary for a project, provide appropriate protection from pest entry while the pest barriers are removed.</p> <p>MA 8.7 Keep Vegetation and Clutter Away From Building and Mechanical Systems Components</p> <p>Remove clutter, eliminate woodpiles and waste near the building, and remove any bushes, trees or other vegetation within 2 feet of the structure. Keep vegetation away from outdoor air intakes and outdoor mechanical equipment. Do not pile soil or mulch against the building’s exterior walls.</p>	<p>EA 8.1 Create an IPM Plan</p> <p> If there is no IPM plan for the building, work with the building owner and/or property manager to develop and implement one. Use the HUD, National Center for Healthy Housing (NCHH) and Local Initiatives Support Corporation (LISC) resources listed below when developing the plan. Use pamphlets and active engagement (e.g., information sessions, peer-to-peer education) to teach property managers and occupants about IPM. Refer to Appendix B for more information about property management and occupant education on IPM.</p> <p>EA 8.2 Use Sealable Garbage Containers Outside</p> <p>Ensure exterior garbage cans and dumpsters are sealable and sanitized regularly.</p>



Appendix B: Property Management and Occupant Education

References for Priority Issue 8.0 Pests:

ASHRAE: Indoor Air Quality Guide, Strategy 3.6

CDC: Rodents

EPA: Introduction to Integrated Pest Management, Principles of IPM

Green Shield: Green Shield Certified

HUD: HUD's Guidance on Integrated Pest Management

LISC: Green & Healthy Property Management: A Guide for Multifamily Buildings

National Pest Management Association: GreenPro Certified

NCHH: Integrated Pest Management: A Guide for Affordable Housing

NCHH: Integrated Pest Management in Multifamily Housing

San Francisco Department of the Environment: Pest Prevention by Design Guidelines

U.S. Department of Agriculture: Cooperative Extension System Offices

PRIORITY ISSUE 9.0 TRACKED-IN POLLUTANTS

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 9.1 Inspect Floor Surfaces at Building Common Entrances</p> <p>Inspect all building common entrances for walk-off mats or entry mat systems. Note accumulation of dirt or moisture on interior floors near building entrances that might indicate need for walk-off mats or entryway floor-cleaning systems.</p>	<p>MA 9.1 Provide Walk-Off Mats</p> <p>Provide walk-off mats to trap dirt and moisture at all building common entrances. The mats need to be long enough to allow at least five full steps for people entering the building (a minimum of 10 feet long). Walk-off mats should be regularly vacuumed and cleaned according to manufacturer's printed instructions. Mats should have anti-slip backings or other means to reduce sliding and tripping hazards. Mats should not be placed over carpeted areas and should have an impervious, readily cleanable surface beneath them.</p> <p>Note:</p> <p><i>Mats should be periodically moved and allowed to dry. Mats in high-traffic areas and over vinyl flooring should be moved and allowed to dry frequently during wet weather conditions (e.g., on a daily basis).</i></p>	<p>EA 9.1 Install Permanent Entryway Systems</p> <p>Install permanent entryway systems at all regularly used building common entrances to capture dirt and moisture, as described in ASHRAE Standard 189.1-2014, Section 8.3.1.5 or EPA's IAQ Design Tools for Schools, Entry Mat Barriers. The entryway system should:</p> <ul style="list-style-type: none"> • Provide a scraper surface, an absorption surface and a finishing surface, in sequence in the direction of travel into the building. • Be as wide as the entry doors. • Have anti-slip backings or other locking mechanisms to reduce sliding and tripping hazards. • Be designed for regular cleaning to remove accumulated dirt. • Not be installed over an existing walk-off mat or other entryway system.

References for Priority Issue 9.0 Tracked-In Pollutants:

- ASHRAE: Indoor Air Quality Guide, Strategy 3.5
- ASHRAE Standard 189.1-2014, Section 8.3.1.5
- EPA: IAQ Design Tools for Schools, Entry Mat Barriers

PRIORITY ISSUE 10.0 BUILDING PRODUCTS/MATERIALS EMISSIONS

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 10.1 Review Content and Emissions Documentation for New Products</p> <p>Review information on the chemical content and emissions for products being considered for purchase and installation during the building upgrade project to determine whether they contain potentially hazardous compounds. Many of these products and materials (e.g., plywood, particleboard, pressed wood, insulation, paints, sealants, cleaning supplies) can contain volatile organic compounds VOCs or other hazardous compounds to which exposure should be minimized or eliminated during and after the upgrade project.</p>	<p>MA 10.1 Select Least Toxic Materials</p> <p>  When installing new products and materials, use the least toxic product or material feasible to do the job effectively. For example, use products and materials that indicate they have (or are certified as having) low-VOC content or low-VOC emissions and follow manufacturers' printed instructions for use.</p> <p>Where possible, specify products and materials that meet independent certification and testing protocols, such as the following:</p> <ul style="list-style-type: none"> • California Department of Public Health, Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers (Emission Testing Method for California Specification 01350) • Carpet and Rug Institute Green Label Plus program criteria, or equivalent standards for carpet • Collaborative for High Performance Schools High Performance Products Database • Green Seal Standard GS-11 • GREENGUARD Gold Certification Program • Master Painters Institute Green Performance Standards X-Green, GPS-1 or GPS-2 • Resilient Floor Covering Institute, FloorScore® • Scientific Certification Systems, SCS-10.2-2007, Indoor Advantage Gold • Insulation products that contain no added formaldehyde and are moisture resistant. <p>MA 10.2 Use Low-Emitting Wood and Composite-Wood Products</p> <p>When installing structural plywood or pressed or composite wood products, select those that are certified compliant with California Title 7 Airborne Toxics Control Measures (ATCM) to reduce</p>	<p>EA 10.1 Air Out New Materials</p> <p>Where possible, air out new materials in a well-ventilated, clean and dry space prior to installation. Off-site opening of wrapped or tightly packaged materials to facilitate this conditioning step also is acceptable.</p> <p>EA 10.2 Seal Composite Wood Products</p> <p>Seal composite wood products (e.g., particleboard and pressed wood) that are not compliant with California Title 17 ATCM or that do not meet Section 6.1 of EPA's Indoor airPLUS Construction Specifications with a sealant intended to reduce VOC emissions. Seal all exposed surfaces and holes, as appropriate. Check with vendors for recommendations on sealing their engineered wood products.</p> <p>EA 10.3 Investigate and Correct Contaminant Source Problems After Building Modifications</p> <p>If odors or complaints indicate VOCs or other airborne contaminants after work has been completed, remove any potential sources (e.g., art/craft materials, fiberglass that may contain formaldehyde) from the room or area. If removal is not feasible, consider installing local exhaust ventilation for sources that are limited to a specific room or area, at least on a temporary basis until the off gassing has subsided. If these actions do not solve the problem (e.g., persistent odors, occupant complaints), hiring an environmental professional and testing may be necessary.</p> <p>EA 10.4 Post-Construction Flush-Out or Post-Construction Baseline IAQ Monitoring Per ASHRAE Standard 189.1</p> <p>After construction is completed, meet the requirements of ASHRAE Standard 189.1-2014, Section 10.3.1.4(b) for either a flush out or Post-Construction baseline IAQ monitoring before occupancy resumes in the renovated building/spaces.</p> <p>A flush-out period longer than specified in ASHRAE Standard 189.1-2014 can</p>



See Appendix A: Worker Protection



Appendix B: Property Management and Occupant Education

PRIORITY ISSUE 10.0 BUILDING PRODUCTS/MATERIALS EMISSIONS (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
	<p>formaldehyde emissions. If California Title 17 ATCM compliant materials are not available, use wood products that meet Section 6.1 of EPA's Indoor airPLUS Construction Specifications or composite wood products that contain no added formaldehyde.</p> <p>Notes:</p> <p>(1) <i>California Title 17 ATCM regulations require reduced formaldehyde emissions from composite wood products and finished goods that contain composite wood products sold, offered for sale, supplied, used or manufactured for sale in California.</i></p> <p>(2) <i>Title VI of TSCA sets national formaldehyde emission standards for composite wood products that are identical to California's Phase II emission standards. EPA currently is developing the regulations to implement these standards nationally.</i></p> <p>MA 10.3 Post-Construction Flush-Out With Outdoor Air</p> <p>After construction is completed, ventilate the renovated building/spaces with the design outdoor air ventilation rates before occupancy resumes. Ensure that HVAC systems are operational and capable of adequately controlling indoor humidity levels during the flush out. Do not conduct a "bake-out" in an attempt to reduce VOC emissions after the building is occupied, because it may cause VOCs to be absorbed by other interior materials and may damage building components.</p> <p>If possible, follow the post-construction flush-out requirements specified in ASHRAE Standard 189.1-2014, Section 10.3.1.4(b), which requires a total number of air changes corresponding to the ventilation system operating at its design outdoor airflow rate continuously, 24 hours per day for 14 days. A longer flush-out period can be used if there are concerns or complaints about IAQ after the initial flush out. Additional, periodic flush out also may be needed for spaces that have intermittent or infrequent occupancy and are not ventilated for extended periods.</p> <p>MA 10.4 Limit VOC Absorption During Construction</p> <p>Follow guidance outlined in Minimum Action 23.4 to protect absorptive materials during construction.</p>	<p>be used if there are concerns or complaints about IAQ after the initial flush out. Additional, periodic flush out also may be needed for spaces that have intermittent or infrequent occupancy and are not ventilated for extended periods.</p> <p>EA 10.5 Promote Transparency of Chemical Constituents in Products and Materials</p> <p> To promote transparency of chemical constituents associated with the manufacture of a product and substances residing in the final product, require products that have submitted their complete chemical inventory to a third party for verification. Make the verification/certification by the third party publicly available.</p>

References for Priority Issue 10.0 Building Products/Materials Emissions:

ASHRAE: Indoor Air Quality Guide, Strategies 5.1 and 5.2
 ASHRAE Standard 189.1-2014, Sections 10.3.1.4 and 10.3.1.4(b)
 California Department of Public Health: Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers (Emission Testing Method for California Specification 01350)
 California Title 17 ATCM to Reduce Formaldehyde Emissions from Composite Wood Products
 Carpet and Rug Institute: Green Label Plus
 Collaborative for High Performance Schools: High Performance Products Database
 EPA: Formaldehyde Emission Standards for Composite Wood Products
 EPA: Volatile Organic Compounds' Impact on Indoor Air Quality
 EPA: Indoor airPLUS Construction Specifications
 Green Seal: Green Seal Standard for Paints and Coatings, GS-11
 Master Painters Institute: MPI Green Performance Standards GPS-1-12 or GPS-2-12 or Extreme Green
 Resilient Floor Covering Institute: FloorScore®
 Scientific Certification Systems: SCS-EC10.2-2007, Environmental Certification Program, Indoor Air Quality Performance
 TSCA Title VI: Formaldehyde Standards for Composite Wood Products
 UL Environment: GREENGUARD Gold Certification Program



Appendix B: Property Management and Occupant Education

PRIORITY ISSUE 11.0 VENTED COMBUSTION APPLIANCES

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 11.1 Complete a Combustion Safety Inspection</p> <p>Complete a safety inspection of all vented combustion equipment in the building (e.g., furnaces, boilers, water heaters). The inspection shall include observations for applicable code requirements including proper clearances, condition of venting, assessment of the potential for back-drafting, integrity of fuel lines, safety of electrical connections and condition of the appliance itself. Document deficiencies and proposed repairs.</p> <ul style="list-style-type: none"> For gas-fired appliances and equipment, make this assessment using applicable installation standards, including the National Fuel Gas Code, ANSI Z223.1/NFPA 54, the applicable ANSI Z21 gas-fired appliance safety standards, and manufacturer’s printed instructions. Determine whether gas-fired appliance installations comply with Section 9.3 “Air for Combustion and Ventilation” of ANSI Z223.1/NFPA 54 for proper venting, including influences of other building ventilation and exhausting equipment. For oil-fired appliances and equipment, make this assessment using applicable installation standards, including the Standard for the Installation of Oil-Burning Equipment, ANSI/NFPA 31, the applicable ANSI/UL oil-fired appliance safety standard, and manufacturer’s printed instructions. Performance test vented combustion appliances to ensure proper draft under worstcase depressurization. Identify combustion appliances that have pilot burners. Determine whether carbon monoxide (CO) detection and warning equipment is installed in dwelling units and other locations within the building (e.g., mechanical rooms with combustion equipment). 	<p>MA 11.1 Correct Deficiencies and Ensure Proper Operation of Combustion Equipment</p> <p>Correct all deficiencies identified during the assessments and ensure compliance with applicable codes and standards. Test combustion equipment for proper draft and venting under worst-case conditions before and after building upgrade measures that affect envelope leakage and airflows (e.g., air sealing, insulation and the addition or upgrade of exhaust fans). Repair, remove, or replace combustion equipment and address other issues or deficiencies as needed to meet the applicable codes and standards.</p> <p>Note:</p> <p><i>All equipment removals should include proper disposal so that hazardous units are not reinstalled or used elsewhere.</i></p> <p>Address depressurization and potential back drafting problems (e.g., with combustion make-up air, fan interlocks, transfer grilles, jumper ducts, louvered doors, door undercuts, duct leakage repair), or adjust the exhaust equipment causing the problems provided it does not conflict with the specific exhaust requirements for spaces served by the exhaust equipment. Ensure that combustion appliances are installed with sufficient access for proper maintenance and are operating in compliance with the original manufacturer’s printed specifications.</p> <p>MA 11.2 Ensure Proper Exhaust Locations</p> <p>Ensure combustion exhaust is captured as close to the combustion source as possible, exhausted directly outdoors, and not vented into other indoor spaces such as attics, crawlspaces or basements.</p> <p>MA 11.3 Ensure Adequate Make-Up Air</p> <p>Ensure that vented appliances have sufficient make-up air to replace vented air and maintain normal operating conditions.</p>	<p>EA 11.1 Install Power Vented or Sealed Combustion Equipment</p> <p>If replacing combustion equipment located in occupied or conditioned spaces as part of the building upgrade, recommend power-vented or sealed-combustion equipment. Install new combustion equipment in accordance with ACCA Standard 5.</p> <p>EA 11.2 Upgrade Combustion Appliances</p> <p>Consider replacing older, lower efficiency appliances that have pilot burners with higher efficiency appliances incorporating electronic ignition.</p>

PRIORITY ISSUE 11.0 VENTED COMBUSTION APPLIANCES (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
	<p>MA 11.4 Ensure Proper Boiler Operation</p> <p>Ensure that boiler-firing adjustments are working properly so that soot is not dispelled out of the atmospheric dampers into boiler rooms. Confirm that boilers do not release black smoke through the chimney for more than a very brief period.</p> <p>MA 11.5 Ensure CO Detection and Warning Equipment is Installed</p> <p> Ensure CO detection and warning equipment is installed and located according to NFPA 720 and any applicable local or state requirements.</p>	

References for Priority Issue 11.0 Vented Combustion Appliances:

- ACCA: Standard 5 QI-2015, HVAC Quality Installation Specification
- ANSI Z223.1/NFPA 54: National Fuel Gas Code
- ANSI Z21 Series Standards for Residential Gas-Fired Appliances
- DOE: Standard Work Specifications for Multi-Family Home Energy Upgrades, Section 5.3102.2, Venting Sealed Combustion Appliances
- DOE: Standard Work Specifications for Multi-Family Home Energy Upgrades, Section 5, Heating and Cooling
- NFPA 31: Standard for Installation of Oil-Burning Equipment
- NFPA 211: Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
- NFPA 720: Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment



Appendix B: Property Management and Occupant Education

PRIORITY ISSUE 12.0 UNVENTED COMBUSTION APPLIANCES

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 12.1 Identify Unvented Combustion Appliances and Applicable Regulations</p> <p>Identify any unvented gas or kerosene space heaters or vent-free combustion appliances (e.g., ovens, cooktops, fireplaces).</p> <p>Determine whether any local or state regulations prohibiting these devices apply.</p> <p>Check locations of unvented gas or kerosene space heaters and assess the potential for the unvented heaters to influence the thermostat that controls the primary heat source (e.g., the central heating system). Assess the potential for the space heaters to override the operation of the primary heat source.</p> <p>Determine whether CO detection and warning equipment is installed in dwelling units with unvented combustion appliances.</p>	<p>MA 12.1 Ensure Adequate Exhaust and Ventilation in Kitchens Equipped with Gas Cooking Appliances</p> <p>Ensure ASHRAE Standard 62.2-2013 requirements, and any applicable building code requirements, for local exhaust and outdoor air ventilation are met for kitchens equipped with gas cooking appliances. Ensure that kitchen exhaust fans vent directly to the outdoors. See Priority Issue 21.0 Local Exhaust Ventilation for additional guidance.</p> <p>MA 12.2 Remove Unvented Combustion Space Heaters</p> <p>With the occupants' permission, remove any unvented gas or kerosene space heaters that do not conform to local or state regulations. If the heaters are used as the primary source of heat for a space, replace them with electric or vented, code-compliant heating systems.</p> <p>Note:</p> <p><i>All equipment removals should include proper disposal so that hazardous units are not reinstalled or used elsewhere.</i></p> <p>With the occupants' permission, remove other unvented heaters, except when used as a secondary heat source and it can be confirmed that the unit is listed to ANSI Z21.11.2. Heaters that are not listed to ANSI Z21.11.2 should be removed prior to the building upgrade, if feasible, but may remain until a replacement heating system is in place.</p> <p>If occupants object to these recommendations:</p> <ul style="list-style-type: none"> • Provide occupants with information about the hazards of improperly operating unvented space heaters or vent-free appliances including, for example the manufacturers' written instructions and CPSC's Carbon Monoxide Questions and Answers and EPA's Carbon Monoxide's Impact on Indoor Air Quality. The manufacturers' instructions may specify open windows during operation because use of the device requires adequate or additional ventilation to remove products of combustion such as CO, nitrogen oxides, carbon dioxide, particulate matter and water vapor. 	<p>This cell is intentionally blank.</p>



PRIORITY ISSUE 12.0 UNVENTED COMBUSTION APPLIANCES (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
	<ul style="list-style-type: none"> Suggest occupants replace gas-fired unvented space heaters not listed to ANSI Z21.11.2 with a vented appliance or, at a minimum, consider upgrading the heater to a new model consistent with ANSI Z21.11.2. Inform occupants if any unvented combustion space heaters or vent-free gas fireplaces appear to be oversized for their application. <p>Note: <i>The proper size of a space heater depends on a room's dimensions and its heat loss characteristics. A 5,000 BTU/hour space heater often can be a suitable size for a room with a floor area of 150 square feet.</i></p> <p>MA 12.3 Advise Occupants on Proper Operation and Maintenance Advise occupants to always consult and follow the manufacturer's printed instructions for proper operation and maintenance. If the manufacturer's instructions are not available, advise or assist occupants in obtaining replacement instructions.</p> <p>Note: <i>The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) can be a source of information to obtain manufacturers' instructions for unvented combustion appliances.</i></p> <p>Advise occupants that unvented space heaters should not be used in a manner that influences the thermostat controlling the primary heat source, thereby causing the space heater to operate in place of the primary heat source.</p> <p>MA 12.4 Ensure CO Detection and Warning Equipment is Installed  Ensure CO detection and warning equipment is installed and located according to NFPA 720 and any applicable local or state requirements.</p>	<p>This cell is intentionally blank.</p>

References for Priority Issue 12.0 Unvented Combustion Appliances:

- AHRI
- ANSI Z21.11.2-2013: Gas-Fired Room Heaters, Volume II, Unvented Room Heaters
- ASHRAE Standard 62.2-2013: Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
- CPSC: Carbon Monoxide Questions and Answers
- DOE: Standard Work Specifications for Multi-Family Home Energy Upgrades, Section 2.0202.1, Unvented Space Heaters
- EPA: Carbon Monoxide's Impact on Indoor Air Quality
- NFPA 720: Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment



PRIORITY ISSUE 13.0 OZONE FROM INDOOR SOURCES		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 13.1 Determine the Presence of Ozone-Producing Equipment</p> <p>In every dwelling unit where an audit and/or upgrade will occur, determine whether any air-cleaning devices designed to intentionally produce ozone (i.e., ozone generators) are present.</p>	<p>MA 13.1 Avoid Air-Cleaning Equipment that Intentionally Produces Ozone</p> <p>Do not install air-cleaning devices designed to produce ozone (i.e., ozone generators).</p> <p>Recommend removal of air-cleaning devices designed to produce ozone intentionally, if present.</p>	<p>This cell is intentionally blank.</p>

References for Priority Issue 13.0 Ozone from Indoor Sources:

California EPA Air Resources Board (CARB): [Hazardous Ozone-Generating “Air Purifiers”](#)
 EPA: [Ozone Generators that are Sold as Air Cleaners](#)

PRIORITY ISSUE 14.0 ENVIRONMENTAL TOBACCO SMOKE (ETS)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 14.1 Determine Whether There is a Smoke-Free Policy Determine whether the building has a smoke-free policy prohibiting smoking in common areas and residential dwelling units.</p> <p>AP 14.2 Determine Whether There is an Exterior Smoking Policy Determine whether the building has an exterior smoking policy that prohibits smoking within a specified distance (e.g., 10, 20 or 25 feet) of the building's operable windows, outdoor air intakes and entryways.</p> <p>AP 14.3 Identify Occupants' Smoking-Related Concerns Determine whether there has been a pattern of complaints from occupants about smoking odors or other smoking-related concerns.</p> <p>AP 14.4 Assess Whether Compartmentalization is a Possible ETS Control Strategy Identify spaces in the building with strong ETS sources that can be isolated using compartmentalization techniques. The intent is to reduce ETS migration by maintaining airtightness, controlling pressure differences, and limiting uncontrolled airflow and cross contamination among spaces.</p> <ul style="list-style-type: none"> Identify the ETS migration pathways due to pressure differences within the building and across the building envelope, which can be caused by a variety of factors (e.g., thermal stack effect, mechanical ventilation if not properly designed and maintained, inadequate air balance, operation of combustion appliances). Make visual observations or use infrared thermography, chemical smoke, and/or pressure testing to identify all penetrations at the perimeter of the space/dwelling unit that can be air sealed to reduce ETS transfer. ASTM E1186-03 (2009) Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems can be used to guide the air sealing assessment work. 	<p>MA 14.1 Actions to Take if There is a Smoke-Free Policy and a History of Complaints  If there is a pattern of complaints and the building has an interior and/or exterior smoke-free policy, discuss occupant education, signage and implementation methods with the building owner and/or property manager. Review the policies and revise as necessary. If feasible, increase the distances of exterior smoking areas from operable windows, outdoor air intakes and building entrances.</p> <p>MA 14.2 Actions to Take if There is Not a Smoke-Free Policy If there is a pattern of complaints and the building does not have an interior and exterior smoke-free policy, take the appropriate actions, when feasible, in the following order, for the most effective ETS control strategy: (1) Source Control, (2) Ventilation and Air-Pressure Control, and (3) Air Sealing.</p> <p><u>1. Source Control</u></p> <ul style="list-style-type: none">  Propose developing and implementing a smoke-free policy to the building management. See Appendix B: Property Management and Occupant Education for guidance on implementing a smoke-free policy. <p>Note: <i>Eliminating ETS through a building-wide smoke-free policy is the most effective, and cost efficient, method of controlling ETS. There is no safe level of ETS exposure and no engineering technique can eliminate ETS infiltration. This guidance recognizes that eliminating smoking in all multifamily residential buildings is not immediately possible. Therefore, alternative techniques for reducing exposure also are discussed.</i></p> <ul style="list-style-type: none"> Propose including an exterior smoking policy that prohibits smoking within a specified distance (e.g., 10, 20 or 25 feet) from the building's operable windows, entryways and outdoor air intakes. 	<p>EA 14.1 Additional Actions if There is a History of Complaints and a Smoke-Free Policy is Not Feasible If there is a pattern of ETS-related complaints and a smoke-free policy is not feasible:</p> <ul style="list-style-type: none"> Follow the Expanded Actions guidance in Priority Issues 18.0 through 21.0, as applicable to the type of ventilation system. Provide air sealing in separating walls, floors and ceilings such that dwelling units demonstrate less than 0.3 cfm leakage per square foot of enclosure area (i.e., sum of all wall, ceiling and floor areas) at 50 Pascals pressure difference, or as low a pressure difference as possible, during a blower door test conducted according to either ASTM E779-10 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization or ASTM E1827-11 Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door. The test shall be conducted as if the dwelling unit tested is exposed to outdoor air on all sides, top, and bottom by opening doors and windows in adjacent dwelling units. <p>Notes:</p> <p>(1) <i>A progressive sampling strategy, as defined in Chapter 4 of the Residential Manual for Compliance with California's 2001 Energy Efficiency Standards, can be employed in performing the blower door test.</i></p> <p>(2) <i>The activities above are intended to further reduce, but not eliminate, ETS migration.</i></p> <p>(3) <i>When air sealing, the air barrier assembly must have been evaluated by the Air Barrier Association of America (ABAA) and installed according to the manufacturer's specifications. Fire-rated assemblies must be sealed using approved fire-rated materials. The fire rating requirements supersede the ABAA evaluation requirement.</i></p>



Appendix B: Property Management and Occupant Education

PRIORITY ISSUE 14.0 ENVIRONMENTAL TOBACCO SMOKE (ETS) (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<ul style="list-style-type: none"> Inspect and identify all joints, seams and leaks in the ventilation duct system than can be sealed. 	<p>Consider following ASHRAE Standard 189.1-2014, which specifies a 25-foot minimum separation distance for exterior smoking areas.</p> <ul style="list-style-type: none"> Propose identifying dwelling units where smoking is not allowed, and physically locate these units as far as possible from units where smoking is allowed. Wind- or temperature-induced stack effect and window operation can have a large impact on air transfer between units on different floors. If possible, locate the smoking units higher in the building where there often is more air exfiltration to the outdoors, which also will make the other compartmentalization strategies more effective (see Priority Issue 16.0). <p><u>2. Ventilation and Air-Pressure Control</u></p> <ul style="list-style-type: none"> Follow the Minimum Actions in Priority Issues 18.0 through 21.0, as applicable to the type of ventilation system. For dwelling units served by a central exhaust ventilation system, balance airflows for each unit by sealing duct/shaft leaks and installing air balancing devices (such as constant airflow regulators or orifice plates) at the exhaust points in each dwelling unit. When flows are the same from adjacent dwelling units with similar leakage characteristics, there is less potential for air and odor transfer between units. If possible, increase outdoor air supply ventilation rates to non-smoking dwelling units to pressurize the units and reduce infiltration. <p><u>3. Air Sealing</u></p> <p>Air sealing may be performed in smoking units, non-smoking units or both. Some air leakage pathways are very difficult to access in existing buildings. It often takes successive rounds of air sealing to reduce migration of ETS, and it is very difficult to eliminate all leakage between dwelling units.</p> <ul style="list-style-type: none"> Identify potential areas of uncontrolled ETS leakage from adjacent units via visual inspection, infrared thermography, chemical smoke and/or pressure testing. ASTM E1186-03 (2009) Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems can be used to guide the air sealing assessment work. Reduce ETS transfer between adjacent units by sealing vertical shafts, joints and penetrations in adjoining walls, ceilings and floors. <ul style="list-style-type: none"> Find and seal the largest openings first, for example: joints around plumbing penetrations, joints around ventilation openings, lighting penetrations, openings behind baseboard heaters, electrical outlets, etc. To track progress during sealing, a blower door depressurization test of airflow at a pressure difference of 50 Pascals can be used. Note that exhaust duct systems should be temporarily sealed off during the blower door depressurization test. Apply weather-stripping to all doors between dwelling units and common hallways to minimize air leakage into the hallways. If the existing ventilation system relies on make-up air provided to dwelling units by pressurized corridors, do not weather-strip unit entry doors and restore or repair the make-up air system as needed. If make-up air is not provided by pressurized corridor systems, provide outdoor make-up air to each unit (e.g., trickle vents) and do not install pressurized corridor make-up air systems. 	

PRIORITY ISSUE 14.0 ENVIRONMENTAL TOBACCO SMOKE (ETS) (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
	<p>Notes:</p> <p>(1) <i>The activities above are intended to reduce ETS migration but will not eliminate it.</i></p> <p>(2) <i>The above air sealing strategies are intended to help reduce the exposure of occupants in non-smoking units adjacent to smokers' units. These actions are unlikely to reduce the risks of ETS to occupants living in the smokers' units.</i></p> <p>(3) <i>When air sealing, the air barrier assembly must have been evaluated by the Air Barrier Association of America (ABAA) and installed according to manufacturer specifications. Fire-rated assemblies must be sealed using approved fire-rated materials. The fire rating requirements supersede the ABAA evaluation requirements.</i></p> <p>(4) <i>Also refer to Priority Issue 16.0 Compartmentalization to Prevent Odor or Unwanted Air Transfer.</i></p>	

References for Priority Issue 14.0 Environmental Tobacco Smoke (ETS):

ABAA: Air Barrier Materials, Components, Assemblies & Systems
 ASHRAE Standard 62.2-2013: Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
 ASHRAE Standard 189.1-2014: Standard for the Design of High-Performance Green Buildings
 ASTM E779-10: Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
 ASTM E1186-03 (2009): Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
 ASTM E1827-11: Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
 California Energy Commission: Residential Manual for Compliance with California's 2001 Energy Efficiency Standards, Chapter 4 Compliance Through Quality Construction
 MNCEE: Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments
 NCHH: Improving Ventilation in Existing or New Buildings with Central Roof Exhaust
 NCHH: Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation
 NCHH: Improving Ventilation in New and Existing Multi-Family Buildings with Individual Unit Ventilation Systems
 UL: Fire-Resistance and Smoke Protection

PRIORITY ISSUE 15.0 WOOD SMOKE AND OTHER SOLID FUEL EMISSIONS

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 15.1 Determine Whether Wood- or Coal-Burning Appliances Are Present Determine whether there are wood- or coal-burning appliances (e.g., wood stove or furnace, wood pellet stove, fireplace) in the building. If a building policy on wood- and coal-burning devices exists, review it for compatibility with the Minimum Actions in this section.</p> <p>AP 15.2 Assess Proper Size and Operation of Wood- or Coal-Burning Appliances Assess what the proper size of any wood- or coal-burning appliances will be after the building upgrade is complete. If the current unit is oversized, recommend replacement with a properly sized, EPA-certified appliance.</p> <p>AP 15.3 Determine Evidence of Wood Smoke Emissions If wood- or coal-burning appliances are present, use any of the following practices to determine whether there is evidence of wood smoke emissions affecting the building:</p> <ul style="list-style-type: none"> • Look for evidence of soot on the walls or ceiling or creosote staining near the flue pipe. • Determine whether a strong odor of wood smoke can be identified within common areas or dwelling units. • Ask occupants whether they regularly (i.e., daily) smell wood smoke indoors during the heating season. <p>AP 15.4 Assess Appliance Safety Assess appliance safety by considering:</p> <ul style="list-style-type: none"> • Appliance condition, especially leaks, cracks or faulty flue connections. • Proper distances of appliance and flue from combustible materials (minimum clearances) and/or proper protection of combustibles. • Proper size and materials of floor protection. • Proper venting system according to Priority Issue 11.0 Vented Combustion Appliances. <p>AP 15.5 Determine Whether Wood-Burning Appliances Are EPA-Certified Determine whether any wood-burning appliances are EPA-certified (i.e., more energy efficient and cleaner burning). An EPA-certified wood heater can be identified by a permanent metal label affixed to the back or side of the wood heater.</p> <p>AP 15.6 Determine Whether Hydronic Heating Equipment Is Present Determine whether an outdoor wood- or coal-fired appliance is generating hydronic heat. If the wood- or coal-burning appliance is operating during the assessment, observe the opacity of the smoke leaving the chimney.</p> <p><i>Note: One hundred percent opacity means nothing can be seen through the smoke. At 20 percent opacity, there is very little smoke and you can see almost completely through it. Smoke with opacity of more than 20 percent is an indication that unseasoned wood is being burned, a non-EPA-approved stove is in use or the heater is operating poorly. Ensure trash and vegetation are not being burned in the units. Refer to the EPA Burn Wise website for additional information.</i></p>	<p>MA 15.1 Ensure Proper Operation of Wood- or Coal-Burning Appliances Correct any problems identified during the assessments. If evidence of soot, wood smoke, or other health or safety concerns is apparent, work with a certified fireplace or chimney safety professional to identify and correct the problems.</p> <p>If a new appliance is installed during the upgrade, ensure it is properly sized for the post upgrade heating load. Ensure any new wood-burning appliances are EPA-certified.</p> <p>MA 15.2 Recommend Periodic Inspection and Maintenance of the Chimney and Appliance Encourage the building owner or property manager to have a certified professional inspect and maintain the chimney and wood- or coal-burning appliance annually.</p> <p>MA 15.3 Share EPA Burn Wise Tips Share EPA's Burn Wise Tips with the building owner or property manager.</p>	<p>EA 15.1 Install Properly Sized, EPA-Certified Wood-Burning Appliances Replace non-certified wood- or coal-burning appliances with properly sized and installed EPA-certified appliances. Appliances should be installed according to the manufacturer's written instructions.</p> <p>Alternatively, replacement heating equipment that does not burn solid fuels also can be considered.</p>

References for Priority Issue 15.0 Wood Smoke and Other Solid Fuel Emissions:

- EPA: [Burn Wise, Consumers – Best Burn Practices](#)
- EPA: [Burn Wise, Consumers – Choosing Appliances](#)
- EPA: [Burn Wise, Consumers – Frequent Questions](#)
- EPA: [Burn Wise Tips](#)
- EPA: [List of EPA Certified Wood Stoves](#)
- EPA: [List of Qualified Hydronic Heaters](#)
- NFPA 211: [Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances](#)

Compartmentalization

PRIORITY ISSUE 16.0 COMPARTMENTALIZATION TO PREVENT ODOR OR UNWANTED AIR TRANSFER		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 16.1 Determine Building Locations with Strong Pollutant Sources</p> <p>Determine which areas or dwelling units in the building are likely to be sources of irritating pollutants or noxious odors or where unwanted air transfer occurs. Refer to complaint logs and building owner/property manager reports, and perform an IAQ walkthrough inspection. Include common areas and nonresidential spaces in the building (e.g., retail spaces, fitness facilities, beauty and nail salons). To the extent possible, work with the building owner, property manager and other occupants to identify IAQ concerns that arise from pollutant migration among dwelling units, common areas and commercial spaces. Refer to EPA's Building Air Quality Action Plan for more information on IAQ walkthrough inspections.</p> <p>AP 16.2 Assess Spaces for Compartmentalization</p> <p>Identify spaces in the building with strong pollutant sources that could be isolated using compartmentalization techniques, including dwelling units, common areas, nonresidential spaces (e.g., conference/meeting rooms, health club/exercise rooms, retail spaces, attached garages, combustion appliance rooms, utility shafts, elevators, stairwells). The intent is to reduce pollutant and odor migration by limiting uncontrolled airflow and cross contamination among spaces, achieved by air sealing and controlling pressure differences.</p> <ul style="list-style-type: none"> Identify the pollutant migration pathways due to pressure differences within the building and across the building envelope, which can be caused by a variety of factors (e.g., thermal stack effect, mechanical ventilation if not properly designed and maintained, inadequate air balance, operation of combustion appliances). Make visual observations or use infrared thermography, chemical smoke and/or pressure testing to identify all penetrations at the perimeter of the space/dwelling unit 	<p>MA 16.1 Minimize Pollutant Transfer Between Spaces</p> <p>Follow the guidance in the order listed below for the most effective strategy: (1) Source Control, (2) Ventilation and Air Pressure Control, and (3) Air Sealing.</p> <p><u>1. Source Control</u></p> <p>If pollutant sources and odors were identified and can be readily addressed see the relevant priority issues in this Guide. For example –</p> <ul style="list-style-type: none"> For sewer gases or other pollutants, see Priority Issue 6.0 Belowground Contaminants. For suspected VOCs, see Priority Issue 10.0 Building Products/ Materials Emissions. For tobacco smoke transfer control, see Priority Issue 14.0 Environmental Tobacco Smoke (ETS). For contaminants from attached garages, see Priority Issue 7.0 Garage Air Pollutants. For wood smoke, see Priority Issue 15.0 Wood Smoke and Other Solid Fuel Emissions. For emissions from vented combustion appliances, see Priority Issue 11.0 Vented Combustion Appliances. For emissions from unvented combustion appliances, see Priority Issue 12.0 Unvented Combustion Appliances. For cooking odors, see Priority Issue 21.0 Local Exhaust Ventilation. <p><u>2. Ventilation and Air Pressure Control</u></p> <ul style="list-style-type: none"> Follow the Minimum Actions in Priority Issues 18.0 through 21.0, as applicable to the type of ventilation system. If an existing ventilation system relies on central exhaust, repair or replace any balancing devices at each exhaust point, as needed. Provide dedicated pathways for make-up ventilation air in dwelling units, as required under the 	<p>EA 16.1 Expanded Ventilation and Air Pressure Control</p> <p>Follow the Expanded Actions guidance in Priority Issues 18.0 through 21.0, as applicable to the type of ventilation system. Reduce excess negative pressures inside the dwelling units resulting from unbalanced exhaust systems.</p> <p>If the existing ventilation exhaust system relies on a central exhaust, specify and install a new balancing device at each exhaust point with a minimum operating pressure to help ensure that required airflow and system performance are not significantly affected by stack effect.</p> <p>EA 16.2 Expanded Air Sealing for Dwelling Units</p> <p>If the building is undergoing extensive rehabilitation, extend compartmentalization efforts to all dwelling units. Provide air sealing in all separating walls, floors and ceilings to achieve compartmentalization within each dwelling unit, with an airtightness of 0.3 cfm per square foot of enclosure area (i.e., sum of all wall, ceiling and floor areas) at 50 Pascals pressure difference, or as low a pressure difference as possible, during a blower door test conducted according to either ASTM E779-10 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization or ASTM E1827-11 Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door. The test shall be conducted as if the dwelling unit were exposed to outdoor air on all sides and on top and bottom by opening doors and windows in adjacent dwelling units. Refer to ASHRAE Standard 62.2-2013, Section 8 for multifamily buildings.</p>

PRIORITY ISSUE 16.0 COMPARTMENTALIZATION TO PREVENT ODOR OR UNWANTED AIR TRANSFER (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>that can be air sealed to reduce transfer as part of the building upgrade. ASTM E1186-03 (2009) Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems can be used to guide the air sealing assessment work.</p> <ul style="list-style-type: none"> Inspect and identify all joints, seams and leaks in the ventilation duct system that can be sealed. 	<p>Minimum Actions of the sections referenced above. If necessary, provide mechanically supplied make-up air to spaces with mechanical exhaust to prevent excess negative pressure. The total net exhaust flow of the two largest exhaust appliances (including kitchen fan and clothes dryer) shall be limited to 15 cfm per 100 square feet of occupiable floor area when in operation at full capacity, or compensating outdoor airflow must be provided.</p> <p>Note: <i>Effective compartmentalization can be difficult to achieve with a central exhaust ventilation system because the system experiences significant pressure fluctuations due to seasonal conditions affecting the stack effect pressures within the building.</i></p> <ul style="list-style-type: none"> If the existing ventilation system relies on make-up air provided from pressurized corridors to each dwelling unit via leaks around entry doors (e.g., door undercuts and doors that are not weather-stripped), then the compartmentalization principle can be compromised by air drawn from neighboring spaces. Prevent unwanted air transfer and cross contamination from adjacent spaces by implementing compartmentalization air sealing as described below. <p><u>3. Air Sealing</u></p> <p><u>3a. Air Sealing – General</u></p> <ul style="list-style-type: none"> Where leakage of odors or unwanted air transfer between adjacent areas has been identified, reduce the transfer by using sealants or caulking to create a continuous air barrier. Seal all penetrations in the adjoining surfaces including joints between walls, ceilings and floors; electrical outlets and switches; wiring, plumbing and duct penetrations; and chase ways. Seal openings between mechanical rooms and occupied spaces: <ul style="list-style-type: none"> Air seal ventilation ductwork. Provide tight-fitting windows and self-closing doors fitted with gaskets in the spaces that are likely to be sources of irritating or noxious odors. Seal the enclosure at receiving areas or docks. Make as airtight a connection as practical between the bottom of the trash chute and the compactor and dumpster assembly. Limit makeup air provided to trash rooms to below exhaust airflows to maintain a negative pressure relative to adjacent spaces, which will reduce odor and pollutant release to upper floors during corridor trash door use. Provide all combustion air and makeup air for equipment in the mechanical room from the outdoors. <p><u>3b. Air Sealing – Dwelling Units</u></p> <ul style="list-style-type: none"> Where leakage of odors or unwanted air transfer between adjacent dwelling units has been identified, and the dwelling unit compartmentalization can be accomplished as part of the building upgrade project, all penetrations between adjoining dwelling units and where fire walls are located must be air sealed with suitable air sealing or fire stop materials. Where possible, air sealing shall be directed to openings in interior surfaces without tightening the exterior. According to the 2012 International Building code, walls 	

PRIORITY ISSUE 16.0 COMPARTMENTALIZATION TO PREVENT ODOR OR UNWANTED AIR TRANSFER (continued)		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
	<p>separating dwelling units in the same building, walls separating sleeping units in the same building, shall be treated as fire partitions.</p> <ul style="list-style-type: none"> • If new ventilation systems are being installed, avoid pressurizing corridors or depressurizing dwelling units more than 5 Pascals below the pressure in adjacent units. • If common hallways are intentionally pressurized with respect to the dwelling units, then doors in the dwelling units leading to the common hallways need not be weather-stripped, provided that dwelling units are at a negative pressure relative to the hallways of 1 Pascal or greater when the doors between the hallway dwelling unit are closed. <p>Notes:</p> <p>(1) <i>Compartmentalization is intended to reduce odors due to unwanted air transfer, but it does not eliminate them.</i></p> <p>(2) <i>Compartmentalization activities must consider ventilation system design and operating characteristics to reduce driving forces for unintended airflow between dwelling units.</i></p> <p>(3) <i>When air sealing, the air barrier assembly must have been evaluated by the Air Barrier Association of America (ABAA) and installed according to manufacturer's specifications. Fire-rated assemblies must be sealed using approved fire-rated materials. The fire rating requirements supersede the ABAA evaluation requirement.</i></p>	

References for Priority Issue 16.0 Compartmentalization to Control Odor or Unwanted Air Transfer:

- ABAA: Air Barrier Materials, Components, Assemblies & Systems
- ASHRAE: Standard 62.2-2013 – Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
- ASTM E779-10: Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
- ASTM E1186-03 (2009): Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
- ASTM E1827-11: Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
- DOE: Standard Work Specifications for Multi-Family Home Energy Upgrades, Section 3: Air Sealing
- EPA: Building Air Quality Action Plan, Step 2: Develop an IAQ Profile of Your Building, Part 2: Conduct a Walkthrough
- International Code Council: International Building Code, 2012 Edition
- UL: Fire-Resistance and Smoke Protection

Heating, Ventilation and Air Conditioning (HVAC)

PRIORITY ISSUE 17.0 HVAC EQUIPMENT		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 17.1 Evaluate the Condition of Existing HVAC Systems and Components</p> <p>Evaluate the condition of existing HVAC systems and their components (e.g., furnaces, boilers, cooling equipment, air handlers, exhaust air systems, make-up air systems, heat pumps and ductwork) in accordance with minimum inspection standards of ASHRAE/ACCA Standard 180, or other equivalent industry standards.</p> <p>Refer to Priority Issues 18.0 through 20.0 for outdoor air ventilation, as applicable to the type of ventilation system, and Priority Issue 21.0 Local Exhaust Ventilation for additional guidance.</p> <p>AP 17.2 Determine Appropriate HVAC System Sizing</p> <p>Determine whether the existing HVAC systems are sized properly. Refer to the Air Conditioning Contractors of America (ACCA) Manual J for low-rise residential applications, ACCA Manual N for commercial applications, the ASHRAE Load Calculation Applications Manual, ASHRAE Standard 183, or ASHRAE Handbooks for HVAC load calculations. Refer to ACCA Manual S or ASHRAE Handbooks for equipment selection. If HVAC system replacements or modifications are anticipated, base heating/cooling load and equipment sizing calculations on post-upgrade conditions.</p>	<p>MA 17.1 Implement Corrective Actions for Proper HVAC Operation</p> <p>Based on the results of the system assessment (e.g., equipment condition, size and feasibility of corrective actions), repair, modify or recommend installing new HVAC equipment to ensure it can provide the needed ventilation, temperature and humidity control. The ability to modify and adjust the existing HVAC equipment may be limited by its initial design. Review the original equipment specifications and seek outside engineering assistance as needed.</p> <p>If maintenance, cleaning or repairs are needed to restore the HVAC system to proper functioning, perform in accordance with ASHRAE Standard 180, ACCA Standard 6, ASHRAE Handbooks, or equivalent standards and guidelines.</p> <p>Refer to Priority Issues 18.0 through 20.0 for outdoor air ventilation, as applicable to the type of ventilation system, and Priority Issue 21.0 Local Exhaust Ventilation for additional guidance.</p> <p>MA 17.2 Properly Size and Install New HVAC Equipment</p> <p>If replacing equipment, base equipment sizing calculations on the post-upgrade heating and cooling load calculations. Use ACCA Manual J for low-rise residential applications, ACCA Manual N for commercial applications, the ASHRAE Load Calculation Applications Manual, ASHRAE Standard 183, or ASHRAE Handbooks for HVAC load calculations. Use ACCA Manual S or ASHRAE Handbooks for equipment selection.</p> <p>Install new equipment in accordance with ACCA Standard 5 and verify installation in accordance with ACCA Standard 9, ASHRAE Handbooks, or equivalent standards and guidelines.</p>	<p>EA 17.1 Install Higher Efficiency Filters in HVAC Systems</p> <p>For new HVAC systems, install filters with the highest MERV rating that the equipment is capable of physically accommodating and for which there is adequate fan capacity to overcome the filters' pressure drop.</p> <p>For existing systems, check with the manufacturer to determine whether filters with higher MERV ratings can be installed. Install filters with the highest MERV rating that can be accommodated by the equipment.</p> <p>EA 17.2 Provide Additional HVAC Training to Building Operations and Maintenance Staff</p> <p>Conduct follow-up training (e.g., 6 months or 1 year after the initial training). This will reinforce staff skills and knowledge and provide an opportunity for staff to ask questions after they become familiar with the upgraded building and systems.</p> <p>Recommend building operations and maintenance staff attend a Building Operator Certification (BOC) course or other comparable training regarding HVAC, IAQ and energy use.</p>

PRIORITY ISSUE 17.0 HVAC EQUIPMENT (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
	<p>MA 17.3 Ensure There is Adequate Air Filtration</p> <p>For HVAC equipment that serves dwelling units, ensure new HVAC systems have air filtration with a minimum MERV 6 rating, located upstream of thermal conditioning equipment, as stated in ASHRAE Standard 62.2-2013.</p> <p>If nonresidential spaces are included in the scope of work, ensure new HVAC systems have air filtration with a minimum MERV 8 rating, located upstream of all cooling coils or other devices with wetted surfaces, as stated in ASHRAE Standard 62.1-2013.</p> <p>For existing HVAC systems, check with the manufacturers to determine whether filters with these MERV ratings can be accommodated by the equipment and, if not, install filters with the highest MERV rating that can be accommodated.</p> <p>There shall be no air bypass around filters, and no air cleaners designed to intentionally produce ozone shall be installed.</p> <p>MA 17.4 Control Bacterial Growth in HVAC Systems and Mechanical Equipment</p> <p>Follow ASHRAE Standard 188-2015 or OSHA Technical Manual, Section III: Chapter 7 Legionnaires’ Disease to protect against bacterial growth in building water systems (e.g., cooling towers, evaporative condensers, humidifiers, hot and cold water systems, fire sprinkler systems, ice machines, eyewash stations, safety showers).</p> <p>MA 17.5 Train Building Staff on HVAC Operations and Maintenance</p> <p>After the upgrade, building staff should be trained on the operations and maintenance of the HVAC systems including the outdoor air ventilation strategy (see Priority Issues 18.0 through 20.0, as applicable); temperature, humidity and other HVAC controls; measuring and adjusting airflows; preventative maintenance; and troubleshooting problems. The training should include any needed seasonal adjustments, air filter change-out schedules, control system set point adjustments, and other maintenance and operational requirements for mechanical equipment. An operations and maintenance manual should be provided to the building staff.</p> <p> Discuss with the building owner or property manager the need to educate occupants about the basic operation of ventilation, heating and cooling systems in dwelling units. This should include any maintenance (e.g., air filter change-out) and adjustments that are the occupants’ responsibility.</p>	

References for Priority Issue 17.0 HVAC Equipment:

ACCA: Manual J Residential Load Calculation
 ACCA: Manual N Commercial Load Calculation
 ACCA: Manual S Residential Equipment Selection
 ACCA: ANSI/ACCA Standard 5 QI-2015. HVAC Quality Installation Specification
 ACCA: ANSI/ACCA Standard 6 QR-2015, Restoring the Cleanliness of HVAC Systems
 ACCA: ANSI/ACCA Standard 9 QIvp-2011, HVAC Quality Installation Verification Protocols
 American Technical Publishers and the International Union of Operating Engineers: Indoor Air Quality Solutions for Stationary Engineers
 ASHRAE/ACCA Standard 180-2012, Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems
 ASHRAE/ACCA Standard 183-2007 (RA 2014), Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings
 ASHRAE Standard 188-2015, Legionellosis: Risk Management for Building Water Systems
 ASHRAE: Handbook – Fundamentals
 ASHRAE: Handbook – HVAC Systems and Equipment
 ASHRAE: Load Calculation Applications Manual
 ASHRAE Standard 62.1-2013, Ventilation for Acceptable Indoor Air Quality, Section 5.8
 ASHRAE Standard 62.2-2013: Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings Section 6.7
 DOE: Standard Work Specifications for Multi-Family Home Energy Upgrades, Sections 2.0702.2 and 2.0702.4, and Section 5: Heating and Cooling
 EPA: Residential Air Cleaners (Second Edition) A Summary of Available Information
 OSHA: OSHA Technical Manual, Section III: Chapter 7 Legionnaires’ Disease



Appendix B: Property Management and Occupant Education

PRIORITY ISSUE 18.0 MECHANICAL VENTILATION FOR INDIVIDUAL DWELLING UNITS

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 18.1 Determine Whether Dwelling Units Have Individual Mechanical Ventilation Systems</p> <p>Individual mechanical ventilation systems in dwelling units include the following configurations:</p> <ul style="list-style-type: none"> • Occupant-controlled bath and/or kitchen exhaust fans in a dwelling unit. Can also include operable windows in a dwelling unit, in combination with the exhaust fans. • Continuously operating bath and/or kitchen exhaust fans in a dwelling unit (with or without operable windows), or other exhaust fan(s) provided in a dwelling unit for mechanical ventilation. • Outdoor air ventilation supplied via a dwelling unit’s space conditioning air handler. <p>For other dwelling unit ventilation configurations, refer to Priority Issue 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust or Priority Issue 20.0 Natural (Not Fan-Powered) Ventilation.</p> <p>AP 18.2 Determine Whether Dwelling Unit Mechanical Ventilation Systems Meet ASHRAE Standard 62.2-2013 Requirements</p> <p>Determine whether the mechanical ventilation systems in dwelling units meet ASHRAE Standard 62.2-2013 requirements (including Appendix A for existing buildings and Section 8 for multifamily buildings). This includes:</p> <ul style="list-style-type: none"> • Dwelling unit ventilation rate. • Bath and kitchen exhaust fan airflow rates. • Proper location of exhaust discharges. <p>Conduct the assessment in as many dwelling units as possible. If a sample of dwelling units is assessed, be sure to include any units for which there are indoor air quality complaints.</p> <p>AP 18.3 Determine Whether Common Corridors and Nonresidential Spaces Meet Ventilation Requirements</p> <p>Determine the amount of outdoor</p>	<p> MA 18.1 Repair and Upgrade Dwelling Unit Mechanical Ventilation Systems As Needed</p> <p>If dwelling units are served by individual mechanical ventilation systems:</p> <ul style="list-style-type: none"> • Ensure a continuous or intermittent operating schedule in the dwelling unit to meet ASHRAE Standard 62.2-2013 ventilation requirements. Ensure controls are operating properly. • If ventilation air is provided integral to the space conditioning system, the system shall be configured to provide the required ventilation regardless of the heating or cooling demand in the dwelling unit. • If each dwelling unit has dedicated mechanical exhaust for outdoor air ventilation: <ul style="list-style-type: none"> o Adjust, repair, or replace existing exhaust ducts and fans serving the dwelling unit as needed to meet ASHRAE Standard 62.2-2013 requirements (including Appendix A and Section 8). o Remove blockages in exhaust grilles, ductwork and components (e.g., constant airflow regulators). o Ensure ducts for all exhaust fans terminate outside the building. o Air seal exhaust ventilation ductwork with approved materials to prevent duct leakage within building cavities. o Advise the building owner or property manager to implement a preventative maintenance plan to inspect exhaust grilles in all dwelling units at least once per year. • Ensure outdoor air intakes that are part of ventilation systems for dwelling units are located a minimum distance of 10 feet from contaminant sources including plumbing stacks, vents, exhaust hood discharges or vehicle exhaust (see ASHRAE Standard 62.2-2013). 	<p>EA 18.1 Install Balanced Ventilation Systems With Energy Recovery in Dwelling Units</p> <p>To provide balanced ventilation and reduce the heating and cooling costs associated with outdoor air ventilation consider installing energy recovery equipment when the exhaust airflows from the dwelling unit can be readily combined to flow through an energy recovery device to pre-condition the incoming outdoor ventilation air.</p> <p>EA 18.2 Meet Outdoor Air Filtration and Air-Cleaning Requirements of ASHRAE Standard 189.1, As Applicable to Nonresidential Spaces</p> <p>For nonresidential spaces that are included in the scope of service, in geographic locations where the outdoor air exceeds the national standards for particulate matter (PM_{2.5}, PM₁₀) or ozone, ensure that the outdoor air filtration and air-cleaning requirements of ASHRAE Standard 189.1-2014, Section 8.3.1.3 are met for mechanical ventilation systems:</p> <ul style="list-style-type: none"> • Particulate-matter filters or air-cleaning devices with a MERV of at least 8 shall be used in areas where the National Ambient Air Quality Standard for PM₁₀ is exceeded. • Particulate-matter filters or air-cleaning devices with a MERV of at least 13 shall be used in areas where the National Ambient Air Quality Standard for PM_{2.5} is exceeded. • Air-cleaning devices to remove ozone must be provided and used in areas that are in “nonattainment” with the National Ambient Air Quality Standard for ozone. The ozone removal efficiency of the system shall be at least 40%.



PRIORITY ISSUE 18.0 MECHANICAL VENTILATION FOR INDIVIDUAL DWELLING UNITS (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>air ventilation provided to common corridors and whether this meets the ASHRAE Standard 62.1-2013 minimum requirement of 0.06 cfm per square foot of floor area.</p> <p>If nonresidential spaces (e.g., exercise rooms, lobbies, mailrooms, commercial/retail spaces) are included in the scope of service, determine whether the ventilation in these spaces meets the requirements of ASHRAE Standard 62.1-2013.</p> <p>AP 18.4 Identify and Assess Outdoor Air Intakes</p> <p>Identify the location of outdoor air intakes for all ventilation systems and assess their distances from outdoor pollutant sources (e.g., vehicle exhaust, plumbing vents, exhaust discharges).</p>	<p>MA 18.2 Repair, Adjust and Upgrade Ventilation Systems in Common Corridors and Nonresidential Spaces As Needed</p> <p>Ensure common corridors in the building meet the ASHRAE Standard 62.1-2013 minimum outdoor air ventilation rate requirement of 0.06 cfm per square foot of floor area.</p> <p>If included in the scope of service, ensure nonresidential spaces in the building meet the ventilation requirements of ASHRAE Standard 62.1-2013.</p> <p>If it is not possible to achieve the ASHRAE Standard 62.1-2013 minimum outdoor air ventilation rates, adjust systems to provide the maximum amount of outdoor air ventilation possible.</p>	

References for Priority Issue 18.0 Mechanical Ventilation for Individual Dwelling Units:

- [ASHRAE Standard 62.1-2013 – Ventilation for Acceptable Indoor Air Quality](#)
- [ASHRAE Standard 62.2-2013 – Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings](#)
- [ASHRAE Standard 189.1-2014, Standard for the Design of High-Performance Green Buildings, Section 8.3.1.3 Filtration and Air Cleaner Requirement](#)
- [EPA: National Ambient Air Quality Standards](#)
- [NCHH: Improving Ventilation in New and Existing Multi-Family Buildings With Individual Unit Ventilation Systems](#)

PRIORITY ISSUE 19.0 MECHANICAL VENTILATION FOR MULTIPLE DWELLING UNITS USING CENTRAL EXHAUST

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 19.1 Determine Whether Dwelling Units Are Served by Central Mechanical Exhaust Ventilation Systems</p> <p>Central exhaust ventilation systems serving multiple dwelling units is a configuration where the building has one or more central exhaust fans, each of which serves multiple dwelling units. Ventilation is provided to dwelling units via outdoor make-up air induced by the central exhaust fans.</p> <p>Note:</p> <p><i>A central HVAC air handler supplying outdoor air directly to multiple dwelling units is uncommon in existing multifamily residential buildings. This document does not include guidance for this configuration.</i></p> <p>For other dwelling unit ventilation configurations, refer to Priority Issue 18.0 Mechanical Ventilation for Individual Dwelling Units or 20.0 Natural (Not Fan-Powered) Ventilation.</p> <p>AP 19.2 Determine Whether Central Mechanical Exhaust Ventilation Systems Meet ASHRAE Standard 62.2-2013 Requirements</p> <p>Determine whether the ventilation in each dwelling unit meets ASHRAE Standard 62.2-2013 requirements (including Appendix A for existing buildings and Section 8 for multifamily buildings). This includes:</p> <ul style="list-style-type: none"> • Dwelling unit ventilation rate. • Bath and kitchen exhaust fan airflow rates. • Proper location of exhaust discharges. <p>Conduct the assessment in as many dwelling units as possible. If a sample of dwelling units is assessed, be sure to include any units for which there are indoor air quality complaints.</p> <p>AP 19.3 Determine Whether Common Corridors and Nonresidential Spaces Meet Ventilation Requirements</p> <p>Determine the amount of outdoor air ventilation provided to common corridors and whether this meets the ASHRAE Standard 62.1-2013 minimum</p>	<p> MA 19.1 Repair and Upgrade Central Mechanical Exhaust Ventilation Systems As Needed</p> <p>If dwelling units are served by central mechanical exhaust systems:</p> <ul style="list-style-type: none"> • Adjust, repair, or replace the ventilation systems so each dwelling unit served by the central exhaust system meets the requirements of ASHRAE Standard 62.2-2013 for existing buildings (including Appendix A and Section 8), including: <ul style="list-style-type: none"> o Adjust, repair or replace the central fans, ductwork and fittings to meet ASHRAE Standard 62.2-2013 requirements for whole-building ventilation for all dwelling units served. o Ensure that each dwelling unit receives the required exhaust airflow by: <ul style="list-style-type: none"> - Removing blockages in exhaust ductwork. - Air sealing exhaust air ductwork using approved materials. Ensure the roof curb connection, the lateral connections, and the sheetrock/plaster connections behind the exhaust grilles are sealed. - Installing air-regulating exhaust dampers at each exhaust grille (typically proprietary flow-limiting devices or orifice plates). • If possible, adjust the exhaust system to provide continuous operation, and meet the ASHRAE Standard 62.2-2013 whole-building ventilation rate requirement for each dwelling unit. Intermittent operation should be avoided unless each unit is provided with a backdraft damper or motorized damper at each exhaust point. 	<p>EA 19.1 Air Seal Exhaust Ventilation Shaft</p> <p>Air seal the central exhaust system's ventilation shaft with a spray seal system (aerosol or fluid applied). This allows sealing of the leakage area associated with non-accessible duct joints to provide pressure control and improve the capability to balance exhaust airflows among dwelling units. Ensure that the ductwork sealing required under Minimum Actions (roof curb connections, lateral connections and connections behind exhaust grilles) has been completed before air sealing the ventilation shaft.</p> <p>EA 19.2 Meet Outdoor Air Filtration and Air-Cleaning Requirements of ASHRAE Standard 189.1, As Applicable to Nonresidential Spaces</p> <p>If nonresidential spaces are included in the scope of service, in geographic locations where the outdoor air exceeds the national standards for particulate matter (PM_{2.5}, PM₁₀) or ozone, ensure that the outdoor air filtration and air-cleaning requirements of ASHRAE Standard 189.1-2014, Section 8.3.1.3 are met for mechanical ventilation systems:</p> <ul style="list-style-type: none"> • Particulate-matter filters or air-cleaning devices with a MERV of at least 8 shall be used in areas where the National Ambient Air Quality Standard for PM₁₀ is exceeded. • Particulate-matter filters or air-cleaning devices with a MERV of at least 13 shall be used in areas where the National Ambient Air Quality Standard for PM_{2.5} is exceeded. • Air-cleaning devices to remove ozone must be provided and used in areas that are in "nonattainment" with the National Ambient Air Quality Standard for ozone. The ozone removal efficiency of the system shall be at least 40%.



PRIORITY ISSUE 19.0 MECHANICAL VENTILATION FOR MULTIPLE DWELLING UNITS USING CENTRAL EXHAUST (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>requirement of 0.06 cfm per square foot of floor area.</p> <p>If nonresidential spaces (e.g., exercise rooms, lobbies, mailrooms, commercial/retail spaces) are included in the scope of service, determine whether the ventilation in these spaces meets the requirements of ASHRAE Standard 62.1-2013.</p> <p>AP 19.4 Identify and Assess Outdoor Air Intakes</p> <p>Identify the location of outdoor air intakes and assess their distances from outdoor pollutant sources (e.g., vehicle exhaust, plumbing vents, exhaust discharges).</p>	<ul style="list-style-type: none"> • Compartmentalize to reduce make-up air coming from adjacent units. Refer to Priority Issue 16.0. <ul style="list-style-type: none"> o If make-up air is provided by pressurized corridors, do not apply weather stripping to unit entry doors; restore or repair make-up air system as needed. o If make-up air is not provided by pressurized corridor systems, provide outdoor make-up air in each dwelling unit (e.g., trickle vents) and do not install pressurized corridor make-up air systems. o Advise the building owner or property manager to implement a preventative maintenance plan to inspect exhaust grilles in all dwelling units at least once per year. • Ensure outdoor air intakes that are part of ventilation systems for dwelling units are located a minimum distance of 10 feet from contaminant sources including plumbing stacks, vents, exhaust hood discharges or vehicle exhaust (see ASHRAE Standard 62.2-2013). • If mechanical exhaust systems serve several areas, ensure the backdraft dampers are installed as required by local codes and ASHRAE Standard 62.2-2013. <p>MA 19.2 Repair, Adjust and Upgrade Ventilation Systems in Common Corridors and Nonresidential Spaces As Needed</p> <p>Ensure common corridors in the building meet the ASHRAE Standard 62.1-2013 minimum outdoor air ventilation rate requirement of 0.06 cfm per square foot of floor area.</p> <p>If included in the scope of service, ensure nonresidential spaces in the building meet the ventilation requirements of ASHRAE Standard 62.1-2013.</p> <p>If it is not possible to achieve the ASHRAE Standard 62.1-2013 minimum outdoor air ventilation rates, adjust systems to provide the maximum amount of outdoor air ventilation possible.</p>	

References for Priority Issue 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust:

[ASHRAE Standard 62.1-2013 – Ventilation for Acceptable Indoor Air Quality](#)
[ASHRAE Standard 62.2-2013 – Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings](#)
[ASHRAE Standard 189.1-2014, Standard for the Design of High-Performance Green Buildings, Section 8.3.1.3 Filtration and Air Cleaner Requirement](#)
[EPA: National Ambient Air Quality Standards](#)
[NCHH: Improving Ventilation in Existing or New Buildings With Central Roof Exhaust](#)
[New York State Energy Research and Development Authority \(NYSERDA\): Improving Central Exhaust Systems for Multifamily Buildings](#)



PRIORITY ISSUE 20.0 NATURAL (NOT FAN-POWERED) VENTILATION

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 20.1 Determine Whether Dwelling Units Are Served By Natural Ventilation (Not Fan-Powered) Systems</p> <p>Natural ventilation is a configuration where outdoor air ventilation is provided to dwelling units without using mechanical fans, and includes passive rooftop hoods, passive exhaust shafts and exhaust grilles that serve one or more dwelling units.</p> <p>For other dwelling unit ventilation configurations, refer to Priority Issue 18.0 Mechanical Ventilation for Individual Dwelling Units or Priority Issue 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust.</p> <p>AP 20.2 Determine Whether ASHRAE Standard 62.2-2013 Mechanical Ventilation Exceptions Are Met</p> <p>Determine whether the dwelling units and/or building meet the exceptions to the whole-building mechanical ventilation requirement in ASHRAE Standard 62.2-2013, Section 4.1.1.</p> <p>AP 20.3 Determine Whether Common Corridors and Nonresidential Spaces Meet Ventilation Requirements</p> <p>Determine the amount of outdoor air ventilation provided to common corridors and whether this meets the ASHRAE Standard 62.1-2013 minimum requirement of 0.06 cfm per square foot of floor area.</p> <p>If nonresidential spaces (e.g., exercise rooms, lobbies, mailrooms, and commercial/retail spaces) are included in the scope of service, determine whether the ventilation in these spaces meets the requirements of ASHRAE Standard 62.1-2013.</p> <p>AP 20.4 Identify and Assess Openings for Outdoor Air Ventilation</p> <p>Identify the location of openings for outdoor air ventilation and assess their distances from outdoor pollutant sources (e.g., vehicle exhaust, plumbing vents, exhaust discharges).</p>	<p> MA 20.1 Repair and Upgrade Natural Ventilation Systems As Needed</p> <p>If the dwelling unit is served by natural ventilation and does not meet the exceptions to the whole-building mechanical ventilation requirement in ASHRAE Standard 62.2-2013, Section 4.1.1, or does not perform as intended, convert the natural ventilation system to a fan-powered system:</p> <ul style="list-style-type: none"> In dwelling units that have no fan-powered space conditioning systems, install a low-noise (1 sone or less) exhaust fan ducted directly to the outdoors for each bathroom and kitchen. Ensure that each exhaust fan meets the local exhaust (e.g., kitchen or bath) requirements of ASHRAE Standard 62.2-2013 and at least one exhaust fan (or a system including multiple fans) meets ASHRAE Standard 62.2-2013 requirements for whole-building ventilation (per the Standard's Appendix A and Section 8). In dwelling units equipped with fan-powered air handlers for space conditioning equipment, where possible: <ul style="list-style-type: none"> Provide ducted, filtered outdoor air to the return side of the HVAC unit and install a timer to ensure the operating schedule and outdoor air ventilation rate meet ASHRAE Standard 62.2-2013 intermittent ventilation requirements. The system shall be capable of providing the required ventilation regardless of the heating or cooling demand in the dwelling unit. Install a low-noise (1 sone or less) exhaust fan ducted directly to the outdoors in each bathroom and kitchen, meeting the requirements of ASHRAE Standard 62.2-2013. If providing central fan-powered mechanical exhaust ventilation systems as part of the building upgrade, refer to Priority Issue 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust. 	<p>EA 20.1 Include Requirements for Advanced Passive Ventilation Systems</p> <p>If a passive ventilation system is desired in lieu of a mechanical system, the passive system must be designed and approved by a licensed engineer taking into account expected stack effect, wind, and local terrain and shielding.</p> <p>Implement all air sealing measures described in Minimum Action 19.1 and Expanded Action 19.1 for the central ventilation shaft(s) to ensure airflow is from the dwelling units and not from shaft leakage.</p> <p>The ventilation rate for each dwelling unit must be sufficient to achieve the goal of an ASHRAE Standard 62.2-2013 mechanical ventilation rate, specifically that the annual average ventilation rate shall not be less than if a mechanical system had been installed in accordance with ASHRAE Standard 62.2-2013.</p> <p>EA 20.2 Meet Outdoor Air Filtration and Air-Cleaning Requirements of ASHRAE Standard 189.1, As Applicable to Nonresidential Spaces</p> <p>If nonresidential spaces are included in the scope of service, in geographic locations where the outdoor air exceeds the national standards for particulate matter (PM_{2.5}, PM₁₀) or ozone, ensure that the outdoor air filtration and air-cleaning requirements of ASHRAE Standard 189.1-2014, Section 8.3.1.3 are met for mechanical ventilation systems:</p> <ul style="list-style-type: none"> Particulate-matter filters or air-cleaning devices with a MERV of at least 8 shall be used in areas where the National Ambient Air Quality Standard for PM₁₀ is exceeded. Particulate-matter filters or air-cleaning devices with a MERV of at least 13 shall be used in areas where the National Ambient Air Quality Standard for PM_{2.5} is exceeded.



PRIORITY ISSUE 20.0 NATURAL (NOT FAN-POWERED) VENTILATION (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
	<ul style="list-style-type: none"> Ensure ventilation openings for introducing outdoor air into dwelling units are located a minimum distance of 10 feet from contaminant sources including plumbing stacks, vents, exhaust hood discharges or vehicle exhaust (see ASHRAE Standard 62.2-2013). <p>MA 20.2 Repair, Adjust and Upgrade Ventilation Systems in Common Corridors and Nonresidential Spaces As Needed</p> <p>Ensure common corridors in the building meet the ASHRAE Standard 62.1-2013 minimum outdoor air ventilation rate requirement of 0.06 cfm per square foot of floor area.</p> <p>If included in the scope of service, ensure nonresidential spaces in the building meet the ventilation requirements of ASHRAE Standard 62.1-2013.</p> <p>If it is not possible to achieve the ASHRAE Standard 62.1-2013 minimum outdoor air ventilation rates, adjust systems to provide the maximum amount of outdoor air ventilation possible.</p>	<ul style="list-style-type: none"> Air-cleaning devices that remove ozone must be provided and used in areas that are in “nonattainment” with the National Ambient Air Quality Standard for ozone. The ozone removal efficiency of the system shall be at least 40%.

References for Priority Issue 20.0 Natural (Not Fan-Powered) Ventilation:

ASHRAE Standard 62.1-2013 – Ventilation for Acceptable Indoor Air Quality
 ASHRAE Standard 62.2-2013 – Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
 ASHRAE Standard 189.1-2014, Standard for the Design of High-Performance Green Buildings, Section 8.3.1.3 Filtration and Air Cleaner Requirement
 EPA: National Ambient Air Quality Standards
 NCHH: Improving Ventilation in Existing or New Buildings With Central Roof Exhaust
 NCHH: Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation
 NYSEDA: Improving Central Exhaust Systems for Multifamily Buildings

PRIORITY ISSUE 21.0 LOCAL EXHAUST VENTILATION		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 21.1 Identify Contaminant Sources That Require Exhaust Ventilation</p> <p>Identify rooms or areas with localized contaminant sources that require exhaust ventilation such as bathrooms, kitchens, garages and other spaces with strong pollutant sources. To the extent possible, include nonresidential spaces in the building (e.g., retail spaces, fitness facilities, beauty and nail salons), which may require collaboration with the building owner, property manager, and other tenants and occupants within the building.</p> <p>AP 21.2 Assess Dwelling Units for Local Exhaust and Compliance with ASHRAE Standard 62.2-2013</p> <p>Determine whether dwelling units in the building have local exhaust ventilation, particularly in kitchens and bathrooms.</p> <p>Determine whether the dwelling units comply with the local exhaust requirements for kitchens and bathrooms of ASHRAE Standard 62.2-2013, including the standard's Appendix A for existing buildings, as applicable. Determine kitchen and bathroom exhaust flow rates and whether exhaust is vented directly to the outdoors.</p> <p>AP 21.3 Assess Clothes Dryer Exhausts</p> <p>Determine whether clothes dryers exhaust directly to the outdoors. Condensing dryers piped to a drain are exempt. Inspect or verify that clothes dryer exhaust duct(s) do not discharge into crawlspaces or attics or within walls. Inspect clothes dryer vents for restrictions and lint buildup.</p> <p>AP 21.4 Determine Whether Spaces Outside Dwelling Units Comply With Applicable Local Exhaust Requirements</p> <p>Determine whether spaces outside dwelling units in the building comply with the exhaust requirements of ASHRAE Standard 62.1-2013, Table 6.5, as applicable. To the extent possible, include nonresidential spaces in the building (e.g., retail spaces, fitness facilities, beauty and nail salons, parking garages), which may require collaboration with the building owner, property manager and other tenants.</p>	<p>MA 21.1 Install, Repair or Replace Local Exhaust Ventilation in Dwelling Units</p> <p>If ASHRAE Standard 62.2-2013 requirements for kitchen and bathroom exhausts are not met, install, repair or replace local exhaust ventilation in dwelling units to meet the requirements. Ensure ducts are sized and installed properly and exhausted directly to the outdoors.</p> <p>In dwelling units where local exhaust ventilation is deficient and cannot be corrected with exhaust fans, increase the whole-building ventilation airflow that applies to the dwelling unit to compensate using the alternative compliance method (Appendix A of Standard 62.2-2013).</p> <p>Ensure that, if provided, kitchen and bath exhaust fans are operational, vented directly to the outdoors, and meet the continuous or intermittent exhaust rate requirements of ASHRAE Standard 62.2-2013.</p> <p> Advise building management and occupants about the need to use exhaust fans in kitchens and bathrooms during activities that generate pollutants and moisture (e.g., cooking and showering).</p> <p>MA 21.2 Ensure Proper Venting of Clothes Dryers</p> <p>Ensure that all clothes dryers exhaust directly to the outdoors and cannot be readily diverted indoors by occupants. Condensing dryers piped to a drain are exempt.</p> <p>MA 21.3 Meet Exhaust Requirements for Spaces Outside Dwelling Units</p> <p>Install, repair or replace exhaust ventilation in spaces outside dwelling units to meet the minimum exhaust rates specified in ASHRAE Standard 62.1-2013, Table 6.5. This may include, for example, janitor closets, trash storage areas, laundry facilities and parking garages.</p> <p>To the extent possible, work with the building owner, property manager and other building tenants to ensure retail and other nonresidential spaces have exhaust ventilation that meets the applicable requirements of ASHRAE Standard 62.1-2013, Table 6.5.</p> <p>MA 21.4 Implement Minimum Actions for Compartmentalization to Supplement Exhaust Ventilation</p> <p>Follow the Minimum Actions under Priority Issue 16.0 Compartmentalization to enhance the effectiveness of exhaust ventilation and reduce odor migration and unwanted airflow from adjacent spaces.</p>	<p>EA 21.1 Upgrade Kitchen and Bath Exhausts</p> <p>Ensure kitchen and bath exhausts meet requirements of ASHRAE Standard 62.2-2013, without the need to use the alternative compliance path (Appendix A of ASHRAE Standard 62.2-2013).</p> <p>EA 21.2 Use Strategies in Bathrooms to Control Local Exhaust Fan</p> <p>Use one or more of the following strategies in bathrooms to control the use of the local exhaust fan:</p> <ul style="list-style-type: none"> • An occupancy/motion sensor. • An automatic humidistat controller. • An automatic timer to operate the fan for 20 minutes or more after an occupant leaves the room. • A continuously operating exhaust fan. <p>EA 21.3 Install Additional Local Exhaust Ventilation</p> <p>For spaces outside dwelling units with strong, localized pollutant sources (e.g., arts and crafts rooms, exercise rooms, cleaning supply closets), consider installing dedicated local exhaust ventilation.</p> <p>EA 21.4 Implement Expanded Actions for Compartmentalization to Supplement Exhaust Ventilation</p> <p>Follow the Expanded Actions under Priority Issue 16.0 to further enhance the effectiveness of exhaust ventilation and reduce odor migration and unwanted airflow from adjacent spaces.</p>

References for Priority Issue 21.0 Local Exhaust Ventilation:

 [ASHRAE Standard 62.1-2013 – Ventilation for Acceptable Indoor Air Quality](#)
[ASHRAE Standard 62.2-2013 – Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings](#)
 Appendix B: Property Management and Occupant Education

PRIORITY ISSUE 22.0 BUILDING SAFETY FOR OCCUPANTS		
ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 22.1 Assess Building Safety Document safety hazards that are observed during the building IAQ walkthrough, energy audit or other inspections. Immediately inform the building owner and property manager of any urgent and life-threatening conditions.</p> <p>AP 22.2 Assess Smoke and CO Alarms Determine whether there are working smoke alarms and CO alarms installed in dwelling units and other locations in the building.</p> <p>AP 22.3 Identify Prevalence and Storage of Harmful Chemicals Identify products containing hazardous chemicals (e.g., strong cleaners, hazardous materials, pesticides) that are stored in accessible locations.</p> <p>AP 22.4 Identify Fire Extinguisher Locations Check whether there are working fire extinguishers in dwelling units and appropriate common areas. Work with the building owner or property manager to assess whether fire extinguisher placement meets applicable codes.</p> <p>AP 22.5 Assess Water Heater Temperature Settings Determine whether water heater temperature settings are within the allowable limits of the local and state codes.</p> <p>AP 22.6 Assess Whether Knob-and-Tube Electrical Wiring Is Present Assess whether knob-and-tube electrical wiring is present in the building and whether it is located in areas impacted by the building upgrades.</p>	<p>MA 22.1 Correct Safety Hazards Identified During Assessments Immediately correct urgent and life-threatening safety risks. Correct other safety hazards during the building upgrade activities.</p> <p>MA 22.2 Correct Deficiencies in Smoke and CO Alarms  Replace non-functioning smoke and CO alarms. If smoke alarms or CO alarms are not present, install new alarms consistent with local code requirements; if local code requirements do not exist, install smoke alarms and CO alarms in every dwelling unit consistent with CPSC guidance and located according to NFPA 720. If new batteries are used, consider installing 10-year lithium batteries. Provide client education on appropriate response to alarm activation.</p> <p>Note: <i>It is recommended that CO alarms have a digital display and provide peak level readings.</i></p> <p>MA 22.3 Recommend Appropriate Storage of Hazardous Chemicals Recommend appropriate and controlled storage of products containing hazardous chemicals (e.g., strong cleaners, hazardous materials, pesticides).</p> <p>MA 22.4 Provide Adequate Fire Extinguishers Work with the building owner or property manager to ensure there are fire extinguishers installed according to applicable code requirements.</p> <p>MA 22.5 Adjust Water Heater Temperatures Ensure that water heater set points do not exceed allowable limits of local and state codes. Otherwise, ensure that water heater set points do not exceed 120°F to prevent scalding.</p> <p>MA 22.6 Follow Precautions When Knob-and-Tube Electrical Wiring Is Present Follow the precautions outlined in DOE Standard Work Specifications for Single-Family Home Energy Upgrades, Section 2.0601.1, for knob-and-tube electrical wiring. This includes requirements that live knob-and-tube wiring shall not be covered or surrounded, and that exposed knob-and-tube wiring shall be replaced with new appropriate wiring, as required by the National Electrical Code or authority having jurisdiction.</p>	<p>EA 22.1 Install CO Alarms Capable of Detecting and Storing Low Levels Install CO alarms that can detect and store peak CO levels of less than 30 parts per million in dwelling units.</p> <p>EA 22.2 Install Fall Prevention Measures Install grab bars and handrails for fall prevention. Install guards to prevent falls as stated in the NCHH-American Public Health Association (APHA) National Healthy Housing Standard, Section 3.7. For housing with small children, recommend that occupants install child safety gates at the top and bottom of stairs inside the dwelling unit.</p> <p>EA 22.3 Install Light Switches in Stairwells Recommend installation of light switches at the top and bottom of all stairwells.</p> <p>EA 22.4 Consider Step Lighting Consider installation of safety lighting on or near steps. Consider energy-efficient LED lighting.</p> <p>EA 22.5 Repair Malfunctioning Doors, Windows, Roofs and Floors Repair malfunctioning doors, windows, roofs and floors.</p> <p>EA 22.6 Ensure Safety of Electrical Systems Have qualified personnel ensure that electrical systems are in accordance with applicable codes.</p>

References for Priority Issue 22.0 Multifamily Building Safety:

- CDC: [Check for Safety: A Home Fall Prevention Checklist for Older Adults](#)
- CPSC: [Carbon Monoxide Questions and Answers](#)

- DOE: [Standard Work Specifications for Single-Family Home Energy Upgrades](#), Section 2.0601.1
- EPA: [Safer Choice](#)
- NCHH-APHA: [National Healthy Housing Standard](#), Section 3.7
- NFPA 720: [Standard for the Installation of Carbon Monoxide \(CO\) Detection and Warning Equipment](#)
- UL 2034: [Standard for Single and Multiple Station Carbon Monoxide Alarms](#)

 Appendix B: Property Management and Occupant Education

PRIORITY ISSUE 23.0 PROTECTING INDOOR AIR QUALITY (IAQ) DURING CONSTRUCTION

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 23.1 Assess Occupancy During Construction Periods</p> <p>Determine the nature of building occupancy during the construction periods. Identify areas of the building that will be occupied. Identify any special needs of the building occupants (e.g., children, elderly, disabled). Identify occupant complaints or concerns.</p> <p>AP 23.2 Identify Construction Contaminants and Pathways</p> <p>Identify potential IAQ contaminant sources from building upgrades (e.g., activities, materials and equipment that have the potential to cause IAQ problems) and pathways through which contaminants could affect the air quality for the building occupants (e.g., adjacent areas, return ducts, stairwells).</p> <p>AP 23.3 Identify Risk of Mercury Exposure</p> <p>Identify the extent to which mercury exposure is a risk during the building upgrade.</p> <p>Mercury exposure is a risk in a building where broken mercury-containing products and devices such as thermometers, thermostats, compact fluorescent lamp (CFL) bulbs, and fluorescent lamps are identified—especially when a designated place for proper disposal of such material is not available. If the upgrade involves installing or replacing mercury-containing products such as thermostats, thermometers, fluorescent lamps and CFL bulbs, mercury is a potential risk as part of the upgrade.</p>	<p> MA 23.1 Minimize Occupant and Worker Exposures During Construction</p> <p>When conducting activities that may result in exposure to airborne contaminants (e.g., cutting or grinding materials, painting, installing insulation) comply with local laws and adhere to the Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA) Indoor Air Quality Guidelines for Occupied Buildings Under Construction. Minimize occupant and worker exposure to VOCs, particles and other airborne contaminants using the following procedures:</p> <ul style="list-style-type: none"> • Restrict building occupants and workers without the personal protective equipment needed for the work being performed from construction areas. • Separate construction areas from occupied portions of the building using appropriate containment and ventilation practices. Ensure that work areas are properly isolated (e.g., by constructing a sealed, rigid-wall air barrier with a lockable door separating the work area from occupants or isolating smaller work areas with a plastic sheeting air barrier). Ensure that work areas are ventilated with exhaust to the outdoors to protect workers and occupants. Contaminants should be captured as close as possible to the emissions source. Work areas should be under negative pressure relative to surrounding spaces. Ensure that construction contaminants exhausted to the outdoors do not re-enter the building. <p>Note:</p> <p><i>If negative pressurization in the work areas is not possible, consider an exhausted double wall buffer zone to separate work areas from surrounding areas.</i></p> <ul style="list-style-type: none"> • Ensure fire egress requirements from occupied portions of the building are maintained when isolating work areas. • Do not conduct dry sanding without implementing containment measures for the dust generated. • Establish vehicle staging areas for loading and unloading materials and equipment at least 100 feet from outdoor air intakes, operable windows and entryways to the building. • Clean the area thoroughly and frequently, and before re-entry of unprotected workers or occupants to ensure removal of any dust that may contain pollutants. Use sealed HEPA-rated vacuums. • Follow all manufacturers’ printed instructions, which may indicate the need to evacuate building occupants and other unprotected individuals from work areas during and for some period after the use of a product. • Ensure sufficient ventilation and cure time to protect occupants before re-entry into the work area. • Create specific plans to contain particulate matter during demolition activities. • Limit the impact of airborne contaminants released by roofing materials during installation (e.g., hot mop asphalt, seam sealing on ethylene propylene diene monomer (EPDM), polyvinyl chloride or modified bitumen roofing). Establish isolation barriers and keep roofing materials away from outdoor air intakes. • Promptly respond to any occupant complaints or concerns. 	<p>EA 23.1 Consider Additional Protections As Appropriate</p> <p>Consider implementing the following options:</p> <ul style="list-style-type: none"> • Require rigid-wall air barriers with sealed, lockable entries between work areas and occupied spaces and provide negative pressurization to contain contaminants. • Create a buffer zone around work sites. • Restrict construction activities to hours of reduced occupancy when feasible. • Conduct temporary air cleaning. • Stage construction activities in controllable sizes. • Control pressurization and the indoor environment with temporary HVAC equipment. • Vacate the entire building, when feasible. <p>EA 23.2 Replace Mercury-Containing Products and Materials, Where Possible</p> <p>Encourage replacement of mercury-containing products and devices (excluding fluorescent lights and CFL bulbs) with products that do not contain mercury.</p>



See Appendix A: Worker Protection

PRIORITY ISSUE 23.0 PROTECTING INDOOR AIR QUALITY (IAQ) DURING CONSTRUCTION (continued)

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
	<p>MA 23.2 Protect HVAC Systems</p> <p>Protect HVAC systems from contaminants during work activities.</p> <ul style="list-style-type: none"> • Seal openings in existing ducts located in work areas to avoid infiltration of dust and debris. • New HVAC equipment, ducts, diffusers and return registers should be stored in a clean, dry place and should be covered to prevent dust accumulation. • If operating an HVAC system that interfaces with work areas, ensure the system does not pull return air from the work areas and install air filters with a MERV 8 rating or higher during construction activities. • Visually inspect ductwork after construction activities have been completed and clean internal surfaces as needed to remove dust and debris. • Ensure all filters that were used during work activities have been removed and new filters are properly installed before operating the HVAC system during occupancy. <p>MA 23.3 Handle Mercury Properly</p> <p>If mercury is identified, determine whether the building has a mercury spill response plan and provide guidance to the property manager and occupants on how to perform proper clean up. Refer to EPA guidance on clean up.</p> <p>Take particular care not to break any mercury-containing materials during upgrade activities. If an accidental spill occurs, refer to EPA guidance on clean up. Properly dispose of fluorescent lighting and CFL bulbs that may be part of energy upgrade activities.</p> <p>MA 23.4 Protect Highly Absorptive Materials</p> <p>Protect any existing absorptive materials (e.g., fabrics, furnishings, carpets) by fully covering with plastic sheeting. Fully secure all edges of sheeting to protect materials from airborne contaminants and emissions caused by construction.</p> <p>Schedule the installation of new absorbent materials after major dust and pollutant-generating activities have been completed. Ensure that materials have not been exposed to moisture and are dry before installation.</p> <p>MA 23.5 Safely Install Spray Foam Insulation</p> <p> Employ safe work practices to avoid exposure to SPF insulation. Follow the manufacturers' printed instructions for vacating building occupants, and other unprotected individuals not involved in the application of the SPF products, from the premises during and for some period after SPF application. Require and confirm SPF to be installed in strict accordance with manufacturer's printed requirements.</p> <p>Note:</p> <p><i>The curing time (complete reaction) of SPF insulation varies depending on the type of product, application technique, temperature, humidity and other factors. While the SPF is curing, it still contains unreacted chemicals, which include isocyanates and proprietary chemicals. Manufacturers estimate that it can take approximately 1 to 3 days after application for the two-component high-pressure "professional" SPF system to cure fully and approximately 8 to 24 hours for the one-component foam to cure. Exposure to isocyanates may cause skin, eye and lung irritation, asthma, and sensitization. Exposures to isocyanates should be minimized. See EPA's Spray Polyurethane Foam Web page for more information.</i></p>	

References for Priority Issue 23.0 Protecting Indoor Air Quality (IAQ) During Construction:

- American Chemistry Council: [Spray Polyurethane Foam Health and Safety](#)
- ASHRAE Standard 62.1-2013 – Ventilation for Acceptable Indoor Air Quality, Section 7.1.4.2
- EPA: [Building Air Quality Action Plan, Step 8: Establish Procedures for Responding to IAQ Complaints](#)
- EPA: [Mercury Releases and Spills](#)
- EPA: [Spray Polyurethane Foam \(SPF\) Home Insulation and How to Use it More Safely](#)
- SMACNA: [IAQ Guidelines for Occupied Buildings Under Construction](#)

 See Appendix A: Worker Protection

PRIORITY ISSUE 24.0 JOBSITE SAFETY

ASSESSMENT PROTOCOLS (AP)	MINIMUM ACTIONS (MA)	EXPANDED ACTIONS (EA)
<p>AP 24.1 Evaluate Risks</p> <p> Evaluate worker health and safety concerns that could be encountered during the building upgrade. Refer to Appendix A: Worker Protection for recommended evaluation measures and actions.</p>	<p>MA 24.1 Ensure Worker Protection</p> <p> See Appendix A: Worker Protection for recommended actions to protect worker health and safety, and available resources.</p>	<p>This cell is intentionally blank.</p>



See Appendix A: Worker Protection

Section 3

Appendices



Appendix A: Worker Protection

This appendix contains information to help those performing and supervising the building upgrade assess the risks to workers; it recommends actions to minimize risks to workers' health and safety and identifies resources for additional information. Worker protection is especially important in older buildings. Areas undergoing construction may contain remnants of legacy contaminants, such as lead and asbestos. Although these materials often are not considered harmful if left undisturbed or covered, they can become a concern when disturbed. Therefore, it is essential that the contractors review available information about the existence of such materials before beginning any modifications to the building. In some situations, only certified personnel can perform certain activities outlined in this Guide.

By law, employers and supervisors are required to provide workers with a workplace that is free from recognized hazards that can cause or are likely to cause death or serious physical harm, as required in Section 5(a)(1) of the Occupational Safety and Health Act of 1970. Employers and supervisors must ensure the following:

1. Work site operations are conducted in compliance with OSHA regulatory requirements. OSHA regulatory requirements identify the following construction hazards to be addressed:
 - Asbestos-Containing Materials:
29 CFR Part 1926.1101
 - Chemical Hazards:
29 CFR Part 1910.1200 and 29 CFR Part 1926.59
 - Confined Spaces in Construction:
29 CFR Part 1926, Subpart AA
 - Electrical:
29 CFR Part 1926, Subpart K
 - Falls:
29 CFR Part 1926.501
 - Ladders:
29 CFR Part 1926.1053
 - Lead:
29 CFR Part 1926.62 and 40 CFR 745
 - Personal Protective Equipment:
29 CFR Part 1926.28

2. Workers are trained in the hazards of their job and the methods to protect themselves.
3. Workers are provided the protective equipment needed to reduce site exposures. Employers are required to perform a Personal Protective Equipment Hazard Assessment for each employee.

Table A1 provides a list of recommended assessments and actions for worker safety concerns. Project contract documents (drawings or specifications) and site plans should include precautions to address these issues. Table A1 also includes measures an employer needs to take to evaluate existing and potential health concerns and recommended actions to ensure worker safety. Assistance with developing these worker protection plans often is available from state or federal training programs. OSHA offers training courses and educational programs to help broaden worker and employer knowledge on the recognition, avoidance, and prevention of safety and health hazards in their workplaces. OSHA also offers training and educational materials that help businesses train their workers and comply with the Occupational Safety and Health Act (see <http://www.osha.gov/dte/index.html>).

When known pollutants are being produced or disturbed during retrofit activities, follow appropriate standards – including OSHA, National Institute for Occupational Safety and Health (NIOSH) and EPA standards – to minimize worker and occupant exposure. The document “IAQ Guidelines for Occupied Buildings Under Construction” published by the Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA) also can be used as a best-practices manual for maintaining IAQ in occupied buildings undergoing renovation or construction. The SMACNA document covers how to manage sources of air pollutants, control measures, quality control and documentation, and communication with occupants.

Table A1: Recommended Assessments and Actions for Worker Safety Concerns

ASBESTOS	
Assessments	Actions
Determine whether workers will be exposed to asbestos-containing material (ACM). Because of the widespread prior use of ACM, construction and renovation activities in older buildings may expose workers to this hazard.	<ul style="list-style-type: none"> • Building upgrade activities may expose workers to ACM and require compliance with the OSHA rule at 29 CFR Part 1926.1101, which specifies the required protection measures. • See OSHA's website on asbestos for additional information and resources.
CHEMICAL HAZARDS	
Assessments	Actions
Determine whether workers will be exposed to chemical hazards. Based on 29 CFR Part 1926.59, a chemical hazard is a chemical that is either a physical hazard (e.g., explosive, flammable) or a health hazard (e.g., acute or chronic health effects may occur).	<ul style="list-style-type: none"> • Comply with the OSHA rule at 29 CFR Part 1910.1200, which includes the following requirements (not an exhaustive list): <ul style="list-style-type: none"> o that chemical content information be made available for all chemicals in use; o that containers be properly labeled; and o that workers handling chemicals be properly trained. • Use chemicals that are best in class for the particular application in terms of having low toxic content and/or low contaminant emissions. Examples include paints, adhesives, sealants and coatings that meet the emissions criteria of California Department of Public Health Specification 01350. • Proper health and safety precautions should be employed by workers that use or may come in contact with pesticides or chemical contaminants in building materials, subsoils or vapors. • For pesticides, comply with EPA's Agricultural Worker Protection Standard (includes all amendments as of October 3, 1997). • See OSHA's website on hazard communication for additional information and resources.
CONFINED SPACES	
Assessments	Actions
Determine whether workers will be exposed to confined-space hazards.	<ul style="list-style-type: none"> • Comply with the OSHA rule at 29 CFR Part 1926, Subpart AA Confined Spaces in Construction. • See OSHA's website on confined spaces for additional resources on confined space hazards. • Ensure the workspace is cleaned regularly and has adequate ventilation and exhaust and that construction is phased properly to protect workers and occupants from construction activities that are considered high risk, as outlined in SMACNA "IAQ Guidelines for Occupied Buildings Under Construction," 2nd Edition. • See OSHA's Protect Yourself: Carbon Monoxide Poisoning Quick Card for additional information on sources of CO and recommended actions for preventing CO exposure. • See Priority Issue 10.0 Building Products/Materials Emissions and EPA's Safer Choice website for more information on selecting less toxic products and materials that can be used in confined spaces.

DUST	
Assessments	Actions
Determine whether the work will generate dust. Use best practice measures to manage and control air contaminants in areas of work.	<ul style="list-style-type: none"> • Educate workers about dust containment procedures and how to control dust and debris created by equipment used in construction activities. • Use work methods that minimize dust and prevent dust from spreading to other areas of the building. • Isolate areas where work is being performed (e.g., sealed with plastic sheeting) to contain any dust that is generated during construction activities. • Turn off forced-air, central heating and air conditioning systems (including local, window air conditioning units) while work that generates dust is under way. • Collect and remove all construction dust and debris. • Conduct a careful cleanup routinely and at the end of the project. • See OSHA's websites on wood dust and combustible dust for additional information and resources. • See EPA's RRP Program Rule requirements at 40 CFR Part 745 for recommended actions to prevent, contain and clean up lead dust.
ELECTRICAL	
Assessments	Actions
Determine whether workers will be exposed to electrical hazards.	<ul style="list-style-type: none"> • Follow OSHA rule 29 CFR Part 1926 Subpart K requirements for protecting workers from electrical hazards (not an exhaustive list): <ul style="list-style-type: none"> o Employers must make sure that all non-double-insulated electric equipment is equipped with a grounding conductor (three-wire type). o Worn or frayed electric cords must not be used. o Employers must provide either ground-fault circuit interrupters or an assured equipment grounding conductor program (which includes the regular testing of all equipment grounding conductors) to protect employees from ground faults. • See OSHA's Electrical Incidents E-Tool for additional information on electrical safety.
FALLS	
Assessments	Actions
Determine whether workers will be required to work at heights of 6 feet or more.	<ul style="list-style-type: none"> • If work is required at heights of 6 feet or more, protect workers with guardrails or by properly securing to prevent falls. • See OSHA rule at 29 CFR Part 1926.501 for additional information on requirements. • See OSHA's Web page on fall protection and OSHA's Falls E-Tool for additional information on protecting workers from fall hazards.
LADDERS	
Assessments	Actions
Determine whether workers will be using ladders.	<ul style="list-style-type: none"> • Follow OSHA rule at 29 CFR Part 1926.1053, which includes the following requirements (not an exhaustive list): <ul style="list-style-type: none"> o Portable ladders must be able to support at least four times the maximum intended load. o Ladders that must lean against a wall are to be positioned at a 4:1 angle. o Ladders are to be kept free of oil, grease, wet paint and other slipping hazards. o The area around the top and bottom of a ladder must be kept clear. o Ladders must not be tied or fastened together to provide longer sections. o Metal ladders must not be used while working on electrical equipment or electrical wiring. • See the OSHA rule at 29 CFR Part 1926.1053 for additional information on requirements. • See OSHA's publication Stairways and Ladders: A Guide to OSHA Rules for additional resources on ladder safety.

LEAD	
Assessments	Actions
Determine whether building upgrade activities will expose workers to lead dust (for example, from lead paint used in buildings constructed before 1978), according to the Assessment Protocols outlined in Priority Issue 3.0 Lead .	<ul style="list-style-type: none"> • If the facility was built before 1978, the existing paint is assumed to contain lead, unless EPA-approved testing methods show otherwise, and building upgrade activities must comply with EPA's RRP Program Rule requirements at 40 CFR Part 745 and the OSHA rule at 29 CFR Part 1926.62. • See OSHA's publication Lead in Construction for information on OSHA requirements to protect construction workers from lead hazards.
MOLD	
Assessments	Actions
Determine whether workers will be exposed to mold.	<ul style="list-style-type: none"> • All suspected moldy areas should be remediated by properly trained individuals. Moisture problems need to be identified and fixed or mold will return. If mold is expected to be disturbed during activities, immediately bring this to the attention of the site manager. Refer to OSHA's A Brief Guide to Mold in the Workplace; NIOSH's Recommendations for the Cleaning and Remediation of Flood-Contaminated HVAC Systems; EPA's Mold Remediation in Schools and Commercial Buildings; the American Conference of Government Industrial Hygienists' Bioaerosols: Assessment and Control; the American Industrial Hygiene Association's Recognition, Evaluation, and Control of Indoor Mold; or the Institute of Inspection, Cleaning and Restoration Certification's S520 Standard and Reference Guide for Professional Mold Remediation. • See EPA's Molds and Moisture website for additional information on mold remediation.
POLYCHLORINATED BIPHENYLS (PCBs)	
Assessments	Actions
Determine whether workers may be handling PCB-containing or PCB-contaminated building materials, including fluorescent light ballasts and caulk.	<ul style="list-style-type: none"> • See EPA's PCB-Containing Fluorescent Light Ballasts Web page for information on proper maintenance, removal and disposal of PCB-containing fluorescent light ballasts. If leaking ballasts are discovered, wear protective clothing including chemical-resistant (nitrile) gloves, boots and disposable overalls. • See EPA's Steps to Safe Renovation and Abatement of Buildings That Have PCB Containing Caulk website for information on this topic. Work practices to help ensure worker and occupant safety include employing protective measures (both interior and exterior), complying with occupational protective regulations, communicating with building occupants/third parties, setting up the work area to prevent the spread of dust, using appropriate tools that minimize the generation of dust/heat, and leaving the work area clean.
SPRAY POLYURETHANE FOAM (SPF)	
Assessments	Actions
Determine whether workers will be using SPF, which may contain chemicals such as isocyanates (e.g., methylene diphenyl diisocyanate), amines, flame retardants and other additives. There are three main types of SPF products (two-component high pressure, two-component low pressure and one-component foam), each of which has different applications. Determine which of the three main types of SPF products will be used.	<ul style="list-style-type: none"> • Applicators, crews and building occupants in the work area are required to use protective equipment to prevent exposure to isocyanates and other SPF chemicals. Protective equipment requirements vary depending on the type of SPF product. • Review label and product information for ingredients, hazards, directions, safe work practices and precautions. • Ensure health and safety training is completed and safe work practices are followed to prevent eye, skin and inhalation exposures during and after SPF installation. • Exercise caution when determining a safe re-entry time for unprotected occupants and workers based on the manufacturer's printed recommendation. If occupants or workers experience breathing problems or other adverse health effects from SPF application, seek immediate medical attention. • See OSHA's Green Job Hazards website for additional information on the hazards associated with SPF. • See EPA's Spray Polyurethane Foam (SPF) home website for additional information. • See the American Chemistry Council's Spray Polyurethane Foam Health and Safety website for additional information.

Appendix B: Property Management and Occupant Education

Building upgrade activities provide valuable opportunities for building owners, property managers and contractors to educate building occupants on IAQ and safety, which will help occupants maintain healthy indoor environments after the upgrades are complete. Building owners, property managers and contractors are encouraged to provide occupants with training that reinforces the health protections identified in this Guide.

Building occupants play a critical role in helping building owners and property managers maintain healthy living environments, for example, by reporting moisture and pest problems, cooperating with pest management professionals in implementing an integrated pest management policy, and following any smoke-free housing policies that exist.

Property managers play a critical role in maintaining multifamily residential properties, making them healthier living environments for occupants and prop-

erty maintenance staff. After the building upgrade is completed, property managers, maintenance staff, and contractors hired by the building owner and/or property manager can take actions to support the health protections incorporated by the building upgrades.

The following priority areas are discussed in this appendix:

- Pest Control
- Moisture Control
- Lead
- Smoke-Free Housing
- Cleaning and Building Products
- Ventilation
- Carbon Monoxide

PEST CONTROL	
Goal	Minimize pest problems using IPM strategies. These cost-effective strategies prevent and address pest problems while minimizing harm to people, property and the environment. IPM methods rely on a range of strategies to prevent and control pest issues. IPM strategies generally are more effective than traditional pest control approaches.
Actions	<p>1. Ensure contracts with pest professionals require these IPM elements:</p> <ul style="list-style-type: none"> • IPM Certification: Require all pest professionals to provide proof of IPM certification from a state agency or third party (e.g., GreenPro, Green Shield or equivalent IPM certification). • IPM Policy: Pest professionals should be required to include an IPM policy in pest control contract documentation. The IPM policy must include a clear plan of action consistent with the IPM requirements outlined below. • Inspections: Pest professionals should conduct initial and periodic inspections of the building's exterior and interior spaces to identify pest entry points and evidence of pests. A written evaluation of pest control needs should be provided for approval by the building owner or property manager. The evaluation should identify problem areas and recommend structural, sanitary or procedural modifications that will reduce pest access to food, water and shelter (e.g., seal entry points such as openings, cracks and crevices; cover and control pest access to trash cans/dumpsters/trash chutes). • Implementation: Pest professionals will work with building owners and property managers to determine when, how, and by whom the actions identified in the inspections will be undertaken (e.g., safely remove pests, nests, accumulated excrement and allergens; secure trash storage; effectively seal pest entry and migration openings; and plan pesticide use [if any]). Pest professionals will implement their portion of the agreed upon actions. • Pesticide Use: Pesticide application should be considered only after all other options have been attempted in response to observed pest problems. <ul style="list-style-type: none"> ⇒ Approved Products: The IPM contract or IPM policy must include a list of approved products. Only least hazardous or least toxic pesticide products² should be specified in an IPM contract. Do not apply any pesticide product that has not been included in the IPM policy or approved in writing by the building owner or property manager.

² As an example, the San Francisco Department of Environment's pesticide hazards screening list can be used, although it is not comprehensive. Tier III products in this list are considered least toxic. If a product being considered for application cannot be found on this list, the San Francisco Department of Environment's Guide to the City of San Francisco's Reduced-Risk Pesticide List can be used to determine the level of toxicity of the chemical in question.

PEST CONTROL (continued)

Actions

- ⇒ **Application by Need:** Whenever possible, spot treatments should be used rather than area-wide applications. Applied pesticides must be beyond the reach of children and pets (e.g., inside sealed cracks and cavities; in approved, secured bait stations). Employ the least hazardous material, most precise application technique and minimum quantity of pesticide necessary to achieve control. Ensure application of products containing pesticides render the pesticides inaccessible to occupants, visitors, pets (if allowed) and staff.
- ⇒ **Specificity:** Employ pesticides that are specific to target pests.
- ⇒ **Prohibited Products:** Pesticide sprays (unless an insect growth regulator or needed to address bedbug infestations), foggers or bombs, and organophosphate or chlorinated hydrocarbons pesticides are not permitted.
- ⇒ **Pesticide Storage:** The pest control contractor should not store any pesticide product in the building.
- ⇒ **Notification:** Pest control contractors should be required to provide written notice to the property management and occupants of the intention to apply any pesticide, and post signage in the areas to be treated, all at least 24 hours prior to application. It is recommended that this notice be given 72 hours in advance of the pesticide application so that occupants can prepare their dwelling units for the application and arrange to be away from the property, if necessary. Rooms of dwelling units and other areas to be sprayed with insecticides must have signage posted at conspicuous locations and entries at least 24 hours prior to application.
- ⇒ **Compliance and Enforcement:** Individuals applying pesticides must do so in a manner not only consistent with federal laws, but also consistent with state and local laws. In general, states have primary authority for compliance monitoring and enforcing against use of pesticides in violation of the labeling requirements. Additionally, the agency with primary responsibility for pesticides differs from state to state. Usually it is a state's department of agriculture, but may be a state's environmental agency or other agency.
- **Insect Control:** Insecticides are to be applied as “crack and crevice” treatments (i.e., the insecticide is not visible to a bystander during or after the application process). For cockroaches, baits, gels, growth regulators and boric acid are preferred.
- **Rodent Control:** As a rule, rodent control inside and around buildings shall be accomplished with trapping devices only.
 - ⇒ **Trapping Devices:** Trapping devices shall be out of public view to avoid being disturbed by routine cleaning. Devices shall be checked on a defined schedule and the pest management contractor shall be responsible for disposing of all trapped rodents.
 - ⇒ **Bait Boxes:** All bait boxes shall be placed out of general view, in locations where they will not be disturbed by routine operations. Bait boxes shall have lids securely locked or fastened and shall be secured so they cannot be picked up or moved. Bait boxes shall be labeled with the contractor's business name and address, and dated by the contractor's technician at the time of installation and each servicing.
 - ⇒ **Rodenticides:** In exceptional circumstances, when rodenticides are deemed essential, the contractor shall obtain approval from the building owner or property manager. All rodenticides, regardless of packaging, shall be placed in locations not accessible to children, pets, wildlife and domestic animals; or the rodenticides shall be in EPA-approved tamper-resistant bait boxes.
- **Occupant Education:** Contract documents should include provisions for the pest control professional to provide on-site occupant education, in conjunction with building owner or property manager.
- 2. Ensure the building owner, property manager and maintenance staff undertake the following activities:**
 - **Preventative Measures:** Maintenance staff will help prevent pest issues by:
 - ⇒ Providing regular housekeeping in common areas, hallways, stairwells, laundry rooms and maintenance/utility areas.
 - ⇒ Sealing cracks, holes and crevices to prevent pest entry.

PEST CONTROL (continued)

Actions	<ul style="list-style-type: none"> ⇒ Providing an enclosed area for the storage of trash and prompt trash removal service. ⇒ Integrating pest exclusion (e.g., sealing holes, cracks and crevices) with energy efficiency and air sealing activities. • Review and Approve Contractor IPM Plan: Building owners/property managers review and approve the IPM plan submitted by the pest control contractor and work with occupants to undertake appropriate actions. • Occupant Complaints: Maintenance staff respond promptly to pest complaints from occupants. Approximately 10 to 14 days after any action has been taken, the building owner/property manager should follow up to evaluate the conditions. • Written Notice: Building owners/property managers shall provide advance written notice to occupants, preferably 72 hours, but not less than 24 hours, prior to pesticide application. • Unit Turnover: Building owners/property managers shall inspect for pest problems at unit turnover and identify any needed pest control work by maintenance staff and/or pest control professionals to prevent and address pest issues. • Occupant Education: Building owners/property managers should develop, in conjunction with the IPM contractor, education and outreach materials to occupants for lease signing, periodic occupant education sessions, and during pest infestations. To the extent feasible, incorporate the following elements into occupant leases, and work to ensure occupants understand their responsibilities: <ul style="list-style-type: none"> ⇒ Report to management pest sightings and conditions that may attract pests. ⇒ Do not use foggers, bombs or sprays. A pesticide use policy must be prepared including what, if any, over-the-counter products are acceptable for use in the building. Illegal pesticides shall be strictly prohibited (e.g., Miraculous Insecticide Chalk, Tres Pacitos). ⇒ Keep dwelling units clean, clutter-free and in sanitary condition according to lease requirements. ⇒ Prepare dwelling units for pest management service visits according to instructions provided in advance. ⇒ Participate in monitoring their dwelling unit with traps provided by management, when needed.
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Resources for Pest Control:

- [ASHRAE: Indoor Air Quality Guide: Best Practices for Design, Construction and Commissioning](#)
- [Boston Public Health Commission: Integrated Pest Management: A Guide for Managers and Owners of Affordable Housing](#)
- [Enterprise Green Communities: Green Operations & Maintenance Training in a Box](#)
- [EPA: Introduction to Integrated Pest Management, Principles of IPM](#)
- [EPA: Pesticides: Controlling Pests](#)
- [Green Shield: Green Shield Certified](#)
- [National Pest Management Association: GreenPro Certified](#)
- [NCHH: Integrated Pest Management in Multifamily Housing](#)
- [Northeastern IPM Center at Cornell University: Integrated Pest Management: A Guide for Affordable Housing](#)

MOISTURE CONTROL	
Goal	Incorporate regular checks for moisture problems into ongoing property inspections, work order responses and at unit turnover to minimize moisture and mold problems. Moisture and mold have been associated with asthma and other respiratory problems. Excessive moisture also can contribute to pest problems and deteriorated lead-based paint.
Actions	<p>1. Perform the following during annual inspections, at unit turnover (as appropriate) and during work order responses:</p> <ul style="list-style-type: none"> • Plumbing <ul style="list-style-type: none"> ⇒ Inspect under sinks for leaks. ⇒ Check toilets for leaks with dye test and replace flapper as needed. ⇒ Inspect shower stall, shower faucets and shower diverter valve for leaks. Recommended installation of showerheads with WaterSense label, rated for less than 2 gallons per minute (gpm). ⇒ Inspect faucets and aerators for leaks. Install new faucets as needed, with WaterSense label; kitchen faucets rated for less than 1.5 gpm, bath faucets rated for less than 0.5 gpm. ⇒ Inspect under dishwashers and washing machines for leaks. ⇒ Repair all leaks identified. • Exhaust Ventilation <ul style="list-style-type: none"> ⇒ Check for proper operation of kitchen and bathroom exhaust fans, and confirm exterior venting and fan flows. ⇒ Verify clothes dryer exhaust vent is intact and vented to the outdoors. • Exterior Moisture <ul style="list-style-type: none"> ⇒ Inspect outside gutters and downspouts to be sure water is moved away from the building and property. ⇒ Check for standing water near the building, and correct grade and drainage as needed. • Interior Moisture <ul style="list-style-type: none"> ⇒ Inspect for moisture stains, mold or musty odor. ⇒ Inspect for standing water. ⇒ Inspect for signs of mold or moisture damage. • Occupant Education <ul style="list-style-type: none"> ⇒ Advise occupants to report immediately any plumbing leaks; window, wall or roof leaks; standing water; or condensation problems. ⇒ Advise occupants about the need to use exhaust fans in kitchens and bathrooms during activities that generate pollutants and moisture (e.g., cooking and showering). ⇒ Refer occupants to EPA's A Brief Guide to Mold, Moisture and Your Home.

Resources for Moisture Control:

- CDC-NIOSH: [Dampness and Mold Assessment Tool](#)
- EPA: [A Brief Guide to Mold, Moisture and Your Home](#)
- NCHH: [Healthy Homes Maintenance Checklist](#)

LEAD	
Goal	Ensure lead-based paint does not pose a hazard in building operations and maintenance activities.
Actions	<p>1. If maintenance staff will be disturbing lead paint, they shall be trained and certified under EPA's Lead Renovation, Repair and Painting Program for lead-safe work practices.</p> <ul style="list-style-type: none"> • Occupant Education: Ensure building occupants are provided with information on lead and renovations as required under EPA's Lead Renovation, Repair and Painting Program.

Resources for Lead:

- EPA: [Lead](#)
- EPA: [The Lead-Safe Certified Guide to Renovate Right](#)
- EPA: [Renovation, Repair and Painting Program](#)

SMOKE-FREE HOUSING	
Goal	Explore establishing a smoke-free housing policy as part of the building upgrade. Smoking is the single greatest cause of disease and premature death in the United States affecting smokers, and non-smokers through secondhand smoke. It also contributes to occupant complaints related to odor and increases the operational cost of the property.
Actions	<ul style="list-style-type: none"> • A detailed list of actions to implement smoke-free housing policies is provided in HUD's Change is in the Air: An Action Guide for Establishing Smoke-Free Public Housing and Multifamily Properties and Smoke Free Housing: A Toolkit for Owners/Management Agents of Federally Assisted Public and Multi-family Housing, and the NCHH's Reasons to Explore Smoke-Free Housing. Several key steps are summarized here: <ol style="list-style-type: none"> 1. Work with the building owner or property manager to establish a smoke-free housing policy: <ul style="list-style-type: none"> • Conduct an occupant survey of interest in smoke-free housing. • Pending results of the survey, develop a plan to implement a smoke-free housing policy and establish suitable areas outside of the building that can be used for smoking. Amend tenant leases to be consistent with smoke-free policy. • Occupant Education: Educate occupants on smoking policy in the building. Install signage and provide printed material for visitors at the main entrances of the building with information about the smoke-free housing policy. • Enforce any smoke-free housing policy and related lease restrictions (see text box below).

Sample Smoke-Free Housing Policy

Effective [DATE], the use of all smoking products (cigarettes, cigars, pipes and electronic smoking devices) is prohibited on [Property Name] property and within 25 feet of the building. This prohibition applies to all indoor and outdoor areas (dwelling units, entry areas, walkways, grassed areas, picnic areas and parking lots at [Property Name] property). This policy applies to all employees, visitors, residents, subcontractors, volunteers and vendors.

Sample Exception (for existing properties establishing a smoke-free policy)

Current residents who use smoking products that have entered into a lease agreement prior to [DATE] will be permitted to continue to use tobacco products in their dwelling units for 12 months after the smoke-free policy is in effect. Therefore, on [DATE], all units will be smoke-free and at that time all smokers will need to adhere to the set policy. This exception shall not extend to visitors or anyone other than the lease holder/occupant.

Sample Lease Addendum Language

Include in the "Definitions" section of the lease:

Smoking: "Smoking" shall include the inhaling, exhaling, burning or carrying of any lighted cigarette, cigar or other tobacco product; the emissions produced by electronic smoking devices; and the burning of cannabis or illegal substances.

Include in the restrictions section of the lease:

Smoking: Due to the increased risk of fire and the known health effects of secondhand smoke, smoking is prohibited indoors and within 25 feet of the residential building. This restriction applies to both private and common areas and applies to all owners, tenants, guests and service persons.

Resources for Smoke-Free Housing:

National:

EPA: [Secondhand Tobacco Smoke and the Health of Your Family](#)
 EPA: [Smoke-free Homes](#)
 HUD: [Change is in the Air: An Action Guide for Establishing Smoke-Free Public Housing and Multifamily Properties](#)
 HUD: [Optional Smoke-Free Housing Policy Implementation, Notice H 2010-21](#)
 HUD: [Smoke-Free Housing: A Toolkit for Owners/Management Agents of Federally Assisted Public and Multi-family Housing](#)
 HUD: [Smoke-Free Housing: A Toolkit for Residents of Federally Assisted Public and Multi-family Housing](#)

NCHH: [Reasons to Explore Smoke-Free Housing](#)
 TTAC: [Tobacco Technical Assistance Consortium](#)

State and Local:

Boston [Smoke-Free Homes](#)
 Capital District (New York) [Tobacco-Free Coalition](#)
 Michigan [Smoke-Free Apartment](#)
 Minnesota [Smoke-Free Housing](#)
 Smoke-Free Housing Coalition of Maine

CLEANING AND BUILDING PRODUCTS	
Goal	Use housekeeping practices, maintenance practices and related products that minimize the use of harmful or toxic chemicals wherever possible.
Actions	<p>1. Follow a cleaning plan: For every area in the building that needs to be cleaned, staff should identify:</p> <ul style="list-style-type: none"> • Items to be cleaned (e.g., floors, walls, windows, carpets). • Individual(s) responsible for cleaning each item. • Frequency with which each item must be cleaned. • Specific cleaning methods that must be used (e.g., micro-fiber dust mop [no brooms], warm water and mild detergent in a damp wipe [no sprays], HEPA-filtration vacuums). • Cleaning materials to be used for each surface. <p>2. Where possible, require staff and contractors to specify products that meet independent testing and certification protocols. Examples are provided below; this is not an exhaustive list.</p>

CLEANING SUPPLIES	
Cleaners	Green Seal, EPA Safer Choice Label, or ECOLOGO Certified.
NEW FLOORING & CABINETS	
Carpet, Carpet Cushion and Entry Mats	Green Label Plus Certified by Carpet and Rug Institute. Recycle removed carpet: vendor to supply price quote to recycle removed carpet and components (e.g., 100%, 50% or 30% recycled).
Resilient Flooring	FloorScore® Certified by Resilient Flooring Covering Association.
Flooring Adhesives	No- or low-VOC (less than 50 grams/liter [g/L]) for carpet and flooring tile adhesives.
Cabinets	Urea formaldehyde-free cabinets, certified to be compliant with California Title 17 for Formaldehyde – Phase 2, if available. Products produced in registered plants certified under the Kitchen Cabinet Manufacturers Association Environmental Stewardship Certification Program (ESP 05-12).
PAINT	
Interior Paint	Master Painters Institute Green Performance Standards X-Green, GPS-1 or GPS-2. Green Seal Standard GS-11 certified (e.g., VOC content for flat paints less than 50 g/L, VOC content for non-flat paints less than 150 g/L).

Resources for Cleaning and Building Products:

[Carpet and Rug Institute: Green Label Plus](#)

[ECOLOGO: ECOLOGO Product Certification](#)

[Enterprise Green Communities: Green Operations & Maintenance Training in a Box](#)

[EPA: Safer Choice](#)

[Green Seal: Green Seal Standard for Paints and Coatings, GS-11](#)

[Kitchen Cabinet Manufacturers Association: Environmental Stewardship Certification Program \(ESP 05-12\)](#)

[Master Painters Institute: Green Performance Standards GPS-1 or GPS-2, X-Green](#)

[Resilient Flooring Covering Association: FloorScore®](#)

VENTILATION	
Goal	Confirm ventilation systems are functioning as intended to reduce buildup of moisture and contaminants in dwelling units and common areas. Moisture can contribute to mold growth and breathing problems such as asthma. Contaminants from kitchen cooking can contain small particles and nitrogen oxides that also can adversely affect health.
Actions	<p>1. Perform the following during annual inspections and at unit turnover:</p> <ul style="list-style-type: none"> Inspect bath and kitchen fans to determine whether they are clear of obstructions, operational and moving air at the correct airflow rates. Ensure that fans are operating as intended (e.g., manually or automatically controlled intermittent operation, continuous operation). Remove any items put up by occupants to block airflows at supply or exhaust grilles. Identify the source(s) of occupant dissatisfaction that prompted blocking the airflows and take corrective action. Replace filters in HVAC systems with new filters at unit turnover, semi-annually or as often as recommended by manufacturer. Conduct a ventilation system assessment to determine whether adequate ventilation rates are being provided to dwelling units. Assess ventilation rates in common areas. Occupant Education: Advise occupants about the need to use exhaust fans in kitchens and bathrooms during activities that generate pollutants and moisture (e.g., cooking and showering). Educate occupants about the basic operation of ventilation, heating and cooling systems. This should include any maintenance (e.g., air filter change-out) and adjustments that are the occupants' responsibility.

Resources for Ventilation:

- [NCHH: Improving Ventilation in Existing or New Buildings With Central Roof Exhaust](#)
- [NCHH: Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation](#)
- [NCHH: Improving Ventilation in New and Existing Multi-Family Buildings With Individual Unit Ventilation Systems](#)
- [NYSERDA: Improving Central Exhaust Systems for Multifamily Buildings](#)

CARBON MONOXIDE	
Goal	Ensure combustion appliances are maintained and operated safely, and occupants are protected against carbon monoxide.
Actions	<p>1. Conduct regular inspections and preventive maintenance on all combustion appliances. Ensure proper venting of combustion by-products to the outdoors. Regularly inspect carbon monoxide alarms for proper operation.</p> <ul style="list-style-type: none"> Occupant Education: Ensure building occupants are provided with information on the hazards of combustion pollutants including carbon monoxide.

Resources for Carbon Monoxide:

- [Consumer Product Safety Commission: Carbon Monoxide Questions and Answers](#)
- [EPA: Carbon Monoxide's Impact on Indoor Air Quality](#)
- [EPA: Protect Your Family and Yourself from Carbon Monoxide Poisoning](#)

Appendix C: Abbreviations and Acronyms

AARST – American Association of Radon Scientists and Technologists, Inc.	IPM – integrated pest management
ABAA – Air Barrier Association of America	IRC – International Residential Code
ACCA – Air Conditioning Contractors of America	IUOE – International Union of Operating Engineers
ACGIH – American Conference of Governmental Industrial Hygienists	LED – light-emitting diode
ACM – asbestos-containing material	LISC – Local Initiatives Support Corporation
AHRI – Air-Conditioning, Heating, and Refrigeration Institute	MA – Minimum Action
AIHA – American Industrial Hygienists Association	MDI – methylene diphenyl diisocyanate
ANSI – American National Standards Institute	MERV – minimum efficiency reporting value
AP – Assessment Protocol	MNCEE – Minnesota Center for Energy and Environment
APHA – American Public Health Association	MPI – Master Painters Institute
ASHRAE – formerly American Society of Heating, Refrigerating and Air-Conditioning Engineers	MPI GPS – Master Painters Institute Green Performance Standard
ASTM – American Society for Testing and Materials	MSDS – Material Safety Data Sheet
ATCM – Airborne Toxic Control Measures	NAAQS – National Ambient Air Quality Standard
ATP – American Technical Publishers	NCHH – National Center for Healthy Housing
BOC – Building Operators Certification	NESHAP – National Emission Standards for Hazardous Pollutants
BPI – Building Performance Institute	NFGC – National Fuel Gas Code
BTU – British Thermal Unit	NFPA – National Fire Protection Association
CARB – California Air Resources Board	NIOSH – National Institute for Occupational Safety and Health
CDC – U.S. Centers for Disease Control and Prevention	NIST – National Institute of Standards and Technology
cfm – cubic feet per minute	NVLAP – National Voluntary Laboratory Accreditation Program
CFL – compact fluorescent lamp	NYSERDA – New York State Energy Research and Development Authority
CFR – Code of Federal Regulations	OSHA – Occupational Safety and Health Administration
CO – carbon monoxide	PCBs – polychlorinated biphenyls
CPSC – Consumer Product Safety Commission	pCi/L – picocuries per liter (in air)
CSA – Canadian Standards Association	PLM – polarized light microscopy
DOE – U.S. Department of Energy	PM_{2.5} – Particulate matter \leq 2.5 micrometers in diameter
DOL – U.S. Department of Labor	PM₁₀ – Particulate matter \leq 10 micrometers in diameter
EA – Expanded Action	RRP – renovation, repair and painting
EPA – U.S. Environmental Protection Agency	SMACNA – Sheet Metal and Air Conditioning Contractors' National Association
EPDM – ethylene propylene diene monomer	SPF – spray polyurethane foam
ETS – environmental tobacco smoke	TEM – transmission electron microscopy
FAQs – Frequently Asked Questions	TSCA – Toxic Substances Control Act
FLBs – Fluorescent Light Ballasts	UL – Underwriters Laboratories
g/L – grams/liter	U.S. – United States
gpm – gallons per minute	USDA – U.S. Department of Agriculture
HEPA – high-efficiency particulate air	VOC – volatile organic compound
HUD – U.S. Department of Housing and Urban Development	WAPTAC – Weatherization Assistance Program Technical Assistance Center
HVAC – heating, ventilation and air conditioning	WPS – Worker Protection Standard
IAQ – indoor air quality	
IBC – International Building Code	
IFGC – International Fuel Gas Code	
IICRC – Institute of Inspection, Cleaning and Restoration Certification	

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APPENDIX E: MASTER VERIFICATION CHECKLIST



Indoor Air Quality Guidelines for Multifamily Building Upgrades

Note: This Verification Checklist is to be used in conjunction with the assessment protocols and recommended actions in Section 2 of *Energy Savings Plus Health: Indoor Air Quality Guidelines for Multifamily Building Upgrades*.

Building Identification:

City/State/Zip:

Date:

1.0 Moisture Control and Mold

Assessment Protocol and Action Verification	Complete	N/A	NOTES
AP 1.1 Inspected the interior and exterior of the building and the building’s mechanical systems for evidence of moisture problems, and documented the results.			
AP 1.2 Determined whether the project requires mold remediation or additional moisture control measures based on the findings of the moisture inspection described in Assessment Protocol (AP) 1.1 .			
AP 1.3 Identified moisture problems to address/repair before building upgrades.			
AP 1.4 Assessed for moisture or mold problems that cannot be resolved under the building upgrade project. Did not start construction projects that would reduce the building’s air infiltration rate if there are unresolved moisture problems.			
MA 1.1 Repaired moisture problems identified during the assessment including plumbing leaks, rain leaks and foundation leaks.			
MA 1.2 Conducted mold remediation following professional guidance, such as EPA’s Mold Remediation In Schools and Commercial Buildings and Institute of Inspection, Cleaning and Restoration Certification (IICRC) Mold Remediation Standard S520.			
MA 1.3 Addressed standing water problems. Corrected surface water pooling near the foundation before insulating basement or crawlspace walls.			
MA 1.4 Managed rainwater in assemblies included within the scope of work (e.g., drainage planes and flashings). Ensured there is adequate slope and drainage away from the building.			
MA 1.5 Ensured proper heating, ventilation and air conditioning (HVAC) condensate drainage.			
MA 1.6 Prevented condensation in the building by air sealing the enclosure, managing water vapor flow, managing air pressure relationships, ensuring all piping and valves with condensation potential are adequately insulated, and controlling indoor humidity sources.			
MA 1.7 Properly sized HVAC systems to manage moisture inside the building. Installed supplemental dehumidification equipment if needed to avoid indoor moisture problems.			

Color Codes

Assessment Protocol (AP)

Minimum Action (MA)

Expanded Action (EA)

1.0 Moisture Control and Mold (continued)				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
MA 1.8	Used nonporous construction materials in moisture-prone areas.			
MA 1.9	Protected open roof areas from rain during construction, and designed and constructed roofing systems and flashing details to ensure proper moisture barriers. Repaired leaks before air sealing or insulating the attic.			
MA 1.10	Protected on-site materials from moisture.			
EA 1.1	Retrofitted crawlspaces so that they are sealed, insulated, ventilated with conditioned air, properly drained and waterproofed. Installed a high capacity, energy-efficient dehumidifier in the space (if climate conditions warranted).			
EA 1.2	Followed EPA or other professional guidance to perform additional activities to remediate mold growth.			
2.0 Asbestos				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 2.1	Determined potential asbestos hazards in the building and identified asbestos-containing materials (ACM). Completed assessments for ACM prior to initiating building upgrade tasks that have the potential to disturb ACM.			
AP 2.2	If unsure whether material contains asbestos, contacted a trained and accredited asbestos professional to assess, sample, and test the material, as needed. Notified the building owner and/or property manager of any ACM identified during the assessments.			
MA 2.1	Addressed ACM during building upgrades and used accredited personnel for abatement or repair. Immediately isolated the area if suspected ACM was found to be damaged (e.g., unraveling, frayed, breaking apart). For suspected ACM that must be disturbed as part of the project, contacted an accredited and properly trained asbestos professional.			
MA 2.2	Exercised caution to prevent the release of asbestos particles into the air during work activities (e.g., no dusting, sweeping or vacuuming ACM debris; no sawing, sanding, scraping or drilling holes into ACM; no using abrasive pads or brushes to strip ACM).			
MA 2.3	Did not remove or disturb insulation that appears to be vermiculite.			
MA 2.4	Conducted asbestos abatement before blower door testing and exercised caution when conducting blower door testing where friable asbestos or vermiculite attic insulation is present (e.g., used positively pressurized blower door testing).			

Color Codes

Assessment Protocol (AP)

Minimum Action (MA)

Expanded Action (EA)

3.0 Lead

Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 3.1	Assumed lead-based paint was used in buildings built before 1978, unless testing shows otherwise. Recognized that lead-based paint may be present in any building. Tested any suspected surfaces that will be disturbed during the building upgrade.			
AP 3.2	Determined the area of any lead-based paint that will be disturbed during the planned work.			
MA 3.1	Complied with EPA's Renovation, Repair and Painting (RRP) Program Rule. Used a Certified Renovator, followed leadsafe work practices, isolated the work area to avoid occupant exposure, minimized lead dust, left no dust or debris behind, and successfully performed cleaning verification or clearance testing.			
MA 3.2	Informed maintenance staff that if they will be disturbing lead paint, they must be trained and certified under EPA's RRP Program for lead-safe work practices.			
EA 3.1	Complied with expanded requirements including the U.S. Housing and Urban Development's (HUD) lead-safe rehabilitation practices and EPA lead hazard standards for lead dust testing.			
EA 3.2	Replaced windows that test positive for lead-based paint.			
EA 3.3	Ensured all future paint applications in the building are lead-free.			
4.0 Polychlorinated Biphenyls (PCBs)				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 4.1	Determined whether fluorescent light ballasts containing polychlorinated biphenyls (PCBs) are present.			
AP 4.2	Assessed whether caulk will be disturbed during building upgrade activities.			
MA 4.1	Replaced PCB-containing fluorescent light ballasts that are leaking with new lighting fixtures. Any oil or stains leaked from PCB-containing ballasts were properly cleaned up or disposed of. Considered replacement of all PCB-containing light ballasts with new lighting fixtures.			
MA 4.2	If PCBs were potentially present in caulk that was disturbed during building renovations, took steps to minimize exposure following EPA's information at the Polychlorinated Biphenyls (PCBs) in Building Materials Web page.			
MA 4.3	Adhered to requirements of 40 CFR Part 761 to ensure that any PCB-containing waste was handled properly. Documented and stored copies of all test results and all disposal measures.			

Color Codes

Assessment Protocol (AP)

Minimum Action (MA)

Expanded Action (EA)

5.0 Radon

Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 5.1	Selected a radon testing professional from a list of qualified testers obtained from the state radon office. If there are no state requirements, selected a radon professional who is certified by the National Radon Proficiency Program or the National Radon Safety Board.			
AP 5.2	Tested for radon either: (1) both pre- and post-upgrade work, or (2) only post-upgrade work. Followed sampling guidance in American Association of Radon Scientists and Technologists, Inc. (AARST) Protocol for Conducting Radon and Radon Decay Product Measurements in Multifamily Buildings, MAMF-2012.			
MA 5.1	Before completing upgrade activities, took precautionary measures listed in the first column of Table 2. Radon Testing Options and Reduction Strategies.			
MA 5.2	After building upgrade work, followed the appropriate Minimum Actions outlined in Table 2. Radon Testing Options and Reduction Strategies, depending on post-work radon test results. Mitigated high radon levels according to AARST Radon Mitigation Standards for Multifamily Buildings, RMS-MF 2014.			
MA 5.3	Notified the building owner and/or property manager about the radon test results and radon-reduction measures that were implemented. Advised periodic retesting in areas of the building that have been mitigated for radon.			
EA 5.1	Followed the appropriate Expanded Actions outlined in Table 2. Radon Testing Options and Reduction Strategies, depending on post-work radon test results.			

6.0 Belowground Contaminants (Except Radon)

Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 6.1	Evaluated potential sources and odors (e.g., gasoline, sewer gas or fuel oil).			
AP 6.2	Evaluated the sewer vent system to confirm that drain traps have water in them and inspected drain lines for breaks or leaks.			
AP 6.3	If an odor is detected but its source cannot be identified, and the building is in a known area of contamination, notified local or state authorities and/or pursued additional assessments before continuing project work.			
AP 6.4	Conducted a further assessment if vapor-forming soil or groundwater contamination is suspected on or near the building site. Consulted state or tribal voluntary Brownfields cleanup programs or environmental regulatory agencies for information on the risks of vapor intrusion in the area.			
MA 6.1	Repaired or replaced failed or unattached sewer vent system components before proceeding with building upgrade projects.			

Color Codes

Assessment Protocol (AP)

Minimum Action (MA)

Expanded Action (EA)

6.0 Belowground Contaminants (Except Radon) (continued)				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
MA 6.2	Addressed drain traps prone to drying out by developing a maintenance plan to periodically add water to the traps, and considered installation of inline drain seals to floor drains prone to drying out.			
MA 6.3	Mitigated soil gas vapor intrusion in compliance with local or state standards (Table X5.1 of American Society for Testing and Materials [ASTM] E2600 or EPA guidance).			
EA 6.1	Installed floor drain seals to untrapped floor drains.			
EA 6.2	Installed automatic drain trap primers in floor drains that are susceptible to drying out to ensure that a small amount of water is periodically delivered to the trap and to prevent it from drying out.			
EA 6.3	Implemented measures to prevent migration of soil-gas contaminants into occupied spaces for new construction and building expansion projects located on Brownfield sites, as described in ASHRAE Indoor Air Quality (IAQ) Guide, Strategy 3.4.			
7.0 Garage Air Pollutants				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 7.1	Identified whether the building has any attached garages.			
AP 7.2	Checked for HVAC systems inside any attached garages.			
AP 7.3	Identified air leaks between any attached garages and occupied spaces that share a surface with the garages.			
AP 7.4	Identified whether any combustion engines other than automobiles and trucks are operated in attached garages.			
MA 7.1	Eliminated/minimized unwanted air transfer of garage air pollutants to dwelling units via mechanical equipment and ductwork.			
MA 7.2	Compartmentalized attached garages from occupied spaces by sealing openings and penetrations. Ensured a carbon monoxide alarm is installed in every room that shares a floor, ceiling or wall with the garage. Provided an exhaust fan in any attached garage, vented directly to the outdoors.			
EA 7.1	Relocated air-handling equipment that serves occupied spaces from the garage to an area within conditioned space.			
EA 7.2	Performed additional efforts to compartmentalize garages from occupied spaces.			
EA 7.3	Advised the building owner or property manager to remove all combustion engine-operated equipment (except automobiles and trucks) from inside the garage, where feasible.			

Color Codes

Assessment Protocol (AP)

Minimum Action (MA)

Expanded Action (EA)

8.0 Pests

Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 8.1	Identified potential pests of concern, including any organisms likely to colonize the building based on project location.			
AP 8.2	Identified evidence of pests, and determined whether pesticides are being used in the building to control pest populations.			
AP 8.3	Assessed whether the building already has an Integrated Pest Management (IPM) plan and whether it is being followed and sustained.			
MA 8.1	Mitigated pest infestations; selected an IPM professional for pest management needs.			
MA 8.2	Reduced the potential for pest entry into the building by blocking, sealing and eliminating pest entry points around the building envelope.			
MA 8.3	Patched and sealed openings in areas with evidence of rodent infestation with rodent-resistant materials prior to installing weatherization materials that may be susceptible to gnawing.			
MA 8.4	Reduced the risk of pest dispersal throughout the building by sealing and blocking interior passageways.			
MA 8.5	Implemented protections for outdoor air intakes and exhausts to eliminate pest entryways.			
MA 8.6	Maintained existing pest protections within the building.			
MA 8.7	Removed clutter, eliminated woodpiles and waste near the building, and removed any bushes, trees or vegetation closer than two feet from the structure. Kept vegetation away from outdoor air intakes and outdoor mechanical equipment. Did not pile up soils and mulches against the building's exterior walls.			
EA 8.1	If there is no IPM plan for the building, worked with the building owner and/or property manager to develop and implement one.			
EA 8.2	Ensured exterior garbage cans and dumpsters are sealable and sanitized regularly.			
9.0 Tracked-In Pollutants				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 9.1	Inspected all building common entrances for walk-off mats or entry mat systems. Noted conditions of dirt or moisture accumulation near entrances that might need walk-off mats or entryway floor cleaning systems.			
MA 9.1	Provided walk-off mats to trap dirt and moisture at all building common entrances.			
EA 9.1	Installed permanent entryway systems at all regularly used building common entrances to capture dirt and particulates in accordance with ASHRAE Standard 189.1, Section 8.3.1.5, or EPA's IAQ Design Tools for Schools, Entry Mat Barriers.			

Color Codes

Assessment Protocol (AP)

Minimum Action (MA)

Expanded Action (EA)

10.0 Building Products/Materials Emissions				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 10.1	Reviewed content and emissions documentation for products and materials being considered for the project to determine whether they contain potentially hazardous compounds.			
MA 10.1	Selected the least toxic products or materials feasible for each application. Used products and materials that indicate they have (or are certified as having) low-volatile organic compound (VOC) content or low-VOC emissions. Specified products and materials that meet independent certification and testing protocols (see examples listed in MA 10.1).			
MA 10.2	Selected low-emitting wood and composite-wood products compliant with California Title 17 Airborne Toxic Control Measures (ATCM). If California Title 17 ATCM compliant materials are not available, used wood products that meet Section 6.1 of EPA's Indoor airPLUS Construction Specifications.			
MA 10.3	Performed a post-construction building flush-out in the renovated building/spaces before occupancy resumed.			
MA 10.4	Followed guidance outlined in MA 23.4 to protect absorptive materials during construction.			
EA 10.1	Aired out new construction materials in a well-ventilated, clean and dry space prior to installation.			
EA 10.2	Sealed composite wood products with a low-VOC or no-VOC sealant intended to reduce VOC emissions.			
EA 10.3	Investigated and corrected potential contaminant source problems after building modifications.			
EA 10.4	Performed a post-construction flush out or baseline IAQ monitoring per ASHRAE Standard 189.1, Section 10.3.1.4(b) after construction was completed.			
EA 10.5	Required products that have submitted their complete chemical inventory to a third party for verification. Made the verification / certification by the third party publicly available.			
11.0 Vented Combustion Appliances				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 11.1	Completed a safety inspection of all vented combustion appliances. The inspection shall include observations for applicable code requirements including proper clearances, condition of venting, assessment of the potential for back-drafting, integrity of fuel lines, safety of electrical connections and condition of the appliance itself.			
MA 11.1	Repaired, removed or replaced combustion appliances as needed to correct all deficiencies identified during the assessments and ensure compliance with applicable codes and standards. Ensured proper venting after modifications that affected building envelope leakage and airflows.			
MA 11.2	Ensured that all combustion exhaust is captured as close to the combustion source as possible, exhausted directly outdoors, and not vented into other indoor spaces such as attics, crawlspaces or basements.			

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11.0 Vented Combustion Appliances (continued)				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
MA 11.3	Ensured that vented appliances have sufficient makeup air to replace vented air and maintain normal operating conditions.			
MA 11.4	Ensured that boiler-firing adjustments are operating properly.			
MA 11.5	Ensured carbon monoxide (CO) detection and warning equipment is installed and located according to National Fire Protection Association (NFPA) 720 and any applicable local or state requirements.			
EA 11.1	Installed power-vented or sealed-combustion equipment when replacing combustion equipment located in occupied or conditioned spaces. Installation was performed in accordance with Air Conditioning Contractors of America (ACCA) Standard 5.			
EA 11.2	Replaced older, lower efficiency appliances that have pilot burners with higher efficiency appliances incorporating electronic ignition.			
12.0 Unvented Combustion Appliances				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 12.1	Identified unvented combustion appliances and determined whether any local or state regulations prohibiting these devices apply. Checked locations of unvented gas or kerosene space heaters and assessed the potential for the unvented heaters to influence the thermostat that controls the primary heat source. Determined whether CO detection and warning equipment was installed in dwelling units with unvented combustion appliances.			
MA 12.1	Ensured adequate ventilation and exhaust in spaces with unvented combustion equipment. Ensured ASHRAE Standard 62.2-2013 requirements, and any applicable building code requirements, for local exhaust and outdoor air ventilation are met for kitchens equipped with gas cooking appliances. Ensured that kitchen exhaust fans vent directly to the outdoors.			
MA 12.2	With the occupants' permission, removed all unvented combustion space heaters that do not conform to local or state regulations.			
MA 12.3	Advised occupants to always consult and follow the manufacturers' printed instructions for proper operation and maintenance of unvented combustion appliances. Advised occupants that unvented space heaters should not be used in a manner that influences the thermostat controlling the primary heat source, thereby causing the space heater to operate in place of the primary heat source.			
MA 12.4	Ensured CO detection and warning equipment is installed and located according to NFPA 720 and any applicable local or state requirements.			

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13.0 Ozone from Indoor Sources				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 13.1	Determined whether any air-cleaning or purifying equipment designed to intentionally produce ozone (e.g., ozone generators) was present.			
MA 13.1	Did not install any air cleaning equipment designed to intentionally produce ozone. Recommended removal of existing air cleaning equipment designed to produce ozone intentionally, if present.			
14.0 Environmental Tobacco Smoke (ETS)				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 14.1	Determined whether the building has a smoke-free policy prohibiting smoking in common areas and residential dwelling units.			
AP 14.2	Determined whether the building has an exterior smoking policy that prohibits smoking within a specified distance (e.g., 10, 20 or 25 feet) of the building's operable windows, outdoor air intakes and entryways.			
AP 14.3	Identified whether there have been occupant complaints or concerns about smoking.			
AP 14.4	Assessed whether space compartmentalization is a possible ETS control strategy.			
MA 14.1	If there is a pattern of smoking-related complaints and the building has an interior and/or exterior smoke-free policy, discussed occupant education, signage and implementation methods with building owner and/or property manager. Reviewed the building smoking policies and revised as necessary.			
MA 14.2	If the building does not have interior and exterior smoke-free policies, took appropriate actions for ETS control, including (1) source control, (2) ventilation and air-pressure control, and (3) air sealing. Proposed developing and implementing indoor smoke-free and exterior smoking policies, as appropriate.			
EA 14.1	Pursued additional ETS control actions if there is a history of complaints and a smoke-free policy is not feasible.			
15.0 Wood Smoke and Other Solid Fuel Emissions				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 15.1	Determined whether there are wood- or coal-burning appliances in the building. If a building policy on wood- and coal-burning devices exists, reviewed it for compatibility with the Minimum Actions in this section.			
AP 15.2	Assessed what the proper size of any wood- or coal-burning appliances will be after the building upgrade is complete. If the current unit is oversized, recommended replacement with a properly sized, EPA-certified appliance.			

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15.0 Wood Smoke and Other Solid Fuel Emissions (continued)			
Assessment Protocol and Action Verification	Complete	N/A	NOTES
AP 15.3	If wood- or coal-burning appliances are present, determined whether there is evidence of wood smoke emissions affecting the building (e.g., evidence of soot on the walls or ceiling, creosote staining near the flue pipe, a strong odor of wood smoke within common areas or dwelling units).		
AP 15.4	Assessed wood- or coal-burning appliance safety, including appliance condition, proper distances of the appliance and flue from combustible materials, adequate floor protection, and proper venting of combustion by-products.		
AP 15.5	Determined whether any wood-burning appliances are EPA-certified.		
AP 15.6	Determined whether an outdoor wood- or coal-fired appliance is generating hydronic heat. If the wood- or coal-burning appliance is operating during the assessment, observed the opacity of the smoke leaving the chimney.		
MA 15.1	Corrected any problems identified during the assessments, and worked with a certified fireplace or chimney safety professional as needed. Any new appliances are properly sized and EPA-certified.		
MA 15.2	Encouraged the building owner or property manager to have a certified professional inspect and maintain the chimney and wood- or coal-burning appliance annually.		
MA 15.3	Shared EPA's Burn Wise Tips with the building owner or property manager.		
EA 15.1	Replaced non-certified wood- or coal-burning appliances with properly sized, EPA-certified appliances; or replaced them with heating equipment that does not burn solid fuels.		
16.0 Compartmentalization to Prevent Odor or Unwanted Air Transfer			
Assessment Protocol and Action Verification	Complete	N/A	NOTES
AP 16.1	Determined which areas or dwelling units in the building are likely to be sources of irritating pollutants or noxious odors or where unwanted air transfer occurs. To the extent possible, worked with building owner, property manager and occupants to identify IAQ concerns that arise from pollutant migration among dwelling units, common areas and commercial spaces.		
AP 16.2	Identified spaces in the building with strong pollutant sources that could be isolated using compartmentalization techniques. The intent is to limit uncontrolled airflow and cross contamination among spaces, achieved by air sealing and controlling pressure differences.		
MA 16.1	Minimized pollutant transfer between spaces by implementing: (1) source control, (2) ventilation and air pressure control, and (3) air sealing. Referred to MA 16.1 for detailed guidance.		
EA 16.1	Implemented expanded ventilation and air pressure control strategies to reduce contaminant transfer between spaces.		
EA 16.2	Implemented expanded air sealing to reduce contaminant transfer between spaces.		

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17.0 HVAC Equipment

Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 17.1	Conducted an HVAC assessment to evaluate the condition of existing HVAC systems and components in accordance with minimum inspection standards of ASHRAE/ACCA Standard 180 or other equivalent standards and guidelines.			
AP 17.2	Determined whether the existing HVAC systems are sized properly. If HVAC system replacements or modifications are anticipated, based heating/cooling load and equipment sizing calculations on post-upgrade conditions.			
MA 17.1	Repaired, modified or replaced equipment to ensure that existing HVAC systems operate properly.			
MA 17.2	Properly sized and installed any new HVAC equipment.			
MA 17.3	Ensured new HVAC systems for dwelling units have air filtration with a minimum MERV (minimum efficiency reporting value) 6 rating, and new HVAC systems for nonresidential spaces have air filtration with a minimum MERV 8 rating. For existing HVAC systems, checked with manufacturers to determine whether filters with these MERV ratings can be accommodated by the equipment and, if not, installed filters with the highest MERV ratings that can be accommodated.			
MA 17.4	Followed ASHRAE Standard 188-2015 or Occupational Safety and Health Administration (OSHA) Technical Manual, Section III: Chapter 7 Legionnaires' Disease to protect against bacterial growth in building water systems.			
MA 17.5	Trained building staff on operations and maintenance of the HVAC systems after the building upgrade.			
EA 17.1	Increased filter efficiencies in new and existing HVAC systems to the highest MERV ratings possible based on equipment capabilities.			
EA 17.2	Developed plans to conduct follow-up HVAC training with building operations and maintenance staff (e.g., 6 months or 1 year after the initial training).			

18.0 Mechanical Ventilation for Individual Dwelling Units

Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 18.1	Determined whether dwelling units have individual mechanical ventilation systems. For other outdoor air ventilation configurations, referred to Priority Issues 19.0 and 20.0 .			
AP 18.2	Determined whether dwelling unit mechanical ventilation systems meet ASHRAE Standard 62.2-2013 requirements.			
AP 18.3	Determined whether ventilation provided to corridors and nonresidential spaces, as applicable, meets the requirements of ASHRAE Standard 62.1-2013.			

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18.0 Mechanical Ventilation for Individual Dwelling Units (continued)				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 18.4	Identified the locations of outdoor air intakes for all ventilation systems and assessed their distances from outdoor pollutant sources.			
MA 18.1	Repaired or upgraded dwelling unit mechanical ventilation systems as needed to ensure proper operation and to meet the requirements of ASHRAE Standard 62.2-2013.			
MA 18.2	Repaired or upgraded ventilation systems serving corridors and nonresidential spaces, as applicable, to ensure proper operation and to meet the requirements of ASHRAE Standard 62.1-2013. If it is not possible to achieve the ASHRAE Standard 62.1-2013 minimum outdoor air ventilation rates, adjusted systems to provide the maximum amount of outdoor air ventilation possible.			
EA 18.1	Installed balanced ventilation systems with energy recovery in dwelling units.			
EA 18.2	For nonresidential spaces that are included in the scope of service, in locations where the ambient outdoor air exceeds national standards for particulate matter (PM _{2.5} , PM ₁₀) or ozone, ensured that the outdoor air filtration and air-cleaning requirements of ASHRAE Standard 189.1-2014 are met for mechanical ventilation systems.			
19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 19.1	Determined whether dwelling units are served by central mechanical exhaust ventilation systems. For other outdoor air ventilation configurations, referred to Priority Issues 18.0 and 20.0 .			
AP 19.2	Determined whether central mechanical exhaust ventilation systems meet ASHRAE Standard 62.2-2013 requirements in dwelling units.			
AP 19.3	Determined whether ventilation provided to corridors and nonresidential spaces, as applicable, meets the requirements of ASHRAE Standard 62.1-2013.			
AP 19.4	Identified the locations of outdoor air intakes for all ventilation systems and assessed their distances from outdoor pollutant sources.			
MA 19.1	Repaired or upgraded central mechanical exhaust ventilation systems as needed to ensure proper operation and to meet the requirements of ASHRAE Standard 62.2-2013 in dwelling units.			
MA 19.2	Repaired or upgraded ventilation systems serving corridors and nonresidential spaces, as applicable, to ensure proper operation and to meet the requirements of ASHRAE Standard 62.1-2013. If it is not possible to achieve the ASHRAE Standard 62.1-2013 minimum outdoor air ventilation rates, adjusted systems to provide the maximum amount of outdoor air ventilation possible.			

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19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust (continued)

Assessment Protocol and Action Verification		Complete	N/A	NOTES
EA 19.1	Air sealed the central exhaust system's ventilation shaft with a spray seal system (aerosol or fluid applied). Ensured that the ductwork sealing required under Minimum Actions (roof curb connections, lateral connections and connections behind exhaust grilles) was completed before air sealing the ventilation shaft.			
EA 19.2	For nonresidential spaces that are included in the scope of service, in locations where the ambient outdoor air exceeds national standards for particulate matter (PM _{2.5} , PM ₁₀) or ozone, ensured that the outdoor air filtration and air-cleaning requirements of ASHRAE Standard 189.1-2014 are met for mechanical ventilation systems.			

20.0 Natural (Not Fan-Powered) Ventilation

Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 20.1	Determined whether dwelling units are served by natural ventilation systems. For other outdoor air ventilation configurations, referred to Priority Issues 18.0 and 19.0 .			
AP 20.2	Determined whether the dwelling units and/or building meet the exceptions to the whole-building mechanical ventilation requirement in ASHRAE Standard 62.2-2013, Section 4.1.1.			
AP 20.3	Determined whether ventilation provided to corridors and nonresidential spaces, as applicable, meets the requirements of ASHRAE Standard 62.1-2013.			
AP 20.4	Identified the locations of outdoor air intakes for all ventilation systems and assessed their distances from outdoor pollutant sources.			
MA 20.1	Converted the natural ventilation system to a fan-powered system if the dwelling unit served by natural ventilation does not meet the exceptions to the whole-building mechanical ventilation requirement in ASHRAE Standard 62.2-2013.			
MA 20.2	Repaired or upgraded ventilation systems serving corridors and nonresidential spaces, as applicable, to ensure proper operation and to meet the requirements of ASHRAE Standard 62.1-2013. If it is not possible to achieve the ASHRAE Standard 62.1-2013 minimum outdoor air ventilation rates, adjusted systems to provide the maximum amount of outdoor air ventilation possible.			
EA 20.1	Included requirements for advanced passive ventilation systems. The ventilation rate for each dwelling unit must be sufficient to achieve the goal of an ASHRAE Standard 62.2-2013 mechanical ventilation rate (i.e., the annual average ventilation rate shall not be less than if a mechanical system was installed according to ASHRAE Standard 62.2-2013).			
EA 20.2	For nonresidential spaces that are included in the scope of service, in locations where the ambient outdoor air exceeds national standards for particulate matter (PM _{2.5} , PM ₁₀) or ozone, ensured that the outdoor air filtration and air-cleaning requirements of ASHRAE Standard 189.1-2014 are met for mechanical ventilation systems.			

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Expanded Action (EA)

21.0 Local Exhaust Ventilation

Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 21.1	Identified rooms or areas with localized contaminant sources that require exhaust ventilation.			
AP 21.2	Determined whether dwelling units have local exhaust ventilation in kitchens and bathrooms, and whether there is compliance with the requirements for kitchens and bathrooms in ASHRAE Standard 62.2-2013.			
AP 21.3	Determined whether clothes dryers exhaust directly to the outdoors. Inspected clothes dryer vents for restrictions and lint buildup.			
AP 21.4	Determined whether spaces outside dwelling units comply with exhaust requirements of ASHRAE Standard 62.1-2013, Table 6.5, as applicable. To the extent possible, included retail and other nonresidential spaces in the building.			
MA 21.1	Installed, repaired or replaced local exhaust ventilation in dwelling units to meet the requirements of ASHRAE Standard 62.2-2013 for kitchen and bathroom exhausts. Advised building management and occupants about the need to use exhaust fans in kitchens and bathrooms during activities that generate pollutants and moisture (e.g., cooking and showering).			
MA 21.2	Ensured that all clothes dryers exhaust directly to the outdoors and cannot be readily diverted indoors by occupants.			
MA 21.3	Installed, repaired or replaced exhaust ventilation in spaces outside dwelling units to meet the minimum exhaust rates specified in ASHRAE Standard 62.1-2013, Table 6.5. To the extent possible, worked with the building owner, property manager and other building tenants to include retail and other nonresidential spaces.			
MA 21.4	Followed the Minimum Actions under Priority Issue 16.0 Compartmentalization to enhance the effectiveness of exhaust ventilation and reduce odor migration and unwanted airflow from adjacent spaces.			
EA 21.1	Ensured kitchen and bath exhausts in dwelling units meet requirements of ASHRAE Standard 62.2-2013, without the need to use the Standard's alternative compliance path.			
EA 21.2	Used one or more strategies in bathrooms to control the use of local exhaust fans (e.g., an occupancy/ motion sensor, an automatic humidistat controller, an automatic timer to operate the fan for 20 minutes or more after an occupant leaves the room, or a continuously operating exhaust fan).			
EA 21.3	Installed additional local exhaust ventilation in spaces outside dwelling units with strong, localized pollutant sources.			
EA 21.4	Followed the Expanded Actions under Priority Issue 16.0 Compartmentalization to enhance the effectiveness of exhaust ventilation and reduce odor migration and unwanted airflow from adjacent spaces.			

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22.0 Building Safety for Occupants

Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 22.1	Documented safety hazards observed during the building IAQ walkthrough, energy audit or other inspections. Immediately informed the building owner and property manager of any urgent and life-threatening conditions.			
AP 22.2	Determined whether there are working smoke alarms and CO alarms installed in dwelling units and other locations in the building.			
AP 22.3	Identified products containing hazardous chemicals (e.g., strong cleaners, hazardous materials, pesticides) that are stored in accessible locations.			
AP 22.4	Checked whether there are working fire extinguishers in dwelling units and appropriate common areas. Worked with the building owner or property manager to assess whether fire extinguisher placement meets applicable codes.			
AP 22.5	Determined whether the water heater temperature settings are within the allowable limits of the local and state codes.			
AP 22.6	Assessed whether knob-and-tube electrical wiring is present in the building and whether it is located in areas impacted by the building upgrades.			
MA 22.1	Immediately corrected urgent and life-threatening safety risks. Corrected other safety hazards during the building upgrade activities.			
MA 22.2	Replaced non-functioning smoke and CO alarms. If smoke alarms or CO alarms were not present, installed new alarms consistent with local code requirements; if local code requirements do not exist, installed smoke alarms and CO alarms in every dwelling unit consistent with Consumer Product Safety Commission (CPSC) guidance and located according to NFPA 720.			
MA 22.3	Recommended appropriate storage of hazardous chemicals.			
MA 22.4	Worked with the building owner or property manager to ensure there are fire extinguishers installed according to applicable code requirements.			
MA 22.5	Ensured that water heater set points do not exceed allowable limits of local and state codes. Otherwise, ensured that water heater set points do not exceed 120°F to prevent scalding.			
MA 22.6	Followed precautions in U.S. Department of Energy (DOE) Standard Work Specifications for Single-Family Home Energy Upgrades for knob-and-tube electrical wiring (e.g., live knob-and-tube wiring shall not be covered or surrounded, and exposed knobandtube wiring shall be replaced with new appropriate wiring, as required by the National Electrical Code or authority having jurisdiction).			
EA 22.1	Installed CO alarms that can detect and store peak CO levels of less than 30 parts per million in dwelling units.			

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22.0 Building Safety for Occupants (continued)				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
EA 22.2	Installed fall prevention measures.			
EA 22.3	Installed light switches at the top and bottom of all stairwells.			
EA 22.4	Installed safety lighting on or near steps.			
EA 22.5	Repaired malfunctioning doors, windows, roofs and floors.			
EA 22.6	Qualified personnel ensured the safety of electrical systems by confirming they are in conformance with applicable codes.			
23.0 Protecting IAQ During Construction				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 23.1	Determined building occupancy patterns during expected construction periods, and identified any special needs of the building occupants.			
AP 23.2	Identified potential construction-related contaminants and the pathways through which they could impact the IAQ experienced by building occupants.			
AP 23.3	Identified the extent to which mercury exposure is a risk during the building upgrade (e.g., if the upgrade involves installing or replacing mercury-containing products such as thermostats, thermometers, fluorescent lamps and compact fluorescent lamp [CFL] bulbs).			
MA 23.1	Minimized occupant and worker exposures during construction (e.g., adhered to Sheet Metal and Air Conditioning Contractors' National Association [SMACNA] Indoor Air Quality Guidelines for Occupied Buildings Under Construction). Properly isolated work areas from occupants. Contained construction contaminants. Thoroughly cleaned work areas prior to re-entry of occupants. Promptly responded to any occupant complaints or concerns.			
MA 23.2	Protected HVAC systems from contaminants during work activities, performed post-construction inspections. Cleaned to remove dust and debris from ductwork, as needed. Ensured new HVAC filters were installed prior to occupancy.			
MA 23.3	If mercury is identified, determined whether the building has a mercury spill response plan. Provided guidance to the property manager and occupants on how to perform proper clean up following EPA guidance. Used caution not to break mercury-containing materials during upgrade activities. Properly disposed of fluorescent lighting and CFL bulbs.			
MA 23.4	Protected highly absorptive materials from airborne contaminants and emissions caused by construction.			

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23.0 Protecting IAQ During Construction (continued)				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
MA 23.5	Employed safe work practices to avoid exposure to SPF insulation. Followed manufacturers' printed instructions for vacating building occupants, and other unprotected individuals not involved in the application of the spray polyurethane foam (SPF) products, from the premises during and for some period after SPF application.			
EA 23.1	Considered and implemented additional protections as appropriate and necessary to protect the health and safety of building occupants.			
EA 23.2	Replaced mercury-containing products and devices with products that do not contain mercury, excluding fluorescent lights and CFL bulbs.			
24.0 Jobsite Safety				
Assessment Protocol and Action Verification		Complete	N/A	NOTES
AP 24.1	Evaluated worker health and safety concerns that could be encountered during the building upgrade. Referred to Appendix A: Worker Protection for recommended evaluation measures and actions.			
MA 24.1	Referred to Appendix A: Worker Protection for recommended actions to protect worker health and safety, and available resources.			

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