

# Energy Savings Plus Health

## Indoor Air Quality Guidelines for Single-Family Renovations





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# Section 1: Introduction



## PURPOSE AND SCOPE

### Goal

Millions of American homes will be retrofitted in the coming years to improve their energy efficiency, repair or add building features, or make them “greener.” Integrated healthy home and energy-efficiency retrofit activities can simultaneously lower utility costs and improve indoor air quality (IAQ). Leading energy-efficiency retrofit programs have demonstrated the feasibility of integrating many IAQ and safety improvements. Home energy retrofit activities might negatively affect IAQ, however, if the appropriate home assessment is not made before work begins and issues that may affect IAQ are not identified and properly addressed. The U.S. Environmental Protection Agency (EPA) developed the ***Energy Savings Plus Health: Indoor Air Quality Guidelines for Single-Family Renovations*** to provide practical guidance on improving or maintaining indoor environmental quality during home energy upgrades or renovations that include energy efficiency.

### Single-Family Housing Focus

These protocols apply to existing single-family homes. EPA has a related document for multifamily buildings. Both documents provide guidance for conducting home assessments and undertaking the responses necessary to maintain or improve IAQ and safety. The protocols also can help improve the quality of home weatherization projects and other energy-efficiency retrofit or remodeling jobs, thus reducing failures and repeat service calls.

### Intended Audience

These protocols are intended for use by the home energy retrofit industry—including energy-efficiency retrofit and housing rehabilitation professionals and contractors—and others engaged in energy-focused residential retrofit, renovation or remodeling efforts. They also are intended for voluntary adoption by federal, state, tribal and local weatherization assistance programs; federally funded housing renovation programs; industry standards organizations; private-sector home performance contracting organizations; and public and environmental health professionals.

Programs and contractors undertaking energy retrofit and renovation projects are encouraged to coordinate their services with local health and housing resources to provide families 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 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 always must be taken to ensure that these activities do not cause improper venting of combustion appliances and increase occupant exposure to combustion byproducts, including carbon monoxide; introduce or increase indoor exposures to other pollutants; or introduce or exacerbate moisture and mold problems within the building.

## HOW THIS GUIDE IS ORGANIZED

This document is organized by Priority Issue to highlight important indoor environment issues that may relate to home renovations. Each Priority Issue has an introduction that provides brief background on why it should be considered during a project as it relates to health. Each Priority Issue also includes a recommended assessment protocol, along with a set of potential actions (minimum or expanded) to be taken during the retrofit project, as described below.

1. **Assessment Protocols (AP)** are EPA-recommended or EPA-required protocols for evaluating existing conditions of concern and the potential for additional concerns that may arise from retrofit activities.
2. **Minimum Actions (MA)** include critical actions that home energy retrofit contractors should take to help ensure that their work does not introduce new IAQ concerns or make existing conditions worse.
3. **Expanded Actions (EA)** include additional actions to promote healthy indoor environments that can be taken during many home energy retrofit projects, if budget and resources allow.

National standards and guidance documents related to these guidelines are listed at the end of each Priority Issue in an abbreviated format that can be identified with more detailed information in the [References Section](#). However, work should be conducted in compliance with state and local requirements as well. All equipment removals should include proper disposal, so that hazardous units are not reinstalled or used elsewhere.

### The icons used in these protocols are listed as follows:



Worker Protection

Indicates an issue where worker safety is a primary concern. See [Appendix A: Worker Protection](#) for information on assessing the risks to workers, recommended actions to minimize risks to workers' health and safety, and additional resources.



Client Education

Indicates an issue where occupant education is especially important. If the icon appears in a Priority Issue section, appropriate occupant education on health and safety is strongly recommended as part of the retrofit activities. See [Appendix B: Client Education](#) for recommended occupant health messages and additional resources.



# Section 2: Assessment Protocols and Recommended Actions





# CONTAMINANTS<sup>1</sup> AND SOURCES

## PRIORITY ISSUE 1.0: ASBESTOS

Asbestos is a mineral fiber that was used in a variety of building construction materials for insulation and as a fire retardant. Asbestos-containing material (ACM), such as insulation, may be found in attics, within walls and on heating systems (e.g., on boilers and hot water/steam pipes). Asbestos also was used in floor tiles, wallboard and other building materials. When materials containing asbestos are disturbed or damaged, fibers and particles can be released into the air, where they can be inhaled, increasing the risk of developing such lung diseases as asbestosis (lung scarring), lung cancer and mesothelioma (a cancer of the abdominal lining).



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## ASSESSMENT PROTOCOLS

### AP 1.1 Determine Potential Asbestos Hazard

Consider the age of the structure. In particular, homes built between the 1930s and 1970s are more likely to have asbestos-containing building material.

Possible sources of asbestos include, but are not limited to, the following:

- Attic insulation (especially vermiculite)
- Wall insulation (e.g., vermiculite, insulation blocks)
- Insulation on hot water/steam pipes, boilers and furnace ducts
- Vinyl flooring (including 9 × 9-inch or 12 × 12-inch floor tiles, vinyl sheet flooring, and 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
- Door gaskets in furnaces and wood- or coal-burning appliances (seals may contain asbestos)
- Soundproofing or decorative surface materials sprayed on walls or ceilings, including popcorn ceilings
- Patching and 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) heating, ventilating and air conditioning (HVAC) ducts, combustion vent or transite flue
- Original plaster



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<sup>1</sup> Contaminants are listed alphabetically and are not in order of importance or prioritized in any other way.



If unsure whether the material in question contains asbestos, contact a qualified asbestos professional to assess the material before performing retrofits or any renovations.

## Notes

- The [EPA vermiculite guidance](#) referenced in the Relevant Standards or Guidance on page 10 includes photos to help identify vermiculite insulation.
- Expanded perlite, another mineral product often used in building materials that is not known to contain asbestos, can be mistaken for vermiculite.
- Although perlite is generally white in color, compared with the gray-to-brown coloring of vermiculite, visual identification can be difficult because of natural variations of the material.
- If you are unsure whether the material in question is vermiculite or perlite, contact a qualified asbestos professional for assistance.

## MINIMUM ACTIONS

### MA 1.1 Avoid Disturbance

If suspected ACM is undamaged and does not need to be disturbed as part of the retrofit activity, do not disturb it.

### MA 1.2 ACM-Damaged Material

If suspected ACM is damaged (e.g., unraveling, fraying, breaking apart), immediately isolate the area(s). For example, separate the work area in question from occupied portions of the building using appropriate containment practices AND do not disturb. For suspected ACM that is damaged or that must be disturbed as part of the retrofit activity, contact an asbestos professional for abatement or repair, in accordance with federal, state and local requirements. EPA recommends using only a licensed or trained professional to abate, repair or remove ACM in homes. To find a trained and accredited asbestos professional, check the list for your State Asbestos Contacts

Typically, trained professionals can repair asbestos by doing one of the following:

- Sealing or encapsulating—Treating the material with a sealant that either binds the asbestos fibers together or coats the material so that fibers are not released. Pipe, furnace and boiler insulation often can be repaired this way.



- Covering or enclosing—Placing a protective layer over OR around the ACM to prevent the release of fibers or covering exposed insulated piping with a protective wrap or jacket.
- Removing—Removing ACM is recommended when remodeling OR making major changes to a home that will disturb ACM or if ACM is damaged extensively and cannot be repaired otherwise (by covering, enclosing, sealing or encapsulating).

### MA 1.3 Work Practices to Avoid

When working around ACM—

- Do not dust, sweep or vacuum ACM debris.
- Do not saw, sand, scrape or drill holes in the material.
- Do not use abrasive pads or brushes to strip materials.
- Do not track material that could contain asbestos through the house. Dust, sweep or vacuum ACM debris.

Do not remove or disturb insulation that looks like vermiculite (e.g., attic or wall insulation). Testing may be performed to confirm whether vermiculite contains asbestos. Insulation materials throughout the home may have been sourced from different locations, however, and obtaining a representative sample from all building cavities with vermiculite may be impractical. As such, you should assume that they contain asbestos and manage accordingly. Hire a professional asbestos contractor if planned renovations would disturb vermiculite in attics or walls to make sure that the material is handled and/or removed safely.

Any asbestos abatement or repair work should be completed before blower door 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). Do not conduct air leakage tests (e.g., duct blaster tests) on ductwork that contains asbestos insulation.

### Notes

- Appropriate identification of ACM or awareness that it is likely present 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 retrofit, use a qualified and trained person to conduct an initial exposure assessment to determine potential worker exposures and required exposure controls.
- Asbestos awareness training is recommended for retrofit workers, especially auditors and crew chiefs.



## Relevant Standards or Guidance

- Find Laboratories for Testing Asbestos: [EPA Asbestos Professionals](#)
- The National Institute of Standards and Technology (NIST) maintains a list of asbestos laboratories accredited under the National Voluntary Laboratory Accreditation Program: Call NIST at (301) 975-4016 or email [nvlap@nist.gov](mailto:nvlap@nist.gov).
- ASTM (formerly known as American Society for Testing and Materials) E2600
- [Building Performance Institute \(BPI\) Technical Standards: Technical Standards for the Heating Professional](#)
- [U.S. Department of Labor \(DOL\), Occupational Safety and Health Administration \(OSHA\), 29 Code of Federal Regulations \(CFR\) Part 1926, Subpart Z](#)
- [DOL, OSHA, Asbestos](#)
- [DOL, OSHA, Asbestos—Construction](#)
- [EPA Asbestos](#)



If working in a pre-1980 building, see [Appendix A: Worker Protection](#) (Asbestos and Confined Spaces)

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## EXPANDED ACTIONS

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## **PRIORITY ISSUE 2.0:** **BELOWGROUND CONTAMINANTS (EXCEPT RADON)**

Belowground contaminants—organic and inorganic chemicals in soil or ground water—can result from a variety of intended, accidental or naturally occurring activities and events, such as manufacturing, mineral extraction, waste disposal, accidental spills, illegal dumping, leaking underground storage tanks, hurricanes, floods, pesticide use and fertilizer application. Some belowground contaminants can enter buildings through structural holes and cracks and cause health problems for some occupants. Contaminant sources in soil gas may include former industrial sites, local pesticide applications, spills, nearby dry cleaners or leaking landfills, and abandoned or leaking gasoline or fuel storage tanks. There are many potential belowground contaminants with many possible health effects.

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### **ASSESSMENT PROTOCOLS**

#### **AP 2.1 Evaluate Sources**

Visually evaluate potential sources AND check for odors of gasoline, sewer gas or fuel oil. Pay particular attention to ground-contact spaces and areas with drain, waste and vent piping. Inquire about occupant complaints of odors that might originate from the sewer system or beneath the building. If you detect an odor but cannot identify its source and the house is in a known contaminated area, such as a Brownfield or another Land Revitalization project, notify local or state authorities AND/OR pursue additional assessment from a qualified professional before making additional energy upgrades. See the relevant standards and guidance at the end of this section for more information on Brownfields and Land Revitalization activities near you.

Soil or ground water contamination on or near the building site could contain volatile contaminants or breakdown products that may pose an IAQ risk through soil gas intrusion. If this is suspected, EPA recommends further assessment before air sealing. Consult your state or tribal voluntary Brownfield cleanup program OR environmental regulatory agency for information on the risks of vapor intrusion in your area.

#### **Note**

A records search of the property and surrounding areas may provide information regarding past uses and spill reports.

**AP 2.2 Evaluate the Sewer Vent System**

Visually evaluate the integrity of the sewer vent system (e.g., ensure that drain traps have water in them, inspect drain lines for breaks or leaks, check for blockages), particularly if there is the odor of sewer gas in the home (e.g., during the initial assessment or a fan depressurization test).

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**MINIMUM ACTIONS****MA 2.1 Correct Sewer Vent System Problems**

Repair or replace failed or unattached sewer vent system components before proceeding with energy retrofits or renovation. If the assessments reveal sewer gas odors from drain traps that are dry because of infrequent use, fill the traps with a nontoxic liquid that has a slow evaporation rate (e.g., mineral oil).

Because of their continuous usage, drain traps in sinks and toilets are seldom a problem. Floor drains in an obscure location, such as a mechanical room or a maintenance closet, can dry out. 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.

**MA 2.2 Mitigate Soil Gas Vapor Intrusion**

If soil gas vapor intrusion is identified in the assessment, mitigate in compliance with state or local standards. If there are no such standards, follow EPA guidance below for vapor intrusion evaluation and mitigation.

**Note**

The causes or sources of contaminants must be identified and corrected before air sealing or other building upgrade actions are performed to ensure that the problem is not exacerbated.

## EXPANDED ACTIONS

### EA 2.1 Consider a Floor Drain Seal

If there is an untrapped floor drain, consider installing an inline floor drain seal similar to those often used during radon mitigations.

### EA 2.2 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.

### EA 2.3 Prevent Entry of Soil Gases From Brownfields Sites

Projects located on Brownfields sites (as classified by a federal, state, tribal 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 American Society of Heating, Refrigerating and Air-Conditioning Engineers' (ASHRAE) [\*Indoor Air Quality Guide, Best Practices for Design, Construction, and Commissioning\*](#), Strategy 3.4.

## Relevant Standards or Guidance

- [ASHRAE Indoor Air Quality Guide](#)
- American Society of Plumbing Engineers (ASPE) Databook
- ASTM E2121
- [EPA Brownfields and Land Revitalization Projects Near You](#)

Follow the guidance in these documents while complying with state and local standards:

- ASTM E2600
- [EPA Office of Land and Emergency Management](#) (OLEM), formerly known as the EPA Office of Solid Waste and Emergency Response (OSWER)
- [EPA Vapor Intrusion Mitigation Approaches](#)

## PRIORITY ISSUE 3.0: BUILDING PRODUCTS/MATERIAL EMISSIONS



Potentially important sources of IAQ contaminants are interior building materials, furniture and equipment. Interior building materials—including carpets, carpet padding, paints, sealants and caulking, adhesives, floor and ceiling tiles, cabinets, molding, composite wood products, and other woodwork—can contain contaminants that are gradually emitted (off-gassed) throughout the life of the material. The contaminants include volatile and semivolatile organic compounds (VOCs and SVOCs, respectively) and small particulate substances that act as eye or throat irritants.

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### ASSESSMENT PROTOCOLS

#### **AP 3.1 Assess Product Choices**

Review information on the chemical content and emissions of the products that are being considered for purchase and installation during an upgrade project of a building to determine whether they contain potentially hazardous compounds. Many of these products and materials (e.g., paints, particle board, pressed wood, insulation, sealants, plywood, cleaning supplies) may contain VOCs, including formaldehyde, and/or other hazardous compounds to which exposure should be minimized or eliminated during and after an upgrade project.

#### **AP 3.2 Carpet**

Identify carpeting in areas prone to wetting or moisture problems, as well as carpeting that is old and may have adsorbed chemical, particle and microbiological contaminants that could be released back into the air.

#### **AP 3.3 Ventilation**

Assess ventilation to determine compliance with the Minimum Actions and [Priority Issue 17.0: Whole-Dwelling Ventilation for Distributed Contaminant Sources](#).



## Notes

Dilution using whole-house ventilation will help reduce VOCs and other airborne contaminants from indoor sources in most homes.

In most circumstances, testing for VOCs is not necessary. If odors or occupant complaints indicate potential VOCs or other airborne contaminants, follow the source control and ventilation actions under Minimum Actions and Expanded Actions.

If working with materials associated with chemical emissions or dust generation, including spray polyurethane foam insulation, see [Priority Issue 20.0: Jobsite Safety](#) and [Appendix A: Worker Protection](#).



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## MINIMUM ACTIONS

### MA 3.1 Minimize Occupant and Worker Exposure to VOCs or Other Airborne Contaminants

- Use appropriate dust-control and protective equipment, ensure the proper isolation (e.g., by sealing with plastic sheeting) and exhaust ventilation to the outdoors of work areas during activities that result in VOC emissions (e.g., installing spray foam insulation, painting, sealing, finishing) AND ventilate as close as possible to the source of contaminant emissions.
- Thoroughly clean work areas and allow odors to dissipate before re-occupancy.
- After the use of a product, building occupants and other unprotected individuals may need to be evacuated from work areas for some period of time, per the manufacturer's recommendations.

### MA 3.2 Remove Contaminated Building Materials

Using appropriate personal protective equipment (PPE), remove contaminated building materials found during the assessment that cannot be salvaged. These materials should be double bagged in 6-millimeter or thicker polyethylene bags. The bagged materials usually can be discarded as ordinary construction waste. Packaging mold-contaminated materials in sealed bags before removing them from the containment area is important to minimize the spread of mold spores throughout the building. Large items that have heavy mold growth should be covered with polyethylene sheeting and sealed with duct tape before being removed from the containment area.

### MA 3.3 New Products Source Control

When installing new materials, consider using the least toxic product or material that is feasible to effectively do the job.

- **Paints:** Use products that meet VOC content limits for their respective category and VOC content limits for any colorants added to the final product in accordance with South Coast Air Quality Management District (SCAQMD) “Rule 1113 – Architectural Coatings, Amended February 5, 2016.”
- **Flooring:** Use products that, when tested, meet the California Department of Public Health (CDPH) Standard Method V1.2-2017 for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers, the VOC emission-testing method for California Specification 01350. Examples of green-label programs consistent with the standard method are listed below by flooring type.
  - **Carpet:** Carpet and Rug Institute (CRI) Green Label Plus; GREENGUARD
  - **Smooth and Resilient Flooring:** FloorScore®, GREENGUARD Gold, Scientific Certification Systems (SCS) Indoor Air Advantage
  - **Adhesives:** Use mechanical or peel-and-stick products. Other products should meet SCAQMD Rule 1168 VOC content limits.
  - **Composite Wood:** Use materials compliant with Toxic Substances Control Act of 1976 (TSCA) Title VI or California 93120 Phase 2 requirements. Beginning June 1, 2018, composite wood products sold, supplied, offered for sale, manufactured or imported in the United States are required to be labeled as California Air Resources Board (CARB) Airborne Toxic Control Measures (ATCM) Phase II or TSCA Title VI compliant. Beginning on March 22, 2019, composite wood products must be labeled as TSCA Title VI compliant. These products include hardwood plywood, medium-density fiberboard and particle board, as well as household and other finished goods containing these products.

See [Priority Issue 17.0: Whole-Dwelling Ventilation for Distributed Contaminant Sources](#).

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## EXPANDED ACTIONS

### EA 3.1 Hard Surface Flooring

Remove carpeting or other fleecy material, identified during the assessment, that is old or in areas prone to wetting or moisture problems and install only water-resistant hard-surface flooring. Areas prone to wetting include, but are not limited to, kitchens, bathrooms, entryways, laundry areas and utility rooms.

### EA 3.2 New Products Source Control Expanded

When available, choose products and materials that meet stricter independent certification and testing protocols, such as—

- **Paints:** Use products that have (1) VOC emissions compliant with the CDPH Standard Method V1.2–2017 AND (2) VOC content meeting SCAQMD Rule 1113. Master Painters Institute (MPI) Green Performance Standards Extreme Green and Green Wise Gold are consistent with these VOC content and emission standards.
- Use paints that do not contain nonylphenol ethoxylate (NPE). (See Health Product Declarations [HPDs] to identify NPE-free products.)

### EA 3.3 Existing Condition Source Control/Supplemental Ventilation

If odors, complaints or testing indicate potential VOCs or other airborne contaminants, remove any potential sources (e.g., hobby 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 isolated in a specific room or area.

### EA 3.4 Added Precautions

To reduce VOCs, including formaldehyde and emissions from composite wood products (e.g., particle board, pressed wood), minimize the edges and seal accessible surfaces, including cut edges and holes, especially those of materials manufactured prior to June 2018 (when federal regulations required formaldehyde emission compliance with TSCA Title VI). Use sealants intended to reduce VOC emissions. If these actions do not solve existing problems (e.g., persistent odors, occupant complaints), hiring an environmental professional may be necessary.

**EA 3.5 Testing**

If VOCs appear to be present based on odors or complaints and source control or ventilation do not alleviate the problem, testing by a qualified professional may be useful.

**Relevant Standards or Guidance**

- [American Chemistry Council: Spray Polyurethane Foam Health and Safety](#)
- [CDPH: Standard Method for Testing and Evaluation of VOC Emissions from Indoor Sources—Emission Testing Method for California Specification 01350](#)
- [Carpet and Rug Institute: Green Label Plus](#)
- [EPA Formaldehyde Emission Standards for Composite Wood Products TSCA Title VI](#)
- [EPA Safer Choice](#)
- EPA SPF: Quick Safety Tips for Spray Polyurethane Foam Users
- [FloorScore®](#)
- [Green Seal 11](#)
- Green Wise Gold
- [GREENGUARD Gold](#)
- [Health Product Declarations \(HPDs\)](#)
- [Master Painters Institute \(MPI\)](#)
- SCAQMD, Rule 1113
- SCAQMD, Rule 1168
- SCS Indoor Air Advantage



## **PRIORITY ISSUE 4.0:**

### **CARBON MONOXIDE AND OTHER COMBUSTION APPLIANCE EMISSIONS (NITROGEN OXIDES, VOCs AND PARTICULATES)**

Carbon monoxide (CO) is a colorless, odorless and toxic gas that can be produced by poorly functioning combustion equipment. Exposure can result in death or, at lower levels, headaches, fatigue and flu-like symptoms. Other combustion emissions that can increase respiratory risks include, but are not limited to, VOCs, particulates and nitrogen oxides.



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## **ASSESSMENT PROTOCOLS**

### **AP 4.1 Conduct Assessment of CO Sources**

- Determine whether the home has combustion appliances or equipment or an attached garage. Identify any fuel-burning combustion appliances in the home (e.g., gas, oil, kerosene, wood- or coal-burning appliances).
- Determine whether there are working CO alarms.
- Ask occupants whether they have supplemental portable combustion equipment (e.g., generators, unvented gas or kerosene space heaters).
- Inquire about occupant complaints of odors or health effects that might be attributable to improperly operating combustion equipment.



### **AP 4.2 Ambient CO Testing**

- Test the interior living space for CO following procedures outlined in BPI-1200-S, but avoid testing near combustion equipment that already has undergone CO testing.
- Test for CO outside of the home (e.g., near front entrance) to document general outdoor levels, but avoid testing near obvious sources of CO (e.g., motor vehicles, lawn equipment).

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## **MINIMUM ACTIONS**

### **MA 4.1 CO Alarms**

- Specify and install CO alarms in all homes. See [Priority Issue 18.0: Home Safety](#) for details.



**MA 4.2 Correct Sources**

- If CO levels in interior living spaces exceed outdoor levels, investigate potential sources and take appropriate action to reduce them (e.g., have a qualified professional tune, repair or replace improperly operating combustion appliances; apply weatherstripping or air sealing between the garage and the home).
- Information on preventing and/or minimizing CO exposures in occupied living spaces can be found in [Priority Issue 6.0: Garage Air Pollutants](#), [Priority Issue 12.0: Wood Smoke and Other Solid Fuel Emissions](#), [Priority Issue 13.0: Heating, Ventilating and Air Conditioning \(HVAC\) Equipment](#), and [Priority Issue 14.0: Combustion Safety, Vented Combustion Appliances](#).

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**EXPANDED ACTIONS**

See [Appendix B: Client Education](#) for recommended installation of CO alarms that can detect and store peak CO levels of less than 30 parts per million.

**Relevant Standards or Guidance**

- BPI-1100-T-2014

## **PRIORITY ISSUE 5.0:** ENVIRONMENTAL TOBACCO SMOKE

Environmental tobacco smoke (ETS) exposure increases the risks of lung cancer, heart disease, stroke, more frequent and severe asthma attacks, sudden infant death syndrome, and other health issues.



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### **ASSESSMENT PROTOCOLS**

#### **AP 5.1 Look for Signs of Smoking Indoors**

Signs can include, but are not limited to, ashtrays, cigarette packs and odors.

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### **MINIMUM ACTIONS**

#### **MA 5.1 Encourage Occupants Not to Smoke in the Home**

See [Appendix B: Client Education](#).



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### **EXPANDED ACTIONS**

#### **EA 5.1 Smoke-Free Policies in Rental Buildings**

See the companion guide on multifamily protocols for information on ETS, including smoke-free policies and strategies to minimize the movement of smoke between units.

## Relevant Standards or Guidance

- [Air Barrier Association of America: Air Barrier Materials, Components, Assemblies & Systems](#)
- [ASHRAE Standard 62.2-2019: Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings](#)
- [ASHRAE Standard 189.1-2017: Standard for the Design of High-Performance Green Buildings](#)
- [ASTM E779-19: Standard Test Method for Determining Air Leakage Rate by Fan Pressurization](#)
- [ASTM E1186-17 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](#)
- [U.S. Department of Housing and Urban Development \(HUD\): Smoke Free Housing: A Toolkit for Owners/Management Agents](#)
- [Minnesota Center for Energy and Environment: Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments](#)
- [National Center for Healthy Housing \(NCHH\): 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](#)
- [Public Health Advocacy Institute: Public Health Advocacy Institute Smoke-Free Homes](#)
- [Underwriters Laboratories \(UL\): Technical Resources](#)



## **PRIORITY ISSUE 6.0:** GARAGE AIR POLLUTANTS (CO, BENZENE AND OTHER VOCs)

Garage air pollutants (e.g., benzene, VOCs, CO) may be generated by car emissions and stored household products and, when inhaled, can increase risks of respiratory tract irritation, nervous system damage and cancer.



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### **ASSESSMENT PROTOCOLS**

#### **AP 6.1 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.

#### **AP 6.2 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).

#### **AP 6.3 Locate Air Leaks**

Using ASTM E1186-17, identify the location of any air leaks from the garage to the occupied spaces that may provide pathways for hazardous emissions to enter the occupied spaces. Look for leaks around walls, doors, ceilings, ductwork, air conditioners, furnaces, chimneys, and electrical and pipe penetrations.

#### **AP 6.4 Identify Combustion Appliances or Hobby Equipment**

Determine whether there are unvented combustion appliances or hobby equipment that may be used in the garage.

#### **AP 6.5 Occupant Complaints**

Inquire about occupant complaints of odors that might originate from the garage.

#### **Note**

If combustion appliances are present, see [Priority Issue 4.0: Carbon Monoxide and Other Combustion Appliance Emissions](#), [Priority Issue 14.0: Combustion Safety for Vented Combustion Appliances](#) and [Priority Issue 15.0: Combustion Safety for Unvented Combustion Appliances](#) for recommended actions.

## MINIMUM ACTIONS

### MA 6.1 Eliminate or Minimize Unwanted Air Transfer to Dwelling via Mechanical Equipment and Ductwork

Do not install in a garage new HVAC equipment or ductwork that serves occupied spaces. Do the following for existing air-handling equipment and ductwork that serves occupied spaces and is located in a garage:

- 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 with 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.

#### Note

This may have an impact on your HVAC system's performance. An HVAC professional should ensure proper function.

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 applicable codes.



### MA 6.2 Compartmentalize Garage From Occupied Spaces

To minimize the movement of air and contaminants from the attached garage to the house, air seal walls and ceilings separating the garage from the living spaces.

At a minimum, air seal these locations (if present):

- Doors (ensure tight closure AND install weatherstripping)
- Electrical, plumbing and duct penetrations
- Cracks between mud sill, rim joists, subfloors and/or bottom of gypsum board
- Leaks in the ductwork and air handlers and gaps around the ductwork penetrating from the garage to the occupied space

If heat is needed in the garage, use a properly installed supplemental heating system.

## EXPANDED ACTIONS

### EA 6.1 Minimize Pollutants Entering Home

Take steps to reduce air pressure in the garage and minimize flow from the garage to the house.

- If occupants spend significant time in the garage (e.g., the garage is used as a workshop or playroom) or HVAC equipment is located in the garage, install local exhaust fan(s) rated for continuous operation and vented outdoors in attached garages, in accordance with section 5.6 of [EPA's Indoor airPLUS Construction Specifications](#) or [2018 International Mechanical Code](#) (Table 403.3).
- Relocate the air-handling equipment and associated ductwork from the garage to an area within a conditioned space.
- If accessible, add blocking to the floor system to help air seal the space between the garage and living space in homes that have a room above the garage.
- Use blower door techniques (see guidance listed below) to identify air-leakage pathways between the house and the garage and to verify the effectiveness of air sealing.

### Relevant Standards or Guidance

- Air Conditioning Contractors of America (ACCA) 5 QI-2010
- [ASHRAE 62.2-2019](#)
- [EPA Indoor airPLUS Specification 5.6](#)
- [Home Energy, Blower Door Techniques](#)
- [2018 International Mechanical Code](#)

See other sections:

- [Priority Issue 4.0: Carbon Monoxide and Other Combustion Appliance Emissions](#)
- [Priority Issue 14.0: Combustion Safety for Vented Combustion Appliances](#)
- [Priority Issue 15.0: Combustion Safety for Unvented Combustion Appliances](#)



## PRIORITY ISSUE 7.0: LEAD

Lead exposure can result in neurological damage, decreases in IQ, learning difficulties, slowed growth and, in rare cases, death. Children and pregnant women are at greatest risk. Exposure sources include peeling, flaking lead-based paint and lead in household dust, soil and water.

### Note

EPA's Lead Renovation, Repair and Painting (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 training providers accredited by EPA or an authorized state program, and follow specific lead-safe work practices. There are a few exemptions from the RRP Rule for natural disaster recovery. If you believe you might be eligible for this exemption or for more information go to [EPA's website for renovations after a disaster and dealing with lead-based paint](#).

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## ASSESSMENT PROTOCOLS

### AP 7.1 Assess Paint Conditions

Assume that there is lead-based paint in homes built before 1978, unless testing shows otherwise. Determine whether paint will be disturbed by the work or the assessment. Identify peeling, bubbled or worn paint, which could contain lead. Identify old painted cribs, old painted furniture and/or vinyl blinds because these items may contain lead.

### AP 7.2 Testing Method

Hire a contractor certified by EPA or an authorized state program to test all components that will be disturbed to determine whether lead-based paint is present. Paint testing can be accomplished using EPA-recognized test kits (available in hardware stores), paint chip sampling or X-ray fluorescence (XRF) analysis. Check local requirements, because some states do not allow paint testing using test kits. The minimum and expanded actions of lead-safe work practices apply only to paint that is assumed or confirmed to contain lead.

**Note**

Testing performed by uncertified people, including property owners or property managers, is not sufficient. To learn more about EPA-recognized test kits, visit the EPA [Lead Test Kits](#) web page.

**MINIMUM ACTIONS****MA 7.1 Comply With EPA's Lead-Based Paint RRP Program Rule**

The rule's key instructions are to—

- Use a certified firm.
- Follow lead-safe work practices if disturbing more than 6 square feet (ft<sup>2</sup>) per room of interior or 20 ft<sup>2</sup> of exterior painted surfaces. These minimum surface areas do not apply to window replacement, use of prohibited practices or demolition.
- Contain the work area to avoid resident exposure.
- Minimize lead dust and leave no dust or debris behind.
- Achieve visual post-cleaning criteria.

**MA 7.2 Comply With State and Local Lead-Related Regulations**

Such regulations may be applicable to lead hazard reduction activities and may require additional certified personnel.

**Note**

This is not a complete summary of the regulatory requirements. The intent of this protocol is to provide information regarding regulatory requirements and promote the most health-protective steps that are feasible and practical. The minimum action recommended in this protocol 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.

## EXPANDED ACTIONS

### EA 7.1 Follow HUD's Lead-Safe Rehabilitation Work Practices

Follow the HUD lead-safe rehabilitation practices. In addition to EPA's RRP Rule, the following HUD practices are recommended:

- Do not allow the use of test kits to identify lead-based paint. Acceptable test methods are laboratory or XRF analysis, and these must be performed by a certified inspector or risk assessor.
- Lower the thresholds for interior painted surface area from 6 ft<sup>2</sup> to 2 ft<sup>2</sup> per room, or 10 percent of a small component type.
- Possibly require a risk assessment to identify lead hazards and recommend either interim controls or an abatement to address them, depending on the amount of federal assistance.
- Require meeting lead dust clearance testing standards if more than 2 ft<sup>2</sup> of paint or more than 10 percent of a small component is disturbed.

### Note

Lead dust clearance testing includes measuring for lead dust on floors, windowsills and window troughs after the work is conducted. See HUD Guidelines for [Clearance Testing](#).

### EA 7.2 Replace Windows Containing Lead-Based Paint

Replace windows with suspected or known lead-based paint with energy-efficient ENERGY STAR® windows. Repair flaking, peeling or bubbled paint suspected or known to contain lead, following applicable lead-based paint requirements.

### EA 7.3 Install Walk-Off Mats

Install walk-off mats in areas with potential lead in soil (e.g., urban areas and neighborhoods with pre-1950 homes).

### EA 7.4 Replace Lead Service Lines

Determine whether a lead service line (LSL) connects the drinking water main under the street with the building. If an LSL is present, replace it before or while replacing the water heater. Follow American National Standards Institute (ANSI)/America Water Works Association (AWWA) C810-17 Standard when replacing the LSL. To determine whether the service line is lead, contact the utility company for guidance



and inspect the line where it enters the property. See the [lead service line replacement collaborative](#) source below for additional guidance.

### EA 7.5 Client Engagement

Advise clients that older painted cribs, furniture and vinyl miniblinds may contain lead.



### Relevant Standards or Guidance

- DOL, OSHA, EPA
- [EPA Lead Website](#)
- [EPA Lead-Based Paint RRP Program: Small Entity Compliance Guide to Renovate Right](#)
- EPA Post-Disaster Renovations and Lead-Based Paint
- EPA RRP Rule: 40 CFR Part 745, Subpart E
- HUD Guidelines for [Clearance Testing](#)
- HUD Lead-Safe Housing Rule: 24 CFR Part 35, Subpart J
- [Lead Service Line Replacement Collaborative](#)

If working in a pre-1978 building, see [Appendix A: Worker Protection](#) (Lead).



## PRIORITY ISSUE 8.0: MOISTURE (MOLD AND OTHER BIOLOGICALS)



Excess moisture indoors can support biological growth. Potential health effects and symptoms associated with mold exposure include allergic reactions, asthma and other respiratory complaints. There is no practical way to eliminate all mold and mold spores in the indoor environment; the best way to control indoor mold growth is to control moisture.

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### ASSESSMENT PROTOCOLS

#### AP 8.1 Inspect for Moisture Problems

Inquire about occupant complaints of visible suspected mold or water stains or moldy odors that might indicate the presence of a moisture and mold problem. 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, but are not limited to, the following:

- Water damage or stains (e.g., on walls, ceilings or floor coverings)
- Foundation cracks that leak water
- Signs of seepage or wicking (e.g., salt deposits left behind from water, peeling paint, delaminating materials)
- Visible mold growth
- Mold growth in ductwork and plenums
- Wet or damp spots
- Musty odor
- Ground water, 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
- Condensation or moisture damage in attics
- Improperly functioning HVAC condensate drainage
- Other condensation (consider surface temperature, relative humidity and dew point temperature when evaluating the potential for condensation problems)

## Notes

- Be aware of all rainwater drainage systems to ensure that they all are functioning properly.
- If the assessments reveal that an atmospherically vented combustion device is causing an indoor humidity problem, the device should be repaired in accordance with the guidance provided in [Priority Issue 14.0: Combustion Safety, Vented Combustion Appliances](#).

### AP 8.2 Determine Whether Mold Remediation Is Required

- Determine whether the project requires mold remediation and/or 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 [EPA Mold Remediation in Schools and Commercial Buildings](#) and [Institute of Inspection Cleaning and Restoration Certification \[IICRC\] Mold Remediation Standard S520](#) for additional information).

### AP 8.3 Identify Moisture or Mold Problems to Address/Repair Before Building Upgrades

Document the moisture or mold problems that will be addressed as part of the building upgrade project and identify which must be repaired before the building upgrades are performed. EPA recommends first addressing moisture issues and then remediating all mold problems.

### AP 8.4 Identify Moisture Problems That May Limit Other Building Upgrades

If significant moisture problems exist that cannot be addressed or are outside the scope of the project, do not install building upgrades that would reduce the building's air infiltration rate or would not be durable in a wet environment. Examples of such moisture problems include buildings that have damp or water-stained materials or significant condensation or humidity problems, such as condensation on multiple windows and in attics. Water-sensitive renovation materials—such as fibrous insulation or gypsum board—will be damaged, and their energy-conserving benefits will be compromised.

## MINIMUM ACTIONS

### MA 8.1 Repair Moisture Problems

Repair all moisture problems identified during the assessments. It is important to correct a moisture problem at its source. The following actions to correct moisture issues should be taken or referred to the client before the retrofit work begins:

- Repair roof leaks before air sealing or insulating the attic.
- Address surface water pooling near the foundation before insulating basement or crawlspace walls near wet areas. Address standing water problems, such as water pooling near the foundation and water that does not drain from flat roofs, by ensuring that there is adequate slope and drainage away from the building, particularly for downspouts that carry rainwater from the roof. Correct standing water problems near foundations and crawlspaces before insulating and weatherizing.
- Manage rainwater in assemblies receiving retrofits (e.g., drainage planes and flashings), following guidance in [EPA's Indoor airPLUS Construction Specifications](#) 1.5 and 1.6.



### MA 8.2 Conduct Mold Remediation

Conduct any necessary mold remediation by following professional guidance, such as EPA's Mold Remediation in Schools and Commercial Buildings or ANSI/IICRC Mold Remediation Standard S520. Do not disturb mold growth without following professional guidelines or employing the services of trained mold remediation professionals.

### MA 8.3 Ensure Proper HVAC Condensate Drainage for New and Existing Equipment

Ensure that condensate collects in drain pans under cooling coils and exits via a deep seal trap. Standing water (and possible microbial contamination) 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). Verify that condensate lines are trapped properly and charged with liquid.

### MA 8.4 Prevent Condensation in the Building Enclosure

As part of an energy project, ensure that air sealing of the enclosure limits the flow of moist air into contact with cool surfaces and materials. Ensure that all piping, valves and ductwork with condensation potential—including surfaces that will pass through unconditioned spaces—are adequately covered with airtight, vapor-impermeable insulation.

## Notes

- Air sealing the interface between the ceiling and attic helps prevent ice dams on roofs in cold, snowy climates.
- Carefully select and place insulation and air/moisture retarders to control moisture flow, energy flow and temperature to avoid condensation and moisture accumulation on surfaces and within materials.
- Strictly follow all building codes for vapor retarder placement.
- Control indoor humidity sources.
- Ensure that existing bath and kitchen exhaust fans are operating properly and vented directly to the outdoors.
- Ensure that clothes dryers exhaust directly to the outdoors. Condensing clothes dryers piped to a drain are exempt.
- When work involves a crawlspace, ensure proper crawlspace ventilation that meets applicable building codes (e.g., ventilation openings through foundation walls per the 2018 International Building Code, Section 1203.3).
- If work is done in the attic, ensure proper attic ventilation that meets applicable building codes.
- Install dehumidifiers in humid climates to avoid moisture problems if air conditioning systems cannot effectively control relative humidity below 60 percent under partial cooling load conditions.
- Remove unvented combustion space heaters.

### **MA 8.5 Use Nonporous Materials in Moisture-Prone Areas**

Install only water-resistant, hard-surface flooring in kitchens, bathrooms, entryways, laundry areas and utility rooms.

### **MA 8.6 Control Moisture During Roofing Modifications**

For roof repairs or modifications that are determined to be a necessary part of the upgrade, take precautions to control moisture, for example—

- 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.

### **MA 8.7 Protect On-Site Materials From Moisture**

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.



Conduct any required mold remediation following EPA or other professional guidance (see [Appendix A: Worker Protection](#)—Mold).

See Mold and Moisture section in [Appendix B: Client Education](#).

## Notes

- Replacing an atmospherically vented or fan-powered combustion device that draws combustion air from inside the home with a high-efficiency sealed combustion device can reduce the ventilation rate, which could result in cold-weather condensation in some building enclosures.
- An atmospherically vented combustion device that is causing an indoor humidity problem should be repaired in accordance with [Priority Issue 14.0: Combustion Safety, Vented Combustion Appliances](#).

### MA 8.8 Ensure Proper Operation of HVAC Humidifiers

Identify the presence of humidification equipment connected to forced-air heating and cooling systems and ducts and determine whether it is operating properly and not wetting HVAC components and ducts. Repair any malfunctioning equipment or consider eliminating or replacing it with alternate humidification systems.

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## EXPANDED ACTIONS

### EA 8.1 Retrofit Crawlspace

Where permitted by building codes, retrofit crawlspaces so that they are sealed, insulated, ventilated with conditioned air, properly drained and waterproofed (see section 1.4 of [EPA's Indoor airPLUS Construction Specifications](#), EPA's [Moisture Control Guidance for Building Design, Construction and Maintenance](#), and the [2018 International Building Code](#), Section 1203.3.2). For example, cover earthen floors in basements and crawlspaces with sealed vapor barriers (with appropriate capillary break and drainage), seal sump covers, and add a high-capacity, energy-efficient dehumidifier in the crawlspace if the climate conditions warrant it.

### EA 8.2 Inspect Ducts Under Slab-on-Grade Floors

Inspect supply and return ducts located beneath slab-on-grade floors for evidence of moisture and mold accumulations. Flooding events and ground moisture can enter ducts and cause mold growth, which can be distributed throughout the building. Mold growth may require abandoning and rerouting ducts.

### EA 8.3 Use HVAC Systems to Manage Moisture

Use HVAC systems to manage moisture inside the building:

- Ensure proper sizing when specifying new or replacement air conditioning systems. Base the calculations on post-upgrade project conditions. Use the ACCA Manual J, the ASHRAE *Load Calculation Applications Manual*, 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 percent, evaluate whether the air conditioning system has an oversized design-sensible capacity or an undersized design-latent capacity.
- Consult and use HVAC professionals when evaluating or changing systems.

## Relevant Standards or Guidance

- [Appendix A: Worker Protection](#) (Mold and Confined Spaces) as appropriate
- [ANSI/ACCA Manual J](#)
- [ANSI/ACCA Manual S](#)
- [ANSI/IICRC S500-2015 Water Damage Restoration](#)
- [ANSI/IICRC S520-2008 Mold Remediation](#)
- ASHRAE Applications Manual
- [ASHRAE Handbooks](#)
- [EPA Indoor airPLUS Specifications](#): 1.4, 1.5, 1.6
- [EPA Moisture Control Guidance for Building Design, Construction and Maintenance](#)
- [EPA Mold Remediation in Schools and Commercial Buildings Guide](#)
- [International Building Code 2018](#)





## PRIORITY ISSUE 9.0: PESTS



Some pests, such as rodents and cockroaches, leave behind urine and droppings that can cause disease or increase asthma risks when inhaled. Other pests, such as mosquitos and pigeons, can be responsible for many diseases or lung infections.

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### ASSESSMENT PROTOCOLS

#### AP 9.1 Identify Evidence

Look for evidence of mice, squirrels or other rodents; termites; birds; bats; cockroaches; and other pests. Note the location and identify pest-contaminated materials (e.g., nests, feces). Determine whether rodenticides or pesticides are being used.

#### AP 9.2 Occupant Complaints

Inquire about occupant complaints of pests in the building.

- Areas that have significant potential for pest infestations include attics, basements, crawlspaces, chimneys, mechanical stacks and plumbing cleanouts.
- Termite and some other types of pest infestations are often an indication of moisture problems. See [Priority Issue 8.0: Moisture \(Mold and Other Biologicals\)](#) for identifying moisture problems.

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### MINIMUM ACTIONS

#### MA 9.1 Removal

Remove pest-infested materials while wearing appropriate protective gear such as an N95 respirator, gloves, eye protection, pants and long sleeves OR determine whether professional assistance is needed to do so before conducting energy retrofit work in pest-infested areas.

#### MA 9.2 Termites

Alert the owner of any termite infestations and inform the owner of the need to seek assistance from an integrated pest management (IPM) professional (e.g., Greenpro, Greenshield or equivalently trained IPM professional).

**MA 9.3 Do Not Disturb Pest Exclusion Materials**

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.

**MA 9.4 Pest Exclusion**

In areas with evidence of rodent infestations, patch the exterior holes and cracks that are larger than 0.25 × 0.36 inches with pest-resistant materials (e.g., copper mesh, hardware cloth, sheet metal, concrete) before applying air-sealing materials (e.g., caulk or foam) OR before insulating.

- Protect air intakes from potential bird and pest entry (e.g., cover openings with 0.5-inch screen or galvanized mesh).
- Protect exhaust vents from rodent, bird and pest entry (e.g., cover openings with louvers).
- Avoid creating conditions that can clog the exhaust system, particularly dryer vents.

**MA 9.5 Client Engagement**

Advise the owner/resident to regularly clean/fix screens or dampers over the exterior air intake and exhaust systems (e.g., at least semiannually or when replacing HVAC filters). Also advise the owner/resident to remove clutter, eliminate wood piles near the house, and remove bushes, trees or other vegetation that are within 2 feet of the structure, all of which can serve as rodent harborage.



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**EXPANDED ACTIONS****EA 9.1 Pest Exclusion**

Seal holes in exterior walls that could allow pest entry, and use door sweeps with rodent-proof materials.

**EA 9.2 Cockroaches**

Follow IPM guidelines for roach control. If feasible, apply boric acid or gels into any opened areas, crevices or holes before sealing them. Follow relevant state pesticide applicator standards, which may limit who can apply such products.

**Note**

Some states require that pest management professionals be licensed.

**EA 9.3 Trash Management**

Provide sealable outside garbage cans OR advise clients to use them.

**Relevant Standards or Guidance**

- [Centers for Disease Control and Prevention \(CDC\) Resource on Rodents](#)
- [EPA: Integrated Pest Management \(IPM\) Principles](#)
- [NCHH: Integrated Pest Management: A Guide for Affordable Housing](#)
- [New York City Department of Health and Mental Hygiene, Integrated Pest Management Toolkit](#)

## PRIORITY ISSUE 10.0: POLYCHLORINATED BIPHENYLS



Polychlorinated biphenyls (PCBs) can be found in some building lights, electrical equipment, paints and other industrial products. If lights or electrical systems are damaged or if they leak, people can be exposed to toxins. EPA classified PCBs as a probable human carcinogen, or cancer-causing agent. Long-term exposures may also have significant toxic effects on the immune, nervous, reproductive, and endocrine systems, and other health concerns. For more information on PCBs visit [www.epa.gov/pcbs/learn-about-polychlorinated-biphenyls-pcbs](http://www.epa.gov/pcbs/learn-about-polychlorinated-biphenyls-pcbs).

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### ASSESSMENT PROTOCOLS

#### AP 10.1 Assess Light Ballasts

Determine whether fluorescent light ballasts contain PCBs.

#### Notes

- Some homes may have fluorescent light fixtures with ballasts manufactured before 1979 that contain PCBs. Ballasts manufactured between 1979 and 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 marked clearly as electronic.
- Although no longer commercially produced in the United States, PCBs may be present in products and materials produced before the 1979 PCB ban. Products that may contain PCBs include the following:
  - Transformers and capacitors
  - Electrical equipment, including voltage regulators, switches, reclosers, bushings and electromagnets
  - Oil used in motors and hydraulic systems
  - Old electrical devices or appliances containing PCB capacitors
  - Fluorescent light ballasts
  - Cable insulation
  - Thermal insulation material, including fiberglass, felt, foam and cork
  - Adhesives and tapes
  - Oil-based paint
  - Caulking

- Plastics
- Carbonless copy paper
- Floor finish

The PCBs used in these products were chemical mixtures made up of a variety of individual chlorinated biphenyl components known as congeners. Most commercial PCB mixtures are known in the United States by their industrial trade names, the most common being Arochlor.

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## MINIMUM ACTIONS

### MA 10.1 Replace Light Ballasts

If fluorescent light ballasts do not have the statement “No PCBs” or are not marked as electronic, assume that the ballasts contain PCBs and replace the lighting with new fixtures, 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 and install new lighting fixtures. Refer to EPA’s [Steps to Safe Renovation and Repair Activities](#) web page to follow safe work practices to minimize PCB exposure during removal and properly dispose of the materials.

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## EXPANDED ACTIONS

### EA 10.1 Assess Other Building Products

The presence of PCBs may not be limited to fluorescent light ballasts. PCBs also were used in other products, including caulk, paint and electrical systems. See EPA’s website on PCBs for a complete list of products of concern and, where possible, remove and replace them. Refer to EPA’s [Steps to Safe Renovation and Repair Activities](#) web page on safe work practices that minimize PCB exposure during removal and properly dispose of the materials.

### Relevant Standards or Guidance

- [EPA PCB-Containing Light Ballasts](#)
- [EPA PCBs in Caulk](#)
- [Steps to Safe Renovation and Repair Activities](#)

## PRIORITY ISSUE 11.0: RADON

Radon is a radioactive gas generated by the natural decay of uranium in the soil and rock below and around buildings. It can enter homes through holes and cracks. Breathing radon gas increases the risk of lung cancer.



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### ASSESSMENT PROTOCOLS

#### AP 11.1 Radon Testing

EPA recommends testing all houses for radon and providing clients with the test results. At the time of testing, clients should receive a copy of EPA's [A Citizen's Guide to Radon](#). Short-term tests offer an affordable screening method for many homes. Longer term testing may provide a more accurate representation of the annual exposure to radon and the need for mitigation. If short-term results are between 2 and 10 picocuries per liter (pCi/L), consider conducting a long-term radon test (minimum 90 days).

#### AP 11.2 Pre- and Post-Upgrade Testing During Energy Upgrades

Pre- and post-upgrade testing as part of an energy upgrade is strongly encouraged.

#### AP 11.3 Determine Whether the Home Has an Active or Passive Radon Mitigation System

Active mitigation systems include a radon vent fan (usually located in an attic, in an attached garage or on the building exterior) and an indicator (visual or sound) that the fan is operating. If an active mitigation system is installed and functioning, no further action is required; however, testing is recommended to ensure the system is reducing radon below the national action level.

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### MINIMUM ACTIONS

#### MA 11.1 If Pre- and Post-Upgrade Test Results Indicate a Potential Increase and Post-Upgrade Levels Are $\geq 4$ pCi/L

If radon levels after energy upgrades or renovation are  $\geq 4$  pCi/L AND higher than the radon levels before upgrades, install mitigation in accordance with ASTM 2121 or ANSI/AARST SGM-SF-2017. (For post-upgrade test levels between 4 and 10 pCi/L, consider a long-term test [minimum 90 days] to confirm an increase before undertaking mitigation.)

**MA 11.2 If Pre-Upgrade Test Results Are Not Available and Radon Levels After Energy Upgrades or Renovation Are  $\geq 4$  pCi/L**

If pre-upgrade test results are not available and radon levels after energy upgrades or renovation are  $\geq 4$  pCi/L, install mitigation in accordance with ASTM 2121 or ANSI/AARST SGM-SF-2017. (For levels between 4 and 10 pCi/L, consider a long-term test [minimum 90 days] to confirm levels of  $> 4$  pCi/L before undertaking mitigation.)

**MA 11.3 Install Precautionary Measures**

Installing precautionary measures may help to prevent increases in radon if pre-upgrade test results are not available or if pre-upgrade test results are  $> 2$  pCi/L AND mitigation is not planned.

- Install whole-dwelling ventilation, in accordance with ASHRAE Standard 62.2 (see [Priority Issue 17.0: Whole-Dwelling Ventilation for Distributed Contaminant Sources](#), which recommends Standard 62.2 as a minimum action). Note that exhaust-only systems have been shown to potentially increase radon in some basements; if basements are occupiable, consider such alternative ventilation strategies as balanced systems, taking into account other sources that warrant ventilation, such as cooking.
- Cover exposed earthen floors in basements and crawlspaces, according to Section 1.2 of [EPA's Indoor airPLUS Construction Specifications](#) or Section 2.0403.2 of the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory's (NREL) Single-Family Standard Work Specifications ([sww.nrel.gov](https://www.nrel.gov)).
- Air seal the sumps (e.g., install an airtight sump cover) in such a way that water can drain from above (e.g., with a ball valve) and below the sump cover.

**Note**

As mentioned in MA 2.1, because of their continuous usage, drain traps in sinks and toilets are seldom a problem. Floor drains in an obscure location, such as a mechanical room or maintenance closet, can dry out. 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.



### MA 11.4 Client Education

Educate the client about the test results and radon reduction measures that were followed. Inform the client that the radon-testing protocols were completed to ensure that the energy upgrade work did not introduce indoor radon problems.



#### Note

These protocols do not necessarily mitigate a prior indoor radon problem in the home. Advise the client to refer to EPA's [A Citizen's Guide to Radon](#) for more information about radon risks.

### MA 11.5 Poorly Operating Mitigation System

If a previously installed radon mitigation system is not operating correctly (does not mitigate the level to below the EPA action level), advise the client to contact the installer of the system or consult with the state radon office.

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## EXPANDED ACTIONS

### EA 11.1 Install Radon Mitigation

Install mitigation systems in any house with radon levels of  $\geq 4$  pCi/L before or after energy upgrades or renovation, in accordance with ANSI/AARST SGM-SF-2017. If the post-upgrade radon level is between 2 and 4 pCi/L, refer the client to EPA's *A Citizen's Guide to Radon* or mitigate in accordance with ANSI/AARST SGM-SF-2017.

### EA 11.2 Pursue Added Precautionary Measures

Install airtight drain fittings (e.g., trap or flange system) in the floor drains of the foundation. Seal and caulk penetrations, opening or cracks in below-grade walls and floors that contact the ground with a sealant that meets the requirements of ASTM C920.

### Relevant Standards or Guidance

- ANSI/AARST Protocol for Conducting Measurements of Radon
- ANSI/AARST Standard SGM-SF-2017
- [ASHI Radon Mitigation System Inspection Checklist](#)
- ASTM C920
- ASTM E2121
- [EPA Indoor airPLUS Specification 1.2](#)
- [EPA: Where You Live \(State Radon Contact Information\)](#)
- [EPA's A Citizen's Guide to Radon](#)
- [NREL: Single-Family Standard Work Specifications](#)

## PRIORITY ISSUE 12.0: WOOD SMOKE AND OTHER SOLID FUEL EMISSIONS

Smoke from wood- and solid fuel–burning appliances is made up of a complex mixture of gases and fine particles. Breathing this smoke can cause or aggravate burning eyes, heart disease, heart attacks and respiratory ailments such as asthma, chronic obstructive pulmonary disease (commonly known as COPD) and bronchitis.

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### ASSESSMENT PROTOCOLS

#### Note

Many of the following may require input from certified/trained professionals. For a certified professional near you, consult the [Chimney Safety Institute of America \(CSIA\)](#) or the [National Fireplace Institute \(NFI\)](#).

#### **AP 12.1 Determine Whether Wood- or Other Solid Fuel–Burning Appliances (e.g., Wood Stove or Furnace, Wood Pellet Stove, Fireplace) Are in the Home**

Determine whether a hydronic heater (e.g., outdoor wood-fired boiler) is present.

#### **AP 12.2 Assess Proper Size and Operation of Solid Fuel–Burning Appliances**

- Assess what the proper size of any solid fuel–burning appliances will be after the building upgrade is complete (see EPA [Burn Wise](#)).
- Determine whether the solid fuel–burning appliance is 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.

#### **AP 12.3 Assess Appliance Safety**

Assess by considering the following:

- Condition of the appliance (especially leaks, cracks or faulty flue connections)
- Proper distance of appliance to combustible materials (minimum clearances) and/or proper protection of combustibles
- Proper size and materials of floor protection

- Proper venting system (See [Priority Issue 14.0: Combustion Safety, Vented Combustion Appliances](#) and [Priority Issue 15.0: Combustion Safety, Unvented Combustion Appliances.](#))
- Effect of exhaust ventilation equipment on proper draft of appliance

Contact the manufacturer regarding installation guidance for proper venting, distance from combustibles, and floor protection as well as adhering to local building code.

#### **AP 12.4 Identify Presence of Indoor Smoke**

If wood- or other solid fuel–burning appliances are present, determine whether there is evidence of indoor smoke emissions affecting the home by using any of the following or equivalent practices:

- Look for evidence of soot on the walls or ceiling or creosote staining near the flue pipe.
- Determine whether the inside of the home smells like wood smoke.
- Ask occupants whether they regularly smell wood smoke indoors during the heating season.

If the solid fuel–burning appliance is operating during the assessment, observe the opacity of the smoke leaving the chimney.

#### **Note**

Opacity of 100 percent means that nothing can be seen through the smoke. At 20 percent opacity, there is very little smoke, and a person 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 that trash and vegetation are not being burned in the units. Refer to the EPA [Burn Wise](#) website for additional information.

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## **MINIMUM ACTIONS**

### **MA 12.1 Correct Indoor Smoke Problems**

If evidence of soot, wood smoke or other health safety concern is apparent, work with a certified fireplace or chimney safety professional to identify and correct the problems. For a certified professional near you, consult the [CSIA](#) or the [NFI](#).

### MA 12.2 Ensure Installation of Properly Sized and Certified Equipment

- If the current unit is oversized, recommend replacement with a properly sized, EPA-certified appliance.
- If a new appliance is installed during the upgrade, ensure that it is sized properly for the post-upgrade heating load (see EPA [Burn Wise](#)). Ensure that any new wood-burning appliances are EPA certified.

### MA 12.3 Occupant Engagement



- Encourage the homeowner to have a certified professional (e.g., certified by CSIA) inspect and maintain the chimney and wood- or other solid fuel–burning appliance annually.



- Share EPA [Burn Wise](#) tips with the homeowner to encourage the use of the right fuel for the appliance.

## EXPANDED ACTIONS

### EA 12.1 Replace Noncertified Appliances

Replace noncertified solid fuel–burning appliances with properly sized and installed wood pellet stoves or EPA-certified appliances—or with heating equipment that does not burn solid fuels—after the retrofit is complete. For fireplaces, consider installing retrofit devices that reduce emissions. Appliances should be installed according to the manufacturer’s instructions.

### Relevant Standards or Guidance

- CSIA
- [EPA Burn Wise Guides, Lists and Tips](#)
- The Clean Air Association of the Northeast States (NESCAUM) Regulations
- National Fire Protection Association (NFPA) 211

Also refer to [Priority Issue 14.0: Combustion Safety, Vented Combustion Appliances](#).

# CRITICAL BUILDING SYSTEMS FOR HEALTHY INDOOR ENVIRONMENTS

## PRIORITY ISSUE 13.0: HEATING, VENTILATING AND AIR CONDITIONING (HVAC) EQUIPMENT

HVAC equipment can help to improve IAQ by bringing in outdoor air and reducing the risk of respiratory health effects and exposures to pollutants. Most existing HVAC systems do not have the proper features or functionality to achieve this result. In addition, poorly functioning equipment can produce unwanted health effects.

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### ASSESSMENT PROTOCOLS

#### AP 13.1 Evaluate Existing Equipment

Working with a qualified professional, evaluate the condition of the existing HVAC system components (e.g., furnace, boiler, cooling equipment, air handler, exhaust air system, make-up air system, heat pump, ductwork), in accordance with minimum inspection standards of ANSI/ACCA Standard 4 (Maintenance of Residential HVAC Systems).

- The HVAC assessment is to include an evaluation of whether the system is functioning properly, based on ANSI/ACCA checklists appropriate for the type of equipment.
- Determine whether the HVAC system is sized properly, in accordance with ACCA Manuals J/D/S or other equivalent standardized guidelines.

#### AP 13.2 Occupant Complaints of Temperature, Humidity or Noise

Inquire about occupant comfort complaints of temperature or humidity in the conditioned spaces or unusual noise from HVAC equipment.

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### MINIMUM ACTIONS

#### MA 13.1 Make Repairs and Modifications or Install New Equipment

- On analyzing the results of the system assessment (e.g., equipment condition, size and feasibility of corrective actions), repair or modify existing HVAC equipment or recommend installing new HVAC equipment to ensure that the needed ventilation, local exhaust system, and temperature and humidity controls are provided. The ability to modify and adjust the existing HVAC equipment may be limited by its initial design. Review the original equipment specifications, consulting with HVAC technical/engineering professionals.

- If maintenance, cleaning, repairs or tuning are needed to restore the HVAC to proper functioning, conduct those activities in accordance with ANSI/ACCA Standard 6 (Restoring the Cleanliness of HVAC Systems) and ANSI/ACCA Standard 4 (Maintenance of Residential HVAC Systems).
- If replacing equipment, base the sizing calculations on post-upgrade conditions, as well as heating and cooling load calculations, by using the ACCA Manuals J/D/S or ASHRAE handbooks. Refer to Section 4 of EPA Indoor airPLUS Construction Specifications.
- Install new equipment in accordance with ANSI/ACCA Standard 5 (HVAC Quality Installation Specification) and verify installation in accordance with ANSI/ACCA Standard 9 (HVAC Quality Installation Verification Protocols).

### **MA 13.2 Ensure That There Is Adequate Air Filtration**

Ensure that newly installed central forced-air HVAC systems have a filter with a minimum efficiency reporting value (MERV) of 11 or higher located upstream of the thermal conditioning equipment.

- 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 and educate the owner about the recommended MERV rating and filter replacement schedule.
- No air should bypass the filters.
- Do not install air cleaners that intentionally produce ozone.

### **MA 13.3 Control Mold and Bacterial Growth in HVAC Systems and Mechanical Equipment**

Ensure that existing HVAC equipment is free of visible mold growth in ducts, drain pans and coils, and—if any mold is visible—correct the cause of the condition (see [Priority Issue 8.0: Moisture \(Mold and Other Biologicals\)](#)).

### **MA 13.4 Inform Homeowner of HVAC Design**

Discuss with the homeowner the basic operation of the HVAC system, including any maintenance (e.g., changing the air filter) and minor adjustments.



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## **EXPANDED ACTIONS**

### **EA 13.1 Upgrade the HVAC Equipment**

- Consider replacing functioning HVAC equipment that is near the end of its service life or that can be upgraded to improve operating and ventilation

efficiency and/or filtration efficiency with new energy-efficient HVAC equipment, and base the sizing calculations on post-retrofit conditions. Refer to Section 4 of EPA Indoor airPLUS Construction Specifications.

- Follow ANSI/ACCA Standard 5 (HVAC Quality Installation Specification), Standard 9 (HVAC Quality Installation Verification Protocols), ASHRAE handbooks or other equivalent standards and guidelines.

### **EA 13.2 Balance Equipment**

With the help of an HVAC professional, balance existing equipment to ensure appropriate air flows and pressure.

### **EA 13.3 Install Higher Efficiency Filters in HVAC Systems**

For new HVAC systems, install filters with the highest MERV rating (preferably 13 or above) that the equipment is capable of physically accommodating and for which there is adequate fan capacity to overcome the filters' pressure drop. Consult ENERGY STAR's certified homes program requirements.

## **Relevant Standards or Guidance**

- ANSI/ACCA 4 QM-2013
- ANSI/ACCA 5 QI-2015
- ANSI/ACCA 6 QR-2007
- ANSI/ACCA 9 QIVP-2008
- ANSI/ACCA Manual D
- [ANSI/ACCA Manual J](#)
- [ANSI/ACCA Manual S](#)
- [ASHRAE Handbooks: ASHRAE Handbook Series](#)
- ASHRAE 52.2-2017
- [ASHRAE 62.2-2019](#), Section 6
- ENERGY STAR Checklist
- [EPA Air Cleaners and Air Filters in the Home](#)
- [EPA Indoor airPLUS Specifications](#): 4.1, 4.2 and 4.7

Also see ventilation requirements in [Priority Issue 16.0: Source or Local Exhaust Ventilation](#) and [Priority Issue 17.0: Whole-Dwelling Ventilation for Distributed Contaminant Sources](#).



## PRIORITY ISSUE 14.0: COMBUSTION SAFETY, VENTED COMBUSTION APPLIANCES



Proper venting of combustion appliances reduces the risks of exposure to CO and other combustion byproducts. Proper venting also can ensure that combustion appliances function correctly and efficiently.

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### ASSESSMENT PROTOCOLS

#### AP 14.1 Safety Inspection

Complete a safety inspection of all vented combustion appliances in the dwelling (e.g., furnaces, boilers, space heaters, water heaters). The inspection shall include observations for proper clearances and condition of venting, as well as assessment of the potential for spillage/backdrafting, the integrity of fuel lines, and the safety of electrical connections and the appliance itself.

- For gas-fired appliances and equipment, conduct this assessment following ANSI/BPI-1100-T-2014 and ANSI BPI-1200-S-2017 and manufacturer’s instructions. Consider evaluating 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 the evaluation by 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.
- Wood stoves and fireplaces are vented appliances that have special issues and requirements—also refer to [Priority Issue 12.0: Wood Smoke and Other Solid Fuel Emissions](#).
- Identify combustion appliances that have pilot burners. Performance test vented combustion appliances (e.g., boilers, furnaces, space heaters and water heaters) using qualified professionals to ensure proper draft under worst-case depressurization and perform CO testing. Conduct a safety inspection of combustion appliances for the purpose of placing the combustion appliance zone (CAZ) under the greatest depressurization achievable, in accordance with ANSI/BPI-1200-S-2017, to determine whether any combustion safety issues may result from changes to the building envelope. *Note: When conducting CAZ*

testing, a 5 Pa depressurization limit may not be appropriate for all venting conditions.

- Determine whether CO detection and warning equipment is installed.

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## MINIMUM ACTIONS

### MA 14.1 Correct Safety Deficiencies

- Correct all safety deficiencies identified during the assessments and ensure compliance with appropriate and applicable codes and standards. Using qualified professionals, test the combustion appliances for proper draft and venting under greatest achievable depressurization conditions, both before and after retrofit measures that affect envelope leakage and airflows (e.g., air sealing, insulation, addition or upgrade of exhaust fans). Repair, remove or replace combustion equipment and address other issues or deficiencies, as needed, to meet the appropriate and applicable codes and standards.
- All equipment removal should include proper disposal so that hazardous units are not reinstalled or used elsewhere.

### MA 14.2 Correct Potential Depressurization and Spillage Problems

Address depressurization and potential spillage/backdrafting problems (e.g., with combustion make-up air, fan interlocks, transfer grilles, jumper ducts, louvered doors, door undercuts, duct leakage repair) identified during worst-case draft and vent testing or adjust the exhaust equipment that is causing the problems, provided it does not conflict with the specific exhaust requirements for spaces served by the exhaust equipment.

### MA 14.3 Whole-House Fans

If a whole-house fan is used for cooling at night, advise occupants to open several windows before operating the fan.



### MA 14.4 Ensure That CO Detection and Warning Equipment Is Installed

Ensure that CO detection and warning equipment is installed properly, working properly and located according to NFPA 720/NFPA 72 and any applicable local or state requirements. According to [NFPA Safety Tips for CO Alarms](#), the homeowner should test CO alarms at least once a year and replace them when necessary according to the manufacturer's instructions.



**MA 14.5 Ensure Proper Exhaust Locations**

Ensure that combustion exhaust is directed to the outdoors and not vented near doorways, windows or other openings or into other indoor spaces such as attics, crawlspaces or basements.

**MA 14.6 Ensure Adequate Make-Up Air**

Ensure that vented appliances have sufficient make-up air to replace vented air and maintain normal operating conditions.

**MA 14.7 Ensure Proper Oil Furnace and Boiler Operation**

Ensure that firing adjustments are working properly so that no soot is dispelled out of the atmospheric dampers into mechanical rooms. If appliances release black smoke through the chimney, contact a qualified service technician for repairs.

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**EXPANDED ACTIONS****EA 14.1 Equipment Replacement**

If replacing combustion equipment located in occupied or conditioned spaces as part of the retrofit process, recommend power-vented or sealed combustion equipment (see Section 5.1 of [EPA's Indoor airPLUS Construction Specifications](#)). Install new combustion equipment in accordance with ANSI/ACCA 5 QI 2015 HVAC Quality Installation Specifications.

The following actions apply to both new and existing appliances:

- **EA 14.1.1 Ensure Sufficient Access**

Ensure that combustion appliances are installed with sufficient access for proper maintenance and that they are operating in compliance with the original manufacturer's printed specifications.

- **EA 14.1.2 Upgrade Combustion Appliances**

Consider replacing older, lower-efficiency appliances that have pilot burners with higher-efficiency appliances that have electronic ignition.

## Relevant Standards or Guidance

- ANSI/ACCA 5 QI-2015
- ANSI Z223.1/NFPA 54
- ANSI/BPI-1100-T-2014, Combustion Appliance Inspection
- ANSI/BPI-1200-S-2017 Standard Practice for Basic Analysis of Buildings
- [ASHRAE 62.2-2019](#), Section 6
- [EPA Indoor airPLUS Specification](#) 5.1
- NFPA 31
- NFPA 211
- NFPA 720/NFPA 72

See other sections: [Priority Issue 4.0: Carbon Monoxide and Other Combustion Appliance Emissions](#).

## **PRIORITY ISSUE 15.0:**

### **COMBUSTION SAFETY, UNVENTED COMBUSTION APPLIANCES**

Unvented combustion appliances can create CO and combustion byproducts, as well as moisture. Exposure to CO and combustion byproducts can increase the risk of respiratory issues that can result in respiratory infection, lung disease such as emphysema, lung cancer or, in extreme cases, death.

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#### **ASSESSMENT PROTOCOLS**

##### **AP 15.1 Identify Unvented Appliances**

Identify any unvented gas or kerosene space heaters or vent-free combustion appliances (e.g., fireplaces, cooktops, ovens, kerosene or gas space heaters), and determine whether any state or local regulations prohibiting these devices apply.

##### **AP 15.2 Determine Whether CO Detection and Warning Equipment Is Installed and Working**

##### **AP 15.3 Inquire About Occupant Complaints**

Inquire about occupant complaints of odors or health effects that might be attributable to improperly operating combustion equipment.

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#### **MINIMUM ACTIONS**

##### **MA 15.1 Vent Kitchen Exhaust Outdoors**

Ensure that the kitchen exhaust fan vents to the outdoors. If not, see [Priority Issue 16.0: Source or Local Exhaust Ventilation](#) for recommended actions.

##### **MA 15.2 Evaluate Removal/Replacement of Unvented Appliances**

With the occupants' permission—

- Identify unvented gas or kerosene space heaters that do not conform to state and local regulations and remove them as appropriate. If the space heaters are the primary source of heat, replace them with code-compliant electric or vented heating systems.
- Remove other unvented heaters, except when used as a secondary heat source AND when it can be confirmed that the unit is being used in accordance with ANSI Z21.11.2. Units that are not installed or are not being used or operated in

compliance with their intended purpose, according to ANSI Z21.11.2, should be removed before the retrofit but may remain in place until a replacement heating system is installed.

All equipment removal should include proper disposal so that hazardous units are not reinstalled or used elsewhere. If the occupant objects to these recommendations, refer them to [Appendix B: Client Education](#) (Combustion Safety).

### MA 15.3 Engage Occupants

Advise the occupant that it is always important to consult and follow the manufacturer's instructions for proper operation and maintenance. If the manufacturer's instructions are not available to the occupant, advise or assist the occupant in obtaining replacement instructions or contacting the Air-Conditioning, Heating and Refrigeration Institute (AHRI) for information on obtaining these instructions for gas appliances.



### MA 15.4 Ensure That CO Detection and Warning Equipment Is Installed

Ensure that CO detection and warning equipment is installed properly, working properly and located according to NFPA 720/NFPA 72 and any applicable local or state requirements.

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## EXPANDED ACTIONS

### EA 15.1 Consider Kitchen Exhaust and Outdoor Air Ventilation

Consider meeting ASHRAE Standard 62.2-2019 requirements, Section 5, and any applicable building code requirements for local exhaust and outdoor air ventilation for kitchens equipped with gas cooking appliances.

### Relevant Standards or Guidance

- AHRI
- ANSI Z21.11.2/Canadian Standards Association
- [ASHRAE Standard 62.2-2019](#), Section 5
- NFPA 720/NFPA 72
- State and Local Regulations

See other sections:

- [Priority Issue 4.0: Carbon Monoxide and Other Combustion Appliance Emissions](#)
- [Priority Issue 16.0: Source or Local Exhaust Ventilation](#)

## PRIORITY ISSUE 16.0: SOURCE OR LOCAL EXHAUST VENTILATION

Local ventilation can help to reduce moisture and contaminants at localized sources such as in kitchens and bathrooms.

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### ASSESSMENT PROTOCOLS

#### **AP 16.1 Determine Local Exhaust Compliance With ASHRAE 62.2**

Determine whether the home complies with the local exhaust requirements for kitchens and baths of ASHRAE Standard 62.2-2019, Section 5 and Appendix A, as applicable, and determine whether kitchen and bath exhausts vent to the outdoors.

#### **AP 16.2 Determine Clothes Dryer Exhaust Compliance With ASHRAE 62.2**

Determine whether the home complies with the local exhaust requirements for clothes dryers in ASHRAE Standard 62.2-2019, Section 6. Determine whether clothes dryers vent 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.

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### MINIMUM ACTIONS

#### **MA 16.1 Install, Repair or Replace Local Exhaust Ventilation in Dwelling Units**

If ASHRAE Standard 62.2-2019 requirements for kitchen and bathroom exhausts are not met, a professional should repair, replace or install local exhaust ventilation in dwelling units to meet the requirements.

- Ensure that ducts are sized and installed properly and are exhausted directly to the outdoors.
- If ASHRAE Standard 62.2 requirements for local exhaust ventilation in kitchens and bathrooms cannot be met, increase the whole-building ventilation airflow to compensate for insufficient local exhaust flow using the alternative compliance method (Appendix A of Standard 62.2-2019).
- Advise the homeowner and occupants about the need to use exhaust fans in kitchens and bathrooms during activities that generate pollutants and moisture (e.g., cooking, showering).





**MA 16.2 Ensure Proper Venting of Clothes Dryers**

Ensure that all clothes dryers exhaust directly to the outdoors and cannot be readily diverted indoors by the occupants.

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**EXPANDED ACTIONS****EA 16.1 Consider Installing Exhaust Fans**

Even if the home is in compliance with ASHRAE Standard 62.2-2019 without bathroom or kitchen exhaust fans (i.e., using Appendix A), EPA recommends installation of exhaust fans vented to the outdoors, in accordance with Section 5 of ASHRAE Standard 62.2-2019 requirements, to improve pollutant source removal.

**EA 16.2 Consider Strategies in Bathrooms to Control Local Exhaust Fan**

Use one or more of the following strategies in bathrooms to control the use of the local exhaust fan:

- Occupancy/motion sensor
- Automatic humidistat controller
- Automatic timer to operate the fan for 20 minutes or more after an occupant leaves the room
- Continuously operating exhaust fan

**EA 16.3 Consider Exhaust for Other Sources**

For other spaces with strong, localized pollutant sources, consider installing additional (dedicated) local exhaust ventilation and/or removing the source if applicable (see [CONTAMINANTS AND SOURCES](#) section).

Evaluate whether extended operation of exhaust ventilation systems may—

- Compromise proper venting of combustion appliances by conducting spillage assessment on vented appliances (ANSI/BPI-1100-T-2014).
- Cause unwanted entry of airborne pollutants from adjoining spaces by conducting pressure-mapping diagnostics.

**Relevant Standards or Guidance**

- ANSI/BPI-1100-T-2014, Section 7. Combustion Appliance and Fuel Distribution System Inspection
- [ASHRAE 62.2-2019](#)
- BPI-1100-T-2014, Indoor Air Quality and Ventilation and Baseload Energy Efficiency sections

## PRIORITY ISSUE 17.0: WHOLE-DWELLING VENTILATION FOR DISTRIBUTED CONTAMINANT SOURCES

Providing controlled, whole-dwelling mechanical ventilation with increased levels of fresh air can help to improve IAQ and dilute or remove contaminants from various sources throughout the home.

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### ASSESSMENT PROTOCOLS

#### **AP 17.1 Determine Whether a Mechanical Ventilation System Is Present**

Mechanical ventilation systems in homes include the following configurations (which can include, but not rely on, operable windows):

- Continuously operating bath and/or kitchen exhaust fans or other exhaust fan(s)
- Outdoor air ventilation supplied via a heating/cooling air handler
- Balanced supply and exhaust ventilation (e.g., heat recovery ventilator [HRV], energy recovery ventilator [ERV])

#### **AP 17.2 Determine Whether the Home Meets Ventilation Requirements of ASHRAE Standard 62.2**

Confirm that the home meets ASHRAE 62.2-2019 standards.

- Use ASHRAE 62.2-2019 Section 4 requirements OR Appendix A—Existing Buildings if local exhaust ventilation in bathrooms and kitchens is deficient. Blower door testing and measuring fan flows (e.g., bathroom or kitchen exhaust) will be required.
- Determine whether additional ventilation measures are needed to meet the ASHRAE Standard 62.2-2019 requirements.

#### **AP 17.3 Identify Outdoor Air Intakes**

Identify the location of outdoor air intakes and assess their distances from outdoor pollutant sources (e.g., vehicle exhaust, plumbing vents, exhaust discharges, roadways with high traffic volumes).

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## MINIMUM ACTIONS

### MA 17.1 Repair and Upgrade Existing Mechanical Ventilation Systems

- Ensure that a continuous or intermittent operating schedule is set in the dwelling unit to meet ASHRAE Standard 62.2-2019 ventilation requirements. Ensure that controls are operating properly. (*Note: If it is not possible to achieve the ASHRAE Standard 62.2-2019 minimum outdoor air ventilation rates, adjust the systems to provide the maximum amount of outdoor air ventilation possible.*)
- If the local exhaust ventilation in bathrooms and kitchens is deficient, use the alternative compliance supplement (Appendix A of Standard 62.2-2019).
- If ventilation air is provided integral to the space conditioning system, the system should be configured to provide the required ventilation, regardless of the heating or cooling demand in the dwelling unit.
- If the home has dedicated mechanical exhaust for outdoor air ventilation—
  - Adjust, repair or replace existing exhaust ducts and fans as needed in an attempt to meet ASHRAE Standard 62.2-2019 requirements.
  - Remove blockages in exhaust grilles, ductwork and components (e.g., constant airflow regulators).
  - Ensure ducts for all exhaust fans terminate outside the building.
  - Air seal exhaust ventilation ductwork with approved materials to prevent duct leakage within building cavities.
  - Advise the homeowner to inspect exhaust grilles at least once per year.
- Ensure that outdoor air intakes are located at least 10 feet from contaminant sources.

### MA 17.2 Install Ventilation to Meet ASHRAE 62.2

Install additional ventilation measures as necessary to meet ASHRAE Standard 62.2-2019 requirements for whole-building ventilation, if within the scope of project.

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## EXPANDED ACTIONS

### EA 17.1 Install Balanced Ventilation Systems with Energy Recovery

Install balanced ventilation to ensure that ventilation air comes from the outdoors. In areas with sufficient heating or cooling demand and when the exhaust airflows from the dwelling unit can be combined readily to flow through an energy recovery device to precondition the incoming outdoor ventilation air, consider installing HRVs or ERVs.

**EA 17.2 Provide Added Outdoor Air Filtration**

In geographic locations where the outdoor air exceeds the U.S. National Ambient Air Quality Standards for fine and coarse particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>, respectively) or ozone, provide enhanced filtration within 500 feet of a busy highway:

- Particulate-matter filters or air-cleaning devices with a MERV of at least 11 should be used in areas where the National Ambient Air Quality Standard for PM<sub>10</sub> is exceeded.
- Particulate-matter filters or air-cleaning devices with a MERV of at least 13 should be used in areas where the National Ambient Air Quality Standard for PM<sub>2.5</sub> is exceeded, or within 500 feet of busy highways (e.g., annual average daily traffic > 100,000 vehicles—San Francisco Department of Public Health).

**EA 17.3 Consider Air Cleaning to Remove Ozone**

Air-cleaning devices to remove ozone may be provided and used in areas that are in “nonattainment” with the National Ambient Air Quality Standard for ozone. More information on where to locate and how to utilize air cleaners and air filters in the home can be found in [EPA's Guide to Air Cleaners in the Home](#).

**Relevant Standards or Guidance**

- [ANSI/ASHRAE Standard 189.1-2017](#)
- [ASHRAE 62.2-2019](#)
- Building America Tools and Resources
- [EPA's Guide to Air Cleaners in the Home](#)

# SAFETY

## PRIORITY ISSUE 18.0: HOME SAFETY

Fire hazards, electrical hazards and CO exposure can result in injuries or death. Smoke and CO alarms help to warn residents of harmful building conditions. Safety risks also include trip and fall hazards, as well as unsafe storage of hazardous chemicals.



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## ASSESSMENT PROTOCOLS

### AP 18.1 Assess Conditions

- If the home has combustion appliance equipment, a fireplace or an attached garage, confirm that CO alarms exist and are working.
- Determine whether there are working smoke alarms.
- Identify knob-and-tube electrical wiring.
- Identify harmful chemicals in accessible locations.
- Check whether there is a fire extinguisher in the home.
- Determine whether the hot water heater temperature setting is within allowable limits of local and state codes.
- Document other home safety hazards that are observed during the energy audit/assessment/retrofit (e.g., missing handrails, nonintact stairs, insufficient lighting, holes in floors).

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## MINIMUM ACTIONS

### MA 18.1 Replace Nonworking Alarms

- Replace nonworking CO alarms and follow guidance in [Priority Issue 4.0: Carbon Monoxide and Other Combustion Appliance Emissions](#) for homes with combustion appliances, equipment or attached garages. If new batteries are used, install 10-year lithium batteries.
- Replace nonworking smoke alarms. If new batteries are used, install 10-year lithium batteries.
- Ensure CO and smoke alarms are located according to NFPA 720/NFPA 72 and any applicable local or state requirements.

**MA 18.2 Address Safety Hazards**

Correct life-threatening safety hazards (e.g., fall hazards) and provide client education on safety concerns, including having access to a properly charged fire extinguisher. Do not bury unsafe wiring in attic insulation.

**EXPANDED ACTIONS****EA 18.1 Knob-and-Tube Electrical Wiring**

Have qualified personnel replace knob-and-tube electrical wiring in accordance with applicable electrical codes.

**EA 18.2 Address Other Safety Hazards**

- For households with small children or elderly occupants, discuss scald prevention with clients AND adjust the hot water heater set-point to 120 degrees Fahrenheit to prevent scalding.
- In homes with elderly persons, install grab bars, handrails and lighting as appropriate.
- For households with small children, recommend installation of gates at the tops of stairs.
- Recommend installation of light switches at the top and bottom of stairs.
- Recommend installation of safety lighting above stairs. Consider energy-efficient LED lighting.
- Recommend repair of malfunctioning doors, windows, roofs and floors.
- Recommend appropriate and controlled storage of hazardous chemicals (e.g., strong cleaners, household hazardous materials) and pesticides (e.g., remove from accessible locations).
- Repair identified safety hazards.

**Relevant Standards or Guidance**

- ANSI/UL 2034
- [CDC Fall Prevention Checklist](#)
- [CDC Home Safety Checklists](#)
- Consumer Product Safety Commission (CPSC) Document #466
- [EPA Safer Choice](#)
- HUD Notice: Public Housing Assessment System Physical Condition Scoring Process Interim Scoring, Corrections and Republication
- NFPA 720/NFPA 72

## PRIORITY ISSUE 19.0: PROTECTING IAQ DURING CONSTRUCTION

Precautions can help to minimize worker and occupant exposure to air contaminants during construction and prevent IAQ problems after construction is complete.



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### ASSESSMENT PROTOCOLS

#### AP 19.1 Assess Occupancy During Construction Periods

- 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.

#### AP 19.2 Identify Construction Contaminants and Pathways

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 air quality for building occupants (e.g., adjacent areas, return ducts, stairwells).

#### AP 19.3 Identify Potential for Mercury Exposure

Identify the potential for mercury exposure during the building upgrade. Mercury exposure can occur when mercury-containing products and such devices as thermometers, thermostats, compact fluorescent lamp (CFL) bulbs and fluorescent lamps are broken and mercury is released into the building.

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### MINIMUM ACTIONS

#### MA 19.1 Minimize Occupant and Worker Exposures During Construction

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 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:

- Restrict building occupants and workers from visiting construction areas without the PPE needed for the work being performed.

- If appropriate, separate construction areas from occupied portions of the building using appropriate containment and ventilation practices. For example, (1) ensure that work areas are properly isolated by erecting an air barrier separating the work area from occupants and (2) if necessary, ventilate the work area with exhaust to the outdoors to establish negative pressure relative to surrounding spaces.
- Ensure that construction contaminants exhausted to the outdoors do not re-enter the building.

### **MA 19.2 Protect HVAC Systems**

Protect HVAC systems from contaminants during work activities.

- 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 that 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 that all filters that were used during work activities have been removed, and check that new filters are installed properly before operating the HVAC system during occupancy.

### **MA 19.3 Ventilation Post-Rehabilitation**

Ventilate the building with as much outside air as possible before permanently occupying. 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.



### **MA 19.4 Handle Mercury Properly**

- If mercury contamination is identified, provide guidance to the homeowner and occupants on how to perform proper cleanup. Refer to EPA guidance on cleanup listed in the Relevant Standards or Guidance at the end of this Priority Issue.
- Take particular care not to break any mercury-containing materials during upgrade activities. If an accidental spill occurs, refer to [EPA guidance on cleanup](#). Properly dispose of fluorescent lighting and CFL bulbs that may be part of energy upgrade activities.



**MA 19.5 Protect Highly Absorptive Materials in Work Area**

- Protect any existing absorptive materials (e.g., fabrics, furnishings, carpets) by fully covering them with plastic sheeting.
- 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.

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**EXPANDED ACTIONS****EA 19.1 Consider Additional Protections as Appropriate**

Consider implementing the following options:

- 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.

If negative pressurization in the work areas is not possible, consider an exhausted double-wall buffer zone to separate work areas from surrounding areas.

- Ensure that 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.
- Clean the area thoroughly and frequently and before re-entry of unprotected workers or occupants to ensure the removal of any dust that may contain pollutants. Use sealed HEPA-rated vacuums.
- Follow all manufacturers' printed instructions, which may indicate the need to increase ventilation or evacuate building occupants and other unprotected individuals from work areas during, and for some period of time 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 PM 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, 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.

### **EA 19.2 Replace Mercury-Containing Products and Materials, Where Possible**

Encourage replacement of mercury-containing products and devices (excluding fluorescent lights and CFL bulbs) with products that do not contain mercury. Follow EPA guidance for disposal of mercury-containing products.

#### **Relevant Standards or Guidance**

- [EPA: Cleaning Up a Broken CFL](#)
- [EPA: Mercury in Consumer Products](#)
- [EPA: What to Do if a Mercury Thermometer Breaks](#)

## PRIORITY ISSUE 20.0: JOBSITE SAFETY

Taking precautions to provide a safe job site reduces risks for workers and occupants.



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### ASSESSMENT PROTOCOLS

#### AP 20.1 Evaluation

Evaluate existing and potential health concerns and activities. Refer to [Appendix A: Worker Protection](#) for recommended evaluation measures and actions.



#### Note

By law, employers and supervisors are required to ensure that workers are working with a written OSHA Safety and Health Plan. More details about these requirements and resources are available in [Appendix A: Worker Protection](#).



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### MINIMUM ACTIONS

#### MA 20.1 Protect Workers and Occupants

Protect workers and occupants from on-site health and safety hazards by—

- Ensuring proper isolation (e.g., sealed with plastic sheeting) and ventilation of work area to the outdoors during activities that result in VOC emissions (e.g., installing spray foam insulation, painting, sealing, finishing) AND ventilating as close to the source of VOCs as possible.
- Using appropriate dust control and protective equipment.
- Thoroughly cleaning work area before re-occupancy.
- Adding precautions to protect occupants during and after installation of spray polyurethane foam:
  - Evacuating building occupants and other unprotected trade workers from the work area.
  - Using appropriate personal protective equipment (e.g., chemical-resistant [nitrile] gloves, appropriate respirator, chemical-resistant clothing) for anyone in the work area.



- Cleaning the area thoroughly and waiting until the foam cures before allowing unprotected workers or occupants to reoccupy the work area.

See [Appendix A: Worker Protection](#) for recommended actions to protect worker safety, including available resources.

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## EXPANDED ACTIONS

For additional information on each of the topics, visit the resources provided under each issue in [Appendix A: Worker Protection](#).

# References



## STANDARDS AND OTHER REQUIREMENTS

### **ACCA 4 QM-2007**

ANSI/ACCA Standard 4: Maintenance of HVAC Systems. 2007. Air Conditioning Contractors of America.

### **ACCA 5 QI-2010**

ANSI/ACCA Standard 5: HVAC Quality Installation Specification. 2010. Air Conditioning Contractors of America.

### **ACCA 6 QR-2007**

ANSI/ACCA Standard 6: Restoring the Cleanliness of HVAC Systems. 2007. Air Conditioning Contractors of America.

### **ACCA 9 QIVP-2008**

ANSI/ACCA Standard 9: HVAC Quality Installation Verification Protocols. 2008. Air Conditioning Contractors of America.

### **ANSI/AARST Standard MAH-2014**

Protocol for Conducting Measurements of Radon and Radon Decay Products in Homes. 2014. American Association of Radon Scientists and Technologists.

### **ANSI/ACCA 1 Manual D—2016**

Manual D—Residential Duct Systems. 2016. Air Conditioning Contractors of America Association.

### **ANSI/ACCA 2 Manual J—2016**

Manual J—Residential Load Calculation. 2016. Air Conditioning Contractors of America Association.

### **ANSI/ACCA 3 Manual S—2014**

Manual S—Residential Equipment Selection. 2014. Air Conditioning Contractors of America Association.

### **ANSI/IICRC S500-2015**

ANSI/IICRC Standard and Reference Guide for Professional Water Damage Restoration. Institute of Inspection, Cleaning and Restoration Certification. [webstore.ansi.org/Standards/IICRC/ANSIIICRCS5002015](https://www.webstore.ansi.org/Standards/IICRC/ANSIIICRCS5002015). Last Accessed September 2020.

**ANSI/IICRC S520-2015**

ANSI/IICRC Standard and Reference Guide for Professional Mold Remediation. Institute of Inspection, Cleaning and Restoration Certification. [webstore.ansi.org/Standards/IICRC/ANSIIICRCS5202015](http://webstore.ansi.org/Standards/IICRC/ANSIIICRCS5202015). Last Accessed September 2020.

**ANSI/UL 2034**

ANSI Standard/UL 2034-2005: Single and Multiple Station Carbon Monoxide Alarms. 2017. American National Standards Institute.

**ANSI Z21 Series**

Standards for Residential Gas-Fired Appliances. American National Standards Institute/Canadian Standards Association.

**ANSI Z21.11.2/CSA**

ANSI Standard Z21.11.2-2016. Gas-Fired Room Heaters—Volume II, Unvented Room Heaters. 2007. American National Standards Institute/Canadian Standards Association.

**ANSI Z223.1/NFPA 54**

ANSI Standard Z223.1/NFPA 54: National Fuel Gas Code. 2018. American National Standards Institute/American Gas Association and National Fire Protection Association.

**ANSI/ASHRAE/ASHE Standard 189.3-2017**

Design, Construction, and Operation of Sustainable High-Performance Health Care Facilities. 2017. American Society of Heating, Refrigeration and Air-Conditioning Engineers.

**ASHRAE Handbook—Fundamentals**

2017. [www.ashrae.org/technical-resources/ashrae-handbook/description-2017-ashrae-handbook-fundamentals](http://www.ashrae.org/technical-resources/ashrae-handbook/description-2017-ashrae-handbook-fundamentals). Last Accessed September 2020.

**ASHRAE Handbook—HVAC Applications**

2019. [www.ashrae.org/technical-resources/ashrae-handbook/description-2019-ashrae-handbook-hvac-applications](http://www.ashrae.org/technical-resources/ashrae-handbook/description-2019-ashrae-handbook-hvac-applications). Last Accessed September 2020.

**ASHRAE Handbook—HVAC Systems and Equipment**

2016. [www.ashrae.org/technical-resources/ashrae-handbook/description-2016-ashrae-handbook-hvac-systems-and-equipment](http://www.ashrae.org/technical-resources/ashrae-handbook/description-2016-ashrae-handbook-hvac-systems-and-equipment). Last Accessed September 2020.

**ASHRAE Indoor Air Quality Guide**

2009. [www.ashrae.org/technical-resources/bookstore/indoor-air-quality-guide](http://www.ashrae.org/technical-resources/bookstore/indoor-air-quality-guide). Last Accessed September 2020.

**ASHRAE Standard 52.2-2017/2007**

ANSI/ASHRAE Standard 52.2-2017/2007: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. 2007. American Society of Heating, Refrigeration and Air-Conditioning Engineers.

**ASHRAE Standard 62.1-2019**

ANSI/ASHRAE Standard 62.1-2019: Ventilation for Acceptable Indoor Air Quality. 2019. American Society of Heating, Refrigerating and Air Conditioning Engineers. [www.ashrae.org/resources--publications/bookstore/standards-62-1--62-2](http://www.ashrae.org/resources--publications/bookstore/standards-62-1--62-2). Also includes published addenda. Last Accessed November 2020.

**ASHRAE Standard 62.2-2019**

ANSI/ASHRAE Standard 62.2-2019: Ventilation and Acceptable Indoor Air Quality in Residential Buildings. [www.ashrae.org/resources--publications/bookstore/standards-62-1--62-2](http://www.ashrae.org/resources--publications/bookstore/standards-62-1--62-2). 2019. Also includes published addenda. Last Accessed November 2020.

**ASHRAE Standard 183-2007/2017**

ANSI/ASHRAE/ACCA Standard 183-2007 (RA 2017). Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings.

**ASTM C920**

ASTM Standard C920: Standard Specification for Elastomeric Joint Sealants, Class 25. 2018. American Society for Testing and Materials.

**ASTM E2121**

ASTM Standard E2121: Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings. 2009. American Society for Testing and Materials.

**ASTM E2600**

ASTM Standard E2600-10: Standard Guide for Vapor Encroachment Screening on Property Involved in Real Estate Transactions. 2010. American Society for Testing and Materials.

**BPI-1100-T-2014**

BPI-1100-T-2014: Home Energy Auditing Standard (under development; formerly BPI-101). Building Performance Institute. [www.bpi.org/sites/default/files/ANSI-BPI-1100-T-2014%20Home%20Energy%20Auditing%20Standard.pdf](http://www.bpi.org/sites/default/files/ANSI-BPI-1100-T-2014%20Home%20Energy%20Auditing%20Standard.pdf). Last Accessed September 2020.



**BPI Technical Standards**

Technical Standards for the Building Analyst Professional, CAZ Depressurization Limits Table. 2012. Building Performance Institute. [bpi.org/sites/default/files/Technical%20Standards%20for%20the%20Building%20Analyst%20Professional.pdf](http://bpi.org/sites/default/files/Technical%20Standards%20for%20the%20Building%20Analyst%20Professional.pdf). Last Accessed September 2020.

**BPI Technical Standards**

Technical Standards for the Heating Professional, Blower Door Testing. 2007. Building Performance Institute. [www.bpi.org/sites/default/files/Technical%20Standards%20for%20the%20Heating%20Professional.pdf](http://www.bpi.org/sites/default/files/Technical%20Standards%20for%20the%20Heating%20Professional.pdf). Last Accessed September 2020.

**California Air Resources Board**

Composite Wood Products Airborne Toxic Control Measure (ATCM) Phase 2. [ww2.arb.ca.gov/our-work/programs/composite-wood-products-program](http://ww2.arb.ca.gov/our-work/programs/composite-wood-products-program). Last Accessed September 2020.

**California Department of Public Health**

Standard Method for Testing and Evaluation of VOC Emissions from Indoor Sources. Emission Testing Method for California Specification 01350: Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers Version V1.2–2017. [www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/VOC.aspx](http://www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/VOC.aspx). Last Accessed September 2020.

**California Title 17**

California Code of Regulations, Title 17, sections 93120–93120.12. 2008. State of California. [www.arb.ca.gov/regact/2007/compwood07/fro-final.pdf](http://www.arb.ca.gov/regact/2007/compwood07/fro-final.pdf). Last Accessed September 2020.

**Carpet and Rug Institute**

Green Label Plus. [www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus](http://www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus). Last Accessed September 2020.

**DOE, NREL**

Single-Family Standard Work Specifications. U.S. Department of Energy, National Renewable Energy Laboratory. [sws.nrel.gov](http://sws.nrel.gov). Last Accessed September 2020.

**DOL, OSHA, 29 CFR Part 1926, Subpart K**

Electrical. Standards for Construction. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=FEDERAL\\_REGISTER&p\\_id=16956](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=16956). Last Accessed September 2020.

**DOL, OSHA, 29 CFR Part 1926.21, Subpart C**

Safety and Health Regulations for Construction: General Safety and Health Provisions: Safety Training and Education. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.21](http://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.21). Last Accessed April 2021.

**DOL, OSHA, 29 CFR Part 1926.28(a), Subpart C**

Personal Protective Equipment. Safety and Health Regulations for Construction: Occupational Health and Environmental Controls. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10614](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10614). Last Accessed September 2020.

**DOL, OSHA, 29 CFR Part 1926.59, Subpart D**

Hazard Communication. Safety and Health Regulations for Construction: Occupational Health and Environmental Controls: Hazard Communication. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_id=10633&p\\_table=STANDARDS](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10633&p_table=STANDARDS). Last Accessed September 2020.

**DOL, OSHA, 29 CFR Part 1926.62, Subpart D**

Lead. Safety and Health Regulations for Construction: Occupational Health and Environmental Controls. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10641](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10641). Last Accessed September 2020.

**DOL, OSHA, 29 CFR Part 1926.501, Subpart M**

Fall Protection. Safety and Health Regulations for Construction. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_id=10757&p\\_table=STANDARDS](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10757&p_table=STANDARDS). Last Accessed September 2020.

**DOL, OSHA, 29 CFR Part 1926.1053, Subpart X**

Ladders. Safety and Health Regulations for Construction. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=standards&p\\_id=10839](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10839). Last Accessed September 2020.

**DOL, OSHA, 29 CFR Part 1926.1101, Subpart Z**

Asbestos. Safety and Health Regulations for Construction: Toxic and Hazardous Substances; Sampling and Analysis: Non-mandatory. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10864](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10864). Last Accessed September 2020.

**EPA Asbestos and Vermiculite**

General information and state and regional contacts. [www.epa.gov/asbestos](http://www.epa.gov/asbestos). Last Accessed September 2020.

**EPA Formaldehyde Emission Standards for Composite Wood Products TSCA Title VI**

Background, resources, guidance. [www.epa.gov/formaldehyde/formaldehyde-emission-standards-composite-wood-products](http://www.epa.gov/formaldehyde/formaldehyde-emission-standards-composite-wood-products). Last Accessed September 2020.

**EPA Indoor airPLUS Specifications**

Indoor airPLUS Construction Specifications 1.2, 1.4, 1.5, 1.6, 4.1, 4.2, 4.7, 5.1, 5.6, 6.1, 6.2 and 6.3. U.S. Environmental Protection Agency. [www.epa.gov/indoorairplus/indoor-airplus-program-documents](http://www.epa.gov/indoorairplus/indoor-airplus-program-documents). Last Accessed September 2020.

**EPA Integrated Pest Management**

General information and tools. [www.epa.gov/managing-pests-schools/introduction-integrated-pest-management](http://www.epa.gov/managing-pests-schools/introduction-integrated-pest-management). Last Accessed September 2020.

**EPA Moisture Control Guidance for Building Design, Construction and Maintenance**

Provides guidance for moisture control in buildings. 2013. [www.epa.gov/indoor-air-quality-iaq/moisture-control-guidance-building-design-construction-and-maintenance](http://www.epa.gov/indoor-air-quality-iaq/moisture-control-guidance-building-design-construction-and-maintenance). Last Accessed September 2020.

**EPA Mold Remediation in Schools and Commercial Buildings**

Information and resources for mold remediation. 2008. [www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide](http://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide). Last Accessed September 2020.

**EPA Protect Your Family from Asbestos—Contaminated Vermiculite Insulation**

[www.epa.gov/asbestos/protect-your-family-asbestos-contaminated-vermiculite-insulation](http://www.epa.gov/asbestos/protect-your-family-asbestos-contaminated-vermiculite-insulation). Last Accessed September 2020.

**EPA Renovation, Repair and Painting Program Rule**

Federal Register 40 CFR Part 745: Lead; Clearance and Clearance Testing Requirements for the Renovation, Repair and Painting Program, Proposed Rule. 2010. U.S. Environmental Protection Agency, 75(87):25038–25073. [www.epa.gov/lead/lead-renovation-repair-and-painting-program\\_edocket.access.gpo.gov/2010/pdf/2010-10102.pdf](http://www.epa.gov/lead/lead-renovation-repair-and-painting-program_edocket.access.gpo.gov/2010/pdf/2010-10102.pdf). Last Accessed September 2020.

**EPA Safer Choice**

Tools and resources. [www.epa.gov/saferchoice](http://www.epa.gov/saferchoice). Last Accessed September 2020.

**FloorScore®**

Standards for Resilient Flooring and Related Resources. [rfci.com/floorscore](https://rfci.com/floorscore). Last Accessed September 2020.

**Green Seal Standard GS-11**

GS-11: Green Seal Environmental Standard for Paints and Coatings. 2008. Green Seal, Inc. [www.greenseal.org/green-seal-standards/gs-11/](https://www.greenseal.org/green-seal-standards/gs-11/). Last Accessed September 2020.

**GREENGUARD Gold**

GREENGUARD Environmental Institute. [www.greenguard.org/en/manufacturers/manufacturer\\_childrenSchools.aspx](https://www.greenguard.org/en/manufacturers/manufacturer_childrenSchools.aspx). Last Accessed September 2020.

**Green Wise Gold**

Paint standards. [www.greenwisepaint.com](https://www.greenwisepaint.com). Last Accessed September 2020.

**Health Product Declarations**

Open Standard Specification. [www.hpd-collaborative.org](https://www.hpd-collaborative.org). Last Accessed September 2020.

**Home Energy**

Introduction to Blower Doors. 1999. [homeenergy.org/show/article/id/1014](https://homeenergy.org/show/article/id/1014). Last Accessed September 2020.

**HUD Title 24**

U.S. HUD Title 24, Subparts J and R: Lead-Based Paint Poisoning Prevention in Certain Residential Structures. 2004. U.S. Department of Housing and Urban Development.

**International Building Code, 2018**

International Code Council, Inc. [codes.iccsafe.org/content/IBC2018?site\\_type=public](https://codes.iccsafe.org/content/IBC2018?site_type=public). Last Accessed September 2020.

**International Mechanical Code, 2018**

International Code Council, Inc. [codes.iccsafe.org/content/IMC2015](https://codes.iccsafe.org/content/IMC2015). Last Accessed September 2020.

**Master Painters Institute**

Master Painters Institute (MPI) Green Performance Standards for Paints and Coatings [GPS-2; Extreme Green]. [www.paintinfo.com/index.asp](https://www.paintinfo.com/index.asp); [www.paintinfo.com/GPS/gps.pdf](https://www.paintinfo.com/GPS/gps.pdf). Last Accessed September 2020.

**National Center for Healthy Housing IPM**

Integrated Pest Management: A Guide for Affordable Housing. [www.stoppests.org/what-is-ipm/guide/](http://www.stoppests.org/what-is-ipm/guide/). Last Accessed September 2020.

**NFPA 31**

Standard for the Installation of Oil-Burning Equipment. 2016. National Fire Protection Association.

**NFPA 211**

Standard for Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances. 2019. National Fire Protection Association.

**NFPA 720/NFPA 72**

Standard for the Installation of Household Carbon Monoxide (CO) Warning Equipment. National Fire Alarm and Signaling Code. 2015/2019. National Fire Protection Association.

**Northeast States for Coordinated Air Use Management Regulations**

Outdoor Hydronic Heater Model Regulations, including installation of new technology and EPA Phase 2 units, pages 4–5. 2007. Clean Air Association of the Northeast States. [www.nescaum.org/documents/modelregulationoutdoorhydronicheatersfinalB.pdf](http://www.nescaum.org/documents/modelregulationoutdoorhydronicheatersfinalB.pdf). Last Accessed September 2020.

**Scientific Certification Systems**

Indoor Advantage Standard EC 10.3 2014 V4.0, Indoor Air Quality Product Performance Standard for Building Interiors. March 2017. [cdn.scsglobalservices.com/files/standards/scs\\_stn\\_ec10.3-2014\\_v4.0\\_031617.pdf](http://cdn.scsglobalservices.com/files/standards/scs_stn_ec10.3-2014_v4.0_031617.pdf); [www.scsglobalservices.com/services/indoor-air-quality-certification](http://www.scsglobalservices.com/services/indoor-air-quality-certification). Last Accessed September 2020.

**South Coast Air Quality Management District**

Rule 1113 VOC Content Limits. [www.aqmd.gov/home/rules-compliance/compliance/vocs/architectural-coatings/tos](http://www.aqmd.gov/home/rules-compliance/compliance/vocs/architectural-coatings/tos), [www.aqmd.gov/home/rules-compliance/compliance/vocs/rules](http://www.aqmd.gov/home/rules-compliance/compliance/vocs/rules). Last Accessed September 2020.

## GUIDANCE

### **Air Conditioning, Heating and Refrigeration Institute**

HVAC Industry Guidelines. [www.ahrinet.org/Standards/HVACR-Industry-Guidelines](http://www.ahrinet.org/Standards/HVACR-Industry-Guidelines). Last Accessed September 2020.

### **American Chemistry Council**

Spray Polyurethane Foam Health and Safety. American Chemistry Council. [www.spraypolyurethane.org](http://www.spraypolyurethane.org). Last Accessed September 2020.

### **American Conference of Governmental Industrial Hygienists**

Bioaerosols Assessment and Control. 1999. American Conference of Governmental Industrial Hygienists. [www.techstreet.com/standards/bioaerosols-assessment-and-control?product\\_id=2088254](http://www.techstreet.com/standards/bioaerosols-assessment-and-control?product_id=2088254). Last Accessed April 2021.

### **American Industrial Hygiene Association**

Recognition, Evaluation, and Control of Indoor Mold. 2008. American Industrial Hygiene Association. [www.aiha.org/education/marketplace/indoor-mold-book](http://www.aiha.org/education/marketplace/indoor-mold-book). Last Accessed September 2020.

### **American Society of Home Inspectors: Radon Mitigation System Inspection Checklist**

American Society of Home Inspectors Radon Mitigation System Inspection Checklist. [19january2017snapshot.epa.gov/sites/production/files/2014-08/documents/ashicklst.pdf](http://19january2017snapshot.epa.gov/sites/production/files/2014-08/documents/ashicklst.pdf). Last Accessed September 2020.

### **ASHRAE Handbooks**

ASHRAE Handbook Series. American Society of Heating, Refrigeration and Air-Conditioning Engineers.

### **ASPE Data Book**

A Plumbing Engineer's Guide to System Design and Specifications, Volume 2: Plumbing Systems, p. 10. 2000. American Society of Plumbing Engineers.

### **California Air Resources Board: Formaldehyde**

Formaldehyde in the Home. California Environmental Protection Agency, Air Resources Board. [www.arb.ca.gov/research/indoor/formaldgl08-04.pdf](http://www.arb.ca.gov/research/indoor/formaldgl08-04.pdf). Last Accessed September 2020.

### **California Air Resources Board: Ozone**

Resources on Ozone Producing Air Cleaners. California Environmental Protection Agency, Air Resources Board. [www.arb.ca.gov/research/indoor/ozone.htm](http://www.arb.ca.gov/research/indoor/ozone.htm). Last Accessed September 2020.

**CDC Fall Prevention Checklist**

Check for Safety: A Home Fall Prevention Checklist for Older Adults. 2015. Centers for Disease Control and Prevention. [www.cdc.gov/steady/pdf/check\\_for\\_safety\\_brochure-a.pdf](http://www.cdc.gov/steady/pdf/check_for_safety_brochure-a.pdf). Last Accessed September 2020.

**CDC Home Safety Checklists**

Older Adults Fall. Centers for Disease Control and Prevention. [www.cdc.gov/HomeandRecreationalSafety/Falls/index.html](http://www.cdc.gov/HomeandRecreationalSafety/Falls/index.html). Last Accessed September 2020.

**CDC Mold Cleanup**

Cleanup and Remediation. 2017. Centers for Disease Control and Prevention. [www.cdc.gov/mold/cleanup.htm](http://www.cdc.gov/mold/cleanup.htm). Last Accessed September 2020.

**CDC Mold Prevention Strategies**

Mold Prevention Strategies and Possible Health Effects in the Aftermath of Hurricanes and Major Floods. 2006. Centers for Disease Control and Prevention. [www.cdc.gov/mmwr/preview/mmwrhtml/rr5508a1.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5508a1.htm). Last Accessed September 2020.

**CDC Resource on Rodents**

Resource on Rodents. 2010. Centers for Disease Control and Prevention. [www.cdc.gov/rodents](http://www.cdc.gov/rodents). Last Accessed September 2020.

**CDC, NIOSH, Cleaning and Remediation of HVAC Systems**

NIOSH Interim Recommendations for the Cleaning and Remediation of Flood-Contaminated HVAC Systems: A Guide for Building Owners and Managers. Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health. [www.cdc.gov/niosh/topics/emres/cleaning-flood-hvac.html](http://www.cdc.gov/niosh/topics/emres/cleaning-flood-hvac.html). Last Accessed September 2020.

**CDC, NIOSH, Protective Clothing and Ensembles, Safety and Health Topics**

2010. Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health. [www.cdc.gov/niosh/topics/protclothing](http://www.cdc.gov/niosh/topics/protclothing). Reviewed 2016. Last Accessed September 2020.

**CDC, NIOSH, Respirators, Safety and Health Topics**

2011. Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health. [www.cdc.gov/niosh/topics/respirators](http://www.cdc.gov/niosh/topics/respirators). Reviewed 2016. Last Accessed September 2020.

**Chimney Safety Institute of America**

Top-Down Method of Stove Loading. Chimney Safety Institute of America. [www.csia.org/top\\_down\\_burn.html](http://www.csia.org/top_down_burn.html). Last Accessed September 2020.

**Collaborative for High-Performance Schools**

High-Performance Products Database. Collaborative for High-Performance Schools. [chps.net/products](https://chps.net/products). Last Accessed September 2020.

**Consumer Product Safety Commission**

Carbon Monoxide Questions and Answers. 2008. U.S. Consumer Product Safety Commission. [www.cpsc.gov/Safety-Education/Safety-Education-Centers/Carbon-Monoxide-Information-Center/Carbon-Monoxide-Questions-and-Answers](https://www.cpsc.gov/Safety-Education/Safety-Education-Centers/Carbon-Monoxide-Information-Center/Carbon-Monoxide-Questions-and-Answers). Last Accessed September 2020.

**DOE**

Building America Tools and Resources. 2019. Office of Energy Efficiency & Renewable Energy. U.S. Department of Energy. [www.energy.gov/eere/buildings/building-america-tools-and-resources](https://www.energy.gov/eere/buildings/building-america-tools-and-resources). Last Accessed September 2020.

**DOE**

Weatherization and Workforce Guidelines for Home Energy Upgrades: 2011. U.S. Department of Energy. [www.energy.gov/eere/wipo/downloads/weatherization-and-workforce-guidelines-home-energy-upgrades-fact-sheet](https://www.energy.gov/eere/wipo/downloads/weatherization-and-workforce-guidelines-home-energy-upgrades-fact-sheet). Last Accessed September 2020.

**DOL, OSHA, Asbestos**

Asbestos. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/asbestos](https://www.osha.gov/SLTC/asbestos). Last Accessed September 2020.

**DOL, OSHA, Asbestos—Construction**

Asbestos—Construction. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/asbestos/construction.html](https://www.osha.gov/SLTC/asbestos/construction.html). Last Accessed September 2020.

**DOL, OSHA, Carbon Monoxide Poisoning Quick Card**

Protecting Yourself from Carbon Monoxide Poisoning Quick Card. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/sites/default/files/publications/carbon\\_monoxide.pdf](https://www.osha.gov/sites/default/files/publications/carbon_monoxide.pdf). Last Accessed April 2021.

**DOL, OSHA, Combustible Dust**

Combustible Dust. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dsg/combustibledust/index.html](https://www.osha.gov/dsg/combustibledust/index.html). Last Accessed September 2020.



**DOL, OSHA, Confined Spaces**

Confined Spaces. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/confinedspaces/index.html](http://www.osha.gov/SLTC/confinedspaces/index.html). Last Accessed September 2020.

**DOL, OSHA, Electrical Incidents E-Tool**

Electrical Incidents E-Tool. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/etools/construction/electrical\\_incidents/mainpage.html](http://www.osha.gov/SLTC/etools/construction/electrical_incidents/mainpage.html). Last Accessed September 2020.

**DOL, OSHA, Falls**

Fall Protection. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/fallprotection/index.html](http://www.osha.gov/SLTC/fallprotection/index.html). Last Accessed September 2020.

**DOL, OSHA, Falls E-Tool**

Falls E-Tool. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/etools/construction/falls/mainpage.html](http://www.osha.gov/SLTC/etools/construction/falls/mainpage.html). Last Accessed September 2020.

**DOL, OSHA, Green Jobs Hazards**

Green Jobs Hazards, Weather Insulating/Sealing. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dep/greenjobs/weather\\_spf.html](http://www.osha.gov/dep/greenjobs/weather_spf.html). Last Accessed September 2020.

**DOL, OSHA, Hazard Communication**

Hazard Communication. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dsg/hazcom/index.html](http://www.osha.gov/dsg/hazcom/index.html). Last Accessed September 2020.

**DOL, OSHA, Lead**

Lead. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/lead/index.html](http://www.osha.gov/SLTC/lead/index.html). Last Accessed September 2020.

**DOL, OSHA, Lead—Construction**

Lead in Construction. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/Publications/osha3142.pdf](http://www.osha.gov/Publications/osha3142.pdf). Last Accessed September 2020.

**DOL, OSHA, Mold in Workplace**

A Brief Guide to Mold in the Workplace. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dts/shib/shib101003.html](http://www.osha.gov/dts/shib/shib101003.html). Last Accessed September 2020.

**DOL, OSHA, OSH Act of 1970**

Section 5 (a)(1). U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/laws-regs/oshact/section5-duties](http://www.osha.gov/laws-regs/oshact/section5-duties). Last Accessed September 2020.

**DOL, OSHA, Permissible Exposure Limits**

Permissible Exposure Limits—Annotated Tables. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dsg/annotated-pels](http://www.osha.gov/dsg/annotated-pels). Last Accessed September 2020.

**DOL, OSHA, Stairways and Ladders**

Stairways and Ladders: A Guide to OSHA Rules. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/Publications/osh3124.pdf](http://www.osha.gov/Publications/osh3124.pdf). Last Accessed September 2020.

**DOL, OSHA, Wood Dust**

Wood Dust. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/wooddust/index.html](http://www.osha.gov/SLTC/wooddust/index.html). Last Accessed September 2020.

**ENERGY STAR® Checklist**

Rater Design Review Checklist ENERGY STAR® Certified Homes. 2008. [www.energystar.gov/ia/partners/bldrs\\_lenders\\_raters/downloads/rev\\_8/Rater%20Checklists%20v101%202015-06-26\\_clean\\_fillable\\_508.pdf?8255-eac0](http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/rev_8/Rater%20Checklists%20v101%202015-06-26_clean_fillable_508.pdf?8255-eac0). Last Accessed September 2020.

**EPA Asbestos**

Asbestos in Your Home. 1990. U.S. Environmental Protection Agency. [nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=20001EVF.txt](http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=20001EVF.txt). Last Accessed September 2020.

**EPA Asbestos**

Regional and State Asbestos Contacts. 2011. U.S. Environmental Protection Agency. [www.epa.gov/asbestos/state-asbestos-contacts](http://www.epa.gov/asbestos/state-asbestos-contacts). Last Accessed September 2020.

**EPA Asthma**

Indoor Environmental Asthma Triggers. 2011. U.S. Environmental Protection Agency. [www.epa.gov/asthma/triggers.html](http://www.epa.gov/asthma/triggers.html). Reviewed 2019. Last Accessed September 2020.

**EPA Burn Wise**

Guides for best burn practices and identifying cleaner-burning appliances, lists of appliances, and tips. [www.epa.gov/burnwise](http://www.epa.gov/burnwise). Reviewed 2019. Last Accessed September 2020.

**EPA Brownfields and Land Revitalization Activities Near You**

Information about Brownfields and Land Revitalization in your region. [www.epa.gov/brownfields/brownfields-and-land-revitalization-activities-near-you](http://www.epa.gov/brownfields/brownfields-and-land-revitalization-activities-near-you). Last Accessed September 2020.

**EPA Carbon Monoxide**

Carbon Monoxide's Impact on Indoor Air Quality. 2011. [www.epa.gov/indoor-air-quality-iaq/carbon-monoxides-impact-indoor-air-quality](http://www.epa.gov/indoor-air-quality-iaq/carbon-monoxides-impact-indoor-air-quality). Last Accessed September 2020.

**EPA Environmental Tobacco Smoke**

Secondhand Smoke and Smoke-Free Homes. 2010. [www.epa.gov/indoor-air-quality-iaq/secondhand-smoke-and-smoke-free-homes](http://www.epa.gov/indoor-air-quality-iaq/secondhand-smoke-and-smoke-free-homes). Last Accessed September 2020.

**EPA IAQ**

Air Cleaners and Air Filters in the Home. 2018. U.S. Environmental Protection Agency, Indoor Air Quality. [www.epa.gov/indoor-air-quality-iaq/air-cleaners-and-air-filters-home](http://www.epa.gov/indoor-air-quality-iaq/air-cleaners-and-air-filters-home). Last Accessed September 2020.

**EPA IAQ**

Ozone Generators That Are Sold as Air Cleaners. 2010. U.S. Environmental Protection Agency, Indoor Air Quality. [www.epa.gov/indoor-air-quality-iaq/ozone-generators-are-sold-air-cleaners](http://www.epa.gov/indoor-air-quality-iaq/ozone-generators-are-sold-air-cleaners). Last updated December 23, 2019. Last Accessed September 2020.

**EPA IAQ**

Volatile Organic Compounds' Impact on Indoor Air Quality. 2011. U.S. Environmental Protection Agency. [www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality](http://www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality). Last updated November 6, 2017. Last Accessed September 2020.

**EPA IPM**

Integrated Pest Management Principles. 2011. U.S. Environmental Protection Agency, Integrated Pest Management. [www.epa.gov/safepestcontrol/integrated-pest-management-ipm-principles](http://www.epa.gov/safepestcontrol/integrated-pest-management-ipm-principles). Last updated April 11, 2019. Last Accessed September 2020.

**EPA Lead**

Lead Test Kits. 2018. U.S. Environmental Protection Agency. [www.epa.gov/lead/lead-test-kits](http://www.epa.gov/lead/lead-test-kits). Last updated July 7, 2020. Last Accessed September 2020.

**EPA Lead Accredited Training Programs**

Locate Accredited Renovation Training Programs. U.S. Environmental Protection Agency. [cfpub.epa.gov/flpp/searchrrp\\_training.htm](http://cfpub.epa.gov/flpp/searchrrp_training.htm). Last updated February 10, 2017. Last Accessed September 2020.

**EPA Lead-Based Paint Renovation, Repair, and Painting Program**

Lead-Safe Certified Guide to Renovate Right Brochure. 2011. U.S. Environmental Protection Agency. [nepis.epa.gov/Exe/ZyNET.exe/60001QJN.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2006+Thru+2010&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C06thru10%5CTxt%5C00000021%5C60001QJN.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL](http://nepis.epa.gov/Exe/ZyNET.exe/60001QJN.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2006+Thru+2010&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C06thru10%5CTxt%5C00000021%5C60001QJN.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL). Last Accessed April 2021.

**EPA Lead-Based Paint Renovation, Repair, and Painting Program**

Small Entity Compliance Guide to Renovate Right. 2010. U.S. Environmental Protection Agency. [www.epa.gov/lead/small-entity-compliance-guide-renovate-right-epas-lead-based-paint-renovation-repair-and-0](http://www.epa.gov/lead/small-entity-compliance-guide-renovate-right-epas-lead-based-paint-renovation-repair-and-0). Last Accessed September 2020.

**EPA Mercury**

Mercury in Consumer Products. 2019. U.S. Environmental Protection Agency. [www.epa.gov/mercury/mercury-consumer-products](http://www.epa.gov/mercury/mercury-consumer-products). Last updated October 16, 2019. Last Accessed September 2020.

**EPA Mercury**

What to Do if a Mercury Thermometer Breaks. 2019. U.S. Environmental Protection Agency. [www.epa.gov/mercury/what-do-if-mercury-thermometer-breaks](http://www.epa.gov/mercury/what-do-if-mercury-thermometer-breaks). Last updated December 18, 2019. Last Accessed September 2020.

**EPA Mercury in CFLs**

Cleaning Up a Broken CFL. 2019. U.S. Environmental Protection Agency. [www.epa.gov/cfl/cleaning-broken-cfl](http://www.epa.gov/cfl/cleaning-broken-cfl). Last updated May 21, 2019. Last Accessed September 2020.

**EPA Mold**

A Brief Guide to Mold, Moisture, and Your Home. 2010. U.S. Environmental Protection Agency. [www.epa.gov/mold/brief-guide-mold-moisture-and-your-home](http://www.epa.gov/mold/brief-guide-mold-moisture-and-your-home). Last updated on August 14, 2020. Last Accessed September 2020.

**EPA Mold**

Mold. 2010. U.S. Environmental Protection Agency. [www.epa.gov/mold](http://www.epa.gov/mold). Last updated on January 16, 2020. Last Accessed September 2020.

**EPA Mold**

Mold Remediation in Schools and Commercial Buildings. 2010. U.S. Environmental Protection Agency. [www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide](http://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide). Last updated July 20, 2020. Last Accessed September 2020.

**EPA PCBs**

Polychlorinated Biphenyls. 2011. U.S. Environmental Protection Agency. [www.epa.gov/pcbs](http://www.epa.gov/pcbs). Last updated July 27, 2020. Last Accessed September 2020.

**EPA PCBs**

Steps to Safe PCB Abatement Activities. U.S. Environmental Protection Agency. [www.epa.gov/pcbs/steps-safe-pcb-abatement-activities](http://www.epa.gov/pcbs/steps-safe-pcb-abatement-activities). Last updated July 14, 2019. Last Accessed September 2020.

**EPA PCBs**

Steps to Safe Renovation and Repair Activities. U.S. Environmental Protection Agency. [www.epa.gov/pcbs/steps-safe-renovation-and-repair-activities](http://www.epa.gov/pcbs/steps-safe-renovation-and-repair-activities). Last updated July 14, 2019. Last Accessed September 2020.

**EPA PCB-Containing Light Ballasts**

Proper Maintenance, Removal, and Disposal of PCB-Containing Fluorescent Light Ballasts. 2011. U.S. Environmental Protection Agency. [www.epa.gov/pcbs/polychlorinated-biphenyls-pcbs-building-materials](http://www.epa.gov/pcbs/polychlorinated-biphenyls-pcbs-building-materials). Last updated June 29, 2020. Last Accessed September 2020.

**EPA PCBs in Caulk**

Information for Contractors Working in Older Buildings that May Contain PCBs. U.S. Environmental Protection Agency. [www.epa.gov/pcbs/polychlorinated-biphenyls-pcbs-building-materials#Information-Contractors](http://www.epa.gov/pcbs/polychlorinated-biphenyls-pcbs-building-materials#Information-Contractors). Last Updated June 29, 2020. Last Accessed September 2020.

**EPA Pests**

Got Pests? Control Them Safely. 2011. U.S. Environmental Protection Agency. [www.epa.gov/safepestcontrol/got-pests-control-them-safely](http://www.epa.gov/safepestcontrol/got-pests-control-them-safely). Last updated June 16, 2017. Last Accessed September 2020.

**EPA Post-Disaster Renovations and Lead-Based Paint**

Guidance for renovations after a disaster and dealing with lead-based paint. [www.epa.gov/lead/post-disaster-renovations-and-lead-based-paint](http://www.epa.gov/lead/post-disaster-renovations-and-lead-based-paint). Last updated March 12, 2018. Last Accessed September 2020.

**EPA Radon**

Find Information about Local Radon Zones and State Contact Information. U.S. Environmental Protection Agency. [www.epa.gov/radon](http://www.epa.gov/radon). Last updated January 14, 2021. Last Accessed March 2021.

**EPA Safer Choice**

Safer Choice Information product information. [www.epa.gov/saferchoice](http://www.epa.gov/saferchoice). Last updated June 3, 2020. Last Accessed September 2020.

**EPA SPF**

Spray Polyurethane Foam Product Types. [archive.epa.gov/epa/saferchoice/spray-polyurethane-foam-product-types.html](http://archive.epa.gov/epa/saferchoice/spray-polyurethane-foam-product-types.html). Last updated September 12, 2016. Last Accessed September 2020.

**EPA State Asbestos Contacts**

List of State asbestos contacts to help find trained and accredited asbestos professionals. [www.epa.gov/asbestos/state-asbestos-contacts](http://www.epa.gov/asbestos/state-asbestos-contacts). Last updated December 17, 2019. Last Accessed September 2020.

**EPA Vapor Intrusion Mitigation Approaches**

Indoor Air Vapor Intrusion Mitigation Approaches. 2008. U.S. Environmental Protection Agency. [www.epa.gov/vaporintrusion/indoor-air-vapor-intrusion-mitigation-approaches](http://www.epa.gov/vaporintrusion/indoor-air-vapor-intrusion-mitigation-approaches). Last updated September 12, 2016. Last Accessed September 2020.

**EPA Vermiculite**

Protect Your Family From Asbestos-Contaminated Vermiculite Insulation. 2011. U.S. Environmental Protection Agency. [www.epa.gov/asbestos/protect-your-family-asbestos-contaminated-vermiculite-insulation](http://www.epa.gov/asbestos/protect-your-family-asbestos-contaminated-vermiculite-insulation). Last updated January 2, 2020. Last Accessed September 2020.

**EPA, OLEM (formerly known as OSWER), Draft Guidance for Evaluating Vapor Intrusion**

Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). 2002. U.S. Environmental Protection Agency. [archive.epa.gov/epawaste/hazard/web/pdf/appa-c.pdf](http://archive.epa.gov/epawaste/hazard/web/pdf/appa-c.pdf). Last Accessed September 2020.

**FloorScore®**

Resilient Flooring Scientific Certification Systems Global Services.  
[www.scsglobalservices.com/services/floorscore](http://www.scsglobalservices.com/services/floorscore). Last Accessed September 2020.

**Home Energy, Advanced Blower Door Techniques**

David Bohac, “Zone Pressure Diagnostic.” 2002. Home Energy. [www.homeenergy.org/show/article/nav/diagnostics/page/7/id/267](http://www.homeenergy.org/show/article/nav/diagnostics/page/7/id/267). Last Accessed September 2020.

**HUD Lead-Safe Work Practices**

The Renovation, Repair and Painting Rule. U.S. Department of Housing and Urban Development. [www.hud.gov/program\\_offices/healthy\\_homes/training/rrp/rrp](http://www.hud.gov/program_offices/healthy_homes/training/rrp/rrp). Last Accessed September 2020.

**HUD Notice**

Federal Register Public Housing Assessment System Physical Condition Scoring Process Interim Scoring, Corrections and Republication. 2001. U.S. Department of Housing and Urban Development. 66(117): 59084–59124. [www.huduser.org/portal/datasets/pis/66FR59084.pdf](http://www.huduser.org/portal/datasets/pis/66FR59084.pdf). Last Accessed September 2020.

**Lead Service Line Replacement Collaborative**

Guidance and Resources. [www.lslr-collaborative.org](http://www.lslr-collaborative.org). Last Accessed September 2020.

**Minnesota Center for Energy and Environment**

Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments. 2004. Minnesota Center for Energy and Environment. [www.mncee.org/getattachment/Resources/Projects/Secondhand-Smoke-Research/Reduction-of-Environmental-Tobacco-Smoke-Transfer-in-Minnesota-Multifamily-Buildings-Using-Air-Sealing-and-Ventilation-Treatments.pdf.aspx](http://www.mncee.org/getattachment/Resources/Projects/Secondhand-Smoke-Research/Reduction-of-Environmental-Tobacco-Smoke-Transfer-in-Minnesota-Multifamily-Buildings-Using-Air-Sealing-and-Ventilation-Treatments.pdf.aspx). Last Accessed September 2020.

**National Center for Healthy Housing Fact Sheet**

Reasons to Explore Smoke-Free Housing. 2009. National Center for Healthy Housing. [www.enterprisecommunity.org/resources/reasons-explore-smoke-free-housing-factsheet-14014](http://www.enterprisecommunity.org/resources/reasons-explore-smoke-free-housing-factsheet-14014). Last Accessed September 2020.

**National Center for Healthy Housing Fact Sheet**

Testing for Lead-Contaminated Dust. 2001. National Center for Healthy Housing. [nchh.org/resource-library/factsheet\\_lead\\_dust.pdf](http://nchh.org/resource-library/factsheet_lead_dust.pdf). Last Accessed September 2020.

**National Center for Healthy Housing IPM**

IPM Guide Fact Sheets. 2010. National Center for Healthy Housing. [nchh.org/who-we-are/nchh-publications/fact-sheets/ipm-guide-fact-sheets](https://www.nchh.org/who-we-are/nchh-publications/fact-sheets/ipm-guide-fact-sheets). Last Accessed September 2020.

**New York City Department of Health and Mental Hygiene**

How to Control Pests Safely. 2008. New York City Department of Health and Mental Hygiene. [www1.nyc.gov/site/doh/health/health-topics/pests-and-pesticides.page](https://www1.nyc.gov/site/doh/health/health-topics/pests-and-pesticides.page). Last Accessed September 2020.

**New York City Department of Health and Mental Hygiene, Integrated Pest Management Toolkit**

Protocols, Specifications for IPM During Renovation. [www1.nyc.gov/site/doh/health/health-topics/pests-and-pesticides-building-owners.page](https://www1.nyc.gov/site/doh/health/health-topics/pests-and-pesticides-building-owners.page). Last Accessed September 2020.

## ADDITIONAL RESOURCES

**CDC, NIOSH**

Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health. [www.cdc.gov/niosh](https://www.cdc.gov/niosh). Last reviewed May 25, 2018. Last Accessed September 2020.

**DOL, OSHA**

U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov](https://www.osha.gov). Last Accessed September 2020.

**EPA IAQ**

Care for Your Air: A Guide to Indoor Air Quality. 2008. U.S. Environmental Protection Agency. [www.epa.gov/sites/production/files/2014-08/documents/careforyourair.pdf](https://www.epa.gov/sites/production/files/2014-08/documents/careforyourair.pdf). Last Accessed September 2020.

**EPA IAQ**

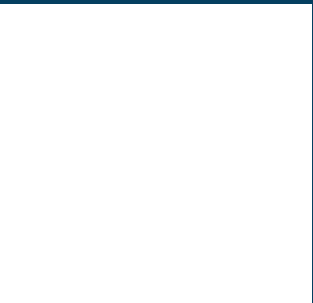
Formaldehyde's Impact on Indoor Air Quality. 2011. U.S. Environmental Protection Agency. [www.epa.gov/indoor-air-quality-iaq/formaldehydes-impact-indoor-air-quality](https://www.epa.gov/indoor-air-quality-iaq/formaldehydes-impact-indoor-air-quality). Last updated September 6, 2016. Last Accessed September 2020.

**White House, Recovery Through Retrofit**

Recovery Through Retrofit. 2009. White House. [obamawhitehouse.archives.gov/sites/default/files/fact\\_sheet\\_recovery\\_through\\_retrofit.pdf](https://obamawhitehouse.archives.gov/sites/default/files/fact_sheet_recovery_through_retrofit.pdf). Last Accessed September 2020.



# Appendix A: Worker Protection



Engaging in energy-focused retrofits, home weatherization projects, and renovation or remodeling efforts can present risks to occupants, and workers' health and safety also may be compromised if risks are not assessed appropriately and corrective actions are not taken. This Appendix was developed to call attention to issues that are of concern to workers' health and safety. Information on assessing the risks to workers, recommended actions to minimize risks to workers' health and safety, and additional resources are provided below.

By law, employers and supervisors are required to ensure that—

1. Worksite operations are conducted in compliance with Occupational Safety and Health Administration (OSHA) regulatory requirements.
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.

OSHA regulatory requirements identify the following construction hazards to be addressed:

- Chemical Hazards—[29 CFR 1926.59](#)
- Confined Space—[29 CFR 1926.21](#)
- Electrical—[29 CFR 1926 Subpart K](#)
- Falls—[29 CFR 1926.501](#)
- Ladders—[29 CFR 1926.1053](#)

Site plans should address safety and health and should include precautions to address multiple construction issues, including the issues outlined in the following section, *Recommended Assessments and Actions for Priority Worker Safety Concerns*. This section also details measures for an employer to take when evaluating existing and potential health concerns, as well as recommended actions to ensure worker safety. Free help with developing these plans is often available from state or federal training (consulting) programs.

When known pollutants are being produced or disturbed during retrofit activities, follow appropriate standards (including OSHA, National Institute for Occupational Safety and Health [NIOSH], U.S. Environmental Protection Agency [EPA] Lead Safe, and Building Performance Institute) to minimize worker and occupant exposure.

When possible, choose construction products whose manufacturers disclose all ingredients, and verify that they are free of formaldehyde, mercury and other known toxic substances.

# RECOMMENDED ASSESSMENTS AND ACTIONS FOR PRIORITY WORKER SAFETY CONCERNS

## ASBESTOS

### Assessment

Determine whether workers will be exposed to asbestos-containing material (ACM).

### Actions

- Retrofitting/renovation activities may expose workers to ACM (e.g., if the home was built before 1990) and require compliance with the OSHA rule at [29 CFR 1926.1101](#), which provides the required protection measures.
- See [OSHA's website on asbestos](#) for additional information and resources.

## CHEMICAL HAZARDS

### Assessment

Determine whether workers will be exposed to chemical hazards.

### Actions

- If renovation or retrofitting activities will require the handling of chemical substances, compliance with the OSHA rule at [29 CFR 1926.59](#) is necessary. It requires that chemical safety information be made available for all chemicals in use, that containers be properly labeled and that workers handling them be trained properly.
- See [OSHA's website on chemical hazards communication](#) for additional information and resources.

## CONFINED SPACES

### Assessment

Determine whether workers will be exposed to confined-space hazards.

### Actions

- Ensure that work space has breathable air (i.e., ventilate the work space if necessary). [Section 5\(a\)\(1\) of the OSH Act of 1970](#) requires employers to protect workers from serious workplace hazards. Under the OSHA rule at [29 CFR 1926.21](#), all employees required to enter confined or enclosed spaces must be instructed on the nature of the hazards involved, the necessary

precautions that need to be taken, and the use of required protective and emergency equipment.

- See OSHA’s website on confined spaces and [OSHA’s Confined Spaces Advisor tool](#) for additional resources on confined space hazards in general industry.
- See [OSHA’s Protecting Yourself from Carbon Monoxide Poisoning Quick Card](#) for additional information on sources of carbon monoxide and recommended actions for preventing carbon monoxide exposure.
- See [EPA’s website on the Safer Choice Program](#) for more information on selecting less-toxic products and materials for use in confined spaces.

## DUST

### Assessment

Determine whether the work will create dust.

### Actions

- Workers should know about dust containment procedures and be able to control dust and debris created by equipment used in construction activities.
- Use work methods to minimize dust and prevent dust from spreading to other areas of the home.
- The rooms or areas where work is being done may need to be isolated (e.g., sealed with plastic sheeting) to contain any dust that is generated.
- Turn off forced-air, central heating and air conditioning systems (including local, window air conditioning units) while work that creates dust is being completed.
- Collect and remove all construction debris.
- Conduct a careful cleanup.
- See OSHA’s websites on [wood dust](#), [combustible dust](#) and [permissible exposure limits](#) for additional information and resources.
- See [EPA’s Renovation, Repair and Painting \(RRP\) Program Rule \(40 CFR Part 745\)](#) for recommended actions to prevent, contain and clean up dust.

## ELECTRICAL

### Assessment

Determine whether workers will be exposed to electrical hazards.

### Actions

- The OSHA rule at [29 CFR 1926, Subpart K](#) contains requirements for protecting workers from electrical hazards. Employers must make sure that all non-double-insulated electric equipment is equipped with a grounding conductor (three-wire type). Worn or frayed electric cords must not be used. 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 website on electrical incidents](#) for additional information on electrical safety.

## FALLS

### Assessment

Determine whether workers will be required to work at heights of 6 feet or more.

### Actions

- If work is required at heights of 6 feet or more, the workers must be protected with guard rails or tied off to prevent falling. (See OSHA rule at [29 CFR 1926.501](#) for additional information on requirements.)
- See [OSHA's website on fall protection](#) and [OSHA's Falls E-Tool](#) for additional information on protecting workers from fall hazards.

## LADDERS

### Assessment

Determine whether workers will be using ladders.

### Actions

- If ladders are used, portable ladders must be able to support at least four times the maximum load intended. Ladders that must lean against a wall are to be positioned at a 4:1 angle. Ladders are to be kept free of oil, grease, wet paint and other slipping hazards. The area around the top and bottom of the ladder must be kept clear. Ladders must not be tied or fastened together to provide longer sections. Metal ladders must not be used while working on electrical

equipment and electrical wiring. See the OSHA rule at [29 CFR 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

### Assessment

Determine whether retrofitting or renovation activities will expose workers to lead dust (paint) (e.g., pre-1978 buildings), according to the Assessment Protocols outlined in the Lead section (under [Priority Issue 7.0](#)).

### Actions

- If the facility was built before 1978, the existing paint is assumed to contain lead. Retrofitting or renovation activities must comply with [EPA's RRP Program Rule \(40 CFR 745\)](#) and the OSHA rule at [29 CFR 1926.62](#).
- See OSHA's publication [Lead in Construction](#) for information on OSHA requirements to protect workers from lead hazards in the construction industry.

## MOLD

### Assessment

Determine whether workers will be exposed to mold.

### Actions

- All suspected moldy areas should be remediated by properly trained individuals. Moisture problems need to be identified and fixed or else mold will return. If mold is expected to be disturbed during activities, refer to [OSHA's A Brief Guide to Mold in the Workplace](#), [NIOSH's Recommendations for Cleaning and Remediation of Flood-Contaminated HVAC Systems: A Guide for Building Owners and Managers](#), [EPA's Mold Remediation in Schools and Commercial Buildings](#), [ACGIH's Bioaerosols Assessment and Control](#), [AIHA's Recognition, Evaluation, and Control of Indoor Mold](#) or [American National Standards Institute/Institute of Inspection Cleaning and Restoration Certification \(IICRC\) S520 Standard and IICRC R520 Reference Guide for Professional Mold Remediation](#). See [EPA's website on mold and moisture](#) for additional information on mold and mold remediation.

## POLYCHLORINATED BIPHENYLS (PCBs)

### Assessment

Determine whether workers might be handling PCB-containing or PCB-contaminated building materials, including fluorescent light ballasts and caulk.

### Actions

- See [EPA's website on PCB-Containing Light Ballasts](#) for information on proper maintenance, removal and disposal of PCB-containing fluorescent light ballasts. If leaking ballasts are discovered, wear protective clothing that includes chemical-resistant (nitrile) gloves, boots and disposable overalls.
- See [EPA's website on PCBs in Caulk—Steps to Safe Renovation and Repair Activities](#) for additional information on the safe renovation and abatement of buildings that have PCB-containing caulk. Work practices to help ensure worker and occupant safety include incorporating 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. See OSHA rule at [29 CFR 1926.28\(a\)](#) for information on suitable personal protective equipment (PPE) for dust-generating work methods.

## SPRAY POLYURETHANE FOAM (SPF)

### Assessment

Determine whether SPF will be used on site.

### Actions

- **Minimize occupant and worker exposure to VOCs or other airborne contaminants.** Ensure proper isolation (e.g., containing the work area with plastic sheeting) and exhaust ventilation to the outdoors of work areas during activities that result in VOC emissions (e.g., painting, sealing, finishing) by ventilating as close as possible to the source of contaminant emissions.
- **Worker and occupant protections.** When SPF or poured polyurethane foam insulation is used, follow the manufacturers' instructions for (1) vacating building occupants and other unprotected individuals not involved in the application of the products from the premises during and for some period of time after application, (2) isolating and ventilating the work areas, and (3) using PPE.

## Notes

The curing time (complete reaction) varies depending on the type of SPF product, product formulation, applicator technique, foam thickness, temperature, humidity and other factors. It is important that the applicator read the manufacturer's instructions to ensure proper application and to consult curing and re-occupancy times specific to the product utilized. [Together, these factors will affect re-occupancy time.](#) While the SPF is curing, it still contains unreacted chemicals that include isocyanates and proprietary chemicals. Exposure to isocyanates may cause skin, eye and lung irritation, as well as respiratory tract sensitization during the installation and cure period. Exposures to isocyanates should be minimized. Cutting or trimming foam before it is fully cured may cause exposure to unreacted SPF chemicals. See [EPA's SPF web resources](#) and [American Chemistry Council's Center for the Polyurethanes Industry Spray Polyurethane Foam Health and Safety website](#) for additional information.

Regarding urea formaldehyde foam insulation, this type of SPF contains formaldehyde. Because of safety concerns about potential formaldehyde exposures, it is banned in Canada and Massachusetts.



## REFERENCES

### **American Chemistry Council: Spray Polyurethane Foam Health and Safety**

[www.spraypolyurethane.org](http://www.spraypolyurethane.org)

- [Guidance on Ventilation During Installation of Interior Applications of High-Pressure Spray Polyurethane Foam](#)
- [Guidance on Best Practices for the Installation of SPF](#)
- [Health and Safety Product Stewardship Workbook for High-Pressure Application of Spray Polyurethane Foam \(SPF\)](#)
- [Spray Polyurethane Foam Chemical Health and Safety Training](#)

### **DOL, OSHA, Green Jobs Hazards: Green Jobs Hazards**

Weather Insulating/Sealing. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dep/greenjobs/weather\\_spf.html](http://www.osha.gov/dep/greenjobs/weather_spf.html). Last Accessed September 2020.

### **Spray Polyurethane Foam Alliance**

[www.sprayfoam.org](http://www.sprayfoam.org)

## WORKER PROTECTION RESOURCES

### GENERAL

#### **CDC, NIOSH**

Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health. [www.cdc.gov/niosh](http://www.cdc.gov/niosh). Last reviewed May 25, 2018. Last Accessed September 2020.

#### **CDC, NIOSH**

Protective Clothing and Ensembles, Safety and Health Topics. 2010. Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health. [www.cdc.gov/niosh/topics/protclothing](http://www.cdc.gov/niosh/topics/protclothing). Last reviewed August 24, 2016. Last Accessed September 2020.

#### **CDC, NIOSH**

Respirators, Safety and Health Topics. 2011. Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health. [www.cdc.gov/niosh/topics/respirators](http://www.cdc.gov/niosh/topics/respirators). Last reviewed April 9, 2020. Last Accessed September 2020.

#### **DOL, OSHA**

U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov](http://www.osha.gov). Last Accessed September 2020.

### ASBESTOS

#### **DOL, OSHA, 29 CFR Part 1926.1101, Subpart Z**

Asbestos. Safety and Health Regulations for Construction: Toxic and Hazardous Substances; Sampling and Analysis: Non-mandatory. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_id=10862&p\\_table=STANDARDS](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10862&p_table=STANDARDS). Last Accessed September 2020.

#### **DOL, OSHA, Asbestos**

Asbestos. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/asbestos](http://www.osha.gov/SLTC/asbestos). Last Accessed September 2020.

## CHEMICAL HAZARDS

### **DOL, OSHA, 29 CFR Part 1926.59, Subpart D**

Hazard Communication. Safety and Health Regulations for Construction: Occupational Health and Environmental Controls: Hazard Communication. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_id=10633&p\\_table=STANDARDS](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10633&p_table=STANDARDS). Last Accessed September 2020.

### **DOL, OSHA, Hazard Communication**

Hazard Communication. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dsg/hazcom/index.html](http://www.osha.gov/dsg/hazcom/index.html). Last Accessed September 2020.

## CONFINED SPACE

### **DOL, OSHA, 29 CFR Part 1926.21 Subpart C**

General Safety and Health Provisions: Safety Training and Education. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_id=10607&p\\_table=STANDARDS](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10607&p_table=STANDARDS). Last Accessed September 2020.

### **DOL, OSHA, Carbon Monoxide Poisoning Quick Card**

Protecting Yourself from Carbon Monoxide Poisoning Quick Card. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/sites/default/files/publications/carbon\\_monoxide.pdf](http://www.osha.gov/sites/default/files/publications/carbon_monoxide.pdf). Last Accessed April 2021.

### **DOL, OSHA, Confined Spaces**

Confined Spaces. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/confinedspaces/index.html](http://www.osha.gov/SLTC/confinedspaces/index.html). Last Accessed September 2020.

### **DOL, OSHA, OSH Act of 1970**

Section 5 (a)(1). U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/laws-regs/oshact/section5-duties](http://www.osha.gov/laws-regs/oshact/section5-duties). Last Accessed September 2020.

**EPA Safer Choice.** Safer Choice Information Product Information. 2011. U.S. Environmental Protection Agency. [www.epa.gov/saferchoice](http://www.epa.gov/saferchoice). Last Accessed September 2020.

## DUST

### **DOL, OSHA, Combustible Dust**

Combustible Dust. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dsg/combustibledust/index.html](http://www.osha.gov/dsg/combustibledust/index.html). Last Accessed September 2020.

### **DOL, OSHA, Permissible Exposure Limits**

Permissible Exposure Limits—Annotated Tables. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dsg/annotated-pels/](http://www.osha.gov/dsg/annotated-pels/). Last Accessed September 2020.

### **DOL, OSHA, Wood Dust**

Wood Dust. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/wooddust/index.html](http://www.osha.gov/SLTC/wooddust/index.html). Last Accessed September 2020.

### **EPA Renovation, Repair and Painting (RRP) Program Rule**

Federal Register 40 CFR Part 745: Lead; Clearance and Clearance Testing Requirements for the Renovation, Repair and Painting Program, Proposed Rule. 2010. U.S. Environmental Protection Agency, 75(87):25038–25073. [www.epa.gov/lead/lead-renovation-repair-and-painting-program\\_edocket.access.gpo.gov/2010/pdf/2010-10102.pdf](http://www.epa.gov/lead/lead-renovation-repair-and-painting-program_edocket.access.gpo.gov/2010/pdf/2010-10102.pdf). Last Accessed September 2020.

## ELECTRICAL

### **DOL, OSHA, 29 CFR Part 1926, Subpart K**

Electrical Standards for Construction. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=FEDERAL\\_REGISTER&p\\_id=16956](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=16956). Last Accessed September 2020.

### **DOL, OSHA, Electrical Incidents E-Tool**

Electrical Incidents E-Tool. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/etools/construction/electrical\\_incidents/mainpage.html](http://www.osha.gov/SLTC/etools/construction/electrical_incidents/mainpage.html). Last Accessed September 2020.

## FALLS

### **DOL, OSHA, 29 CFR Part 1926.501, Subpart M**

Fall Protection. Safety and Health Regulations for Construction. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_id=10757&p\\_table=STANDARDS](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10757&p_table=STANDARDS). Last Accessed September 2020.

### **DOL, OSHA, Falls**

Falls. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/fallprotection/index.html](http://www.osha.gov/SLTC/fallprotection/index.html). Last Accessed September 2020.

### **DOL, OSHA, Falls E-Tool**

Falls E-Tool. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/SLTC/etools/construction/falls/mainpage.html](http://www.osha.gov/SLTC/etools/construction/falls/mainpage.html). Last Accessed September 2020.

## LADDERS

### **DOL, OSHA, 29 CFR Part 1926.1053, Subpart X**

Ladders. Safety and Health Regulations for Construction. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=standards&p\\_id=10839](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10839). Last Accessed September 2020.

### **DOL, OSHA, Stairways and Ladders**

Stairways and Ladders: A Guide to OSHA Rules. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/Publications/osh3124.pdf](http://www.osha.gov/Publications/osh3124.pdf). Last Accessed September 2020.

## LEAD

### **DOL, OSHA, 29 CFR Part 1926.62, Subpart D**

Lead. Safety and Health Regulations for Construction: Occupational Health and Environmental Controls. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10641](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10641). Last Accessed September 2020.

### **DOL, OSHA, Lead—Construction**

Lead in Construction. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/Publications/osh3142.pdf](http://www.osha.gov/Publications/osh3142.pdf). Last Accessed September 2020.

**EPA Renovation, Repair and Painting Program Rule**

Federal Register 40 CFR Part 745: Lead; Clearance and Clearance Testing Requirements for the Renovation, Repair and Painting Program, Proposed Rule. 2010. U.S. Environmental Protection Agency, 75(87):25038–25073. [www.epa.gov/lead/lead-renovation-repair-and-painting-program](http://www.epa.gov/lead/lead-renovation-repair-and-painting-program). Last updated May 5, 2020. Last Accessed September 2020.

**MOLD****American Conference of Governmental Industrial Hygienists**

Bioaerosols Assessment and Control. 1999. American Conference of Governmental Industrial Hygienists. [www.techstreet.com/standards/bioaerosols-assessment-and-control?product\\_id=2088254](http://www.techstreet.com/standards/bioaerosols-assessment-and-control?product_id=2088254). Last Accessed April 2021.

**American Industrial Hygiene Association**

Recognition, Evaluation, and Control of Indoor Mold. 2008. American Industrial Hygiene Association. [www.aiha.org/education/marketplace/indoor-mold-book](http://www.aiha.org/education/marketplace/indoor-mold-book). Last Accessed September 2020.

**CDC Mold Cleanup**

Cleanup and Remediation. 2017. Centers for Disease Control and Prevention. [www.cdc.gov/mold/cleanup.htm](http://www.cdc.gov/mold/cleanup.htm). Last reviewed October 24, 2017. Last Accessed September 2020.

**CDC Mold Prevention Strategies**

Mold Prevention Strategies and Possible Health Effects in the Aftermath of Hurricanes and Major Floods. 2006. Centers for Disease Control and Prevention. [www.cdc.gov/mmwr/preview/mmwrhtml/rr5508a1.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5508a1.htm). Last reviewed May 25, 2006. Last Accessed September 2020.

**CDC, NIOSH, Cleaning and Remediation of HVAC Systems**

Recommendations for the Cleaning and Remediation of Flood-Contaminated HVAC Systems: for Building Owners and Managers. Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. [www.cdc.gov/niosh/topics/emres/cleaning-flood-hvac.html](http://www.cdc.gov/niosh/topics/emres/cleaning-flood-hvac.html). Last reviewed September 19, 2018. Last Accessed September 2020.

**DOL, OSHA, Mold in Workplace**

A Brief Guide to Mold in the Workplace. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dts/shib/shib101003.html](http://www.osha.gov/dts/shib/shib101003.html). Last Accessed September 2020.

**EPA Mold**

Mold and Moisture. 2010. U.S. Environmental Protection Agency. [www.epa.gov/mold](http://www.epa.gov/mold). Last updated January 16, 2020. Last Accessed September 2020.

**EPA Mold**

Mold Remediation in Schools and Commercial Buildings. 2010. U.S. Environmental Protection Agency. [www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide](http://www.epa.gov/mold/mold-remediation-schools-and-commercial-buildings-guide). Last updated July 20, 2020. Last Accessed September 2020.

**IICRC**

S500 Standard and Reference Guide for Professional Water Damage Restoration. 2006. Institute of Inspection, Cleaning and Restoration Certification.

**PCBs****EPA PCB-Containing Light Ballasts**

Proper Maintenance, Removal, and Disposal of PCB-Containing Fluorescent Light Ballasts. 2011. U.S. Environmental Protection Agency. [www.epa.gov/pcbs/policy-and-guidance-polychlorinated-biphenyl-pcbs#fluorescent-light-ballasts](http://www.epa.gov/pcbs/policy-and-guidance-polychlorinated-biphenyl-pcbs#fluorescent-light-ballasts). Last updated July 27, 2020. Last Accessed September 2020.

**EPA PCBs in Caulk—Steps to Safe Renovation and Repair Activities**

U.S. Environmental Protection Agency. [www.epa.gov/pcbs/steps-safe-renovation-and-repair-activities](http://www.epa.gov/pcbs/steps-safe-renovation-and-repair-activities). Last updated January 17, 2017. Last Accessed September 2020.

**DOL OSHA, 29 CFR Part 1926.28(a), Subpart C**

Personal Protective Equipment. Safety and Health Regulations for Construction: Occupational Health and Environmental Controls. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10614](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10614). Last Accessed September 2020.

**SPRAY POLYURETHANE FOAM****American Chemistry Council: Spray Polyurethane Foam Health and Safety**

American Chemistry Council. [www.spraypolyurethane.org](http://www.spraypolyurethane.org). Last Accessed September 2020.

**DOL, OSHA, Green Jobs Hazards**

Green Jobs Hazards, Weather Insulating/Sealing. U.S. Department of Labor, Occupational Safety and Health Administration. [www.osha.gov/dep/greenjobs/weather\\_spf.html](http://www.osha.gov/dep/greenjobs/weather_spf.html). Last Accessed September 2020.

**EPA SPF**

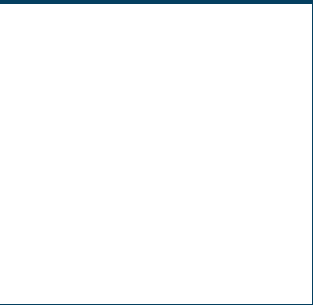
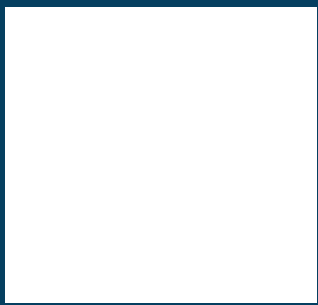
Spray Polyurethane Foam (SPF) Insulation and How to Use It More Safely. 2011. U.S. Environmental Protection Agency. [archive.epa.gov/epa/saferchoice/spray-polyurethane-foam-spf-insulation-and-how-use-it-more-safely.html](http://archive.epa.gov/epa/saferchoice/spray-polyurethane-foam-spf-insulation-and-how-use-it-more-safely.html). Last updated September 2, 2020. Last Accessed March 2021.

**EPA SPF**

Vacate and Safe Re-Entry Time for Spray Polyurethane Foam Application. 2011. U.S. Environmental Protection Agency. [archive.epa.gov/epa/saferchoice/vacate-and-safe-re-entry-time-spray-polyurethane-foam-application.html#:~:text=Some%20manufacturers%20recommend%2024%20hours,the%20recommended%20time%20may%20vary](http://archive.epa.gov/epa/saferchoice/vacate-and-safe-re-entry-time-spray-polyurethane-foam-application.html#:~:text=Some%20manufacturers%20recommend%2024%20hours,the%20recommended%20time%20may%20vary). Last updated September 2, 2020. Last Accessed March 2021.



# Appendix B: Client Education



## WHY PROVIDE CLIENT EDUCATION

Home energy upgrades, when completed in accordance with the U.S. Environmental Protection Agency's (EPA) ***Energy Savings Plus Health: Indoor Air Quality Guidelines for Single-Family Renovations***, can help improve the indoor air quality and safety in homes. Energy upgrade work also presents a valuable chance to interact with occupants, giving the contractor an opportunity to provide helpful education on indoor air quality and safety to further ensure the positive impact of a more energy efficient, healthier home. With effective education, occupants are better prepared to maintain healthy home improvements and less likely to create new health hazards in their homes.

## KEY ISSUES

Programs, crews and contractors are encouraged to incorporate into their client education strategies into a set of messages related to 15 topics identified in the protocols for occupant education (presented here alphabetically):

1. Asbestos
2. Asthma triggers
3. Carbon monoxide (CO) and other combustion pollutants
4. Combustion safety
5. Environmental tobacco smoke (ETS)
6. Lead
7. Mold and moisture
8. Pests
9. Polychlorinated biphenyls (PCBs)
10. Portable home air-cleaning equipment
11. Radon
12. Tracked-in pollutants
13. Trips, falls and other safety hazards
14. Volatile organic compounds (VOCs) in household products and materials
15. Wood smoke and solid fuel emissions

These issues and health messages are described in the following section, which summarizes how these priority indoor environmental concerns affect occupants and provides suggested occupant education health messages.

# PRIORITY HEALTH CONCERNS AND RECOMMENDED OCCUPANT HEALTH MESSAGES

## ASBESTOS

Asbestos-containing material in homes may include pipe and furnace insulation, vermiculite insulation installed before 1990, floor tiles, exterior shingles and roofing. Exposure can cause lung cancer, mesothelioma (cancer of the lining of the chest and abdominal cavity) and asbestosis, in which the lungs become scarred with fibrous tissue.

### Recommended Occupant Health Messages

- Do not disturb materials that may contain asbestos, including pipe insulation, attic vermiculite insulation, exterior shingles and floor tiles (particularly 9 × 9-inch tiles).
- Consult state requirements for asbestos testing and mitigation.

## ASTHMA TRIGGERS

Asthma triggers are commonly found in homes, schools and offices and include moisture, mold, dust mites, pests (such as cockroaches or mice), secondhand smoke and pet dander. A home may have mold growing on a shower curtain; dust mites in pillows, blankets or stuffed animals; secondhand smoke in the air; and cat and dog hairs on the carpet or floors.

Asthma triggers cause symptoms, including coughing, chest tightness, wheezing and breathing problems. An asthma attack occurs when symptoms keep getting worse or are suddenly very severe. Asthma attacks can be life threatening.

### Recommended Occupant Health Messages

- Work with a doctor to identify triggers and develop an Asthma Action Plan that includes ways to reduce exposures to any identified asthma triggers. For help on developing a plan and to see examples visit EPA's Asthma Action Plan website at [www.epa.gov/asthma/asthma-action-plan](http://www.epa.gov/asthma/asthma-action-plan).
- To minimize dust mites, wash bedding in hot water once a week and dry completely. Use dust-proof (allergen-impermeable) mattress and pillow covers. Choose washable stuffed toys; wash them often in hot water, and dry thoroughly.
- Keep pets out of bedrooms and off furniture. Consider keeping pets outside, if possible.

- See sections of this table on Environmental Tobacco Smoke, Mold and Moisture, and Pests for recommendations regarding these asthma triggers.

## CO AND OTHER COMBUSTION POLLUTANTS

Combustion pollutants are gases or particles that come from burning materials. Common combustion pollutants include CO and nitrogen dioxide (NO<sub>2</sub>).

CO is a colorless, odorless gas that can cause headaches, impaired vision and coordination, flu-like symptoms, dizziness, and, at high concentrations, confusion, nausea and death. CO sources include combustion equipment (e.g., furnaces and wood stoves), unvented combustion appliances (e.g., vent-free fireplaces), portable generators, and other combustion equipment and automobiles operated in attached garages.

NO<sub>2</sub> is a colorless, odorless gas that causes eye, nose and throat irritation, shortness of breath, and an increased risk of respiratory infection. The primary sources of NO<sub>2</sub> indoors are combustion processes, such as:

- Unvented combustion appliances (e.g., gas stoves)
- Vented appliances with defective installations
- Welding
- Tobacco smoke
- Kerosene heaters

### Recommended Occupant Health Messages

- CO alarms should be installed in all homes.
- Test CO alarms annually. Replace every 5 to 7 years. It is recommended that CO alarms have a digital display and provide peak-level readings. *Note: Some CO alarms can detect and store levels < 30 parts per million.*
- Never operate a portable generator or any gasoline engine-powered tool in or near an enclosed space such as a garage, house or other building. Even with open doors and windows, these spaces can trap CO and allow it to quickly build to lethal levels.
- Never warm up cars in attached garages, even if the garage door to the outside is open.
- For gas vent-free heaters and fireplaces, inform the occupant of identified operation or installation issues and suggested actions.
- Consult manufacturer installation and operating instructions for proper operation and maintenance of gas appliances. If manufacturer instructions are not

available, contact the manufacturer to obtain replacement instructions or contact the Air Conditioning Heating and Refrigeration Institute for information on obtaining these instructions for gas appliances.

## COMBUSTION SAFETY

If not installed, maintained and operated properly, vented and unvented combustion appliances can pose a fire hazard or emit moisture and dangerous combustion gases, including CO, into the living spaces.

### Recommended Occupant Health Messages

- Be familiar with the hazards of improperly operating unvented space heaters or vent-free appliances, including, for example, the manufacturers' written instructions and the Consumer Product Safety Commission's (CPSC) [Carbon Monoxide Questions and Answers](#), as well as EPA's [Carbon Monoxide's Impact Indoor Air Quality](#) website. The manufacturers' instructions may specify open windows during operation because the 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.
- 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 that is consistent with ANSI Z21.11.2.
- Ensure that unvented combustion space heaters or vent-free gas fireplaces are not oversized for their application per manufacturers' instructions. The proper size of a space heater depends on a room's dimensions and its heat-loss characteristics. For example, a 5,000 BTU per hour space heater often can be a suitable size for a room with a floor area of 150 square feet.
- 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.

## ETS

Exposure to ETS, also known as "secondhand smoke," can occur if someone smokes in a home or an apartment building. Exposure to secondhand smoke increases the risk of lung cancer in adults. Children are at increased risk for ear infections, bronchitis and pneumonia, sudden infant death syndrome (SIDS), and asthma symptoms. Secondhand smoke triggers symptoms in people who have asthma or chronic obstructive pulmonary disease (commonly known as COPD).

**Recommended Occupant Health Messages**

- Secondhand smoke poses health risks to nonsmokers (e.g., cancer in adults, SIDS, breathing problems in children).
- Do not allow smoking in the home. Smoke outside to reduce the risk to others in the home.

Explore a smoke-free housing policy, particularly in rental properties. See the [National Center for Healthy Housing's fact sheet called Reasons to Explore Smoke-Free Housing](#) for additional information.

**LEAD**

Housing-related lead sources include flaking or peeling lead-based paint, leaded dust, lead in soil and lead in drinking water. Children younger than age 6 and pregnant women are at greatest risk. Exposure can cause learning difficulties, behavioral problems, hearing damage and, in extreme cases, seizures or death.

**Recommended Occupant Health Messages**

- In homes built before 1978, (1) if repainting, remodeling or disturbing paint, use lead-safe work practices and (2) repair peeling paint using lead-safe work practices in homes as its laid out in the Lead Renovation, Repair and Painting Rule.
- Find out if your child has elevated levels of lead in his or her blood. Because lead poisoning often occurs with no obvious symptoms, it frequently goes unrecognized. You can test your child for lead poisoning by asking your pediatrician to do a simple blood test. Elevated blood lead levels can cause serious [health effects in children](#). If you know your child has lead poisoning, talk to your pediatrician and local health agency about what you can do.
- For pre-1978 homes with chipping exterior paint, have EPA-certified lead-based paint professionals test soil for lead content and remove or cover lead-contaminated soil. More information can be found at EPA's Lead Abatement, Inspection, and Risk Assessment web page: [www.epa.gov/lead/lead-abatement-inspection-and-risk-assessment](http://www.epa.gov/lead/lead-abatement-inspection-and-risk-assessment).
- Encourage occupants to test old painted cribs and furniture for lead-based paint and vinyl blinds for lead.
- If the water heater is to be replaced, determine whether there is a lead service line (LSL) that connects the drinking water main under the street with the building. If an LSL is present, consider replacing it before or while replacing the water heater. Ensure that your contractor follows the American National

Standards Institute (ANSI)/(ANSI)/America Water Works Association (AWWA) C810-17 Standard when replacing the LSL. To determine whether the service line has lead, contact the utility for guidance and inspect the line as it enters the property. See [www.lslr-collaborative.org](http://www.lslr-collaborative.org) for additional guidance.

## MOLD AND MOISTURE

Mold can grow almost anywhere, wherever there is moisture in a house. Asthma symptoms, allergic reactions and other respiratory symptoms can be triggered by damp indoor environments and mold. Inhaling mold spores can trigger asthma attacks in people who are sensitive to mold.

### Recommended Occupant Health Messages

- If you see less than about 10 square feet of mold on hard surfaces—
  1. Repair moisture problems to avoid dampness or mold growth.
  2. Clean it up with soap and water.
  3. Let the area dry completely.
- If you see more than 10 square feet of mold on hard surfaces, consult EPA's Mold Remediation in Schools and Commercial Buildings web page at [www.epa.gov/mold/printable-version-mold-remediation-schools-and-commercial-buildings](http://www.epa.gov/mold/printable-version-mold-remediation-schools-and-commercial-buildings).
- Dry any water-damaged areas and items within 24–48 hours after a leak or spill to prevent mold growth.
- Avoid installing carpet in areas prone to wetting or moisture problems.
- Run bathroom and kitchen fans when showering, cooking, and so forth and run the whole-house ventilation system according to manufacturer's instructions to help minimize moisture and contaminant buildup.
- Absorbent or porous materials, such as ceiling tiles and carpet, may have to be thrown away if they become moldy. Mold can grow on or fill in the empty spaces and crevices of porous materials, so the mold may be difficult or impossible to remove completely

## PESTS

Rodents, cockroaches, termites, birds, bats and other pests can be found in homes. Exposure to some pest droppings and body parts (e.g., from mice and cockroaches) can trigger asthma attacks. Rodents also can carry pathogens such as hantavirus, which can result in a deadly condition called hantavirus pulmonary syndrome.

Misusing pesticides to address pest problems can sometimes result in harmful exposures to carcinogens or chemicals that result in respiratory problems or allergic reactions.

#### **Recommended Occupant Health Messages**

- Follow integrated pest management strategies to reduce pest infestations and avoid the overuse of pesticides: (1) Reduce pest access to water and food by properly storing food and trash and by using effective housekeeping techniques. (2) Limit pest entry by sealing holes and cracks. (3) Use targeted and least toxic pesticides.
- Clean up pest droppings and body parts to reduce allergens.
- Safely store pesticides out of the reach of children.

## **PCBs**

PCBs were manufactured domestically from 1929 until their manufacture was banned in 1979. PCBs have been shown to cause a variety of adverse health effects, including effects on the immune, reproductive, nervous and endocrine systems in animals. PCBs also have been shown to cause cancer in animals. Studies in humans provide supportive evidence for potential carcinogenic and noncarcinogenic effects of PCBs.

#### **Recommended Occupant Health Messages**

- Although no longer commercially produced in the United States, PCBs may be present in products and materials produced before the 1979 PCB ban (e.g., transformers and capacitors, cable insulation, oil-based paint, caulk, plastics, floor finish).
- Materials suspected of PCB contamination should be sampled, tested and safely abated by a professional.

## **PORTABLE HOME AIR-CLEANING EQUIPMENT**

Ozone can be generated by household equipment and can be found in outdoor air. Breathing ozone can increase respiratory risks, including asthma, and decrease lung function. Some devices sold as household air cleaners can produce harmful ozone levels.

#### **Recommended Occupant Health Messages**

- Recommend removal of existing portable air-cleaning equipment designed to intentionally produce ozone. Consult the California Air Resources Board for a list of equipment that meets their certification program. To filter particles, choose a portable air cleaner that has a clean air delivery rate that is large



enough for the size of the room or area in which you will use it. For help on choosing the proper air cleaner for your home, you can explore EPA's [Guide to Air Cleaners in the Home](#).

- If new portable air cleaners are installed, use those with mechanical filtration versus those producing ozone. Only install equipment that meets California Air Resources Board standards or does not produce ozone.

## RADON

Radon is the number one cause of lung cancer for nonsmokers. It is the second leading cause of lung cancer overall (after smoking), accounting for 21,000 deaths annually. A radioactive gas that comes from the natural decay of uranium in soil and water, radon can enter homes through openings in walls and floors where they come into contact with the ground. An estimated one in every 15 U.S. homes has radon levels at or above EPA's action level of 4 picocuries per liter (pCi/L).

### Recommended Occupant Health Messages

- The only way to know the radon level in your home is to test for it. See EPA's [Find a Radon Test Kit or Measurement and Mitigation Professional](#) web page for more information on acquiring a test kit.
- EPA and the Surgeon General recommend testing all homes below the third floor for radon.
- Mitigate radon in homes if levels are greater than or equal to 4 pCi/L. Strongly consider working with a certified radon mitigator to mitigate homes with levels between 2 and 4 pCi/L.
- Radon levels below 4 pCi/L still pose a health risk but may be reduced in many cases. See EPA's [A Citizen's Guide to Radon](#).
- Make sure that any existing radon mitigation system is functioning properly. If a vent fan is installed, check its condition first.

## TRACKED-IN POLLUTANTS

A significant portion of the dust and dirt on floors can come into the house on shoes. This material may contain allergens, pesticides, lead and other hazardous substances from outdoors.

**Recommended Occupant Health Messages**

- Remove shoes or install walk-off mats (doormats) to trap dirt and moisture at all commonly used entrances.
- Wipe off the bottom of shoes thoroughly.
- Indoor mats should have anti-slip backings or other means to reduce sliding and tripping hazards—commercially constructed mats are better than carpet samples or remnants.
- Mats should not be placed over carpeted areas or existing walk-off mats and should have an impervious, readily cleanable surface beneath them.
- Walk-off mats should be vacuumed regularly, cleaned and dried to remove accumulated dirt and moisture, according to manufacturer's printed instructions.
- Ideally, one should place a grate or another mat made of very stiff bristles at the outside of the entrance(s).

## TRIPS, FALLS AND OTHER SAFETY HAZARDS

Trips, falls, poisoning and burns are significant injury risks in homes. Poor lighting, lack of handrails, unstable stairs and other housing hazards increase the risk of falls. Improperly stored chemicals increase the risk of poisoning. For more information on how to properly handle and store hazardous chemicals visit EPA's hazardous waste website at [www.epa.gov/hw](http://www.epa.gov/hw).

**Recommended Occupant Health Messages**

- In homes where elderly persons live, reduce trip hazards, provide sufficient lighting on stairs, ensure that handrails and grab bars are in key locations, and follow CDC's [Check for Safety: A Home Fall Prevention Checklist for Older Adults](#).
- In homes with young children, install gates at the tops of stairs, securely store chemicals and pesticides, minimize risk of contact with hot surfaces, ensure a safe outdoor play area (including playground equipment, pools, open pits and wells), and ensure that interior doors can be opened from inside and outside.

## VOCs IN HOUSEHOLD PRODUCTS AND MATERIALS

VOCs are found in many household products and materials, including paints, carpets and pads, pressed wood, composite wood, cleaning supplies, air fresheners, and furniture. Exposures can cause eye, nose and throat irritation; liver damage; and cancer.

### Recommended Occupant Health Messages

- Select low-VOC products when possible (e.g., paint, carpet, furniture, cabinets, adhesives, cleaning products). Green testing and rating programs that assess products for VOCs and other health hazards include—
  1. California Department of Public Health, Emission Testing Method for California Specification 01350
  2. Carpet and Rug Institute Green Label or Green Label Plus program criteria or equivalent standards for carpet
  3. Collaborative for High Performance Schools High-Performance Products Database.
  4. Green Seal Standard GS-11
  5. GREENGUARD Children and Schools Certification Program
  6. Master Painters Institute Green Performance Standards GPS-1 or GPS-2
  7. Scientific Certification Systems Standard EC-10.2-2007 (Indoor Advantage Gold)
- If using pressed or composite wood products, avoid products containing urea formaldehyde. Select products compliant with the Toxic Substances Control Act Title VI. For more information, please visit EPA's formaldehyde emission standards for composite wood products at [www.epa.gov/formaldehyde/formaldehyde-emission-standards-composite-wood-products](http://www.epa.gov/formaldehyde/formaldehyde-emission-standards-composite-wood-products).
- Local ventilation can be used when strong sources of VOCs or other airborne contaminants are isolated to a specific room or area. Whole-house ventilation also will help reduce VOCs and other airborne contaminants in most homes.
- Safely store chemicals out of the reach of children.

## WOOD SMOKE AND SOLID FUEL EMISSIONS

The smoke from wood burning is made up of a complex mixture of gases and fine particles (also called particle pollution, particulate matter, or PM). In addition to particle pollution, wood smoke contains several toxic harmful air pollutants, including—

- Benzene
- Formaldehyde
- Acrolein
- Polycyclic aromatic hydrocarbons

The more efficiently you burn wood (e.g., using an EPA-certified wood stove and dry, seasoned wood), the less smoke is created.

The biggest health threat from smoke is from fine particles, also called fine particulate matter or PM<sub>2.5</sub>. These microscopic particles can get into your eyes and respiratory system, where they may cause burning eyes, runny nose and such illnesses as bronchitis. Fine particles can make asthma symptoms worse and trigger asthma attacks. Fine particles also can trigger heart attacks, stroke, irregular heart rhythms and heart failure, especially in people who are already at risk for these conditions.

### Recommended Occupant Health Messages

- Ensure that the fireplace chimney or wood stove flue is working properly (i.e., there is no wood smoke in the home).
- Clean the chimney once a year.
- Follow the guidance found on EPA's [Best Wood-Burning Practices](#) web page.
- If purchasing a new stove, ensure that it is EPA-certified.

## CLIENT EDUCATION RESOURCES

EPA has many publications suitable for occupant education on indoor air quality in homes, including **Care for Your Air: A Guide to Indoor Air Quality**, which can be found on EPA's Indoor Air Quality home page at [www.epa.gov/iaq](http://www.epa.gov/iaq).

### ASBESTOS

#### **EPA Asbestos**

Asbestos. 2018. U.S. Environmental Protection Agency. [www.epa.gov/asbestos](http://www.epa.gov/asbestos). Last updated April 24, 2020. Last Accessed September 2020.

#### **EPA Asbestos**

Protect Your Family from Exposures to Asbestos. 1990. U.S. Environmental Protection Agency. [www.epa.gov/asbestos/protect-your-family-exposures-asbestos](http://www.epa.gov/asbestos/protect-your-family-exposures-asbestos). Last updated January 2, 2020. Last Accessed September 2020.

### ASTHMA TRIGGERS

#### **EPA Asthma**

Asthma Triggers: Gain Control. 2011. U.S. Environmental Protection Agency. [www.epa.gov/asthma/asthma-triggers-gain-control](http://www.epa.gov/asthma/asthma-triggers-gain-control). Last updated July 13, 2020. Last Accessed September 2020.

### CARBON MONOXIDE

#### **Air-Conditioning, Heating and Refrigeration Institute**

Air-Conditioning, Heating and Refrigeration Institute. [www.ahrinet.org/default.aspx](http://www.ahrinet.org/default.aspx). Last Accessed September 2020.

#### **CPSC**

Carbon-Monoxide-Questions-and-Answers. 2008. U.S. Consumer Product Safety Commission. [www.cpsc.gov/Safety-Education/Safety-Education-Centers/Carbon-Monoxide-Information-Center/Carbon-Monoxide-Questions-and-Answers](http://www.cpsc.gov/Safety-Education/Safety-Education-Centers/Carbon-Monoxide-Information-Center/Carbon-Monoxide-Questions-and-Answers). Last Accessed September 2020.

#### **EPA Carbon Monoxide**

Carbon Monoxide's Impact on Indoor Air Quality. 2011. U.S. Environmental Protection Agency. [www.epa.gov/indoor-air-quality-iaq/carbon-monoxides-impact-indoor-air-quality](http://www.epa.gov/indoor-air-quality-iaq/carbon-monoxides-impact-indoor-air-quality). Last updated July 15, 2020. Last Accessed September 2020.

## ENVIRONMENTAL TOBACCO SMOKE

### EPA Environmental Tobacco Smoke

Secondhand Smoke and Smoke-Free Homes. 2010. U.S. Environmental Protection Agency. [www.epa.gov/indoor-air-quality-iaq/secondhand-smoke-and-smoke-free-homes](http://www.epa.gov/indoor-air-quality-iaq/secondhand-smoke-and-smoke-free-homes). Last updated July 15, 2020. Last Accessed September 2020.

### National Center for Healthy Housing Fact Sheet

Reasons to Explore Smoke-Free Housing. 2009. National Center for Healthy Housing. [www.enterprisecommunity.org/resources/reasons-explore-smoke-free-housing-factsheet-14014](http://www.enterprisecommunity.org/resources/reasons-explore-smoke-free-housing-factsheet-14014). Last Accessed September 2020.

## LEAD

### EPA Lead-Based Paint Renovation, Repair, and Painting Program

Lead-Safe Certified Guide to Renovate Right Brochure. 2010. U.S. Environmental Protection Agency. [nepis.epa.gov/Exe/ZyNET.exe/60001QJN.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2006+Thru+2010&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C06thru10%5CTxt%5C00000021%5C60001QJN.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL](http://nepis.epa.gov/Exe/ZyNET.exe/60001QJN.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2006+Thru+2010&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C06thru10%5CTxt%5C00000021%5C60001QJN.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL). Last Accessed April 2021.

### EPA Lead

Lead Abatement, Inspection, and Risk Assessment. U.S. Environmental Protection Agency. [www.epa.gov/lead/lead-abatement-inspection-and-risk-assessment](http://www.epa.gov/lead/lead-abatement-inspection-and-risk-assessment). Last updated Mary 28, 2020. Last Accessed September 2020.

## MOLD AND MOISTURE

### EPA Mold

A Brief Guide to Mold, Moisture, and Your Home. 2010. U.S. Environmental Protection Agency. [www.epa.gov/mold/brief-guide-mold-moisture-and-your-home](http://www.epa.gov/mold/brief-guide-mold-moisture-and-your-home). Last updated August 14, 2020. Last Accessed September 2020.

## PESTS

### EPA Pests

Got Pests? Control Them Safely. 2011. U.S. Environmental Protection Agency. [www.epa.gov/safepestcontrol/got-pests-control-them-safely](http://www.epa.gov/safepestcontrol/got-pests-control-them-safely). Last updated June 16, 2017. Last Accessed September 2020.

### New York City Department of Health and Mental Hygiene

How to Control Pests Safely. 2008. New York City Department of Health and Mental Hygiene. [www1.nyc.gov/assets/doh/downloads/pdf/pest/pest-bro-healthy-home.pdf](http://www1.nyc.gov/assets/doh/downloads/pdf/pest/pest-bro-healthy-home.pdf). Last Accessed September 2020.

## PCBs

### EPA PCBs

Polychlorinated Biphenyls. 2018. U.S. Environmental Protection Agency. [www.epa.gov/pcbs](http://www.epa.gov/pcbs). Last updated July 27, 2020. Last Accessed September 2020.

## PORTABLE HOME AIR CLEANING EQUIPMENT

### Association of Home Appliance Manufacturers

Room Air Cleaning Certification Program. [www.ahamdir.com/462-2/](http://www.ahamdir.com/462-2/). Last Accessed September 2020.

### California Air Resources Board

California Certified Air Cleaning Devices. [www.arb.ca.gov/research/indoor/aircleaners/consumers.htm](http://www.arb.ca.gov/research/indoor/aircleaners/consumers.htm). Last Accessed September 2020.

### EPA Guide to Air Cleaners in the Home

2018. EPA's reference guide to selecting a portable air cleaner, furnace filter, or HVAC filter. [www.epa.gov/indoor-air-quality-iaq/air-cleaners-and-air-filters-home](http://www.epa.gov/indoor-air-quality-iaq/air-cleaners-and-air-filters-home). Last updated July 2, 2020. Last Accessed September 2020.

### EPA IAQ

Ozone Generators That Are Sold as Air Cleaners. [www.epa.gov/indoor-air-quality-iaq/ozone-generators-are-sold-air-cleaners](http://www.epa.gov/indoor-air-quality-iaq/ozone-generators-are-sold-air-cleaners). Last updated December 23, 2019. Last Accessed September 2020.

## RADON

### **EPA Find a Radon Test Kit or Measurement and Mitigation Professional**

[www.epa.gov/radon/find-radon-test-kit-or-measurement-and-mitigation-professional#who](http://www.epa.gov/radon/find-radon-test-kit-or-measurement-and-mitigation-professional#who). Last updated March 25, 2020. Last Accessed September 2020.

### **EPA Radon Guidance**

A Citizen's Guide to Radon. 2009. U.S. Environmental Protection Agency. [www.epa.gov/sites/production/files/2016-12/documents/2016\\_a\\_citizens\\_guide\\_to\\_radon.pdf](http://www.epa.gov/sites/production/files/2016-12/documents/2016_a_citizens_guide_to_radon.pdf). Last Accessed September 2020.

## SAFETY

### **CDC Fall Prevention Checklist**

Check for Safety: A Home Fall Prevention Checklist for Older Adults. 2009. Centers for Disease Control and Prevention. [www.cdc.gov/steady/pdf/STEADI-Brochure-CheckForSafety-508.pdf](http://www.cdc.gov/steady/pdf/STEADI-Brochure-CheckForSafety-508.pdf). Last Accessed September 2020.

### **EPA Hazardous Waste**

Learn the Basics of Hazardous Waste. [www.epa.gov/hw/learn-basics-hazardous-waste](http://www.epa.gov/hw/learn-basics-hazardous-waste). Updated 2020. Last Accessed September 2020.

## VOLATILE ORGANIC COMPOUNDS IN HOUSEHOLD PRODUCTS AND MATERIALS

### **California Department of Public Health CAL-IAQ Program Standard**

Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.2. 2017. California Department of Public Health. [www.cdph.ca.gov/Programs/CCDCPHP/DEODC/EHLB/IAQ/CDPH%20Document%20Library/CDPH-IAQ\\_StandardMethod\\_V1\\_2\\_2017\\_ADA.pdf](http://www.cdph.ca.gov/Programs/CCDCPHP/DEODC/EHLB/IAQ/CDPH%20Document%20Library/CDPH-IAQ_StandardMethod_V1_2_2017_ADA.pdf). Last Accessed September 2020.

### **California Title 17**

California Code of Regulations, Title 17, sections 93120–93120.12. 2008. State of California. [www.arb.ca.gov/regact/2007/compwood07/fro-final.pdf](http://www.arb.ca.gov/regact/2007/compwood07/fro-final.pdf). Last Accessed September 2020.

### **Carpet and Rug Institute**

Green Label, Green Label Plus. The Carpet and Rug Institute. [www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus/](http://www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus/). Last Accessed September 2020.



**EPA IAQ**

Volatile Organic Compounds' Impact on Indoor Air Quality. 2017. U.S. Environmental Protection Agency. [www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality](http://www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality). Last updated November 6, 2017. Last Accessed September 2020.

**GREENGUARD Children and Schools Certification Program**

GREENGUARD Environmental Institute. [greenguard.org/en/manufacturers/manufacturer\\_childrenSchools.aspx](http://greenguard.org/en/manufacturers/manufacturer_childrenSchools.aspx). Last Accessed September 2020.

**Green Seal Standard GS-11**

GS-11: Green Seal Environmental Standard for Paints and Coatings. 2008. Green Seal, Inc. [www.greenseal.org/green-seal-standards/gs-11](http://www.greenseal.org/green-seal-standards/gs-11). Last Accessed September 2020.

**Master Painters Institute GPS-1 and GPS-2**

Master Painters Institute Green Performance Standards for Paints and Coatings [GPS-1 and GPS-2]. 2008. Master Painters Institute, Inc. [www.specifygreen.com/EvrPerf/EnvironmentalPerformance.html](http://www.specifygreen.com/EvrPerf/EnvironmentalPerformance.html). Last Accessed September 2020.

**Scientific Certification Systems**

Indoor Advantage Standard EC 10.3 2014 V4.0, Indoor Air Quality Product Performance Standard for Building Interiors. March 2017. [cdn.scsglobalservices.com/files/standards/scs\\_stn\\_ec10.3-2014\\_v4.0\\_031617.pdf](http://cdn.scsglobalservices.com/files/standards/scs_stn_ec10.3-2014_v4.0_031617.pdf); [www.scsglobalservices.com/services/indoor-air-quality-certification](http://www.scsglobalservices.com/services/indoor-air-quality-certification). Last Accessed September 2020.

## WOOD SMOKE AND SOLID-FUEL EMISSIONS

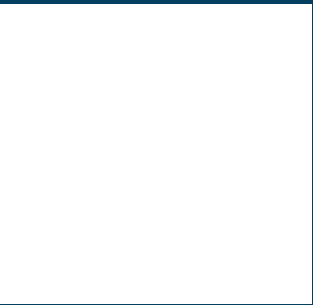
**Chimney Safety Institute of America**

Top-Down Method of Stove Loading. Chimney Safety Institute of America. [www.csia.org/top\\_down\\_burn.html](http://www.csia.org/top_down_burn.html). Last Accessed September 2020.

**EPA Burn Wise Guides**

Best Wood-Burning Practices. 2019. U.S. Environmental Protection Agency. [www.epa.gov/burnwise/best-wood-burning-practices](http://www.epa.gov/burnwise/best-wood-burning-practices). Last updated March 25, 2020. Last Accessed September 2020.

# Appendix C: Abbreviations and Acronyms



**ACCA**–Air Conditioning Contractors of America  
**ACM**–asbestos-containing material  
**AHRI**–Air-Conditioning, Heating and Refrigeration Institute  
**ANSI**–American National Standards Institute  
**AP**–assessment protocol  
**ASHI**–American Society of Home Inspectors  
**ASHRAE**–American Society of Heating, Refrigerating and Air-Conditioning Engineers  
**ASPE**–American Society of Plumbing Engineers  
**ASTM**–American Society for Testing and Materials  
**ATCM**–Airborne Toxic Control Measures  
**AWWA**–America Water Works Association  
**BPI**–Building Performance Institute  
**CARB**–California Air Resources Board  
**CAZ**–combustion appliance zone  
**CDC**–Centers for Disease Control and Prevention  
**CDPH**–California Department of Public Health  
**CFL**–compact fluorescent lamp  
**CFR**–Code of Federal Regulations  
**CO**–carbon monoxide  
**CO<sub>2</sub>**–carbon dioxide  
**COPD**–chronic obstructive pulmonary disease  
**CPSC**–Consumer Product Safety Commission  
**CRI**–Carpet and Rug Institute  
**CSA**–Canadian Standards Association  
**CSIA**–Chimney Safety Institute of America  
**DOE**–U.S. Department of Energy  
**DOL**–U.S. Department of Labor  
**EA**–expanded actions  
**EPA**–U.S. Environmental Protection Agency  
**EPA OLEM (formerly known as OSWER)**–U.S. Environmental Protection Agency Office of Land and Emergency Management, formerly known as the U.S. EPA Office of Solid Waste and Emergency Response  
**ERV**–energy recovery ventilator  
**ETS**–environmental tobacco smoke  
**ft<sup>2</sup>**–square feet  
**GS**–Green Seal  
**HRV**–heat recovery ventilator  
**HUD**–U.S. Department of Housing and Urban Development

**HVAC**—heating, ventilating and air conditioning  
**IAQ**—indoor air quality  
**IPM**—integrated pest management  
**LED**—light-emitting diode  
**LSL**—lead service line  
**MA**—minimum actions  
**MERV**—minimum efficiency reporting value  
**MPI**—Master Painters Institute  
**MPI GPS**—Master Painters Institute Green Performance Standard  
**NCHH**—National Center for Healthy Housing  
**NESCAUM**—The Clean Air Association of the Northeast States  
**NFPA**—National Fire Protection Association  
**NIOSH**—National Institute for Occupational Safety and Health  
**NIST**—National Institute of Standards and Technology  
**NO<sub>2</sub>**—nitrogen dioxide  
**NPE**—nonylphenol ethoxylate  
**OSHA**—Occupational Safety and Health Administration  
**PCBs**—polychlorinated biphenyls  
**pCi/L**—picocuries per liter  
**PM**—particulate matter  
**PPE**—personal protective equipment  
**RRP**—(EPA Lead) Renovation, Repair and Painting (Rule)  
**SCAQMD**—South Coast Air Quality Management District  
**SCS**—Scientific Certification Systems  
**SIDS**—sudden infant death syndrome  
**SPF**—spray polyurethane foam  
**TSCA**—Toxic Substances Control Act  
**U.S.**—United States  
**VOCs**—volatile organic compounds  
**XRF**—X-ray fluorescence

